Disaster Risk Reduction

UWDMC
Disaster Management Center
University of Wisconsin-Madison

Disaster Risk Reduction

DD04 - Study Guide and Course Text

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This self-study course was designed as a collaboration between the University of Wisconsin-Disaster Management Center (UWDMC), the USAID Office of U.S. Foreign Disaster Assistance (OFDA) and the International Resources Group (IRG). The self-study content is based on a 3-4 day workshop held throughout the Caribbean. The project was led by Juan Pablo Sarmiento and Don Schramm. Key players in this distance learning transition effort include Rene Carillo, Cecil Bailey, Yuri Chakalall, Clive Lorde, Audrey Mullings, Howie Prince and Cecil Shillingford.

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Produced by the University of Wisconsin – Madison

Disaster Management Center
Department of Engineering Professional Development
432 North Lake Street
Madison, Wisconsin 53706 USA
Phone: 608.262.5441
Fax: 608.263.3160
Email: dmc@engr.wisc,edu

COVER PHOTO: Storm Surge, Hurricane Ivan, Trinidad, Associated Press, 2004

Outline of Content

Getting Started…

Before you start the course we suggest you take the course pre-test on the next pages to find out how much you may already know about disaster risk reduction. If you find you do well on parts of this self-test, you can move quickly over those parts of the course in the study guide and leave yourself more time for other parts. If you don't do well at first, do not worry. It will become clearer as you study. After reviewing the answers for the course pre-test, study each of the seven units of this course as a separate lesson, taking and reviewing the self-assessment test at the end of each.

When you have completed all the self-assessment tests to your satisfaction, you may request the final examination package as explained in Unit 1. The package will be mailed to the proctor you nominate and includes instructions on taking the examination. When you request your final; examination, please take a moment to compete and return the course evaluation at the end of this publication.

After your proctor returns your completed examination to the University of Wisconsin-Disaster Management Center (UWDMC), it will normally take 1-2 months for grading, transcript recording of your CEUs and preparation of your Certificate of Completion. On successful completion of the examination the certificate will be mailed to you with enrollment information about additional self-study courses.

Course Pretest

As you begin your studies of disaster risk reduction, take this course pre-test to help you understand better what you may already know about the subject and how best to study the course material. If you find you do well on parts of this self-test, you can move more quickly over that subject in the study guide and leave yourself more time for other sections. If you don't do well at first, do not worry. It should become clear in time!

Answers are at the end of this pre-test.
For multiple choice and true/false questions, circle the best answer.

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1. Components of recovery are:
    A. Prevention
    B. Alert
    C. Transfer and financing
    D. Rehabilitation and reconstruction
    E. All of the above

---

2. Earthquakes, hurricanes, and volcanoes can be prevented.

    True False

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3. Which of the following is a Risk Transfer Instrument
    A. Standard operational procedures
    B. Insurance
    C. Emergency plans
    D. None of the above

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4. The lack of development can make countries less vulnerable and susceptible to risk.

    True False

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5. In the institutional framework for disaster risk management, stakeholders are only at the national level.

    True False

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6. A hazard:
    A. is a potentially damaging physical event, phenomenon, or human activity
    B. may cause the loss of life or injury, property damage,
    C. may generate social and economic disruption or environmental degradation.
    D. all of the above

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7. The categories of natural hazards are
    A. hydro meteorological
    B. geological
    C. biological
    D. all of the above

8. The severity of the drought does not depend on the degree of moisture deficiency, only in the duration, and the size of the affected area.

    True False

9. An earthquake can be caused by
    A. a sudden slip on a fault,
    B. by volcanic or magmatic activity,
    C. sudden stress changes in the earth.
    D. all of the above

10. The pyroclastic flows are the less important manifestation of volcanoes.

    True False

11. Tsunami waves originate from undersea or coastal seismic activity and can be caused by earthquakes, landslides, and volcanic eruptions.

    True False

12. Landslides are not associated with earthquakes, hurricanes, floods and volcanoes.

    True False

13. Risk is comprised of two factors:
    A. alert and alarm
    B. hazard and vulnerability
    C. vulnerability and susceptibility
    D. hazards and threats

14. The specific value of damage a community is willing to assume is called acceptable risk.

    True False

15. A disaster situation exceeds the capacity of the community or society affected to cope using its own resources.

    True False

16. What are the two main measurable components of a hazard?

_____

_____

17. What are the elements of a society on which a hazard has indirect effects?

_____

_____

18. Writing Building Codes will ensure their effectiveness as a Disaster Risk Reduction Tool.

True False

19. The use of incentives as a means of encouraging the use of Disaster Risk Reduction measures is an Active Risk Reduction strategy.

True False

20. Which of the following are National Disaster Risk Reduction stakeholders?
    A. Central Government
    B. National Disaster Offices
    C. Private Sector
    D. All of the above

21. Which of the following is not a risk financing measure?
    A. Public Asset Coverage
    B. Budget self insurance
    C. Cat Bonds
    D. Market Insurance

22. The Jones Family decided to set aside 5% of their annual income to be used to retrofit their home to make it more resilient against hurricane. Which risk transfer mechanism best describes their action?
    A. Budget Self Insurance
    B. Reinsurance
    C. Market Insurance
    D. Risk Pooling and diversification

23. Insurance companies have in recent times refused coverage to coastal properties in the region mainly because:
    A. The properties have not used building codes in their designs
    B. The areas in question are considered as high risks
    C. The areas in question are close to the sea
    D. Government regulations about setback are unclear

24. A problem statement and the solution/decision are needed to start preparing a work plan.

    True False

25. Preparing a Responsibility chart you determine, WHAT needs to be done, WHO will do it, WHEN, RESOURCES required, MONITORING mechanisms and REPORT requirements.

    True False

Pretest Self Assessment Answers

1. D
2. F
3. B
4. F
5. F
6. D
7. D
8. F
9. D
10. F
11. T
12. F
13. B
14. T
15. T
16.

- Magnitude or Intensity;
- Likelihood or Probability of occurrence in any particular location within any specified period of time.

17.

- Economic impact
- Social impact
- Environmental impact
- Political impact

18. F
19. T
20. D
21. D
22. A
23. B
24. T
25. T

GLOSSARY: DISASTER RISK REDUCTION

Disaster Risk Management
An Introductory Course
Glossary of Terms

The basic definitions on natural hazard risk reduction presented here are drawn from several sources including the International Secretariat for Disaster Reduction and United States Agency for International Development, Office of Foreign Disaster Assistance.

A

Acceptable risk
The specific value of damage a community is willing to assume.

The level of loss a society or community considers acceptable given existing social, economic, political, cultural, technical and environmental conditions.

In engineering terms, acceptable risk is also used to describe structural and non-structural measures undertaken to reduce possible damage at a level which does not harm people and property, according to codes or "accepted practice" based, among other issues, on a known probability of hazard.

Alert
A formal declaration of the near or imminent occurrence of an adverse event. This information should lead emergency organizations to activate previously established mechanisms, and the population to take specific precautions.

B

Biological hazards
Processes of organic origin or those conveyed by biological vectors, including exposure to pathogenic micro-organisms, toxins and bioactive substances, which may cause the loss of life or injury, property damage, social and economic disruption or environmental degradation

Building Codes
Ordinances and regulations controlling the design, construction, materials, alteration and occupancy of any structure to insure human safety and welfare. Building codes include both technical and functional standards.

C

Capacity
A combination of all the strengths and resources available within a community, society or organization that can reduce the level of risk, or the effects of a disaster.

Capacity may include physical, institutional, social or economic means as well as skilled personal or collective attributes such as leadership and management. Capacity may also be described as capability.

D

Development
The cumulative and lasting increase, tied to social changes in the quantity and quality of a community's goods, services and resources, with the purpose of maintaining and improving the quality and security of human life.

Direct damage
Direct damage is all damage sustained by immovable assets and inventories of finished and semi-finished products, raw materials, other materials and spare parts.

Disaster
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 or society to cope using its own resources

Disaster Risk Management
The systematic management of administrative decisions, organization, operational skills and capacities to implement policies, strategies and coping capacities of the society and communities to lessen the impacts of natural hazards and related environmental and technological disasters.

This comprises all forms of activities, including structural and non-structural measures to avoid (prevention) or to limit (mitigation and preparedness) adverse effects of hazards.

Disaster risk reduction (disaster reduction)
The conceptual framework of elements considered with the possibilities to minimize vulnerabilities and disaster risks throughout a society, to avoid (prevention) or to limit (mitigation and preparedness) the adverse impacts of hazards, within the broad context of sustainable development.

Drought
Period of abnormally dry weather that persists long enough to produce a serious hydrologic imbalance (for example, crop damage, water supply shortage, etc.). The severity of the drought depends upon the degree of moisture deficiency, the duration, and the size of the affected area.

E

Earthquake
Term used to describe both sudden slip on a fault, and the resulting ground shaking and radiated seismic energy caused by the slip, or by volcanic or magmatic activity, or other sudden stress changes in the earth.

G

Geological Hazards
Geological hazards are natural earth processes or phenomena that include internal earth processes of tectonic origin as well as external processes such as mass movements.

Geological hazard includes internal earth processes or tectonic origin, such as earthquakes, geological fault activity, tsunamis, volcanic activity and emissions as well as external processes such as mass movements: landslides, rockslides, rock falls or avalanches, surfaces collapses, expansive soils and debris or mud flows.

H

Hazard
A potentially damaging physical event, phenomenon and/or human activity that 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, hydrometeorological 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, frequency and probability.

Hazard analysis
Identification, studies and monitoring of any hazard to determine its potential, origin, characteristics and behaviour.

Hurricane
A rotating, intense low-pressure system, which forms over tropical oceans where there are warm waters, humid air and converging winds.

Hydrometeorological hazards
Natural processes or phenomena of atmospheric, hydrological or oceanographic nature, which may cause the loss of life or injury, property damage, social and economic disruption or environmental degradation.

Examples of hydrometeorological hazards are: floods, debris and mud floods; tropical cyclones, storm surges, thunder/hailstorms, rain and wind storms, blizzards and other severe storms; drought, desertification, wildland fires, temperature extremes, sand or dust storms; permafrost and snow or ice avalanches.

Hydrometeorological hazards can be single, sequential or combined in their origin and effects.

I

Indirect damage
This is damage to the flows of goods that cease to be produced or the services that cease to be provided during a period of time beginning almost immediately after the disaster and possibly extending into the rehabilitation and reconstruction phase.

L

Landslide
Movement of surface material down a slope.

M

Mitigation
Structural and non-structural measures undertaken to limit the adverse impact of natural hazards, environmental degradation and technological hazards.

P

Preparedness
Activities and measures taken in advance to ensure effective response to the impact of hazards, including the issuance of timely and effective early warnings and the temporary removal of people and property from threatened locations.

Prevention

Activities to provide outright avoidance of the adverse impact of hazards and means to minimize 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, related to disaster risk reduction changing attitudes and behaviour contribute to promoting a "culture of prevention".

R

Reconstruction
Reconstruction is the process of infrastructure repair, restoration of the production system, and resumption of the population's normal life pattern.

Recovery
Decisions and actions taken after a disaster with a view to restoring or improving the pre-disaster the living conditions of the stricken community, while encouraging and facilitating necessary adjustments to reduce disaster risk.

Recovery (rehabilitation and reconstruction) affords an opportunity to develop and apply disaster risk reduction measures.

Rehabilitation
This is the transition period that begins during response to re-establish temporary critical basic services in the short-term.

Relief/response
The provision of assistance or intervention during or immediately after a disaster to meet the life preservation and basic subsistence needs of those people affected. It can be of an immediate, short-term, or protracted duration.

Resilience/resilient
Resilience is the capacity of a system, community or society potentially exposed to hazards to adapt, by resisting or changing in order to reach and maintain an acceptable level of functioning and structure. This is determined by the degree to which the social system is capable of organizing itself to increase its capacity for learning from past disasters for better future protection and to improve risk reduction measures.

Response

The provision of assistance or intervention during or immediately after a disaster to meet the life preservation and basic subsistence needs of those people affected. It can be of an immediate, short-term, or protracted duration.

Risk
The probability of harmful consequences, or expected losses (deaths, injuries, property, livelihoods, economic activity disrupted or environment damaged) resulting from interactions between natural or human-induced hazards and vulnerable conditions. Conventionally risk is expressed by the relation Risk = Hazards x Vulnerability.

Beyond expressing a possibility of physical harm, it is crucial to recognize that risks are inherent or can be 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.

Risk assessment
Methodology to determine the nature and extent of risk by analysing 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 (ISDR, 2004).

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

Risk Identification
Systematic use of available information to estimate the geographic extent of the hazard, its intensity, and its probability of occurrence and the related consequences.

Risk Management
Risk management is the efficient planning, organization, direction and control process aimed at risk identification, risk reduction, disaster management and recovery.

Risk Transfer
Risk transfer refers to instruments that share/hedge economic risks before losses occur.

S

Socio-economic disaster risk reduction measures

Socio-economic disaster risk reduction measures are those that are designed to address gaps and weaknesses in the systems whereby communities and society as a whole prepare to respond to disaster events.

Storm Surge
A storm surge consists of unusual volumes of water flowing onto shorelines.

Structural measures
Engineering measures and construction of hazard-resistant and/or protective structures and infrastructure

T

Torrential rain
Any rain that pours fast, violently, or heavily.

Tropical depression
A low-pressure system forming in tropical latitudes with wind speeds of 62 kilometres per hour (38 mph).

Tropical storm
A low-pressure system which has a maximum sustained surface wind speed which ranges from 63 kilometres per hour to 116 kilometres per hour (39-73 mph).

Tropical wave
A low-pressure system forming in tropical latitudes as a trade wind easterly with wind speeds of up to 36 kilometres per hour (22 mph).

Tsunami
Sea wave of local or distant origin that results from large-scale seafloor displacements associated with large earthquakes, major submarine slides, or exploding volcanic islands

V

Volcano
Vent or chimney to the earth's surface from a reservoir of molten rock, called magma, deep in the crust of the earth.

Vulnerability

The condition determined by physical, social, economic and environmental factors or processes, which increase the susceptibility of a community to the impact of hazards.

Positive factors, which increase the ability of people and the society they live in, to cope effectively with hazards and can reduce their susceptibility, are often designated as capacities.

Vulnerability Assessment

Vulnerability assessments are systematic examinations of population, buildings, infrastructure and selected geographic areas to identify who, what and where are susceptible to damage from the effects of natural hazards.

1 WELCOME AND COURSE INTRODUCTION

Learning Objectives

By studying this Unit you will learn about:

- Purpose, objectives, and methodology of the course
- History and development process of the course

*Welcome to this University of Wisconsin-Disaster Management Center (UWDMC) self-study course on **Disaster Risk Reduction (DD04)**. This is a practical distance learning course about hazards, disasters, and risk reduction. The goal of this course is to inform about these topics or to validate what you already know*.

Course Purpose

The goal is to provide concepts, information, tools, and instruments that will increase the overall awareness and understanding of Disaster Risk Management in general and the topics of Risk Reduction, Transfer, and Financing in particular.

Organization of this Course

This course is divided into seven Units.

- **UNIT 1: Welcome and Course Introduction**
  This Unit offers an overview of the course and provides information about the course objectives and methodology. There is a reference about the design and development process of the course and the main stakeholders involved.

- **UNIT 2: Introduction to Disaster Risk Management**
  This Unit explores in detail the common hazards in the Caribbean region, focusing on the three categories of natural hazards: hydrometeorological, geological and biological. This is the foundation for the course.

- **UNIT 3: Disaster Risk Management and Development**
  This Unit covers the concept of Disaster Risk Management and introduces its components: Risk Identification (hazard and Vulnerability Studies) Risk Reduction and Transfer (Prevention, Mitigation, Transfer, and Financing) Adverse Event Management (Preparedness, Alert, Response) and Recovery (Rehabilitation and Reconstruction).

- **UNIT 4: Disaster Risk Identification**
  This Unit identifies and links four inter-related activities: Hazard Data Collection and Mapping, Vulnerability Assessment, Risk Assessment, and Post-Disaster Assessment.

- **UNIT 5: Disaster Risk Reduction**
  This Unit presents the concept of Disaster Risk Reduction and how it can address either existing or future vulnerability, through measures in five categories: physical, socio-economic, environmental, management/Institutional, and post-disaster.

- **UNIT 6: Disaster Risk Transfer and Financing**
  This Unit focuses on disaster risk transfer mechanisms (insurance, market insurance ,and re-insurance) and financing instruments (budget, self-insurance, public asset coverage financing, catastrophe bonds, and disaster assistance funds).

- **UNIT 7: Capacity Development for Disaster Risk Reduction**
  This Unit introduces guidelines for preparing a work plan (action plan) which involves three main activities: planning; implementation and evaluation; and trouble-shooting.

Performance Objectives for this Course
Upon completion of this twenty-five hour course, you will know how to:

- List potential hazards and apply the process of building risk scenarios for a specific hazard
- Identify opportunities for intervention in each area of disaster risk management, indicating constraints and consequences
- Prepare an action plan and identify constraints and correction strategies for the implementation of risk reduction and transfer measures identified
- Demonstrate the ability to apply the criteria, tools and techniques presented in the course

Learning Objectives for this Course
In addition, on course completion, you will be able to:

- Explain key concepts and the areas components of disaster risk management
- Identify the stakeholders and their roles disaster risk management
- Describe the processes of characterizing a hazard and of conducting a vulnerability assessment using a given scenario
- Apply the process of building risk scenarios
- Describe categories of disaster risk reduction
- Analyze contexts in which active and passive measures area taken
- Identify components of disaster risk transfer and financing
- Elaborate an action plan

Every disaster risk reduction situation is different and a solution that works well in one location or scenario may be completely inappropriate in another. By considering the underlying factors presented in the course and the logic of systems based on a clear analysis of context and need, you should be able to decide on the best approach for your own unique situation.

How to Use this Course

Self-study is more demanding than traditional classroom instruction because each learner has to provide an individual framework for study instead of having it imposed by the course or workshop timetable. One of the problems with self-study courses is that people begin with great enthusiasm at a pace that they cannot sustain. The best way to undertake this distance education course is to plan your own study schedule over a pre-set period by thinking ahead and making your own clear, planned schedule for study.

The course is designed to take approximately 25 hours to complete. This includes the time for reading, reflecting, answering the questions in the text, and taking the final exam.

Pre-test
The pre-test included at the beginning of the course allows you to test your general knowledge about disaster risk reduction. This test consists of 25 multiple choice or true/false questions. Taking the test before beginning should stimulate you to compare your own thoughts about hazards and disasters to those presented in the text. The pre-test allows you to quickly determine how much you already know about the ideas presented here, and can help you to see which parts of the course you can move through more quickly or those you may need to spend more time on. If you score very well on the pre-test, it is likely that you do not need to take this course for the purpose of learning new information, although it may be a useful review.

Instant Feedback: Self-assessment questions and exercises
One drawback to self-study is that instant feedback from the instructor or your colleagues is not possible. To address the need for feedback, each chapter has several multiple choice questions. Exercises are found throughout the chapters to help you get the most from the materials. Each chapter concludes with a summary of key points as a review.

Final Examination
As a final complement to the self-assessment tests and activities which are included in the course text, there is a final examination administered by the University of Wisconsin-Disaster Management Center (UWDMC). When you have completed all the self-assessment tests and activities to your satisfaction, you may request a final examination package.

A final examination in an Independent Study course is always taken under the supervision of a proctor. The proctor administers the examination according to the instructions sent with it. You must obtain a proctor and make arrangements for writing the examination. Normally there is no charge for this service. Anyone in a position of educational or academic authority (for example, a registrar, dean, counselor, school principal or education officer) may serve as your proctor. Librarians and clergy are also acceptable proctors. Your immediate supervisor or someone else of authority in your company or organization may also be your examination proctor.

Write the proctor's name, title, and business mailing address on the REQUEST FOR FINAL EXAMINATION form included at the end of this publication and send it to the University of Wisconsin-Disaster Management Center. The UWDMC will mail the examination papers with instructions to your proctor who will monitor your taking the test. You will be notified when it is sent.

Upon receiving the notice, you should contact the proctor to make an appointment for the **closed-book** examination and to obtain any instructions about writing the exam. After you have written the examination, the proctor will mail it back to the University for grading and it will normally take 1-2 months for grading. Upon successful completion of the exam, the University will record your continuing education units (CEUs) on a university transcript and prepare your *Certificate of Completion.* Your certificate will be mailed to your postal address.

Evaluating the Course

A course Evaluation Form is also included at the end of this module. Please take a moment to fill out and return this form. Your reactions are important to help us improve future editions of these course materials. We appreciate your taking time to share your thoughts with us.

Background Information about the Disaster Risk Reduction Course

The Caribbean Region has experienced extensive damage from the incidence of natural hazards such as hurricanes, floods, earthquakes, volcanoes, and tsunamis. These extreme events have caused substantial loss of life, destruction of critical infrastructure, economic disruption, and environmental damage. Development has been delayed because already scarce resources targeted for development projects must be reallocated to emergency response and reconstruction efforts in the post-disaster period.

Research predicts that the frequency and magnitude of some natural hazards are likely to increase in the coming decades. Given the predictions of sea level rise associated with global climate change and highly populated coastal areas where much development is concentrated, Caribbean countries are also likely to be exposed to greater disaster risk in the next decades.

The Caribbean Development Bank (CDB) in 2000 accelerated its activities in disaster risk management to assist borrowing member countries (BMCs). It established a Disaster Mitigation Facility for the Caribbean (DMFC) project in its Projects Department, with support from the United States Agency for International Development-Office of Foreign Disaster Assistance (USAID OFDA). Starting in 2007, a permanent disaster risk management function has been established within the Bank's Projects Department under the Project Services Division.

To achieve increased stakeholder awareness and participation in disaster risk management, the CDB's DMFC, in collaboration with its partners USAID OFDA, developed an Introductory Course in Disaster Risk Reduction. The course is specifically designed to expose the broad range of stakeholders to the basic principles of disaster risk reduction. This will be done through enhancing stakeholder awareness, providing disaster risk management information, teaching disaster risk reduction in particular, and utilizing information, tools, instruments twoards the participants' knowledge and experiences

The Introductory Course in Disaster Risk Management targets a core group of multisectoral and multidisciplinary strategic users to extend the reach and impact of the course. These include a broad range of disaster risk management stakeholders, including governmental organisations, civil society organizations at the community, national and regional levels, other national disaster agencies, and related professional associations.

The major problem related with the lack of risk management activities in the Caribbean region, according to the World Bank document entitled “Revisiting the Challenge,” is stated as such:

This review established that there is already considerable experience with risk management in the region. However, the existing knowledge is not well developed, has not been widely shared and has not been incorporated into mainstream development decisions in either the public or private sector.

A. *A continued perception that risk management is the sole province of government agencies responsible for disaster management rather than a shared responsibility involving sector ministries, trade associations, and the private sector.*
B. *Low public demand for risk management measures due to complacency, a lack of understanding of the risks involved, and the perceived cost of these measures.*
C. *A lack of dissemination and public education with respect to the potential benefits and successful experiences with hazard risk management.*

Alter several trials, OFDA made different adjustments both in content and format based on different contributions from experts, instructors, and former course participants from the Caribbean. Nevertheless, the original elements from the design and development group remain intact. Later the course was translated and adapted to the Latin American context.

UNIT ONE SUMMARY

This Unit offers an overview of the course and provides information about the course objectives and methodology. At the end of the unit there is a reference about the design and development process of the course and the main stakeholders involved.

COURSE NOTES

COURSE NOTES

2 INTRODUCTION TO RISK MANAGEMENT

Learning Objectives

By studying this Unit you will learn to:

- Identify the natural hazards which are common in the region
- Explain the concepts of hazard, vulnerability, risk and disaster

2.0 Common Natural Hazards

> ***Hazard***
> *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 (United Nations International Secretariat for Disaster Reduction (ISDR, 2004).*

2.1. Origin of Natural Hazards

Hazards may have different origins: *natural* (geological, hydrometeorological and biological) or *induced by human processes* (environmental degradation and technological hazards).

ACTIVITY 2.1: HAZARDS AND CAUSES

Indicate whether the following hazards are natural (N) or human-made (HM) in their origin. Link them to possible causes.

- *Flooding*
- *Storm surge*
- *Volcanic eruption*
- *Hurricanes*
- *Radioactive pollution*

YOUR ANSWER FOR ACTIVITY 2.1

Hazard	Cause	Origin

✓ ***ANSWERS: At the end of this Unit***

2.2 Categories of Natural Hazards

There are three categories of natural hazards: hydrometeorological, geological, and biological. For the purposes of this course, all three will be defined, but only the first two will be examined.

> **Hydrometeorological hazards**
> Natural processes or phenomena of an atmospheric, hydrological or oceanographic nature.

Examples: Hurricanes, floods, storm surges

> **Geological hazards**
> Natural earth processes or phenomena that include internal earth processes of tectonic origin as well as external processes such as mass movements.

Examples: Earthquakes, volcanoes

> **Biological hazards**
> Processes of organic origin or those conveyed by biological vectors, including exposure to pathogenic microorganisms, toxins and bioactive substances.

Examples: Bird flu (avian influenza A (H5N1) virus), severe acute respiratory syndrome (corona virus), and mad cow disease (bovine spongirorm encephalopathy-BSE prioi).

Hazards may cause **the loss of life or injury, property damage, social and economic disruption, or environmental degradation.**

ACTIVITY 2.2: HAZARD CATEGORIES

1) Provide a list of natural hazards that are common in your country.

2) Group the natural hazards you have listed and classify them as hydrometeorological or geological.

YOUR ANSWER FOR ACTIVITY 2.2

Hydrometeorological	Geological

✓ ***ANSWERS: At the end of this Unit***

2.3 Classification of Natural Hazards

Hazards can be single, sequential, or combined in their origin and effects. Each hazard is characterized by its location, intensity, frequency, and probability. These characteristics will be discussed in more detail in Unit 4.

Some regions are vulnerable to the impact of common hazards such as tropical systems, nevertheless some countries are also subjected to specific threats, volcanic activity, tsunamis, and storm surges.

2.3.1 Hydrometeorological Hazards

The following are definitions of natural phenomena that fall into the category of hydrometerological hazards. These definitions are those used by the World Meteorological Organisation.

Tropical wave
A low-pressure system forming in tropical latitudes as a trade wind easterly with wind speeds of up to 36 kilometres per hour (22 mph).

Tropical waves bring much needed rains after the dry season. However, they present a hazard when they turn into tropical storms.

Tropical depression
A low-pressure system forming in tropical latitudes with wind speeds of 62 kilometres per hour (38 mph).

Tropical storm
A low-pressure system which has a maximum sustained surface wind speed which ranges from 63 kilometres per hour to 116 kilometres per hour (39-73 mph).

Tropical storms and waves can develop into hurricanes.

Hurricane
A rotating, intense low-pressure system, which forms over tropical oceans where there are warm waters, humid air and converging winds.

- Hurricanes derive their energy from the latent heat of water vapour condensation over warm tropical seas.
- Hurricanes consist of wind speeds of 117 kilometers per hour and over (74 mph or more).
- The eye of the hurricane is relatively clear and calm area inside the circular wall of convective clouds, which spiral in an anticlockwise direction.
- The eye lies at the geometric centre of the hurricane and can be 30 to 59m kilometers (19 to 31 mls) in diameter.
- A hurricane can have a diameter of 650 kilometers (404)mls.

The Saffir-Simpson Scale is a rating based on the hurricane's present intensity.

- Category One: winds 119-153 km/hr(74-95mph)
- Category Two: winds 154-177 km/hr(96-110mph)
- Category Three: winds178-209 km/hr(111-130mph
- Category Four: winds 210-249 km/hr(131-155mph)
- Category Five: winds greater than 249 m/hr(155mph)

SEE KEY RESOURCES (Annex B.2) for more information about the Saffir-Simpson Scale.

The destructive potential of a hurricane is significant. In the 60-year period between 1942 and 2002, over `20,000 people lost their lives in the Caribbean due to hurricanes. The impact of hurricanes on the development of the region will be discussed later in this unit.

Storm Surge
A storm surge consists of unusual volumes of water flowing onto shorelines.

- The height of the storm surge is the difference between the observed level of the sea surface and the level that would have occurred in the absence of the hurricane.
- Storm surge is usually estimated by subtracting the normal or astronomic high tide from the observed storm tide.
- It is a complex phenomenon, which behaves quite differently from one shoreline to another.
- Storm surges generated by hurricanes have the potential to cause the greatest damage.
- The increase in coastal settlement has put much economic investment, in particular coastal infrastructure, at risk from sea damage.
- Storm surges also cause flooding further inland through the blockage of the outfalls of drainage systems.

Torrential rain
any rain that pours down fast, violently, or heavily (Eschelbach, 2007).

Torrential rains can also be considered natural hazards since they sometimes result in disastrous flooding of low-lying areas.

Asia remained the region hardest hit and most affected by natural disasters in 2007. Indeed 37% of the year's reported disasters occurred in Asia, accounting for 90% of all the reported victims and 46% of the economic damage due to natural disasters in the world. Asia was especially hard hit by strong monsoon related events. Other regions of the world also experienced some history making hydro-meteorological disasters. Africa and South America were mainly affected by hydrological disasters (i.e. Mexico, Uruguay and Zambia) experienced their countries worst flooding events ever recorded by the Center for Research on the Epidemiology of Disasters (CRED).

According to the International Panel on Climate Change (IPCC, 2001) small islands are among the countries that will be most seriously impacted by climate change. In addition to projected impacts of climate change (including sea-level rise, sea temperature increase, and wind and ocean currents), one of the major concerns is the potential for increased frequency and severity of climatic extremes.

Drought
A period of abnormally dry weather that persists long enough to produce a serious hydrologic imbalance (for example, crop damage, water supply shortage, etc.). The severity of the drought depends upon the degree of moisture deficiency, the duration, and the size of the affected area. (From National Oceanic and Atmospheric Administration, 2007).

Droughts are often associated with the El Niño phenomena (CDERA, 2001). While few specific interventions have been made at the regional level to address drought within the disaster risk management framework, extremes with regards to reduced precipitation will have negative implications for both water resources and disaster risk management within the region.

2.3.2 Geological Hazards

As mentioned earlier, there are several types of geological hazards. The following are definitions of these types of hazards.

> **Earthquake**
> The sudden slip on a fault and the resulting ground shaking and radiated seismic energy caused by the slip, or by volcanic or magmatic activity, or other sudden stress changes in the earth (USGS, n.d.).

Earthquakes result from a slow build up of pressure along tectonic plates that make up the earth's crust. If this pressure is suddenly released, then parts of the surface may experience a jerking movement, known as an earthquake. Within the crust, the point at which the release in pressure occurs is known as the *focus*. Above this, on the surface and usually receiving the worst of the shock or seismic waves, is the *epicentre*.

- Earthquakes may be highly destructive natural hazards that may occur at any time with practically no warning.
- They may have sudden impact causing the destruction of buildings and infrastructure in seconds, killing or injuring people.
- In 1692, most of Port Royal in Jamaica disappeared beneath the sea, and in 1907 Kingston was destroyed.
- The Virgin Islands suffered considerable damage in 1867.
- Port-au-Prince was destroyed twice in twenty years in the eighteenth century.

> **Volcano**
> A vent or chimney to the earth's surface from a reservoir of molten rock, called magma, deep in the crust of the earth.

- Volcanoes may produce *pyroclastic flows* which are mixtures of hot gas, ash and other volcanic rocks travelling very quickly down the slopes of volcanoes. These flows can cause much damage including the loss of lives and destruction of buildings and infrastructure.

- Several islands are volcanic in origin: Hawaii, Canary islands, Java, Monsterrat, Martinique, Guadeloupe, the U.S. Virgin Islands, St. Kitts, Nevis, Grenada, St. Lucia, Dominica and St. Vincent and the Grenadines. These volcanoes are either active or dormant. Within the last century, Martinique, Monsterrat, and St. Vincent were devastated by volcanic eruptions.

Tsunami
A sea wave of local or distant origin that results from large-scale seafloor displacements associated with large earthquakes, major submarine slides, or exploding volcanic islands (USGS, n.d.).

Tsunami is a Japanese word meaning “harbour wave.” These waves originate from undersea or coastal seismic activity caused by earthquakes, landslides, and volcanic eruptions. Whatever the cause, sea water is displaced with a violent motion and swells up, ultimately surging over land with great destructive power.

- Tsunamis may measure 150 kilometres between successive wave crests and in deep water of the ocean may travel the speed of a jet airplane of around 800 kilometres per hour.
- In the past 500 years, there have been at least ten earthquake-generated tsunamis in the Caribbean. These occurred for example in Haiti, Guadeloupe, Puerto Rico, the Dominican Republic, and the U.S Virgin Islands. Four of them killed approximately 350 persons.
- The most recent tsunami that devastated South East Asia in 2004 is a good example of the catastrophe associated with a tsunami. That event killed over 220,000 people and affected at least 11 countries.

Landslide
The movement of surface material down a slope (USGS, n.d.).

Landslide is a general term covering a wide variety of landforms and processes involving the movement of earth, rock or debris down slope under the influence of gravity. Landslides may also take place in conjunction with earthquakes, hurricanes, floods and volcanoes.

2.4 Key Terms

The concept of **hazard** was introduced at the beginning of this Unit. The terms *vulnerability, risk*, and *disaster* will be discussed in this part of the unit.

> **Vulnerability**
> The condition determined by physical, social, economic and environmental factors or processes, which increase the susceptibility of a community to the impact of hazards (ISDR, 2004).

ACTIVITY 2.3: COMMUNITY VULNERABILITY

What are some physical, social, economic, and political factors that make a community vulnerable?

YOUR ANSWER FOR ACTIVITY 2.3

✓ ***ANSWERS: At the end of this Unit***

Think about the possible LOSSES resulting from these factors; include losses witnessed from your experience.

Risk
The probability of harmful consequences or expected losses (deaths, injuries, property, livelihoods, economic activity distributed or environment damage) resulting from interactions between natural or human-induced hazards and vulnerable conditions (ISDR, 2004).

Risk can be expressed as the ***probability*** of loss of life, injuries, property damage, loss of livelihood, disruption of economic activity, or environmental damage. Risk is comprised of two factors: hazard and vulnerability. Hazard and vulnerability are characteristics or circumstances related to the probability of creating unwanted results

Conventionally, risk is expressed by the function of hazards and vulnerability. The equation *R = f (H,V)* means that risk is a function of the hazard and the level of vulnerability, and it is directly proportional to both of these factors. In order to prepare an accurate risk estimate, it is necessary to analyze both the hazard and the level of vulnerability. Some disciplines also include the concept of exposure to refer particularly to the physical aspects of vulnerability.

Beyond expressing a possibility of physical harm, it is crucial to recognize that risks are inherent or can be 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.

Example: Structures that can be damaged due to flooding, potential loss of school days due to flooding, loss of crops due to volcanic eruption, coral reef damage due to storm surges, and psychological damage to citizens.

Acceptable Risk
The probability of harmful consequences or expected losses (deaths, injuries, property, livelihoods, economic activity distributed or environment damage) resulting from interactions between natural or human-induced hazards and vulnerable conditions (ISDR, 2004).

ACTIVITY 2.4: EXPLORING ACCEPTABLE RISK

1. You are traveling home by airplane after a long and exhausting business trip. You are planning to surprise your partner by being present for an important anniversary. A storm is now forming; even though some airlines cancelled flights your airline has decided to fly. It has a good safety flight record. Would you consider it an acceptable risk to fly in poor weather conditions so as to get home on time?

YOUR ANSWER FOR ACTIVITY 2.4.1

2. After the inundation 10 years ago caused by the river overflow, your house was flooded and you had to be evacuated by rescue patrol. Since then, several levees have been constructed on the river to protect homes and other properties. This year it is predicted that rainfall will be higher than normal and it is expected that some of the levees may be breeched. Voluntary evacuation is recommended by the river authorities. Would you voluntarily evacuate or would you see this as an acceptable risk and stay?

YOUR ANSWER FOR ACTIVITY 2.4.2

✓ ***ANSWERS: At the end of this Unit***

Disaster
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 or society to cope using its own resources (ISDR, 2004).

A disaster results from the combination of hazards, conditions of vulnerability and insufficient capacity or measures to reduce the potential negative consequences of risk**.**

UNIT TWO SUMMARY

This Unit describes common hazards, focusing on the three categories of natural hazards: hydrometeorological, geological and biological. Key terms are *hazard, vulnerability, risk, acceptable risk,* and *disaster*. This is the foundation for the course.

UNIT TWO ACTIVITIES - POSSIBLE ANSWERS

ACTIVITY 2.1: HAZARDS AND CAUSES

Hazard	Cause	Origin
Flooding	• Torrential rainfall • Hurricanes • Deforestation • Erosion	Natural Human-made
Storm surge	Hurricanes	Natural
Volcanic eruption	Geological fault	Natural
Hurricane	Low pressure weather system	Natural
Radioactive pollution	Improper nuclear waste disposal	Human-made

ACTIVITY 2.2: HAZARD CATEGORIES

Classification of Natural Hazards

Hydrometeorological	Geological
Hurricanes	Volcanoes
Tropical storms	Tsunamis
Tropical waves	Landslides
Storm surges	Mud flows
Torrential rains	Earthquakes
Floods	Landslides

ACTIVITY 2.3: COMMUNITY VULNERABILITY

- Buildings located in low-lying, flood prone areas (for example Caroni Plains, Trinidad and Georgetown, Guyana);
- Buildings located on steep slopes (for example, Kingston, Jamaica, Port of Spain, Trinidad);
- Cities next to a rushing river surrounded by steep slopes or a nuclear plant;
- An aqueduct near an active volcano; power towers in a seismic area.

ACTIVITY 2.4: EXPLORING ACCEPTABLE RISK

1. It is acceptable if the airline has a good safety record.
2. There is fact: even though the levees have been constructed the risk persists. The decision will depend on the expected loses by the floods and the options available for a relocation, safety conditions and economic and social opportunities, among other considerations.

UNIT TWO SELF ASSESSMENT QUESTIONS
(Circle the best answer)

1. A hazard:

    A. is a potentially damaging physical event, phenomenon, or human activity
    B. may cause the loss of life or injury, property damage,
    C. may generate social and economic disruption or environmental degradation.
    D. all of the above

3. The categories of natural hazards are

    A. hydrometeorological
    B. geological
    C. biological
    D. all of the above

4. Which of the following statements is consistent with the progression in intensity of wind speeds?

    A. Tropical wave, Tropical storm, Tropical depression, Hurricane
    B. Tropical depression, Tropical wave, Hurricane, Tropical storm
    C. Tropical wave, Tropical depression, Tropical storm, Hurricane
    D. Tropical depression, Tropical wave, Tropical storm, Hurricane

4. The storm surge is the less important phenomena associated with a hurricane.

    True *False*

5. The severity of the drought does not depend on the degree of moisture deficiency, only in the duration, and the size of the affected area.

    True *False*

6. An earthquake can be caused by
    A. a sudden slip on a fault,
    B. by volcanic or magmatic activity,
    C. sudden stress changes in the earth.
    D. all of the above

7. The pyroclastic flows are the less important manifestation of volcanoes.

   True *False*

8. Tsunami waves originate from undersea or coastal seismic activity and can be caused by earthquakes, landslides, and volcanic eruptions.

   True *False*

9. Landslides are not associated with earthquakes, hurricanes, floods and volcanoes.

   True *False*

10. Vulnerability is associated to the susceptibility of a community to the impact of hazards.

    True *False*

11. Risk is comprised of two factors:
    - *A. alert and alarm*
    - *B. hazard and vulnerability*
    - *C. vulnerability and susceptibility*
    - *D. hazards and threats*

12. The specific value of damage a community is willing to assume is called acceptable risk.

    True *False*

13. A disaster situation exceeds the capacity of the community or society affected to cope using its own resources.

    True *False*

14. A disaster results from:
    - *A. combination of hazards*
    - *B. conditions of vulnerability*
    - *C. insufficient capacity or measures to reduce the potential negative consequences of risk*
    - *D. all of the above*

UNIT TWO SELF ASSESSMENT ANSWERS

1. D
2. D
3. C
4. F
5. F
6. D
7. F
8. T
9. F
10. T
11. B
12. T
13. T
14. D

COURSE NOTES

3 DISASTER RISK MANAGEMENT AND DEVELOPMENT

Learning Objectives

By studying this Unit you will learn to:

- List the areas and components of risk management
- Describe the relationship between disaster risk reduction and development
- Identify the stakeholders and their roles in disaster risk management

3.1 Disaster Risk Management

> **Disaster Risk Management**
> The systematic management of administrative decisions, organization, operational skills and capacities to implement policies, strategies and coping capacities of the society and communities to lessen the impacts of natural hazards and related environmental and technological disasters. This comprises all forms of activities, including structural and non-structural measures to avoid (prevention) or to limit (mitigation and preparedness) adverse effects of hazards (ISDR, 2004).

Disaster risk management includes the areas of risk identification, risk reduction and transfer, adverse event management, and recovery.

Disaster Risk Management Areas	Components
Risk identification	Hazard and vulnerability studies
Risk reduction and transfer	Prevention, mitigation, transfer, and financing
Adverse event management	Preparedness, alert, response
Recovery	Rehabilitation and reconstruction

3.1.1 Risk Identification

> **Risk Identification**
> The systematic use of available information to determine the probability of certain adverse events occurring and the related consequences.

Risk identification is an essential, preliminary step because it provides important information used in all other components of disaster risk management, such as risk reduction, extreme event management, risk transfer, and recovery actions.

3.1.2 Risk Reduction and Risk Transfer

> **Risk Reduction**
> An evolving area of disaster risk management aimed at risk elimination or reduction by intervening in the vulnerability.

In other words, risk reduction involves clear and explicit effort to avoid the occurrence of disasters. Risk reduction comprises two components: prevention and mitigation.

While the ISDR defines *risk reduction* as prevention, mitigation, and preparedness, the term is used in this course to refer to prevention and mitigation since the focus is more on avoidance of the risk and mitigation of impacts.

> **Prevention**
> Activities to provide outright avoidance of the adverse impact of hazards and the means to minimize related environmental, technological and biological disasters (ISDR, 2004).

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, the hope is that changing attitudes and behaviour will contribute to promoting a "culture of prevention."

Examples: Permanent relocation of houses, industries, commercial enterprises, and infrastructure that are located in hazardous areas such as flood prone areas or near volcanoes.

Investing in preventive measures is justified in areas frequently affected by disasters, depending on social and technical feasibility and cost/benefit considerations. In practice, preventative measures tend to be costly. Also, prevention may not benefit existing development, but it can be most beneficial and feasible in future development processes such as a change in land use or the expansion of a city away from the hazard prone area.

> **Mitigation**
> Structural and non-structural measures undertaken to limit the adverse impact of natural hazards, environmental degradation and technological hazards (ISDR, 2004).

Examples: Construction of flood control structures and building facilities to withstand major earthquakes (structural), land use plans, and acquisition of properties at risk by the state (non-structural).

ACTIVITY 3.1: HAZARD IMPACTS

Examine the list of hazards and indicate which of these are preventable. Also list which of these and its impacts can be mitigated.

- Hurricanes
- Earthquakes
- Flooding
- Volcanic eruption
- Torrential rainfall
- Toxic waste contamination
- Oil spills
- Industrial pollution

YOUR ANSWER FOR ACTIVITY 3.1

Hazard impact that can be prevented	*Hazard impact that can be mitigated*

✓ ***ANSWERS: At the end of this Unit***

Some events can be prevented, but most of them cannot. Mitigation tends to reduce the damaging effects to life and property caused by non-preventable events.

Risk Transfer
Instruments that share / hedge economic risks before losses occur.

Examples: Insurance, reinsurance, catastrophe bonds, emergency funds, etc.

3.1.3 Adverse Event Management

During the 1980s, disaster management focused predominantly on the execution of actions necessary for a timely response after the event had occurred. Since then, it has been found that disasters can be substantially reduced if people are well informed and motivated towards a culture of disaster prevention and resilience, which in turn requires the collection, compilation, and dissemination of relevant knowledge and information on hazards, vulnerabilities, and capacities. This is known as preparedness.

> **Preparedness**
> Activities and measures taken in advance to ensure effective response to the impact of hazards, including the issuance of timely and effective early warnings and the temporary evacuation of people and property from threatened locations (ISDR, 2004).

Some examples of preparedness activities are:

- Maintaining databases of physical, human, and financial resources.
- Training personnel for DANA and for emergency action.
- Informing the community about the risk and the way to respond to an adverse event.
- Selecting and display of evacuation routes and shelter areas.
- Locating trategically resources – warehousing.
- Implementingf communication and public information networks.
- Creating simulation exercises – search and rescue, aid and assistance, and security.

Alerts have been typically included as part of preparedness. Their use is also a component of adverse event management.

> **Alert**
> A formal declaration of the imminent occurrence of a hazard. This information should lead emergency organisations to activate previously established mechanisms, and the information should encourage the population to take specific precautions.

It is not always possible to issue an alert. It is feasible when some hazards occur slowly such as tropical storms, tsunamis that have originated far from the shore, or torrential rains in the mountains. However, it is not feasible in others that occur quickly such as earthquakes or landslides resulting from heavy rainfall.

Usually, different types of alert are defined depending on the level of certainty that an event will occur.

Actions common in the alert stage:

- Establishing monitoring networks, such as:
  - Satellite images, remote sensors and tele-detection.
  - Volcano watch and monitoring networks.
  - Mud flow and landslide detectors.
  - Seismologic networks for earthquakes and tsunamis.
  - Hydro-meteorological networks for climate behaviour.
- Utilizing existing resources for communication, such as:
  - Mass media with pre-recorded messages.
  - Radio, email, fax and telephone communication networks.

> **Response**
> The provision of assistance or intervention during or immediately after a disaster to meet the life preservation and basic subsistence needs of those people affected. It can be of an immediate, short-term, or protracted duration (ISDR, 2004).

Examples:
- Evacuation of risk areas
- Search and rescue of affected people
- Medical assistance for stabilization
- Temporary shelter, food and clothes supply
- Quarantine and security
- Damage assessment
- Supply management

3.1.4 Recovery

> **Recovery**
> Decisions and actions taken after a disaster with a view to restoring or improving the pre-disaster living conditions of the stricken community, while encouraging and facilitating necessary adjustments to reduce disaster risk (ISDR, 2004).

Recovery presents an opportunity to develop and apply disaster risk reduction measures. Components of recovery include *rehabilitation* and *reconstruction.*

Rehabilitation
The transition period that begins during response to re-establish temporary critical basic services in the short-term.

Rehabilitation refers to short-term measures, re-establishing basic services such as:
- distribution of potable water and food
- placement of electrical generators for emergency supply
- establishment of emergency health care units
- implemented temporary solutions for transportation and communication
- construction of temporary shelters

Reconstruction
The process of infrastructure repair, restoration of the production system, and resumption of the population's normal life pattern.

Reconstruction provides opportunity to improve earlier living conditions because it deals with long-term measures.

Examples:
- construction of new roads
- re-establishment of communication networks
- development of housing plans for homeless tenants
- construction of new water treatment plants with redundant systems to manage future risks
- repair and retrofitting of critical infrastructure such as bridges, hospitals, public buildings, and etc.

There is a close link between all components of Disaster Risk Management in such a way that the implementation of one affects the others.

3.2 Disaster Risk Management and Development

Natural events such as earthquakes, volcanoes, hurricanes, and floods pose a growing threat to national and regional development strategies. This is compounded by the expanding population and economic growth in different regions worldwide. Natural hazards can delay future development due to the loss of resources. They may also cause a shift of scarce resources earmarked for development projects to emergency response and reconstruction following the events. As well, they can depress the investment climate. Proactive disaster risk management, which involves priority investment in mitigation and prevention, is an essential strategy for sustainable development in the Caribbean Region.

Damage from adverse events can be direct or indirect, short-term or long-term.

Direct damage
All damage sustained by immovable assets and inventories of finished and semi-finished products, raw materials, other materials and spare parts (UNECLAC, 1991).

Examples: Damage to property such as physical infrastructure (water and sewerage systems, electricity, roads, drainage), buildings, installations, machinery, equipment, means of transport, storage facilities, furniture and damage to agricultural land.

Indirect damage
Damage to the flows of goods that cease to be produced or the services that cease to be provided during a period of time beginning almost immediately after the disaster and possibly extending into the rehabilitation and reconstruction phase (UNECLAC, 1991).

Examples: Loss of production opportunities and future income, increases in poverty levels, and increased costs of transport due to the loss of ports, roads and bridges.

ACTIVITY 3.2: DIRECT/INDIRECT DAMAGES

Give examples for direct and indirect damages.

YOUR ANSWERS FOR ACTIVITY 3.2:

Direct Damage:

Indirect Damage:

✓ ***ANSWERS: At the end of this Unit***

Another Example: The CDB estimates that the damage caused by the hurricane season in 2004 cost the Caribbean Region more than US$4.5 billion (CDB, 2004). Countries have suffered losses approaching and exceeding the annual Gross Domestic Product (GDP) from a single hurricane event. According to the United Nations Commission for Latin America and the Caribbean (2005), the damage from Hurricane Ivan was estimated at more than 200% of Grenada's GDP.

Prior to Hurricane Ivan, Grenada's economy was projected to grow by 4.7 per cent in 2004 and at an average rate of 5.0 percent between 2005 and 2007. The growth was fueled by developments in the agriculture and construction sectors and in the tourism industry for 2004.

With the passage of Hurricane Ivan, economic activity was projected to decline by approximately -1.4 percent in 2004 (resulting in an overall impact of six percentage points of GDP growth) reflecting a contraction in tourism and the halt in production of traditional crops. Hurricane Ivan caused a loss of life, destroyed or damaged 90% of the housing stock, damaged shelters, the hospital, the electricity and water and sewerage infrastructure, and crop lands.

3.3 Link between Development and Disaster Risk Management

> **Development**
> The cumulative and lasting increase, tied to social changes in the quantity and quality of a community's goods, services and resources, with the purpose of maintaining and improving the quality and security of human life.

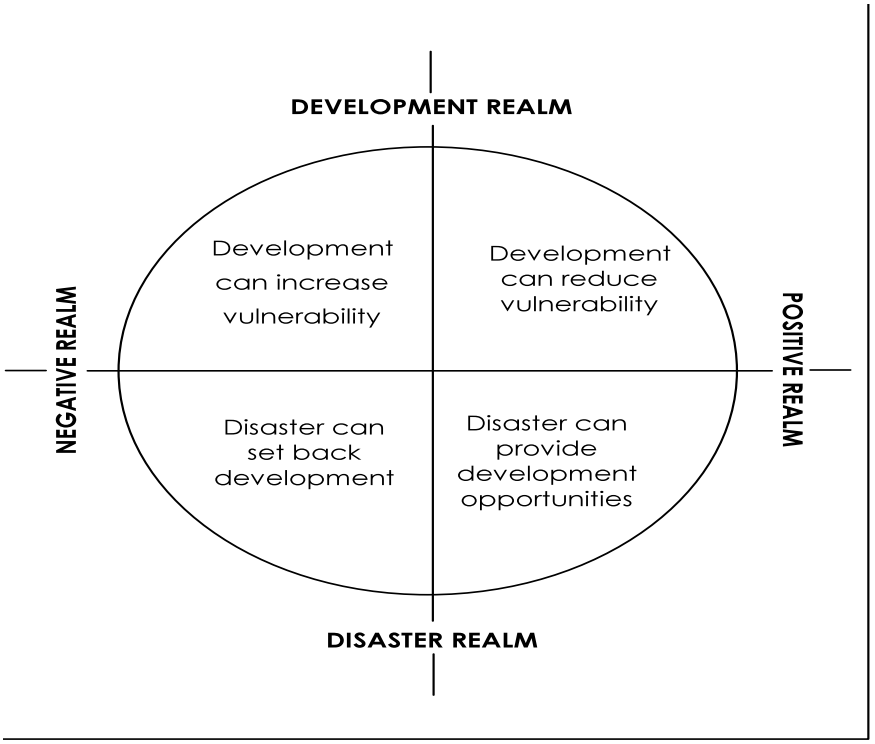
There is a link between *development* and *disaster risk management.* Development can facilitate disaster risk management or can complicate it by not taking risk reduction principles into account in planning processes.

Conversely, the lack of development can make countries more vulnerable and susceptible to risk. At the same time, the development choices made by individuals, communities, and nations can result in an unequal distribution of disaster risk. The poor often bear the most impact from natural hazards in terms of lives, loss of livelihoods, and rebuilding their communities and infrastructure.

The relationship between natural hazard/disaster risk and development is best illustrated using four basic themes as shown in the following diagram. The diagram shows aspects of a nation's/community's development and vulnerability. From the graph it is possible to analyse the quadrants pertaining to development and disaster vulnerability.

The circle is divided into positive and negative aspects of the disaster/development relationship by the vertical axis. The right side represents the positive side of the relationship and the left side deals with the negative side of the relationship.

The following are examples of the relationship between natural hazards/ disaster risk and development: Development can increase vulnerability to natural hazards through, for example, dense urban settlement, development of hazardous sites, environmental degradation, technological failures or imbalance of pre-existing natural or social systems.



Source: Coburn, Spence, and Pomonis, 1994.

Example: In Guyana, the use of the kokers to regulate the drainage of the city of Georgetown proved to be very effective in mitigating flooding. However, the lack of maintenance of this infrastructure because of limited economic resources caused flooding of the city. Additionally, the development of housing and higher urban density in Georgetown led to increased sedimentation in the water courses that drained the city, which eventually resulted in flooding caused by the inadequately maintained drainage system. This is an example of how public works, like the kokers and the drainage systems which are considered a development achievement, can increase the risk of the community due to inadequate maintenance, whether due to the lack of economic resources or competing government priorities.

Development programmes can reduce vulnerability by, for example, strengthening of urban utility systems, use of hazard resistant building techniques, institution building, and appropriate agricultural and forestry programmes.Natural hazards/disaster risks can set back development as occurs when years of development initiatives are destroyed.

Example: Infrastructure improvements (such as transport and utility systems) are destroyed by a flood.

Natural hazards/disaster risks can provide development opportunities by creating a social and political atmosphere of acceptance to change, highlighting the sources of underdevelopment that exacerbated the impact and focusing international attention and aid on the disaster area.

3.4 Institutional Framework for Disaster Risk Management

Stakeholders exist at the national, regional, and international levels. Some of these stakeholders are lead agencies and others are support agencies depending on the component of disaster risk management. These stakeholders should be promoting, coordinating, or implementing disaster risk management activities within sectors across the region. The advantages of this coordination are:

- Cost effectiveness as a result of economies of scale
- Availability of expertise
- Broad-based access to public and private sector decision makers

ACTIVITY 3.3: STAKEHOLDER SUMMARY MATRIX

1. On the next two pages, you will use the blank Summary Matrix. For this activity, begin by choosing one of the following natural hazards: flooding, landslides, hurricanes or volcanic eruptions.

2. Complete the Summary Matrix of Roles and Activities of Stakeholders for the natural hazard you have chosen.

3. Introduce categories of agencies involved at the community, national, regional, and international levels. Then, list possible roles and explore connections between various agencies.

YOUR ANSWERS FOR ACTIVITY 3.3:
BLANK TABLE PROVIDED ON THE NEXT PAGE

Risk Management Component	Responsible agencies/agents	Principal responsibilities[i]		
		Pre-event phase	Extreme Event phase	Post-Event phase
1. **Hazard Identification**				
2. Risk Identification				
3. Risk Reduction				
4. Risk Transfer				
5. Disaster Management				
6. Recovery				

UNIT THREE SUMMARY

This Unit presents the concept of Disaster Risk Management and introduces its components:

- Risk Identification (Hazard and Vulnerability Studies)
- Risk Reduction and Transfer (Prevention, Mitigation, Transfer, and Financing)
- Adverse Event Management (Preparedness, Alert, Response)
- Recovery (Rehabilitation and Reconstruction)

The relation between Disaster Risk Management and Development is described. Finally, an Institutional Framework for Disaster Risk Management is introduced and that Framework constitutes the basis for future analysis during the course.

UNIT THREE ACTIVITIES - POSSIBLE ANSWERS

ACTIVITY 3.1: HAZARD IMPACTS

Hazard impact that can be prevented	***Hazard impact that can be mitigated***
Oil spill	Earthquake
Toxic waste contamination	Hurricane
Industrial pollution	Volcanic eruption
Landslide	Landslide
Flooding	Flooding

ACTIVITY 3.2: DIRECT/INDIRECT DAMAGES

Direct damage includes key infrastructure--e.g.

- water and sewerage
- electricity
- road
- drainage
- buildings such as hospitals

Indirect damage

- interruptions to economic activities
- loss of income
- increased costs due to the hazard

ACTIVITY 3.3: SEE NEXT PAGES

SAMPLE ANSWER ACTIVITY 3.3

Risk Management Component	Responsible agencies/agents	Principal responsibilities[ii]		
		Pre-event phase	**Extreme Event phase**	**Post-Event phase**
1. **Hazard Identification**	**Lead** ➢ Scientific/research agencies ➢ Special technical agencies ➢ Universities **Support** ➢ Local government & communities ➢ Investors (multilateral, bilateral, private banks) ➢ NDOs[iii] & regional coordination mechanism	➢ Hazard identification and mapping	Systematic observation of hazard characteristics and damage	➢ Analysis of hazard and impact observations ➢ Updating of hazard maps
2. Risk Identification	**Lead** ➢ Technical disciplines (Engineering, Physical Planning) ➢ Universities **Support** ➢ Insurers & Re-insurers ➢ Sector technical units	➢ Vulnerability assessments ➢ Risk analysis and formulation of impact scenarios		➢ Updating of vulnerability assessments and risk information, based on post-events diagnostic surveys
3. Risk Reduction	**Lead** ➢ Sectoral ministries ➢ Property owners ➢ Private sector companies, including insurance ➢ Local government & Communities **Support** ➢ Ministries of Finance and Planning ➢ NDOs & regional coordination mechanism	➢ Incorporating risk reduction in new development plans and investments ➢ Investing in retrofitting ➢ Investing in protective measures		➢ Exploit opportunities for risk reduction as part of recovery ➢ Set performance criteria and goals for sectors

4. Risk Transfer	**Lead** ➢ Property owners ➢ Sector infrastructure managers ➢ Insurance brokers ➢ Insurers and re-insurers **Support** ➢ Ministries of Finance and Planning ➢ Ministries of Trade and Commerce	➢ Analyse and quantify risk ➢ Set risk transfer mechanisms	N/A	➢ Damage assessment and adjustments ➢ Collection and allocation of insurance payments ➢ Revisit decision regarding acceptable level of risk
5. Disaster Managemen	**Lead** ➢ NDOs & regional coordination mechanism ➢ Public health agencies ➢ Red Cross and other NGOs ➢ Community organizations **Support** ➢ Sectoral ministries ➢ Ministries of Finance and Planning Technical disciples (Engineering & Physical Planning)	➢ Contingency planning ➢ Preparedness programmes and training ➢ Forecasting and warning ➢ Public information and awareness ➢ Maintain inventory of updated hazard and risk information	➢ Monitoring of events and impacts ➢ Coordination of disaster response ➢ Ensuring public health and safety ➢ Mobilisation and delivery of national and international relief ➢ Public warning and information ➢ Coordinate damage and needs assessment	➢ Evaluate effectiveness of disaster response ➢ Prepare lessons learned for improved disaster management, risk identification and reduction activities ➢ Ensure that lessons learned are incorporated in recovery ➢ Undertake diagnostic surveys to analyse damage, possible causes and remedies
6. Recovery	**Lead** ➢ Communities and property owners ➢ Local government ➢ Sectoral ministries ➢ Private sector companies **Support** ➢ Ministries of Finance and Planning NDOs & regional coordination mechanism	➢ Develop recovery plans for all sectors, based on realistic impact scenarios ➢ Identify responsible parties and performance criteria for reconstruction	➢ Monitor events and impacts ➢ Participate in damage and needs assessment	➢ Develop recovery plans ➢ Mobilize resources for recovery ➢ Implement recovery projects and programmes ➢ Incorporate risk reduction in the recovery projects and programmes ➢ Disseminate results of diagnostic surveys

Shaded areas signify priority during that particular phase.
NDO= National Disaster Office

UNIT THREE SELF ASSESSMENT QUESTIONS
(Circle the best answer)

1. Disaster Risk Management includes the areas of risk identification, risk reduction and transfer, adverse event management and recovery.

   True *False*

2. Components of recovery are:

   A. Prevention
   B. Alert
   C. Transfer and financing
   D. Rehabilitation and reconstruction
   E. All of the above

3. Earhquakes, hurricanes, and volcanos can be prevented.

   True *False*

4. Of the following, which have impacts that can be prevented?

   A. Oil spills
   B. Toxic waste contamination
   C. Industrial pollution
   D. All of the above

5. *Risk transfer* refers to instruments that share or hedge economic risks before losses occur

   True *False*

6. Which of the following is a Risk Transfer Instrument

   A. Standard operational procedures
   B. Insurance
   C. Emergency plans
   D. None of the above

7. *Alerts* are a component of Risk Identification.

   True *False*

8. There are four critical elements of alerts. They are (a) the alert must be public, (b) the alert must be timely, (c) the alert must be clear and concise and (d) the alert must be official.

   True *False*

9. Preparedness is a component of adverse event management; preparedness activities are undertaken immediately following a response.

   True *False*

10. *Direct damage* is all damage sustained by immovable assets.

    True *False*

11. The lack of development can make countries less vulnerable and susceptible to risk.

    True *False*

12. *Indirect damage* can be considered as damage to the housing stock only.

    True *False*

13. In the institutional framework for disaster risk management, stakeholders are only at the national level.

    True *False*

14. For Hazard Identification, which of the following agencies play a supportive role?
    A. Scientific/research agencies
    B. Universities
    C. Special technical agencies
    D. All of the above
    E. None of the above

15. In recovery, communities and property owners, local government, sectoral ministries and private sector companies play a leading role.

    True *False*

UNIT THREE SELF ASSESSMENT ANSWERS

1. T
2. D
3. F
4. D
5. T
6. B
7. F
8. T
9. F
10. T
11. F
12. F
13. F
14. E
15. T

COURSE NOTES

COURSE NOTES

4 DISASTER RISK IDENTIFICATION

Learning Objectives

By studying this Unit you will learn to:

- Explain the process of characterising a hazard
- Explain the process of conducting a vulnerability assessment using a given scenario
- Apply the process of building risk scenarios

4.0 Introduction

The focus of this Unit is on the application of a series of practical steps necessary for characterising a hazard. As you move through the Unit, apply these steps systematically to the given scenario, emphasizing the benefits to be derived from such a process.

Since not much can be done to avoid the occurrence and reduce the intensity of most natural hazards, hazard risk management activities and programmes necessarily focus on reducing existing and future vulnerability to damage and loss.

We have already identified three inter-related components of disaster risk management actions:

Risk Identification, Risk Reduction and Risk Transfer.

This Unit focuses on *risk identification*. It begins with how to characterize a hazard, followed by describing risk identification activities, and then ends with how to build risk scenarios.

STEPS

1. Characterising the hazard
2. Describing risk identification activities
3. Building risk scenarios

> **Risk Identification**
> Systematic use of available information to estimate the geographic extent of the hazard, its intensity, and its probability of occurrence and the related consequences.

Risk identification is an essential, preliminary step because it provides important information, which is used in all other components of disaster risk management, such as risk reduction, risk transfer, financing, and recovery.

4.1 Characterising Natural Hazards

The measurable components of a hazard are:

- The magnitude or intensity of the hazard
- The likelihood or probability of the hazard occurring in any particular location within any specified period of time.

Concepts Used in Characterising Natural Hazards

Concept	Meaning	Tool
Intensity	Level of damage	Earthquakes: Mercalli Scale Winds: Beaufort Scale Hurricane: Saffir-Simpson Scale
Magnitude	Energy/power	Earthquakes: Magnitude Scale Hurricane : Saffir-Simpson
Probability	Likelihood	Statistics or models
Frequency	Number of times in a given period of time	11 hurricanes of Category 4 or 5 in Caribbean Region between 1989 and 2001
Return Period	Period in which an event of special characteristics is expected to happen	Historic analysis. Expect a return of a major flood in ten years.
Duration	Time in which the person, object or system is exposed to the effects of an event.	Slow onset: floodplains, drought. Rapid onset: flash floods, earthquakes.
Impacted area	Extension of impacted area and its characteristics.	Surveillance, maps, satellite photos, aerial photos.

Hazard assessment requires information on all of the above characteristics of natural hazards.

4.2 Risk Identification Activities

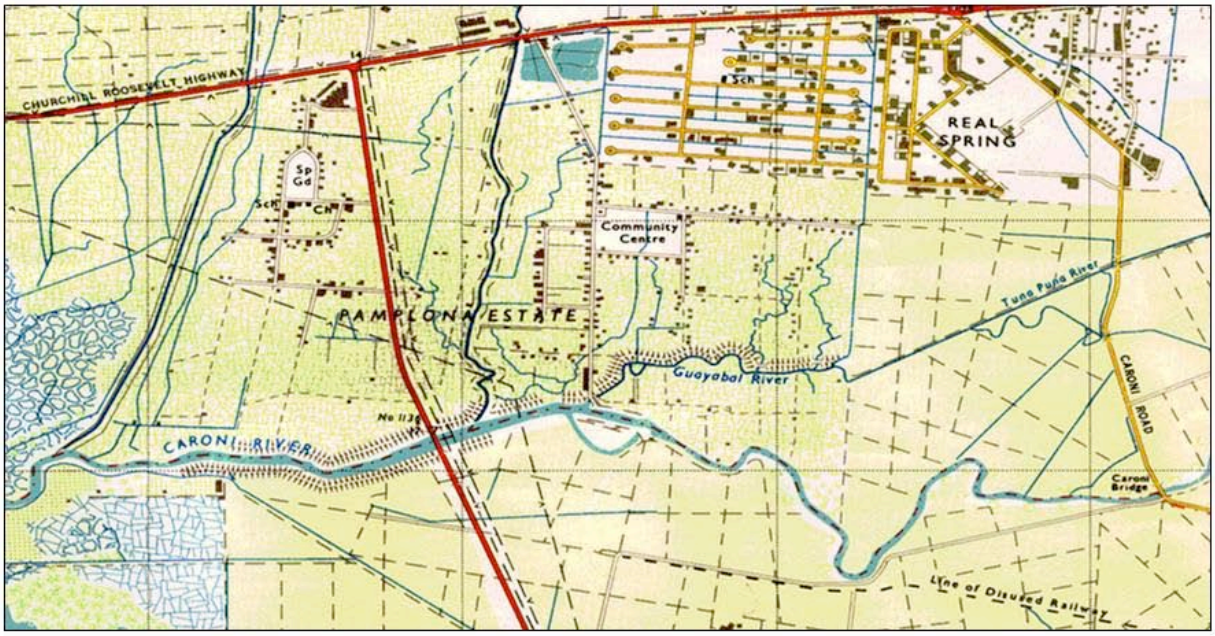
There are four important risk identification activities*:*

1. Hazard data collection and mapping
2. Vulnerability assessment
3. Risk assessment
4. Post-disaster assessment.

4.2.1 Hazard data collection and mapping

The identification and conveying of information on locations that are exposed to hazards, and the expected severity of hazard effects, determine many other components of disaster risk management, such as development siting, environmental protection and insurance coverage.

Map :- Areas Susceptible to Flooding



Use of Hazard Maps

1. To identify hazards, and indicate areas exposed to a particular hazard over a range of intensities and probabilities;
2. As tools for land use planning and management; and
3. To define areas where specific land management tools are applied; to identify property or structures to be acquired or relocated for risk reduction purposes.

Examples: Formal hazard mapping projects and geographic information system (GIS) database development are typical examples of risk identification and documentation activities.

Vulnerability Assessments
Systematic examinations of population, buildings, infrastructure and selected geographic areas to identify who, what and where are susceptible to damage from the effects of natural hazards.

As you will recall from Unit 1, *vulnerability* was defined as the conditions determined by physical, social (including gender), economic and environmental factors or processes, which increase the susceptibility of a community to the impact of a hazard.

Vulnerability assessments are conducted to help determine conditions that increase susceptibility to damage and assess the capacity of the population to manage the consequences.

Vulnerability assessments combine the information from risk identification with an inventory of the existing (or planned) property, infrastructure and population exposed to a hazard. They determine resource exposure, community sensitivity and community resilience.

Resilience
The capacity of a system, community or society potentially exposed to hazards to adapt, by resisting or changing in order to reach and maintain an acceptable level of functioning and structure (ISDR, 2004).

Resilience is determined by the degree to which the social system is capable of organizing itself to increase its capacity for learning from past disasters for better future protection and to improve risk reduction measures.

In the social field, resilience refers to the “human capacity which permits persons after having passed through adverse situations to be not only safe but also transformed through this experience” (Chamochumbi 2006)

Other meanings of Resilience:

- “the capacity of human being to overcome difficulties and at the same time learning from the errors” (Chamochumbi 2006).
- “the capacity of a family to adapt and reconstruct from the adverse situation” (Chamochumbi 2006).
- “human resilience is the capacity of an individual or social system to live well and develop positively, irrespective of the difficult conditions and even being reinforced and transformed" (Chamochumbi 2006).

Vulnerability assessments should be undertaken in particular for critical infrastructure, such as medical facilities, emergency shelters and public safety agencies. It might include lifelines such as potable water, sewerage, energy, and telecommunications

systems to ensure the safety of the public and the continuity of public infrastructure during and after hazard events. Too often, public buildings such as schools are designated as shelters without conducting vulnerability assessments as to whether they are safe shelters during the occurrence of a natural hazard.

4.2.2 Assessing Vulnerability

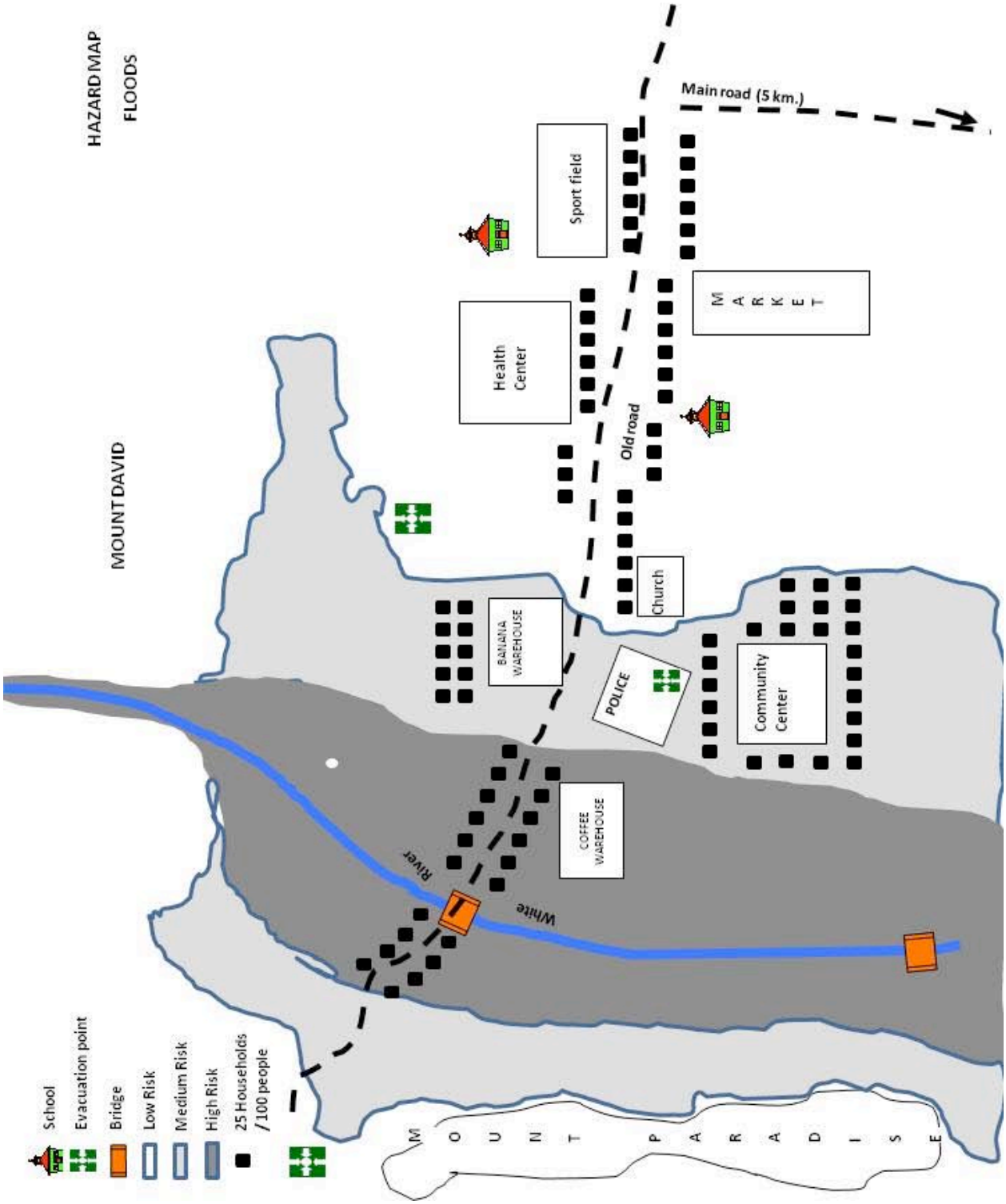
Vulnerability assessments have been used to guide critical decisions concerning the safety of residents. Despite their critical role as emergency shelters, many school buildings throughout the world are at risk of hazard-related damage. School vulnerability assessments and risk management activities have been undertaken in many (World Bank, 2002) countries.

Both the private and public sectors benefit from having access to information from vulnerability assessments. For example, the kinds of information listed below is critical (World Bank, 2002):

- Estimate damage and casualties that would result from various intensities of the hazard;
- Determine appropriate and safe uses of facilities;
- Identify weak links in infrastructure systems; and
- Prioritise limited retrofit and use of rehabilitation funds.

ACTIVITY 4.1 VULNERABILITY ASSESSMENT

With the map provided, conduct a vulnerability assessment using the following matrix. Assume that there are four persons per household and 5 families per black squared dot.



YOUR ANSWERS FOR ACTIVITY 4.1

Type of Land Parcel	**Characteristics of Land Parcel**	**Population, assets and infrastructure in high risk areas**	**Population, assets and infrastructure in medium risk areas**
Residential	Flood prone		
Commercial	Flood prone		
Industrial	Hazardous materials deposited on site		
Agricultural	Flood prone		
Educational	Flood prone		
Lifelines & critical facilities	Flood prone		

✓ ***ANSWERS: At the end of this Unit***

4.2.3 Risk Assessment

> **Risk Assessment**
> Methodology to determine the nature and extent of risk by analysing 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 (ISDR, 2004).

Information obtained from risk assessments provide critical information on the potential economic impact and costs associated with hazard-related risks.

The process of conducting a risk assessment is based on a review of both the technical features of hazards such as their location, intensity, frequency and probability, and also the analysis of the physical, social, economic and environmental dimensions of vulnerability and exposure, while taking particular account of the coping capabilities pertinent to the risk scenarios (ISDR, 2004).

It is useful for providing information to governments and funding agencies in developing budget estimates for and prioritising disaster risk management interventions.

4.2.4 Post-disaster Assessment

Even the most robust programme of hazard mapping and vulnerability assessments could fail to identify some existing vulnerabilities. This may arise from concealed hazards and existing weaknesses or an incomplete understanding of hazard impacts and interactions.

Post-disaster assessments can give new and important insights into hazard-related focus and into deficiencies in current development management systems, such as specific inadequate building practices, environmental management programmes, and development policies.

4.3 Building Risk Scenarios

Building risk scenarios is an important aspect of risk identification. There are THREE phases:

PHASE ONE: *HAZARD (H) ASSESSMENT*
Create a hazard inventory

Step 1: List the hazards that may occur
Step 2: Determine priorities
Step 3: Assess a hazard
- H1-- Research records
- H2-- Establish potential intensities/ magnitudes
- H3-- Define frequency / return period
- H4-- Define zoning

PHASE TWO: *VULNERABILITY (V) ASSESSMENT*

V1-- Determine endangered elements
V2-- Determine characteristics of endangered population
V3-- Identify organisational level
V4-- Establish community's response capability

PHASE THREE: *ASSESSMENT OF RISK SCENARIOS (RS)*

RS1-- Decide on the level of magnitude of the event
RS2-- Describe the trigger event (hazard)
RS3-- Detail the expected impact

PHASE ONE: *HAZARD ASSESSMENT*

Create a Hazard Inventory - First approach to a hazards assessment
Although a hazard may not have affected you recently, it is highly likely it will in the future. The full range of potential hazards should be examined and there should be an assessment of how they could affect some specific area. Knowing the type of hazards that could affect a community it is important to set priorities. The outcome of this process is a prioritised hazard list.

Sarmiento (2005) developed the following approach to analysing hazards. Read the given scenario and then apply step by step, the approach that is outlined below.

Hazard Inventory - First Approach to Hazards Assessment
Step 1: List potential hazards
Step 2: Prioritize potential hazards
Outcome **Prioritized list of hazards**

STEP 1: List the hazards that may occur

--Research newspapers and other historical records.
--Review existing plans and reports.
--Talk to the experts in the community, parish, government, universities.
--Gather information on Internet Web sites.

STEP 2: Determine relative priorities for dealing with hazards

--Use factors such as frequency, potential impact areas and magnitude to help establish priorities for dealing with hazards.
--Define criteria to assign a value to each variable.

Frequency
Number of times in which an event of specific characteristics is expected to happen in a given period of time.

Use a 10-year period as a reference.

- 1 = 1 or less time in that period
- 3 = 3 times in that period.
- 5 = 5 or more times in that period

Potential impact areas: This variable is comparative, which means that you need to

- assess the hazards listed in Step 1
- assign the score 1 to the hazard that affects a smaller area (geographically defined), and 5 to the hazard that affects a wider physical area
- assign the score 2 to 4 according to the impact area historically registered or the impacted area expected

Intensity/ Magnitude: This variable is comparative, which means that you need to

- assess the hazards listed in Step 1
- assign the score 1 to the hazard that has less impact on people (physical and economic damage), and 5 to the hazard that causes the highest impact.
- assign the score 2 to 4 according to the level of damage historically registered or the impacted area expected.

Hazards Assessment Expected Outcome (HAEO):

Example of Prioritized Hazard List (PHL)

Frequency x Potential Impact Area x Intensity/Magnitude = Total Score

Hazard	**Frequency**	**Impacted Area**	**Intensity/ Magnitude**	**Total**
Storm surge	2	4	5	**40**
Hurricane	3	5	4	**60**
Flood	4	4	4	**64**
Landslides	2	1	5	**10**
Coastal erosion	3	2	3	**18**
Earthquake	1	4	5	**20**
Wildfire	3	3	3	**27**

ACTIVITY 4.2 DETERMINING HAZARD PRIORITIES

Using the following information, develop a ***Prioritized Hazard List (PHL), Hazards Assessment Expected Outcome (HAEO)***

Community of Blue Valley, Northern Region

LOCATION

Region: **North**
Parish: **St Croiss**
Community: **Blue Valley**
Distance to nearest main city: **Johnstown, 15 km.**
Distance to the Capital: **29 km.**

BACKGROUND

Blue Valley is a relatively prosperous zone within the St Croiss Parish in the Northern Region of the island. It has an average temperature of 25º C. and regular rains during the months of April-November.

The community has grown in recent years, due to migration from rural areas, especially from the eastern region. The census of this year indicates that there are 9.378 inhabitants, of which 42.5% are under 20 years of age. Half of the population has been there less than 10 years.

The coverage of public services has increased to respond to the demand of the increasing population. There is a health center which has sufficient human resources to take care of the population; more complex health services are available in Johnstown, located at 15 km from Blue Valley. There are two schools (primary and a secondary) in the community.

However, the potable water network has not expanded. Therefore, most of the newcomers, who inhabit the west zone of Blue Valley, are supplied by wells and latrines, while the rest of the population has access to the potable water and sewage network. Approximately 80 percent of the population has electricity, nevertheless in the western zone there is less coverage.

There is a police station in Blue Valley with 4 agents to maintain the security of the community. In addition, there are regular patrols by the Armed Forces from its base in Johnstown. They provide support to the police covering an extensive rural area in the Northern and Eastern regions.

The population depends mainly on agriculture. They also produce coffee and a unique variety of banana for local consumption and export. Young adults sometimes relocate to Johnstown, looking for employment opportunities.

DISASTER HISTORY

Event: **LANDSLIDE**
Effects: **A.** Housing (See Hazard Map)
B. Potable Water System; especially the primary network in the east side of the community.
C. Agriculture (livelihood), and in the coffee area in Mount Paradise (See Hazard Map)
D. White River blocked by debris.
Date: Last time debris blocked the river was in 1999
Recurrence: Annual, usually at the end of the rainy season in October or November.

Event: **EARTHQUAKE**
Effects: **A.** Housing
B. Landslides especially in Mount David (See Hazard Map)
Date: Frequent seismic activity, at least one movement G II-III in the Mercalli scale is felt monthly by the community (last significant earthquake: Magnitude 5.9 in 1978 caused 26 deaths).
Recurrence: Unpredictable. The historical record is incomplete.

Event: **FLOOD**
Effects: **A.** Housing (See Hazard Map)
B. Contamination of wells in the western zone (the population not covered by the potable water system)
C. Destruction of fields were the banana trees are located
Date: November 2003 and end of October 2006.
Recurrence: Annual overflow of the river. Important damage has been recorded every 3 to 5 years**.**

YOUR ANSWERS FOR ACTIVITY 4.2

Hazard	**Frequency**	**Impacted Area**	**Intensity/ Magnitude**	**Total**
Storm surge				
Hurricane				
Flood				
Landslides				
Coastal erosion				
Earthquake				
Wildfire				

✓ **ANSWERS: At the end of this Unit**

STEP 3: Assess a hazard

Using the hazard chosen from your **Hazards Assessment Expected Outcome** (HAEO), analyze it using the following four (4) steps.

Assessing a Hazard
H 1: Research records
H 2: Establish potential intensities/ magnitudes
H 3: Define frequency / return period
H 4: Define zoning
Outcome **Hazard identified with three potential intensities/ magnitudes**

H 1 – Research records
Look for historical records or studies on that specific hazard.

H 2 – Establish intensity/ magnitude
Use the available information as a source of reference (historical, through technical or probability studies) to establish potential magnitudes – high, medium and low – for each hazard.

H 3 – Define frequency / return period
For each of the levels described in Step H2, define how often it happens (number of times in a given period of time) and what is its return period (period in which an event of special characteristics is expected to happen).

H 4 – Define zoning
For each of the levels described in Step H2, define the areas that will receive the impact of the hazard. Determine if it is a limited area or if it includes an extensive zone.

Indicate the expected characteristics or effects of the event (with differences, if applicable). For example, damage caused by an earthquake, according to the geology and type of soil in the different areas of a city or territory; storm surge according to the bathymetry of the area; flooding in different areas of a city or territory.

Hazards Assessment Expected Outcome (HAEO): Hazard identified with three potential magnitudes
Hazard identified with three potential intensities/ magnitudes (high, medium and low) and description of its respective characteristics (appearance, length, frequency / recurrence, zoning).

PHASE TWO: *VULNERABILITY ASSESSMENT*

Based on the characteristics of the hazard, and for each one of the three intensities/magnitudes defined, check the existing capabilities and endangered elements using the following four steps. The expected outcome of the vulnerability assessment will be a vulnerability to a hazard identified.

Assessing Vulnerability
V 1: Determine endangered elements
V 2: Determine characteristics of endangered population
V 3: Identify organisational level
V 4: Establish community's response capability
Outcome **Vulnerability expressed regarding an identified hazard described in terms of endangered elements, characteristics of endangered population, and the response capabilities of both institutions and communities.**

V 1: Determine endangered elements
The elements that are vulnerable to the hazard include population, neighborhoods, or environmental zones.
Consider critical facilities such as:

- Shelters, schools, hospitals, and fire stations
- Lifelines such as water, sewerage, transportation, telecommunications, energy and gas systems
- Housing
- Historical buildings and archaeological sites

V 2: Determine characteristics of endangered population:

- number of residents
- health condition
- socio-economic characteristics

V 3: Identify organisational level:

- institutional organisation and coordination
- knowledge level on risk matters
- activities in place to respond to the event and recover from potential damage

V 4 : Establish community's response capability:

- level of knowledge on risk issues
- resilience shown by the community;
- participation in the design, test and planning execution

Vulnerability Assessment Expected Outcome (VAEO):
Vulnerability expressed regarding an identified hazard described in terms of endangered elements, characteristics of the endangered population, and the capabilities of both institutions and communities to respond to such a situation.

ACTIVITY 4.3; ASSESSING VULNERABILITY

Following the Blue Valley case presented in Activity 4.2, here is additional information for that community. Working on floods, apply Steps V1 to V4 to the given scenario.

HYDROMETEOROLOGICAL INFORMATION

River: White River
Location: The river's source is 25 km. north of Blue Valley. It passes through the northern part of the settlement turning west, passing through crop lands close to Mount Paradise.
Lakes: N/A
Springs: Several springs along the western side of the community in Mount Paradise are used for irrigation
Location*:* 3 km from the community.

ACCESS TO BLUE VALLEY:

Starting in Johnstown, take the road Johnstown-St Croiss, drive 10 Km east and then take at right the secondary road to Blue Valley, after 5 Km you will arrive at the southern end of the community.
The main road is an asphalt road in good condition. The secondary road is rough and unpaved. During the raining season transit is interrupted by floods.
There is an old road that is used to connect Johnstown and St Croiss; this road enters the town from the west. There is no formal maintenance for this road. The local association of banana producers invests from time to time in this road to allow the transit of their small trucks (2 tons max).

PHYSICAL INFRASTRUCTURE:

INSTITUTION	INFRASTRUCTURE	HUMMAN RESOURCES
Rural Primary School Thomas Cook	Building 1,000 mts.² (16 classrooms, Principal's Office, 16 WC); total area 2,500 mts.²; it has access to the potable water system.	15 teachers, 1 principal, 1 deputy, 8 administrative employees
Secondary School Alfred Lewis Valentine	Building 850 mts.² (12 classrooms, Principal's Office, 10 WC); total area 2,000 mts.²; it has a well that provides all the water needed.	10 teachers, 1 principal, 1 deputy, 6 administrative employees.
Church	Building 800 mts.²; 4 WC. It has access to the potable water system.	

Sport Field	Building 500 mts.², within an area of 6,400 mts.²; 20 WC; It has access to the potable water system.	
Health Center	Building 750 mts.², within an area of 1,500 mts.²; it has its own well. The health center has 15 beds plus a maternal-child section with 10 beds.	2 general physicians, 3 professional nurses, 6 auxiliaries, 5 health promoters, 1 administrator, 1 person in charge of the pharmacy and 1 for the warehouse.
Warehouse of the Coffee Producers Association	Building 1,500 mts.²; it has its own well. 4 WC.	
Warehouse of the Banana Producers Association	Building 800 mts.²; it has its own well. 4 WC.	
Community Center	Building 750 mts.²; it has its own well. 8 WC.	

NATURAL RESOURCES:

Mount Paradise is a natural reserve with a beautiful virgin forest.

COMMUNICATION:

Radio stations: Radio Peace (Church) & Radio Highland
Telephone: Community base 208-8780; cellular Coffee Association (Jeremy Mullany 9-665-9420);
Health Center has communication via radio with the St Croiss regional health office.
There are 72 pickups, 16 trucks (5-tons), 5 trucks (10-tons) in town.

COMMUNITY ORGANIZATIONS:

(a) Committee Pro-development
(b) Potable Water Commission
(c) Parent Association
(d) Community Health Committee
(e) Association of Coffee Producers
(f) Association of Banana Producers
(g) Church
(h) Sports Association

COMMUNITY SCHEDULE

PERIOD / ACTIVITY	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
RAINS				X	X	X	X	X	X	X	X	
LAND PREPARING	X	X										
PLANTING			X									
CROP MAINTENANCE, FERTILIZATION, PEST AND DISEASE CONTROL, WEED CONTROL				X	X							
HARVEST AND STORAGE							X				X	
MIGRATION TO THE CAPITAL	X	X	X									

PERIOD / ACTIVITY	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
ENDEMIC DISEASES					DENGUE	DENGUE	DENGUE			WBD* ARI**	WBD* ARI**	
	Malaria & Leishmaniasis cases the all year											
OVERFLOWS, FLOODS AND LANDSLIDES										X	X	

* Water-borne diseases
* *Acute respiratory infection

CENSUS

Gender	Number	Illiterate	School Enrollment			
			P 1-3	P 4-6	S 1-3	Univ.
Women	2898	222	324	1566	630	156
Men	2484	114	234	1272	726	138
			< 4 years	5-9 years	10-14 years	15-19 years
Children	3990	N/A	1116	1056	954	864

HOUSING RISK

HAZARD / RISK	Seismic	Floods	Landslides
	# Houses	# Houses	# Houses
High	380	500	200
Medium	595	875	320
Low	1300	900	600

YOUR ANSWERS FOR ACTIVITY 4.3

V 1: Determine endangered elements

V 2: Determine characteristics of endangered population

V 3: Identify organisational level

V 4: Establish community's response capability

✓ ***ANSWERS: At the end of this Unit***

PHASE THREE: *ASSESSMENT OF RISK SCENARIOS*

It is possible to define risk scenarios in designated geographical areas for previously identified specific hazards.

Assessing Risk Scenarios
RS 1: Decide on the level of magnitude of the event
RS 2: Describe the trigger event (hazard)
RS 3: Detail the expected impact
Outcome **Description of the specific trigger event (hazard) and the direct and indirect consequent effects expected.**

For the construction of a scenario, the magnitudes described for the hazard should be taken into consideration together with the definition of three risk levels: high, medium and low**.** The outcome of the assessment of risk scenarios will be the description of the resulting direct and indirect effects expected from the manifestation of a specific hazard.

RS 1 – Decide on the level of magnitude of the event
Because the process for building scenarios takes time and dedication, one of the levels described in the HAEO has to be selected. This decision must be based on practical criteria for the event's recurrence. For example: Consider those events which show a designated level of magnitude over a 20-30 year period. It is important to take into account that if a medium level is selected, you are in fact covering circumstances that could occur at a lower level.

RS 2 – Describe the trigger event (hazard)
For the selected level, use the following terms to describe the hazard:

- slow or rapid onset
- duration
- geographical extent
- magnitude/intensity
- sequence and characteristics of the event's appearance. (Follow what is described in the HAEO).

RS 3 – Describe expected impact
This description is for the hazard level selected and described in the selected step

Potential Effects
For each one of the scenarios described, provide details on the probable impact on:

- People
- Critical facilities (Shelters, schools, hospitals and fire stations)
- Lifelines (Water, Sewerage, telecommunications, energy and gas systems)
- Housing
- Historical sites

Direct damage
Direct damage is all damage sustained by immovable assets and inventories of finished and semi-finished products, raw materials, other materials and spare parts (UNECLAC, 1991).

Indirect effects
- Economic impact
- Social impact
- Environmental impact
- Political impact

Risk Scenario Expected Outcome (RSEO):
Description of the characteristics of a specific trigger event (hazard) with the resulting direct and indirect effects expected.

ACTIVITY 4.4: BUILDING A RISK SCENARIO

The community of Blue Valley has decided to build a risk scenario for floods using the highest historical impact recorded. Apply steps RS1 to RS3.

YOUR ANSWERS FOR ACTIVITY 4.4

RS 1 – Decide on the level of magnitude of the event

RS 2 – Describe the trigger event (hazard)

RS 3 – Describe expected impact

✓ ***ANSWERS: At the end of this Unit***

ACTIVITY 4.5: POSSSIBLE STAKEHOLDERS

Based on the information related to Risk Identification covered in this Unit, identify the possible stakeholders involved in your region/country/jurisdiction.

YOUR ANSWERS FOR ACTIVITY 4.5

1--Hazard Identification

2--Risk Identification

3--Risk Reduction

4--Risk Transfer

5--Disaster Management

6--Recovery

✓ ***ANSWERS: At the end of this Unit***

UNIT FOUR SUMMARY

This Unit focuses on the topic of Disaster Risk Identification. The Unit identifies and links the four inter-related activities: Hazard data collection and mapping, Vulnerability assessment, Risk assessment and Post-disaster assessment. Special attention is given to hazard characterization as the basis for risk identification. The topic of building risk scenarios is presented mainly as a process for a systematic multi-hazard approach that can be followed using information available at the community level or can be applied in a technical and scientific environment with the heights and complex standards. This process of building scenarios includes hazard inventory and prioritization; assessing a hazard, assessing vulnerability and assessing risk scenarios.

UNIT FOUR ACTIVITIES - POSSIBLE ANSWERS

ACTIVITY 4.1 VULNERABILITY ASSESSMENT

Type of Land Parcel	Characteristics of Land Parcel	Population, assets and infrastructure in high risk areas	Population, assets and infrastructure in medium risk areas
Residential	Flood prone	500 households / 2000 people	875 households / 3500 people
Commercial	Flood prone	Coffee Warehouse	Banana Warehouse
Industrial	Hazardous materials deposited on site	No	No
Agricultural	Flood prone	Extensive area, banana & coffee plantation	Extensive area, banana & coffee plantation
Educational	Flood prone	No	No
Lifelines & critical facilities	Flood prone	Old road and 2 bridges	Old road, the Police Station and the Community Center

ACTIVITY 4.2 DETERMINING HAZARD PRIORITIES

Hazard	Frequency	Impacted Area	Intensity/ Magnitude	Total
Storm surge				
Hurricane				
Flood	3	4	4	**48**
Landslides	5	3	3	**45**
Coastal erosion				
Earthquake	1	5	5	**25**
Wildfire				

ACTIVITY 4.3: ASSESSING VULNERABILITY

V 1: Determine endangered elements

See the information obtained in Activity 4.1.

In addition to the endangered elements described in that list, it would be important to include the existing sanitary infrastructure both in the main area of the town and the fragile and deficient west side location.

You should consider their function and the implication of any damage to them. Damage to the bridges and/or to the old road will have serious impact in the banana market, in employment and economic income of the community

V 2: Determine characteristics of endangered population

The community in Blue Valley has 9,378 inhabitants, of which 42.5% are under 20 years of age. There is an appropriate 25 bed health care center and access to more complex services at 15 km from Blue Valley. The center has 2 general physicians, 3 professional nurses, 6 auxiliaries and 5 health promoters. There is a police station with 4 agents.

In logistical terms there are in town 72 pickups, 16 trucks (5-tons), 5 trucks (10-tons) in town.

The town is divided in two main segments. First the formal, relatively well organised, has an acceptable infrastructure and services. The second is composed of newcomers; it is informal with less access to utilities and more exposed to natural hazards especially floods. The population depends mainly on agriculture, coffee and banana for local consumption and export. Young adults look for employment opportunities outside of town.

V 3: Identify organisational level

Blue Valley has relevant community and commercial associations. There is not information about community based organizations present in the west side of town.

V 4 : Establish community's response capability

Even though there is an important record of disasters there is not a fire brigaden or first responsder organizations. There is not mention of emergency committees. The only institutions with potential to participate actively in disaster preparedness and relief are health and police.

VAEO: The community of Blue Valley as regards floods shows a critical vulnerability due the exposure of almost 20% of the population to high risk areas, and 40% to a medium risk areas. Additionally the higher risk population has poor sanitary conditions on a daily basis. Agriculture and land transportation are particularly susceptible to floods and thus the whole community that depends on them for livelihood. There is no mention of any risk or disaster management initiatives, either existing capacity or other resources.

ACTIVITY 4.4: BUILDING A RISK SCENARIO

RS 1 – Decide on the level of magnitude of the event
Using the highest historical impact known for floods we can state:
Flash flood caused by river overflow.
This event is a 5 year event (Return period).
The probability is that 2 events of this magnitude in a decade are unlikely(Frequency).
The potential affected area is mainly the White River valley, impacting both sides of the river.

RS 2 – Describe the trigger event (hazard)
The overflow is caused by intense rain in a short period of time over the island. 300 mm in 24 hours are enough to generate a chaotic situation. Additionally the rain and the soil saturation will induce several small landslides that will end in the white river producing hydraulic clogging of the riverbed *(*colmatation), making worse the situation by increasing the river water level and its speed.

RS 3 – Describe expected impact
As a result of intense rain in a short period of time over the island, a 5 year flood event will generate a massive flash flood of the White River, along with dispersed landslides that will aggravate the situation.

The White River valley will be entirely flooded, destroying most of the banana plantation, and impacting directly 2,000 inhabitants living in lower lands close to the river, threatening their lives (depending on the time of the event and the possibility or not to alert the community), their dwellings and the already weak sanitary infrastructure may be swept away by the water.

An additional 3,500 people (those who settle in the medium risk zones) will be affected to a lesser degree. Housing in this area is likely to be flooded for more than two to three weeks. There will be critical deterioration of the sanitary conditions.

Moreover, the flood will cause a serious access problem to the town (Old road and the bridges over the White River), impacting in the short term first responder activities, evacuation and food availability; and in the long term, generating a serious socio-economic disruption for the community of Blue Valley and the whole island.

ACTIVITY 4.5: POSSSIBLE STAKEHOLDERS

This Activity should be considered a personal reflection.

UNIT FOUR SELF ASSESSMENT QUESTIONS 

1. List the components of disaster risk management which disaster risk identification provides information for.

2. What are the two main measurable components of a hazard?

3. List the four Risk Identification activities

4. List three of the uses, to which vulnerability assessments can be put.

5. How can hazard maps be used?

6. What technical features of a hazard must be reviewed in conducting a risk assessment process?

7. What areas does post-disaster assessment provide important information on?

8. Complete the following formula for determining the Prioritised Hazard List

a. Frequency X _____X _____ = Total score

9. What are the elements of a society on which a hazard has indirect effects?

10. What terms would you use to describe the trigger event (hazard) in the "Assessment of Risk Scenarios"?

UNIT FOUR SELF ASSESSMENT ANSWERS

1. Risk reduction; Risk Transfer and Financing; Adverse Event Management; Recovery
2. Magnitude or Intensity; Likelihood or Probability of occurrence I any particular location within any specified period of time.
3. Hazard data collection and mapping, Vulnerability assessment, Risk assessment, Post-disaster assessment
4. To estimate damage and casualties that would result from various intensities of the hazard; To determine appropriate and safe uses of facilities; To identify weak links in infrastructure systems; To prioritise limited retrofit and use of rehabilitation funds
5. To identify hazards, and indicate areas exposed to a particular hazard over a range of intensities and probabilities; As tools for land use planning and management; To define areas where specific land management tools are applied; to identify property or structures to be acquired or relocated for risk reduction purposes.
6. Location, intensity, frequency, and probability.
7. Specific hazard related focus, current development management systems (inadequate building practices, environmental management programmes and development policies)

8. Frequency x Potential Impact Area x Intensity/Magnitude = Total Score

9. Economic impact, Social impact, Environmental impact, Political impact
10. slow or rapid onset, duration, geographical extent, magnitude/intensity, sequence and characteristics of the event's appearance.

COURSE NOTES

COURSE NOTES

5 DISASTER RISK REDUCTION

Learning Objectives

By studying this Unit you will learn to:

- Identify the five categories of disaster risk reduction
- Analyse contexts in which active and passive disaster risk reduction measures are taken
- Identify the key stakeholders involved

5.0 Introduction

If developing countries are to meet the challenge of sustainable development, they will have to take effective measures to manage natural hazards.

Research indicates that the impact experienced during a hazard event is determined in part by a range of choices, including options in relation to:

- where to locate development
- how buildings and infrastructure are constructed
- how development practices and land use decisions affect natural environmental systems

5.1 Disaster Risk Reduction

> **Disaster Risk Reduction**
> The conceptual framework of elements considered with the possibilities to minimize vulnerabilities and disaster risks throughout a society, to avoid (prevention) or to limit (mitigation and preparedness) the adverse impacts of hazards, within the broad context of sustainable development (ISDR, 2004).

The disaster risk reduction framework is composed of the following fields of action, as described in ISDR (2002):

- 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 organizational, 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
- Early warning systems including forecasting, dissemination of warnings, preparedness measures and reaction capacities.

Disaster risk reduction measures can address either existing or future vulnerability.

ACTIVITY 5.1: MEASURES AND VULNERABILITY
In this matrix, identify which measures are more appropriate and which are for future vulnerability.

YOUR ANSWERS FOR ACTIVITY 5.1

MEASURES	Existing	Future
Implementation and enforcement of building codes and standards		
Retrofit		
Human resource management practices		
Institutional strengthening		
Relocation		
Environmental protection measures		

✓ ***ANSWERS: At the end of this Unit***

Measures to address future vulnerability can have a more profound effect over the long term, but must always be paired with activities to safeguard individuals and resources with existing vulnerabilities.

5.2 Disaster Risk Reduction Measures

There are five categories of disaster risk reduction measures:

- Physical
- Socio-economic
- Environmental
- Management and institutional
- Post disaster

5.2.1 Physical Measures

> **Physical Risk Reduction Measures**
> Structural and non- structural measures that are undertaken to help avoid or alleviate the damage and losses that result from hazards.

Poor location choice and development practices contribute significantly to the impact experienced during a natural hazard event.

- Development along floodways
- Poorly designed infrastructure in high-hazard coastal locations causes damage and loss of key infrastructure or houses
- Inappropriate cutting of slopes or excess loading of unstable slopes when constructing roads can cause landslides, and rock falls that can damage roads, bridges, houses and vegetation
- Inappropriate farming and forestry practices in upper watersheds can significantly increase flood levels and speeds lower in the basin
- Inappropriate beach sand mining can limit the ability of the beach to buffer wave and surge energy, and to regenerate after a storm event.

The damage which results from settling in poor locations and inappropriate development practices is for the most part avoidable, with investment in hazard assessments, the will and commitment to incorporate disaster risk management into decisions affecting and guiding development at all levels. Physical disaster risk reduction measures can help avoid and or alleviate the level of damage and losses.

Structural Measures

> **Structural Measures**
> Any physical construction to reduce or avoid possible impacts of hazards, which include engineering measures and construction of hazard-resistant and protective structures and infrastructure (ISDR, 2004).

Examples:

- Construction of flood control structures, dykes, levees etc.
- Wind proofing
- Elevation

- Seismic retrofitting and other types of retrofitting for critical facilities and historic buildings
- Burial of utilities for example electricity poles

For our purposes, the term *structural* applies to a broader range of actions than implied by its definition within the engineering community.

Non-Structural Measures

> **Non-Structural Measures**
> Policies, awareness, knowledge development, public commitment, and methods and operating practices, including participatory mechanisms and the provision of information, which can reduce risk and related impacts (ISDR, 2004).

Examples:

- Engineering design such as designing for vibration, lateral loads, wind loads, load surcharges, flood resistance
- Physical development plans that identify land use zones that are developable and those that are hazard prone
- Development regulations (design standards, building codes)
- Acquisition of hazardous properties
- Tax and fiscal incentives such as grants, preferential loans to assist property owners to upgrade property
- Legalizing land ownership and giving tenants protective rights to encourage them to upgrade their building stock
- Public education.

Building Codes

> **Building Codes**
> Ordinances and regulations controlling the design, construction, materials, alteration, and occupancy of any structure to insure human safety and welfare. Building codes include both technical and functional standards (ISDR, 2004).

The building code can only have success in disaster risk reduction if certain preconditions exist.

- Engineers who must implement the code accept its importance and endorse its use
- Engineers understand the code and the design criteria
- The code must be fully endorsed by authorities through checking and penalizing designs that do not comply
- There should be an independent third party to review the use of the building code from the design phase to actual construction

- Increased level of training for engineers and architects
- The existence of explanatory manuals to interpret the code requirements.

In many countries, non-engineered buildings make up a large percentage of the total building stock. To improve disaster risk reduction, education of builders in practical construction techniques is needed.

ACTIVITY 5.2: VULNERABILITY AND IMPACT

1. **Identify facilities which should be carefully located to reduce the vulnerability of a settlement?**

YOUR ANSWERS FOR ACTIVITY 5.2.1

2. **What is the potential impact of location on disaster risk reduction in relation to utilities?**

YOUR ANSWERS FOR ACTIVITY 5.2.2

✓ ***ANSWERS: At the end of this Unit***

5.2.2 Socio-economic Measures

Socio-economic Disaster Risk Reduction Measures
Ordinances and regulations controlling the design, construction, materials, alteration, and occupancy of any structure to insure human safety and welfare. Building codes include both technical and functional standards (ISDR, 2004).

Those measures designed to address gaps and weaknesses in the systems whereby communities and society as a whole prepare to respond to disaster events.

Poverty makes the poor more vulnerable to the impact of natural hazards than other income groups. Several reasons account for this and are as follows:

- High land prices frequently push poorer communities to live in marginal, hazard-prone sites, such as steep slopes or low-lying coastal areas
- Lack of access to alternatives often leads the poor to use natural resources unsustainably, such as seen in deforestation and poor agricultural practices such as slash and burn cultivation
- Limited resources or insecure land tenure can induce the poor to occupy vulnerable lands such as unstable slope, swamps, river-banks or other low-lying coastal areas
- Easy access to useful resources such as fertile soils on volcanic slopes or floodplains can prompt settlement of hazardous locations
- The lack of a financial buffer or a long-term claim to land can lead to destructive management practices of natural resources surrounding low-income settlements, exacerbating hazard risks
- Disaster risk reduction measures need to address the underlying social and economic problems, which affect the disadvantaged because they lead to higher vulnerability to natural hazards.

In some countries, women may be disproportionately more vulnerable than their male counterparts to the impacts of natural hazards.

The ultimate goal of socio-economic measures is to increase the resilience of individuals and communities to hazard effects.

ACTIVITY 5.3: MEASURES AND ACTIONS

Measure: Building awareness of hazard vulnerabilities**.**

***1. Identify actions for building awareness of hazard vulnerabilities*.**

YOUR ANSWERS FOR ACTIVITY 5.3.1

Measure: Constructing community and mutual assistance networks and programmes, for example:

- public-and private-sector employment protection programmes,
- Community and national social networks and health systems

2. What is the potential impact of such programmes?

YOUR ANSWERS FOR ACTIVITY 5.3.2

✓ ***ANSWERS: At the end of this Unit***

5.2.3 Environmental Measures

As part of a new initiative to introduce environmental disaster risk reduction measures, the Caribbean Development Bank has developed a standard approach to natural hazard impact assessment for use in the Caribbean among borrowing member countries.

Environmental disaster risk reduction measures
Those designed to protect existing, or rehabilitate degraded, environmental systems that have the capacity to reduce the impact of natural hazards.

Examples:

- Policies and programmes such as development control or environmental impact assessments that reduce or eliminate the effect of human activities on the environment
- Physical measures that restore or fortify damaged environmental systems such as mangrove replanting, coral reef protection, reforestation of critical watersheds or restoration of degraded river courses

5.2.4 Management and Institutional Measures

Disaster risk reduction also requires certain organizational and procedural measures. Changes in physical planning, upgrading structures, and changes in the characteristics of building stock are processes that take decades. The objectives and policies that guide the mitigation processes have to be sustained over a number of years; such objectives and policies have to survive the changes in political administration that are likely to happen within that time (such as changes in budgetary priorities and policies). The institutionalization of disaster risk reduction requires a consensus of opinion that disaster risk reduction efforts are of on-going importance.

Institutionalising disaster risk reduction requires the following strategies, among others:

- Education seeks to introduce the risk management concept inside culture. Those changes are necessary to generate attitudes, behaviours, and commitments in such a way that citizens can contribute to the security and sustainability of their communities' development.
- The professional training of engineers, planners, economists, social scientists, and other managers to include hazards and disaster risk reduction within their normal area of competence is gradually becoming common. Increasing the exposure of these groups to international expertise and transfer of technology in disaster mitigation is an important part of building capability in the affected country.
- Information is a critical element in planning for disaster risk reduction.
- The political will to enforce disaster risk reduction measures.

Example:

- Research and policy-making organizations are important in that they provide disaster risk reduction strategies both nationally and locally.
- Consultation procedures and representation of the community in mitigation decisions and management of the implementation of mitigation activities.
- At the local level, community-based mitigation requires the strengthening of the capability of the local institutions to carry out local protection measures. Such training and support can often be carried out most effectively by national or international NGOs.

5.2.5 Post-disaster Measures

Time and budget pressures and communication and transport difficulties in the post-disaster environment make it difficult to increase resilience during reconstruction.

However, the reconstruction and rehabilitation work during this period determines the capability of the system to weather future hazards. Reconstruction measures are a component of long-term response and recovery and form a critical component of a comprehensive disaster risk reduction programme. The recovery period is an important phase in that it provides an important window of opportunity for implementing necessary disaster risk reduction measures.

Examples:

- Pre-approval and tested reconstruction plans and procedures with identified financing.

5.3 Active and Passive Disaster Risk Reduction Strategies

As noted earlier, a differentiation can be made between active and passive disaster risk reduction measures. The former relies on incentives and the latter depends on the use of regulations.

Active Risk Reduction Strategies

Those used by the authorities to promote desired actions by offering incentives.

These measures are often associated with development programmes in areas of low income.

Examples of incentives are:

- Tax exemptions and other incentives for those who fulfill planning regulations such as adoption of the building code
- Economic assistance (grants and preferential loans)
- Subsidies on safety equipment, safer building materials, etc
- Provision of financial opportunities for the construction of key facilities: safer buildings, shelters, refuge points, storage
- Training and education
- Public information dissemination and awareness raising
- Promotion of voluntary insurance
- Creation of community organizations.

ACTIVITY 5.4: ADVANTAGES AND DISADVANTAGES

What are the advantages and disadvantages of active disaster risk reduction strategies?

YOUR ANSWERS FOR ACTIVITY 5.4--ADVANTAGES

YOUR ANSWERS FOR ACTIVITY 5.4--DISADVANTAGES:

✓ ***ANSWERS: At the end of this Unit***

Context in which the active strategies are taken
Active strategies are useful in disaster risk reduction, but there are constraints in running them. These programmes aim to create a self-perpetuating safety culture in areas of weak authority or poor ability to comply with existing controls. They are useful in areas of low income, rural areas or elsewhere where there is no external jurisdiction over land use or building activity. However, such programmes require large budgets, skilled workers, and extensive administration.

Passive Disaster Risk Reduction Strategies
Those used by the authorities to prevent undesired actions, as for example **controls and penalties** (as opposed to incentives). However, these actions are usually more appropriate for well-established local authorities in areas with higher incomes.

Examples:
- Land use regulations
- Requirements to conform with building design codes
- Checking compliance of controls on site
- Not approving the construction of utilities and infrastructure in areas where development is undesired
- Imposing court proceedings, fines, closure orders on offenders, and compulsory insurance.

Requirements of Passive Disaster Risk Reduction Strategies
Passive disaster risk reduction strategies are effective when the following conditions exist:
- An existing and enforceable system of control
- Acceptance by the target community of the objectives and the authority imposing the controls
- The economic capability of the affected community to comply with the regulations

Best practices for effective disaster risk reduction strategies
- Disaster risk reduction strategies will, in many cases, be incorporated as an element of larger scale development programmes; successful strategies include a range of measures. The appropriate mix will be different for each location and type of hazard.
- The selection of an appropriate strategy is guided by evaluating and considering the costs and benefits (in terms of savings from not spending on future losses) of a range of possible measures.
- To obtain political acceptability, a disaster risk reduction strategy needs to contain a mixture of immediately visible improvements, and of less visible, but long-term sustainable benefits.
- Disaster risk reduction strategies are much easier to implement in the immediate aftermath of a disaster or near-disaster; awareness of the impact of similar natural hazards elsewhere assists in obtaining public and political support for disaster protection.
- Disaster risk reduction strategies developed during disaster reconstruction encompass all the hazards likely to be encountered in the future.
- Disaster risk reduction strategies are promoted as far as possible beyond the reconstruction areas to other areas at risk from similar hazards.
- Empower the local community by promoting planning and management of its own defences and obtaining outside assistance only where needed.

5.4 Disaster Risk Reduction Stakeholders

A range of individual agencies and organisations are active in the management of hazard risks in the Caribbean. Disaster risk management actions are taken at many different levels simultaneously to achieve maximum effectiveness.

Disaster Risk Reduction Stakeholders

Local

- Local organizations
- Non-governmental organizations
- Community based organisations
- Local disaster committees
- Local governments

National

- Central government
- National disaster offices
- Private sector

Sub-regional and Regional

- Organisation of Eastern Caribbean States
- Caribbean Disaster Emergency Relief Agency
- Caribbean Development Bank (DMFC)

Multi-Lateral and Bi-Lateral Lending Institutions and Development Partners

ACTIVITY 5.5: ACTIVE AND PASSIVE

For the scenario given in Unit 4, identify some active and passive disaster risk reduction strategies.

YOUR ANSWERS FOR ACTIVITY 5.1--ACTIVE

YOUR ANSWERS FOR ACTIVITY 5.1--PASSIVE

✓ ***ANSWERS: At the end of this Unit***

UNIT FIVE SUMMARY

This Unit presents the concept of Disaster Risk Reduction and how it can address either existing or future vulnerability, through measures grouped in five categories: Physical, Socio-economic, Environmental, Management and Institutional and Post disaster. Active and Passive Disaster Risk Reduction Strategies are introduced; the first based on incentives, the second based on regulations. There is an analysis of the stakeholders involved and the different environments in which both strategies have been conceived and implemented.

UNIT FIVE ACTIVITIES - POSSIBLE ANSWERS

ACTIVITY 5.1: MEASURES AND VULNERABILITY

MEASURES	Existing	Future
Implementation and enforcement of building codes and standards	X	X
Retrofit	X	
Human resource management practices		X
Institutional strengthening	X	X
Relocation		X
Environmental protection measures		X

ACTIVITY 5.2: VULNERABILITY AND IMPACT

1. The careful location of schools, hospitals, emergency facilities (first responder groups) and major infrastructure such as water pumping stations, electrical power transformers and telephone exchanges can reduce the vulnerability of a settlement.

2. The building of several smaller facilities such as telephone exchanges and water treatment plants reduces vulnerability as opposed to constructing one central facility.

ACTIVITY 5.3: MEASURES AND ACTIONS

Building awareness of hazard vulnerabilities.

Short-term, high-profile campaigns using broadcasts, literature and posters; also more long-term, low-profile campaigns that are carried out through general education.

Potential impact of community and mutual assistance networks and programmes

Contribute to the availability of jobs and income, and thus to the recovery and its sustainability after a disaster event.

ACTIVITY 5.4: ADVANTAGES AND DISADVANTAGES

Advantages:

Active measures may produce better results in some communities because they:

- Tend to promote a self-perpetuating safety culture
- Do not rely on the economic capability of the affected community
- Do not rely on the ability of the local authorities to enforce controls.

Disadvantage: Active disaster risk reduction measures are more costly to initiate.

ACTIVITY 5.5: ACTIVE AND PASSIVE

ACTIVE:

- Creation of a community association for disaster reduction in the Blue Valley
- Economic assistance (grants) to build river banks and to maintain the channels clean
- Provision of financial assistance for the construction of an early warning system, shelters and emergency storages
- Economic compensation for housing relocation

PASSIVE:

- Land regulation for the valley of the White River. No dwellings allowed in high risk areas.
- Building codes regulations for housing in medium risk areas.
- Pile dwellings (stilt houses) are mandatory in those areas.

UNIT FIVE SELF ASSESSMENT QUESTIONS

(Circle the best answer)

1. Which of the following is not a risk reduction measure?

   A. Environmental
   B. Socio - Economic
   C. Physical
   D. Rehabilitation

2. Structural and Non Structural measures are elements of what category of Risk Reduction Measures?

   A. Socio-economic measures.
   B. Physical measures.
   C. Environmental measures
   D. Post Disaster measures

3. Construction of Flood control structures, wind proofing and elevation are examples of which of the following.

   A. Non structural measures
   B. Building codes
   C. Structural measures
   D. Rehabilitation

4. Writing Building Codes will ensure their effectiveness as a Disaster Risk Reduction Tool.

   True *False*

5. The ultimate goal of Socio – economic Risk Reduction measures is to

   A. Increase the resilience of individuals and communities to the effects of hazards.
   B. Provide alternate employment to the poor
   C. Ensure that women are not overlooked during disasters
   D. To protect the environment from the impact of disasters

6. Environmental measures that have the capacity to reduce the impact of natural hazards are designed to protect existing, or rehabilitate degraded environmental systems.

True *False*

7. The use of incentives as a means of encouraging the use of Disaster Risk Reduction measures is an Active Risk Reduction strategy.

   True *False*

8. Which of the following is not a Passive Disaster Risk Reduction Strategy?

   A. Land use regulations
   B. Requirements to conform with building codes
   C. Use of fines, closure orders and compulsory insurance
   D. Tax exemptions

9. Which of the following is a requirement or condition for the effectiveness of Passive Disaster Risk Reduction strategies?

   A. An existing and enforceable system of control
   B. Acceptance of the objectives and the authority of the imposed controls by the target community.
   C. The economic capability of the affected community to comply with the regulations.
   D. All of the above

10. Which of the following are National Disaster Risk Reduction stakeholders?

    A. Central Government
    B. National Disaster Offices
    C. Private Sector
    D. All of the above

UNIT FIVE SELF ASSESSMENT ANSWERS

1. D
2. B
3. C
4. F
5. A
6. T
7. T
8. D
9. D
10. D

COURSE NOTES

6 DISASTER RISK TRANSFER AND FINANCING

Learning Objectives

By studying this Unit you will learn to:

- Identify components of disaster risk transfer and financing
- Explore options for disaster risk transfer in a given scenario, highlighting constraints and consequences

6.0 Introduction

In small island developing states, there are often critical components of infrastructure for which no replacement is easily available. Furthermore, it may be impossible to eliminate completely the vulnerability of key assets. This occurs because some assets are located in hazardous areas and are, therefore, too expensive to retrofit. In these cases, it is important to reduce financial risk through disaster risk transfer mechanisms.

Governments and business can reduce the financial impact of hazards by insuring key assets and infrastructure, establishing loans that can be executed in the after shock of an adverse event of a given magnitude and setting aside catastrophe funds.

Disaster Risk Transfer
Use of financial instruments that share / hedge economic risks before losses occur.

6.1 Linkage between Risk Transfer and other Components of Disaster Risk Management

Disaster risk transfer ensures that funds are readily available to rectify the damage or replace the facility, should a loss occur. It does not reduce actual vulnerability. As a result, risk transfer mechanisms should always be implemented in support of, rather than as a replacement for, broad disaster risk reduction initiatives, such as improved building practices and land use planning, among others.

Risk transfer and financing as the other areas of risk management build on activities of risk identification such as hazard characterization, vulnerability assessments, and risk scenarios which provide critical information to establish the feasibility and cost-benefit analysis for the risk transfer instruments.

6.2 Components of Disaster Risk Transfer and Financing

The main components of risk transfer and financing are:

- Insurance--Market insurance and re-insurance.
- Risk financing-- Budget self-insurance, public asset coverage financing, catastrophe bonds, disaster assistance funds.

6.2.1 Insurance

> **Insurance**
> Contract by which an insurance company assumes the risk of occurrence of an uncertain adverse event, committing itself to pay for losses determined in the contract in exchange for a premium. The premium must be paid by the customer in anticipation.

Insurance is an integral part of a disaster risk management strategy and risk transfer. It distributes the losses (transfers the risks) among a pool of at-risk households, businesses and/or governments and to the reinsurance markets. As primary and re-insurance markets become more international and attract capital from investors throughout the world, insurance becomes an instrument for transferring disaster economic risks over the globe.

Insurance and other insurance-related instruments are a cost-effective way of transferring and spreading the economic risks of natural disasters in developing countries. However, in developing countries, insured losses are negligible.

Facts:

+ Insured losses in developing countries, however, are negligible. In low income countries only about 1% of disaster losses are insured (Hoff et al., 2003).

+ Asia (excluding Japan) and Africa only represent 6.3% of the world insurance market.

+ Of all natural catastrophes in 2002, only 4.8% were insured in Asia and 1.1% in Africa (Swiss Re 2003), and only 3.8% of all damages from natural disasters between 1985-1999 were insured in Latin America and the Caribbean (Aufrett, 2003).

Catastrophic risks are becoming more insurable as developments in computer technologies provide improved methods for estimating the risks. On the other hand, insurers are pulling out of many catastrophic risk markets because of the increasing frequency of occurrence of mega-loss events which have threatened the solvency of a number of insurers and raised alarms that insurers may be over exposed in many regions and states. This has led to an increase in premiums on catastrophe insurance with a corresponding reduction in demand.

Many factors contribute to the relatively high and volatile cost of insurance, such as high exposure to hazards, limited financial reserves, high administrative costs, great reliance on reinsurance and the prevalence of under-insurance (World Bank, 2002).

Example of high price of risk transfer

Commenting on the high price of risk transfer, Auffret (2003) points out that in the Caribbean Region, catastrophe insurance premiums are estimated to represent about

1.5% of GDP during the period 1970-1999; at the same time, average losses per annum (insured and uninsured) accounted for only about 0.5% of GDP.

To increase private sector coverage, both insurers and public institutions have called for public-private partnerships, which could help to start-up insurance schemes for the previously "uninsurable." The intention of the public-private partnership is to allow governments to subsidize private sector premiums so as to ensure a larger proportion of the "uninsurable" building stock has insurance coverage.

The types of insurance that will be discussed in this lesson plan are as follows: Budget Self-Insurance, Market Insurance and Reinsurance. The concept of Risk Pooling and Diversification will also be discussed in relation to insurance.

A) Market Insurance

> **Market insurance**
> Mechanism by which losses are stabilised through pre-payment in the form of regular premium payments.

In market insurance the insurer assumes the risk. Insurance makes funds available to undertake repairs or rebuild after a disaster.

Examples:

- **Business interruption insurance** can help companies and their employees survive the recovery and rehabilitation period.
- **Hurricane, earthquake, fire insurance** of a property covers the cost of the losses stated in the clauses of the policy.

B) Reinsurance

> **Reinsurance**
> Insurance by another insurer of all or a part of a risk previously assumed by an insurance company.

A significant insurance practice is that of reinsurance, whereby risk may be divided among several insurers, reducing the exposure to loss faced by each insurer. Reinsurance is done through contracts called *treaties*, which specify how the premiums and losses will be shared by participating insurers.

In the Caribbean, great reliance on re-insurance makes insurance prices vulnerable to shocks unrelated to disaster experiences in the region.

The Caribbean region suffered considerable damage from severe hurricanes such as David, Hugo, Gilbert, Gabrielle, Luis and Marilyn in the 1980s and 1990s. As a consequence, many insurance and reinsurance companies withdrew from the market.

Those that remained imposed onerous conditions for coverage including very high deductibles; separate, increased rates for windstorms; and the insertion of a clause to eliminate the possibility of underinsurance.

The extent of disaster insurance in the developing countries is very low in comparison with developed countries. It is purchased by businesses, hotels, and other types of enterprises.

Governments, whether from internal or external sources, have difficulties to insure assets and properties. On the other hand, unless there is a express policy regarding finance protection, there is a strong limitation to maintain available funds for post-disaster recovery and reconstruction.

If insurance premiums are set to reflect the risk, this will create incentives for homeowners and businesses to take disaster risk reduction measures and to relocate out of high-risk areas. In spite of the arguments mentioned previously, there are some references that show different results due to the insurance market pressure and the imperfect incentive mechanisms.

6.2.2 Risk Pooling and Diversification

Insurance costs can be especially high for geographically concentrated or homogeneous groups or facilities. This is possible because of the potential for simultaneous damage to all members of the group or category.

Diversification of the risk pool, through banding with others from separate areas or industries can reduce insurance premiums for all participants. It also generates the benefits of negotiating power particularly for small states because they can base this on economies of scale. Specific industry groups, such as larger hotel chains and services (health, communications, energy) use this option as a mechanism to lower the premium costs and negotiate conditions as a block.

Examples:

1. CARILEC an association of electricity companies in the Caribbean Region pool and diversify risks.

2. Puerto Rico created a Reserve for Catastrophe Losses under which a portion of tax-deductible property insurance premiums is passed to a trust for re-insuring Puerto Rican insurers. It is also a good example of public-private partnerships to assist in risk transfer.

3. Small cities such as Manizales (Colombia) have implemented an insurance policy to cover against earthquakes using the property tax as a way to collect the premium cost and negotiate with insurance companies through the municipality as a block.

6.2.3 Disaster Risk Financing

Risk financing mechanisms allow losses to be paid off in the medium to long-term via some form of credit facility. Such mechanisms provide cost-effective, multi-year coverage that assists with the stabilisation of premiums and increases the availability

of funds for insurance purposes. The types of risk financing instruments that are discussed in this lesson are budget self insurance, public asset coverage financing, catastrophe bonds and disaster assistance funds.

A) Budget Self-insurance

> **Budget self-insurance**
> Measure taken by individual property owners to allocate a modest yearly budget for improvement, maintenance, and selected retrofit investments for their property (buildings, land, infrastructure) which helps to reduce future expected losses in the event of a disaster.

The owner need not incur the cost of the purchase of regular insurance. Additionally, the owner can claim a higher tax deduction for property maintenance. As a result of these, the cost of insurance is reduced.

Examples: Building a river barrier; housing retrofitting; installing impact resistant windows; installing shutter systems; installing hurricane straps on the roofs of houses.

B) Public Asset Coverage Financing

Public asset coverage financing
Process by which governments seek to finance the reconstruction of damaged critical public assets which are important for restoring economic growth in the aftermath of a disaster.

Governments carry a large and highly dependent portfolio of infrastructure assets. Some of these are critical for restoring economic growth. However, most public assets are not covered by insurance.

Funds for rebuilding damaged assets must come from annual budgets or external sources and these are typically limited. However, public budgets are under tremendous pressure in the post-disaster period.

Example:
The Insurance Corporation of Barbados (ICB) was established in 1978 to insure assets of the state and of certain statutory boards, as well as to underwrite and manage all classes of risk in Barbados. The Insurance Corporation of Barbados Limited is now under public ownership but provides the same coverage.

Best Practices
- Insurance coverage for critical public assets will ensure that key infrastructure can be rebuilt or rehabilitated if damaged by an adverse event.

- Selection of assets that merit insurance coverage is based on careful prioritisation of public facilities and on comprehensive vulnerability assessments for public facilities.

ACTIVITY 6.1: CRITICAL PUBLIC ASSETS

List a few examples of critical public assets to consider.

YOUR ANSWERS FOR ACTIVITY 6.1

✓ ***ANSWERS: At the end of this Unit***

C) Catastrophe Bonds

> **Catastrophe Bond (Cat bond)**
> Bond that is purchased by investors which transfers risks to the global capital market.

Recently, another risk-transfer instrument, commonly called a catastrophe or cat bond, has emerged, which can be used to replace traditional reinsurance. Cat bonds make use of different formulas to trigger compensation based on losses or on a physical phenomenon such as wind speed or precipitation. These bonds are purchased by investors and thus transfer the risk to the global capital markets.

Catastrophe bonds emerged as instruments primarily for insurers. Insurers cannot diversify dependent risks by writing a large number of similar policies, and therefore locally operating insurance companies diversify through reinsurance.

Reinsurance companies, in turn, manage their risk by an even wider and more global diversification, but in the early 1990s large losses from U.S. catastrophes strained the capacity of the reinsurance markets and raised the price of reinsurance. The cat bonds constitute another alternative at this level.

D) Disaster Assistance Funds

> **Disaster Assistance Funds**
> Resources assigned to respond to adverse events of important magnitude and declared disasters.

These resources should be available and be kept as liquid assets that can be accessed immediately when required. While these investments are not used, they should be generating interests.

The following is news article from www.caribbean360.com from June 4, 2007:

The Caribbean Catastrophe Risk Insurance Facility (CCRIF) -launched June 1st, 2007 provides participating Caribbean governments with immediate access to funds if hit by a hurricane or earthquake. "This parametric solution has been designed to automatically respond based on the predefined hazard and actuarial models developed for the region. This means that the participating nations will immediately qualify to receive a standard cash injection based on the severity of the catastrophe." CCRIF was able to secure US$110 million of claims paying capacity on the international reinsurance and capital markets. The reinsurance structure consists of four layers: CCRIF retains the first layer of US$10 million; reinsurers underwrite the second (US$15 million) and third layers (US$25 million); the top layer (US$70 million) is financed with reinsurance (US$50 million) plus US$20 million coverage through a catastrophe swap between the World Bank (IBRD) and CCRIF.

The US$20 million swap between IBRD and CCRIF is the first transaction to enable emerging countries to use a derivative transaction to access the capital market to insure against natural disasters. It is also the first time a diversified pool of emerging market countries' catastrophe risk is placed in the capital markets.

The CCRIF's capacity to service claims is based on its own reserves combined with the financial capacity of the international financial markets. This will allow CCRIF to respond to events occurring once every 1,000 years or more, achieving a higher level of resiliency than international standards. Work is also being considered to expand the scope of the coverage provided by CCRIF to other natural hazards such as floods and tsunamis. CCRIF participating governments are: Anguilla, Antigua & Barbuda, Bahamas, Barbados, Belize, Bermuda, Cayman Islands, Dominica, Grenada, Haiti, Jamaica, St Kitts & Nevis, St Lucia, St Vincent & the Grenadines, Trinidad & Tobago, Turks and Caicos Islands.

ACTIVITY 6.2: TRANSFER AND FINANCING

Using the matrix that follows, summarize the risk transfer and financing mechanisms that are covered in this Unit.

YOUR ANSWERS FOR ACTIVITY 6.2:

Mechanisms	Definition	Users	Advantages	Limitations

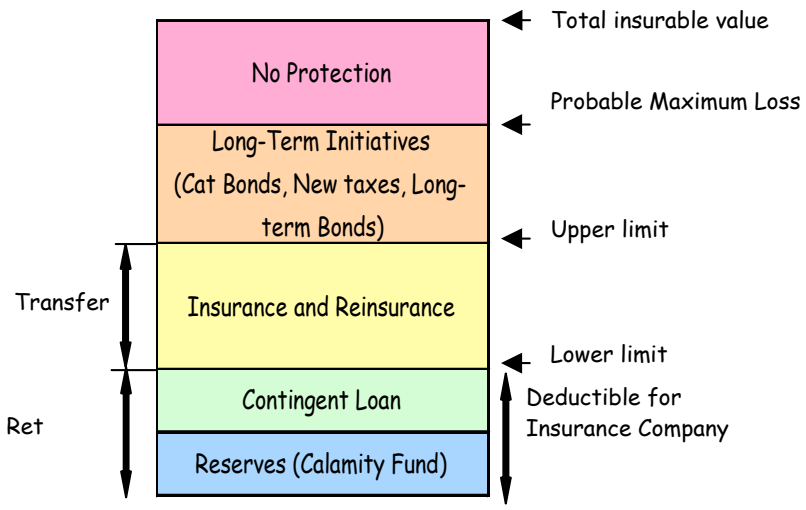
✓ ***ANSWERS: At the end of this Unit***

Summary of Potential and Challenges of Risk Transfer and Financing

A) Potential of Disaster Risk Transfer and Financing

1. The potential of insurance and these alternative instruments for transferring the risks of disasters to investors across the globe is enormous.
2. The worldwide losses from extreme disasters are only a small percentage of the world capital market, which deviates everyday by several billion dollars.
3. This highlights the scope and potential of trans-border risk transfer, especially for governments of developing countries that cannot form a viable insurance pool of taxpayers within their borders.

B) Challenges of Adopting Risk Transfer and Financing



This diagram illustrates the complementarities among instruments related to risk retention, transfer, and financing.

The first two layers (retention) is the state's responsibility through the calamity funds or contingent loans.

The third layer (transfer) constitutes the value of losses that can be transferred to the insurance/reinsurance sector.

The fourth layer could be covered by the capital markets and/or be covered by loans from multi-lateral entities. It is at this level where resources are included to finance the coverage of public assets.

Frequently, there is an upper layer that does not have coverage.

ACTIVITY 6.3: RISK TRANSFER OPPORTUNITIES
Using the scenario from Unit 4, identify opportunities for disaster risk transfer and suggest which instruments of disaster risk transfer are most applicable to the given scenario. Indicate the constraints and consequences that are associated with disaster risk transfer.

Think also about opportunities for disaster risk transfer in your current job, community or personal situation.

YOUR ANSWERS FOR ACTIVITY 6.3: 

Mechanisms	Constrains	Consequences

✓ ***ANSWERS: At the end of this Unit***

UNIT SIX SUMMARY

This Unit focuses on disaster risk transfer mechanisms: insurance, market insurance and re-insurance, and financing instruments: budget self-insurance, public asset coverage financing, catastrophe bonds, disaster assistance funds. These instruments are not substitutes for the risk reduction measures discussed in previous Units. It is important that homeowners, businesses and Government understand all the risks transfer and financing instruments that are available to them. This will allow for the use of the instruments best suited to transfer and/or finance their risks.

UNIT SIX ACTIVITIES - POSSIBLE ANSWERS

ACTIVITY 6.1: CRITICAL PUBLIC ASSETS

- Shelters, schools, hospitals, and fire stations
- Lifelines (including central plants and distribution networks) such as water, sewerage, telecommunications, energy and gas systems
- Public transportation infrastructure, terminals, ports, airports, bridges
- Historical buildings and archaeological sites

ACTIVITY 6.2: TRANSFER AND FINANCING

On the following page

ACTIVITY 6.2: TRANSFER AND FINANCING

Mechanisms	Definition	Users	Advantages	Limitations
Market insurance	Mechanism by which losses are stabilised through pre-payment in the form of regular premium payments.	Government Private sector NGO's Institutions, associations, individuals	- It allows the reduction of the governments' physical burden after a catastrophic event, and will open the path for facilitating access to the private insurance market sector.	- Lack of insurance's culture - Low coverage. - High price of premiums
Reinsurance	Insurance by another insurer of all or a part of a risk previously assumed by an insurance company.	Insurance Companies	- It transfers the risk to a second insurer -	- After a disaster of significant proportions, premiums for insurance or reinsurance will increase suddenly and dramatically
Budget self-insurance	Measure taken by individual property owners to allocate a modest yearly budget for improvement, maintenance and selected retrofit investments for their property (buildings, land, infrastructure) which helps to reduce future expected losses in the event of a disaster.	Government Private sector NGO's Institutions, associations, individuals	- It constitutes another alternative for re-insurance.	- The risk is retained. - There is a need for political will to invest with a long term vision. - Resources availability. - Should be combined with incentives (tax and/or insurance in order to have better impact)
Public asset coverage financing	Process by which Governments seek to finance the reconstruction of damaged critical public assets which are important for restoring economic growth in the aftermath of a disaster.	Governments	- Insurance coverage for critical public assets will ensure that key infrastructure can be rebuilt or rehabilitated if damaged by an adverse event.	- Selection of assets that merit insurance coverage is based on careful prioritization - There is a need for political will to invest with a long term vision. - Resources availability.
Catastrophe Bond (Cat bond)	Bond that is purchased by investors which transfers risks to the global capital market.	Government Private sector NGO's Institutions, associations, individuals	- They become instruments of risk transfer. - It works in agreement with insurance companies. - It offers higher interest rates and yields than those offered in the market.	- There is a need for special purpose vehicle (SPV) as an intermediary in the process of titling the risk through the bond. - It requires an investment in marketing and promotion and depends on the financial or opportunity costs and on the possibility of accessing resources.
Disaster Assistance Funds	Resources assigned to respond to adverse events of important magnitude and declared disasters	Government	- This account should be maintained in liquid assets. - There are other investments with higher rates of social return	- Accounts that can be cashed out quickly, without any significant costs of transaction.

ACTIVITY 6.3: RISK TRANSFER OPPORTUNITIES

Risk Financial and Risk Transfer mechanisms	Constraints	Consequences
Market insurance	With the information available it is difficult to anticipate if there is an appropriate environment for a massive insurance strategy, but at least for the physical infrastructure like warehouses, schools and the health care center. Another insurance to cover the main crops of the community through the Coffee and Banana Producers.	The insurance will facilitate the early recovery, mitigating the financial risk and the economy of the island.
Reinsurance	- Seek for other partners in the neighbor islands in order to negotiate collectively.	Maintain affordable the premiums.
Budget self-insurance	- The community associations can complement the insurance with some funds available to improve public works in order to reduce vulnerability, stimulate relocation and improve stilt houses in the medium risk areas.	This and the Disaster Assistance Funds are the most feasible risk transfer mechanisms that can be implemented in Blue Valley. In this case the intention is to promote mitigation measures.
Disaster Assistance Funds .	The community and the organizations should assign a percentage of their income to constitute a calamity fund, defining clear procedures to access resources when an emergency or disaster occurs.	Due to the level of exposure of the community to the hazards and their frequency and intensity is a mechanism needed in the short term. In order to face the urgent needs of the disasters' aftermath.

UNIT SIX SELF ASSESSMENT QUESTIONS
(Circle the best answer)

1. Risk transfer can best be described as:

   A. The systematic pooling of financial resource for the purpose of responding to disasters
   B. The use of financial instruments that share economic risks before disaster occur
   C. The purchasing of insurance policies to cover property damage
   D. A structural risk reduction measure

2. Which of the following is not a risk financing measure?

   A. Public Asset Coverage
   B. Budget self insurance
   C. Cat Bonds
   D. Market Insurance

3. Purchasing house insurance coverage from a local company is a risk transfer mechanism called:

   A. Reinsurance
   B. Budget self insurance
   C. Risk Diversification
   D. Market Insurance

4. The Jones Family decided to set aside 5% of their annual income to be used to retrofit their home to make it more resilient against hurricane. Which risk transfer mechanism best describes their action?

   A. Budget Self Insurance
   B. Reinsurance
   C. Market Insurance
   D. Risk Pooling and diversification

5. Which measure below can be considered a risk retention measure?

   A. Purchasing Cat Bonds
   B. Establishing Reserves or Calamity Funds
   C. Purchasing Market Insurance
   D. Reinsurances

6. The CCRIF which uses parametric index to determine payouts is an example of which risk transfer instrument:

   A. Reinsurance
   B. Public Asset Risk Financing
   C. Budget self Insurance
   D. Catastrophe Bond

7. The mandate of an Insurance Corporation to, among other thing, insure the assets of statutory corporations best fits the risk financing measure called:

   A. Risk Pooling and diversification
   B. Disaster Assistance Fund
   C. Budget Self Insurance
   D. Public Asset Coverage Financing

8. Which statement below is false?

   A. Risk transfer and financing measures are good substitutes for risk reduction measures
   B. Risk transfer and financing measures should be used as complimentary measures alongside risk reduction measures
   C. Risk transfer and financing can be considered the opposite to risk retention
   D. Risk transfer and financing measures are not popular measures among rural populations

9. Insurance companies have in recent times refused coverage to coastal properties in the region mainly because:

   A. The properties have not used building codes in their designs
   B. The areas in question are considered as high risks
   C. The areas in question are close to the sea
   D. Government regulations about setback are unclear

UNIT SIX SELF ASSESSMENT ANSWERS

1. B
2. D
3. D
4. A
5. B
6. D
7. D
8. A
9. B

COURSE NOTES

7 CAPACITY DEVELOPMENT FOR DISASTER RISK REDUCTION

Learning Objectives

By studying this Unit you will learn to:

- Utilize the seven steps for producing an action plan
- Identify advantages and disadvantages of the responsibility chart
- Describe the importance of evaluation during the plan implementation
- Apply a matrix for troubleshooting

7.0 Introduction

This Unit consists of guidelines for preparing a *work plan (action plan)* which involves three main activities:

- Planning
- Implementation and evaluation
- Trouble-shooting

In disaster risk reduction, a work plan is necessary to guide decision-makers in executing the most important tasks in the right sequence. *The emphasis is on* ***what, who, when, where, resources and reporting.***

7.1 Responsibility Charting

Several techniques may be used to develop work plans. This course uses the Responsibility-Charting technique, which determines **what actions need to be taken, who will do them, when they will do them** and **what resources are needed to carry them out**. This work plan can be very detailed and it is wise to allow ample time for the responsibility-charting process.

There are several options for preparing a work plan. It can be delegated as follows:

- To an individual or a smaller group that is internal and that can then report back to the larger group
- To an outside consultant
- To a committee or an ad-hoc group which has no outside advice or help

If planning is delegated, it is important that the individual or the group has a good understanding of the problem, has a clear understanding of the terms of reference, has the necessary resources (time, support), and relevant decision-makers are informed and engaged in the review process.

PROBLEM STATEMENT:
SOLUTION/DECISION:

Project Activities (What)	Responsible Personnel (Who)	Timeframe (When)	Resources	Monitoring & Evaluation Mechanisms	Follow-up Actions (Report to)

RESPONSIBILITY CHARTING MATRIX

Steps in the Action Planning Process for a Group
It would be advisable for a Facilitator to guide a group through the following steps:

Step 1
Write the problem statement and the solution/decision at the top of a flip chart. Have these statements on the wall in view at all times.

Step 2
Below that, make a grid of four columns labeled: ***What, Who, When, Resources*** **and explain them.**

Step 3 - Start with the first column: ***What***.
- What action must be taken to implement the solution? For example, risk reduction measures that can be used for flooding.
- Put actions in sequence.
- Ensure that the actions include reporting and evaluation (How to monitor progress and mistakes? What will success look like? How will we know if it worked? How will we collect the information?)
- Write these in the ***What*** column of the grid.

Step 4 - Move to the next column: *Who*
- Determine the decision-makers whose approval/ cooperation will be sought.
- Determine how and who will seek this approval/ cooperation.
- Determine who will have responsibility for the previous action. Only persons present at the meeting can be listed here.
- If someone not present should carry out the task, list an action step for someone present to contact that person.
- Spend time discussing who will be involved in actual implementation – the group, only a few individuals, an individual. Will outside assistance be needed, i.e. an outside expert.
- Write these in the ***Who*** column of the grid.

Step 5 - Move to the next column: *When*

- Identify the time each action will take (start/finish).
- Encourage group members to be realistic. Can that timeline be met with the resources available?
- Is the action dependent on another action being completed first?
- Create a schedule/timeline.
- Establish deadlines.
- Write these in the ***When*** column of the grid.

Step 6 - Move to the next column: *Resources*

- Resources – these can be money, human resources and skills, equipment or materials.
- Identify the human, material and financial resources needed for each action.
- Use the column to help those responsible for the task to think ahead and strategically.
- Resource setting should also include preparation of the budget, or at least provision for it.

Step 7 - Review and summarise resource requirements

Review the chart and summarize the actions and who will do what. Point out those items that have the most immediate target date. Summarise the resources needed and discuss how those resources will be distributed. Tell group members that the plan will be written and copied for each person. Determine how this will be distributed and who will do it, if not the facilitator.

Options for Responsibility Charting:

Include a column ***Report to*** *so as* to identify who will monitor each particular action. This may be useful when plans involve persons from several different groups.

ACTIVITY 7.1: THE STEPS

List the steps for the **Action Planning Process for a Group.**

YOUR ANSWERS FOR ACTIVITY 7.1

✓ ***ANSWERS: At the end of this Unit***

Advantages and Disadvantages of Responsibility Charting

There are both advantages and disadvantages of Responsibility Charting as follows:

Advantages:

- Encourages individuals or group members to take responsibility for solving problems.
- Provides transparency and accountability for each person's responsibilities.
- Models a systematic process.
- Ensures that other key "stakeholders are included or provided for.
- Provides action plan details for those persons who lack vision.
- Starts to disengage Facilitator from the individual or the group.
- Can be delegated to an individual or a smaller group.

Disadvantages:

- Group members may be reluctant to take responsibility.
- Group members may lack sufficient design and planning skills
- Individuals who are decision makers or who can best carry out actions may not be present.
- The planning process can be time consuming. It may not be feasible to do Responsibility Charting in one session if the problem and solution are complex.
- Success depends on the convener/.person initiating the problem solving an the group follow through.

ACTIVITY 7.2: ADVANTAGES AND DISADVANTAGES

For you, which are the three most important advantages and disadvantages of Responsibility Charting

YOUR ANSWERS FOR ACTIVITY 7.2

Advantages:

Disadvantages

✓ ***ANSWERS: At the end of this Unit***

7.2 Implementation and Evaluation

Implementation
Putting plans into action; it is to carry out and monitor the action plan.

Key points:
- Implementation is the step where the leading, directing, and/or coordinating occurs.
- If the group has defined appropriately the problem statement, the solution/decision at the top (Step 1) and the steps to implement the solution (Step 3), the group has made a good start. If the group has poorly completed the previous steps, implementation is also more likely to fail.
- Groups will sometimes lose interest in the implementation, especially if someone else is responsible.
- Tracking progress and identifying mistakes are important tasks of implementation. Sometimes the implementation process itself can be flawed, which will affect the solution.
- Troubleshooting helps to anticipate barriers that may limit success and correct mistakes as they occur in the implementation process.

Evaluation
Measuring if the action plan worked and was effective, was the problem solved and how well did the plan contribute to solving the problem? The purpose of evaluation is to monitor, evaluate and update the plan and document the results.

Key points:
- Evaluation is developed as part of action planning though it should be discussed prior to or at the start of the process.
- Evaluation provides closure on the process.
- If the intended results are not obtained or achieved, then use the evaluation to start the problem-solving process again, returning to Part I of the follow-up process or, if needed, back to Step 1 in the problem-solving process.
- Put recommendations and key findings in writing to the group and key decision-makers.
- Evaluation can be on several levels: the action plan and implementation process, short- or long-term results or how well the solution addressed the problem.

Role of the Facilitator in Implementation and Evaluation
The facilitator may or may not have a role in either of these two activities. If the facilitator does not have an active role, prior to finishing his/her work with the individual or the group, the facilitator can help the group/convener/decision-maker understand what is needed in order to be successful in implementing action plans.

7.3 Troubleshooting Plan and Worksheet

Problem / blockage	Solution

TROUBLESHOOTING WORKSHEET

A troubleshooting worksheet is used to identify all of the things that could get in the way of success in implementing the solution to a problem. It should be used with a Responsibility Chart. Create anticipatory strategies to deal with each of the serious blockages.

Develop a **Troubleshooting Plan** to minimize potential problems to implementation. This involves identifying all the constraints or things that could get in the way of successfully implementing the plan and creating strategies to deal with each of the blockages.

Once this planning step is satisfactorily accomplished, implementation can commence.

Questions to help identify trouble spots:

1. What is the most difficult, complex or sensitive aspects of your plan?
2. What sudden shifts could take place to change priorities or otherwise change the environment?
3. What organizational blocks and barriers could you run into?
4. What technical or materials-related problems could stop or delay you?
5. Should you be aware of any human resources issues? Which ones?
6. In which ways might members of this group not fulfill their commitments?

ACTIVITY 7.3: RESPONSIBILITY CHARTING MATRIX

Using the scenario in Unit 4, choose one hazard and apply steps 3 to 7 using the Responsibility Charting Matrix.

YOUR ANSWERS FOR ACTIVITY 7.3

Project Activities (What)	Responsible Personnel (Who)	Timeframe (When)	Resources	Monitoring & Evaluation Mechanisms	Follow-up Actions (Report to)

✓ ***ANSWERS: At the end of this Unit***

ACTIVITY 7.4: TROUBLESHOOTING WORKSHEET

Using the selected hazard prepare a trouble shooting worksheet and plan.

YOUR ANSWERS FOR ACTIVITY 7.4

PROBLEM STATEMENT

SOLUTION / DECISION

✓ ***ANSWERS: At the end of this Unit***

UNIT SEVEN SUMMARY

This Unit explains guidelines for preparing a work plan (action plan) involving three main activities: Planning; Implementation and evaluation; and Trouble-shooting. In disaster risk reduction, a work plan is necessary to go from ideas to actions and to guide decision-makers in executing the most important tasks in the right sequence. Two techniques are presented: 1) Responsibility Charting which determines what actions need to be taken, who will do them, when they will do them, what resources are needed to carry them out and how they will be reported, and 2) Troubleshooting Plan and Worksheet to identify everything that might get in the way of success in implementing the solution to a problem.

UNIT SEVEN ACTIVITIES - POSSIBLE ANSWERS

ACTIVITY 7.1: THE STEPS

- Identify and write the problem statement and the solution agreed.
- Agree in the columns to be used what, who, when, resources, report to
- What
- Who
- When
- Resources
- Report to
- Review the whole process

ACTIVITY 7.2: ADVANTAGES AND DISADVANTAGES

Advantages

- Better understanding of the actions to be taken
- Buy-in and commitment with the solution of the problem
- learning process on how to work within a team

Disadvantages

- Simple solutions can become impossible missions
- Difficulty to recognize the difference between group processes and content approach

ACTIVITY 7.3: RESPONSIBILITY CHARTING MATRIX

Problem Statement: Annually the river level exceeds the high of the banks at the old port, flooding the San Vincent settlement.
Solution/Decision: Reinforce the banks at the old port

Project Activities (What)	**Responsible Personnel (Who)**	**Timeframe (When)**	**Resources**	**Monitoring & Evaluation Mechanisms**	**Follow-up Actions (Report to)**
Preparation of a request for proposals	Committee Pro-development's lawyer	20 working days. By Jan 30th	--	Committee Pro-development's Auditor	Committee Pro-development's leader
Allocation of resources	Committee Pro-development's accountant	By Jan 30th	Development Funds	Committee Pro-development's Auditor	Committee Pro-development's leader
Proposal selection and contract preparation	Committee Pro-development	By March 30th	--	Committee Pro-development's Auditor	Committee Pro-development's leader
Project execution	Contractor	Start date July 1st. End date September 15th	Development Funds	Committee Pro-development	Community
Monitoring & evaluation	Potable Water Commission's Coordinator	July 1st - September 15th	Water Funds	Committee Pro-development's Auditor	Committee Pro-development's leader

ACTIVITY 7.4: TROUBLESHOOTING WORKSHEET

Problem / blockage	Solution
There is not technical expertise to prepare the RFP's terms of reference ToR	Request support from the central government
There are not enough resources to finance the work.	Establish a cooperative agreement with local associations of coffee and banana producers. Request support from the central government. Prepare a request for international support
There are not proposals submitted	Review ToR, request advice from central government, request international technical support
The contractor does not fulfill the time schedule agreed	Review ToR. Be sure to include all the legal instruments necessary to protect the community and its finance.
There is not follow-up to the contractor's activities.	Define and implement a permanent M&E system in place in order to detect and correct any deviation.

UNIT SEVEN SELF ASSESSMENT QUESTIONS
(Circle the best answer)

1. A problem statement and the solution/decision are needed to start preparing a work plan.

   True *False*

2. Preparing a *work plan (action plan)* involves:

   A. Planning
   B. Implementation and evaluation
   C. Trouble-shooting
   D. All of the above

3. A responsibility charting

   A. Is a planning tool
   B. Can be delegated to individuals or groups
   C. Only works in post-disaster situations
   D. A and B

4. Preparing a Responsibility chart, you determine WHAT needs to be done, WHO will do it, WHEN, RESOURCES required, MONITORING mechanisms and REPORTING requirements.

   True *False*

5. Implementation of the action plan implies:

   A. Putting plans into action;
   B. Carry it out
   C. Monitoring
   D. All of the above

6. It is important to know how well the plan contributes to solving the problem.

   True *False*

7. The purpose of evaluation is to monitor, evaluate and update the plan and document the results.

   True *False*

8. Troubleshooting only deals with potential problems not with solutions.

   True *False*

9. You work in troubleshooting once you have problems during the implementation of the action plan, not before.

   True *False*

10. A troubleshooting worksheet is used to minimize potential problems to a plan implementation.

    True *False*

UNIT SEVEN SELF ASSESSMENT ANSWERS

1. T
2. D
3. D
4. T
5. D
6. T
7. T
8. F
9. F
10. T

COURSE NOTES

Disaster Management Center

University of Wisconsin-Madison

Examination Request Form

This exam must be proctored (supervised) just as it would be for a course taken on campus. Generally, proctors do not charge for this service. In all cases the academic department offering the course must approve the choice of proctor. Qualified proctors include university or college registrars, deans or counselors or professors; high school principals or counselors; directors of educational services at universities, other educational organizations, correctional institutions or the armed services; certified librarians in a supervisory position; or the delegated officials at university testing centers. Students residing outside of the United States may also request, as their proctor, a local director of educational services or an officer of the United States embassy or consulate. Please copy this form as needed.

Date Submitted _____

Course Title DD04 - Disaster Risk Reduction

Student Information:

Name _____

Mailing Address _____

_____

_____

Proctor Information:

Name _____

Title _____

Organization _____

Complete Mailing Address (Please provide street address, in case courier service is used.)

_____

_____

_____

Phone Number OR
Email Address _____

Please return this form by mail or fax, or send the information via e-mail to:
University of Wisconsin–Disaster Management Center
432 Lake Street
Madison, Wisconsin 53706, USA
Fax: 1-608-263-3160 E-mail: dmc@engr.wisc.edu

Disaster Management Center

University of Wisconsin-Madison

Course Evaluation
DD04 – Disaster Risk Reduction

Date you finished the course: _____

What is your present position? _____

How many years have worked in project management? _____

Please circle your answer

How many years of formal education do you have?

0 to 6 years 7 to 12 years 12 to 16 years more than 16 years

How was the content level of this course?

too difficult about right too easy

Was the course material relevant to your work?

Yes No

How useful were the self-assessment tests to you?

very useful OK not useful

How valuable was the total course?

very valuable of some value not valuable

Additional comments:

_____

_____

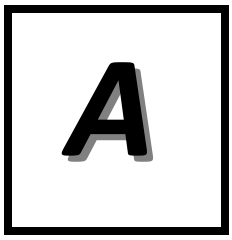
_____

_____

_____

Please return this form by mail or fax, or send the information via e-mail to:

University of Wisconsin–Disaster Management Center
432 Lake Street
Madison, Wisconsin 53706, USA
Fax: 1-608-263-3160 E-mail: dmc@engr.wisc.edu



ANNEX A: COURSE REFERENCES

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B ANNEX B: KEY RESOURCES

Beaufort Wind Scale

Developed in 1805 by Sir Francis Beaufort of England

Force	Wind (Knots)	WMO Classification	Appearance of Wind Effects	
			On the Water	On Land
0	Less than 1	Calm	Sea surface smooth and mirror-like	Calm, smoke rises vertically
1	1-3	Light Air	Scaly ripples, no foam crests	Smoke drift indicates wind direction, still wind vanes
2	4-6	Light Breeze	Small wavelets, crests glassy, no breaking	Wind felt on face, leaves rustle, vanes begin to move
3	7-10	Gentle Breeze	Large wavelets, crests begin to break, scattered whitecaps	Leaves and small twigs constantly moving, light flags extended
4	11-16	Moderate Breeze	Small waves 1-4 ft. becoming longer, numerous whitecaps	Dust, leaves, and loose paper lifted, small tree branches move
5	17-21	Fresh Breeze	Moderate waves 4-8 ft taking longer form, many whitecaps, some spray	Small trees in leaf begin to sway
6	22-27	Strong Breeze	Larger waves 8-13 ft, whitecaps common, more spray	Larger tree branches moving, whistling in wires
7	28-33	Near Gale	Sea heaps up, waves 13-20 ft, white foam streaks off breakers	Whole trees moving, resistance felt walking against wind
8	34-40	Gale	Moderately high (13-20 ft) waves of greater length, edges of crests begin to break into spindrift, foam blown in streaks	Whole trees in motion, resistance felt walking against wind
9	41-47	Strong Gale	High waves (20 ft), sea begins to roll, dense streaks of foam, spray may reduce visibility	Slight structural damage occurs, slate blows off roofs
10	48-55	Storm	Very high waves (20-30 ft) with overhanging crests, sea white with densely blown foam, heavy rolling, lowered visibility	Seldom experienced on land, trees broken or uprooted, "considerable structural damage"
11	56-63	Violent Storm	Exceptionally high (30-45 ft) waves, foam patches cover sea, visibility more reduced	
12	64+	Hurricane	Air filled with foam, waves over 45 ft, sea completely white with driving spray, visibility greatly reduced	

Local forecast by "City, St" or "ZIP"
Go
Text-only version
Get Storm Info
Satellite | Radar
Aircraft Recon
Advisory Archive
Mobile Products
E-mail Advisories
GIS Data | RSS
NHC Products Help
Tropical Analysis and Forecasting
Atlantic | E Pacific
TAFB Products Help
Hurricane Awareness
Be Prepared | Learn
Frequent Questions
AOML Research
Hurricane Hunters
Saffir-Simpson Scale
Forecasting Models
Eyewall Wind Profiles
Glossary/Acronyms
Storm Names
Breakpoints
Hurricane History
Seasons Archive
Forecast Accuracy
Climatology
Deadliest, Costliest and Most Intense
1492-1996 (Atlan)
1851-2004 (USA)
Most Expensive
Most Intense
US Strikes - Decade
US Strikes - State
About NHC/TPC
Mission and Vision
Personnel | Visitors
Library
Joint Hurr Testbed
The NCEP Centers
NOAA Locator
WX4NHC Radio
Contact Us – Help
USA.gov

The Saffir-Simpson Hurricane Scale

The Saffir-Simpson Hurricane Scale is a 1-5 rating based on the hurricane's present intensity. This is used to give an estimate of the potential property damage and flooding expected along the coast from a hurricane landfall. Wind speed is the determining factor in the scale, as storm surge values are highly dependent on the slope of the continental shelf and the shape of the coastline, in the landfall region. Note that all winds are using the U.S. 1-minute average.

Category One Hurricane:

Winds 74-95 mph (64-82 kt or 119-153 km/hr). Storm surge generally 4-5 ft above normal. No real damage to building structures. Damage primarily to unanchored mobile homes, shrubbery, and trees. Some damage to poorly constructed signs. Also, some coastal road flooding and minor pier damage. Hurricane Lili of 2002 made landfall on the Louisiana coast as a Category One hurricane. Hurricane Gaston of 2004 was a Category One hurricane that made landfall along the central South Carolina coast.

Category Two Hurricane:

Winds 96-110 mph (83-95 kt or 154-177 km/hr). Storm surge generally 6-8 feet above normal. Some roofing material, door, and window damage of buildings. Considerable damage to shrubbery and trees with some trees blown down. Considerable damage to mobile homes, poorly constructed signs, and piers. Coastal and low-lying escape routes flood 2-4 hours before arrival of the hurricane center. Small craft in unprotected anchorages break moorings. Hurricane Frances of 2004 made landfall over the southern end of Hutchinson Island, Florida as a Category Two hurricane. Hurricane Isabel of 2003 made landfall near Drum Inlet on the Outer Banks of North Carolina as a Category 2 hurricane.

Category Three Hurricane:

Winds 111-130 mph (96-113 kt or 178-209 km/hr). Storm surge generally 9-12 ft above normal. Some structural damage to small residences and utility buildings with a minor amount of curtainwall failures. Damage to shrubbery and trees with foliage blown off trees and large trees blown down. Mobile homes and poorly constructed signs are destroyed. Low-lying escape routes are cut by rising water 3-5 hours before arrival of the center of the hurricane. Flooding near the coast destroys smaller structures with larger structures damaged by battering from floating debris. Terrain continuously lower than 5 ft above mean sea level may be flooded inland 8 miles (13 km) or more. Evacuation of low-lying residences with several blocks of the shoreline may be required. Hurricanes Jeanne and Ivan of 2004 were Category Three hurricanes when they made landfall in Florida and in Alabama, respectively.

Category Four Hurricane:

Winds 131-155 mph (114-135 kt or 210-249 km/hr). Storm surge generally 13-18 ft above normal. More extensive curtainwall failures with some complete roof structure failures on small residences. Shrubs, trees, and all signs are blown down. Complete destruction of mobile homes. Extensive damage to doors and windows. Low-lying escape routes may be cut by rising water 3-5 hours before arrival of the center of the hurricane. Major damage to lower floors of structures near the shore. Terrain lower than 10 ft above sea level may be flooded requiring massive evacuation of residential areas as far inland as 6 miles (10 km). Hurricane Charley of 2004 was a Category Four hurricane made landfall in Charlotte County, Florida with winds of 150 mph. Hurricane Dennis (pdf) of 2005 struck the island of Cuba as a Category Four hurricane.

Category Five Hurricane:

Winds greater than 155 mph (135 kt or 249 km/hr). Storm surge generally greater than 18 ft above normal. Complete roof failure on many residences and industrial buildings. Some complete building failures with small utility buildings blown over or away. All shrubs, trees, and signs blown down. Complete destruction of mobile homes. Severe and extensive window and door damage. Low-lying escape routes are cut by rising water 3-5 hours before arrival of the center of the hurricane. Major damage to lower floors of all structures located less than 15 ft above sea level and within 500 yards of the shoreline. Massive evacuation of residential areas on low ground within 5-10 miles (8-16 km) of the shoreline may be required. Only 3 Category Five Hurricanes have made landfall in the United States since records began: The Labor Day Hurricane of 1935, Hurricane Camille (1969), and Hurricane Andrew in August, 1992. The 1935 Labor Day Hurricane struck the Florida Keys with a minimum pressure of 892 mb--the lowest pressure ever observed in the United States. Hurricane Camille struck the Mississippi Gulf Coast causing a 25-foot storm surge, which inundated Pass Christian. Hurricane Andrew of 1992 made landfall over southern Miami-Dade County, Florida causing 26.5 billion dollars in losses--the costliest hurricane on record. In addition, Hurricane Wilma (pdf) of 2005 was a Category Five hurricane at peak intensity and is the strongest Atlantic tropical cyclone on record with a minimum pressure of 882 mb.

Tropical Cyclone, Tropical Weather, & TPC Information Topics:
Storm Information, Hurricane Awareness, Historical Information,
Tropical Analysis and Forecasting Branch, About Us, Contact Us

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National Centers for Environmental Prediction
National Hurricane Center
Tropical Prediction Center
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Miami, Florida, 33165-2149 USA
nhcwebmaster@noaa.gov
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Earthquake Hazards Program

Visual Glossary - intensity

A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S | T | U | V | W | X | Y | Z
All Terms

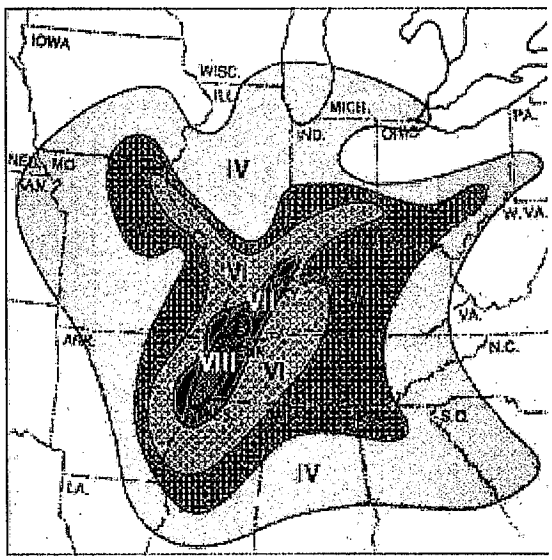
« hypocenter

interplate »

intensity

The intensity is a number (written as a Roman numeral) describing the severity of an earthquake in terms of its effects on the earth&s surface and on humans and their structures. Several scales exist, but the ones most commonly used in the United States are the Modified Mercalli scale and the Rossi-Forel scale. There are many intensities for an earthquake, depending on where you are, unlike the magnitude, which is one number for each earthquake.

See also Earthquake ABC & FAQ discussion.



Map showing intensity for the New Madrid earthquake. (Image courtesy of the Central U.S. Earthquake Consortium)

Department of the Interior | U.S. Geological Survey
URL: http://earthquake.usgs.gov/learning/glossary.php
Page Contact Information: Web Team

USGS science for a changing world

Earthquake Hazards Program

Visual Glossary - magnitude

A | B | C | D | E | F | G | H | I | J | K | L | M | N | O | P | Q | R | S | T | U | V | W | X | Y | Z
All Terms

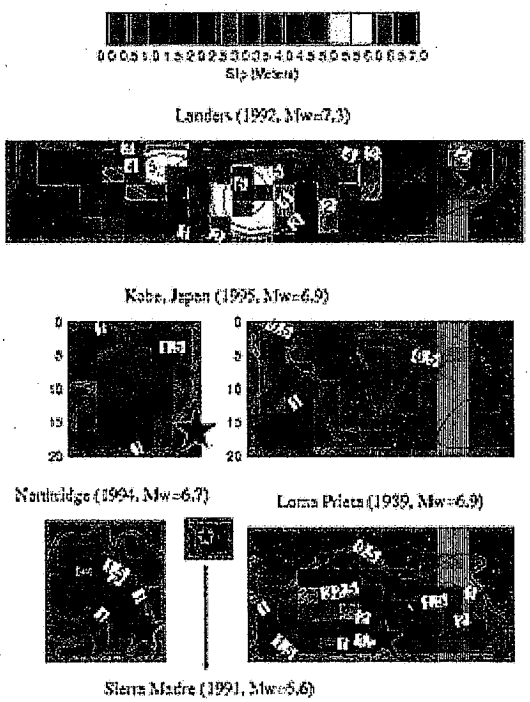
« magnetic polarity reversal

mainshock »

magnitude

The magnitude is a number that characterizes the relative size of an earthquake. Magnitude is based on measurement of the maximum motion recorded by a seismograph. Several scales have been defined, but the most commonly used are (1) local magnitude (ML), commonly referred to as "Richter magnitude," (2) surface-wave magnitude (Ms), (3) body-wave magnitude (Mb), and (4) moment magnitude (Mw). Scales 1-3 have limited range and applicability and do not satisfactorily measure the size of the largest earthquakes. The moment magnitude (Mw) scale, based on the concept of seismic moment, is uniformly applicable to all sizes of earthquakes but is more difficult to compute than the other types. All magnitude scales should yield approximately the same value for any given earthquake.

See also: Earthquake ABC & FAQ discussion.



Compare the fault area of the magnitude 7.3 (top) with that of the magnitude 5.6 (smallest one near the bottom).

USGS science for a changing world

Earthquake Hazards Program

Magnitude / Intensity Comparison

Magnitude and Intensity measure different characteristics of earthquakes. Magnitude measures the energy released at the source of the earthquake. Magnitude is determined from measurements on seismographs. Intensity measures the strength of shaking produced by the earthquake at a certain location. Intensity is determined from effects on people, human structures, and the natural environment.

The following table gives intensities that are typically observed at locations near the epicenter of earthquakes of different magnitudes.

Magnitude / Intensity Comparison

Magnitude	Typical Maximum Modified Mercalli Intensity
1.0 - 3.0	**I**
3.0 - 3.9	**II - III**
4.0 - 4.9	**IV - V**
5.0 - 5.9	**VI - VII**
6.0 - 6.9	**VII - IX**
7.0 and higher	**VIII** or higher

Abbreviated Modified Mercalli Intensity Scale

I. Not felt except by a very few under especially favorable conditions.

II. Felt only by a few persons at rest, especially on upper floors of buildings.

III. Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated.

IV. Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.

V. Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.

VI. Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.

VII. Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly

designed structures; some chimneys broken.

VIII. Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.

IX. Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.

X. Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.

XI. Few, if any (masonry) structures remain standing. Bridges destroyed. Rails bent greatly.

XII. Damage total. Lines of sight and level are distorted. Objects thrown into the air.

The ISDR Secretariat presents these basic definitions on disaster risk reduction in order to promote a common understanding on this subject, for use by the public, authorities and practitioners. The terms are based on a broad consideration of different international sources. This is a continuing effort to be reflected in future reviews, responding to a need expressed in several international venues, regional discussions and national commentary. Feedback from specialists and other practitioners to improve these definitions will be most welcome.

Acceptable risk

The level of loss a society or community considers acceptable given existing social, economic, political, cultural, technical and environmental conditions.

In engineering terms, acceptable risk is also used to assess structural and non-structural measures undertaken to reduce possible damage at a level which does not harm people and property, according to codes or "accepted practice" based, among other issues, on a known probability of hazard.

Biological hazard

Processes of organic origin or those conveyed by biological vectors, including exposure to pathogenic micro-organisms, toxins and bioactive substances, which may cause the loss of life or injury, property damage, social and economic disruption or environmental degradation.

Examples of biological hazards: outbreaks of epidemic diseases, plant or animal contagion, insect plagues and extensive infestations.

Building codes

Ordinances and regulations controlling the design, construction, materials, alteration and occupancy of any structure to insure human safety and welfare. Building codes include both technical and functional standards.

Capacity

A combination of all the strengths and resources available within a community, society or organization that can reduce the level of risk, or the effects of a disaster.

Capacity may include physical, institutional, social or economic means as well as skilled personal or collective attributes such as leadership and management. Capacity may also be described as capability.

Capacity building

Efforts aimed to develop human skills or societal infrastructures within a community or organization needed to reduce the level of risk.

In extended understanding, capacity building also includes development of institutional, financial, political and other resources, such as technology at different levels and sectors of the society.

Climate change

The climate of a place or region is changed if over an extended period (typically decades or longer) there is a statistically significant change in measurements of either the mean state or variability of the climate for that place or region.

Changes in climate may be due to natural processes or to persistent anthropogenic changes in atmosphere or in land use. Note that the definition of climate change used in the United Nations Framework Convention on Climate Change is more restricted, as it includes only those changes which are attributable directly or indirectly to human activity.

Coping capacity

The means by which people or organizations use available resources and abilities to face adverse consequences that could lead to a disaster.

In general, this involves managing resources, both in normal times as well as during crises or adverse conditions. The strengthening of coping capacities usually builds resilience to withstand the effects of natural and human-induced hazards.

Counter measures

All measures taken to counter and reduce disaster risk. They most commonly refer to engineering (structural) measures but can also include non-structural measures and tools

designed and employed to avoid or limit the adverse impact of natural hazards and related environmental and technological disasters.

Disaster

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 or society to cope using its own resources.

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.

Disaster risk management

The systematic process of using administrative decisions, organization, operational skills and capacities to implement policies, strategies and coping capacities of the society and communities to lessen the impacts of natural hazards and related environmental and technological disasters. This comprises all forms of activities, including structural and non-structural measures to avoid (prevention) or to limit (mitigation and preparedness) adverse effects of hazards.

Disaster risk reduction (disaster reduction)

The conceptual framework of elements considered with the possibilities to minimize vulnerabilities and disaster risks throughout a society, to avoid (prevention) or to limit (mitigation and preparedness) the adverse impacts of hazards, within the broad context of sustainable development.

The disaster risk reduction framework is composed of the following fields of action, as described in ISDR's publication 2002 "Living with Risk: a global review of disaster reduction initiatives", page 23:

- *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;*
- *Early warning systems including forecasting, dissemination of warnings, preparedness measures and reaction capacities.*

Early warning

The provision of timely and effective information, through identified institutions, that allows individuals exposed to a hazard to take action to avoid or reduce their risk and prepare for effective response.

Early warning systems include a chain of concerns, namely: understanding and mapping the hazard; monitoring and forecasting impending events; processing and disseminating understandable warnings to political authorities and the population, and undertaking appropriate and timely actions in response to the warnings.

Ecosystem

A complex set of relationships of living organisms functioning as a unit and interacting with their physical environment.

The boundaries of what could be called an ecosystem are somewhat arbitrary, depending on the focus of interest or study. Thus the extent of an ecosystem may range from very small spatial scales to, ultimately, the entire Earth (IPCC, 2001).

El Niño-Southern Oscillation (ENSO)

A complex interaction of the tropical Pacific Ocean and the global atmosphere that results in irregularly occurring episodes of changed ocean and weather patterns in many parts of the world, often with significant impacts, such as altered marine habitats, rainfall changes, floods, droughts, and changes in storm patterns.

The El Niño part of ENSO refers to the well-above-average ocean temperatures along the coasts of Ecuador, Peru and northern Chile and across the eastern equatorial Pacific Ocean, while the Southern Oscillation refers to the associated global patterns of changed atmospheric pressure and rainfall. La Niña is

approximately the opposite condition to El Niño. Each El Niño or La Niña episode usually lasts for several seasons.

Emergency management

The organization and management of resources and responsibilities for dealing with all aspects of emergencies, in particularly preparedness, response and rehabilitation.

Emergency management involves plans, structures and arrangements established to engage the normal endeavours of government, voluntary and private agencies in a comprehensive and coordinated way to respond to the whole spectrum of emergency needs. This is also known as disaster management.

Environmental impact assessment (EIA)

Studies undertaken in order to assess the effect on a specified environment of the introduction of any new factor, which may upset the current ecological balance.

EIA is a policy making tool that serves to provide evidence and analysis of environmental impacts of activities from conception to decision-making. It is utilised extensively in national programming and for international development assistance projects. An EIA must include a detailed risk assessment and provide alternatives solutions or options.

Environmental degradation

The reduction of the capacity of the environment to meet social and ecological objectives, and needs.

Potential effects are varied and may contribute to an increase in vulnerability and the frequency and intensity of natural hazards.

Some examples: land degradation, deforestation, desertification, wildland fires, loss of biodiversity, land, water and air pollution, climate change, sea level rise and ozone depletion.

Forecast

Definite statement or statistical estimate of the occurrence of a future event (UNESCO, WMO).

This term is used with different meanings in different disciplines.

Geological hazard

Natural earth processes or phenomena that may cause the loss of life or injury, property damage, social and economic disruption or environmental degradation.

Geological hazard includes internal earth processes or tectonic origin, such as earthquakes, geological fault activity, tsunamis, volcanic activity and emissions as well as external processes such as mass movements: landslides, rockslides, rock falls or avalanches, surfaces collapses, expansive soils and debris or mud flows.

Geological hazards can be single, sequential or combined in their origin and effects.

Geographic information systems (GIS)

Analysis that combine relational databases with spatial interpretation and outputs often in form of maps. A more elaborate definition is that of computer programmes for capturing, storing, checking, integrating, analysing and displaying data about the earth that is spatially referenced.

Geographical information systems are increasingly being utilised for hazard and vulnerability mapping and analysis, as well as for the application of disaster risk management measures.

Greenhouse gas (GHG)

A gas, such as water vapour, carbon dioxide, methane, chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs), that absorbs and re-emits infrared radiation, warming the earth's surface and contributing to climate change (UNEP, 1998).

Hazard

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 can include latent conditions that may represent future threats and can have different origins: natural (geological, hydrometeorological and biological) 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 characterised by its location, intensity, frequency and probability.

Hazard analysis
Identification, studies and monitoring of any hazard to determine its potential, origin, characteristics and behaviour.

Hydrometeorological hazards
Natural processes or phenomena of atmospheric, hydrological or oceanographic nature, which may cause the loss of life or injury, property damage, social and economic disruption or environmental degradation.

Hydrometeorological hazards include: floods, debris and mud floods; tropical cyclones, storm surges, thunder/hailstorms, rain and wind storms, blizzards and other severe storms; drought, desertification, wildland fires, temperature extremes, sand or dust storms; permafrost and snow or ice avalanches. Hydrometeorological hazards can be single, sequential or combined in their origin and effects.

La Niña
(see El Niño-Southern Oscillation).

Land-use planning
Branch of physical and socio-economic planning that determines the means and assesses the values or limitations of various options in which land is to be utilized, with the corresponding effects on different segments of the population or interests of a community taken into account in resulting decisions.

Land-use planning involves studies and mapping, analysis of environmental and hazard data, formulation of alternative land-use decisions and design of a long-range plan for different geographical and administrative scales.

Land-use planning can help to mitigate disasters and reduce risks by discouraging high-density settlements and construction of key installations in hazard-prone areas, control of population density and expansion, and in the siting of service routes for transport, power, water, sewage and other critical facilities.

Mitigation
Structural and non-structural measures undertaken to limit the adverse impact of natural hazards, environmental degradation and technological hazards.

Natural hazards
Natural processes or phenomena occurring in the biosphere that may constitute a damaging event.

Natural hazards can be classified by origin namely: geological, hydrometeorological or biological. Hazardous events can vary in magnitude or intensity, frequency, duration, area of extent, speed of onset, spatial dispersion and temporal spacing.

Preparedness
Activities and measures taken in advance to ensure effective response to the impact of hazards, including the issuance of timely and effective early warnings and the temporary evacuation of people and property from threatened locations.

Prevention
Activities to provide outright avoidance of the adverse impact of hazards and means to minimize 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, related to disaster risk reduction changing attitudes and behaviour contribute to promoting a "culture of prevention".

Public awareness
The processes of informing the general population, increasing levels of consciousness about risks and how people can act to reduce their exposure to hazards. This is particularly important for public officials in fulfilling their responsibilities to save lives and property in the event of a disaster.

Public awareness activities foster changes in behaviour leading towards a culture of risk reduction. This involves public information, dissemination, education, radio or television broadcasts, use of printed media, as well as, the establishment of information centres and networks and community and participation actions.

Public information
Information, facts and knowledge provided or learned as a result of research or study, available to be disseminated to the public.

Recovery
Decisions and actions taken after a disaster with a view to restoring or improving the pre-disaster living conditions of the stricken community, while encouraging and facilitating necessary adjustments to reduce disaster risk.

Recovery (rehabilitation and reconstruction) affords an opportunity to develop and apply disaster risk reduction measures.

Relief / response
The provision of assistance or intervention during or immediately after a disaster to meet the life preservation and basic subsistence needs of those people affected. It can be of an immediate, short-term, or protracted duration.

Resilience / resilient
The capacity of a system, community or society potentially exposed to hazards to adapt, by resisting or changing in order to reach and maintain an acceptable level of functioning and structure. This is determined by the degree to which the social system is capable of organizing itself to increase its capacity for learning from past disasters for better future protection and to improve risk reduction measures.

Retrofitting (or upgrading)
Reinforcement of structures to become more resistant and resilient to the forces of natural hazards.

Retrofitting involves consideration of changes in the mass, stiffness, damping, load path and ductility of materials, as well as radical changes such as the introduction of energy absorbing dampers and base isolation systems. Examples of retrofitting includes the consideration of wind loading to strengthen and minimize the wind force, or in earthquake prone areas, the strengthening of structures.

Risk
The probability of harmful consequences, or expected losses (deaths, injuries, property, livelihoods, economic activity disrupted or environment damaged) resulting from interactions between natural or human-induced hazards and vulnerable conditions.

Conventionally risk is expressed by the notation Risk = Hazards x Vulnerability. Some disciplines also include the concept of exposure to refer particularly to the physical aspects of vulnerability.

Beyond expressing a possibility of physical harm, it is crucial to recognize that risks are inherent or can be 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.

Risk assessment/analysis
A methodology to determine the nature and extent of risk by analysing 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.

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

Structural / non-structural measures
Structural measures refer to any physical construction to reduce or avoid possible impacts of hazards, which include engineering measures and construction of hazard-resistant and protective structures and infrastructure.

Non-structural measures refer to policies, awareness, knowledge development, public commitment, and methods and operating practices, including participatory mechanisms and the provision of information, which can reduce risk and related impacts.

Sustainable development

Development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It contains within it two key concepts: the concept of "needs", in particular the essential needs of the world's poor, to which overriding priority should be given; and the idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and the future needs. (Brundtland Commission, 1987).

Sustainable development is based on socio-cultural development, political stability and decorum, economic growth and ecosystem protection, which all relate to disaster risk reduction.

Technological hazards

Danger originating from technological or industrial accidents, dangerous procedures, infrastructure failures or certain human activities, which may cause the loss of life or injury, property damage, social and economic disruption or environmental degradation.

Some examples: industrial pollution, nuclear activities and radioactivity, toxic wastes, dam failures; transport, industrial or technological accidents (explosions, fires, spills).

Vulnerability

The conditions determined by physical, social, economic, and environmental factors or processes, which increase the susceptibility of a community to the impact of hazards.

For positive factors, which increase the ability of people to cope with hazards, see definition of capacity.

Wildland fire

Any fire occurring in vegetation areas regardless of ignition sources, damages or benefits.