adpc

Regional Training Manual on Disaster Risk Reduction for **Coastal Zone Managers**

with financial and technical contributions from

ISDR
International Strategy for Disaster Reduction

UNEP

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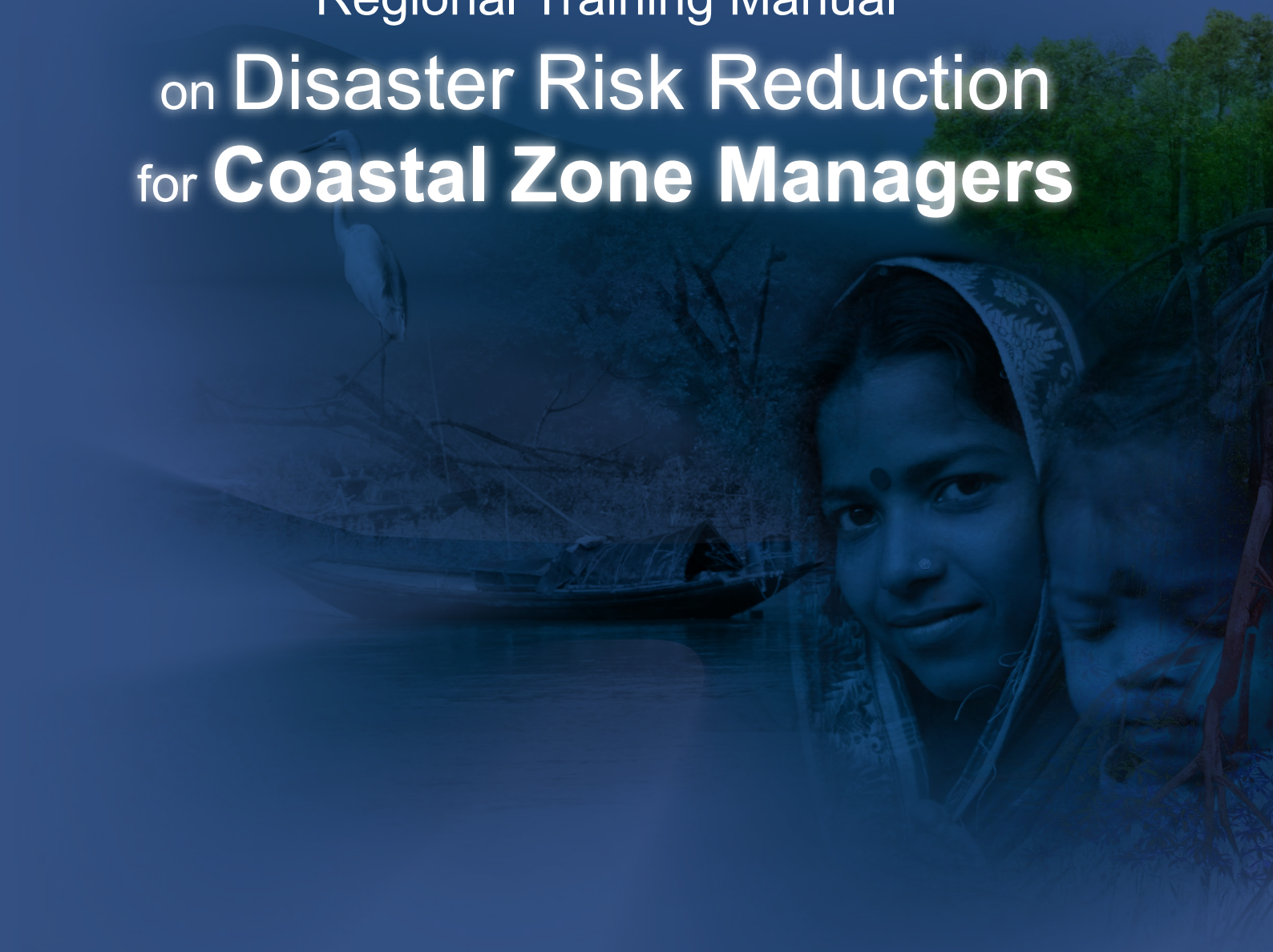

Acknowledgement

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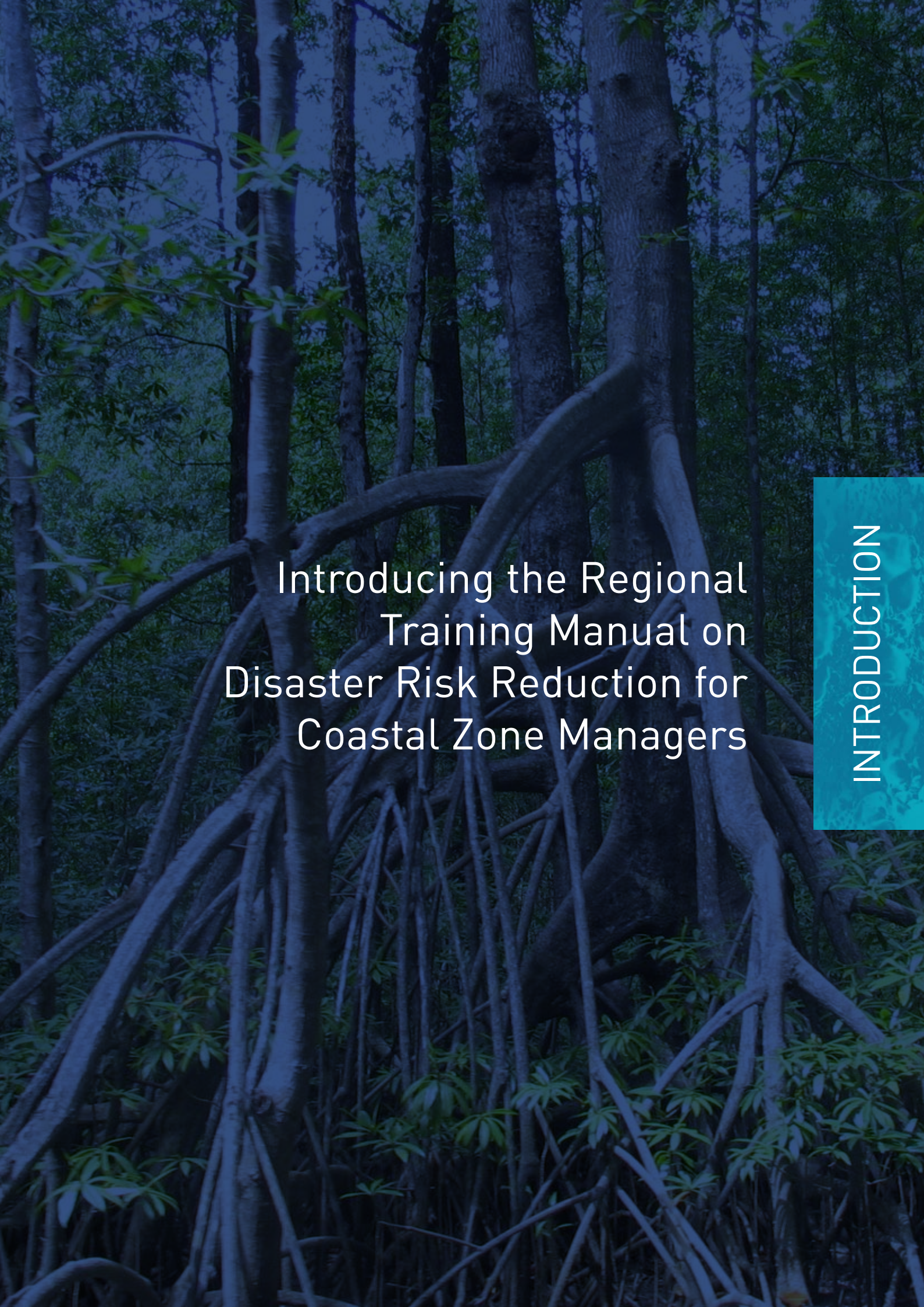
The team greatly appreciates the involvement, technical inputs and guidance provided in every step of the development of the Manual by Serena Fortuna from UNEP Regional Office for Asia and Pacific and the valuable inputs provided by Dr. Glenn Dolcemascolo from UNEP which laid the foundation for this Manual. Guidance provided by Mr. Abhilash Panda from UN/ISDR deserves special mention.

The team expresses sincere acknowledgement to the European Commission AIDCO Programme for the financial support in developing this important Regional Training Manual which is believed would be of great importance in building the capacity for reducing risk from natural hazards in coastal areas of Asia.

This Manual is developed by Loy Rego and Arghya Sinha Roy from ADPC. Support was provided by Peter Roberts and Alex Fowler from ADPC in finalizing the document and the presentations and Lowil Espada for design.



Introducing the Regional Training Manual on Disaster Risk Reduction for Coastal Zone Managers

Background

Asia is one of the region hardest hit by natural hazards and in which the vast populations settled in both urban and rural coastal areas are particularly vulnerable. Global climate change is expected to increase the frequency and intensity of climate related hazards (IPCC Fourth Assessment Report, 2007). Early warning systems and preparedness plans are necessary but are, in themselves, insufficient to reduce risk– additional measures must be taken to address underlying vulnerabilities. Healthy ecosystems play a vital role in this regard.

Coastal ecosystems and associated watersheds provide a wide range of services to coastal communities, including food provision, natural shoreline protection against storms and floods and flood regulation among others. These services are fundamental to building community resilience to coastal hazards, yet they are under threat from a variety of sources.

Thus protecting coastal ecosystems and reducing disaster risk in coastal communities requires the active participation of a broad cross section of stakeholders – the engagement of coastal zone managers and allied environmental professionals is essential for success.

The United Nations Environment Programme (UNEP) through financial support from the United Nations International Strategy for Disaster Reduction (UNISDR) and European Commission AIDCO programme has undertaken to build disaster risk reduction (DRR) capacities of coastal zone managers. The project works with stakeholders at regional and national level (India, Indonesia Sri Lanka and Maldives) and links to the Mangrove for Future (MFF), a multi-agency, multi-country initiative which works for healthy coastal ecosystems for a more prosperous and secure future for coastal communities'.

This manual has been prepared by the Asian Disaster Preparedness Center (ADPC) in partnership with UNEP and through close consultation with the national partners in the project countries and basing on the national training courses developed in the framework of the same project. This regional manual aims at building capacity of coastal zone managers to design and implement coastal development projects that enhance protection of lives and livelihoods while improving environmental quality and protecting ecosystem services. The manual also aims at enhancing the knowledge of DRR practitioners on the prospective services of healthy coastal ecosystems.

Objectives of the Training Course

This Training Manual on 'Disaster Risk Reduction for Coastal Zone Managers' is for use in regional training course on DRR for Coastal Zone Managers, aimed at building the capacity of government officials, NGOs, academia and other entities responsible for developing and implementing coastal zone management (CZM) programs/projects by introducing the issues and opportunities for integrating DRR into CZM projects. The knowledge shared through this training will help the participants in developing projects and regulations on coastal areas that incorporate DRR concerns and measures – but will not turn coastal managers into DRR experts. By being trained in this field, coastal zone managers will also better identify which kind of development projects would increase local vulnerabilities.

At the same time the course also aims at enhancing the awareness of DRR practitioners on the role healthy coastal ecosystems can play in disaster mitigation and prevention, emphasising the importance of adopting integrated coastal development planning (a combination of structural and non structural measures) for reducing risk.

At the end of the Training Course it is expected that the participants would be able to:

1. Identify risks from natural hazards which impact CZM projects and also improper coastal development processes which might lead to accumulation of risk in coastal areas;
2. Understand the conceptual framework of risk reduction;
3. Recognize various measures; structural and non structural, for risk reduction in coastal areas;
4. Apply the theory and use practical tools in integrating DRR in CZM plans and programmes; and
5. Develop a list of actions which they can undertake in their daily work programme in order to reduce the risk in coastal areas.

Content of the Regional Training Course

The course is structured in eight (8) modules. Hereunder is a brief description on each of the module.

Module 1: Introduction to the Course

The course would start with an introductory session, which would establish the importance of the course for the participants and the skills, technique and knowledge they would acquire at the end of the course. The rationale would be established through citing the impacts of natural hazards on coastal development projects as well as how improper planning and implementation of these projects could lead to increase in risk from natural hazards.

Module 2: Knowing the coast better with a DRR perspective

This module would explore two sides namely the importance of coastal development and the services/resources coastal ecosystem provides and at the same time the type of risk coastal areas face; risk arising from a combination of natural and human induced hazards including Climate Change (CC), as magnifying factors of hazards, clubbed with physical, social and economical vulnerabilities and limited capacity.

Module 3: Introducing DRR and its linkages with Climate Change Adaptation

This module would introduce the terminologies, concepts and framework for DRR by explaining the Hyogo Framework for Action (HFA) and its Five Priorities for Action. For each of the priorities, concepts would be explained through examples from coastal environment; systems, stakeholders and concerns. Linkages between Climate Change Adaptation (CCA) and DRR would be highlighted.

Module 4: Assessing the coastal risk from natural hazards

Undertaking risk assessment in itself is a complex exercise and needs to be carried out at various levels. This forms the first step if DRR needs to be integrated in coastal development programs and projects. While there are tools and techniques available, they need to be adapted in the context of coastal areas, data availability and capacity etc. Thus this Module would introduce the available tools for undertaking risk assessment and highlight the type of information required.

Module 5: Measures for DRR in coastal areas

This Module would introduce the various measures that could be adopted to reduce risk in coastal areas; structural man made, structural ecosystem based and non structural measures (policies, laws, plans, awareness, etc) and how to link all these in an integrated manner.

Module 6: Understanding the ground realities: Field Exercise

This Module would give a flavour of the ground realities to the participants by undertaking a field visit to a coastal area affected by natural or human induced hazard, interaction with

communities living in the area to understand their perception of risk and discussions with local agencies on existing systems and plans.

Module 7: Integrating DRR in CZM; linking Policy to Action

Through examples and case studies, this Module would help identify entry points for integrating DRR in CZM policies, plans, programs and projects, thus aiming at influencing the way coastal development projects are planned, designed and implemented with a strong component on disaster resilient development.

Module 8: Taking it back home; where to start from

Through this Module, participants would be able to draw up a list of actions which should be undertaken in their respective organizations to make sure the initiatives they undertake in coastal areas are disaster resilient and do not add to the risk. Some of these actions the participants could directly initiate on their return, where as for some they could only advocate for and raise awareness among their peers.

Course Schedule

Day	Module/Session	Duration
Day 1	Module 1: Introduction to the Course	
	Session 1.1: Knowing the Participants	30 minutes
	Session 1.2: Expectation Setting	30 minutes
	Session 1.3: Why this course? Impact of disasters on coastal development	60 minutes
	Session 1.4: Looking at the skills and building on them	45 minutes
	Module 2: Knowing the coast better with a DRR perspective	
	Session 2.1: Importance of CZM (Optional)	45 minutes
	Session 2.2: Understanding coastal ecosystem services	60 minutes
	Session 2.3: Valuation for ecosystem services (Optional)	60 minutes
Day 2	Module 2: Continued	
	Session 2.4: Understanding the coastal hazards	45 minutes
	Session 2.5: Recognizing the coastal vulnerabilities	60 minutes
	Session 2.6: Introduction to coastal climate change	60 minutes
	Session 2.7: Knowing the coastal risk	45 minutes
	Session 2.8: Stakeholders involved in coastal development	60 minutes
	Guest Speaker/Documentary screening (Optional)	
	Module 3: Introducing DRR and its linkages with Climate Change Adaptation	
	Session 3.1: Understanding the Terminologies	60 minutes
	Session 3.2: Framework for Disaster Risk Reduction	60 minutes
	Session 3.3: Linking DRR and CCA	60 minutes

Day	Module/Session	Duration
Day 3	Module 4: Assessing the Coastal Risk from Natural Hazards	
	Session 4.1: Undertaking Risk Assessments in Coastal Areas	60 minutes
	Session 4.2: Community based coastal risk assessment (Optional)	45 minutes
	Session 4.3: Risk Assessment- Hands on	180 minutes
	Session 4.4: Rapid Environmental Assessment in post disaster situation (Optional)	60 minutes
Day	**Module/Session**	**Duration**
Day 4	Module 5: Measures for DRR in coastal areas	
	Session 5.1: Structural measures- Man-made	60 minutes
	Session 5.2: Structural measures -Ecosystem based	75 minutes
	Session 5.3: Non structural measures for DRR	45 minutes
	Session 5.4: Integrated approach for reducing risk in coastal areas	60 minutes
	Guest Speaker/Documentary screening (Optional)	
Day 5 and 6	Module 6: Understanding the Ground Realities. Field Exercise	
	Session 6.1: Field Work on Risk Assessment (Optional)	2 days
Day 7	Module: 7: Integrating DRR in CZM; Linking Policy to Action	
	Session 7.1: Integrating DRR into National Coastal Zone Policy and Plans (Optional)	30 minutes
	Session 7.2: Integrating DRR into Coastal Development Programs and Projects	30 minutes
	Session 7.3: Integrating DRR into Community development projects in Coastal Areas (Optional)	30 minutes
	Session 7.4: Putting learning's from the field into programs	120 minutes
	Session 7.4: Environment in post-disaster context (Optional)	45 minutes
	Module 8: Taking it back home; where to start from	
	Session 8.1: Defining next steps; formulating actions	120 minutes
	Session 8.2: Course Evaluation	60 minutes

Course Participants

The course is developed specifically for practitioners from the following agencies/ background:

- Government agencies at national and sub-national levels working in the field of CZM
- National research and technical institutes/universities involved in CZM
- NGOs/other agencies working in coastal areas on development projects
- Government agencies, national research & technical institutes, NGOs working in DRR
- The course would also be open for representatives from private sector investing in coastal areas

This course will be helpful for practitioners who are involved in:

- Developing and implementing CZM plans and projects
- Undertaking research in coastal areas, the results of which influence coastal area development
- Implementing community development projects in coastal areas
- Implementing DRR activities in coastal areas

Proposed profile of trainers

It is proposed that the training be delivered by a range of trainers drawn from various partner agencies with respective expertise on DRR, ecosystem and environmental management and CZM and working closely with Governments at national and sub national levels in various countries in Asia. It is proposed to draw the pool of trainers with experience in delivering training along with involvement in programmes and projects on DRR and CZM.

Usage of this Training Manual

This manual is developed aimed at conducting training at a regional level on the 'Disaster Risk Reduction for Coastal Zone Managers'. It is intended to act primarily as a participant's handbook during the delivery of the training course, as a companion document to the power point presentations and compilation of reading material for each of the training session, both of which are provided in the accompanying CD.

In addition, though it also provides suggested approaches for delivery of each session under the course and thus covering some elements of a facilitator's guide, its objective is not to act as a manual for Training of Trainers.

It is believed that the participants attending the training course would find this manual handy in terms of getting introduced to key concepts for each of the session, reinforced with case studies from the region.

Apart from the Introduction, the Manual is structured into three (3) Sections:

- Section 1: Training Modules
- Section 2: Terminologies
- Section 3: References and Reading Materials

A brief description on each of the Section is provided below:

Section 1; Training Module: This section forms the main body of the manual. In this section, each of the session under the eight (8) training modules are detailed out in terms of Session Objectives, Key Terminologies, Key Concepts and References. The paragraphs on Key Concepts forms the base of the session and attempts to summarize the information which would be delivered by the trainer in the session. It is to be noted; the concepts are explained within the boundary of this training course and do not attempt to provide a comprehensive explanation on the said subject as a whole. In this context, it is to be emphasized that the content of the sessions are largely adopted from the National Training Courses being developed under this initiative in India, Indonesia and Sri Lanka and from existing literature and studies, and is aimed to be used for purely educational purposes.

In addition, wherever applicable Case Studies are provided to elaborate the key concepts which the session aims to convey to the participants. An attempt has been made to capture case studies from countries in the region for the sake of familiarity of the participants who are expected to be from the Asian region.

Statistics and information to substantiate the argument/message being conveyed through the session are presented (wherever applicable) under the heading of Quick Facts.

Session Delivery; as explained earlier, though the purpose of this manual is not to act as a facilitator's guide, it does provide possible approaches for delivering each of the session. The suggested approaches are primarily of two types; power point presentations and group exercise. The power point presentations for each of the session is not included in the printed version of the manual and provided in the accompanying CD. The suggested group exercises are provided under this section of the manual. However, it is to be noted that the approach provided in this manual for delivery of each session is a suggested approach and would need to be adapted by the session facilitator according to her/his need and the profile of the actual participants.

Both DRR and CZM being subjects encompassing a broad range of stakeholders and requiring a cross sectoral approach, it is highly recommended that wherever possible external resource persons should be invited from national stakeholders and partner agencies for delivering respective sessions. Considering the vast experiences of the external resource persons, it is believed their involvement in the training course would help in making the delivery richer and also in subsequent revisions of the course materials. In such cases where external resource persons would be engaged in delivering a particular session, the proposed content of this manual corresponding to the session should be provided to the external resource person as suggested outline and the final content should be left to the resource person for detailing.

Section 2; Terminologies: Though each of the session described under Section 1 of this manual provides definitions of key terms which would be discussed in the particular session, this section provides a detailed glossary of terms on the broader subject of DRR, CC and CZM.

Section 3; References and Reading Materials: Though the key concepts under each of the session (in Section 1) attempts to provide a brief summary of information available on the related subject, this Section attempts to provide a compilation of 3 to 5 key documents relevant to the module which would provide the participant with a better understanding of the topic. The documents compiled range from theory, research, case studies etc. In some cases they are relevant abstract from larger documents with the reference of the original document provided. The purpose of the compilation is purely educational. To reduce the size and the carbon footprint of this manual, only the complete list of reading materials is included in the printed version, while the reading material is included only in the accompanying CD.

SECTION_1

Training Modules

Module 1
Introduction to the Course

Modular Learning Objectives

At the end of the Module the participants would be able to:

- Know each other and the resource persons better;
- List out their expectations from this training course;
- Understand the importance of this course and how it would help in their daily work area; and
- Discuss the skills required for developing and implementing disaster resilient CZM programs/projects

Sessions

This Module would consist of four (4) sessions as follows:

Session 1.1. Knowing the Participants
Session 1.2 Expectation Setting
Session 1.3 Why this course? Impact of disasters on coastal development
Session 1.4 Looking at the skills and building on them

Session_1.1 Knowing the Participants

Session Learning Objective

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

Session Duration

Exercise: 30 minutes
Total: 30 minutes

Session Delivery

This session would be delivered through an exercise involving each of the participants.

Materials Required: Paper, markers, masking tape
Instructions:

- Provide each participant with a piece of paper and a marker and ask them to write their names on the top and to finish the statement, "I am...," using six different endings.
- Ask the participants to attach their papers to their chests with masking tape and then walk around the room and read each other's statements.
- Suggest that people spend at least thirty seconds talking with one another.
- When the exercise has been completed, the "I am" sheets can be taped to the wall as a "Group Gallery". If you have photos of participants these can also be added.

Session_1.2 Expectation Setting

Session Learning Objective

At the end of the session the participants would be able to list out their expectations from this training course

Session Duration

Exercise: 30 minutes
Total: 30 minutes

Session Delivery

This session would be delivered through an exercise involving each of the participants.

Materials required: Coloured card papers, Tapes, Board
Instructions:

- Provide each participant with 3 pieces of coloured card paper and request to write their expectation from the Training Course.
- Give around 10 minutes to the participants to write the expectations, after which each participant is requested to read out the expectations which are to be grouped by the facilitator under specific categories such as 'To learn tools and techniques', 'Approaches', 'Learn from examples' etc.
- After all the expectations are grouped, it is the task of the facilitator to summarise the expectations.
- The idea is to keep the expectation put up in a board on one side of the room and to revisit them during the last day of the course in order to understand how much of it has been met by the course.

Session_1.3 Why this course? Impacts of disasters on coastal development

Session Learning Objectives

At the end of the session the participants would be able to understand the importance of this course and how it would help in their daily work area

Session Duration

Power point Presentation: 45 minutes
Discussion: 15 minutes
Total: 60 minutes

Key Concepts

This session would cover the following key concepts:

1. More than half of the world's population lives within 100 km of the shore-line – a figure which could rise to three quarters by the year 2020.
2. In addition, in island and archipelagic nations, national economies and people's livelihoods are inextricably linked with the coasts and the seas. In these countries, the vast living and non-living resources available in the coastal seas provide the primary resources necessary for industrial development within the coastal lowlands.
3. Coastal areas also provide a variety of services, as a result of the processes that occur in the various coastal systems. Examples include shoreline protection, the maintenance of marine biodiversity and water quality, as well as opportunities for transportation, recreation and tourism.
4. Coastal areas are also the preferred sites for urbanization with population density in urbanized coastal cities being among the highest in the world.
5. Coasts are major social and economic development zones that contribute significantly to national economies. In fact, a large part of the gross domestic product (GDP) of the coastal nations is derived from coastal and maritime industries. In some coastal nations, coastal and marine environments contribute an estimated 20 to 60 percent of the GDP.

6. However, the coastal areas are frequently impacted by natural hazards such as cyclones, floods, storm surges and tsunamis. For example the coastal plains of the Philippines, Vietnam and Japan face tropical cyclone every year. Similarly, during La Nina episodes, the frequency and fury of typhoons are heightened, accompanied by devastating floods. The Orissa Super Cyclone in India, 1999, Indian Ocean Tsunami of 2004, Cyclone Sidr in Bangladesh, 2007 and the Cyclone Nargis in Myanmar, 2008; highlights the impacts on coastal development and its effect on lives, livelihoods and the coastal ecosystem.
7. The 2004 Indian Ocean tsunami specifically highlights the impact of coastal hazards on social and economic development of the countries. Apart from the horrific number of lives lost in the countries such as India, Indonesia, Maldives, Sri Lanka and Thailand, the tsunami significantly affected the economy of the countries and especially the ones dependant on coast intense livelihoods namely fisheries and tourism. In, fact in areas such as Banda Aceh, the Indian Ocean tsunami is estimated to have increased the proportion of people living below the poverty line from 30 per cent to 50 per cent.
8. Vietnam with its 3200km of coastline now ranks in the top 5 for countries that will be hardest hit by climate change. It is estimated that a five meter increase in sea level would flood 16 per cent of Vietnam and threaten 35 per cent of its population.
9. The natural hazards in the coastal areas can be divided into discrete (occasional) coastal events and those due to continuing changes over the long period. Table 1.3.1 shows the classification of natural hazards in the coast:

Table 1.3.1 Classification of coastal natural hazards

Discrete coastal events	Continuing changes over the long-term
Severe waves	Relative sea-level change
Storm surges	Coastal erosion
Tsunamis	Saline intrusion
Coastal earthquakes	

(Source: Arthurton, 1998)

10. Along with natural hazards, at times improper development poses threat to coastal area and lead to creation of risk. For example flooding in Mekong Delta is often caused by reduced drainage due to expansion of agricultural activities into wetland areas that previously served an important drainage function.
11. The above scenarios have two fold implications. Firstly, the hazards itself has impacts on the programs/projects which coastal zone managers work on and hence slows down development. On the other hand, when development activities themselves increase the chance of disasters in the area, they create severe risk to the population for whom the development was actually intended., Thus risk reduction should be factored in all CZM programs/projects, so that they are less impacted by disasters and also not contribute to any kind of growing risk.

References for Key Concepts

- Paragraph 1 to 5 and 9; Thia-Eng Chua; The Dynamics of Integrated Coastal Management
- Paragraph 6; Reducing the risk of disasters-helping to achieve sustainable poverty reduction in a vulnerable world: A policy paper; DFID, 2006
- Paragraph 8; The World Bank
- Paragraph 10; Tools for Mainstreaming Disaster Risk Reduction, Guidance Notes for Development Organisations, ProVention Consortium, 2007

Case Study

The 2004 Tsunami

The significant damage statistics of the Indian Ocean Tsunami include the following:

Water and Soil Contamination: Water supplies from ground water, boreholes and aquifers were either infiltrated by seawater and (or) by sewage because of damage to sanitation facilities. In Sri Lanka, all the 62,000 freshwater wells are now contaminated with salt and bacteria. In Aceh, 28,000 ha of coastal irrigation have been affected. Somalia's groundwater is infiltrated by hazardous waste which seeped from damaged coastal dump sites. Up to 90 percent of toilets in the Maldives were lost.

Soil Fertility has also been affected, with reports of rice crops yellowing in the western islands of Indonesia within three weeks of the disaster. In Victoria, the Seychelles, the soils now have a salt content which is double the amount that plants on the islands can tolerate. In Thailand, 20,000 ha were inundated by seawater, damaging 1,500 ha of agricultural land.

Huge amounts of waste. Solid debris, rubble and hazardous waste remain a major concern. Banda Aceh has to dispose of 7 to 10 million cubic meters of wastes. In the Phi Phi Islands, Thailand, only about 13,000 tonnes have so far been collected from estimated total debris of 35,000 tonnes.

Somalia, which allowed the dumping of nuclear and other hazardous waste for as little as USD 2.50 per ton, must now grapple with health consequences of disturbed wastes. Coastal communities in North Hobyo and Warsheik, south of Benadir will have to bear this additional grave concern.

Impacts on livelihoods. Tourism and fisheries were particularly badly affected. In Thailand, 315 hotels and 234 restaurants were totally or partially destroyed. In the Maldives, 87 resorts reported losses of over USD 100 million. Sri Lanka's fishing community's sustained damage to 29,700 fishing boats along with gear and nest. In the Maldives, apart from damaged fishing boats, 374 fish processors lost equipment while two fishery institutions suffered damage.

(Source; UNEP, 2005)

The Orissa ordeal / Orissa saga

The 1999 super cyclone also known as cyclone 05 B / Paradeep cyclone, hit the Orissa coast at 250 km /hour. The cyclone triggered torrential rain over southeast India, causing record breaking flooding in the low-lying areas. The storm surge of about 26 feet (8 meters) struck the coast of Orissa traveling up to 20 km inland. 17,110 km_ of crops were destroyed, and an additional 90 million trees were either uprooted or destroyed. Around 275,000 homes were damaged, leaving 1.67 million people homeless. Another 19.5 million people were affected by the super cyclone to some degree. Over 10,000 people died. The fatality of domestic animals was around 2.5 million. With this around 5 million farmers lost their livelihood. The estimated damage across fourteen affected districts in India was 20,000 crores of Indian National Rupees. It affected places like Bhubaneswar and Nayagarh, which were never traditionally cyclone-prone.

Orissa sorrow seems to be endless. While the 2001 drought parched fields in coastal districts, the unprecedented floods in 2001 submerged 25 of the State's 30 districts. Many of these areas had never witnessed floods before. Orissa has experienced around 952 small and big cyclones and 451 tornadoes between 1891 and 1970. From 1901 to 1981 there were 380 cyclones, of which 272 resulted from depressions in the Bay of Bengal. Twenty-nine of these cyclones were devastating.

(Source: National Training Course on DRR for Coastal Zone Managers, CEE, India, 2009)

Session Delivery

Power point Presentation (provided in the attached CD)

Discussions: Participants would be requested to share experiences of hazards affecting the coastal area they come from. The discussion would highlight the importance of considering hazards with frequent likely return period and the ones which is bringing about continuous change over the long-term. Following questions could be posed to facilitate the discussion:

- What kind of hazards does the coast you come from face?
- Are these hazards frequent?
- What is the greatest impact of these hazards?
- Are there factors due to which the impacts of these hazards are increased?
- Are their measures being taken to reduce these impacts?
- Can the work in which you are involved, help reduce some of the risk from these hazards?

Session_1.4 Looking at the skills and building on them

Session Learning Objectives

At the end of the session the participants would be able to discuss the tasks undertaken by a coastal zone manager for developing and implementing CZM projects and have a better understanding of the knowledge and skills they would acquire at the end of this course which would help in integrating DRR in their task list

Session Duration

Group Exercise: 25 minutes
Presentation by groups: 20 minutes
Total: 45 minutes

Session Delivery

Group Exercise: Materials required: Paper, markers
Instructions:

- Divide the participants into three groups
- Give each group a specific topics for example
  - Development of Coastal Area Plan in a cyclone prone coast
  - Building a sea wall along the coast with no back waters
  - Planting casuarinas on sand dunes along the coast
- Request the participants to list out 2 key tasks for the topic
- Against each task, identify the knowledge required and skills needed
- Identify the gaps in terms of knowledge and skills and discuss the additional knowledge and skill they expect to gain at the end of this course which would help in fulfilling the gaps
- Provide the groups with the template as shown in Table 1.4.1 below.

Table 1.4.1 Group Exercise

Key Task	Knowledge required	Skills Needed	Existing Gaps	Recommendations

Module 2
Knowing the coast better with a DRR perspective

Modular Learning Objectives:

At the end of the Module the participants would be able to:

- Recognize the importance of coastal area and its management in the context of overall development of the geographical area (country/province/cities);
- Appreciate the importance of services the coastal ecosystem provides with special focus to reduce risk and recognize the need of economic valuation of coastal ecosystem services;
- Discuss the different types of coastal hazards; natural and human induced and the types of vulnerabilities specific to coastal areas and recognize the factors that create risk from natural hazards in coastal areas;
- Discuss the causes and impacts of climate change especially in the context of coastal area and as factor contributing to coastal risk; and
- Discuss the various stakeholders involved in a typical CZM program/project and the role each of them play/could play in reducing or creating risk

Sessions

This Module would consist of eight (8) sessions as follows:
Session 2.1: Importance of CZM (Optional)
Session 2.2: Understanding coastal ecosystem services
Session 2.3: Valuation of ecosystem services (Optional)
Session 2.4: Understanding the coastal hazards
Session 2.5: Recognizing the coastal vulnerabilities
Session 2.6: Introduction to coastal Climate Change
Session 2.7: Knowing the coastal risk
Session 2.8: Stakeholders involved in coastal development

Guest Speaker/Documentary screening (Optional)

Session_2.1 Importance of Coastal Zone Management

Session learning Objectives

At the end of the session the participants would be able to:

- Understand what is meant by coastal zone and basic concepts on Coastal Zone Management. This basic understanding would help in subsequent sessions.
- Recognise the importance of coastal zone for the overall development of an area.

Session Duration

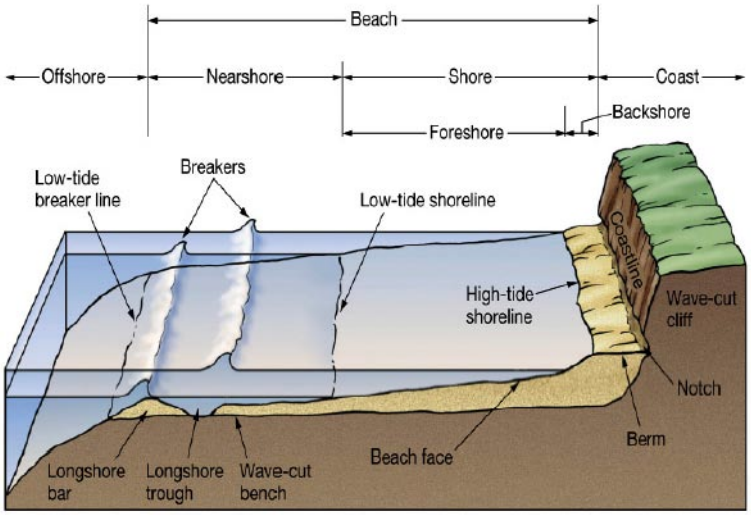
Power point Presentation: 30 minutes
Discussion: 15 minutes
Total: 45 minutes

Key Terminologies

- Coastal zone refers to the transitional region between the land and the ocean. The transitional refers to the two main environments, terrestrial and marine, and their main influences to coastal zone. In the coastal zone, the terrestrial environment influences the marine environment and vice versa.(Source: B. Carter, Coastal environments: an introduction to the physical, ecological, and cultural systems of coastlines, 1988)

Coastal zone covers coast, beach or shore and near shore zone. Figure 2.1.1 defines the various physical characteristics of the area. The seaward area beyond the coastal area is known as the offshore, where the oceanic influence is predominant. The area beyond the backshore in the landward direction is known as the coast. The coastal region extends inland in several ways including tidal mark, tidal influence, salinity mark and seaward extent of the permanent vegetation. The characteristics of this region are marked by the direct physical influence (tidal, salinity, coastal flooding) of coastal waters, the inland boundary of a local unit of Government, or all lands, the use of which may have a direct and significant impact on coastal waters.

Figure 2.1.1 Physical characteristics of coastal zone

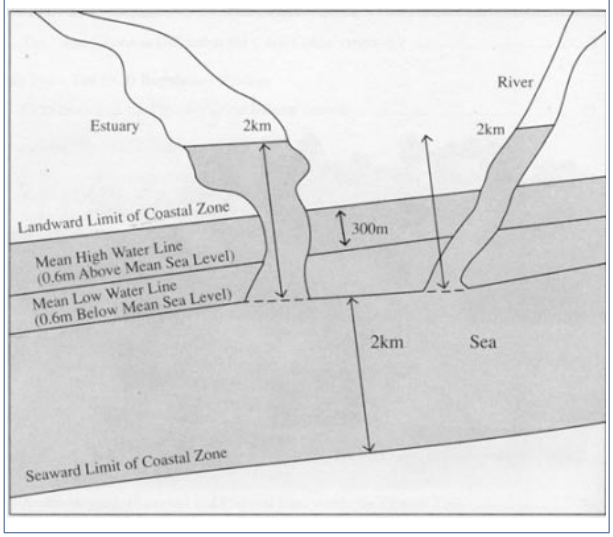


(Source: Millersville University of Pennsylvania, Lecture handout on "The Coastal Ocean", Course ESCI 104, vol. 2006, (2006))

To explain the definition, an example of coastal zone jurisdiction of Sri Lanka is provided below in figure 2.1.2.

- Integrated Coastal Management (ICM) is a natural resources and environmental management framework which employs an integrative, holistic approach and an interactive planning process in addressing the complex management issues in the coastal areas. (Source: Thia-Eng Chua; The Dynamics of Integrated Coastal Management)

Figure 2.1.2 Coastal jurisdiction of Sri Lanka



(Source, National Training Course on DRR for Coastal Zone Management, Coast Conservation Department, Sri Lanka, 2009)

Key Concepts

This session would cover the following concepts:

1. Different countries have different definitions for coastal zone. *For example in Bangladesh three main criteria are used to delineate coastal zones; tidal in fluctuations, salinity and cyclone and storm surge risk. Using these criteria, the coastal zone of Bangladesh consists of the Exclusive*

Economic Zone and 19 districts. Out of these, 12 districts demonstrate all three of the criteria and are defined as Exposed Coast. The remaining seven districts, where one or two of the criteria are observed, are defined as Interior Coast. (Source: Integrated Coastal Zone Management Plan, Government of Bangladesh)

On the other hand as explained earlier; *in Sri Lanka the term "coastal area" is defined as the 2 km wide band of ocean and an adjoining strip of land extending 300 m inland. (Source; Coast Conservation Act, Government of Sri Lanka)*

In Indonesia, the coastal zone is defined as *transition zone between land based and marine ecosystem which is affected by change from land and sea (Source; Law number 27 Year 2007 of Republic of Indonesia)*

2. Being the transitional region between the land and the ocean, the coastal zone is a unique system because it is subjected to dynamic influences from land and ocean ecosystems. Each ecosystem has its specific characteristic and the interaction between these remains ever changing with natural fluctuation in the biological, chemical and geological attributes. The complex and dynamic character of the coastal zone has the physical action on the area, as well as the interaction of three bio-ecological systems: land and sea, sea and air, and sea and sediments. Table 2.1.1 below shows the importance of coastal areas in Indonesia.
3. The uniqueness makes the coastal zone one of most productive ecosystems which abounds with natural resources, and is often considered highly scenic. The coastal zone has several valuable and important resources both in economic and biological terms, such as coral reefs, mangroves, and sea-grass beds. These resources provide numerous functions and services to support a variety of livelihoods and provide the backbone to many local economies. *For example; "in Sri Lanka the Coastal Zone covers approximately 24% of the land area with 32% of the population residing in it. It includes 65% of the urbanized land area with the principal road and rail transport infrastructure, commercial ports, fishery harbours and anchorages. 65% of the industrial output, 80% of tourism related infrastructure and 80% of fish production comes from the coastal zone". (Source, National Training Course on DRR for Coastal Zone Management, Coast Conservation Department, Sri Lanka, 2009)*
4. Coastal zones have been used for different purposes including tourism, fisheries, transportation, mining, and communication. Table 2.1.2 shows the statistics of India's coastal fishing community, emphasizing the importance of coastal livelihoods.

Table 2.1.1 Facts on Indonesian Coastal Area

Parameter	Unit of measurement	Notes
Total number of island	17,508	5 major island: Sumatra, Java, Sulawesi, Borneo, and New Guinea; 30 groups of smaller island (Indonesian Naval Hydro-Oceanographic)
Coastline length (baseline)	80.791 km	The actual length of the Indonesian coastline may be about 204.000 km (Astuti et.al, 1994)
Total land area	1.926.337 km2	24.4% of total area under Indonesian jurisdiction
Area of archipelagic (inner) seas	2.820.000 km2	35.7% of total area under Indonesian jurisdiction
Area of territorial (12 nm zone) sea	420.000 km2	5.3% of total area under Indonesian jurisdiction
Continental shelf area	1.500.000 km2	19% of total area under Indonesian jurisdiction
Area of EEZ (Exclusive Economic Zone)	2.730.000 km2	34.6% of total area under Indonesian jurisdiction
Total area of national jurisdiction	7.892.350 km2	81% of total area under Indonesian jurisdiction (Indonesian Naval Hydro-Oceanographic)

(Source; Tomascik, Mah, Nontji and Moosa, 1997; http://www.asianinfo.org/asianinfo/indonesia/pro-geography.htm)

5. The multiple functions and services supported by the coastal zone have lead to highly intensive exploration and exploitation. These multiple uses, combined with rapid economic and industrial growth in recent decades, have attracted an increasing percentage of the population to live in coastal areas. *For example statistics show that coastal systems are experiencing growing population and exploitation pressures; nearly 40 per cent of the world population lives in this thin fringe of land (Source; Population, Consumption and the Environment, www.pcebase.org).* In Indonesia, 60 million people or 30 per cent of the total population lives in the coastal areas. This increased population has led to significant impacts on the coastal zone.
6. Because of the topography the coastal areas are also frequented by natural hazards and the impact of which is only increased with the growing over exploitation of the coastal resources.
7. Equally of importance is wide range of stakeholders which includes the communities living on the coast, population whose livelihood is dependent on the coast, the managers responsible for managing the coast, the policy makers, natural and social scientist etc. For example Table 2.1.3 shows the range of government agencies involved in managing resources in coast of India. The interaction between the various stakeholders is complex and often not limited to administrative boundaries of coastal zone. *For example in most coastal areas of Indonesia, there has been a lack of integration and regulation of the diverse activities which take place in the coastal zone. This has resulted in resource-use conflicts, severe resource overexploitation, widespread environmental degradation, and social hardship. (Source; Tomas Tamascik, 1997)*

Table 2.1.2 Facts on Indian coastal fishing community

Coastline	8118 km
Coastal States	09
Coastal Districts	65 (Source: 2001 census)
Area of coastal districts	379,610 km2
Number of marine fishing villages	3638
Density population in coastal districts	455 (Source: 2001 census)
Coastal population	10 million > 200 million (within 50 km of the coastline)
Marine fisherman population	3 million
Marine fishermen household	0.5 million
Marine fish production	2.66 million tons (50 percent traditional/near shore waters)
Number of active fishermen	1.03 million
Average number of seagoing fishermen per village	262
Average number of fishermen per village	825
Fish landing centres	2251

(Source; National Training Course on DRR for Coastal Zone Managers; CEE, India, 2009)

Table 2.1.3 Range of agencies involved in managing coastal resources in India

Other Department/ Agency	Responsibility
Ministry of Agriculture	Fisheries Management, Aquaculture
Ministry of Commerce	Marine Products, Special Economic Zones
Ministry of Tourism	Tourism Development
Ministry of Urban Development	Town and Country Planning
Ministry of Home	Disaster Management
Ministry of Defence	Oil Pollution, Poaching etc.
Ministry of Surface Transport	Ports and Harbours
Ministry of Industries	Coastal Industries
Ministry of Mines	Coastal and offshore mining
Ministry of Petroleum and Natural Gas	Exploration of Oil and Natural Gas

(Source: National Training Course on DRR for Coastal Zone Managers; CEE, India, 2009)

8. Since the coastal resources provide numerous services their management should ensure sustainable environmental, social and economical needs, and should be an integrated approach. The coastal zone will remain productive only if there is a holistic and comprehensive approach such as the Integrated Coastal Management (ICM). This approach provides a conceptual framework for ecologically sustainable use of coastal resources, thus meeting the overall objective of ICM which is to provide for the best long-term and sustained use of coastal natural resources and for perpetual maintenance of the most beneficial natural environment. ICM also incorporates modern principles of planning and resource management, intensive information bases and interdisciplinary processes toward an effective general framework for dealing with conflicts arising from interactions of the various uses of coastal areas.
9. Thus effective CZM requires a close coordination and working between various stakeholders involving the government line agencies, research institutes, NGOs and the communities.

References for Key Concepts

- Paragraph 2,3 and 8; Making decentralised coastal zone management work for the South east Asia region: comparative perspectives, Siry, 2006-2007

Quick Facts

Importance of coastal zones to humans

- Coastal areas comprise 20% of the Earth's surface yet contain over 50 percent of the entire human population. By the year 2025, coastal populations are expected to account for 75% of the total world population.
- More than 70% of the world's megacities (greater than 8 million inhabitants) are located in coastal areas.
- Average human population density in coastal areas is about 80 persons /km2.
  (Source: Ocean Info Pack, World Ocean Network)

In spite of its importance

- 1/3 of coastal regions run a high risk of degradation, especially from infrastructure development and pollution. In 4/7 of coastal regions, the degradation is increasing.
- Asia is the second most threatened regions with 69 percent of their coastal ecosystems at risk.
- In Southeast Asia, more than 80 % of the most species-rich coral reefs of the world are threatened by coastal development and fishing pressures, and over half are at high risk.
- In Southeast Asia, 20 to 60 % of sea-grass beds have been lost.
  (Source: Ocean Info Pack, World Ocean Network)

Session Delivery

Power point Presentation (provided in the attached CD)

Discussions:

Participants would be requested to share details of the coast they come from/work in. The discussion could focus on the following:

- What is the definition of the coast in the area they come from?
- Is there any specific topographic feature in the area?
- What are the economic activities in the area?

Session_2.2 Understanding coastal ecosystem services

Session learning Objectives

At the end of the session the participants would be able to appreciate the importance of services the coastal ecosystem provides and understand how these services especially provides a protective role.

Session Duration

Presentation: 40 minutes
Discussion: 20 minutes
Total: 60 minutes

Key Terminologoes

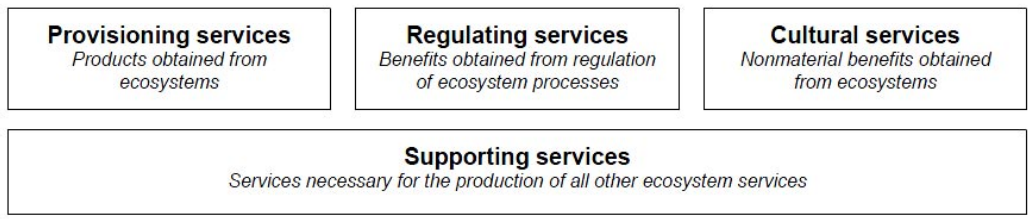
- Ecosystems: Dynamic complexes of plant, animal, and microorganism communities and the non-living environment, interacting as functional units. (Source; Millennium Ecosystem Assessment, 2003)
- Ecosystem services: The benefits people obtain from ecosystems. These include provisioning services such as food and water; regulating services such as flood and disease control; cultural services such as spiritual, recreational, and cultural benefits; and supporting services such as nutrient cycling that maintain the conditions for life on Earth. The concept 'ecosystem goods and services' is synonymous with ecosystem services. (Source; Global Environment Outlook (GEO) 4 environment for development, United Nations Environment Programme, 2007)
- Ecosystem Approach: A strategy for the integrated management of land, water, and living resources that promotes conservation and sustainable use. An ecosystem approach is based on the application of appropriate scientific methods focused on levels of biological organization, which encompass the essential structure, processes, functions, and interactions among organisms and their environment. It recognizes that humans, with their cultural diversity, are an integral component of many ecosystems. (Source; Global Environment Outlook (GEO) 4 environment for development, United Nations Environment Programme, 2007)

Key Concepts

This session would cover the following concepts:

1 The Millennium Ecosystem Assessment classifies the services that ecosystems can provide into four broad categories: provisioning services, regulating services, cultural services, and supporting services (Figure 2.2.1). This typology separates services along functional lines. These categories illustrate the diverse ways in which ecosystems contribute to human welfare.

Figure 2.2.1 Services provided by ecosystem



Source: Millennium Ecosystem Assessment, 2003.

2. Figure 2.2.2 shows the main ecosystem types recognized by the Millennium Ecosystem Assessment and the principal services that each provides. The services provided by the Coastal ecosystem are highlighted in Blue and Red and it emphasizes the fact that one of the important regulatory role the coastal ecosystem plays is reduction of natural hazard.

Figure 2.2.2 Types of ecosystem and services provided by each

	Ecosystem								
Ecosystem service	*Cultivated*	*Dryland*	*Forest*	*Urban*	*Inland water*	*Coastal*	*Marine*	*Polar*	*Mountain*
Freshwater			•		•	•		•	•
Food	•	•	•	•	•	•	•	•	•
Timber, fuel, and fiber	•		•			•			
Novel products	•	•	•		•		•		
Biodiversity regulation	•	•	•	•	•	•	•	•	•
Nutrient cycling	•	•	•		•	•	•		
Air quality and climate	•	•	•	•	•	•	•	•	•
Human health		•	•	•	•	•			
Detoxification		•	•	•	•	•	•		
Natural hazard regulation			•		•	•			•
Cultural and amenity	•	•	•	•	•	•	•	•	•

Source: Millennium Ecosystem Assessment

3. Figure 2.2.3 shows the habitat wise services provided by coastal and marine ecosystem where 'X' indicates the habitat provides a significant amount of the service.

Figure 2.2.3 Services provided by coastal and marine ecosystem

ECOSYSTEM SERVICES	Coastal									Marine		
	Estuaries and marshes	Mangroves	Lagoon and salt ponds	Intertidal	Kelp	Rock and shell reefs	Seagrass	Coral reefs	Inner shelf	Outer shelves edges slopes	Seamounts & mid-ocean ridges	Deep sea and central gires
Biodiversity	X	X	X	X	X	X	X	X	X	X	X	X
Provisioning services												
Food	X	X	X	X	X	X	X	X		X	X	X
Fibre, timber, fuel	X	X	X						X	X		X
Medicines, other resources	X	X	X		X			X	X			
Regulating services												
Biological regulation	X	X	X	X		X		X				
Freshwater storage and retention	X		X									
Hydrological balance	X		X									
Atmospheric and climate regulation	X	X	X	X		X	X	X	X	X		X
Human disease control	X	X	X	X		X	X	X				
Waste processing	X	X	X				X	X				
Flood/storm protection	X	X	X	X	X	X	X	X				
Erosion control	X	X	X				X	X				
Cultural services												
Cultural and amenity	X	X	X	X	X	X	X	X	X			
Recreational	X	X	X	X	X			X				
Aesthetics	X		X	X				X				
Education and research	X	X	X	X	X	X	X	X	X	X	X	X
Supporting services												
Biochemical	X	X			X			X				
Nutrient cycling and fertility	X	X	X	X	X	X		X	X	X	X	X

(Source; Millennium Ecosystem Assessment)

4. So too figure 2.2.4 below showing the ecosystem services provided by the Mangroves and Coral Reefs highlights the regulatory role it provides against natural hazards and protecting the coastal area.

5. However, because these ecosystem services are provided free of charge, as a gift of nature, their importance is often overlooked. Table 2.2.1 shows some of the threats being faced by the coastal ecosystem in India.

Figure 2.2.4 Services provided by mangroves and coral reefs

Ecosystem services	Coral reefs	Mangroves
REGULATING	Protection of beaches and coastlines from storm surges and waves Reduction of beach erosion Formation of beaches and islands	Protection of beaches and coastlines from storm surges, waves and floods Reduction of beach and soil erosion Stabilization of land by trapping sediments Water quality maintenance Climate regulation
PROVISIONING	Subsistence and commercial fisheries Fish and invertebrates for the ornamental aquarium trade Pharmaceutical products Building materials Jewellery and other decoration	Subsistence and commercial fisheries Aquaculture Honey Fuelwood Building materials Traditional medicines
CULTURAL	Tourism and recreation Spiritual and aesthetic appreciation	Tourism and recreation Spiritual – sacred sites
SUPPORTING	Cycling of nutrients Nursery habitats	Cycling of nutrients Nursery habitats

(Source: IUCN)

Table 2.2.1 Threats to coastal ecosystem in India

Coastal Ecosystem	Threats
Mangroves	• Convert mangrove areas into agricultural areas • Cutting of mangroves for fuel wood • Overdose of chemical fertilizers and pesticides detrimental to the mangrove • Seawalls, bunds and other coastal structures often restrict tidal flow, resulting in the killing of mangroves
Coral Reefs	• Destruction due to chemical pollution, mechanical damage, nutrient loading or sediment loading • Pesticides, fertilizers reaching coral reefs from agricultural runoff areas, Destructive fishing practices • Heavy metals from industrial sources, petroleum hydrocarbons. etc chemically damage the corals • Mining and trawl fishing
Sea grass Beds	• Eutrophication, siltation, trawling, coastal engineering constructions and removal for commercial purposes are the major threats for sea grass beds.
Sea Weeds	• Over exploitation for commercial purpose, • Pollution of coastal waters, • Sedimentation
Turtle Nesting Grounds	• Beach erosion, habitat degradation, poaching
Beaches	• Habitat conversion because of Industrial and human settlements, sand mining • Activities which accelerate the erosion processes like clogging of river flow, construction on shoreline • Poorly designed coastal engineering works (that alter long shore currents or wave forces and lead to undesirable erosion and deposition patterns) • Coastal dredging/mining projects
Sand Dunes	• Sand mining, • Leveling for construction of beach resorts • Road, rail and other infrastructure development included unplanned tourism facilities
Rocky Cliffs	• Degradation of the rock cliffs because of mining for the extraction of valuable minerals, e.g. chromium from serpentine, or as a road stone as with granite and basalt, limestone for cement factories
Rocky Foreshores	• Unplanned tourism structures, • Pollution, • Mining of rocks for construction purposes
Estuaries	• Reclamation, • Pollution from urban and industrial waste disposal, • Reduction in fresh water discharge due to dams, • Prevention of fresh water flow, • Dredging for water-ways

Rocky Foreshores	• Unplanned tourism structures, • Pollution, • Mining of rocks for construction purposes
Estuaries	• Reclamation, • Pollution from urban and industrial waste disposal, • Reduction in fresh water discharge due to dams, • Prevention of fresh water flow, • Dredging for water-ways
Lagoons	• Reclamation, • Pollution from urban and industrial waste disposal, • Reduction in fresh water discharge due to dams, • Prevention of fresh water flow, • Dredging for water-ways • Constructions like dike, artificial bars, jetties affect the structure of lagoons
Mudflats	• Reclamation, • Urban and industrial waste disposal, • Waste disposal/effluent discharge
Deltaic Areas	• Reclamation, • Flooding
Tidal Inlets	• Dredging for maintaining the channel increases turbidity, • Channel stabilization disrupts the natural flow of sediment
Barrier Islands	• Sand mining, • Pollution from tourism activities • Erosion
Salt-marshes	• Reclamation, • Cutting and removal of marsh vegetation for agriculture and construction of embankments

(Source: National Training Course on DRR for Coastal Zone Managers, CEE, India, 2009)

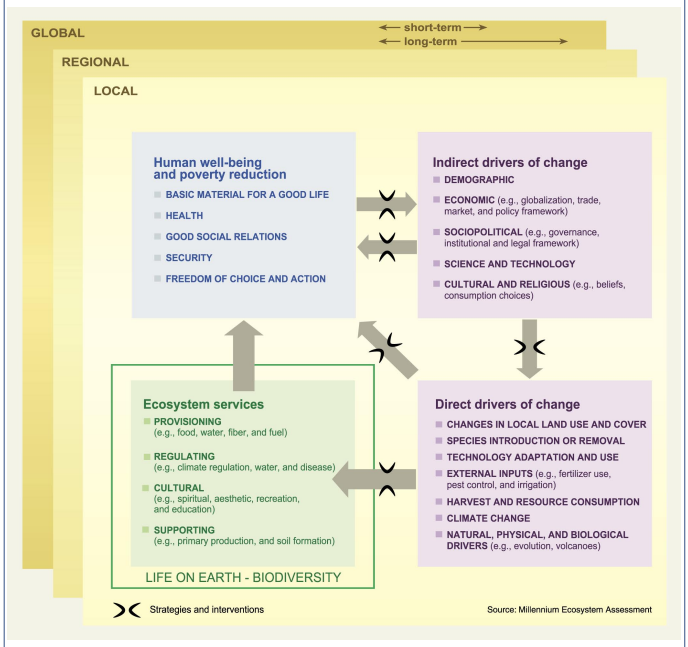
6. Hence, we need to consider protection of these services by adopting a broader approach that recognizes that people in their daily lives depend on a range of services that ecosystems provide. These services are fundamental to attaining development goals as explained in figure 2.2.5.

7. The Millennium Ecosystem Assessment provides a framework (Figure 2.2.6) which can be used by decision makers as diverse as mayors, national economists, natural

Figure 2.2.5 Relation between ecosystem services and development

(Source: Ecosystem services: A guide for decision makers; World Resource Institute)

Figure 2.2.6 Framework to explore links between ecosystems and development



(Source; Millennium Ecosystem Assessment)

resource managers, and conservation planners to explore the links between ecosystems and development, gaining a better understanding of how development goals both affect and depend on ecosystem services.

8. Thus one important task would be to identify these drivers of change which has impact on the coastal ecosystem services. Table 2.2.2 shows the services the coastal ecosystem provides and the drivers of change which includes among others climate change, destruction of mangroves, coral reefs etc.

Table 2.2.2 Services provided by coastal ecosystem and drivers of change

Ecosystem	Ecosystem services	Drivers of ecosystem change
Coastal	Tourism, recreation, cultural value, fisheries (commercial and subsistence), aquaculture, transportation, nutrient cycling, storm/flood protection, climate regulation, disease regulation, waste processing, erosion control, hydropower, freshwater storage	Nutrient runoff and deposition creating dead zones, industrial and urban pollution, dredging of waterways, sediment transport from rivers, climate change, invasive species, conversion of estuaries and wetlands, destruction of estuarine fish nurseries, destruction of mangroves and coral reefs, overexploitation of fisheries, mangroves (for fuel wood), sand for construction, seaweed for consumption

(Source: Ecosystem services: A guide for decision makers; World Resource Institute)

References for Key Concepts

- Paragraph 1, 2 and 6; Millennium Ecosystem Assessment, 2003.

Session Delivery

Power point Presentation (provided in the attached CD)

Discussions

Participants would be requested to share information on the following:

- List 5 different kind of services provided by the ecosystem in your area?
- Under which functional category these services fall?
- Are any of these services changing over years? If yes, what are the factors that are contributing to this change?

Session_2.3 Valuation of ecosystem services

Session learning Objectives

At the end of the session the participants would be able to appreciate the need of economic valuation of coastal ecosystem services especially from a point of view of regulatory services it provides in reducing risk from natural hazards. The session would introduce common tools for carrying out economic valuation and identify the challenges in carrying out economic valuation. The session will also help in the identification of relevant organizations with capacity on valuation of ecosystem services.

Session Duration

Presentation: 30 minutes
Guest Speaker: 30 minutes
Total: 60 minutes

Key Terminologies

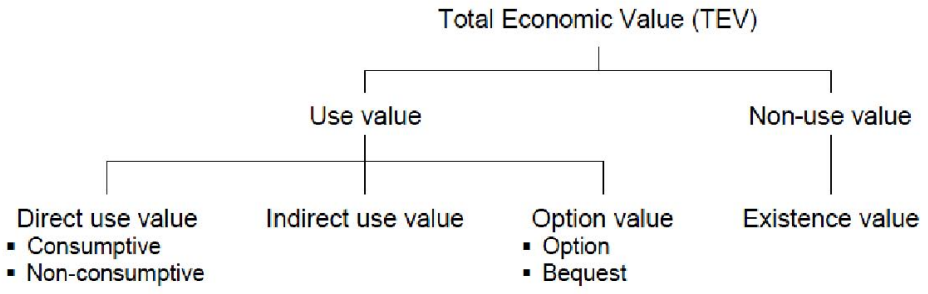
- Economic valuation offers a way to compare the diverse benefits and costs associated with ecosystems, by attempting to measure them and expressing them in a common denominator typically a monetary unit. (Source: World Bank – 2006)

Key Concepts

This session would cover the following concepts:

1. The previous session highlighted the importance of various services coastal ecosystem provides and hence the need to protect them. However, protection through various management processes requires certain amount of resources. Hence it is essential to understand 'How much value' the ecosystem provides and 'to whom', in order to take the appropriate decision on conserving it.
2. Economic valuation offers a way to compare the diverse benefits and costs associated with ecosystems, by attempting to measure them and expressing them in a common denominator— typically a monetary unit.
3. Many methods for measuring the utilitarian values of ecosystem services are found in the resource and environmental economics literature. Some are broadly applicable, some are applicable to specific issues, and some are tailored to particular data sources. A common feature of all methods of economic valuation of ecosystem services is that they are founded in the theoretical axioms and principles of welfare economics. *Most valuation methods measure the demand for a good or service in monetary terms, that is, consumers' willingness to pay (WTP) for a particular benefit, or their willingness to accept (WTA) compensation for its loss. (Source; Hanneman, 1991; Shogren and Hayes, 1997)*
4. One of the common frameworks for undertaking economic valuation is the Total Economic Value (TEV) framework. Figure 2.3.1 below shows a graphical representation of the framework.

Figure 2.3.1 Total Economic Value framework for economic valuation



5. Economic valuation should be used to examine four distinct aspects of the value of ecosystems:
   - Determining the value of the total flow of benefits from ecosystems
   - Determining the net benefits of interventions that alter ecosystem conditions
   - Examining how the costs and benefits of ecosystems are distributed
   - Identifying potential financing sources for conservation
6. These four approaches (Figure 2.3.2) are closely linked and build on each other. They represent four different ways to look at similar data regarding the value of an ecosystem: its total value or contribution to society, the change in this value if a conservation action is undertaken, how this change affects different stakeholders—that is, who are the beneficiaries and who are the losers and how beneficiaries could be made to pay for the services they receive to ensure that the ecosystem is conserved and its services are sustained.

Figure 2.3.2 Approaches to economic valuation of ecosystem

Approaches to valuation

Approach	*Why do we do it?*	*How do we do it?*
Determining the total value of the current flow of benefits from an ecosystem	To understand the contribution that ecosystems make to society	Identify all mutually-compatible services provided; measure the quantity of each service provided; multiply by the value of each service
Determining the net benefits of an intervention that alters ecosystem conditions	To assess whether the intervention is economically worthwhile	Measure how the quantity of each service would *change* as a result of the intervention, as compared to their quantity without the intervention; multiply by the marginal value of each service
Examining how the costs and benefits of an ecosystem (or an intervention) are distributed	To identify winners and losers, for equity and practical reasons	Identify relevant stakeholder groups; determine which specific services they use and the value of those services to that group (or changes in values resulting from an intervention)
Identifying potential financing sources for conservation	To help make conservation financially sustainable	Identify groups that receive large benefit flows, from which funds could be extracted using various mechanisms

(Source: How much is an ecosystem worth? - Assessing the economic value of conservation - The World Bank, IUCN - The World Conservation Union)

7. A major limitation of economic valuation is that the resulting estimates are often highly subjective, being sensitive to both the methods selected and assumptions used. The selected ecosystem services to be valued, coupled with assumptions on period of valuation (number of years) and discount rate (reflecting how we value the future), will have profound effects on the estimates produced. Some techniques focus on narrow, marketable goods and services, which can be more accurately estimated, but omit important non-market and non-use values. In addition, inaccuracies exist because of incomplete understanding of complex ecosystem processes and inherent biological uncertainties (for example, how much wetland is required to provide sufficient flood regulation or water filtration for a population).

Figure 2.3.3 Changes in ecosystem services in terms of trade-offs

Decision	Goal	Example winners	Ecosystem services decreased	Example losers
Increasing one service at the expense of other services				
Draining wetlands for farming	Increase crops, livestock	Farmers, consumers	Natural hazard regulation, water filtration and treatment	Local communities including farmers and some downstream users of freshwater
Increasing fertilizer application	Increase crops	Farmers, consumers	Fisheries, tourism (as a result of dead zones created by excessive nutrients)	Fisheries industry, coastal communities, tourism operators
Converting forest to agriculture	Increase timber (temporarily), crops, livestock, and biofuels	Logging companies, farmers, consumers	Climate and water regulation, erosion control, timber, cultural services	Local communities, global community (from climate change), local cultures
Converting ecosystems and their services into built assets				
Coastal development	Increase capital assets, create jobs	Local economy, government, developers	Natural hazard regulation, fisheries (as a result of removal of mangrove forests or wetlands)	Coastal communities, fisheries industry (local and foreign), increased risks to coastal businesses
Residential development replacing forests, agriculture or wetlands	Increase capital assets, create jobs	Local economy, government, developers, home buyers	Ecosystem services associated with removed ecosystems	Local communities, original property owners and downstream communities
Competition among different users for limited services				
Increased production of biofuel	Reduce dependency on foreign energy	Energy consumers, farmers, government	Use of crops for biofuels instead of food	Consumers (rising food prices), livestock industry
Increased water use in upstream communities	Develop upstream areas	Upstream communities, industries	Water downstream	Downstream communities, industries

(Source: Ecosystem services: A guide for decision makers, World Resource Institute)

8. When identifying risks and opportunities, it can be helpful to think of ecosystem service changes in terms of trade-offs. Trade-offs arises from management choices or actions that intentionally or otherwise alter the quantity or quality of an ecosystem service in order to achieve a goal. Assessing trade-offs involves identifying the different groups that will win and lose in the short term as well as the long term as a result of changes to ecosystem services. Trade-offs can involve economic losses, or losses to the health and well-being of certain populations (Figure 2.3.3).

References for Key Concepts

- Paragraph 2, 3, 5 and 6; How much is an ecosystem worth? - Assessing the economic value of conservation - The World Bank, IUCN
- Paragraph 7 and 8; Ecosystem services: A guide for decision makers; World Research Institute, 2008

Quick Facts

- The total potential sustainable annual economic net benefits per km of healthy coral reef in Southeast Asia is estimated to range from $23,100 to $270,000 arising from fisheries, shoreline protection, tourism, recreation, and aesthetic value. (Source: Burke, Selig and Spalding, 2002)
- Sri Lanka; A 2005 Total Economic Value (TEV) assessment of the Rekawa mangrove lagoon ecosystem, Sri Lanka, found that it was $1,088/ha/year, or $217,600 per year, based on 200-ha of mangrove. Forestry net benefits accounted for $4,800 per year, lagoon fishery $53,600 per year, coastal fishery $98,600 per year, erosion control and buffer against damage from storms $60,000 per year, and existence, bequest and option values to local communities $520 per year. (Source: Gunawardena and Rowan, 2005)
- Indonesia; Potential sustainable economic net benefits per year from coral reefs in Indonesia from fisheries, shoreline protection, tourism, and aesthetic value have been estimated at $1.6 billion per year. (Source: Burke, Selig and Spalding, 2002)

Case Study

The value of mangrove forests as fish nurseries in Thailand

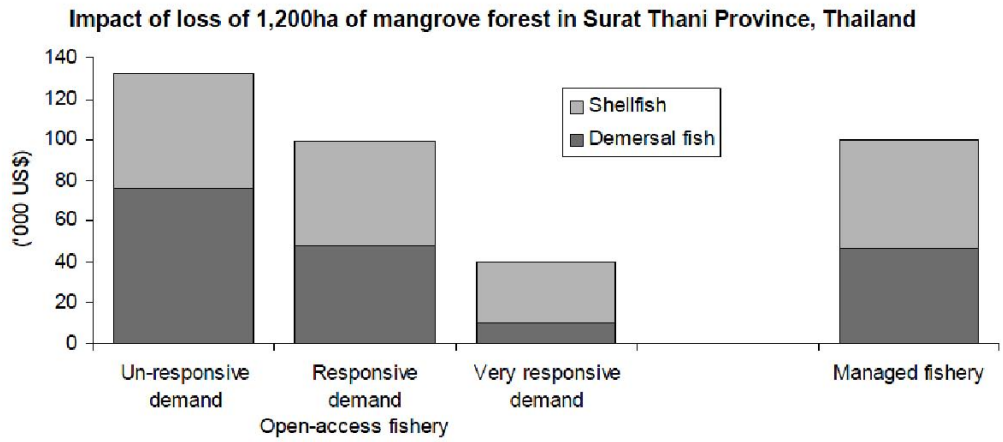
Mangrove forests can provide a number of services. These often include direct uses such as production of fuel wood and other goods, and recreation. Their most valuable services, however, are often their indirect benefits such as storm protection and their role as breeding grounds and fisheries for fish.

A large number of studies have explored the mangrove-fishery linkage. These studies generally use the production function approach: they assess the role that mangroves play as an 'input' into the production' of fish. This type of analysis requires two major elements. The first is an understanding of the role that mangrove forests play in the life cycle of relevant fish species. This might be arrived at either through an understanding of the biological processes at work, or by statistical analysis of the relationship between fish populations and mangrove forest condition (allowing for other factors that also contribute). The second element needed is an understanding of the markets for the products—in this case the fish. The value of mangrove forests is imputed based on how changes in their condition change the value generated in the market for the fish (holding other things constant). When there are multiple species of fish dependent on a given area of mangrove forest, and either the biology or the markets for each species are different, these analyses would have to be conducted separately for each species.

Figure 2.3.4 below shows the estimated consequences of loss of mangrove forest in Surat Thani Province, on the Gulf of Thailand. This region lost half its mangrove forest area in the period

1975- 1993, primarily to expansion of shrimp cultivation. As can be seen, the estimated losses resulting from a loss of 1,200ha of mangrove forest (the approximate annual rate of loss in the early 1990s) depends on both the species concerned and the characteristics of the market. If the fisheries are assumed to be managed, the loss of 1,200ha of mangrove forest would cause losses of about US$100,000. If the fisheries are assumed to be open access, the losses depend on how consumers respond to price changes: losses are highest when consumers are unresponsive (about US$40,000), and lower when consumers are very responsive (about US$132,000). Note that without knowing the benefits of the land uses which replace the lost mangrove forests, we cannot conclude anything about whether society is better or worse off as a result of this deforestation.

Figure 2.3.4 Case study of Thailand showing consequences of loss of mangroves in Surat Thani Province



(Source: How much is an ecosystem worth? - Assessing the economic value of conservation - The World Bank, IUCN - The World Conservation Union)

Session Delivery

Power point Presentation (provided in the attached CD)

Guest Speaker

Since Valuation of ecosystem services is a new concept and not much have taken place in the region on this particular subject, it would be extremely beneficial to invite an expert from this area who could enlighten the participants with examples of valuation undertaken in the Asian region and highlight the typical challenges encountered in the process.

Session_2.4 Understanding the coastal hazards

Session learning Objectives

At the end of the session the participants would be able to discuss the nature and behaviour of different types of coastal hazards (natural and human induced) and understand the relationship between frequency and impact of hazards.

Session Duration

Presentation: 30 minutes
Exercise: 15 minutes
Total: 45 minutes

Key Terminologies

- Hazard: A dangerous phenomenon, substance, human activity or condition that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage.

  Comment: The hazards of concern to disaster risk reduction as stated in footnote 3 of the Hyogo Framework are "... hazards of natural origin and related environmental and technological hazards and risks." Such hazards arise from a variety of geological, meteorological, hydrological, oceanic, biological, and technological sources, sometimes acting in combination. In technical settings, hazards are described quantitatively by the likely frequency of occurrence of different intensities for different areas, as determined from historical data or scientific analysis.

Hazards can be classified as following:

- Biological Hazard: Process or phenomenon of organic origin or conveyed by biological vectors, including exposure to pathogenic micro-organisms, toxins and bioactive substances that may cause loss of life, injury, illness or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage.

  Comment: Examples of biological hazards include outbreaks of epidemic diseases, plant or animal contagion, insect or other animal plagues and infestations.
- Geological Hazard: Geological process or phenomenon that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage.

  Comment: Geological hazards include internal earth processes, such as earthquakes, volcanic activity and emissions, and related geophysical processes such as mass movements, landslides, rockslides, surface collapses, and debris or mud flows. Hydro-meteorological factors are important contributors to some of these processes. Tsunamis are difficult to categorize; although they are triggered by undersea earthquakes and other geological events, they are essentially an oceanic process that is manifested as a coastal water-related hazard.
- Hydro-meteorological Hazard: Process or phenomenon of atmospheric, hydrological or oceanographic nature that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage.

  Comment: Hydro-meteorological hazards include tropical cyclones (also known as typhoons and hurricanes), thunderstorms, hailstorms, tornados, blizzards, heavy snowfall, avalanches, coastal storm surges, floods including flash floods, drought, heat waves and cold spells. Hydro-meteorological conditions also can be a factor in other hazards such as landslides, wild land fires, locust plagues, epidemics, and in the transport and dispersal of toxic substances and volcanic eruption material
- Socio-natural Hazard: The phenomenon of increased occurrence of certain geophysical and hydro-meteorological hazard events, such as landslides, flooding, land subsidence and drought, that arise from the interaction of natural hazards with overexploited or degraded land and environmental resources.

  Comment: This term is used for the circumstances where human activity is increasing the occurrence of certain hazards beyond their natural probabilities. Evidence points to a growing disaster burden from such hazards. Socio-natural hazards can be reduced and avoided through wise management of land and environmental resources.
- Technological Hazard: A hazard originating from technological or industrial conditions, including accidents, dangerous procedures, infrastructure failures or specific human activities, that may cause loss of life, injury, illness or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage.

Comment: Examples of technological hazards include industrial pollution, nuclear radiation, toxic wastes, dam failures, transport accidents, factory explosions, fires, and chemical spills. Technological hazards also may arise directly as a result of the impacts of a natural hazard event
(Source; UN/ISDR, 2009)

Key Concepts

This session would cover the following concepts:

1. Below is a brief description of typical hazards in coastal areas:

Coastal Resource Degradation: Many of the earth's most complex, diverse and productive ecological systems are located in coastal zones. Coastal resources are very productive in both a biological and economic sense. Reefs, mangroves, wetlands, and tidelands provide nursery and feeding areas for many marine species. In addition, these coastal resources also provide important buffer areas for storm protection and to control erosion. Frequently, human activities within coastal areas can contribute to the degradation of these crucial resources.

Flooding: Flooding is a localized hazard that is generally the result of excessive precipitation. The primary types of flooding are riverine flooding, coastal flooding, and urban flooding. Floods can be generally classified as flash floods—the product of heavy localized precipitation in a short time period over a given location— or general floods, caused by precipitation over a longer time period and over a given river basin. Historically, flooding is the most common environmental hazard, due to the widespread geographical distribution of river valleys and coastal areas and the attraction of human settlements to these areas. The severity of a flooding event is determined by a number of local factors, including river basin physiography, precipitation patterns, and recent soil moisture conditions and vegetative state. While flash floods occur within hours of a rain event, general flooding is a longer-term event, and may last for several days.

Sea Level Rise: Sea level rise can be defined as an increase in the mean sea level. Throughout history, the earth has gone through periods of sea level rise and decline, which are directly tied to climate change and global warming and cooling trends over geologic and recent time. Sea level fluctuations are a part of the natural processes on earth that are determined by many factors, but largely are influenced by climate and global warming. In comparison to other disasters that affect the coastal zone, such as tropical cyclones, tsunamis, floods, and earthquakes, sea level rise is on a much more gradual time scale. The impacts of a tsunami can be seen immediately, whereas the effects of sea level rise take a longer period of time to realize. A major potential impact of sea level rise on the natural environment in the coastal zone is that of habitat loss due to wetland inundation, coastal erosion, salt water intrusion, or shift in climate limits on vegetation.

Shoreline Erosion: Shoreline erosion is the wearing away of the land surface by detachment and movement of soil and rock fragments, during a flood or storm or over a period of years, through the action of wind, water, or other geologic processes. Wind, waves, and long shore currents are the driving forces behind coastal erosion. This removal and deposition of sand permanently changes beach shape and structure. Additional factors involved in coastal erosion include human activity, sea-level rise, seasonal fluctuations, and climate change. Shoreline erosion is typically a chronic hazard, but severe shoreline erosion may be induced by a single storm event.

Spills and Chronic Pollution: There are various ways in which pollution can impact coastal areas. Spills can be in the form of oil spills from ships, toxic materials released from storage tanks, petroleum releases from severed pipelines, etc. These events can have devastating effects on coastal environments. In some cases these episodic pollution events are caused by other coastal hazards such as tsunamis, tropical cyclones, and storm surge. Chronic pollution can be caused by numerous sources. Improper

disposal of garbage in coastal communities can be a cause of pollution. Improper treatment of human waste prior to discharge in rivers and coastal waters can also be a cause of pollution. Polluted surface water runoff from land-based sources can be a significant source of pollution to coastal areas. Regardless of the source of pollution, the impacts on coastal resources can be devastating. Many coastal communities rely on coastal resources for their survival.

Storms: Numerous meteorological events can impact the coast, including, very commonly, storms. Various types of storms impact coastal communities, such as severe thunderstorms, tropical cyclones, and extra tropical cyclones.

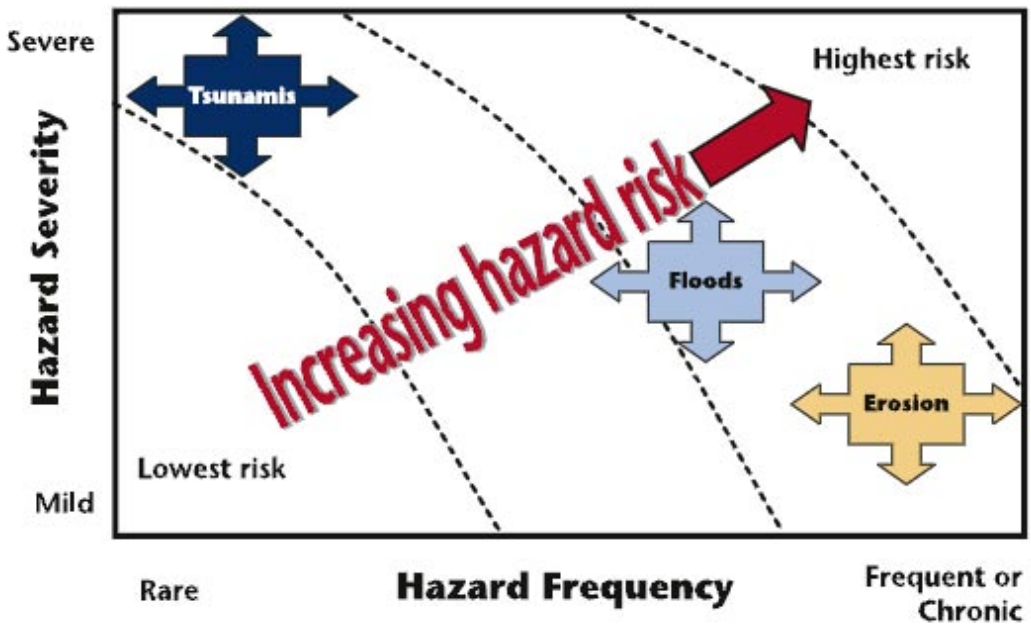
Storm Surge: Storm surge is simply water that is pushed toward the shore by the force of the winds swirling around a storm. This advancing surge combines with the normal tides to create the storm tide. Tropical cyclone-induced storm tides can increase the mean water level 5 meters or more. In addition, wind waves are superimposed on the storm tide. This rise in water level can cause severe flooding in coastal areas, particularly when the storm surge coincides with the normal high tides. The greatest potential for loss of life related to a tropical cyclone is from the storm surge, which historically has claimed nine out of ten victims of these events.

Tsunamis: A tsunami is a series of ocean waves typically generated by an underwater earthquake. Landslides, volcanic activity, and meteor strikes may also generate a tsunami. A tsunami wave may be very small in the deep ocean, but as it approaches land can increase to more than 10 meters in height and reach shore as a fast-moving wall of turbulent water. Tsunamis can inundate low-lying coastal areas with multiple waves that can penetrate and cause destruction far inland. There are two types of tsunamis: distant and local. A distant tsunami travels long distances from the event that triggers it to impact the coast hours later. A local tsunami can impact the coast within minutes after the triggering event, allowing little to no time for warning and evacuation. The frequency of damaging tsunamis throughout the Indian Ocean region has been low compared with other natural hazards such as tropical cyclones, earthquakes, and floods.

2. Lightning: It is the discharge of electricity from a thunder cloud, technically named 'Cumulonimbus'. It is generated mostly in Cumulonimbus clouds. A well developed cumulonimbus cloud is electrically charged and the electro-static charges are distributed in the cloud so that the negative charges are concentrated in the lower part of the cloud and positive charges in the upper part. Under the influence of a charged cloud, the earth surface below the cloud is positively charged by induction. Under the favourable conditions, electrical discharges occur from a charge centre in a cloud either to the induced charge on the earth, or to charge centres of another cloud or to a charge centre of the same cloud. Accordingly, lightning may be categorized mainly into two types namely Ground Flash – Discharge between a cloud and the earth and Cloud Flash– Discharge within a cloud or between clouds.
3. Harmful algal blooms (HAB): Eutrophication of waters caused by excessive nutrients, especially nitrogen, leads to potentially harmful algal blooms (HAB). They result in rapid growth of an algal species that may contain toxins causing negative impacts on coastal resources and /or human beings. HABs can occur naturally due to the reasons like sea surface temperature rise or due to human activities like excessive use of phosphorus and nitrogen fertilizers in agriculture. They get into the sea through river systems causing eutrophication.
4. Hazards can be single, sequential or combined in their origin and effects. For instance, it could be a cyclone followed by floods. Sometimes natural hazards may get augmented by human activities. For instance, natural coastal erosion by wave action may increase due to cutting down of mangroves.
5. The risk from coastal hazards is characterized by the frequency of occurrence and severity of the hazard (Figure 2.4.1). For example tsunamis are typically infrequent

events with moderate to severe consequences. Mild flooding may occur frequently, while severe flooding may be an infrequent event. Coastal erosion may be a chronic event with mild consequences or, coupled with other hazards, may result in severe impacts on the shoreline. Infrequent events with limited predictability pose the greatest risk of disaster and the longest time needed for disaster recovery. Frequent or ongoing hazards such as resource or environmental degradation processes can be monitored to reduce risk.

Figure 2.4.1 Frequency of occurrence and severity of hazards



((Source; How Resilient is your Coastal Community? A guide for evaluating coastal community resilience to tsunamis and other hazards, U.S IOTWS)

6. Hazards on its' own need not be dangerous. However, when clubbed with vulnerable factors can turn into disasters. The following session would help identify some of these vulnerable factors.

References for Key Concepts

- Paragraph1, 5 How Resilient is your Coastal Community? A guide for evaluating coastal community resilience to tsunamis and other hazards, U.S IOTWS
- Paragraph 2 National Training Course for DRR for Coastal Zone Managers, Coast Conservation Department, Sri Lanka, 2009
- Paragraph 3, National Training Course on DRR for Coastal Zone Managers, CEE, India, 2009

Quick Facts

Table 2.4.1 shows the typical coastal hazards in India.

Case Study

The devastating algal bloom in India – Warming effect?

The rich biodiversity of gulf of Mannar region, which is declared as marine biosphere reserve in the south of Tamil Nadu region is in danger. Reason, the harmful algal bloom (HAB). Sudden and rapid multiplication of huge number of Dinoflaggelate Noctiluck (an algal species)

had rapidly depleted oxygen levels in the sea water killing tens of hundreds of fish along the coast and attacking the coral reefs as well. According to Dr. G. Gopakumar, Principal Scientist-in-charge at the Mandapam Regional Centre of the Central Marine Fisheries Research Institute (CMFRI) "Corals got bleached due to lack of oxygen while many fishes and sea animals also died. This type of mass mortality of bio-diversity has taken place for the first time in the Gulf of Mannar. The HAB phenomenon has been reported from other parts of the world, but the "intensity here has been severe."

Table 2.4.1 Typical coastal hazards in Inidia

Hazard	*Region most affected*	*Frequency of occurrence*	*Magnitude of impact*	*Remarks*
Storm surges	Bay of Bengal.	Above table	Biggest killer in this part of the world.	Impact event by event is not easily available, but it should be possible to assemble for the last century at least based on instrumental records.
Tsunami	Needs further study.	Sporadic, not known	Highly damaging.	Need to document occurrence in the past and evaluate the impact
Coastal pollution	All major coastal industrial areas, ports, major cities and towns on the coastline.	Persistent, but sporadic bursts of heavy pollution may occur.	Affects biodiversity & tourism industry, and human health through the marine food chain.	Impact needs to be monitored on continuous basis. Need to generate data base of the major pollution constituents and their effects on ecology. Not well documented or quantified in spite of several EIA studies.
Coastal erosion	Not fully known.	Persistent hazard, but exacerbated by other hazards like cyclones and storms, floods, tsunami, and by anthropogenic activity.	Variable, but can be disruptive.	As with pollution, there is a need to integrate the results of several small-scale, disparate studies.
Oil spills	Usually along shipping routes and around harbours, but, in the event of an accident, almost anywhere.	Variable.	Harmful effect on the coastal or marine ecosystem.	Need to understand how a potential spill will spread, and need methods to reduce effect of harmful toxins.
Harmful algal blooms (HABs)	Mostly off the southwest coast of India, but also occur at other places.	Annual event (may be more), but of short duration.	Variable; affects sea-food chain, tourism; human health hazard.	Need to understand causative effects and spatio-temporal spread;
Submarine mudslides	Not predictable as this depends on soil/sediment structure & texture.	Not known.	Can have serious impact on offshore structures, and result in huge loss for the oil sector.	Need for a detailed study of past events using paleontological methods, and sediment stratification classification.
Impact of global climate change	Global, but projections suggest an increase in the already high frequency of storms in the Bay of Bengal	Projected increase in the frequency of storms in the Bay of Bengal	Not known, subject to uncertainty inherent in global climate models.	Needs to be taken seriously because an already stressed and fragile coastal zone may be subject to more intense and frequent hazards.

(Source: National Training Course on DRR for Coastal Zone Managers, CEE, India, 2009)

Stretching off the coast from Mandapam on the mainland up to Tuticorin, the marine park has suffered the algal bloom in a 30 km stretch from near Pamban to Keezhakarai. Nearly 13.9 tons of commercially important species are killed. During the bloom phase, the coastal water turned dark green. The phosphate and ammonia levels were found very high. At several landing stations very low oxygen levels were recorded due to the bloom - below 1 milliliter (ml) per litre of water against the norm of 5 ml per litre. In the reefs around the algal bloom it is said that no fish was observed because sea grass and seaweed had also been wiped out. Alerted by local fishermen scientist found that the algal bloom was fortunately not toxic and was seen just before the northeast monsoon and in unusually high temperatures. With the onset of monsoon, temperatures dropped and the bloom disappeared by October 15, leaving pale white damaged coral reefs mainly in Vaazhai and Mulli Islands. Are the fingers (reason for this alga bloom) pointing towards sea surface warming along with pollution?

(Source: National Training Course on DRR for Coastal Zone Managers, CEE, India, 2009, Dangerous algal bloom on TN coast; MR Venkatesh Hindustan times- Nov 11, 2008)

Session Delivery

Power point Presentation (provided in the attached CD)

Group Exercise: Materials required: Computer, Projector, Screen
Instructions:

- Show a name of a hazard on the screen and request the participants to match the hazards under following categories;
- Geological,
- Hydro-meteorological,
- Biological and
- Technological hazards.

Session_2.5 Recognizing the Coastal Vulnerabilities

Session learning Objectives

At the end of the session the participants would be able to discuss the different types of vulnerabilities in coastal areas; social, physical and economical and identify the factors which contribute to vulnerabilities in coastal areas

Session Duration

Presentation: 30 minutes
Group Exercise: 30 minutes
Total: 60 minutes

Key Terminologies

- Vulnerability: The characteristics and circumstances of a community, system or asset that make it susceptible to the damaging effects of a hazard.

  Comment: There are many aspects of vulnerability, arising from various physical, social, economic, and environmental factors. Examples may include poor design and construction of buildings, inadequate protection of assets, lack of public information and awareness, limited official recognition of risks and preparedness measures, and disregard for wise environmental management. Vulnerability varies significantly within a community and over time. This definition identifies vulnerability as a characteristic of the element of interest (community, system or asset) which is independent of its

exposure. However, in common use the word is often used more broadly to include the element's exposure. (Source: UN/ISDR, 2009)

- Capacity: The combination of all the strengths, attributes and resources available within a community, society or organization that can be used to achieve agreed goals.

  Comment: Capacity may include infrastructure and physical means, institutions, societal coping abilities, as well as human knowledge, skills and collective attributes such as social relationships, leadership and management. Capacity also may be described as capability. Capacity assessment is a term for the process by which the capacity of a group is reviewed against desired goals, and the capacity gaps are identified for further action. (Source: UN/ISDR, 2009)

Key Concepts

This session would cover the following concepts:

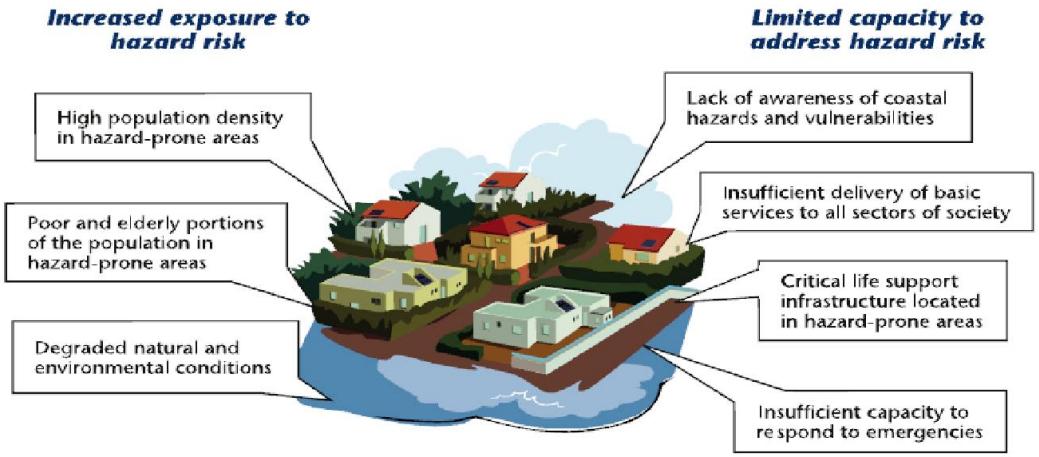
1. Various factors contributing to vulnerability are given in the table 2.5.1. These factors have been grouped under broad categories for better understanding.

Table 2.5.1 Factors contributing to vulnerability

Categories	Vulnerability factors
Geographical	Physiographic characteristics of coasts like slope, elevation, shoreline features
Climatic	Temperature increase
Social	Demographic features (population, gender, age, density), literacy and education, insurance, health
Economic	Livelihood and other economic indicators like property, vehicles, communication systems
Physical	Houses, road bridges, cyclone shelters, transport and communication systems, and other infrastructure
Environmental	Access to and availability and quality of natural resources, quality of ecosystem services
Development related	Type of developmental activity, location, process followed

2. The increased vulnerability of coastal communities to potential hazards is partly due to the constantly increasing coastal population. Human activities are degrading the quality of the coastal environment and integrity of coastal ecosystems on a daily basis, making coastal populations more vulnerable. Coastal habitats such as reefs, mangroves, wetlands, and tidelands provide nursery and feeding areas for many marine species and serve as buffer areas for storm protection and to control erosion. These coastal habitats are being destroyed by a wide range of human uses, including shoreline development, land reclamation, mining, and aquaculture. Runoff, wastewater discharges, and oil spills pollute coastal waters and endanger marine life. Overfishing and the use of destructive fishing practices are causing the decline of fishery resources and changes in marine ecosystem structure and function. The degradation of the coastal environment from chronic human-induced actions threatens food security, livelihoods, and the overall economic development and well being of coastal communities.
3. Most of the coastal population lives in relatively densely populated rural areas and small to medium cities, rather than in large cities. In these relatively rural communities, basic services and disaster warning and response mechanisms are limited (Figure 2.5.1). Limited capacity of a community to plan for and respond to coastal hazards makes coastal populations increasingly vulnerable and increases disaster risk.
4. Following are some of the suggested Indicators for coastal vulnerability
   - Persons/square km (population density) captures threats from coastal development, sewage, land cover clearance, ground water depletion, and overexploitation of resources.

Figure 2.5.1 Factors that contribute to vulnerability in coastal populations



(Source; How Resilient is your Coastal Community? A guide for evaluating coastal community resilience to tsunamis and other hazards, U.S IOTWS)

- Density of tourist rooms (tourist infrastructure) captures the threat to land use and land cover, ground water depletion, water and beach pollution from recreational activities
- Area under intensive aquaculture captures threats to mangrove clearance, land use change (e.g., agriculture), saline intrusion into coastal aquifers, eutrophication, threats to wild stock
- Fertilizer use/ha, cultivated area, irrigated area captures potential threats of eutrophication, groundwater depletion, soil degradation, and land cover change.
- Number of potentially polluting industrial units located captures threats from industrial pollution, land cover change, and ground water depletion
- Total cargo handled at ports measures potential threats from oil spills and impacts on marine life; from species introduction through release of ballast water and need for port extension and consequent impact on marine life.
  (Source: adopted from A framework of indicators potential coastal vulnerability to development, TERI)

References for Key Concepts

- Paragraph 2 and 3; How resilient is your coastal community: A guide for evaluating coastal community resilience to tsunamis and other hazards, U.S. IOTWS, 2007
- Paragraph 4; A framework of indicators potential coastal vulnerability to development, TERI

Session Delivery

Power point Presentation (provided in the attached CD)

Group Exercise: Materials required: Computer, Projector, Screen
Instructions:

- Divide the participants into 3 Groups
- Request each group to fill in the table below by providing an example against each of the criteria contributing to vulnerability in coastal areas. An example of vulnerability due to criteria related to physical aspects is provided in Table 2.5.2 below for better understanding.

Table 2.5.2 Group Exercise	
Category	Example
Physical	The non-engineered houses built along the coast do not have permanent roofs
Economic	
Social	
Environmental	
Climatic	

Session_2.6 Introduction to Coastal Climate Change

Session learning Objectives

At the end of the session the participants would be able to recognise the impacts of climate change and the related increasing vulnerability of the coastal area.

Session Duration

Presentation: 40 minutes
Group Exercise: 20 minutes
Total: 60 minutes

Key Terminologies

- Climate change: means a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods (Source; UNFCCC). The UN Framework Convention on Climate Change (UNFCCC) uses the term "climate change" for human-caused change and "climate variability" for other changes.
- Climate change adaptation: Adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. (Source; UNFCCC)
- Mitigation: In the context of climate change, a human intervention to reduce the sources or enhance the sinks of greenhouse gases. Examples include using fossil fuels more efficiently for industrial processes or electricity generation, switching to solar energy or wind power, improving the insulation of buildings, and expanding forests and other "sinks" to remove greater amounts of carbon dioxide from the atmosphere. (Source; UNFCCC)
- Climate change impacts: The effects of climate change on natural and human systems. Depending on the consideration of adaptation, one can distinguish between potential impacts and residual impacts: Potential impacts: all impacts that may occur given a projected change in climate, without considering adaptation. Residual impacts: the impacts of climate change that would occur after adaptation. See also aggregate impacts, market impacts, and non-market impacts. (Source: IPCC 4th Assessment Report, Working Group 2)

Key Concepts

This session would cover the following concepts:

1. Main characteristics of climate change include: Increase in average global temperature (global warming); change in cloud cover and precipitation; melting of ice caps and glaciers and reduced snow cover and increase in ocean temperatures and ocean acidification.
2. Many of these impacts associated with climate change exacerbate or alter existing hydro-meteorological hazards, such as droughts, floods, storms and heat waves.

Climate change is caused by the anthropogenic emission of greenhouse gases and leads to alterations in global climate patterns with shifts in local precipitation, temperature and weather patterns. According to the Intergovernmental Panel on Climate Change (IPCC), climate change will stress critical ecosystems and lead to water and food shortages this century.

Figure 2.6.1 Socio economic impact on coast

	More frequent floods	Erosion of coast	Inundation by sea water	Rise in water table	Intrusion of salt water	Changes in biological processes
Water resources			✓	✓	✓	✓
Agriculture	✓		✓	✓	✓	
Human health	✓		✓			✓
Fisheries	✓	✓	✓		✓	✓
Tourism	✓	✓	✓			✓
Human settlements	✓	✓	✓	✓		

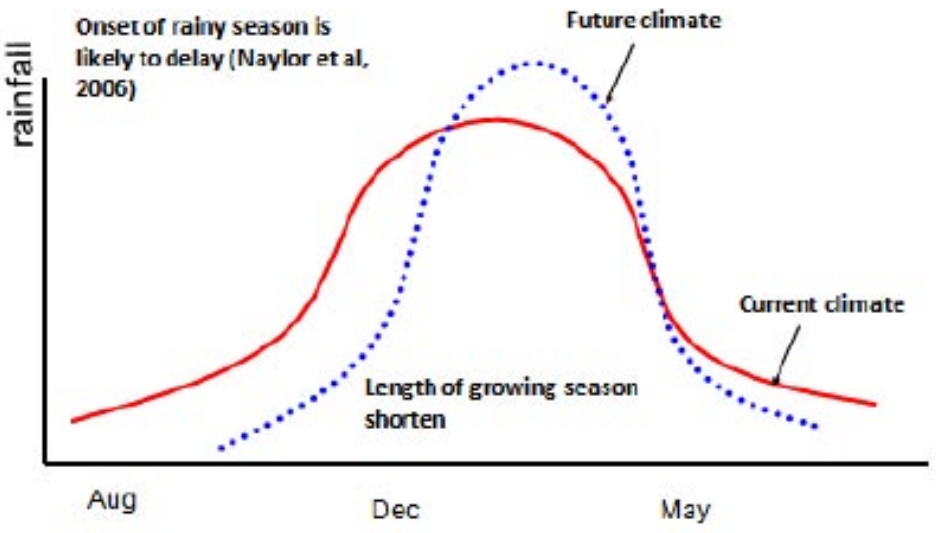
(Source; UNFCCC, 2006)

3. Sea level rise, coastal erosion, ocean acidification, increased cyclones, floods, storm surges height, saltwater intrusion; loss of land & resources and changes in marine species composition/distribution are some of the impacts of climate change in coastal area as illustrated in the figure 2.6.1. This will threaten the vital coastal ecosystems including settlements and services that support livelihood of coastal communities. For example *in Indonesia sea level rise in particular has severe impacts on the coastline. Currently, around 42 million people in Indonesia live in areas less than 10 meters above the average sea level. It has already undermined livelihoods in many islands in Maluku in Indonesia, where fishermen say they can no longer predict the right times or places to catch fish because of the different climate patterns. Rising sea levels could also inundate many of the shrimp and fish ponds in Java, Aceh and Sulawesi. The increase in sea temperature has also caused serious problems for the coral ecosystems and coral bleaching is observed in many places such as in the eastern part of Sumatra, Java, Bali, and Lombok. In 'thousands islands' (north of the Jakarta coast), about 90 to 95 percent of the corals located 25 metres below sea surface have been bleached. (Source; Ministry of Environment, Government of Indonesia)*
4. Typically water resources, agriculture, fisheries, tourism, human settlement are some of the sectors affected by climate change in the coastal areas. Similarly, coastal cities which are typically the hot spots of the country's economic activities are facing the danger of submergence. *For example; around 7 million people are projected to be*

displaced due to submergence of parts of Mumbai and Chennai city in India, due to increase of global temperature of 20 degree centigrade. (Source; National Training Course on DRR for Coastal Zone Managers; CEE, India, 2009)

5. The impact of climate change is also very local specific. Figure 2.6.2 shows the likely change in rainfall pattern in Jawa and Bali in Indonesia.

Figure 2.6.2 Likely change of rainfall pattern in Jawa and Bali



(Source; Presentation made by Ministry of Environment, Government of Indonesia at National Review Workshop on development of National Training Course on DRR for Coastal Zone Managers, Jakarta, May, 2009)

References for Key Concepts

- Paragraph 2; Environment and Disaster Risk, Emerging Perspectives, UNEP, 2007

Quick Facts

Projected impacts of Climate Change in India

- By 2100 temperature rise likely to be over 4o C.(Source; Indo British study, December 2005)
- Projected sea level rise of 1 mm/year is expected.
- Precipitation may rise by 11%
- Climate-related factors could cause India's GDP to decline by up to 9% washing away all the developmental gains
- More than 35% of the population who are living on less than 50 Indian Rupees per day are at high risk
- Intensity and frequency of natural disasters will increase (storm surges, cyclones, flood & drought)
- Water related stress (recession of glaciers, changes in rainfall pattern, sea level rise) are critical concerns
- Climate change is likely to affect agriculture, water resources, critical river basins and ecosystems, natural resources causing 15 to 30% decline in productivity.
- Shifting of growing seasons of major crops like rice may reduce the production by 40%.
- Submergence risk is high in the coastal zone due to sea level rise and floods
- Coasts may suffer due to salination of ground water.
- Disappearance of biodiversity hot spots such as Sunderbans is likely
- Vector related disease incidences may increase

- Ecosystem services will be impacted adversely increasing the risks due to disasters
- Ecological disasters like incidences of coral bleaching, disappearance of wetlands, reduction in mangrove extent, species extinction may become more common

(Source; National Training Course on DRR for Coastal Zone Managers; CEE, India, 2009)

Projected impacts of climate change in Indonesia

- In Indonesia, 42 million people live in areas less than 10m above sea level
- Indonesia has installed a number of instruments to monitor sea level. The existing Indonesia Sea Level Monitoring Network consists of 65 operational stations. Increasing trends in MSL has been observed in a number of stations.
- A rise of about 1 metre could inundate around 405,000 hectares of coastal land, causing the disappearance of many low-lying islands along with coral reefs, mangrove ecosystems and wetlands.
- Industry in coastal areas will also be impacted: oil and gas exploration, transportations, fisheries, settlements, agriculture and tourisms
- A sea level rise of 8-30cm would have serious impacts on coastal cities such as Jakarta and Surabaya because the ground level has also been falling due to building construction and ground water extraction
- Within the period of 2003-2005 alone, there were about 1,429 disaster incidences in Indonesia. About 53.3 percent were hydro-meteorological disasters. Of this figure, floods occur most often (34%), followed by landslides at 16%. Notable examples include: Jakarta, 2007: 422,300 displaced / US$695m in damage, Sinjai, 2007: 200,000 displaced and Aceh, 2006: 110,000 displaced
- A 0.5m sea level rise and continuing subsidence could lead to the permanent inundation of three locations in Jakarta (Kosambi, Penjaringan and Cilincing) and three in Bekasi (Muaragembong, Babelan and Tarumajaya) with a total population of approximately 270,000 people

(Source; Presentation made by UNEP/UNDP at MFF Regional Training on 'Applying Project Cycle Tools to Support Integrated Coastal Zone Management', Semarang, Indonesia, October, 2008)

Case Study

The sinking Sunderbans

Lohachara and Suparibhanga, islands in the Sunderbans have gone under waters - in to the history- before any one even knew of these islands. These are the first inhabited islands to sink into the swelling seas, say reports. So remote are these places that their disappearance was noticed only from the satellite pictures. The islands form part of the UN world heritage site of the mangrove forests, famous for the Bengal tiger, the endangered big cat species. Ganges and the Brahmaputra rivers emptied their waters here into the Bay of Bengal.

The Government of West Bengal, India says that the islands were eroded by ocean currents which is a natural phenomenon and hence cannot be linked with rising sea levels caused by Climate Change. According to scientists global warming induced climate change raised sea levels and made the islands uninhabitable. Washing of these islands off the face of the earth over the three decades only shows that the prediction of climate scientists is coming true.

A six-year study of Calcutta's Jadavpur University also show that two-thirds of nearby populated island Ghoramara has been inundated and will suffer the same fate as Lohachara. Over 10,000 people are homeless over the last decade from these islands. These inhabitants from the vanished Lohachara and the vanishing Ghoramara islands are likely to join the first wave of environment refugees. They have fled to Sagar; one of the largest islands, which itself has already

lost 7,500 acres of land to the sea and facing the high risk of sinking. This influx is putting pressure on the island's fragile resources and the original inhabitants as well.

According to Sugata Hazra from the School of Oceanographic Studies at Jadavpur University, the sea levels could rise up to 3.5 mm a year in the next few decades washing away 15 per cent of the islands (a dozen islands) and displacing 70,000 people and putting 400 Bengal tigers and other distinct flora and fauna in danger. Carteret Islands off Papua New Guinea were predicted to be the first inhabited ones to sink in about eight years' of time, but Lohachara has beaten this prediction.

As the seas continue to swell, they will gulp the island nations, from Maldives to Marshall Islands, inundate vast areas of countries from Bangladesh to Egypt, and submerge huge parts of coastal cities.

According to Asian Development Bank, if sea level increases by 1 meter, 7.1 million people may get displaced,5,76,400 ha of land will turn into waste land in India. Economic activities of major coastal cities such as Bombay may experience the loss up to 2, 28, 700 million Indian Rupees.

(Source: Islands sinking in Sunderbans; Subhra Priyadarshini ; The Telegraph ; Calcutta, India - Monday, October 30, 2006 Disappearing world: Global warming claims tropical island; Geoffrey Lean; The Independent ; Sunday, December 24, 2006)

Lombok, Indonesia

In Lombok Island in Indonesia the main economic activity is located in the coastal area and includes agriculture, fisheries and tourism. The population growth in the Lombok Island between 1994 and 1998 has been an average 1.99 % per year. Climate hazard potency based on temperature change has affected the main economic activities. Air temperature in 1948 reached 26.5 – 27 degree Centigrade while in 2007 increased until 28 – 28.5 degree Centigrade. Effect of this change is decrease in quantity and quality of spring source from year to year, flood and landslide, change in rainy season, sea level rise which can trigger beach abrasion, increase of thunderstorm and sea wave inundation. Impact is seen in the beach abrasion in Penghulu Agung Gatep, Ampenan, Lombok which occurred in March 2007. (Source: Ari Muhammad, www.lead.or.id). Sea level rise and extreme events are predicted in Lombok, Nusa Tenggara Barat, Indonesia. These events will likely affect coastal area inhabitant as shown in Table 2.6.1 below:

Table 2.6.1 Sea Level Rise Scenario in Lombok

	Year 2030	Year 2080	Year 2100
Level of Risk	Area (Ha)		
Low Risk	1215,86	1590,56	1750,56
Moderate Risk	701,9	744,37	1026,31
High Risk	5258,73	5609,18	5635
Extreme Risk	7768,67	7934,11	8039,14

(Source; Presentation made by Ministry of Environment, Government of Indonesia at National Review Workshop on development of National Training Course on DRR for Coastal Zone Managers, Jakarta, May, 2009)

Session Delivery

Power point Presentation (provided in the attached CD)

Group Exercise: Materials required: Computer, Projector, Screen
Instructions:

- Divide the participants into 3 Groups
- Request each group to fill in the table below (Table 2.6.2) by providing an example of possible impact on the sector due to climate change in coastal area.

Table 2.6.2 Group Exercise

Sector	Example
Agriculture	
Fisheries	
Tourism	
Housing	

Session_2.7 Knowing the coastal risk

Session learning Objectives

At the end of the session the participants would be able to connect the concepts earlier discussed in the module and recognise how their interaction leads to creation of risk.

Session Duration

Presentation: 30 minutes
Exercise: 15 minutes
Total: 45 minutes

Key Terminologies

- Risk: The combination of the probability of an event and its negative consequences.
  Comment: This definition closely follows the definition of the ISO/IEC Guide 73. The word "risk" has two distinctive connotations: in popular usage the emphasis is usually placed on the concept of chance or possibility, such as in "the risk of an accident"; whereas in technical settings the emphasis is usually placed on the consequences, in terms of "potential losses" for some particular cause, place and period. It can be noted that people do not necessarily share the same perceptions of the significance and underlying causes of different risks.
  (Source; UN/ISDR, 2009)
- Coping Capacity: The ability of people, organizations and systems, using available skills and resources, to face and manage adverse conditions, emergencies or disasters.
  Comment: The capacity to cope requires continuing awareness, resources and good management, both in normal times as well as during crises or adverse conditions. Coping capacities contribute to the reduction of disaster risks.
  (Source; UN/ISDR, 2009)
- Exposure: People, property, systems, or other elements present in hazard zones that are thereby subject to potential losses.
  Comment: Measures of exposure can include the number of people or types of assets in an area. These can be combined with the specific vulnerability of the exposed elements to any particular hazard to estimate the quantitative risks associated with that hazard in the area of interest.
  (Source; UN/ISDR, 2009)

Key Concepts

This session would cover the following concepts:

1. Vulnerability and Hazards are not dangerous taken separately. But if they come together, they become a risk. Figure 2.7.1 shows the locations and populations in the yellow region are characterised by certain types of vulnerability, those in red and orange are threatened by natural hazards. However, risk only arises in the orange area, where hazard and vulnerability coexist.

Figure 2.7.1 Graphical representation of hazard, vulnerability and risk

(Source; Guidelines Risk Analysis – a Basis for Disaster Risk Management, GTZ, 2004)

2. Hazard and vulnerability must be simultaneously present at the same location to give rise to risk, which then becomes a disaster if the event actually occurs. A society may be vulnerable to floods, but not to earthquakes (and vice versa). Vulnerability can only be identified and studied with reference to a concrete hazard. Vulnerability to a specific type of hazard varies, depending on the sector and context: for example, in housing, vulnerability arises out of the poor quality of buildings and basic infrastructure, in health it arises out of a lack of reserves of medication and first aid equipment, in economic activities such as agriculture it arises out of a shortage of stockpiles, etc. However, it is important to remember that a large part of the vulnerability can be reduced through human capability for self-protection (''coping strategies'').
3. Thus risk can be expressed as the product of the hazard, vulnerability and exposure or in other words Risk = Hazard x Exposure x Vulnerability
4. Different people perceive risk differently. Perception of risk is the subjectivity that people make about their characteristics and severity of a risk and explains why people make different estimates of the danger and decisions to avoid it. For example, communities may regard real every day concerns or problems such as livelihoods, health, and family as more immediate threats than the infrequent natural hazards. Local authorities may be more concerned with street fighting and solid waste management problems than disaster risk. However, factor such as environmental degradation contributes to vulnerability and increases the risk. Similarly, climate change increases hazards and contributes to vulnerability too. Some of the factors which account for varying perceptions of risks are as follows:
   - Socio-economic characteristics- age, gender, ethnicity, income, education, employment, health
   - People's knowledge about of their environment resulting in adopting local coping strategies
   - Lack of knowledge (and experience) about the hazards or threats
   - Ability to cope with hazards and risks through technology, financial attributes education, political power and having a voice.
   - Ability to access help from outside.

References for Key Concepts

- Guidelines Risk Analysis – a Basis for Disaster Risk Management, GTZ, 2004

Session Delivery

Power point Presentation (provided in the attached CD)

Exercise: Materials required: LCD Projector, Flip Chart
Instruction:

1. A set of statements would be screened on the computer
2. Each statement relates to one basic concepts taught in this module
3. On the flip chart, the key terms would be written. Each of the key term refers to one or more of the statements being screened on the computer
4. Each of the statement would be read out by the facilitator and the participants requested to provide the answer

Table 2.7.1 provides an example of the proposed exercise which could be adapted as per the need of the training:

Table 2.7.1 Exercise

Match the following	
Statements	**Concept**
"As a result of the migration from rural to urban, the young generations do not have strong links with their traditional village communities and thus the safety nets which have been developed by Pacific Island societies over hundreds of years are weakening"	• Hazards • Vulnerability • Risk • Capacity • Exposure
"Since 1950, natural disaster have directly affected more than 3.4 million people in Pacific Island Countries and the trend is increasing"	
"A common practice among road designers is to make the road higher than the expected design flood level, thereby ensuring uninterrupted access while floods are in full flush. Sometimes this creates a dilemma because the road embankment itself creates higher flood levels on the uphill side of the road and which can exacerbate flooding of homes and other property."	

Session_2.8 Stakeholders involved in coastal development

Session learning Objectives

At the end of the session the participants would be able to list out the various stakeholders involved in the coastal area and map their role in reducing or creating risk from natural hazards.

Session Duration
Presentation: 15 minutes
Group Exercise: 45 minutes
Total: 60 minutes

Key Concepts

This session would cover the following concepts:

1. Stakeholders or in this case; coastal zone managers would include all actors and groups (both public and private) who affect or have influence on, and/or are affected (positively or negatively) by, the policies, decisions and developmental actions on the coast.
2. In this case, stakeholder analysis would include the process to identify and understand the key people/groups that have a stake or interest in managing the coastal area.
3. Though the primary objective is to understand the range of active stakeholders (those who affect or determine a decision, action or outcome) involved, it is equally important to understand the passive stakeholders; one affected by the decision or action; because they are the ones at the heart of interest and should benefit from the interventions in coastal areas.

4. Since the aim of this course is to make sure the management activities in the coastal areas should be disaster resilient, while carrying out the stakeholder analysis following steps should be followed:

Identifying key stakeholders

- Who are potential beneficiaries of the proposed action related to development in the coastal area?
- Who might be adversely impacted from the proposed action?
- Have vulnerable groups been identified?
- Have supporters and opponents been identified?
- What are the relationships among the stakeholders?

Determining stakeholder interest

- What are the stakeholder's expectation of the policy, project and intervention (i.e. proposed action)?
- What benefits are there likely to be for stakeholders?
- Would the action have any negative impact on the stakeholders? If Yes, what kind of negative impact?
- What stakeholder interests conflict with the objectives of the policy, project and intervention?
- What resources might the stakeholder be able and willing to mobilize for the implementation of the proposed action?

Determining stakeholder power and influence

- What are the relationships between the various stakeholders?
- Who has power over whom? Who is dependent on whom?
- Which stakeholders are organized? How can that organization be influenced or how can the proposed action built upon the skills/values of the stakeholders?
- Who has control over resources? Who has control of information?

Session Delivery

Group Exercise; Mapping the Stakeholders
Materials required: Flip Charts, Markers
Instruction:

1. Divide the participants into 3 groups
2. Provide each group with a theme for example;
    - Coastline inhabited by a cluster of fishing village
    - Coastal forest of 5 km stretch under the Forest Department
    - Coastal town famous for tourism
3. Each group would be required to fill in Table 2.8.1 and discuss the following in respect to their theme:
4. A discussion would be facilitated around the findings of each of the group, highlighting the stakeholders involved and the gaps in the system.

Table 2.8.1 Group Exercise			
	Coastline inhabited by a cluster of fishing village	Coastal forest of 5 km stretch under the Forest Department	Coastal town famous for tourism
Description of the coast			
Primary services provided by the coast			
Primary stakeholders involved in managing these services			
Hazards faced by the area			
Stakeholders involved in dealing with natural hazards in the area			
Existing Vulnerability in the area			
Physical			
Social			
Economical			
Agencies to be involved in dealing with the existing vulnerability			
Any major impact of climate change in the area			
Existing capacity which could reduce the risk from natural hazard			

Module 3
Introduction to DRR and linkages with Climate Change Adaptation

Modular Learning Objectives:

At the end of the Module the participants would be able to:

- Understand the terminologies related to Disaster Risk Reduction (DRR) and distinguish them from terminologies used in climate change
  - Understand the importance and framework of DRR
  - Discuss various measures and approaches for DRR (Policies, Plans, Programs)
  - Identify some responses and options for climate change adaptation and its linkages with DRR

Sessions

This Module would consist of three (3) sessions as follows:
Session 3.1: Understanding the Terminologies
Session 3.2: Framework for Disaster Risk Reduction
Session 3.3: Linking Disaster Risk Reduction and Climate Change Adaptation

Session_3.1 Understanding the terminologies

Session learning Objectives

At the end of the session the participants would be able to understand the key terminologies related to Disaster Risk Reduction (DRR) and Climate Change

Session Duration

Power point Presentation: 30 minutes
Group Discussion: 30 minutes
Total: 60 minutes

Key Terminologies

Only the key terms related to DRR and Climate Change are explained below. The complete list of terminology is provided in Section 2 of this Manual.

- Prevention: The outright avoidance of adverse impacts of hazards and related disasters.

  Comment: Prevention (i.e. disaster prevention) expresses the concept and intention to completely avoid potential adverse impacts through action taken in advance. Examples include dams or embankments that eliminate flood risks, land-use regulations that do not permit any settlement in high risk zones, and seismic engineering designs that ensure the survival and function of a critical building in any likely earthquake. Very often the complete avoidance of losses is not feasible and the task transforms to that of mitigation. Partly for this reason, the terms prevention and mitigation are sometimes used interchangeably in casual use
  (Source; UN/ISDR, 2009)
- Mitigation: The lessening or limitation of the adverse impacts of hazards and related disasters.

  Comment: The adverse impacts of hazards often cannot be prevented fully, but their scale or severity can be substantially lessened by various strategies and actions. Mitigation measures encompass engineering techniques and hazard-resistant construction as well as improved environmental policies and public awareness. It should be noted that in climate change policy, "mitigation" is defined differently, being the

term used for the reduction of greenhouse gas emissions that are the source of climate change.
(Source; UN/ISDR, 2009)

- Preparedness: The knowledge and capacities developed by governments, professional response and recovery organizations, communities and individuals to effectively anticipate, respond to, and recover from, the impacts of likely, imminent or current hazard events or conditions.

  Comment: Preparedness action is carried out within the context of disaster risk management and aims to build the capacities needed to efficiently manage all types of emergencies and achieve orderly transitions from response through to sustained recovery. Preparedness is based on a sound analysis of disaster risks and good linkages with early warning systems, and includes such activities as contingency planning, stockpiling of equipment and supplies, the development of arrangements for coordination, evacuation and public information, and associated training and field exercises. These must be supported by formal institutional, legal and budgetary capacities. The related term "readiness" describes the ability to quickly and appropriately respond when required.
  (Source; UN/ISDR, 2009)
- Response: The provision of emergency services and public assistance during or immediately after a disaster in order to save lives reduces health impacts, ensure public safety and meet the basic subsistence needs of the people affected.

  Comment: Disaster response is predominantly focused on immediate and short-term needs and is sometimes called "disaster relief". The division between this response stage and the subsequent recovery stage is not clear-cut. Some response actions, such as the supply of temporary housing and water supplies, may extend well into the recovery stage.
  (Source; UN/ISDR, 2009)
- Recovery: The restoration, and improvement where appropriate, of facilities, livelihoods and living conditions of disaster-affected communities, including efforts to reduce disaster risk factors.

  Comment: The recovery task of rehabilitation and reconstruction begins soon after the emergency phase has ended, and should be based on pre-existing strategies and policies that facilitate clear institutional responsibilities for recovery action and enable public participation. Recovery programmes, coupled with the heightened public awareness and engagement after a disaster, afford a valuable opportunity to develop and implement disaster risk reduction measures and to apply the "build back better" principle.
  (Source; UNISDR, 2009)

- Climate: Climate in a narrow sense is usually defined as the 'average weather', or more rigorously, as the statistical description in terms of the mean and variability of relevant quantities over a period of time ranging from months to thousands or millions of years. These quantities are most often surface variables such as temperature, precipitation, and wind. Climate in a wider sense is the state, including a statistical description, of the climate system. The classical period of time is 30 years, as defined by the World Meteorological Organization (WMO).

- Climate Change: Climate change refers to a change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external forcing, or to persistent anthropogenic changes in the composition of the atmosphere or in land use. Note that the Framework Convention on Climate Change (UNFCCC), in its Article 1, defines climate change as: 'a change of climate which is attributed directly or indirectly

to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods'. The UNFCCC thus makes a distinction between climate change attributable to human activities altering the atmospheric composition, and climate variability attributable to natural causes. (Source; extracted from GLOSSARY, IPCC 4th Assessment Report, Working Group 2)

- Adaptation: Adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. Various types of adaptation can be distinguished, including anticipatory, autonomous and planned adaptation:

  - Anticipatory adaptation – Adaptation that takes place before impacts of climate change is observed. Also referred to as proactive adaptation.
  - Autonomous adaptation – Adaptation that does not constitute a conscious response to climatic stimuli but is triggered by ecological changes in natural systems and by market or welfare changes in human systems. Also referred to as spontaneous adaptation.
  - Planned adaptation – Adaptation that is the result of a deliberate policy decision, based on an awareness that conditions have changed or are about to change and that action is required to return to, maintain, or achieve a desired state.

  (Source; extracted from GLOSSARY, IPCC 4th Assessment Report, Working Group 2)

- Climate Variability: Climate variability refers to variations in the mean state and other statistics (such as standard deviations, the occurrence of extremes, etc.) of the climate on all spatial and temporal scales beyond that of individual weather events. Variability may be due to natural internal processes within the climate system (internal variability), or to variations in natural or anthropogenic external forcing (external variability). See also Climate change.
  (Source; extracted from GLOSSARY, IPCC 4th Assessment Report, Working Group 2)

Session Delivery

Power point Presentation (provided in the attached CD)

Group Exercise: Materials Required: Flip Chart, Markers
Instructions:

1. Divide the participants in 3 groups and provide each group with the following scenario. The facilitator could choose any one from the three given scenarios or create a new scenario
   - Scenario 1: Coastal community recently affected by a tsunami
   - Scenario 2: Village in a delta region which is hit by floods every year
   - Scenario 3: Village along a hazard prone coast which has just received an early warning of a super cyclone approaching in the next 48 hours
2. Request each of the groups to discuss an example of the following taking in consideration the given scenario
   - Group 1: Recovery, Response
   - Group 2: Prevention, Preparedness
   - Group 3: Preparedness, Mitigation
3. Each group is requested to present the examples and a discussion would be facilitated to discuss and clarify the level of understanding among the participants on the terminologies related to DRR

Session_3.2 Framework for Disaster Risk Reduction

Session learning Objectives

At the end of the session the participants would be able to understand the importance of DRR, get introduced to the framework for DRR; discuss various measures and approaches for DRR particularly in relation to coastal zone management.

Session Duration

Power point Presentation: 30 minutes
Group Exercise: 30 minutes
Total: 60 minutes

Key Terminologies

- Disaster Risk Reduction: The concept and practice of reducing disaster risks through systematic efforts to analyse and manage the causal factors of disasters, including through reduced exposure to hazards, lessened vulnerability of people and property, wise management of land and the environment, and improved preparedness for adverse events.

  Comment: A comprehensive approach to reduce disaster risks is set out in the United Nations-endorsed Hyogo Framework for Action, adopted in 2005, whose expected outcome is "The substantial reduction of disaster losses, in lives and the social, economic and environmental assets of communities and countries." The International Strategy for Disaster Reduction (ISDR) system provides a vehicle for cooperation among Governments, organisations and civil society actors to assist in the implementation of the Framework. Note that while the term "disaster reduction" is sometimes used, the term "disaster risk reduction" provides a better recognition of the ongoing nature of disaster risks and the ongoing potential to reduce these risks. (Source; UNISDR, 2009)

Key Concepts

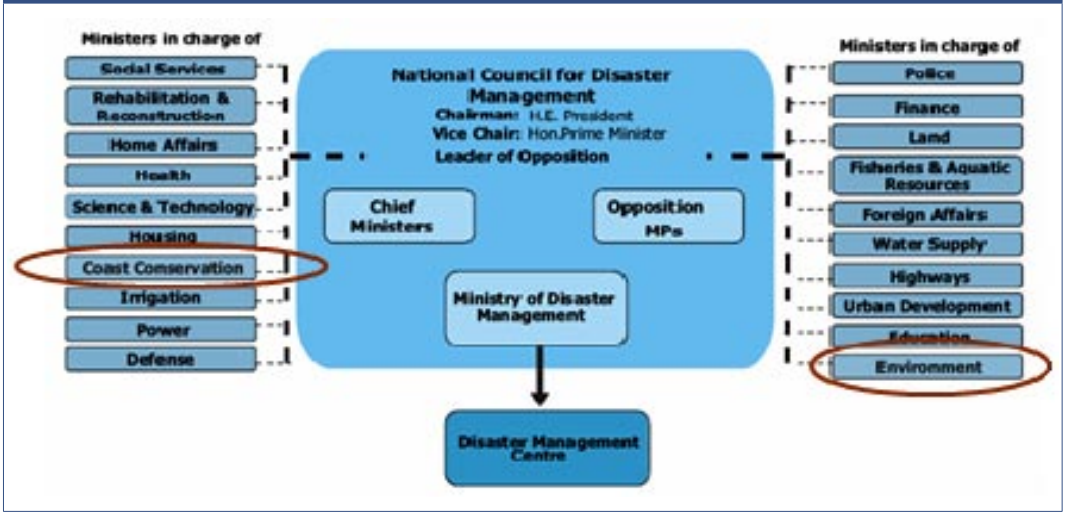
This session would cover the following concepts:

1. Disasters have an enormous impact on development. With every disaster, there is a significant impact on various sectors of development such as agriculture, housing, health, infrastructure etc. This results in a serious social and economic setback to the development and particularly the poverty reduction priorities of the developing countries, and poses a threat for achieving the Millennium Development Goals (MDGs). To meet with this crisis, the scare resources that are programmed for development are often diverted for relief and rehabilitation efforts. *For e.g. in Vietnam it is estimated that a further 4-5 per cent of the population could be pushed into poverty in the event of a disaster. (Source; Asian Development Bank)*
2. On the other hand, the process of development, and the kind of development choices made in many countries, sometimes creates disaster risks. *For e.g. flooding in Mekong Delta, is often caused by reduced drainage due to expansion of agricultural activities into wetland areas that previously served an important drainage function. (Source; ProVention Consortium, 2006)*
3. Thus disasters are unresolved problem of development and there is a need to make sure that every development which takes place needs to reduce future risk of disasters and at same time should be resilient enough to withstand the impact of a natural hazard. This includes all development in the coastal zone and thus all six aspects of development processes namely policy, strategy, programming, project management, external relations and institutional capacity, should integrate DRR.
4. The Hyogo Framework for Action (HFA) has been adopted by the countries around the world as a framework for DRR. HFA offers five areas of priorities for action, guiding

principles and practical means for achieving disaster resilience for vulnerable communities in the context of sustainable development. The below is a brief description of the priorities for action, specifically highlighting on possible linkages with coastal zone management.

5. HFA Priority for Action 1: Ensure that disaster risk reduction is a national and a local priority with a strong institutional basis for implementation
   - **Legislations related to DRR**
     This provides a formal basis for counter-disaster action in the countries and allocates major responsibilities in legal form. DRR legislations should be comprehensive and adopt a multi–hazard holistic approach involving multiple levels of the government and wider stakeholders. It is to be noted that legislation that is relevant to DRR, should also be part of laws governing development, environmental management, social welfare etc. This emphasizes the necessity for legislations related to CZM to integrate DRR.

Figure 3.2.1 Institutional structure for disaster risk reduction in Sri Lanka



(Source; Ministry of Disaster Management and Human Rights, Sri Lanka)

   - **Institutional arrangements for DRR**
     Typically national institutions responsible for DRR are multi-layered with inter ministerial and inter departmental arrangements and its effectiveness often depends on the composition, devolution of responsibility at the sub-national level and its level of engagement with multi-stakeholder. For example the figure 3.2.1 below on national DRR arrangements in Sri Lanka shows the membership of the Coast Conservation Department.

6. HFA Priority for Action 2: Identify, assess and monitor disaster risk and enhance early warning
   - Risk assessment:
     Comprehensive risk assessments need to be carried out, in appropriate scale with a multi-hazard approach. There are two kind of challenges which remains in this aspect; the results of the assessments not reaching the policy makers or being used in development planning on a nationwide scale and secondly the unavailability of data on hazards and factors contributing to socio economic conditions. This requires coordination and information sharing between the various agencies (which are often respective sectoral agencies) that collect the information, carries out the assessments, and uses the results of these assessments in planning and making policies. A recent example of carrying out a comprehensive nationwide risk assessment is in the Maldives. It has developed the disaster risk profile for the entire country taking into consideration exposures of physical, environmental and social aspects. The scale of the assessment is appropriate to guide national policy

and planning and the results of the assessments are being used by the Government agencies in planning and designing the safe islands.

7. HFA Priority for Action 3: Use knowledge, innovation and education to build a culture of safety and resilience of all levels
   - Need for information on disasters is required to be available and accessible at all levels, to all stakeholders (through networks, development of information sharing systems etc). In the context of coast, this emphasizes the need for stronger partnership between the national DRR agencies and the national agency responsible for coastal management, so that the information on natural coastal hazards is exchanged effectively with the managers working in the coastal areas at the sub national level.
8. HFA Priority for Action 4: Reduce the underlying risk factors
   - DRR, Environment and Natural Resource Management

     Natural resource exploitation, urban development and environment degradation all directly affect risk. Changes in weather intensities, circulation, hydrology, and sea level brought about by climate change have increased risk. The loss of ecosystems services that regulate floods and fires increases the vulnerability of vast populations in densely populated coastal areas and flood plain.

     Addressing the factors that create adverse environmental conditions requires strengthened governance systems, improved education, awareness and capacity building systems and appropriate technologies based on both scientific advances and traditional knowledge. Environmental management supports risk reduction through protecting and enhancing the ecological conditions that promote resilience and adaptation to a changing climate. (Source: Environment and Disaster Risk, Emerging Perspectives, UNEP, 2007)

     Thus this priority emphasizes on adopting measures for reducing risk in coastal areas among others. These measures could be structural (man-made or ecosystem based) and non-structural. The Module 5 of this course discusses in details various measures for reducing risk in coastal areas. Furthermore the Module 7 of the course discusses various approaches for integrating DRR in coastal zone management initiatives. These approaches range from policies, plans to programs.
9. HFA Priority for Action 5: Strengthen disaster preparedness for effective response at all levels
   - Preparedness and Emergency Response

     This priority highlights among other the need to periodically update emergency response plans to address changes in physical, social, environmental and climate conditions. With the growing vulnerability to climate change, this is of particular importance especially in the coastal areas.

Session Delivery

Power point Presentation (provided in the attached CD)

Group Exercise:

Objective: Brainstorm the range of activities and stakeholders involvement in a development project in a coastal area which could reduce risk.

Materials Required: Flip Chart, Markers

Instructions:

1. Divide the participants in 5 groups and provide each group with a scenario based on the five priorities of the HFA. The scenarios could be as follows; If your agency is implementing a development project in a coastal area which would indirectly reduce risk from natural hazards;

   Group 1: Define the project and discuss which stakeholders would you work closely with at the local level to incorporate DRR in your project

Group 2: Define the project and discuss how would you make sure the activities you are planning under your project would be safe from impacts of natural hazards;
Group 3: Define the project and discuss how can you raise awareness among the communities on the benefits of the project;
Group 4: Define the project and discuss which development agency you would be working closely with and what inputs would you require from them in order to reduce risk
Group 5: Define the project and discuss in what sort of activities can you involve the local volunteer organization in the project to ensure sustainability of the project

2. Each group would be requested to present the findings of the discussions and discussions would be facilitated to clarify the concepts and connect the links between the five groups.

Session_3.3 Linking DRR and Climate Change Adaptation

Session learning Objectives

At the end of the session the participants would be able to identify some responses and options for Climate Change Adaptation and its linkages with DRR

Session Duration

Presentation: 40 minutes
Discussion: 20 minutes
Total: 60 minutes

Key Terminologies

- Adaptation Adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploit beneficial opportunities. (Source: Extracted from GLOSSARY, IPCC 4th Assessment Report, Working Group 2)
- Adaptive capacity (in relation to climate change impacts) The ability of a system to adjust to climate change (including climate variability and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequences. The whole of capabilities, resources and institutions of a country or region to implement effective adaptation measures. (Source IPCC 4th Assessment Report, Working Group 3, Glossary)

Table 3.3.1 Considerations on coastal ecosystem and climate change

Coastal Ecosystem	Considerations
Beach and Rocky shore	• Migrating in-land as widespread phenomenon • Local response depends on total sediment budget • Tendency for embayment infilling major changes in shoreline geography
Deltas	• Often heavily populated • Land subsidence accentuates impact of SLR • Simplification of delta structure, e.g. for transportation, greatly increases sensitivity
Estuaries and Lagoons	• Increased salinity • Potential decreased water residence time (if increased freshwater run-off) • Increased water temperature • Increased impact of storms
Coral Reefs	• Overall coral health is key • Bleaching, storm damage can negatively affect vertical accumulation rate • High CO2 rates and more acidic water slows growth
Mangroves and Sea Grasses	• Highly sensitive to impacts of CC - all models anticipate significant losses • Local hydrological conditions and sediment budget determine fate • Landward progression observed, but may be blocked by natural or human barriers

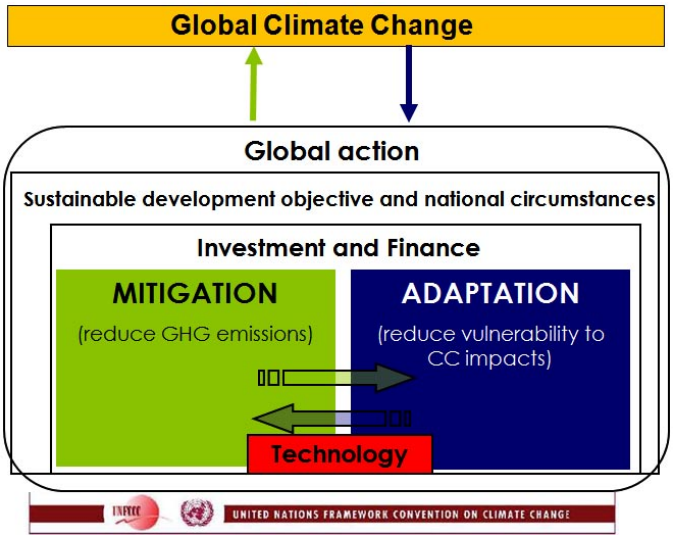
(Source; Presentation made by UNEP at MFF Regional Training on 'Applying Project Cycle Tools to Support Integrated Coastal Zone Management', Semarang, Indonesia, October, 2008)

Key Concepts

This session would cover the following concept:

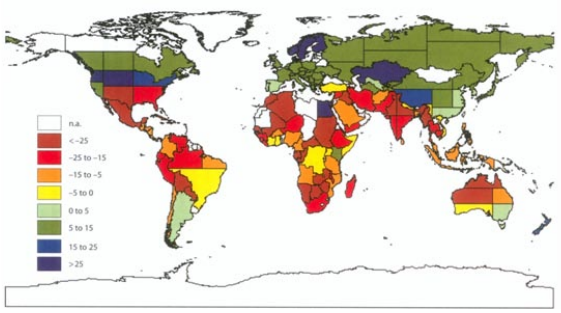
1. In Session 2.6 the impact of climate change on coast is discussed. Table 3.3.1 shows the considerations on coastal ecosystem and Climate Change.
2. Though healthy ecosystem are often the victims but they can also play an important role in reducing risk from natural hazards as well as climate change mitigation. For example; mangroves can act as green belt to reduce the impact of hazards on the coast as well as they serve as carbon sink.
3. Globally the efforts taken up for reducing the impacts of Climate Change is through Mitigation and Adaptation (Figure 3.3.1). In simple words Mitigation looks at the efforts to decrease the amounts of greenhouses gases released to the atmosphere, and Adaptation considers taking the right measure to reduce the negative impacts of Climate Change and is a process through which societies are better able to cope. The discussion in session would concentrate on Climate Change Adaptation.

Figure 3.3.1 Efforts for reducing impacts of climate change



4. In order to explain further let us look at what Climate Change Adaptation means to the Agriculture sector. Because of the impact of Climate Change and change in precipitation pattern, some of the typical impacts on the Agriculture sector are decrease in crop yields, reduction in soil fertility, shifts and changes in lengths of growing seasons and ultimately leading to food insecurity. Furthermore, the figure 3.3.2 shows the projected percentage change in agriculture productivity in 2080 and which clearly highlights that though for some countries (countries shown in light green to dark blue in the map) agriculture productivity from climate change would increase, the overall impact would be negative (countries shown in yellow to dark red in the map). This highlights the need to undertake adaptation strategies such as crop diversification, improved irrigation and fertilizer, mixed farming systems (crops, livestock and trees), dams for water storage, water harvesting, and storage, reduction of run-off and drainage systems.

Figure 3.3.2 Potential impact on agriculture-projected percentage change in agricultural productivity in 2080

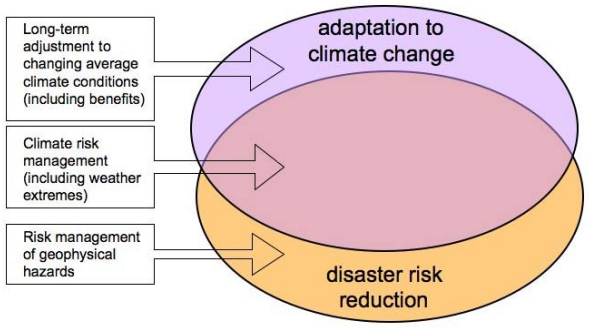


(Source; Cline 2007)

5. Adaptation is classified as Anticipatory and Reactive. While Anticipatory would include responses aimed at reducing exposure to future risk posed by climate change, Reactive includes actions implemented as a response to an already observed climate impact. Table 3.3.2 shows types of adaptation in the context of coastal ecosystem:

6. Most impacts of climate change, especially in the short to medium term, will materialize through variability and extremes. Hence reducing disaster risk is thus a no-regrets Climate Change Adaptation strategy. Climate Change Adaptation and DRR have similar aims and mutual benefits. They are two complementary approaches for sustainable development with areas of overlap offering opportunities for synergies (Figure 3.3.3). They are both closely linked to the poverty alleviation agenda and economic growth and are means to achieve the MDGs and sustainable development. Thus DRR and climate change adaptation should largely be managed as one integrated agenda.
7. The technology for adaptation in coastal zone is of three types namely; Protect, Retreat and Accommodate. Table 3.3.3 provides examples of adaptation in the coastal area and shows its close linkage with DRR.
8. In summary, the need for adaptation is inevitable and we need to take action immediately. Especially for developing countries, climate change is today's crisis, not tomorrow's risk: adaptation matters for development and has to start now. Table 3.3.4 summarizes some of the key needs and actions.

Figure 3.3.3 Disaster risk reduction and climate change adaptation



(Source; Presentation made by GFDRR, World Bank at ASEAN DRM Training Course, Yangon, July 2009)

Table 3.3.2 Types of adaptation in the context of coastal ecosystem

Anticipatory	Reactive
Natural systems	
• Increased ecosystem management • Biodiversity conservation • Protection and conservation of coral reefs, mangroves, sea grass and littoral vegetation • Development of legislation for coastal protection • Research and monitoring of coast and coastal ecosystems	• Longer or shorter growing season • Migration of wetlands • Changes in ecosystems • Protection and conservation of coral reefs, mangroves, sea grass and littoral vegetation
Human systems	
• Establishing new building codes (flood-proof houses on stilts) • Buying hazard insurance • Installing early warning systems • Improved risk management/ coastal zone planning • Enhanced water management • Improving coastal defenses through reforestation/ afforestation (greenbelts), hard structures (if needed) • Integrated CZM • Set-back areas	• Moving home • Changing occupation • Changing insurance premium • Buying air conditioning systems • Offering compensation or subsidies • Enforcing building codes • Beach nourishment • Protection of economic infrastructure • Public awareness to enhance protection of coastal and marine ecosystems • Building sea walls

(Source; modified from UNFCCC 2006 and UNFCC 2008)

Table 3.3.3 Examples of adaptation in coastal areas and linkage with DRR

Protect	Retreat	Accommodate
Protect existing assets and livelihood from Sea Level Rise Seek to exclude the hazard	Avoiding SLR in order to eliminate a direct impact Seek to remove human activities from hazardous zone	Accommodate SLR, reducing the overall severity of damages Allows human activities and hazard to co-exist
• Hard structures – dykes, sea-walls, tidal barriers, detached breakwaters • Soft structures – dune or wetland restoration or creation, beach nourishment, greenbelts, biodiversity conservation • Indigenous options walls of wood, stone or coconut leaf, afforestation	• Establishing set-back zones • Re-locating threatened buildings • Phasing out development in exposed areas • Creating upland buffers • Rolling easements	• Early warning and evacuation systems/ increased awareness • Hazard insurance • New agricultural practices, such as using salt-resistant crops • New building codes • Desalination systems

(Source; Modified from UNFCCC 2006)

Table 3.3.4 Key needs and actions for climate change adaptation	
What is Climate Change Adaptation?	Adapt to the impacts. Need better analyses at national-local level.
Why is it necessary	Adaptation is necessary for development. Climate risks undermine growth and hurt the poor.
When do we start it?	Need to start now to adapt to current climate variability in a cost effective way and prepare for the future.
The good news	In a very real sense development is the best adaptation: strong institutions, education, health, infrastructure, and a diversified economy strengthen resilience.
Understand risk and priorities	Develop hazard and risk analysis, use improved climate data, climate risk analysis, adaptation needs assessments.
Stakeholders	Involve key stakeholders with regular meetings, comprehensive, Processes led by researchers that focus on technical modeling will reduce stakeholder engagement.
Plans	Identify and appraise options, develop plans.
Don't rework government objectives	Mainstreaming in existing strategies ensures that objectives are met, use sectoral strategies to reach local governments and communities, build on existing platforms
Design policies	Encourage a shift towards climate-resilient growth across all sectors of the economy.
Line Ministries	Provide budget allocation for: • Climate resistant public infrastructure (e.g., roads, dams) • Preparedness and emergency response to extreme events • Information to help citizens in their everyday decisions (e.g., early warning systems, seasonal forecasts) • Research and Development (R&D) and extension services in agriculture • Preparedness of the health sector for new diseases
Plan ahead with contingency plans	Provision for unforeseen events; create contingency funds, sign contingent loans, and/or buy insurance for emergency responses to climatic disasters.

(Source; Presentation made by GFDRR, World Bank at ASEAN DRM Training Course, Yangon, July 2009)

References for Key Concepts

- Paragraph 1,2, 3, 5 and 7; Presentation made by UNEP at MFF Regional Training on 'Applying Project Cycle Tools to Support Integrated Coastal Zone Management', Semarang, Indonesia, October, 2008
- Paragraph 4, 6 and 8; Presentation made by GFDRR, World Bank at ASEAN DRM Training Course, Yangon, July 2009

Session Delivery

Power point Presentation (provided in the attached CD)

Group Exercise:
Objective:
Materials Required: Flip Chart, Markers
Instructions:

1. Divide the participants in 4 groups
2. Each group is requested to fill up table 3.3.5 which would recommend possible anticipatory adaptation measures for the four sectors mentioned and highlight wherever these recommendations are linked to DRR;

Table 3.3.5 Group Exercise		
Sector	**Adaptation Measures**	**Link to DRR**
Agriculture		
Fisheries		
Tourism		
Housing		

3. Each group would be requested to present the findings of the discussions. It is to be noted that the same sectors were provided in the group exercise under Session 2.6 which enabled the participants to understand the possible impacts of Climate Change on the sectors. Now with this exercise they would be able to identify possible recommendations for adaptation for the same sectors and explore wherever these recommendations are linked to DRR.

Module 4
Assessing the coastal risk from natural hazards

Modular Learning Objectives

At the end of the Module the participants would be able to:

- Discuss the various steps in undertaking risk assessment in coastal areas
- Identify the information to be collected and agencies to be involved in undertaking risk assessment
- Recognize the critical factors for success for risk assessment
- Appreciate the importance of undertaking risk assessment in CZM programs/projects
- Explain the importance, components and process of community risk assessment
- Explain principles and features of participatory tools and techniques
- Describe common tools for participatory community risk assessment
- Understand the importance of environmental assessments after disasters in order to identify, define, prioritize environmental issues in disaster situations threatening human life and welfare so that their effects can be minimized.

Sessions

This Module would consist of four (4) sessions as follows:
Session 4.1: Undertaking Risk Assessments in Coastal Areas
Session 4.2: Community based risk assessment (Optional)
Session 4.3: Risk Assessment- Hands on
Session 4.4: Rapid Environmental Assessment in post disaster situation (Optional)

Session_4.1 Undertaking risk assessment in coastal area

Session learning Objectives

At the end of the session the participants would be able to understand the need and various steps involved in undertaking risk assessment, the type of information required, agencies involved and its specific importance in CZM.

Session Duration

Power point Presentation: 45 minutes
Discussions: 15 minutes
Total: 60 minutes

Key Terminologies

- Risk Assessment: A methodology to determine the nature and extent of risk by analyzing potential hazards and evaluating existing conditions of vulnerability that together could potentially harm exposed people, property, services, livelihoods and the environment on which they depend.

  Comment: Risk assessments (and associated risk mapping) include: a review of the technical characteristics of hazards such as their location, intensity, frequency and probability; the analysis of exposure and vulnerability including the physical social, health, economic and environmental dimensions; and the evaluation of the effectiveness of prevailing and alternative coping capacities in respect to likely risk scenarios. This series of activities is sometimes known as a risk analysis process.
  (Source; UN/ISDR, 2009)

Key Concepts

This session would cover the following concepts:

1. Risk assessment is based on the recognition that risk is the result of the link between hazard, exposure and vulnerability. The goal of risk assessment is to use this link to estimate and evaluate the possible consequences and impacts of extreme natural events on a population group and their basis for life. This involves impacts at the social, economic and environmental levels. Hazard and vulnerability analyses are parts of risk analysis, and are inseparable activities –vulnerability analysis is not possible without hazard analysis, and vice versa.
2. Risk assessment is not a static one-time process, but rather a dynamic process which is constantly adjusting to changing vulnerabilities, hazards and risks.
3. Thus the goal of risk assessment is :

   To identify possible hazards and vulnerabilities of population groups to natural events, to analyse these and to estimate and assess both the probability of occurrence and the possible potential damage of such natural events; to identify and study possible weaknesses and gaps in existing protective and adaptive strategies.

   To formulate realistic recommendations for measures to overcome weaknesses and reduce the identified and assessed disaster risks and to agree these with those affected. It is particularly important here to identify and improve existing capacities as well as protective strategies.

   To ensure and enhance the feasibility, effect and efficiency of protective measures by working from the risk analysis to a) balance the various interests, b) consider the reasonability of measures and c) make possible social agreements on strategies and measures to reduce disaster risks.
4. Steps in risk assessment:

   Step 1: Hazard assessment is the basic step in risk assessment. It helps to identify the threats and understand their nature and behaviour and helps to answer the following:
   - Where will the hazards occur?
   - What will be the frequency and severity of the hazards?
   - Builds on historic events
   - Intensity/frequency curves for each location
   - Visualization with hazard maps

   Step 2: The next step in undertaking risk assessment is preparing an inventory of assets. This helps us to understand what is at risk? (Exposure) The task would include development of an inventory of elements at risk and their valuation. However, the major issue faced in this step is the lack of availability of data and the issue of data confidentiality.

   Step 3: Vulnerability assessment helps to identify the root causes of elements at risk and the reason why these can be damaged. Some specific hazard related vulnerabilities would include; vulnerable groups (social vulnerability); unsafe infrastructure (physical vulnerability), non diversified economy (economic vulnerability) and deforestation (environmental vulnerability). The findings of a typical vulnerability assessment matrix is shown in Table 4.1.1

   Step 4: In this final step, hazard, exposure and vulnerability are combined to develop the risk maps which can be used for purpose of visualization, building codes, land use planning, emergency preparedness, insurance schemes, awareness raising, development of master plans in urban areas, cost benefit analysis etc.
5. As shown above in Table 4.1.1, since the elements at risk (e.g. crops, houses, forests etc) are component of development sectors be it agriculture, housing, health etc and their characteristics (location, height etc) that contribute to the vulnerability are often determined through development projects, it is essential that all major development projects in hazard prone areas should undertake risk assessment in planning stage. This

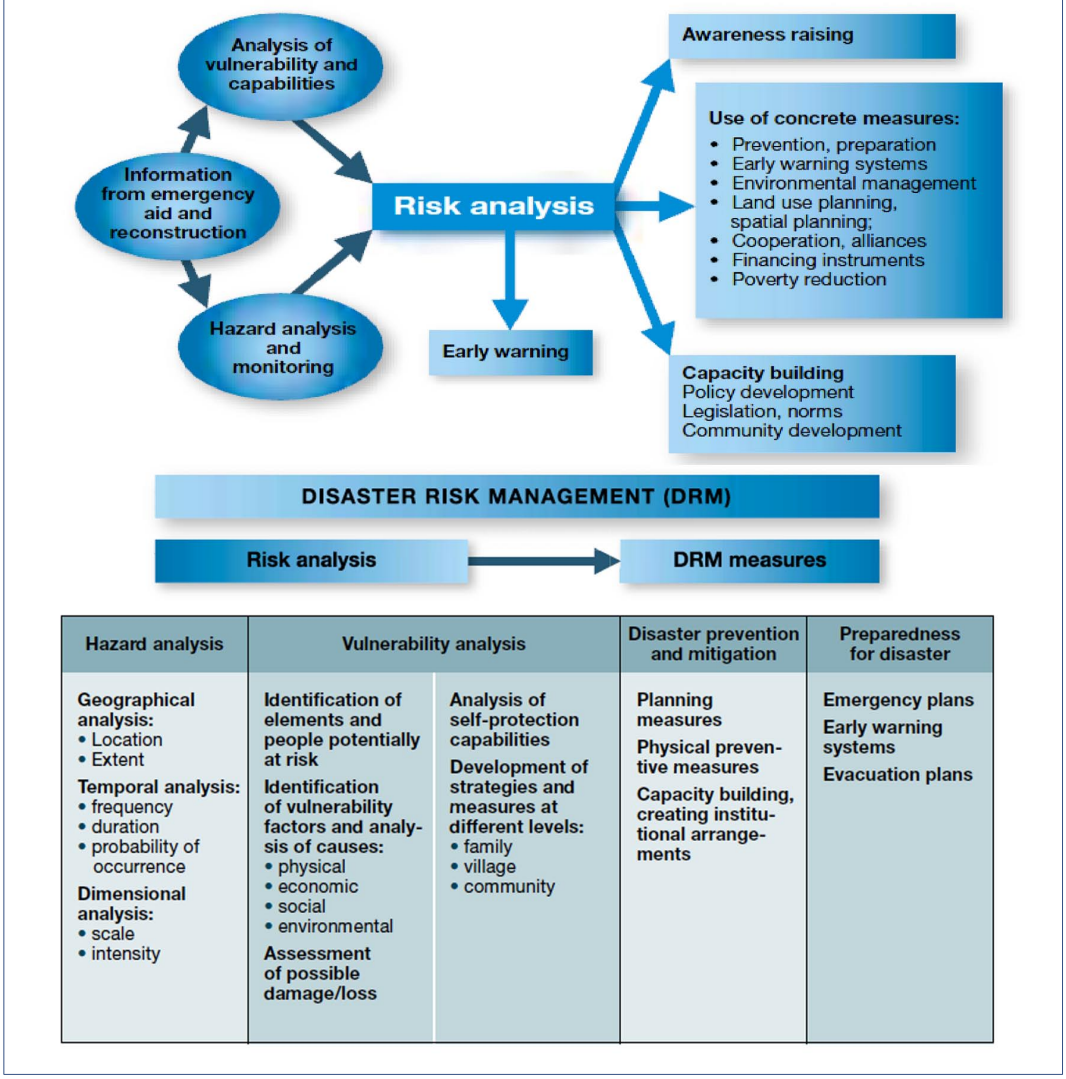
applies even to development projects in coastal areas. Thus coastal zone managers in charge of developing projects

6. In this context, it is to be remembered that Climate Change impacts hazard risks. Change of magnitude and frequency of extreme events, change of average climatic conditions and climate variability, affecting underlying risk factors and development of new threats, all impact the hazard risk. Thus risk assessment for DRR and CCA should be considered as a continuum.

Table 4.1.1 Findings of a typical vulnerability assessment matrix

Setting	Elements at Risk (EAR)	Effects on different EAR	Characteristics of EAR that contribute to vulnerability
Rural	Crops and Fodder	Destroyed, put on fire	Height, water dependent/non-dependent
	Environment	Damage to vegetation, harm to flora and fauna, damage to water ways, mountains	Terrain type, nature of flora and fauna
	Land	Erosion, salinity, deposits, desertification	Location, elements of soil, terrain
	Irrigation system	Deposit of silt, breaking of channels, damage to machinery	Location, design, construction materials
	Animals	Injured, died, disease	Location, characteristics of species, health

Figure 4.1.1 Inputs and Outouts in risk analysis



(Source: Guidelines Risk Analysis – a Basis for Disaster Risk Management, GTZ, 2004)

7. However, carrying out a risk assessment requires usage of wide range of data sets for each of the process steps, mix range of tools which depends on the scope of the project, area, population involved etc. It also depends on the skills available with the project team or agency. In any case since a whole range of factors are involved in risk assessment, close partnership with various agencies is essential as often different agencies are involved in maintaining the baseline date/information.
8. Figure 4.1.1 shows the "Inputs" and "Outputs" in risk assessment and how risk assessment leads in identifying DRM measures respectively.
9. Products of risk assessment

   The products most frequently created in different steps of risk assessment include hazard maps and risk maps.

   - Hazard maps: these are maps which give qualitative and quantitative information on natural hazards, e.g.by presenting the expected danger or maximum level of danger or the event, e.g. slopes at risk from landslides.
   - Risk zone maps: these provide information on the probability of occurrence (in the case of earthquakes, contain the building standards needed for disaster reduction). This is generally the result or product of a hazard analysis.
   - Risk maps are risk zone maps which also contain quantitative information on the risk and the impacts on people, property, environment, etc.

References for Key Concepts

- Paragraph 1,3, 8 and 9 Guidelines Risk Analysis – a Basis for Disaster Risk Management, GTZ, 2004
- Paragraph 6; Presentation made by GFDRR, World Bank at ASEAN DRM Training Course, Yangon, July 2009

Session Delivery

Power point Presentation (provided in the attached CD)

Discussions:

Participants would be requested to share details of their experience in undertaking risk assessments. The discussion could focus on the following:

- Have you been associated in undertaking risk assessment in the planning stage of any development project in the coastal areas?
- Have you seen any impact on/ of development project for not undertaking risk assessment?

Session_4.2 Community based risk assessment

Session learning Objectives

At the end of the session the participants would be able to understand the importance, components and processes of community based risk assessment and discuss some of the common tools used in the process.

Session Duration

Power point Presentation: 30 minutes
Discussion: 15 minutes
Total: 45 minutes

Key Terminologies

- Community- In the context of DRR, a community can be defined as people living in one geographical area, who are exposed to common hazards due to their location. They may

have common experience in responding to hazards and disasters. However, they may have different perceptions of and exposure to risk. Groups within the locality will have a stake in risk reduction measures (either in favour or against).

- Community-Based Disaster Risk Reduction (CBDRR)- A process of DRR in which at risk communities are actively engaged in the identification, analysis, treatment, monitoring and evaluation of disaster risks in order to reduce their vulnerabilities and enhance their capacities. This means that the people are at the heart of decision making and implementation of DRR activities. The involvement of the most vulnerable is paramount and the support of the least vulnerable is necessary.

(Source; ADPC)

Key Concepts

This session would cover the following concepts:

1. Community based disaster risk assessment is a *"participatory process of determining the nature, scope and magnitude of negative effects of hazards to the community and its households within an anticipated time period." (Source; Asian Disaster Preparedness Center).* It is a seven step process (Figure 4.2.1) However, the process is not entirely linear; thus, simultaneous activities are involved in the disaster risk assessment process. Typically the process is seen as an empowering one and includes the following steps: risk assessment, risk analysis and action-planning whereby concrete steps are developed to reduce vulnerability and risk.

Table 4.2.1 Steps for undertaking community based risk assessment

	Steps	Objective	Output
Risk Assessment	1	Describe hazards in the community	List and nature of hazards
	2	Conduct hazard mapping	Community hazard map, community resource map digitized map
	3	Describe vulnerabilities and capacities of community, of women and men	Capacities Vulnerabilities Analysis (VCA)
	4	Determine disaster risks	Comprehensive list of risk faced by the communities
	5	Rank disaster risk	Prioritized list of risks
	6	Decide on acceptable level of risk	Agreed level of risk for family and community security
	7	Decide whether to prevent, reduce, transfer, or live with the disaster risk/s	Agreed strategies

(Source; Community-based disaster risk management, Field Practitioner's Handbook, ADPC, 2004)

2. In the context of community development projects in coastal areas, undertaking community based risk assessment becomes a key to understand the elements at risk and how the proposed development project could be less impacted by the risk or can contribute to reducing the risk. The process should broadly follow the seven steps outline in Table 4.2.1. However, the coastal zone managers responsible for implementing the project should keep in the mind the following while undertaking the community level assessment:
   - Not to rely on information alone, but also use observations and keep cross checking.
   - Look, Listen and learn.
   - Facilitate. Don't dominate. Don't interrupt. Don't Interfere

- Convert hurdles into opportunities.
- Meet people when it suits them
- Spend maximum time in the villages
- Show interest in learning from people
- Don't indicate doubts or disbelief about responses

3. The assessment uses participatory rural appraisal (PRA) tools. Some of the commonly used PRA technique in participatory disaster risk assessment are as follows:
   - Step 1-2: Time line, Resource Mapping, Seasonal Calendar, Ranking, Transect
   - Step 4 -5 : Matrix Ranking, Proportional piling
4. Some of the PRA tools are described below:

   Hazard and Resource Map: Community members know the hazards that confront their communities. For their sake alone, they do not have to draw the hazard map. Hazard maps are made for the benefit of "outsiders" like NGO workers. But hazard and resource mapping is a tool that allows community members to identify graphically the vulnerable members of the community especially the elderly and disabled who are put at risk by hazards such as floods. This tool also enables community members to look at their resource base and make an inventory of their capacities. Children make very good maps of their community.

   Objectives:
   - To identify areas at risk from specific hazards and the vulnerable members of the community
   - To identify available resources that could be used by community members in disaster risk reduction

   Sample Key Questions
   - What are the hazards that put the community at risk?
   - What places/areas in the community are at risk?
   - What community infrastructures or critical facilities are in danger?
   - Who are the people that are most exposed to risk and will likely need assistance?
   - What resources can be found in the community?
   - Who have the least resources in the community (family or community members)?
   - Who have access and control over the available resources?
   - What resources are at risk?
   - Why are they at risk?

   Matrix Ranking: Ranking tools are used to prioritize hazards or disaster risks, needs or options. There are many variations of ranking. The example below uses a set of criteria to determine the impact of the disasters on people's lives. The community members use beans to rank the hazards. Ten beans are used to indicate the most significant indicator and 1 bean to indicate the least significant indicator.

   Objectives: To determine the hazard that has the most serious impact on the community

   Sample Key Questions
   - What are the hazards the community face?
   - What is the impact of each hazard?
   - Which is the most destructive of all the hazards?

Case Study

Vulnerability and capacity assessment in the Solomon Islands

In 2004, Vulnerability and Capacity Assessment (VCA) were undertaken in three communities of the Solomon Islands in the Pacific. The process entailed community groups assessing local risks and hazards with the help of the local branch of the Solomon Islands Red Cross. The recommendations in one of the communities led to small-scale mitigation projects undertaken by the community themselves that have resulted in a reduction of seasonal flooding, safer water supplies and a reduction in mosquitoes, as stagnant water sources were cleaned. Through the participatory VCA methodology, the community identified that debris and timber from logging were blocking the river and causing the flooding in their community during heavy rains. The community then put an action plan together and organized a clean-up campaign. The VCA and clean-up campaign involved representatives from two community groups who speak different languages. The process also helped to bring the two communities closer.

(Source: IFRC)

References for Key Concepts

- Community-based disaster risk management, Field Practitioner's Handbook, ADPC, 2004

Session Delivery

Power point Presentation (provided in the attached CD)

Discussion:

The participants would be encouraged to share their experience in involvement of community based activities in the coastal areas and discuss their observation on involving communities in reducing risk and some of the typical challenges encountered.

Session_4.3 Risk assessment-Hands on

Session learning Objective

At the end of the session the participants would be able to get a hands on in undertaking a risk assessment

Session Duration

Group Exercise: 120 minutes
Presentation by Groups and Discussions: 60 minutes
Total: 180 minutes

Session Delivery

Group Exercises:

Objective:
Materials Required: Flip Chart, Markers

Group Exercise 1: Identification of Hazard
Instructions:

- Divide the participants into 3 Groups
- Each group to identify a community development project in
- Coastal area (Team 1)
- River basin (Team 2)

- Delta (Team 3)
- Identify at least 3 Hazards which affect the area (e.g. cyclone)
- Each group to fill in table 4.3.1

Table 4.3.1 Group Exercise			
Elements at Risk	Hazards		

Group Exercise 2: Identify elements at risk
Instructions:

- Identify at least 3 elements of risk in the area in which you are planning to implement the project (e.g. houses)
- Discuss why are these elements at risk
- Each group to fill in table 4.3.2

Table 4.3.2 Group Exercise		
Elements at Risk	Effects on different elements at risk	Characteristics of elements at risks that contribute to vulnerability

Group Exercise 3: Identify risk level
Instructions:

- Prepare Risk Matrix (Table 4.3.3)
- Develop Risk Statements (at least 3) (e.g. There is a risk that the roofs of the houses would be damaged because of the cyclone)
- Identify Risk Levels using Probability and Consequence (Table 4.3.4)

Table 4.3.3 Group Exercise			
Risk Level			
Risk Statement	Probability	Consequence	Risk Level

Table 4.3.4 Group Exercise					
	Consequence				
Probability	Minor	Moderate	Major	Disastrous	Catastrophic
Certain	Medium	High	High	Very High	Very High
Likely	Medium	Medium	High	High	Very High
Possible	Low	Low	Medium	High	High
Unlikely	Very Low	Low	Medium	High	High

Session_4.4 Rapid environmental assessment in post disaster situation

Session learning Objectives

At the end of the session the participants would be able to understand the importance of identifying and prioritizing environmental issues in post disaster situations which could threaten human life and welfare so that their effects can be minimized. This would be done by introducing the tool on Rapid Environmental Assessment (REA) developed by Benfield Hazard Reasearch centre.

Session Duration

Power point Presentation: 40 minutes
Discussions: 20 minutes
Total: 60 minutes

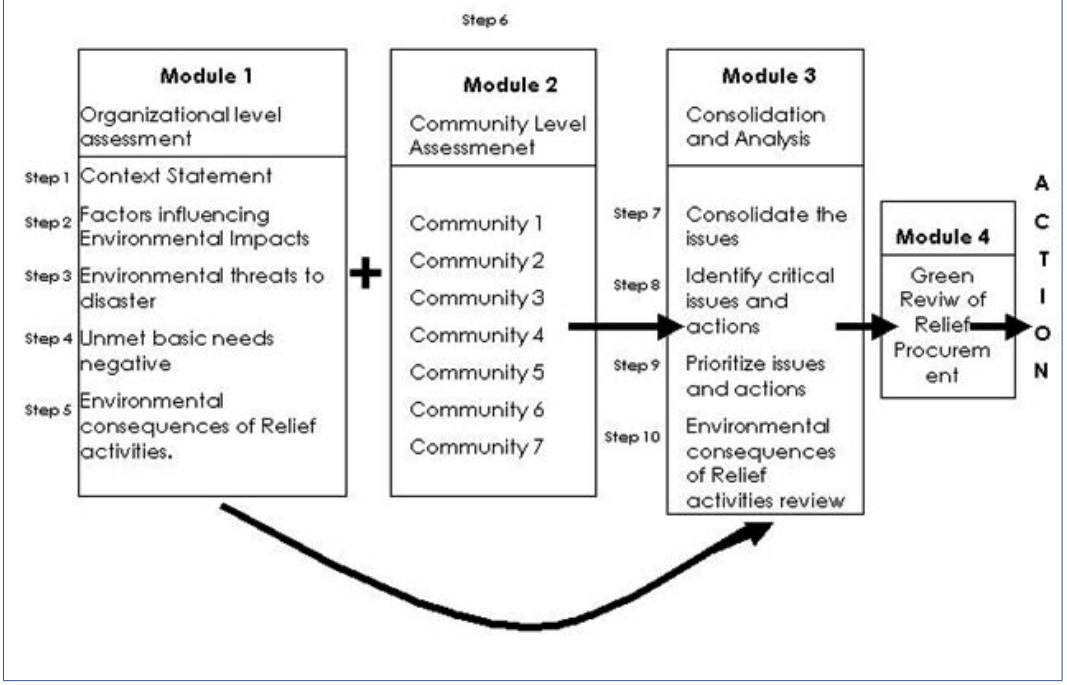
Key Concepts

This session would cover the following concepts:

1. Disasters can result in negative environmental impacts and so too relief aid. Hence environmental assessment is a must immediately after a major disaster. Those who respond to disasters have little time for in depth research and are not likely to be environmental specialist. Actions must be taken quickly and cannot wait for a lengthy, quantitative and thorough assessment process.
2. Rapid Environmental Assessment (REA) is a rapid assessment tool to: identify, define, and prioritize environmental issues in disaster situations threatening human life and welfare so that their effects can be minimized.
   REA is:
   - Simple and rapid;
   - Designed for use in natural, technological and/or political disasters;
   - A useful way to organize and make sense of environmental information available in disasters;
   - A consensus-based qualitative assessment process; and
   - Used to identify follow-up actions during a disaster (Not a tool which provides answers on how to resolve environmental issues)
3. Figure 4.4.1 shows the various process steps involved in REA. As shown in the figure, the REA process takes into account assessment from both an organisational point of view as well as the community perspective. The objective of the organizational level assessment is to identify which of the interventions should be changed to avoid negative impacts, which needs to be implemented despite negative impacts and which needs to be canceled or avoided due to possible negative impacts. Similarly, the community level assessment helps to identify the potential environmental impact of the disaster, identify

the role of the affected people to address negative environmental impacts and identify best practices for relief operations taking into account the views and needs expressed by the affected people_ Both the organizational and community level assessments are consolidated to identify priority issues which need to be addressed.

Figure 4.4.1 Process steps involved in Rapid Environmental Assessment



(Source; Guidelines for Rapid Environmental Impact in Disasters, Benfield Hazard Research Centre)

References for Key Concepts

- Guidelines for Rapid Environmental Impact in Disasters, Benfield Hazard Research Centre

Session Delivery

Power point Presentation (provided in the attached CD)

Discussions:

The discussion would focus around seeking inputs from the participants on possible approaches for reducing impacts on environment of disasters and particularly the impact from the response and relief phase of disasters.

Module 5
Measures for DRR in coastal areas

Modular Learning Objectives

At the end of the Module the participants would be able to:

- Discuss the various types of man-made structure measures and their advantages and disadvantages in reducing disaster risk in coastal areas
- Understand the importance of structural ecosystem based measures for DRR
- Discuss how to identify appropriate and adequate structural ecosystem based risk reduction measures for coastal areas
- Appreciate the importance of non structural measures for coastal risk reduction
- Recognize the importance of adopting an integrated approach of coastal zone management for reducing risk.

Sessions

This Module would consist of four (4) sessions as follows:
Session 5.1: Structural measures; man -made
Session 5.2: Structural measures Ecosystem based
Session 5.3: Non structural measures for DRR
Session 5.4: Integrated approach for reducing risk in coastal area

Session_5.1 Structural measures; man-made

Session learning Objectives

At the end of the session the participants would be able to discuss the various types of commonly used man-made structural measures and their advantages and disadvantages in reducing disaster risk in coastal areas.

Session Duration

Power point Presentation: 45 minutes
Discussion: 15 minutes
Total: 60 minutes

Key Terminologies

- Structural measures: Any physical construction to reduce or avoid possible impacts of hazards, or application of engineering techniques to achieve hazard-resistance and resilience in structures or systems. Comment: Common structural measures for DRR include dams, flood levies, ocean wave barriers, earthquake-resistant construction, and evacuation shelters.
  (Source; UNISDR, 2009)

Key Concepts

This session would cover the following concepts:

1. Coastal structural measures which are man-made involve physical construction for coastal protection, and include engineering measures and construction of hazard-resistant and protective structures such as groynes, breakwaters and seawall. These structures have different purposes and functions and which typically cover:
   - Protection of a receding coastline endangering land and other assets;
   - Protection of low lying areas under natural protection of a beach barrier or dune system;

- Control of undesired fluctuations of the coastal profile around tidal inlets and river estuaries;
- Maintenance of coastal areas of recreational value, in particular, related to tourism;
- Specific protection around and in the vicinity of coastal installations such as harbours, cooling water intakes and marine highways.

2. Coastal protection schemes can be broadly divided into two categories namely, Direct measures, which confront the problem e.g. protective structures and indirect measures which take away the cause of the problem such as preventing sand mining. The following paragraphs provide a brief description on some of these direct measures for coastal protection.
3. Groynes: A groyne is a rigid hydraulic structure built from an ocean shore (or from a bank of a river) that interrupts water flow and limits the movement of sediments. In the coastal areas they create and maintain a wide area of beach or sediment on its up drift side, and reduce erosion on the other. A field of groynes can be used effectively on an eroding part of the coast to reduce locally the long shore sediment transport capacity and thus control coastal erosion. There are many successful applications of fields of groynes having been used to reduce littoral movement and developing the shoreline. Groynes are comparatively easy to construct and their effectiveness may be increased by initially adopting artificial nourishment as required. On the negative side, a field of groynes does cause a regular interruption along the beach and a certain extent of maintenance is required. Groynes can induce local scour and can cause down drift erosion. Hence in the design of groynes due attention has to be focused on the length and permeability which influence the degree of littoral material that is trapped by the groyne, the cost and the level of efficiency required by the groyne field for a particular problem. Typically, a groyne's length and elevation, and the spacing are determined by the local wave energy and beach slope. Groynes that are too long or too high tend to accelerate down drift erosion because they trap too much sediment. Groynes that are too short, too low, or too permeable are ineffective because they trap too little sediment.
4. Artificial Headlands: The fundamental difference between a groyne and an artificial headland is that the latter is a more massive structure designed to eliminate problems of down drift erosion and promote the formation of beaches. Although these structures may take a number of different forms their geometry is such that, as with the offshore breakwater, wave diffraction is used to assist in holding and developing the beach in the lee of the structure. It is important to conduct detailed investigations in the planning and design of these types of structures.
5. Offshore Breakwaters: These are placed generally parallel to and at a certain distance from the shore. These structures can be used to change the transport capacities, both alongshore and onshore/offshore to the coast, resulting in accumulation in the lee of the breakwater. They provide stable beach plan forms and promote the development of natural beaches. These structures demand comparatively less maintenance. On the negative side, offshore breakwaters are fairly large structures and constructing them in near shore regions can be difficult. Since these structures control littoral movement they can cause erosion down drift if designed without considering this aspect.
6. Seawall: It is a form of hard and strong coastal defense constructed on the inland part of a coast to reduce the effects of strong waves. In the past these have been the most widely used option for coast and flood defense ranging from massive vertical retaining walls to sloping revetment. However, it is observed that concrete seawalls and rubble mound armoured revetments are essentially rigid and steep relative to a mobile foreshore and therefore can have substantial impact on the shoreline both in visual or amenity terms and in their effect on coastal processes. The latter can be by wave reflection or the removal of littoral material from the sediment transport system. In effect this type

of structure is used to fix the shoreline. Because of potential vulnerability to toe scour, these structures are frequently used together with some system of beach control such as groynes and/or beach nourishment. If these structures are used in isolation it is very important to provide adequate toe protection and, in the case of concrete seawalls, stability problems may occur unless the foundation of the structure is well below the seabed.

It is noted that concrete seawalls offer a wide range of alternative designs. The availability of a promenade at the top is considered an important recreational feature and the use of steps provides easy access to the beach. These steps could also be effective in dissipation of wave energy. The presence of high wave reflection leading to scour is a major problem with this type of structure. Scour at the toe erodes the beach leading to further problems. In this respect regular maintenance is required and, these structures do not aid beach stability.

Rubble mound sloping revetments armoured with rock or concrete units can be designed to offer good hydraulic performance. These structures are fairly easy to construct and little maintenance is required. However, it is important that these structures are designed with due consideration to the desired relationships between the geometrical characteristics of the individual layers as well as the stability of the toe and the head. If due attention is not focused rapid failure could set in under storm attack and in this respect regular monitoring is required. When using these structures it is necessary to provide means to access the beach.

However, as documented below by Ashoka Trust for Research in Ecology and the Environment (ATREE) in their Policy Brief: Seawalls, experiences of the tsunami in the coast of Tamil Nadu State of India shows that decisions of seawall construction must be taken after close consultation with the communities living on the coast:

- Communities usually do not prefer seawalls as it creates a hindrance to the landing and movement of their boats. For example catamaran, needs sandy beaches to land in and otherwise breaks.
- Agricultural communities are particularly apprehensive about seawalls as they believe it prevents rainwater runoff into the sea, leading to the flooding of agricultural land and degradation of the soil owing to stagnation of water.
- In many of the tsunami affected areas there have been reports that the seawalls actually magnified the damage and as a result of the stones from these walls being thrown towards the land by the tsunami waves.

7. Artificial Nourishment: In artificial nourishment an external supply of sand is used to replenish an eroding stretch of a coast. This method may appear to be expensive and the need for repletion of the process may not attract coastal engineers to adopt this technique. However, careful planning and considerations of capital and maintenance cost have proved that this method can be used effectively, particularly when there is a need to preserve the recreational function of the beach without erecting structures at regular intervals. This method will not have structures interrupting the beach other than those used as terminal structures. Artificial nourishment is attractive when the long shore drift is comparatively small. There is a need for maintenance in the form of recharging for which an economic source of sand supply is required. This method may not prove to be economically beneficial in the presence of severe wave climates which result in high rates of sediment transport. Beach nourishment schemes are generally considered the least objectionable of the coast protection methods from a view point of environmental impact as this method results in the substitution of beach material lost in the erosion process.
8. It is to be noted that these direct coastal protection measures cannot take away the cause of coastal erosion but can contribute positively to reduce its negative effects to a very great extent. Since it is extremely difficult to take materials out of the natural transport mechanism without contributing to new or increased erosion problems

elsewhere, hence before adopting such protection measures it is important to understand the near shore physical processes in the particular coastal region subjected to erosion and also the influence of adopted measures on neighboring regions. It is in this context that it is important that any major coastal protection plan should form an integral part of an overall Coastal Management Plan which considers coastal erosion master planning.

9. Thus there is a wide range of coastal protection works, which are used in practice to control a particular situation. Each of these works may perform a number of different functions, have different long term impact on the coastal ecology, and have varying engineering life spans as well as different capital and maintenance costs. Depending on the situation it may also become necessary to adopt a combination of two methods for improved performance and efficiency. In any case, in the planning stage of protection work proper Environmental Impact Assessment and Environmental Management Plans should be carried out to understand and mitigate the adverse impacts of these structures. Also periodic research and monitoring of beach profile should be undertaken along coastlines which have engineering interventions.

References for Key Concepts

- Paragraph 1,2,3,4,5,6 and 8, Adapted from National Training Course on DRR for Coastal Zone Managers; Coast Conservation Department, Sri Lanka
- Paragraph 7, Policy Brief: Seawalls; Ashoka Trust for Research in Ecology and in Environment

Session Delivery

Power point Presentation (provided in the attached CD)

Discussions:

The facilitator would show images of various kinds of man-made structural coastal protection measures and a discussion would be facilitated on each of them. The participants would be encouraged to share their experience in projects on man-made structural coastal protection measures and their views on its advantages and disadvantages.

Session_5.2 Structural measures; Ecosystem based

Session learning Objectives

At the end of the session the participants would be able to understand the importance and limitations of coastal ecosystem based structural measures for DRR

Session Duration

Power point Presentation: 45 minutes
Guest Speaker: 30 minutes
Total: 75 minutes

Key Terminologies

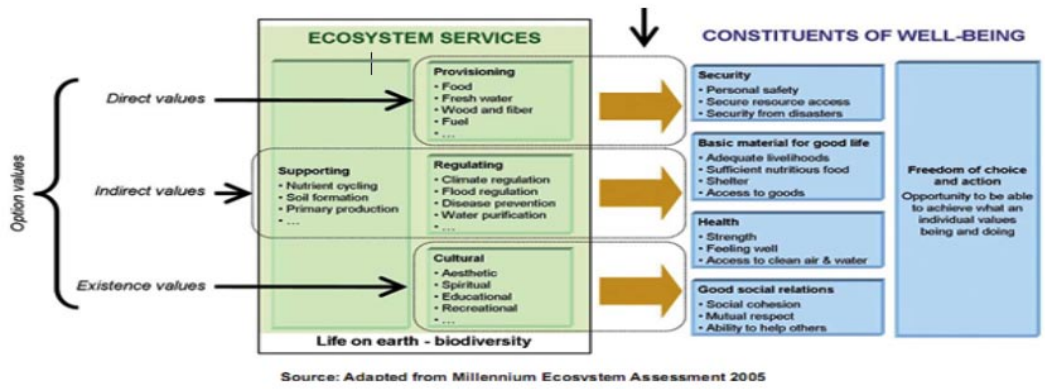
- Ecosystem based management: Management driven by explicit goals executed by policies, protocols and practices, and made adaptable by monitoring and research based on best understanding of the ecological interactions and processes necessary to sustain ecosystem structure and function (Source; Christensen et al, 1996)

Key Concepts

This session would cover the following concepts:

1. Investments in maintaining ecosystem services provides multiple benefits and one of it being the services it provides to reduce risk of natural hazards; as explained in figure 5.2.1. This role of coastal ecosystem particularly the case of bio shield has gained prominence in the aftermath of the Indian Ocean Tsunami. The section below provides a brief description of structural ecosystem based measures in coastal areas such as bio shields and sand dunes and their importance in reducing risk of natural hazards.

Figure 5.2.1 Services provided by the ecosystem to reduce risk of natural hazards



(Source: Adopted from Millennium Ecosystem Assessment, 2005)

2. Bio shields: Bio shields are coastal vegetation structures (both natural and planted) that protect the coast from storm, cyclone and even tsunamis to a varying extent. They also are of great socio- economic importance for the coastal communities and provide access to fuel wood.

   Among the various vegetations acting as the bio shields, mangroves are the most emphasized. They grow in coastal areas and estuaries, mostly in muddy alluvial soil which is submerged by seawater at least once a day and are rich in flora and fauna. They form a protective buffer by reducing the flow, mitigating the wave action and reducing the wave energy. *Experiences of mangrove plantation in countries such as Vietnam have shown that the planting of the species Kandelia Candel; plants of five to six years old planted at one meter interval reduce wave energy at a rate of 20 percent per 100 meters of forests (Source: Mazda et al 1997).*
3. Similarly, *non mangrove vegetation such as Hibiscus tiliaceus – a coastal plant (a large shrub or tree of the family Malvaceae native to Southeast Asia) is commonly used in Japan for green belts to protect housing against tsunamis. Analytical model shows that 30 trees from 100 sq m in a 100-m-wide belt may reduce the maximum tsunami flow pressure by more than 90% (Source: Hiraishi and Harada, 2003)*
4. However, there is a dichotomous view among the scientific community on the actual protective functions the bio shields play. As quoted in the Policy Brief: Bio shields by the Ashoka Trust for Research in Ecology and in Environment, whereas some studies such as the one carried out by Centre of Advanced Study in Marine Biology, Annamalai University, Tamil Nadu in 18 tsunami affected hamlets shows that the settlements behind mangroves and other coastal vegetations suffered less human death and damages, others indicated that the impact of the tsunami was highly dependent on topography (and bathymetry), distance from the shore, and other physical factors, and that vegetation contributed little, if any, protection to the coast.
5. Thus of prime concern in this regard is the choice of the species. For example as highlighted in the Policy Brief: Bio shields by the Ashoka Trust for Research in Ecology and Environment, the magnitude of energy the mangrove plantation can absorb would depend on several biological and geological factors such as tree density, stem and root

diameter, shore slope, bathymetry, spectral characteristics of incident waves and tidal stage. Thus the effectiveness of trees and forest in reducing tsunami impacts depends on width, density and structure of the vegetation, e.g. the threshold of effective hydraulic resistance for a tsunami of 4.65 meter height appears to be approximately 10 cm in diameter. On the other hand narrow strips of coastal trees can exacerbate the damage if trees collapse and add to the floating debris carried inland by tsunami. Coconuts with tall slender profile and superficial rooting system provide little or no protection against tsunami. In case of cyclones, coastal forests are efficient in reducing wind and storm wave impacts up to a certain level. Coastal forests and mangroves in narrow belts do not reduce storm surge efficiently, they can however, help to decelerate flooding velocity and trap floating debris. A dense forest can reduce 0.5 meters of surge for each km of forest. In case of casuarinas or any plantation on either side of fishing hamlets makes the settlements more vulnerable to natural events, such as cyclones, since wind is then funnelled /channelled into the hamlet with plantations on either side blocking the path of the wind. Similarly, in the case of coastal erosion, the right choice of vegetation improve the slope stability, consolidate sediment and diminish the amount of wave energy moving onshore, thus protecting the shoreline from erosion.

6. Local communities too have diverging opinions about coastal plantations. Access to and visibility of the seashore and sea is crucial for fishermen in their daily decision making. In addition, the beach is also used for fishing activities such as fish drying and mending of nets.
7. Thus bio shields should be looked from an all-inclusive interdisciplinary perspective. A complete documentation and assessment of species should be carried out for specific habitats and also the effects of bathymetry and vulnerability of the particular coast to natural hazards should be mapped. There is a need to promote mixed-species planting. Most importantly, the participation and perspectives of local communities should be mandatory before choosing the sites as well as local species being planted because it should also be a source of additional yield to local economies which will avoid illegal felling and damage to the green belt.
8. The degree of protection offered by coastal bio shields depends on a number of variables, including: (i) the characteristics of the hazard itself (e.g. type, force, frequency); (ii) the features of the site (e.g. bathymetry, coastal geomorphology); and (iii) the characteristics of the bio shield (e.g. type of forest/tree, width, height and density of the forest).
9. Care must be taken to avoid making generalizations about the protective role of forests and trees based on evidence from one or a few areas; the many factors that influence the protective role of the forests/trees must be understood and taken into consideration before lessons can be learned and applied elsewhere.
10. Coastal forests and trees are not able to provide effective protection against all hazards (e.g. extremely large tsunami waves, flooding from cyclones and certain types of coastal erosion); provisions for other forms of protection and (in extreme events) for evacuation must be relied upon. Care must be taken not to create a false sense of protection against coastal hazards.
11. Sand Dunes: Coastal sand dune is a hill of sand built by wind action (eolian process) and are of different forms and sizes based on their interaction with the wind. Sand that is brought in by the winds gets trapped by the vegetation that is found on the coasts and this accumulates to form the dune.
12. Following are some of the vital role the sand dunes plays in the coastal area:
    - It stabilises the coastline and acts as the first line of defence against erosion.
    - It acts as physical barrier protecting the hinterland from the forces of the ocean, including wave run-up due to storm surges. Wide beaches and high dunes act as efficient dissipaters of wave energy offering protection to inland property.
    - It also prevents the intrusion of saltwater as a result of inundation by large waves.

- They are vital in maintaining the groundwater level of coastal areas, which is vital in sustaining not only the flora and fauna, but also form an important source of freshwater for coastal populations.

13. Some of the major threats that lead to degradation of coastal sand dune ecosystem include sand mining, infrastructural development, pollution and wrong choice of plantations. In this context it is to be highlighted that erection of coastal protection measures such as seawalls and groynes (described in earlier session) changes the sediment dynamics of the coast, leading to drastic change in the natural balance between erosion and accretion and starves the sand supply on the adjacent sand dunes, leading to more erosion of dunes and thus increasing the vulnerability. Similarly, wrong choice of vegetation such as casuarinas plantations suppresses the dune vegetation communities and lowers the water table.
14. Considering the importance of sand dunes, the Ashoka Trust for Research in Ecology and Environment (ATREE) recommends the following possible management measures to protect this valuable ecosystem:
    - Legal protection of the existing sand dunes from further losses to anthropogenic factors, whether caused directly or indirectly.
    - Development and promotion of planning policies and procedures which will aim to prevent or minimize further losses of sand dune habitat to development.
    - Official and legal recognition and involvement of local initiatives on sand dune protection and restoration
    - Reviving of traditional sand dune restoration and management practices that have proved successful.
    - Restoration of sand dune habitat lost to forestry, agriculture or other human uses.
    - Raising public awareness of the essential mobility of coasts and the value of maintaining unrestricted coastal processes.
    - Engagement and support (monetary and technical) to local communities for the restoration and protection of sand dunes and associated ecosystems.
15. Coral Reefs: Coral reefs play a vital role protecting shorelines from both routine waves as well as the harsher conditions associated with storms and tsunamis (table 5.2.1 shows the services the coral reef provides). The relative share of protection provided by coral reefs varies greatly with coastal context—the elevation and slope of the shore, the geologic origin of the area (and resistance to erosion), and the wave energy along the coast. They act as natural breakwaters that can reduce coastal erosion. At the same time the health of coral depends on many phenomena, example erosion elsewhere can result in sediment, which is being transported and deposited on the reef, unhealthy reefs can also be indicative of poor water quality or extreme turbulence during cyclone flooding.

Table 5.2.1 Services provided by coral reefs

Provisioning Services -Products obtained from ecosystems	Regulating Services -Benefits obtained from regulation of ecosystem processes	Cultural Services -Nonmaterial benefits obtained from ecosystems
• Food-fish and shellfish • Genetic resources • Natural medicines and pharmaceuticals • Ornamental resources • Building resources	• Erosion control • Storm protection	• Spiritual and religious values • Knowledge systems/educational values • Inspiration • Aesthetic Values • Social traditions • Sense of place • Recreation and ecotourism
Supporting Services **Natural processes that maintain the other services**		
• Sand formation • Primary production		

(Source: IUCN)

References for Key Concepts

- Paragraph 4 and 5, Policy Brief: Bio shields; Ashoka Trust for Research in Ecology and in Environment
- Paragraph 8, 9 and 10: FAO. 2007. Coastal protection in the aftermath of the Indian Ocean tsunami: What role for forests and trees? Proceedings of the Regional Technical Workshop, Khao Lak, Thailand, 28–31 August 2006.
- Paragraph 12 and 14, Policy Brief: Sand Dunes; Ashoka Trust for Research in Ecology and in Environment
- Paragraph 10, National Training Course on DRR for Coastal Zone Managers; Coast Conservation Department, Sri Lanka

Case Study

Mangrove Plantation in Vietnam

The recent natural disasters have made Vietnamese officials and citizens pay closer attention to mangrove maintenance. In 1994, the Vietnamese government began a cooperative project focused on planting new trees and maintaining existing mangrove forests, with the ultimate goal of protecting both the environment and the local population. The effort is proving worthwhile. A recent World Wildlife Fund (WWF) report found that although the Vietnamese government spent $1.1 million to plant 12,000ha of trees, they saved $7.3 million/year on sea dike maintenance. Additionally, the 2000 Wukong typhoon destroyed unprotected districts, but left regions protected by mangroves unharmed.

The restoration of mangrove forests has provided economic benefits for the population. One Vietnam News report revealed that intact mangrove forests created jobs for 3,210 households. Additionally, officials estimate that villages accrue a monetary benefit of US$2200-2500 per month due to forest protection and decreased maintenance on sea dikes.

Although Vietnam still suffers from significant mangrove deforestation, its restoration policy is headed in the right direction. Mangrove forests do not guarantee full protection from storm surges, but they do mitigate the effects of one of the region's biggest threats. Therefore, it is in the best interest of the government and local population to restore and maintain nature's natural storm barricades.

(Source: World Research Institute, 2008)

Mangrove Rehabilitation Project in Kuala Sala, Kedah in Peninsular Malaysia

Damage was minimal in the Indian Ocean Tsunami in this area because of the mangroves. 30 percent of the six year old trees (which are about three meters in height) were destroyed by the tsunami. However, the stand was dense enough to dissipate the tsunami's strong energy waves. As a result they protected nearby structures and prevented saltwater intrusion into rice fields. Their buffering effect is demonstrated by the fact that about half a kilometer from the site a bridge and a seawall were destroyed, and the shoreline was heavily eroded by the same tsunami.

(Source; Tamin, 2005)

Importance of sand dunes as documented in various villages impacted by the Indian Ocean Tsunami in Tamil Nadu, India

- **Chinnurpettai:** Chinnurpettai is on elevated land and there are high sand banks right by the shore. Locals attribute the comparatively lower degree of loss and fewer deaths in the tsunami to the sandbanks and the elevated location of the village on top of dunes. All houses that were on higher ground were relatively undamaged in the tsunami as water moved into the low-lying areas around the village. Many villagers, who did not realize this advantage, ran in fear and panic onto the low-lying land near their homes and lost their lives.

- **Nambiyarnagar:** The center of the village is located on an elevated plane and hence was less affected by the tsunami. After the giant waves passed, water congregated to form a small pond on the southern side of the village. Karuvai (Prosopis juliflora) bushes, on the southern side were also washed away by the tsunami.
- **Nayakarkuppam:** The village is roughly 1 sq. km in area. The nearest seafront house stands 500 metres from the sea. A concave shaped sand dune 5 feet in height is the natural defense for the village against the sea. The dune is crest shaped, sloping down to the sea and spreading from the north to the south of the village and beyond. There are three different sand dunes between the shoreline and the village. About 50 metres east of the village is a canal that runs parallel to the shoreline. The community sees these as natural barriers.
- **Kottucherrymedu:** Sea-front houses escaped the impact of the tsunami as they were built on raised sand dunes. When the tsunami hit Kottucherrymedu, it engulfed the village from both sides leaving the houses on top of the sand dunes unaffected. The sand dunes were about 15 feet high, but the tsunami has eroded the dunes and now they only stand 6-7 feet tall.

All these villages are built on or around sand dunes. The word 'medu' in Tamil means 'raised land'. Locals refer to the sand dunes as 'medus'. Settlements have come up on these 'medus' – reflecting the local knowledge of the people about the importance of sand dunes in offering protection.

(Source: Policy Brief: Sand Dunes; Ashoka Trust for Research in Ecology and in Environment)

Session Delivery

Power point Presentation (provided in the attached CD)

Guest Speaker:

A guest speaker with experience in coastal ecosystem would be invited to share her/his experience in protective role provided by coastal ecosystem against natural hazards.

Session_5.3 Non structural measures for DRR

Session learning Objective

At the end of the session the participants would be able to recognize the importance of various non-structural measures for coastal risk reduction

Session Duration

Power point Presentation: 30 minutes
Discussions: 15 minutes
Total: 45 minutes

Key Terminologies

- Non-structural measures: Any measure not involving physical construction that uses knowledge, practice or agreement to reduce risks and impacts, in particular through policies and laws, public awareness raising, training and education.

  Comment- Common non-structural measures include building codes, land use planning laws and their enforcement, research and assessment, information resources, and public awareness programmes. Note that in civil and structural engineering, the term "structural" is used in a more restricted sense to mean just the load-bearing structure, with other parts such as wall cladding and interior fittings being termed non-structural.

- Land use Planning: The process undertaken by public authorities to identify, evaluate and decide on different options for the use of land, including consideration of long term economic, social and environmental objectives and the implications for different communities and interest groups, and the subsequent formulation and promulgation of plans that describe the permitted or acceptable uses.

  Comment: Land-use planning is an important contributor to sustainable development. It involves studies and mapping; analysis of economic, environmental and hazard data; formulation of alternative land-use decisions; and design of long-range plans for different geographical and administrative scales. Land-use planning can help to mitigate disasters and reduce risks by discouraging settlements and construction of key installations in hazard-prone areas, including consideration of service routes for transport, power, water, sewage and other critical facilities.
- Building Codes: A set of ordinances or regulations and associated standards intended to control aspects of the design, construction, materials, alteration and occupancy of structures that are necessary to ensure human safety and welfare, including resistance to collapse and damage.

  Comment: Building codes can include both technical and functional standards. They should incorporate the lessons of international experience and should be tailored to national and local circumstances. A systematic regime of enforcement is a critical supporting requirement for effective implementation of building codes.
- Early Warning Systems: The set of capacities needed to generate and disseminate timely and meaningful warning information to enable individuals, communities and organizations threatened by a hazard to prepare and to act appropriately and in sufficient time to reduce the possibility of harm or loss.

  Comment: This definition encompasses the range of factors necessary to achieve effective responses to warnings. A people-centred early warning system necessarily comprises four key elements: knowledge of the risks; monitoring, analysis and forecasting of the hazards; communication or dissemination of alerts and warnings; and local capabilities to respond to the warnings received. The expression "end-to-end warning system" is also used to emphasize that warning systems need to span all steps from hazard detection through to community response.
  (Source; UN/ISDR, 2009)

Key Concept

This session would cover the following concepts:

1. Non-structural measures to reduce disaster risk can be broadly categorized under two headings; measures to reduce the physical exposure of the hazard such as implementation of coastal setback, land use planning and measures to reduce the vulnerability such as following building codes for construction in coastal areas, having an effective system of early warning in place, implementing poverty reduction initiatives etc. The following paragraph provides brief description on some of the non-structural measures for reducing disaster risk in coastal areas:
2. Coastal Setbacks: Typically coastal setback is defined as the geographical strip or band within the coastal zone within which certain development activities are prohibited or significantly restricted. The provision of setbacks has previously been forwarded as an important issue when developing coastal management plans. In several cases, they were employed to specifically address the issues of coastal erosion. Example of it can be found in Sri Lanka (Coast Conservation Department, 1990) and in Malaysia (Department of Irrigation and Drainage, 1997). *In Sri Lanka, a setback that prohibited construction within 100 m of the mean high water mark is enshrined in its Coast Conservation Act of 1981. (Source; Thia-Eng Chua; The Dynamics of Integrated Coastal Management)*
3. Setback is used to reduce physical exposure of the development activity to hazards and to restrict investments in high risk areas. On the other way, maintaining a setback in the

beach front allows the dynamism of the coastal environment and it helps to minimize development pressure on coastal ecosystems.

4. In case of Sri Lanka, the National Coastal Zone Management Plan (NCZMP), 1990 introduced coastal setbacks and was subsequently amended by 1997 Revised NCZMP. It was not unique setback for entire coastline of the island and the setbacks were determined by the social, economical and ecological conditions of the coastal segment introduced by the plan. The following criteria were used by the Coast Conservation Department in revision of coastal setbacks in 1997.
   - Coastal erosion rate
   - Significance of cultural and archaeological sites
   - Level of use conflicts
   - Legal status
   - Special Area Management sites
   - Extent of coast protection measures carried out
   - Protected areas
   - Exposure to extreme natural attributes such as cyclones, storm surges
   - Geomorphologic characteristics
   - Vulnerability of coastal habitats
   - Significance of other natural components such as scenic beauty, naturalistic and recreational values
   - Level of development

   The main objective of introducing coastal setbacks is to minimize the potential damages and restrict investments in the sea front which is more susceptible to coastal hazards. The coast conservation department currently uses setbacks standards stipulated by NCZMP 1997.
5. However, while these guidelines on setbacks have been stringently set down on paper, they have often not actually been applied. *In Sri Lanka construction on prohibited areas have proliferated due to illegal encroachment on state lands by informal settlers, the growth of unregulated shrimp farming, the militarization of particular coastal areas in the North and East and the expansion of tourism along the Southeast, Southern and Western coasts. (Source; Harris 2005)*
6. Below mentioned are some of the issues in implementation of coastal setbacks. Though these issues are specific to Sri Lanka, they are broadly applicable to most contexts.
   - Scarcity of coastal lands; There are competing demand for coastal lands from different sectors like tourism, fisheries and navigational activities. Statistics also reveal that the coastal area has the high population density in the country. In case of Sri Lanka the situation is more severe in western, southern and some parts of the eastern coast. Hence short-term social and economical benefits attract more and more socio-economical activities in to the coastal areas and scarcity of land make difficulties to maintain a sufficient setback.
   - Inadequate enforcement; In Sri Lanka, the Coast Conservation Department is responsible to ensure implantation of coastal setback standards and has developed a system by incorporating with coast conservation permit system. However, inadequate resources makes the enforcement process difficult. The result is appearing a large number of unauthorized constructions long the coastal belt. That makes coastal environment more vulnerable. India's coastal regulation zone rules are another case in point, Enacted in 1991, these rules are intended to regulate development along the coast and to protect mangroves, coral reefs, coastal forests and sand dunes and are known to be some of the strictest in the world. On the ground, however, their provisions have not always been observed.
   - Inadequate awareness among developers and general public on coastal setback standards and their benefits to individuals and largely to the country ensure compliance with existing laws and regulations.

7. Land use planning: Land use planning is an approach to determine the most suitable options in which land is to be utilized. It addresses the changing relationship between people and their environments through evaluating various socio-economic and environmental conditions. Land use planning ensures sustainable utilization of land resource and reduces people's vulnerability to hazards through controlling human activities. Land use planning legislation is the way to implement land use policies and plans.
8. In case of Sri Lanka, under the Urban Development Act, following land use legislations are introduced and implemented through permitting system.
    - Zoning regulations: It controls the physical development of land and the kind of uses to which each individual property may be allocated. Local authorities implement these regulations under the provisions of Urban Development Act.
    - Sub division regulations: it is the division of land into two or more parcels for the purpose of sale or building development. Urban land use plans has minimum block size to ensure basic environmental conditions for living and to avoid unnecessary concentration of population.
    - Acquisition and relocation: land acquisition is to ensure the land to be utilized only for the allocated purposes. Urban Development Act has provisions for land acquisition lands and relocation of people from the identified hazard prone areas to avoid disaster risk. After Indian Ocean Tsunami, 2004, all coastal dwellers within the coastal reservation areas were relocated to more interior safer lands.
9. Appropriate land-use planning can be used to reduce the risk from hazards.The following paragraphs adapted from the Guidelines of the Regional Consultative Committee on Disaster Management on 'Integrating hazard risk information into land-use planning and zoning programs'; shows the recommended approaches for integrating DRR in land use planning.
    - Identify the most suitable entry point: There are three main entry points for integrating hazard risk information into land use planning and it is important to maximize the potential of each of these. Firstly, where no plan exists the necessary hazard information can be integrated at the start of plan formulation by undertaking a comprehensive hazard risk assessment and compiling or developing hazard maps. The second entry point arises where land use plans are being revised, perhaps when land policy is changed/adapted, when new development is being considered or where different sector plans are changed or developed. Here too, it is important to be aware of any laws that may influence the process of land use planning for example, land tenure rights, development policies and production quotas will impact the way land is distributed, used and settled. It may be necessary to draft new policy that puts in place the legislations for incorporation of hazard risk information into land use planning. Thirdly, an additional entry point presents itself in the wake of disaster, when generally communities are more open to ideas that will reduce their exposure and willingness to participate or complying with new zoning ordinances is more forthcoming at these times.
    - Information needs: The following information should be obtained for
    - Hazard event: Data regarding hazard occurrence, frequency, severity, duration and scale, should be compiled so as to identify and understand the risks of specific • Social factors: Demographic statistics are important for distinguishing current and predicting future population trends and settlement patterns. The key to effective land use planning is to remove settlements from hazard- prone land onto safer sites and in this way remove vulnerable elements from a position of risk.
    - Economic factors: These factors are important to consider when developing land use plans so that appropriate measures can be incorporated to restrict new or relocate existing development and reduce exposure to hazards, which if realized,

could cause serious setbacks to the economic and other development goals of a country.

- Built environment: hazard risks may also arise from the existing built environment, in terms of structures that are not hazard resilient, do not comply with construction standards or are built in high risk zones such as flood plains or along fault lines.
- Hazard awareness of authorities enhanced: It is important that authorities and agencies/departments who will be affected by changes in land use, understand the rationale and purpose of incorporating hazard risk information into land use maps.
- Identify stakeholders and beneficiaries and encourage community participation; A good understanding of stakeholders and beneficiaries requires physical planners to foresee who will be affected by the inclusion of hazard risk information into revised or newly developed land use maps and zoning or whose interests will be at stake. Amongst these will be residents, people working in high- risk areas or living in unsafe structures, developers, physical planners, contractors and the public works department, to name a few. Community participation can crucially determine what approaches will be most effective in context to the local situation and will help physical planners understand the level of risk that is acceptable to the community and how to act tactically in view of this. Community level participation enables concerns to be raised regarding localized hazard vulnerabilities so that hazard prone land can be prioritized for zoning and suggestions can be made as to how national level plans can be applied to the local context.
- Integration of plans into all sectors at all levels; In places where sector plans exist and are formulated independently of land use plans, hazard risk information should be integrated into sector wide plans, as the failure to do so will not only render land use plan's ineffective but will also leave each sector vulnerable to damage following hazards. For this reason it is essential to be aware of revisions and updates to sector plans. As hazards affect all human activities that are exposed to them; including economic, production activities, agriculture, industry, settlement, infrastructure development and resource use, to name a few; it is important that land use planning authorities consider how to implement zoning ordinances and enforce them across all sectors and all levels in order to reduce risks and minimize hazard related losses.
- However, land-use planning is a complex, iterative process. Many of the contentious issues involved in land planning revolve around the fact that sectors value land differently, and that these values are often in conflict. Land-use planning occurs within a political context and oftentimes, short-term gains take priority over what is beneficial and what will be safe in the future. (Source; Thia-Eng Chua; The Dynamics of Integrated Coastal Management)

10. Building codes: Integration of hazard resilient features in the national building code is essential for safe development. Though in most countries the national building code does include specific clauses on hazard resilient construction, these are primarily looked from a view of the most common hazard in the country. But this too requires regular update and more important strict enforcement while implementation. Apart from building codes, sector specific construction guidelines are also required. For example in Sri Lanka, the Irrigation Department has developed flood resistant construction guidelines which can be applied in planning constructions within a flood prone area and National Housing Development Authority has prepared guidelines for housing development in the coastal belt. Implementation of these guidelines can be done through local authorities by incorporating into the permit procedure. Since, these codes and guidelines are not mandatory in Sri Lanka, it is vital to educate policy makers, development planners and the public for implementation.

Table 5.3.1 shows the possible benchmarks for land use and structural design on social and cultural capacity:

Table 5.3.1 Benchmarks for land use and structural design on social and cultural capacity

D3. Developers and communities incorporate risk reduction into the location and design of structures.	
Benchmark Description	***Potential Assessment Questions***
Developers and communities need to be aware of and adopt risk reduction practices in locating and designing structures.	Are builders and architects in the area knowledgeable of and able to apply the building codes and good practices? Do structural engineers factor in risk for designing and constructing safe infrastructure? Have building standards to site, design, and build infrastructure in hazard areas been adopted? Is there a communications outreach program in place to educate the public in hazard-resilient building practices and designs?

(Source; How Resilient is your community? A guide for evaluating coastal community resilience for tsunami and other hazards)

11. Early warning systems: Warning and evacuation consists of three essential parts: an early warning system, evacuation plans, and a well informed public. An effective early warning system consistently detects potential hazards and communicates the threat in a manner that ensures ample warning is received by the community. Warning messages inform individuals on what is happening, what this means to an individual, and how the individual should take action. Warning messages are delivered in clear, simple language, with enough lead time for recipients to respond. Resilient coastal communities have local early warning systems that are operational at all times and are linked to international or national hazard detection and warning systems. These linkages and other components of the warning system also require backup mechanisms that ensure fail-safe operation during hazard events. This redundancy ensures that if one component of the system is not functioning, then the warning message is still delivered.

    Resilient coastal communities also have well publicized evacuation plans in place well in advance of receiving any hazard warning. The development of effective evacuation plans requires expert and local knowledge of the hazard risk, including information on the location of hazard areas and vulnerable populations such as the elderly. Effective evacuation plans also require a high degree of coordination and planning for the development of proper evacuation routes and signs. Regular evacuation drills are needed to ensure that all sectors of society are knowledgeable of the warning and evacuation procedures. Resilient coastal communities also conduct assessments of evacuation drills and post-event warning and evacuation procedures. These assessments provide information to disaster managers and community leaders on how to improve and adapt systems and plans to further reduce or avoid risks from coastal hazards.

    A warning system cannot be effective without education and outreach. No matter how expensive or sophisticated the system, if individuals are not able to understand the warning information or do not know how to respond, there is increased risk that lives may be lost. Comprehensive public awareness campaigns should provide constant reminders about hazards risks, warning procedures, and evacuation plans within coastal communities.

References for Key Concepts

- Paragraph 4.6.and 8, National Training Course on "DRR for Coastal Zone Managers' Coast Conservation Department, Sri Lanka, 2009
- Paragraph 9,RCC Guidelines on 'Integrating hazard risk information into land-use planning and zoning programs' ADPC, 2008
- Paragraph 10 and 11, How Resilient is your community? A guide for evaluating coastal community resilience for tsunami and other hazards
- Paragraph, Thia-Eng Chua; The Dynamics of Integrated Coastal Management

Case Study

A window of opportunity in tsunamis recovery, Thailand

In response to the Indian Ocean Tsunami that hit parts of Asia on 26th December 2004, the Government of Thailand requested assistance from Asian Development Bank in developing a sub- regional development plan (SRDP) for the tsunamis- affected Andaman region. In the worst hit provinces of Krabi, Phanga and Phuket, negative trends in development had been evident proceeding the tsunamis including: uncontrolled development in tourist centres; increased pressure on the natural environment from tourism and poor coordination of planning policies in the sub-region, which following the community led efforts in the tsunamis wake has led to a call for greater empowerment of local people in decision making. Technical assistance from ADB will result in development of a SRDP within the time frame of 15 years (2006-20) and will produce: an overall structure plan, area plans, broad key strategies, priority sector and thematic plans and detailed pilot action plans. This approach takes a multi- sector view and delegates different agencies at central and local level with specific responsibilities. One of the objectives of area plans is to establish land use control guidelines that define areas where development should be restricted in view of environmental and natural resource vulnerabilities or where it can proceed on condition that special design standards are applied in construction. The SRDP of these three coastal provinces in Thailand provides a useful illustration of how hazard information can be used to plan future land uses with the aim of mitigating risks and reducing potential hazard impacts, through use of a participatory, multi-sector approach. Although land use control guidelines will not be able to prevent extensive damage from the most extreme hazard events, it is sufficiently helpful in mitigating damage from average intensity hazard impacts. This also serves as a good practice in incorporating risk

(Source: http://www.adb.org/Documents/TARs/THA/R141-05.pdf)

Session Delivery

Power point Presentation (provided in the attached CD)

Discussions:

The participants would be encouraged to share their views in difficulties faced in implementation of land use plans and enforcement of building codes in coastal areas.

Session_5.4 Integrated approach for reducing risk in coastal areas

Session learning Objective

At the end of the session the participants would be able to recognize the importance of adopting an integrated approach for reducing disaster risk in coastal area.

Session Duration

Power point Presentation: 30 minutes
Exercise: 30 minutes
Total: 60 minutes

Key Concepts

This session would cover the following concepts:

1. No particular measure can be responsive to all hazards or appropriate for all locations. Hence an integrated approach needs to be adopted including structural man-made and ecosystem based approaches along with non structural measures. But this makes the case even more complicated, because mitigation entails difficult choices between competing claims on fragile areas. Choices will involve trade-offs and the need to reconcile opportunities for ecosystem enhancement or restoration such as forests, preserving wetlands, re-establishing dunes or mangroves; securing infrastructure; and re-establishing tourist, agricultural or fishing industries. Evaluation criteria must address such variables as frequency of hazard occurrence, as well as consequences which are quantifiable (for example, the number of hectares of destroyed ecosystems, potential lives lost, cost to construct and maintain) and others that are qualitative (for example, social dislocation and opportunity costs in terms of lost opportunities). (Source; Preuss, Coastal area planning and management with a focus on disaster management and the protective role of coastal forests and trees, Paper presented at Regional Technical Workshop on Coastal protection in the aftermath of the Indian Ocean tsunami. What role for forests and trees? FAO, 2006)
2. Thus in order to have an integrated management approach for reducing risk in the coastal area it requires the following:
   - Having institutional system in place, which would oversight the implementation of various development projects in the coastal area and would coordinate policies between authorities at different level (national/sub national) and across sectors (e.g. agriculture and transportation).
   - Equally important is to have in place legislations for nonstructural measures such as laws on coastal zone management, enforcement of building codes, land use planning etc.
   - Strengthened partnership between the various stakeholders is essential as each of them is involved in collection of specific set of data and using them in their own work.

Case Study

Sri Lanka — reducing river bank erosion

Bank erosion caused by riverine flooding has been a recurring problem. Multiple seasonal flooding events can result in incremental bank erosion, loss of neighbouring property, and degradation of water quality. Sediment transport to the sea leads to channel migration, which can result in siltation of corals and other marine organisms. Cumulatively, these effects can be extremely damaging. Two different approaches were adopted for mitigation:

Mangrove forest, Hikkaduwa, Sri Lanka

A mangrove forest has been planted to reduce low bank erosion, while also protecting adjoining wetland areas that accommodate water detention and drainage. Costs are generated in the planting, because maintenance is minimal. Some continued erosion occurs during maturation of the buffer forest.

Weligama (Mirissa) roadway stabilization

Continuous bank erosion threatens to undermine the roadway. To reduce the threat of access disruption, a retaining wall was constructed to protect the road from erosion caused by the migrating channel. Because of the location of the erosion other solutions, such as vegetation

planting, were not feasible. The benefit of this solution was the immediate protection; a "soft" solution would necessitate re-aligning the roadway.

(Source: Preuss, Coastal area planning and management with a focus on disaster management and the protective role of coastal forests and trees. Paper presented at Regional Technical Workshop on Coastal protection in the aftermath of the Indian Ocean tsunami. What role for forests and trees? FAO, 2006)

Session Delivery

Power point Presentation (provided in the attached CD)

Group Exercise:
Objectives: Defining the steps for selection of DRR measures in coastal area
Materials required: Flip Charts, Markers
Instruction:

1. Divide the participants into 3 groups
2. Each group is provided with a scenario where the risk is known:
   - Coast popular for eco-tourism in a cyclone prone area
   - Erosion along a coast connecting two major cities
   - Fishing village affected by coastal erosion
3. The group should discuss and come up with 5 to 10 points indicating the process they would follow before selecting a combination of DRR measure suitable for addressing the risk in the given scenario. The output would be the completion of the table 5.4.1:

Table 5.4.1 Group Exercise

Step	Process
01	
02	
03	
04	
05	
06	
07	
08	
09	
10	

Module 6
Understanding the Ground Realities, Field Exercise

Modular Learning Objectives

At the end of the Module the participants would be able to:

- Use some of the tools to undertake a risk assessment in a particular geographical area and suggest possible interventions for reducing risk.
- Recognize the importance of integration of DRR in coastal zone management projects

Sessions

This Module would consist of the following session:
Session 6.1: Field Work on Risk Assessment

Session_6.1 Field Work on Risk Assessment

Session learning Objective

At the end of the session the participants would be able to use some of the tools to undertake a risk assessment in a particular geographical area

Session Duration

Travel: 1/2 day
Field work: 1/2 day
Group work to prepare the concept note: 1/2 day
Presentation of group work and discussion: 1/2 day
Total: 2 days

Session Delivery

Field Work

1. The participants would be divided into 2 groups and taken to a particular geographical area on the coast which faces high risk from natural hazards, so to be able to include this in a generic coastal management work they would be in charge of/ preparing during the field visit.

2. The ultimate objective of the field work would be for the participants to undertake a risk assessment of the area.

3. Before leaving for the field, the participants would be briefed on the area and provided with relevant secondary information (maps, statistical data etc.)

4. Each group (Group 1 and Group 2) would be further divided into 3 teams (Team 1, 2, and 3 under Group 1 and Team 4, 5 and 6 under Group 2) and each given a particular topic as follows:

    - Team 1 and 4: To interact with the communities and understand the issues prevalent in the area and their perception on reducing risk.

- Team 2 and 5: To interact with local institutions (government agencies, NGOs etc), in understanding the socio economic issues in the area and development activities being undertaken. Their perception on risk from natural hazards would also be discussed.

- Team 3 and 6: To undertake a survey of the area and try to understand the type of vulnerability existing in the area which would increase the risk of natural hazards.

5. After the day's field work, the teams under each group would work together in coming out with an overall risk assessment for the area (taking into consideration hazards, exposure and vulnerabilities).

6. Depending on the number of participants and the actual field site, the group formation could differ.

7. Each of the group would present their findings and a discussion would be facilitated to draw the important conclusions from the finding.

Module 7
Integrating DRR in CZM-Linking policies to action

Modular Learning Objectives

At the end of the Module the participants would be:

- Convinced of the need and identify entry points to incorporate disaster risk concerns into national Coastal Zone Policies and Plans
- Convinced of the need to assess disaster risk in planning and design of coastal development projects and identify entry points of integrating DRR in the project cycle
- Able to discuss the approaches to integrate DRR in community development projects in coastal areas
- Able to identify the environmental concerns arising from post disaster reconstruction and rehabilitation and discuss ways of integrating environmental safeguards in post disaster recovery

Sessions

This Module would consist of five (5) sessions as follows:

Session 7.1: Integrating DRR into National Coastal Zone Policy and Plans (Optional)
Session 7.2: Integrating DRR into Coastal Development Programs and Projects
Session 7.3: Integrating DRR in community development projects in coastal areas
Session 7.4: Putting learning's from field into program
Session 7.5: Environment in post disaster context

Session_7.1 Integrating DRR in coastal zone policies and plans

Session learning Objectives

At the end of the session the participants would realize the need to incorporate DRR concerns into national policies and plans related to coastal zone and able to identify specific entry points for such integration.

Session Duration

Power point Presentation: 30 minutes
Total: 30 minutes

Key Concepts

This session would cover the following concepts:

1. Coastal policies (or part of environmental policies) set out the broad framework that would steer the country between the needs of coastal development and the necessity to protect the coastal environment.
2. The policies are translated into plans and programs, which outlines the sector based action programmes to be undertaken by different government agencies in the coastal area.
3. With the high risk the coastal areas face from natural hazards, the national policy aimed at coastal zone management should incorporate DRR in order to achieve its objective.
4. For example the Law 27/2007 on 'Integrated coastal and small island management' of Government of Indonesia highlights the need to integrate DRR in the following Articles:

- Article 56: in developing the integrated management and utilization plan for coastal and small islands, the government and or local government oblige to incorporate and implement disaster mitigation.
- Article 57: coastal and small islands disaster mitigation is implemented within the responsibility of the government, local government, and community.
- Article 58: coastal disaster mitigation has to respect social, economy, culture, ecosystem, effectiveness, and areas scope.
- Article 59: 1) everyone in coastal and Small Island oblige to implement the disaster mitigation related to their activities that have potential adverse effects. 2) Disaster mitigation as in verse 1) is conducted through structural/physics and non structural/non physics countermeasure.

5. Though the law 27/2007 gives coastal community a comprehensive legal instrument to increase the coastal socio ecological resilience to coastal hazards and incorporates DRR concerns, the urgent need remains is to translate the Law in a more operational regulation in form of government, presidential and ministerial regulations and to cover aspects such as land use, building code, coastal structural design etc.
6. Furthermore, for management purposes the Article 7 of the Law calls for the development of the Management Plan for Coastal Zone and Small Islands consisting of a Strategic Plan, Zoning Plan, Management Plan and an Action Plan (Figure 7.1.1).
   a. Typically the Strategic Plan provides guidance for stakeholders in managing the coastal resources for long term. It identifies issues, needs, clarifies goals, sets detailed objectives, establishes an action plan and timelines, and establishes priorities for action and provides for periodic progress review. In each of the above sections of plans, DRR needs be highlighted with an objective to provide a strategic direction for better management of coastal zone from impacts of natural hazards.
   b. The Zoning Plan constituting of the spatial implications of the Strategic policy, is a plan which determines the course of resource exploitation of each unit of planning accompanied by the establishment of space structure and patterns in the planning area containing permitted and prohibited activities and activities that require license or permit. The Law further defines four types of zones; multiple use zone, conservation, special national strategic zone and corridor zone. In each of the steps for obtaining license and permit DRR should be integrated with an emphasis to find out if the proposed activity for which the permit is being sought would be impacted by hazards or could lead to creation of risk.
   c. Even the next level of Management Plan, in its aspects on community participation, capacity building, availability of data and information, provides entry points for integrating DRR.
7. In case of India, the Notification under Section 3 (1) and Section 3 (2) (v) of the Environment (Protection) Act, 1986 and rule 5 (3) (d) of the environment (Protection) rules, 1986 declares the coastal stretches as coastal regulation zone (CRZ) and regulates activities in the CRZ.

   The Notification calls for preparation of Coastal Zone Management Plans which aims at identifying and classifying the CRZ areas within the respective territory as per the classification provided. For each of the classification detailed development regulations are provided. Though these development regulations do not directly talk about DRR, it is aimed at maintaining the coastal ecosystem and to prohibit its degradation which is indirectly contributing to DRR. Some specific examples are provided below:
   a. "In Lakshadweep and small Islands: (i) For permitting construction of buildings, the distance from the High Tide Line (HTL) shall be decided depending on the size of the islands. This shall be laid down for each island, in consultation with the experts and with approval of the Ministry of Environment & Forests, keeping in view the land use requirements for specific purposes vis-à-vis local conditions

Figure 7.1.1 Levels of planning in coastal areas, Indonesia

(Source: Policy and Planning for Coastal Areas in Indonesia; Presentation by Dr. Ir, Subandono Diposaptono, Jakarta, May, 2009)

including hydrological aspects erosion and ecological sensitivity; (ii) The buildings within 500 metres from the HTL shall not have more than 2 floors (ground floor and 1st floor), the total covered area on all floors shall not be more than 50 per cent of the plot size and the total height of construction shall not exceed 9 metres; (iii) The design and construction of buildings shall be consistent with the surrounding landscape and local architectural style; (iv) Corals and sand from the beaches and coastal waters shall not be used for construction and other purposes; (v) Dredging and underwater blasting in and around coral formations shall not be permitted; and (vi) However, in some of the islands, coastal stretches may also be classified into categories CRZ-I or II or III, with the prior approval of Ministry of Environment & Forests and in such designated stretches, the appropriate regulations given for respective Categories shall apply."

b. "Construction of beach resorts/hotels with prior approval of Ministry of Environment & Forests in the designated areas of CRZ-III for temporary occupation of tourists/visitors shall be subject to the following conditions:

(i) The project proponents shall not undertake any construction (including temporary constructions and fencing or such other barriers) within 200 metres (in the landward wide) from the High Tide Line and within the area between the Low Tide and High Tide Line;

(i a) live fencing and barbed wire fencing with vegetative cover may be allowed around private properties subject to the condition that such fencing shall in no way hamper public access to the beach;

(i b) no flattening of sand dunes shall be carried out;

(i c) no permanent structures for sports facilities shall be permitted except construction of goal posts, net posts and lamp posts.

(i d) construction of basements may be allowed subject to the condition that no objection certificate is obtained from the State Ground Water Authority to the effect that such construction will not adversely affect free flow of ground water in that area. The State Ground Water Authority shall take into consideration the guidelines issued by the Central Government before granting such no objection certificate.''

8. As explained earlier (Module 5), in Sri Lanka, the National Coastal Zone Management Plan (NCZMP), 1990 introduced coastal setbacks to practice first time in Sri Lanka and subsequently amended by 1997 Revised NCZMP. It was not unique setback for entire coastline of the island and the setbacks were determined by the social, economical and ecological conditions of the coastal segment introduced by the plan. The following criteria were used by the Coast Conservation Department in revision of coastal setbacks in 1997:
   - coastal erosion rate,
   - significance of cultural and archaeological sites,
   - level of use conflicts,
   - legal status,
   - special Area Management sites,
   - extent of coast protection measures carried out,
   - protected areas,
   - exposure to extreme natural attributes such as cyclones, storm surges
   - Geomorphologic characteristics,
   - vulnerability of coastal habitats,
   - significance of other natural components such as scenic beauty, naturalistic and recreational values and
   - level of development.

   The main objective of introducing coastal setbacks is to minimize the potential damages and restrict investments in the sea front which is more susceptible to coastal hazards.
9. The preparation and the implementation of a Coastal Zone Management Plan ensure an orderly and balanced utilization of resources and, where possible, restore and enhance the environmental quality of the coastal zone. Within this framework it is necessary to prepare Coastal Protection Plans, which are coherent sets of measures, specified in time and space, to achieve a certain expected level of protection against existing or anticipated damage and of beach restoration, if appropriate. It is important to recognize that Coastal Protection Plans which form key elements of an overall Coastal Zone Management Plan have to be based upon Policy and Management Options which reflect the strategic approach for achieving long term stability. These Protection Plans as explained in paragraph below can directly contribute to reduction of risk from natural hazards.
10. The policy option identifies possible courses of action on shoreline, as, maintain existing line, setback defence line, retreat and advance. The first option of maintaining the existing line applies to any existing line which is being defended and will generally be preferred whenever there is a substantial investment in infrastructure on the coast. On an eroding coast, the second option-set back - would be used to provide defences on the hinterland so that it is only necessary to defend against tidal inundation. This option can also allow natural features 'room to move' whilst retaining a level of defence against flooding. The third option - the retreat option - is a managed withdrawal, allowing the coast to return to its natural state and can be attractive where the tidal flood plain is relatively narrow. It would also apply where no defence is to be provided on a naturally eroding coast. Finally the fourth option, - the advance option - is included to provide for the possibility of limiting the exposure of low-lying areas by suitable reclamation or the use of tidal barriers. The choice of policy options is largely dependent on the infrastructure

and the extent of the potential flood and erosion areas for any given length of coast. In order to implement the policy options various management options are considered, provided they are appropriate for the coastal classification, and can be summarized as: Do nothing let nature take its course, Reinstate beach nourishment (through sand pumping structural reconstruction etc), Modify remove existing features or structures, structural alterations, beach stabilization and Create embankments, linear protection, intervention (dredging, sand bypassing) etc.

11. Furthermore, since both coastal ecosystem services and DRR come into play in any of a wide range of policy processes, hence, along with the policy directly related to DRR or coastal zone, even other policies such as poverty reduction or water management etc. provide an entry point for integrating DRR and ecosystem services in coastal areas. For example in case of Malaysia, there are nine regulations related to the coastal zone, and each of them provides opportunities for integrating DRR. These legislations are:
    1. Environmental Quality Act 1974;
    2. Town and Country Planning Act 1976;
    3. Merchant Shipping Ordinance 1952;
    4. Land Conservation Act 1960;
    5. National Land Code 1965;
    6. Street, Drainage and Building Act 1974;
    7. Fisheries Act, 1985;
    8. General Administrative Circular No. 5 of 1987: Guidelines for the Approval and/ or Implementation of Development Projects within the Coastal Zone;
    9. National Forestry Act 1984.
12. Malaysia has also made the policy commitment and developed corresponding initiatives related to CZM. Eight policy commitments and initiatives can be identified: the Malaysia Plans, National Coastal Erosion Strategy 1987, State Structure Plans and Local Plans, National Agriculture Policy 1990-2010, National Forestry Policy 1978, National Biodiversity Policy 1998, Draft National Tourism Master Plan, and Draft Policy on Integrated Coastal Zone Management 1991. These policies are either cross sectoral or sectoral in nature and are in line with international commitments on protecting coastal resources and implementing a sustainable development approach.
13. Strategic Environmental Assessment (SEA) is a tool for incorporating environmental considerations into policy, plans and programs and hence provides an opportunity to integrate DRR. In this context, though the usage of SEA is not yet much common in countries of the region, it could be used to incorporate disaster risk in the analysis of possible environmental impacts in a coastal policy or a specific sector in the coastal area. The advantages of SEA as described below provides an excellent opportunity to integrate DRR:
    - SEA introduces environmental considerations into decision making early i.e. before the decisions are made;
    - SEA allows to focus on range of strategic choices/ alternatives & mitigation measures;
    - Influencing decision making based on an extensive and structured assessment on the possible impacts whether they are positive or negative;
    - The scope of SEA is not essentially restricted to environmental considerations. It is so wide that it can include social, economic and political considerations as well. Thus it can incorporate assessment of disaster risks easily; and
    - SEA is different from Environment Impact Assessment (EIA) since EIA most answer the questions on "After" the program/project what would be the impact.

Instead SEA covers a wider perspective of environmental impacts on many numbers of interventions in a sector or a region or a larger program.

References for Key Concepts

- Paragraph 4; Law 27/2007 on 'Integrated coastal and small island management' of Government of Indonesia
- Paragraph 6; Policy and Planning for Coastal Areas in Indonesia; Presentation by Dr. Ir, Subandono Diposaptono, Jakarta, May, 2009
- Paragraph 7; Notification under Section 3 (1) and Section 3 (2) (v) of the Environment (Protection) Act, 1986 and rule 5 (3) (d) of the environment (Protection) rules, 1986,Government of India
- Paragraph 9 and 10; National Training Course on DRR for Coastal Zone Managers, Coast Conservation Department, Sri Lanka
- Paragraph 11 and 12; Making decentralised coastal zone management work for the South east Asia region: comparative perspectives, Siry, 2006-2007

Case Study

Marine Protected Areas in Southern Thailand to protect vulnerable coastal ecosystems

Thailand has several large Marine Protected Areas along the Indian Ocean coastline and for its offshore islands that help ensure protection and maintenance of coral reefs and mangroves. These areas suffered relatively minor damage from the 2004 tsunami and protected human populations living inland from the shoreline areas. At the same time, the government realized that importance of improved management of these areas so that they continue to protect the natural benefits accruing from reefs and mangrove areas to fisheries and shoreline protection and to local communities living in the vicinity. Thus, the Joint Management of Protected Areas Project was launched post-tsunami to revitalize 18 Marine Protected Areas in the southern region. At the same time, these areas are increasingly important as tourist destinations that generate income for local businesses and residents to build village-level resilience. (Source; How Resilient is your Coastal Community? A guide for evaluating coastal community resilience to tsunamis and other hazards, U.S IOTWS)

Certification as means for sustainable development, Thailand

Many countries such as Thailand have converted many of their mangroves to shrimp farms in recent years to meet export demand. The loss of mangroves and the spawning grounds they provide for fish, combined with pollution from shrimp farms, degrade local capture fisheries and the capacity of mangroves to protect against storms. Impacts such as these can have disproportionate effects on some parts of society, particularly the poor living in coastal communities. To address these impacts, aquaculture strategies can be revised to be more sustainable through the use of certification programs. Government and large retailers can help drive certification by adopting sustainable procurement policies. For example, Wal-Mart, a major purchaser of shrimp from Thailand, plans to only purchase shrimp from farms certified under standards drawn up by the Global Aquaculture Alliance (Source; Hudson and Watcharasakwet 2007; Phillips and Subasinghe 2006).

Session Delivery

Power point Presentation (provided in the attached CD)

Session_7.2 Integrating DRR in coastal development programmes and projects

Session learning Objectives

At the end of the session the participants would be able to understand the need and identify the entry points in integrating DRR in the project cycle management of development projects in coastal area.

Session Duration

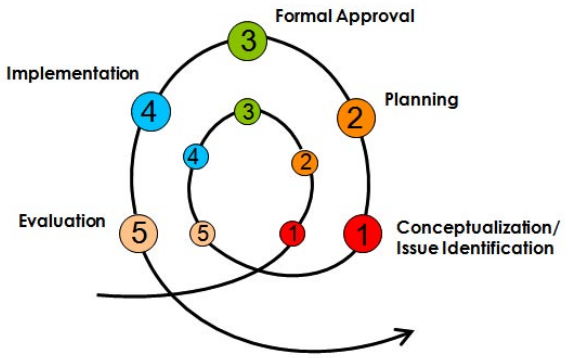
Power point Presentation: 30 min
Total: 30 minutes

Key Concepts

This session would cover the following concepts:

1. A project is *"a series of activities aimed at bringing about clearly specified objectives within a defined time-period and with a defined budget". (Source: European Commission, 2004).* In reality this simple definition covers an enormous variety of project types in terms of size, aims, focus and methods. Nevertheless, there are many basic similarities.
2. Since projects have specified objectives to meet within a certain time period and budget, it should be seen in particular that no factors may affect the project performance and beneficiary group. This emphasizes the need to integrate DRR in all projects, and in this context all projects in coastal areas.
3. The 'project cycle' is a way of viewing the main elements that projects have in common, and how they relate to each other in sequence. The precise formulation of the cycle and its phases varies from one agency to another, but the basic components are more or less similar as explained in Figure 7.2.1.

Figure 7.2.1 Typical components of a project cycle



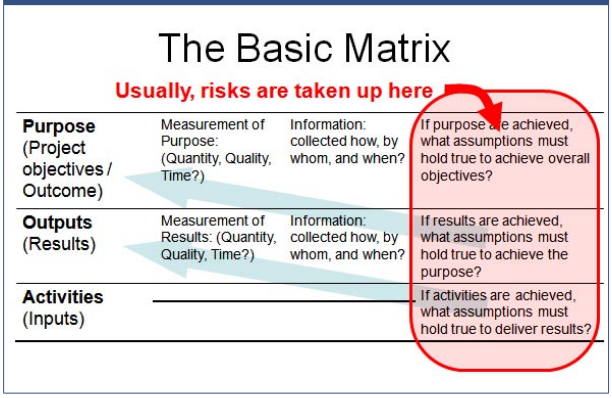
(Source: Olsen, Tobey and Hale, 1998)

4. Most agencies adopt a 'project cycle management' approach: a sequence of actions to develop, implement and evaluate projects that leads in turn into new projects. The aim of project cycle management is to improve the management of projects (and programmes) by ensuring that all relevant issues and conditions are taken into account during design and implementation. In application, project cycle management consists of a set of design and management concepts, techniques and tasks that is used to support informed decision-making. Thus DRR should be factored into all stages of the project cycle.
5. The initial planning stages of the cycle are the key entry points at which disaster risk issues can be factored into projects. But disaster risk should not be forgotten during the other stages of financing, implementation and evaluation, and the various activities that take place within them. The different phases in the project cycle are not separate but part of a process of planning, actions and reflection that, in an ideal world, feeds lessons from one project into others.
6. During the initial phases tools typically used include economic appraisal, environmental appraisal, vulnerability analysis, social livelihoods analysis, social impact assessment

etc. All these tools act as entry points for integrating DRR and hazard information is important for all.

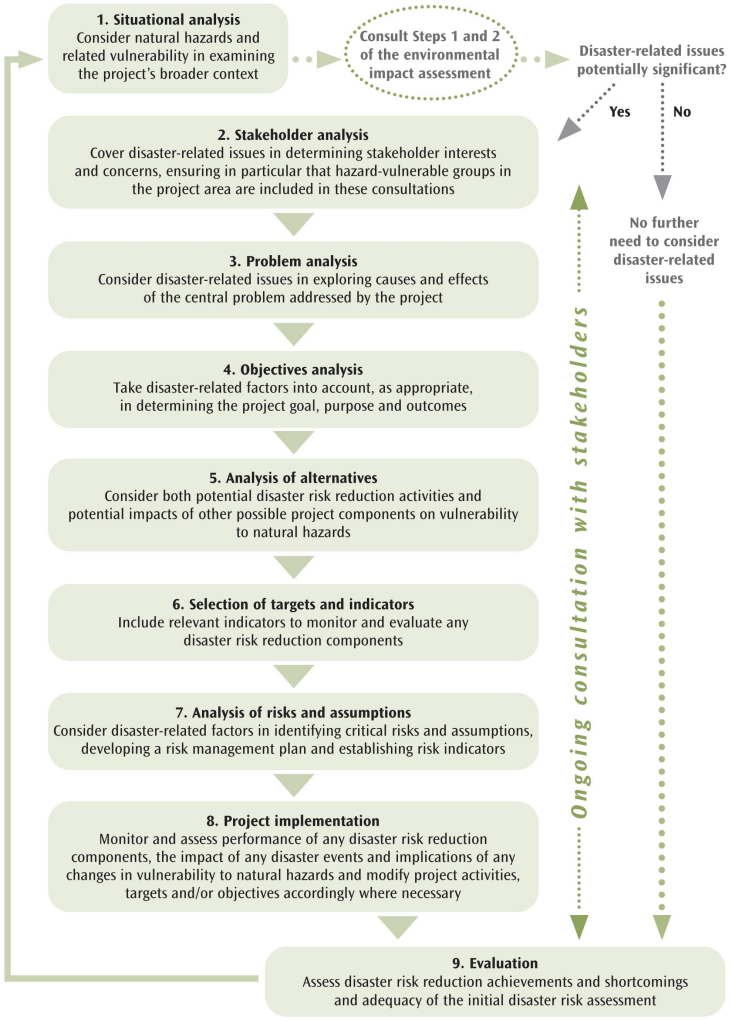
7. Following are some the guiding questions which could be included in the Terms of References of the Preparatory Studies:
   - Are natural hazards capable of creating disasters relevant factors in this project? Which ones? And Why?
   - Could the project increase risk?
   - What risk could have a direct impact on the project?
   - What could be the potential impact of the project in preventing disasters?
8. Of course answering the above mentioned questions would require the following:
   - Ensure information (studies, data) is available
   - Ensure consultation with stakeholders (organisations and individuals) with knowledge on risk management
   - Examine socio-cultural and institutional policies
   - Development/revision of indicators
9. Thus issues related to risk should be addresses in the proposal document of the project in the following sections:
   - Problem Identification
   - Documentation Available
   - Activities
   - Assumptions
   - Risks
   - Sustainability factors
10. Logical framework (Figure 7.2.2), or log frame, analysis is a popular tool for project design and management. It acts as natural tool for use in considering potential disaster risks faced by proposed development projects because analysis of risks and assumptions forms an integral part of the tool.
11. In addition, logical frameworks also includes

Figure 7.2.2 Logical framework



(Source; Applying project cycle tools to supporting integrated coastal management, Presentation by Mr, Tim Greenhow at MFF Regional Training Course, October 2008, Semarang, Indonesia)

Figure 7.2.3 Steps for integrating disaster risk considerations into logical framework



(Source; Tools for Mainstreaming DRR: Guidance notes for Development Organizations; ProVention Consortium, 2007)

an analysis of alternatives, facilitating the exploration of ways of addressing disaster risk and strengthening a project's hazard resilience and sustainability, in the context of both DRR and more general development projects. Logical frameworks are also living documents, providing a framework through which to examine such impacts. It is also a participatory tool providing a structure for consulting and integrating various stakeholder interests and concerns, including those relating to disaster risk, into design. Figure 7.2.3 shows the basic steps in merging disaster risk considerations into logical frameworks.

12. Three essential practices are required in applying log frame analysis to ensure that disaster-related issues are adequately assessed and managed in hazard-prone countries. These include:
    - Application of the tools should begin in very early on in the preparation of a project to maximise their potential value in ensuring that disaster related issues are properly identified, analysed and addressed.
    - Disaster related concerns should be considered at every stage of the analysis, not just in the assessment of risks and assumptions.
    - Log frame matrices should be carefully reviewed in the event of a disaster to explore whether any adjustments are required to project goals and activities to ensure that envisaged achievements remain realistic and sustainable.

References for Key Concepts

- Paragraph 4, 5 10, 11 and 12; Tools for Mainstreaming DRR: Guidance notes for Development Organizations; ProVention Consortium, 2007

Session Delivery

Power point Presentation (provided in the attached CD)

Session_7.3 Integrating DRR in community development projects in coastal areas

Session learning Objective

At the end of the session the participants would be able to discuss steps to integrate DRR in community development in coastal areas

Session Duration

Power point Presentation: 30 minutes
Total: 30 minutes

Key Terminologies

- Resilience: The ability of a system, community or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions.

  Comment: Resilience means the ability to "resile from" or "spring back from" a shock. The resilience of a community in respect to potential hazard events is determined by the degree to which the community has the necessary resources and is capable of organizing itself both prior to and during times of need.
  (UN/ISDR, 2009)

Key Concepts

This session would cover the following concepts:

1. Community development projects are primarily aimed at building community resilience; capacity of a community to adapt to and influence the course of environmental, social and economic change.
2. Coastal community resilience serves as a unifying framework for community-based plans and programs. Enhancing coastal community resilience requires integrating and maintaining an optimal balance of three community-based frameworks typically viewed as independent and separate domains: community development, coastal management, and disaster management (Figure 7.3.1). *Community development provides the enabling governance, socioeconomic, and cultural conditions for resilience (Source; IMM; CED 2000). Coastal management provides the framework for managing human uses of coastal resources and the coastal zone in order to maintain environmental and ecosystem resilience (Source; White et al., 2005; Chua 1998; DENR 2001). Disaster Management focuses on preparedness, response, recovery and mitigation to reduce human and structural losses from disaster events (Source; ADPC 2004)*

Figure 7.3.1 Community-based framework

(Source; How Resilient is your Coastal Community? A guide for evaluating coastal community resilience to tsunamis and other hazards, U.S IOTWS)

3. Eight elements of resilience (Figure 7.3.2) are identified as essential for coastal community resilience. These elements incorporate long-term planning and implementation such as society and economy, coastal management, and land use and structural design.
4. Hence, any community development project in a coastal area provides an entry point for integrating DRR. Moreover, they are better suited to do so because they have direct links with the grassroots and work with the most vulnerable, support local coping strategies and are well placed to test, develop and disseminate innovations.

Figure 7.3.2 Elements of resilience for coastal community

(Source; How Resilient is your Coastal Community? A guide for evaluating coastal community resilience to tsunamis and other hazards, U.S IOTWS)

5. Thus in all phases of the community development project; assessment, design, implementation, monitoring and evaluation, DRR should be integrated. The following simple steps could act as guidance:
   - Step 1: Assessment- In this step while trying to assess the need of the project additional questions could be asked on the possible impact of hazards on achieving the project outcomes or the project outcomes contributing to disaster risk.

- Step 2: Design- If the assessment has identified impacts of natural hazards then at this stage promote the integration of DRR in the design and plan how it can be addressed ensuring collaboration with communities, appropriate government entities, other stakeholders.
- Step 3: Implementation and Monitoring- Make sure the activities being implemented under the project are NOT adding to disaster risk and rather contributing towards risk reduction
- Step 4 and 5: Evaluation- Sometimes the evaluation might lead to the need for another project and the focus of which might be on DRR.

6. However, in real practice often the community development projects be it in coastal areas or elsewhere, fails to integrate DRR because of lack of knowledge and understanding of the nature of risk the area faces, cultural divide between relief and development and risk reduction competing with other pressing development needs.

References for Key Concepts

- Paragraph 2 and 3; How Resilient is your Coastal Community? A guide for evaluating coastal community resilience to tsunamis and other hazards, U.S IOTWS

Case Study

Financing schemes for economic diversification in Sri Lanka

Initiated in 2002, the self-funded financial scheme of Shakthi Farmer Organization in Hambantota district, in Southern Sri Lanka, has helped members meet their financial needs, given that no other formal government or private financial schemes were willing to help in good times or bad. Mainly controlled by women, the program generates loans to diversify member livelihoods beyond traditional fishing and agriculture. The money is also utilized to help member families face climate hazards such as floods and droughts, and also climate-related situations like communal diseases. Beyond financial benefits, members have gained a sense of confidence and security that they did not have before. (Source; How Resilient is your Coastal Community? A guide for evaluating coastal community resilience to tsunamis and other hazards, U.S IOTWS)

Diversifying livelihoods in Ranong, Thailand

Rural villages of Ranong, Thailand rely on both agriculture and fisheries, making them accustomed to balancing risks between the two. While post-disaster recovery is not an effective time to diversify, tsunami "bounce-back" actions complemented livelihood recovery. Provincial programs capitalized on marketing value-added fish products. Projects geared toward local women focused on production of soap, batik, and Muslim scarves, and provided the women with supportive networks, new skills, and supplemental family income, all critical in community rebuilding. (Source; How Resilient is your Coastal Community? A guide for evaluating coastal community resilience to tsunamis and other hazards, U.S IOTWS)

NGOs in Sri Lanka capacitate coastal communities

Sevelanka Foundation and several other NGOs have taken the lead to develop coastal community social and economic capacity to enhance their level of resilience. Such activities focus on organizing communities into functional groups that enhances their social capital and supports livelihood development to enhance small-scale businesses among community members. Such programs are coordinated through a joint NGO and government coordination body that endorses community level work of local and international NGOs and development projects. The community level NGO led projects also focus on addressing other issues in communities, such as coastal resource management and ensuring that warning and evacuation systems are in place and linked to the national warning system of the country. (Source; How Resilient is your Coastal Community? A guide for evaluating coastal community resilience to tsunamis and other hazards, U.S IOTWS)

Session Delivery

Power point Presentation (provided in the attached CD)

Session_7.4 Putting learning's from field into programs

Session learning Objectives

At the end of the session the participants would be able to use the results of the risk assessment undertaken in the field in developing a concept note for development activity in coastal area with increased disaster resilience

Session Duration

Group work to prepare concept note: 75 minutes
Presentation of group work and discussions: 45 minutes
Total: 120 minutes

Session Delivery

Group Exercise

1. The participants would be divided into 2 groups same as in the field work. As much as possible it would be tried to maintain the same group formation.
2. The groups would take the results of the risk assessment earlier carried out in the field work as the base and for the same develop a concept note on the following topics. The concept note would take into consideration the risk involved in the area and accordingly propose activities which would be less impacted by hazards or contribute to reducing the risk while meeting the overall objective of the project.
   - Group 1: Coastal livelihood project
   - Group 2: Community based infrastructure
3. To work on the project concept note preparation the participants will be provided with an example of guidelines the use of which might be requested by donors/agencies/ initiatives (e.g. Mangroves for the Future large project proposal guideline)
4. Each of the group would present their findings and a discussion would be facilitated to draw the important conclusions from the finding.

Session_7.5 Environment in a post-disaster context

Session learning Objective

At the end of the session the participants would be able to identify the environmental concerns arising from post disaster relief, rehabilitation and reconstruction and discuss ways of undertaking environmental needs assessment and integrating environmental safeguards in post disaster recovery

Session Duration

Power point presentation: 30 minutes
Discussions: 15 minutes
Total: 45 minutes

Key Concepts

This session would cover the following concepts:

1. Sound environmental conditions are essential for sustainable recovery of communities. Improper debris disposal, deforestation in order to meet demand for timber, improper

selection of site for shelter, sand mining, improper solid waste management, over fishing are some of the typical challenges faced in post disaster recovery in coastal areas . Hence environmental needs assessment should be carried out and the recovery plan in the aftermath of a disaster should integrate environmental safeguards in all the actions.

2 Environmental needs assessment: The following paragraphs describes in brief the guide developed by UNEP to elaborate a systematic approach to address and assess environmental impacts and concerns following natural disasters. The guide is intended to help:

- Identify environmental impacts and risks caused by the crisis and relief operations as well as potential environmental pressures from recovery
- Identify the negative response-related activities or coping mechanisms resulting from an emergency that can impact the environment or create new environmental risks;
- Assess institutional capacities at the national and local levels to mitigate environmental risks and manage environmental recovery;
- Provide a forward looking plan that aims to "Build Back Better", by integration environmental needs within early recovery programming and across the relevant relief and recovery clusters; and
- Provide a standard reference point for future environmental assessments in the post-crisis setting, in spite of the fact that this tool is expected to be modified to suit the needs of different situations.

The guide outlines three separate but inter-related steps to undertake environmental needs assessment;

- Phase I-Pre-disaster Baseline: Gathering as much reliable information on the actual situation immediately before the disaster- as well as and lead up events to the disaster-is an essential point of departure for the environmental needs assessment. Many different sources of information will need to be consulted. Even then, however, it must be expected that many gaps will become evident in the information available, which may need to be addressed in subsequent steps through specific, directed lines of enquiry.
- Phase II-Situation analysis and site assessment: Additional information will continue to be collected during this phase of the assessment to initially allow a risk mapping exercise to be carried out before then proceeding to actual on-the ground data collection, observation and verification. A series of outline questionnaires are provided to help guide the environmental needs assessment team during this comprehensive stage of the process.
- Phase III- Stakeholder engagement and consultation: Engaging with a broad range of people- from decision makers in line ministries to actual practitioners who have a direct dependency on certain natural resources-is a fundamental part of the environmental needs assessment process. Some consultation will naturally occur during the site assessment work, but given the importance of making sure that people's own voices and experiences are recorded, and their immediate (at least) needs identified, special attention is given to this phase of work. Consultations are also an essential opportunity to ensure that all members of the affected society have an opportunity to contribute to the early recovery process, while at the same time ensuring that cross-cutting issues such as gender are properly addressed.

The final section of the guide also looks at how the date emerging specifically from the environmental needs assessment can be used to guide and influence relevant aspects of the early recovery process. Specific attention needs to be given to addressing identified needs at the

community and institutional levels, as well as to looking at future opportunities and synergies, while ensuring that the environment is not unduly impacted by these processes.

The complete version of the guide can be downloaded from *http://www.unep.org/conflictsanddisasters*

3. Integrating environmental safeguard in disaster management: The following paragraph describes in brief the field manual developed by IUCN with an objective to guide the process of mainstreaming ecosystem concerns-both ecological and economical- into development agenda and integration them in disaster management. The following steps/checklist adopted from the said manual provides guidance on how to Integrate environmental safeguard in disaster management.

Step 1: Ensure that you carry out a post-disaster integrated assessment in order to obtain a complete picture of the state of the ecosystem well-being and human well-being after the disaster. Comparison of these data with the baseline data obtained in the Prevention stage will allow for clear analysis and informed decision-making.

Step 2: Ensure that there is no over-exploitation of species. For example, is timber and sand extraction sustainable and legal?

Step 3: Ensure that existing legislation is followed: Sometimes there are only a few laws related to building and protected areas; in contrast, sometimes there are a plethora of relevant laws for mitigation.

Step 4: Ensure that proper design standards are followed: Avoid using designs that are not appropriate and lack use of environmentally-friendly materials and climate-proofing. Avoid forcing culturally unsuitable designs onto communities. i.e., designs should be drawn up with community input. Ensure that gender concerns are integrated into designs, while making them environmentally-friendly and climate-proof.

Step 5: Minimise habitat change: Ensure that sensitive areas/ecologically and economically valuable areas are not cleared for buildings or resettlements. Ensure that coastal/mountain morphology is not changed by built infrastructure.

Step 6: Minimise pollution:

- Check whether the area is being polluted by the process.
- Check whether there is collection of non-biodegradable solid waste.
- Check how solid waste is being collected and disposed.
- Check whether an effort is being made to reduce, reuse and recycle waste.
- Check whether the air is being polluted by the process.
- Check whether air pollution control measures are in place.

Step 7: Be careful about disposal of debris: Before disposing debris, contact the relevant authorities for identification of recommended disposal sites. Prevent irresponsible dumping of waste. Provide safety training and involve communities in sorting waste.

Step 8: Create awareness among communities about responsible disposal of waste. This is very important for long term mitigation.

Step 9: Prevent the spread of invasive alien species. Check whether IAS is spreading. Building equipment is known to a mechanism through which IAS spread.

Step 10: Ensure that water is not polluted.

- Are resources protected from further contamination, such as faecal waste?
- Are organic and inorganic debris disposed of in a proper manner so that water bodies are not polluted?
- Do housing and new construction ensure good sanitation facilities and sewage systems?
- Do construction designs ensure good drainage systems in place as approved by relevant local authorities?

Step 11: Ensure that measures are taken to mitigate the impacts of and to adapt to climate change.

- Are communities that are most vulnerable to natural disasters identified?
- Have women been identified as an important group for climate change mitigation and adaptation?
- Are energy conservation measures being adopted? For example, is there through-flow ventilation in hot climates? Are energy-saving bulbs and alternate energy sources-such as solar power-being used where ever possible?
    - Are water conservation measures being adopted? For example, in drought prone areas, is there provision for rain water harvesting?
    - Is waste water managed hygienically? Are toilets being built at safe distances from drinking water sources?
    - Are environmentally-friendly materials used as much as possible?

Step 12: Ensure that ecosystems and natural habitats are conserved, restored and created.

- Are efforts being made to replant and landscape during structural changes?
- Is ecosystem restoration being carried out with reference to existing national laws and with reference to existing resource maps?
- Is ecosystem restoration being carried out by matching local needs and priorities the services that ecosystems provide, rather than implementing land use patterns in a top-down manner?
- Are native, multiple-use and locally beneficial species being used while carrying out restoration?
- Are efforts being made to ensure that replanting is carried out only in suitable areas? For example, mangrove replanting in many areas in Asia was carried out in areas where there previously had been no mangroves or where sand dunes - essential for the prevention of coastal erosion - were flattened for this purpose.
- Are efforts being made to ensure that only indigenous species - native to the specific area - being used? For example, using plant species found in the wet zone of Sri Lanka to replant areas of the dry zone will be doomed to fail, as these plants will lack xeromorphic4 adaptations necessary for the dry zone.
- Are efforts in place to ensure that identified IAS is never used?
- Are all relevant government departments - such as the Forest Department, the Coast Conservation Department, Environmental Authority, Urban Authority and the Department of Wildlife Conservation consulted from the beginning and do they play a central role in restoration together with the local communities?
- Is a landscape approach to restoration adopted? Ecosystems do not function as closed units but as open systems that are affected by ecological process that occur on a larger scale. Because of this, it is necessary to look at the broader picture, not just the specific restoration site alone.

References for Key Concepts

- Paragraph 1and 3; Integrating environmental safeguard in disaster management, IUCN
- Paragraph 2: UNEP, Environmental needs assessment in post disaster situations, 2008

Session Delivery

Power point Presentation (provided in the attached CD)

Module 8
Taking it back home-where to start from

Modular Learning Objectives:

At the end of the Module the participants would be able to:

- Formulate an action plan based on the knowledge and skills gained from the course
- Evaluate the course in terms of course structure, knowledge gained, skills imparted, resources exposed to, session delivery, course duration and provide suggestions for improvement

Sessions

This Module would consist of two (2) sessions as follows:
Session 8.1: Defining next steps; formulating actions
Session 8.2: Course Evaluation

Session_8.1 Defining next steps; formulating actions

Session learning Objectives

At the end of the session the participants would be able to list out the things they would be able to incorporate in their work as a result of the knowledge and skills gained from the training course.

Session Duration

Exercise: 30 minutes
Presentation of Group Work: 90 minutes
Total: 120 minutes

Session Delivery

Exercise
Objective: Formulating Action Plan
Materials required: Flip Charts, Markers
Instruction:

1. Each participant is given the below sheet (Table 8.1.1)at the end of each module and requested to fill it up
2. Participants would present their action plans and discussions would be facilitated

Table 8.1.1 Exercise

Module	Knowledge gained	How to use it in your daily work (where ever applicable)
Module 2		
Module 3		
Module 4		
Module 5		
Module 6		
Module 7		
Any other observations		

Session_8.2 Course Evaluation

Session learning Objectives

To help determine how effective this course will be for someone with experience that is similar to the current participants and to find out the scope of improvements for the future.

Session Duration

Filling out of evaluation form: 30 minutes
Sharing of views: 30 minutes
Total: 60 minutes

Session Delivery

Participants are requested to fill out the evaluation form provided below:

About You

1. How many years have you worked in development activities in coastal areas?
   _____years

2. Please indicate your area of specialization/involvement: (please tick)
   - ☐ Technical
   - ☐ Administration
   - ☐ Academic
   - ☐ Donor Agency

About the content of the course

3. How was the level of content in this course?

4. Please tell us activities or sessions you would like to change in the course.

5. If the course was offered again,

   a) What new topics would you like to be included? Please list.
   b) What existing topics could be taken out? Please list.

6. How useful were the following activities?

   Class room exercise
   Field Visit

About the Material

7. How useful to you were the various material given to you?

   a) Participants workbook
   b) Presentations
   c) Reading Materials

8. Please name those hands-out and materials that you found most useful to your work:

   Learning outcomes for you

9. Did you learn any new skills and/or knowledge in this course?

10. Would you be immediately able to apply the knowledge and skills gained from this course to your work?

11. If the answer to Q.11 is 'No' Why? Give details.

About Resource Persons

12. On a scale of 1 to 5 (1 is excellent and 5 is poor), please rate the instructors based on the following criteria:

    (a) use of visuals; and
    (b) ability to explain concepts clearly
    (c) ability to impart skills

Name		1	2	3	4	5
i.	(a)					
	(b)					
	(c)					
ii.	(a)					
	(b)					
	(c)					
iii.	(a)					
	(b)					
	(c)					

Any Other Comments

13. Please add other thoughts, comments or questions below

SECTION_2

Terminologies

Section_2.1 Terminology on Disaster Risk Reduction

Source UN-ISDR, 2009

Acceptable risk

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

Comment: In engineering terms, acceptable risk is also used to assess and define the structural and non-structural measures that are needed in order to reduce possible harm to people, property, services and systems to a chosen tolerated level, according to codes or "accepted practice" which are based on known probabilities of hazards and other factors.

Biological hazard

Process or phenomenon of organic origin or conveyed by biological vectors, including exposure to pathogenic micro-organisms, toxins and bioactive substances that may cause loss of life, injury, illness or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage.

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

Building code

A set of ordinances or regulations and associated standards intended to control aspects of the design, construction, materials, alteration and occupancy of structures that are necessary to ensure human safety and welfare, including resistance to collapse and damage.

Comment: Building codes can include both technical and functional standards. They should incorporate the lessons of international experience and should be tailored to national and local circumstances. A systematic regime of enforcement is a critical supporting requirement for effective implementation of building codes.

Capacity

The combination of all the strengths, attributes and resources available within a community, society or organization that can be used to achieve agreed goals.

Comment: Capacity may include infrastructure and physical means, institutions, societal coping abilities, as well as human knowledge, skills and collective attributes such as social relationships, leadership and management. Capacity also may be described as capability. Capacity assessment is a term for the process by which the capacity of a group is reviewed against desired goals, and the capacity gaps are identified for further action.

Capacity Development

The process by which people, organizations and society systematically stimulate and develop their capacities over time to achieve social and economic goals, including through improvement of knowledge, skills, systems, and institutions.

Comment: Capacity development is a concept that extends the term of capacity building to encompass all aspects of creating and sustaining capacity growth over time. It involves learning and various types of training, but also continuous efforts to develop institutions, political awareness, financial resources, technology systems, and the wider social and cultural enabling environment.

Contingency planning

A management process that analyses specific potential events or emerging situations that might threaten society or the environment and establishes arrangements in advance to enable timely, effective and appropriate responses to such events and situations.

Comment: Contingency planning results in organized and coordinated courses of action with clearly-identified institutional roles and resources, information processes, and operational arrangements for specific actors at times of need. Based on scenarios of possible emergency conditions or disaster events, it allows key actors to envision, anticipate and solve problems that can arise during crises. Contingency planning is an important part of overall preparedness. Contingency plans need to be regularly updated and exercised.

Coping capacity

The ability of people, organizations and systems, using available skills and resources, to face and manage adverse conditions, emergencies or disasters.

Comment: The capacity to cope requires continuing awareness, resources and good management, both in normal times as well as during crises or adverse conditions. Coping capacities contribute to the reduction of disaster risks.

Corrective disaster risk management *

Management activities that address and seek to correct or reduce disaster risks which are already present.

Comment: This concept aims to distinguish between the risks that are already present, and which need to be managed and reduced now, and the prospective risks that may develop in future if risk reduction policies are not put in place. See also Prospective risk management.

Critical facilities

The primary physical structures, technical facilities and systems which are socially, economically or operationally essential to the functioning of a society or community, both in routine circumstances and in the extreme circumstances of an emergency.

Comment: Critical facilities are elements of the infrastructure that support essential services in a society. They include such things as transport systems, air and sea ports, electricity, water and communications systems, hospitals and health clinics, and centres for fire, police and public administration services.

Disaster

A serious disruption of the functioning of a community or a society involving widespread human, material, economic or environmental losses and impacts, which exceeds the ability of the affected community or society to cope using its own resources.

Comment: Disasters are often described as a result of the combination of: the exposure to a hazard; the conditions of vulnerability that are present; and insufficient capacity or measures to reduce or cope with the potential negative consequences. Disaster impacts may include loss of life, injury, disease and other negative effects on human physical, mental and social well-being, together with damage to property, destruction of assets, loss of services, social and economic disruption and environmental degradation.

Disaster risk

The potential disaster losses, in lives, health status, livelihoods, assets and services, which could occur to a particular community or a society over some specified future time period.

Comment: The definition of disaster risk reflects the concept of disasters as the outcome of continuously present conditions of risk. Disaster risk comprises different types of potential losses which are often difficult to quantify. Nevertheless, with knowledge of the prevailing hazards and the patterns of population and socio-economic development, disaster risks can be assessed and mapped, in broad terms at least.

Disaster risk management

The systematic process of using administrative directives, organizations, and operational skills and capacities to implement strategies, policies and improved coping capacities in order to lessen the adverse impacts of hazards and the possibility of disaster.

Comment: This term is an extension of the more general term "risk management" to address the specific issue of disaster risks. Disaster risk management aims to avoid, lessen or transfer the adverse effects of hazards through activities and measures for prevention, mitigation and preparedness.

Disaster risk reduction

The concept and practice of reducing disaster risks through systematic efforts to analyse and manage the causal factors of disasters, including through reduced exposure to hazards, lessened vulnerability of people and property, wise management of land and the environment, and improved preparedness for adverse events.

Comment: A comprehensive approach to reduce disaster risks is set out in the United Nations-endorsed Hyogo Framework for Action, adopted in 2005, whose expected outcome is "The substantial reduction of disaster losses, in lives and the social, economic and environmental assets of communities and countries." The International Strategy for Disaster Reduction (ISDR) system provides a vehicle for cooperation among Governments, organisations and civil society actors to assist in the implementation of the Framework. Note that while the term "disaster reduction" is sometimes used, the term "disaster risk reduction" provides a better recognition of the ongoing nature of disaster risks and the ongoing potential to reduce these risks.

Disaster risk reduction plan *

A document prepared by an authority, sector, organization or enterprise that sets out goals and specific objectives for reducing disaster risks together with related actions to accomplish these objectives.

Comment: Disaster risk reduction plans should be guided by the Hyogo Framework and considered and coordinated within relevant development plans, resource allocations and programme activities. National level plans needs to be specific to each level of administrative responsibility and adapted to the different social and geographical circumstances that are present. The time frame and responsibilities for implementation and the sources of funding should be specified in the plan. Linkages to climate change adaptation plans should be made where possible.

Early warning system

The set of capacities needed to generate and disseminate timely and meaningful warning information to enable individuals, communities and organizations threatened by a hazard to prepare and to act appropriately and in sufficient time to reduce the possibility of harm or loss.

Comment: This definition encompasses the range of factors necessary to achieve effective responses to warnings. A people-centred early warning system necessarily comprises four key elements: knowledge of the risks; monitoring, analysis and forecasting of the hazards; communication or dissemination of alerts and warnings; and local capabilities to respond to the warnings received. The expression "end-to-end warning system" is also used to emphasize that warning systems need to span all steps from hazard detection through to community response.

El Niño-Southern Oscillation phenomenon

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 over many months, such as altered marine habitats, rainfall changes, floods, droughts, and changes in storm patterns.

Comment: The El Niño part of the El Niño-Southern Oscillation (ENSO) phenomenon refers to the well-above-average ocean temperatures that occur along the coasts of Ecuador, Peru and northern Chile and across the eastern equatorial Pacific Ocean, while La Niña part refers to the opposite circumstances when well-below-average ocean temperatures occur. The Southern Oscillation refers to the accompanying changes in the global air pressure patterns that are associated with the changed weather patterns experienced in different parts of the world.

Emergency management

The organization and management of resources and responsibilities for addressing all aspects of emergencies, in particular preparedness, response and initial recovery steps.

Comment: A crisis or emergency is a threatening condition that requires urgent action. Effective emergency action can avoid the escalation of an event into a disaster. Emergency management involves plans and institutional arrangements to engage and guide the efforts of government, non-government, voluntary and private agencies in comprehensive and coordinated ways to respond to the entire spectrum of emergency needs. The expression "disaster management" is sometimes used instead of emergency management.

Emergency services

The set of specialized agencies that have specific responsibilities and objectives in serving and protecting people and property in emergency situations.

Comment: Emergency services include agencies such as civil protection authorities, police, fire, ambulance, paramedic and emergency medicine services, Red Cross and Red Crescent societies, and specialized emergency units of electricity, transportation, communications and other related services organizations.

Environmental degradation

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

Comment: Degradation of the environment can alter the frequency and intensity of natural hazards and increase the vulnerability of communities. The types of human-induced degradation are varied and include land misuse, soil erosion and loss, desertification, wild land fires, loss of biodiversity, deforestation, mangrove destruction, land, water and air pollution, climate change, sea level rise and ozone depletion.

Environmental impact assessment

Process by which the environmental consequences of a proposed project or programme are evaluated, undertaken as an integral part of planning and decision-making processes with a view to limiting or reducing the adverse impacts of the project or programme.

Comment: Environmental impact assessment is a policy tool that provides evidence and analysis of environmental impacts of activities from conception to decision-making. It is utilized extensively in national programming and project approval processes and for international development assistance projects. Environmental impact assessments should include detailed risk assessments and provide alternatives, solutions or options to deal with identified problems.

Exposure

People, property, systems, or other elements present in hazard zones that are thereby subject to potential losses.

Comment: Measures of exposure can include the number of people or types of assets in an area. These can be combined with the specific vulnerability of the exposed elements to any particular hazard to estimate the quantitative risks associated with that hazard in the area of interest.

Extensive risk *

The widespread risk associated with the exposure of dispersed populations to repeated or persistent hazard conditions of low or moderate intensity, often of a highly localized nature, which can lead to debilitating cumulative disaster impacts.

Comment: Extensive risk is mainly a characteristic of rural areas and urban margins where communities are exposed to, and vulnerable to, recurring localised floods, landslides storms or drought. Extensive risk is often associated with poverty, urbanization and environmental degradation. See also "Intensive risk".

Forecast

Definite statement or statistical estimate of the likely occurrence of a future event or conditions for a specific area.

Comment: In meteorology a forecast refers to a future condition, whereas a warning refers to a potentially dangerous future condition.

Geological hazard

Geological process or phenomenon that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage.

Comment: Geological hazards include internal earth processes, such as earthquakes, volcanic activity and emissions, and related geophysical processes such as mass movements, landslides, rockslides, surface collapses, and debris or mud flows. Hydro-meteorological factors are important contributors to some of these processes. Tsunamis are difficult to categorize; although they are triggered by undersea earthquakes and other geological events, they are essentially an oceanic process that is manifested as a coastal water-related hazard.

Greenhouse gases

Gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and emit radiation of thermal infrared radiation emitted by the Earth's surface, the atmosphere itself, and by clouds.

Comment: This is the definition of the Intergovernmental Panel on Climate Change (IPCC). The main greenhouse gases (GHG) are water vapour, carbon dioxide, nitrous oxide, methane and ozone.

Hazard

A dangerous phenomenon, substance, human activity or condition that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage.

Comment: The hazards of concern to disaster risk reduction as stated in footnote 3 of the Hyogo Framework are "... hazards of natural origin and related environmental and technological hazards and risks." Such hazards arise from a variety of geological, meteorological, hydrological, oceanic, biological, and technological sources, sometimes acting in combination. In technical settings, hazards are described quantitatively by the likely frequency of occurrence of different intensities for different areas, as determined from historical data or scientific analysis.

See other hazard-related terms in the Terminology: Biological hazard; Geological hazard; Hydro-meteorological hazard; Natural hazard; Socio-natural hazard; Technological hazard.

Hydro-meteorological hazard

Process or phenomenon of atmospheric, hydrological or oceanographic nature that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage.

Comment: Hydro-meteorological hazards include tropical cyclones (also known as typhoons and hurricanes), thunderstorms, hailstorms, tornados, blizzards, heavy snowfall, avalanches, coastal storm surges, floods including flash floods, drought, heat waves and cold spells. Hydro-meteorological conditions also can be a factor in other hazards such as landslides, wild land fires, locust plagues, epidemics, and in the transport and dispersal of toxic substances and volcanic eruption material

Intensive risk *

The risk associated with the exposure of large concentrations of people and economic activities to intense hazard events, which can lead to potentially catastrophic disaster impacts involving high mortality and asset loss.

Comment: Intensive risk is mainly a characteristic of large cities or densely populated areas that are not only exposed to intense hazards such as strong earthquakes, active volcanoes, heavy floods, tsunamis, or major storms but also have high levels of vulnerability to these hazards. See also "Extensive risk."

Land-use planning

The process undertaken by public authorities to identify, evaluate and decide on different options for the use of land, including consideration of long term economic, social and environmental objectives and the implications for different communities and interest groups, and the subsequent formulation and promulgation of plans that describe the permitted or acceptable uses.

Comment: Land-use planning is an important contributor to sustainable development. It involves studies and mapping; analysis of economic, environmental and hazard data; formulation of alternative land-use decisions; and design of long-range plans for different geographical and administrative scales. Land-use planning can help to mitigate disasters and reduce risks by discouraging settlements and construction of key installations in hazard-prone areas, including consideration of service routes for transport, power, water, sewage and other critical facilities.

Mitigation

The lessening or limitation of the adverse impacts of hazards and related disasters.

Comment: The adverse impacts of hazards often cannot be prevented fully, but their scale or severity can be substantially lessened by various strategies and actions. Mitigation measures encompass engineering techniques and hazard-resistant construction as well as improved environmental policies and public awareness. It should be noted that in climate change policy, "mitigation" is defined differently, being the term used for the reduction of greenhouse gas emissions that are the source of climate change.

National platform for disaster risk reduction

A generic term for national mechanisms for coordination and policy guidance on disaster risk reduction that are multi-sectoral and inter-disciplinary in nature, with public, private and civil society participation involving all concerned entities within a country.

Comment: This definition is derived from footnote 10 of the Hyogo Framework. Disaster risk reduction requires the knowledge, capacities and inputs of a wide range of sectors and organisations, including United Nations agencies present at the national level, as appropriate. Most sectors are affected directly or indirectly by disasters and many have specific responsibilities that impinge upon disaster risks. National platforms provide a means to enhance national action to reduce disaster risks, and they represent the national mechanism for the International Strategy for Disaster Reduction.

Natural hazard

Natural process or phenomenon that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage.

Comment: Natural hazards are a sub-set of all hazards. The term is used to describe actual hazard events as well as the latent hazard conditions that may give rise to future events. Natural hazard events can be characterized by their magnitude or intensity, speed of onset, duration, and area of extent. For example, earthquakes have short durations and usually affect a relatively small region, whereas droughts are slow to develop and fade away and often affect large regions. In some cases hazards may be coupled, as in the flood caused by a hurricane or the tsunami that is created by an earthquake.

Preparedness

The knowledge and capacities developed by governments, professional response and recovery organizations, communities and individuals to effectively anticipate, respond to, and recover from, the impacts of likely, imminent or current hazard events or conditions.

Comment: Preparedness action is carried out within the context of disaster risk management and aims to build the capacities needed to efficiently manage all types of emergencies and achieve orderly transitions from response through to sustained recovery. Preparedness is based on a sound analysis of disaster risks and good linkages with early warning systems, and includes such activities as contingency planning, stockpiling of equipment and supplies, the development of arrangements for coordination, evacuation and public information, and associated training and field exercises. These must be supported by formal institutional, legal and budgetary capacities. The related term "readiness" describes the ability to quickly and appropriately respond when required.

Prevention

The outright avoidance of adverse impacts of hazards and related disasters.

Comment: Prevention (i.e. disaster prevention) expresses the concept and intention to completely avoid potential adverse impacts through action taken in advance. Examples include dams or embankments that eliminate flood risks, land-use regulations that do not permit any settlement in high risk zones, and seismic engineering designs that ensure the survival and function of a critical building in any likely earthquake. Very often the complete avoidance of losses is not feasible and the task transforms to that of mitigation. Partly for this reason, the terms prevention and mitigation are sometimes used interchangeably in casual use.

Prospective disaster risk management *

Management activities that address and seek to avoid the development of new or increased disaster risks.

Comment: This concept focuses on addressing risks that may develop in future if risk reduction policies are not put in place, rather than on the risks that are already present and which can be managed and reduced now. See also Corrective disaster risk management.

Public awareness

The extent of common knowledge about disaster risks, the factors that lead to disasters and the actions that can be taken individually and collectively to reduce exposure and vulnerability to hazards.

Comment: Public awareness is a key factor in effective disaster risk reduction. Its development is pursued, for example, through the development and dissemination of information through media and educational channels, the establishment of information centres, networks, and community or participation actions, and advocacy by senior public officials and community leaders.

Recovery

The restoration, and improvement where appropriate, of facilities, livelihoods and living conditions of disaster-affected communities, including efforts to reduce disaster risk factors.

Comment: The recovery task of rehabilitation and reconstruction begins soon after the emergency phase has ended, and should be based on pre-existing strategies and policies that facilitate clear institutional responsibilities for recovery action and enable public participation. Recovery programmes, coupled with the heightened public awareness and engagement after a disaster, afford a valuable opportunity to develop and implement disaster risk reduction measures and to apply the "build back better" principle.

Residual risk

The risk that remains in unmanaged form, even when effective disaster risk reduction measures are in place, and for which emergency response and recovery capacities must be maintained.

Comment: The presence of residual risk implies a continuing need to develop and support effective capacities for emergency services, preparedness, response and recovery together with socio-economic policies such as safety nets and risk transfer mechanisms.

Resilience

The ability of a system, community or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions.

Comment: Resilience means the ability to "resile from" or "spring back from" a shock. The resilience of a community in respect to potential hazard events is determined by the degree to which the community has the necessary resources and is capable of organizing itself both prior to and during times of need.

Response

The provision of emergency services and public assistance during or immediately after a disaster in order to save lives, reduces health impacts, ensures public safety and meet the basic subsistence needs of the people affected.

Comment: Disaster response is predominantly focused on immediate and short-term needs and is sometimes called "disaster relief". The division between this response stage and the subsequent recovery stage is not clear-cut. Some response actions, such as the supply of temporary housing and water supplies, may extend well into the recovery stage.

Retrofitting

Reinforcement or upgrading of existing structures to become more resistant and resilient to the damaging effects of hazards.

Comment: Retrofitting requires consideration of the design and function of the structure, the stresses that the structure may be subject to from particular hazards or hazard scenarios, and the practicality and costs of different retrofitting options. Examples of retrofitting include adding bracing to stiffen walls, reinforcing pillars, adding steel ties between walls and roofs, installing shutters on windows, and improving the protection of important facilities and equipment.

Risk

The combination of the probability of an event and its negative consequences.

Comment: This definition closely follows the definition of the ISO/IEC Guide 73. The word "risk" has two distinctive connotations: in popular usage the emphasis is usually placed on the concept of chance or possibility, such as in "the risk of an accident"; whereas in technical settings the emphasis is usually placed on the consequences, in terms of "potential losses" for some particular cause, place and period. It can be noted that people do not necessarily share the same perceptions of the significance and underlying causes of different risks.

See other risk-related terms in the Terminology: Acceptable risk; Corrective disaster risk management; Disaster risk; Disaster risk management; Disaster risk reduction; Disaster risk reduction plans; Extensive risk; Intensive risk; Prospective disaster risk management; Residual risk; Risk assessment; Risk management; Risk transfer.

Risk assessment

A methodology to determine the nature and extent of risk by analysing potential hazards and evaluating existing conditions of vulnerability that together could potentially harm exposed people, property, services, livelihoods and the environment on which they depend.

Comment: Risk assessments (and associated risk mapping) include: a review of the technical characteristics of hazards such as their location, intensity, frequency and probability; the analysis of exposure and vulnerability including the physical social, health, economic and environmental dimensions; and the evaluation of the effectiveness of prevailing and alternative coping capacities in respect to likely risk scenarios. This series of activities is sometimes known as a risk analysis process.

Risk management

The systematic approach and practice of managing uncertainty to minimize potential harm and loss.

Comment: Risk management comprises risk assessment and analysis, and the implementation of strategies and specific actions to control, reduce and transfer risks. It is widely practiced by organizations to minimise risk in investment decisions and to address operational risks such as those of business disruption, production failure, environmental damage, social impacts and damage from fire and natural hazards. Risk management is a core issue for sectors such as water supply, energy and agriculture whose production is directly affected by extremes of weather and climate.

Risk transfer

The process of formally or informally shifting the financial consequences of particular risks from one party to another whereby a household, community, enterprise or state authority will obtain resources from the other party after a disaster occurs, in exchange for ongoing or compensatory social or financial benefits provided to that other party.

Comment: Insurance is a well-known form of risk transfer, where coverage of a risk is obtained from an insurer in exchange for ongoing premiums paid to the insurer. Risk transfer can occur informally within family and community networks where there are reciprocal expectations of mutual aid by means of gifts or credit, as well as formally where governments, insurers, multi-lateral banks and other large risk-bearing entities establish mechanisms to help cope with losses in major events. Such mechanisms include insurance and re-insurance contracts, catastrophe bonds, contingent credit facilities and reserve funds, where the costs are covered by premiums, investor contributions, interest rates and past savings, respectively.

Socio-natural hazard *

The phenomenon of increased occurrence of certain geophysical and hydro-meteorological hazard events, such as landslides, flooding, land subsidence and drought, that arise from the interaction of natural hazards with overexploited or degraded land and environmental resources.

Comment: This term is used for the circumstances where human activity is increasing the occurrence of certain hazards beyond their natural probabilities. Evidence points to a growing disaster burden from such hazards. Socio-natural hazards can be reduced and avoided through wise management of land and environmental resources.

Structural and non-structural measures

Structural measures: Any physical construction to reduce or avoid possible impacts of hazards, or application of engineering techniques to achieve hazard-resistance and resilience in structures or systems; **Non-structural measures:** Any measure not involving physical construction that uses knowledge, practice or agreement to reduce risks and impacts, in particular through policies and laws, public awareness raising, training and education.

Comment: Common structural measures for disaster risk reduction include dams, flood levies, ocean wave barriers, earthquake-resistant construction, and evacuation shelters. Common non-structural measures include building codes, land use planning laws and their enforcement, research and assessment, information resources, and public awareness programmes. Note that in civil and structural engineering, the term "structural" is used in a more restricted sense to mean just the load-bearing structure, with other parts such as wall cladding and interior fittings being termed non-structural.

Sustainable development

Development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

Comment: This definition coined by the 1987 Brundtland Commission is very succinct but it leaves unanswered many questions regarding the meaning of the word development and the social, economic and environmental processes involved. Disaster risk is associated with unsustainable elements of development such as environmental degradation, while conversely disaster risk reduction can contribute to the achievement of sustainable development, through reduced losses and improved development practices.

Technological hazard

A hazard originating from technological or industrial conditions, including accidents, dangerous procedures, infrastructure failures or specific human activities, that may cause loss of life, injury, illness or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage.

Comment: Examples of technological hazards include industrial pollution, nuclear radiation, toxic wastes, dam failures, transport accidents, factory explosions, fires, and chemical spills. Technological hazards also may arise directly as a result of the impacts of a natural hazard event.

Vulnerability

The characteristics and circumstances of a community, system or asset that make it susceptible to the damaging effects of a hazard.

Comment: There are many aspects of vulnerability, arising from various physical, social, economic, and environmental factors. Examples may include poor design and construction of buildings, inadequate protection of assets, lack of public information and awareness, limited official recognition of risks and preparedness measures, and disregard for wise environmental management. Vulnerability varies significantly within a community and over time. This definition identifies vulnerability as a characteristic of the element of interest (community, system or asset) which is independent of its exposure. However, in common use the word is often used more broadly to include the element's exposure.

Section_2.2 Terminology on Climate Change

Source: If not indicated: EXTRACTED FROM: GLOSSARY, IPCC 4th Assessment Report, Working Group 1 (http://www.ipcc.ch/pdf/glossary/ar4-wg1.pdf),http://www.ipcc.ch/pdf/glossary/ar4-wg1.pdf,http://www.ipcc.ch/pdf/glossary/ar4-wg2.pdf, http://www.ipcc.ch/pdf/glossary/ar4-wg3.pdf

Abrupt climate change	The nonlinearity of the climate system may lead to abrupt climate change, sometimes called rapid climate change, abrupt events or even surprises. The term abrupt often refers to time scales faster than the typical time scale of the responsible forcing. However, not all abrupt climate changes need be externally forced. Some possible abrupt events that have been proposed include a dramatic reorganization of the thermohaline circulation, rapid deglaciation and massive melting of permafrost or increases in soil respiration leading to fast changes in the carbon cycle. Others may be truly unexpected, resulting from a strong, rapidly changing forcing of a nonlinear system.
Adaptation	Adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. Various types of adaptation can be distinguished, including anticipatory, autonomous and planned adaptation: - Anticipatory adaptation – Adaptation that takes place before impacts of climate change is observed. Also referred to as proactive adaptation. - Autonomous adaptation – Adaptation that does not constitute a conscious response to climatic stimuli but is triggered by ecological changes in natural systems and by market or welfare changes in human systems. Also referred to as spontaneous adaptation. - Planned adaptation – Adaptation that is the result of a deliberate policy decision, based on an awareness that conditions have changed or are about to change and that action is required to return to, maintain, or achieve a desired state. (Source; extracted from GLOSSARY, IPCC 4th Assessment Report, Working Group 2)
Adaptive capacity (in relation to climate change impacts)	The ability of a system to adjust to climate change (including climate variability and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequences. The whole of capabilities, resources and institutions of a country or region to implement effective adaptation measures. *(Source IPCC 4th AR, WG3, Glossary)*
Atmosphere	The gaseous envelope surrounding the Earth. The dry atmosphere consists almost entirely of nitrogen (78.1% volume mixing ratio) and oxygen (20.9% volume mixing ratio), together with a number of trace gases, such as argon (0.93% volume mixing ratio), helium and radioactively active greenhouse gases such as carbon dioxide (0.035% volume mixing ratio) and ozone. In addition, the atmosphere contains the greenhouse gas water vapour, whose amounts are highly variable but typically around 1% volume mixing ratio. The atmosphere also contains clouds and aerosols.
Climate	Climate in a narrow sense is usually defined as the 'average weather', or more rigorously, as the statistical description in terms of the mean and variability of relevant quantities over a period of time ranging from months to thousands or millions of years. These quantities are most often surface variables such as temperature, precipitation, and wind. Climate in a wider sense is the state, including a statistical description, of the climate system. The classical period of time is 30 years, as defined by the World Meteorological Organization (WMO).
Climate change	Climate change refers to a change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external forcing, or to persistent anthropogenic changes in the composition of the atmosphere or in land use. Note that the Framework Convention on Climate Change (UNFCCC), in its Article 1, defines climate change as: 'a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods'. The UNFCCC thus makes a distinction between climate change attributable to human activities altering the atmospheric composition, and climate variability attributable to natural causes. *(Source; extracted from GLOSSARY, IPCC 4th Assessment Report, Working Group 2)*

Climate Change Impacts The effects of climate change on natural and human systems. Depending on the consideration of adaptation, one can distinguish between potential impacts and residual impacts: Potential impacts: all impacts that may occur given a projected change in climate, without considering adaptation. Residual impacts: the impacts of climate change that would occur after adaptation. See also aggregate impacts, market impacts, and non-market impacts. *(Source: IPCC 4th Assessment report WG2, glossary)*

Climate system The climate system is the highly complex system consisting of five major components: the atmosphere, the hydrosphere, the cryosphere, the land surface and the biosphere, and the interactions between them. The climate system evolves in time under the influence of its own internal dynamics and because of external forcing such as volcanic eruptions, solar variations and anthropogenic forcing such as the changing composition of the atmosphere and land use change.

Climate variability Climate variability refers to variations in the mean state and other statistics (such as standard deviations, the occurrence of extremes, etc.) of the climate on all spatial and temporal scales beyond that of individual weather events. Variability may be due to natural internal processes within the climate system (internal variability), or to variations in natural or anthropogenic external forcing (external variability). See also Climate change.

Extreme weather event An extreme weather event is an event that is rare at a particular place and time of year. Definitions of rare vary, but an extreme weather event would normally be as rare as or rarer than the 10th or 90th percentile of the observed probability density function. By definition, the characteristics of what is called extreme weather may vary from place to place in an absolute sense. Single extreme events cannot be simply and directly attributed to anthropogenic climate change, as there is always a finite chance the event in question might have occurred naturally. When a pattern of extreme weather persists for some time, such as a season, it may be classed as an extreme climate event, especially if it yields an average or total that is itself extreme (e.g., drought or heavy rainfall over a season).

Global warming Global warming refers to the gradual increase, observed or projected, in global surface temperature, as one of the consequences of radioactive forcing caused by anthropogenic emissions. *(Source; (IPCC 4th Assessment report WG3, glossary)*

Greenhouse effect Greenhouse gases effectively absorb thermal infrared radiation, emitted by the Earth's surface, by the atmosphere itself due to the same gases, and by clouds. Atmospheric radiation is emitted to all sides, including downward to the Earth's surface. Thus, greenhouse gases trap heat within the surface-troposphere system. This is called the greenhouse effect. Thermal infrared radiation in the troposphere is strongly coupled to the temperature of the atmosphere at the altitude at which it is emitted. In the troposphere, the temperature generally decreases with height. Effectively, infrared radiation emitted to space originates from an altitude with a temperature of, on average, –19 C, in balance with the net incoming solar radiation, whereas the Earth's surface is kept at a much higher temperature of, on average, +14 C. An increase in the concentration of greenhouse gases leads to an increased infrared opacity of the atmosphere, and therefore to an effective radiation into space from a higher altitude at a lower temperature. This causes a radioactive forcing that leads to an enhancement of the greenhouse effect, the so-called enhanced greenhouse effect.

Sea-level rise An increase in the mean level of the ocean. Eustatic sea-level rise is a change in global average sea level brought about by an increase in the volume of the world ocean. Relative sea-level rise occurs where there is a local increase in the level of the ocean relative to the land, which might be due to ocean rise and/or land level subsidence. In areas subject to rapid land-level uplift, relative sea level can fall. *(Source: IPCC 4th Assessment report WG2, glossary)*

Section_2.3 Terminology on Coastal Zone Management

Source: If not indicated: Marine and coastal ecosystems and human well-being, a synthesis report based on findings of Millennium Ecosystem Assessment, UNEP

Coastal zone	Refers to the transitional region between the land and the ocean. The transitional refers to the two main environments, terrestrial and marine, and their main influences to coastal zone. In the coastal zone, the terrestrial environment influences the marine environment and vice versa. *(Source: B. Carter, Coastal environments : an introduction to the physical, ecological, and cultural systems of coastlines, 1988)*
Coastal system	Systems containing terrestrial areas dominated by ocean influences of tides and marine aerosols, plus near shore marine areas. The inland extent of coastal ecosystems is the line where land-based influences dominate, up to a maximum of 100 kilometres from the coastline or 100-metre elevation (whichever is closer to the sea), and the outward extent is the 50- metre-depth contour. See also System.
Ecosystems	Dynamic complexes of plant, animal, and microorganism communities and the non-living environment, interacting as functional units. *(Source; Millennium Ecosystem Assessment, 2003)*
Ecosystem assessment	A social process through which the findings of science concerning the causes of ecosystem change, their consequences for human well-being, and management and policy options are brought to bear on the needs of decision-makers.
Ecosystem Approach	A strategy for the integrated management of land, water, and living resources that promotes conservation and sustainable use. An ecosystem approach is based on the application of appropriate scientific methods focused on levels of biological organization, which encompass the essential structure, processes, functions, and interactions among organisms and their environment. It recognizes that humans, with their cultural diversity, are an integral component of many ecosystems.
Ecosystem management	An approach to maintaining or restoring the composition, structure, function, and delivery of services of natural and modified ecosystems for the goal of achieving sustainability. It is based on an adaptive, collaboratively developed vision of desired future conditions that integrates ecological, socioeconomic, and institutional perspectives, applied within a geographic framework, and defined primarily by natural ecological boundaries.
Ecosystem based management	Management driven by explicit goals executed by policies, protocols and practices, and made adaptable by monitoring and research based on best understanding of the ecological interactions and processes necessary to sustain ecosystem structure and function (Source; Christensen et al, 1996)
Ecosystem services	The benefits people obtain from ecosystems. These include provisioning services such as food and water; regulating services such as flood and disease control; cultural services such as spiritual, recreational, and cultural benefits; and supporting services such as nutrient cycling that maintain the conditions for life on Earth. The concept 'ecosystem goods and services' is synonymous with ecosystem services.
Integrated Coastal Management	A natural resources and environmental management framework which employs an integrative, holistic approach and an interactive planning process in addressing the complex management issues in the coastal areas. (Source: Thia-Eng Chua; the Dynamics of Integrated Coastal Management)
Regulating services	The benefits obtained from the regulation of ecosystem processes, including, for example, the regulation of climate, water, and some human diseases.
Supporting services	Ecosystem services that is necessary for the production of all other ecosystem services. Some examples include biomass production, production of atmospheric oxygen, soil formation and retention, nutrient cycling, water cycling, and provisioning of habitat. Sustainable use (of an ecosystem) Human use of an ecosystem so that it may yield a continuous benefit to present generations while maintaining its potential to meet the needs and aspirations of future generations.

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SECTION_3

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Key Documents and Reading Material

This section provides a list of key documents and reading material classified under two categories. The first category; Key Documents; list documents which covers the broad subject of Disaster Risk Reduction, Climate Change and Coastal Zone Management. The second category; Reading Material provides list of 3 to 5 articles, documents or specific sections of documents, reading of which would provide better understanding on concepts of specific modules and sessions.

The accompanying CD to this document contains the compilation of below mentioned Key Documents and Reading Material. This compilation in full or in part is purely for educational purposes only. Copyright belongs to its respective cited authors and organizations.

Key Documents

ADPC, A Primer, Disaster Risk Management in Asia, 2005

FAO, Integrated coastal area management and agriculture, forestry and fisheries

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Module 6: Field Exercise

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Module: 7: Integrating DRR in CZM; Linking Policy to Action

ProVention Consortium, 2007, Guidance Note 5; Collecting and using information on natural hazards; Tools for mainstreaming disaster risk reduction

ProVention Consortium, 2007, Guidance Note 6; Collecting and using information on natural hazards; Tools for mainstreaming disaster risk reduction

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