Disaster Management System Design

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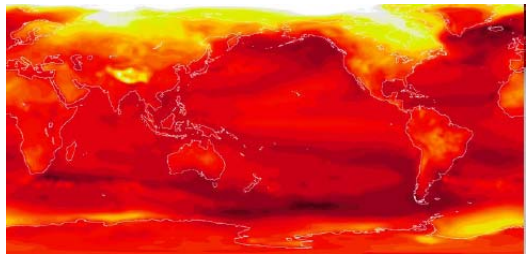
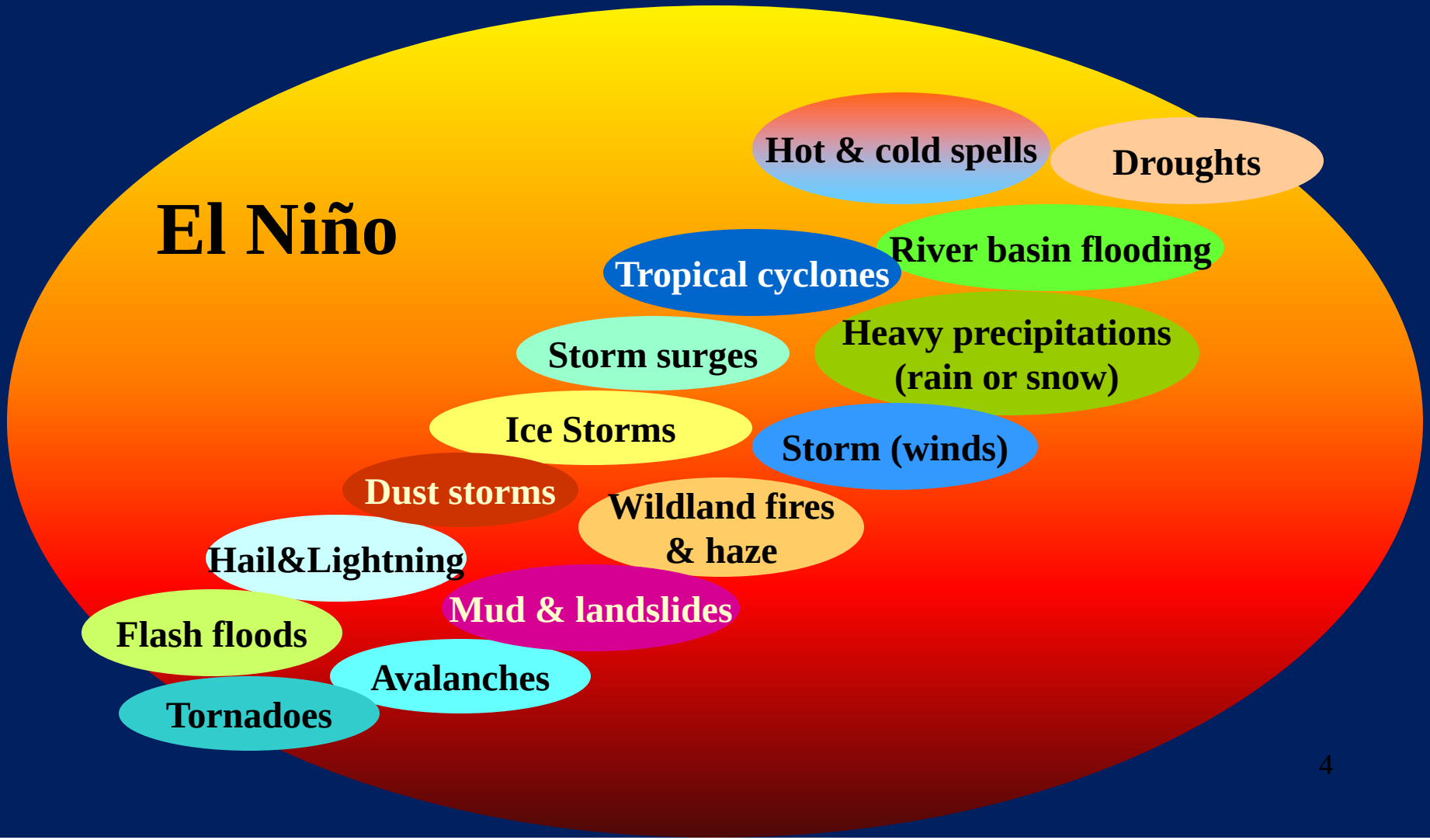


What is the problem?

- People are observing new trends in disaster impacts
- Traditional weather prediction does not work
- Traditional disaster planning and policy are not working
- New development activities are going on, without further consideration of future climatic scenario
- Thus, there is a lack of:
  - Proper perception on climate change
  - Proper understanding and correlation
  - Proper inter-linkages, and
  - Appropriate Actions

Weather- , Water- and Climate-related Hazards

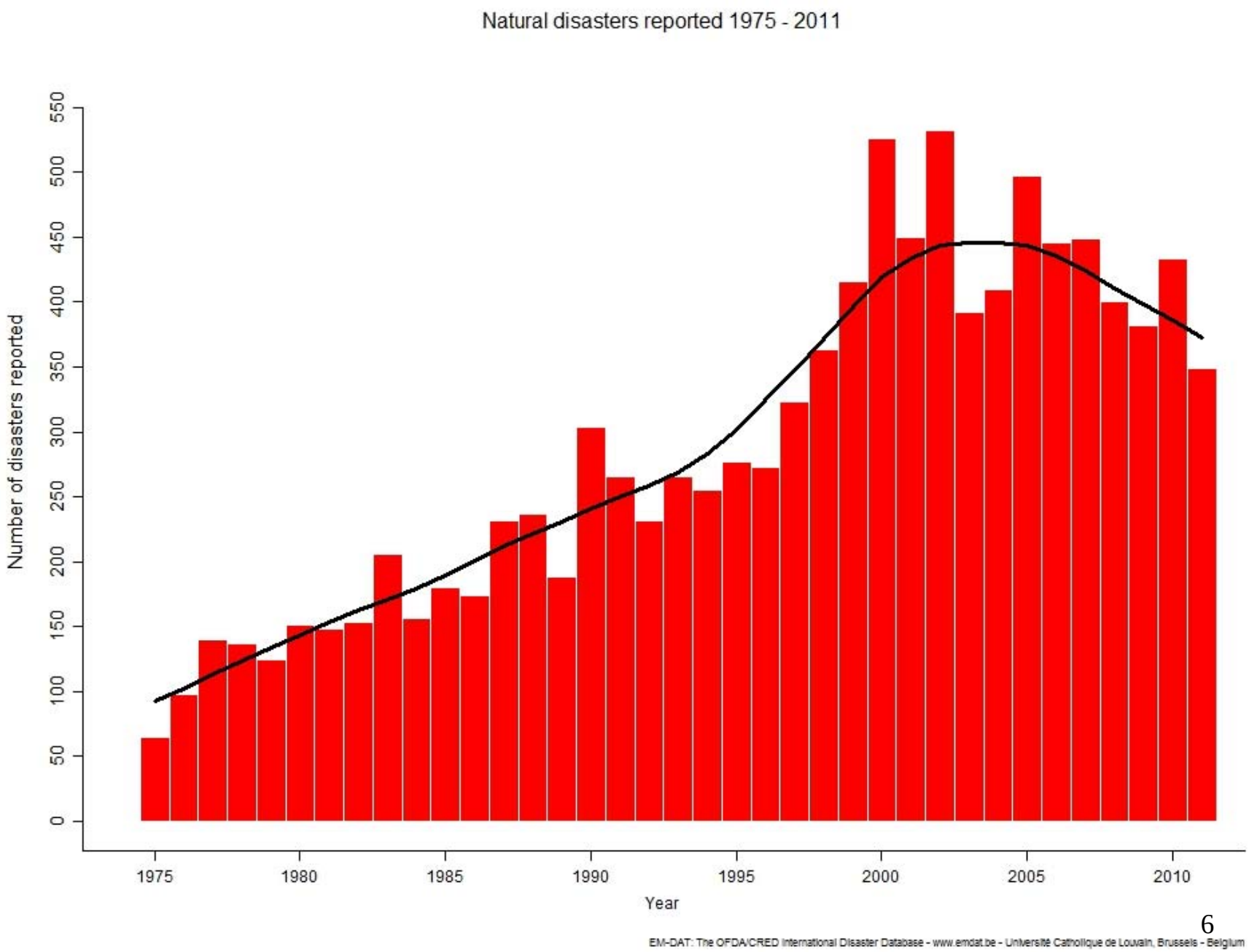


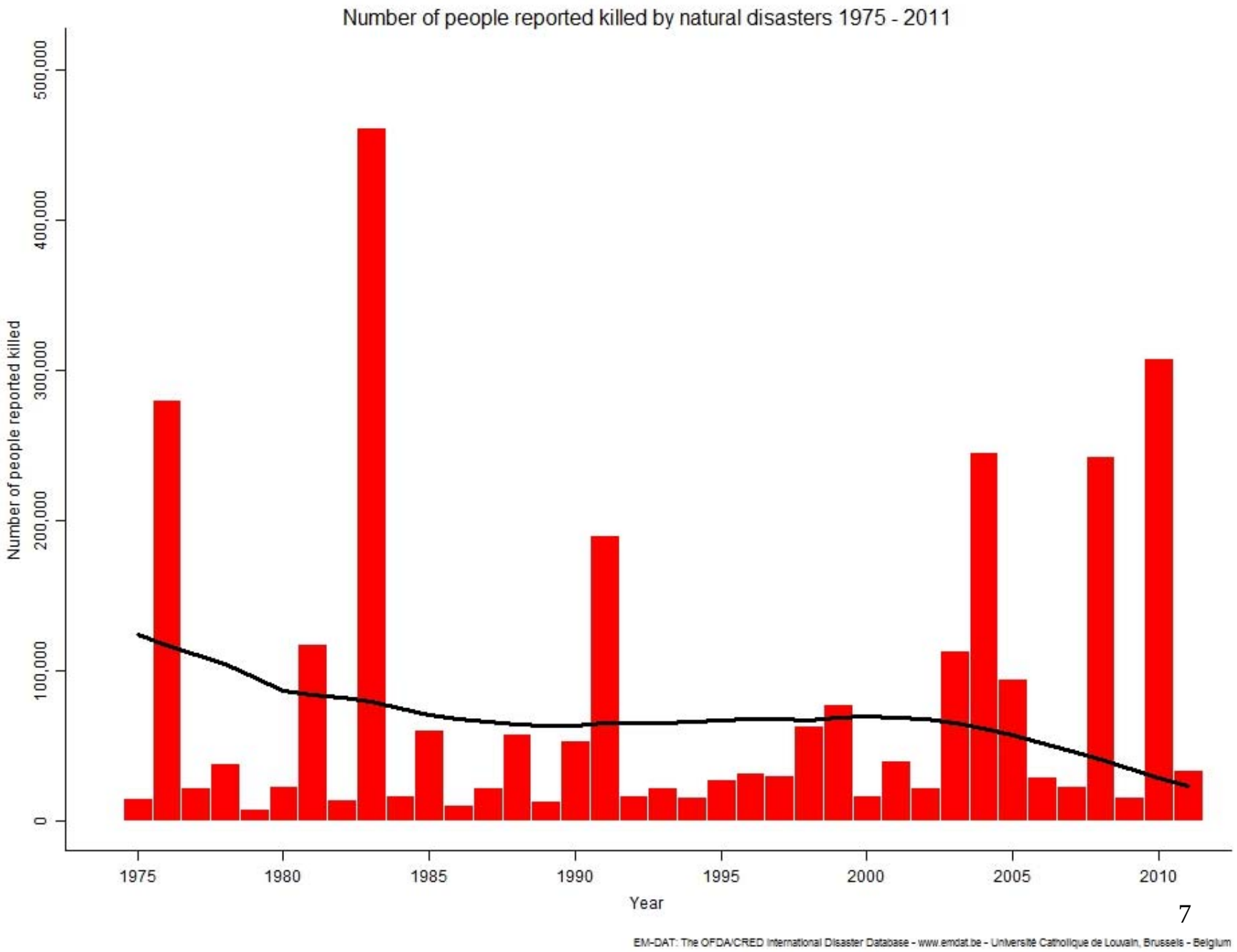
Natural Disasters Trends

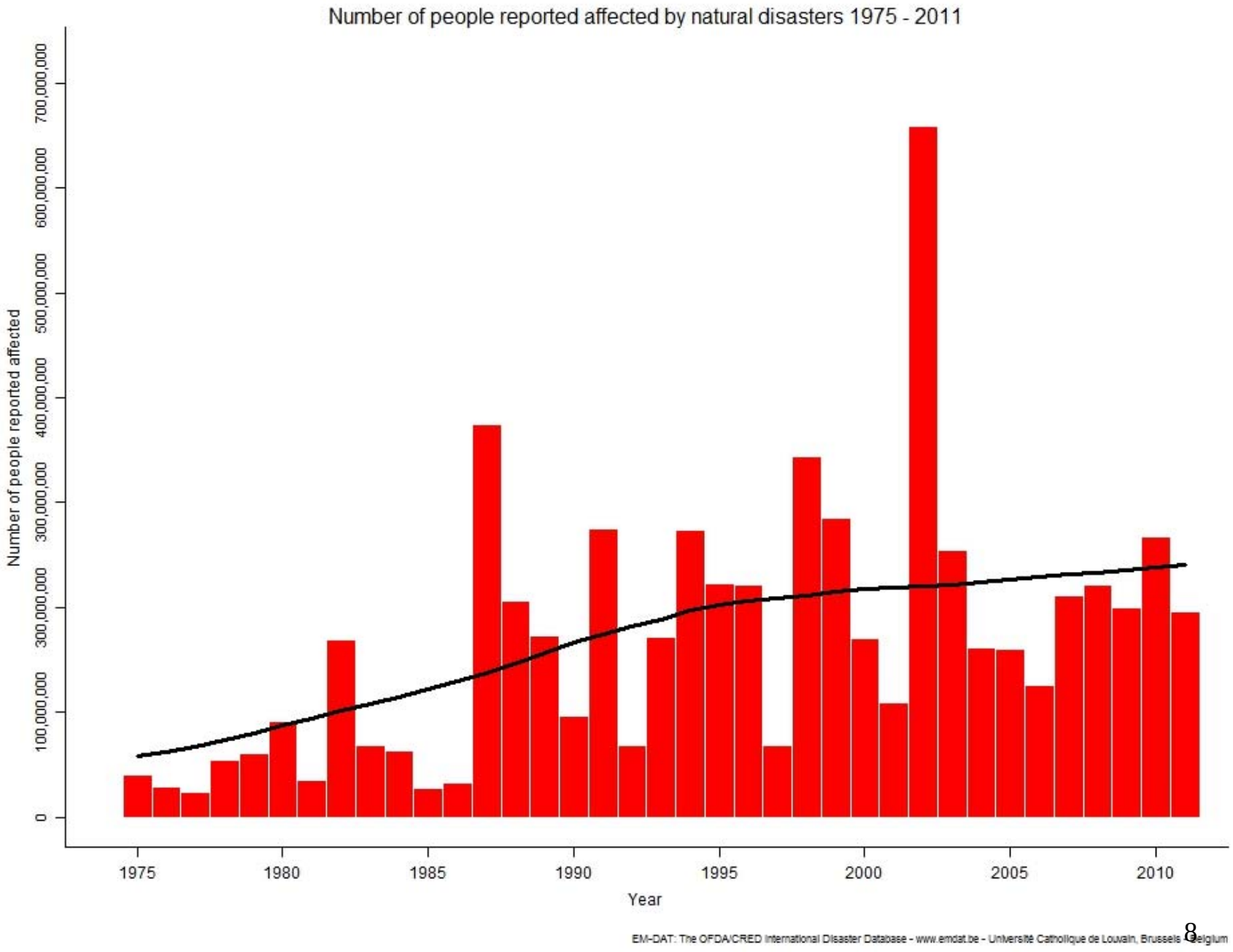
http://www.emdat.be/natural-disasters-trends

Emergency Event Database (EM-DAT) established by the Centre for Research on the Epidemiology of Disasters consist of:

- geophysical events (earthquakes, volcanoes, dry mass movements)
- meteorological events
- hydrological events (floods, wet mass movements)
- climatological events (extreme temperature changes (drought, wildfire)
- biological disasters (epidemics, insect infestations, animal stampedes)


Natural disasters reported 1975 - 2011
Number of disasters reported
0
50
100
150
200
250
300
350
400
450
500
550
1975
1980
1985
1990
1995
2000
2005
2010
Year
EM-DAT: The OFDA/CRED International Disaster Database - www.emdat.be - Université Catholique de Louvain, Brussels - Belgium


Number of people reported killed by natural disasters 1975 - 2011
Number of people reported killed
0
100,000
200,000
300,000
400,000
500,000
1975
1980
1985
1990
1995
2000
2005
2010
Year
EM-DAT: The OFDA/CRED International Disaster Database - www.emdat.be - Université Catholique de Louvain, Brussels - Belgium


Number of people reported affected by natural disasters 1975 - 2011
Number of people reported affected
0
100,000,000
300,000,000
400,000,000
500,000,000
600,000,000
700,000,000
1975
1980
1985
1990
1995
2000
2005
2010
Year
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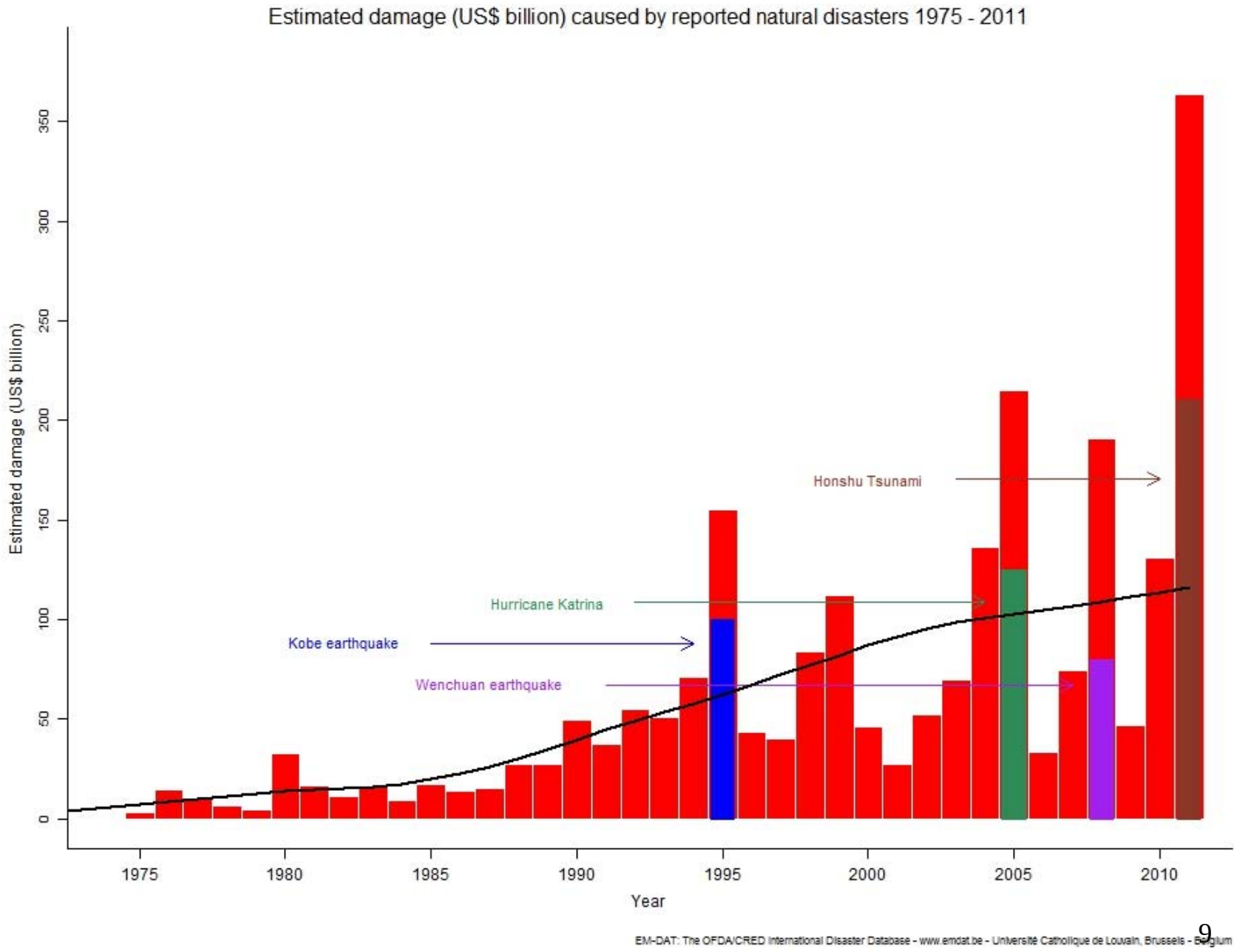
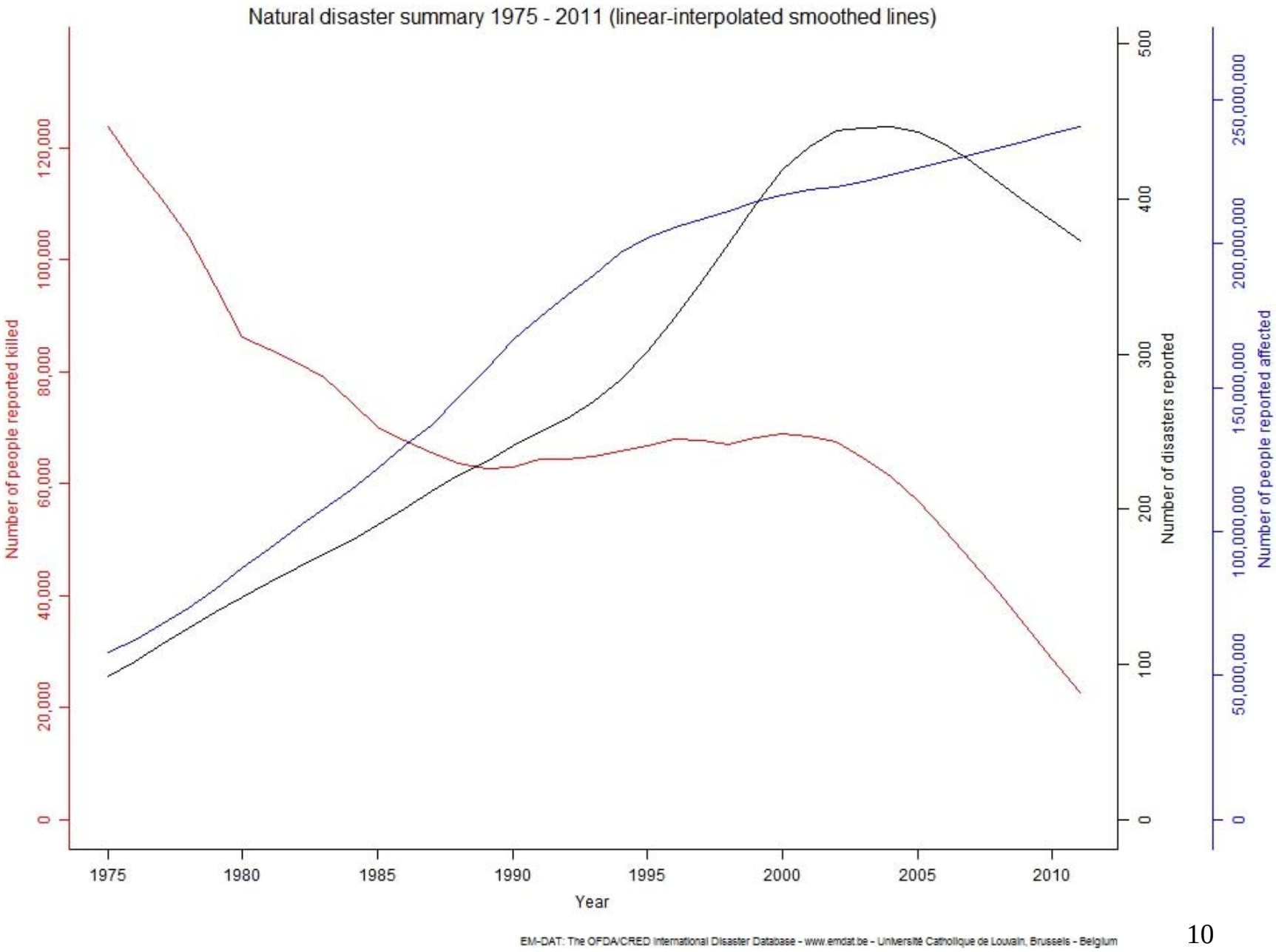

Estimated damage (US$ billion) caused by reported natural disasters 1975 - 2011
Estimated damage (US$ billion)
0
50
100
150
200
250
300
350
1975
1980
1985
1990
1995
2000
2005
2010
Year
Honshu Tsunami
Hurricane Katrina
Kobe earthquake
Wenchuan earthquake
EM-DAT: The OFDA/CRED International Disaster Database - www.emdat.be - Université Catholique de Louvain, Brussels - Belgium


Natural disaster summary 1975 - 2011 (linear-interpolated smoothed lines)
Number of people reported killed
0
20,000
40,000
60,000
80,000
100,000
120,000
Number of disasters reported
0
100
200
300
400
500
Number of people reported affected
0
50,000,000
100,000,000
150,000,000
200,000,000
250,000,000
1975
1980
1985
1990
1995
2000
2005
2010
Year
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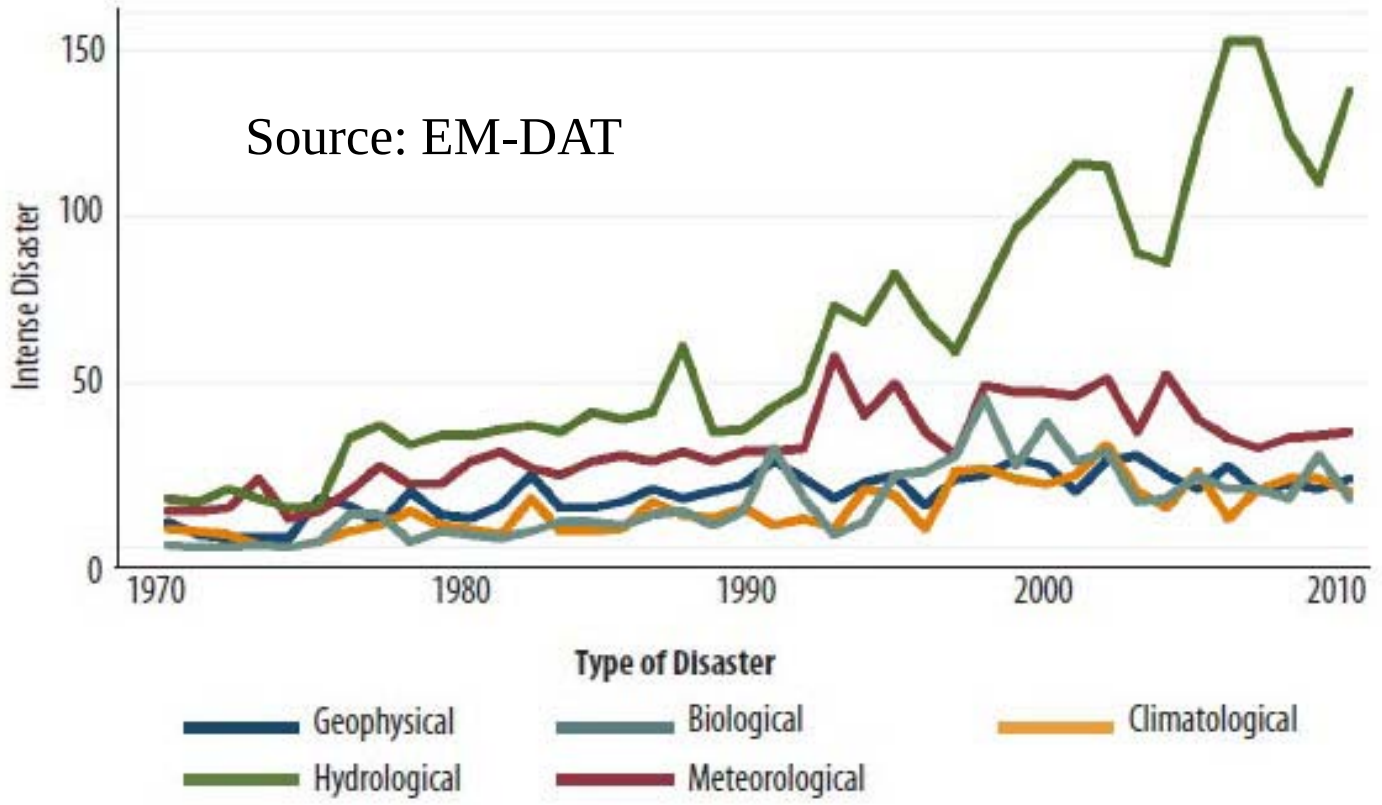
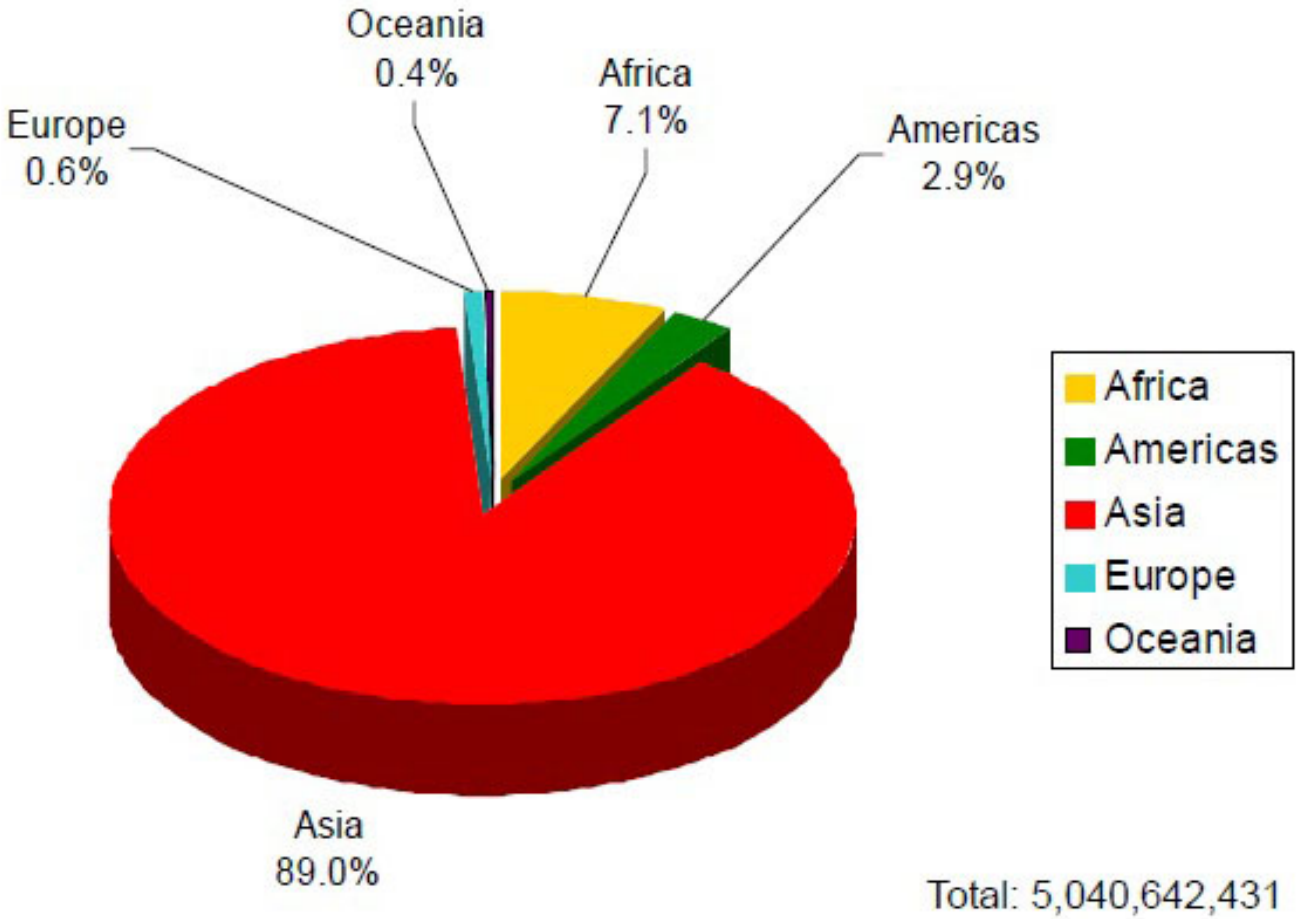


Global Frequency of Intense Natural Disasters

Intense natural disaster events—those killing 100 or more people or affecting 1,000 or more— generally increased during 1971 to 2010.

Independent Evaluation of ADB on "Intense Climate-related Natural Disasters in Asia and Pacific" (April 2012)



Number of People Affected Worldwide (1975-2003)

Source: Compiled by the Asian Disaster Reduction Center based on information from CRED.

Asia accounted for 89% of the world's affected population and almost 50% of all the economic damage reported in the world during the period 1975 - 2003

Hazard

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

Disaster

is a serious disruption of the functioning of a community or a society causing widespread human, material, economic, or environmental losses that exceed the ability of the effected community or society to cope using its own resources

Vulnerability

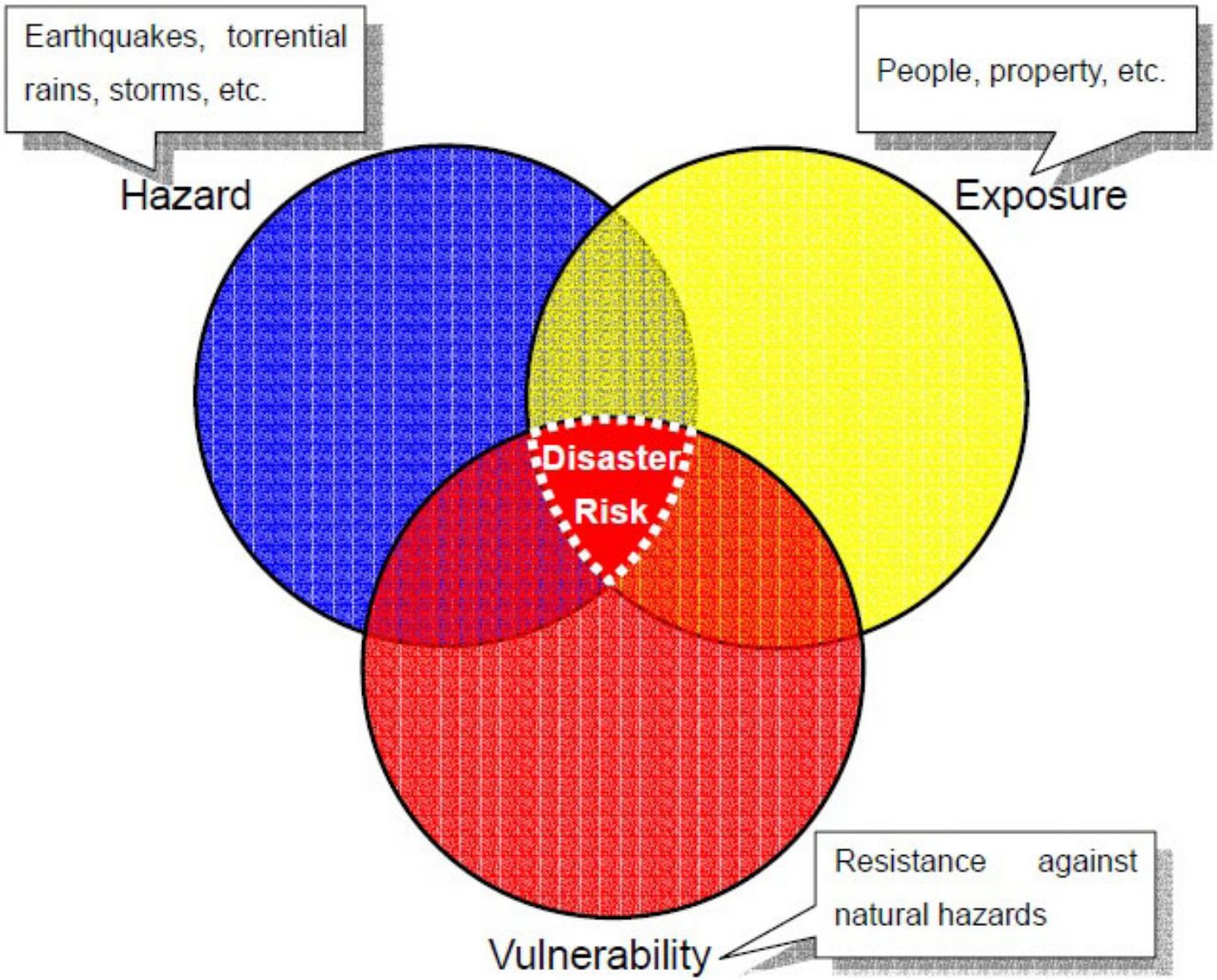
Is a set of conditions and processes resulting from physical and other factors that increase the susceptibility of a community to the effects of hazards

Risk

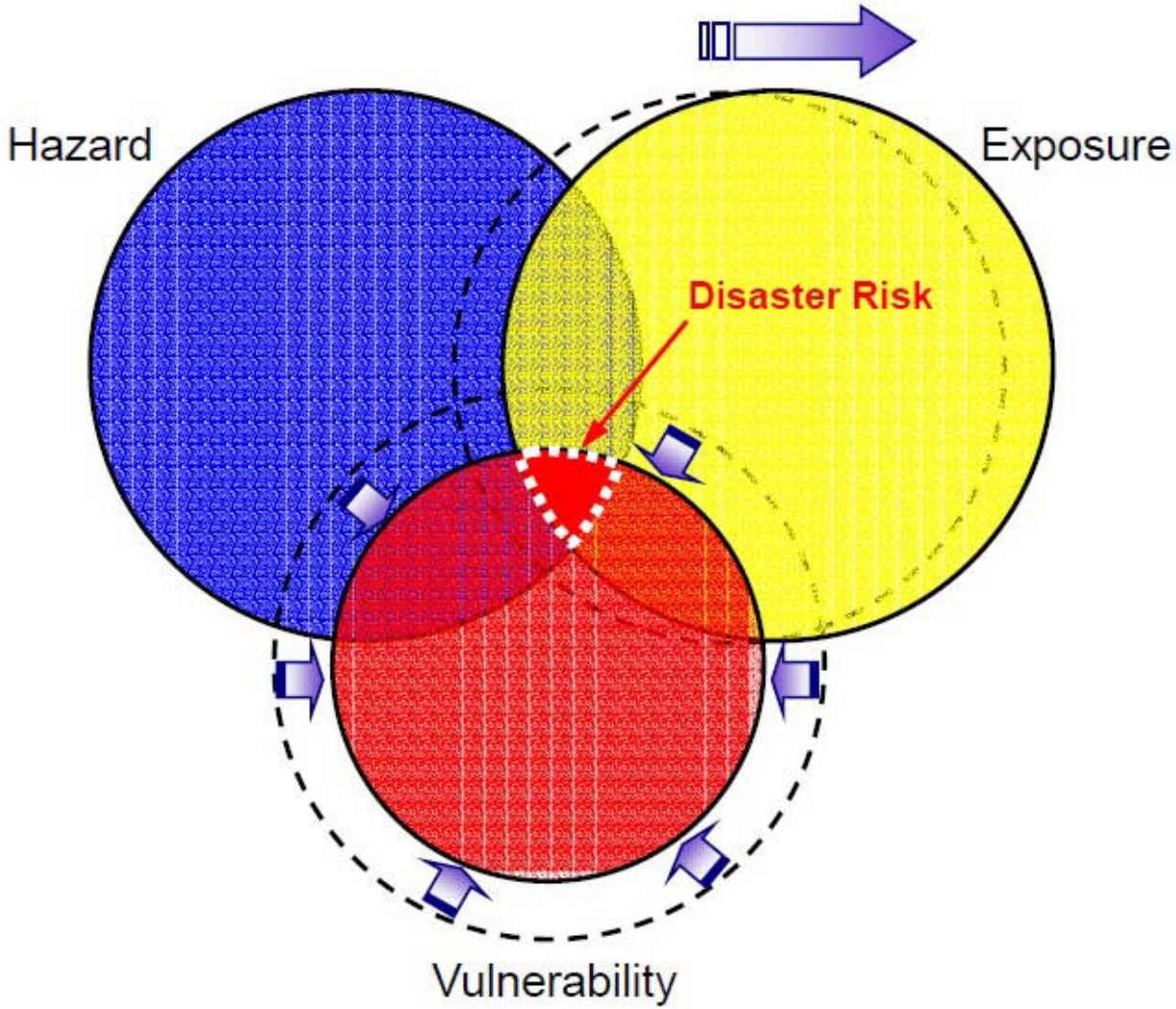
Is the probability of harmful consequences, or the expected loss, from interactions between hazards and conditions of vulnerability in relation to capacity expressed by the equation:

Risk = (hazards x vulnerability) / capacity

Capacity is the way in which people and organizations use existing resources to achieve various beneficial ends under the unusual, abnormal, and adverse conditions of a disaster



Mechanism behind the Emergence of Natural Disaster



Mechanism of Natural Disaster Reduction

What is Climate Change?

- Due to increasing human activities at different levels, prominent changes occur in the climate and natural environment
- **Climate change is already happening:**
  - The global mean surface temperature in the 20th century has risen by about 0,6 °C.
- **Climate change is also projected:**
  - The average sea level is projected to rise by between 0.09 and 0.88 m
  - The global mean surface temperature is projected to increase by 1.4-5.8°C by 2100
- **Climate change projections face some crucial issues:**
  - The projections are often very coarse, and lack local details
  - The projections are often far into future, not immediate future
  - Better in predicting average change than extreme climatic conditions

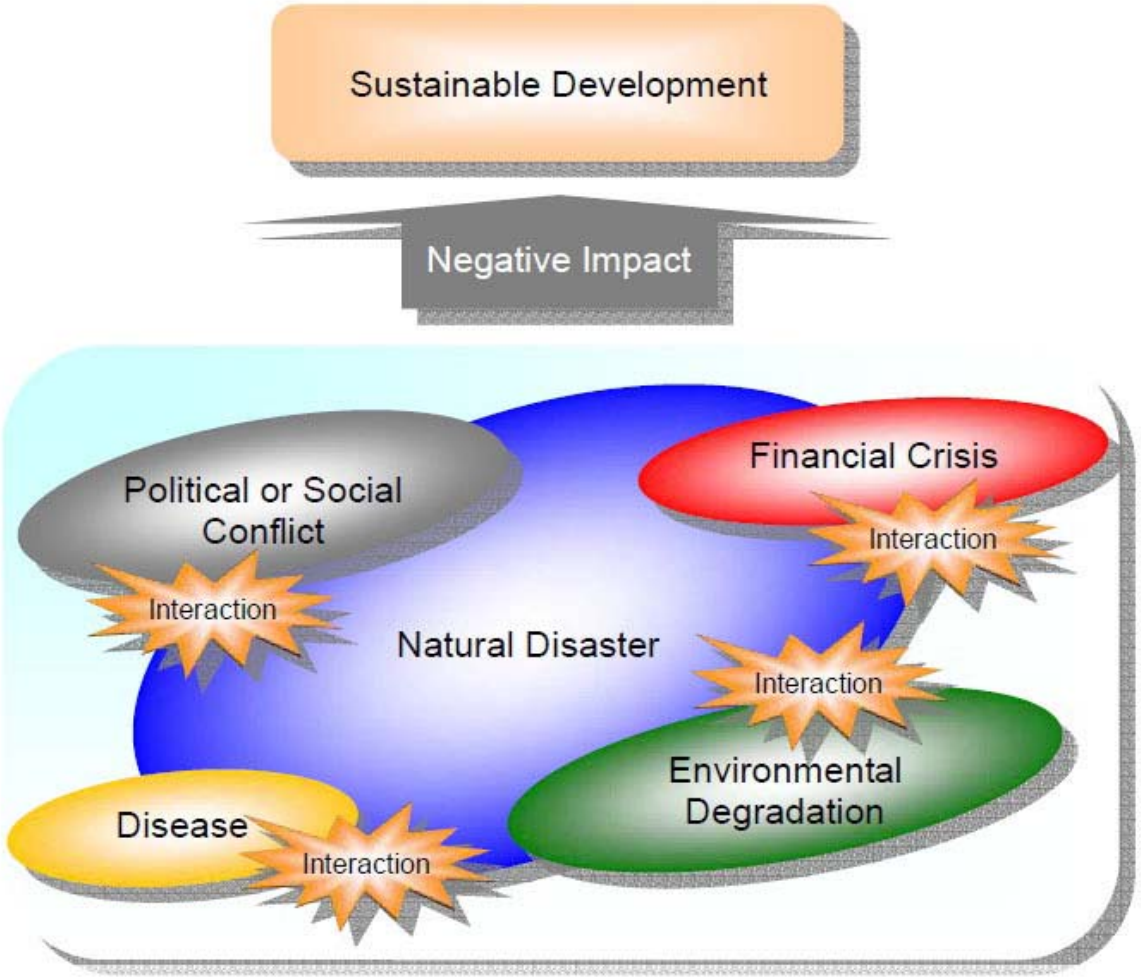
Climate Change and Disasters

- **Climate change will have a variety of impacts in terms of natural disasters:**
  - More droughts, floods, heat waves, water shortages,
  - Increasingly diversion of the typhoon path
- **Impacts will hit the poor hardest**
- **Precautionary principle**
- Climate Change impacts is multiplied with **misguided development**

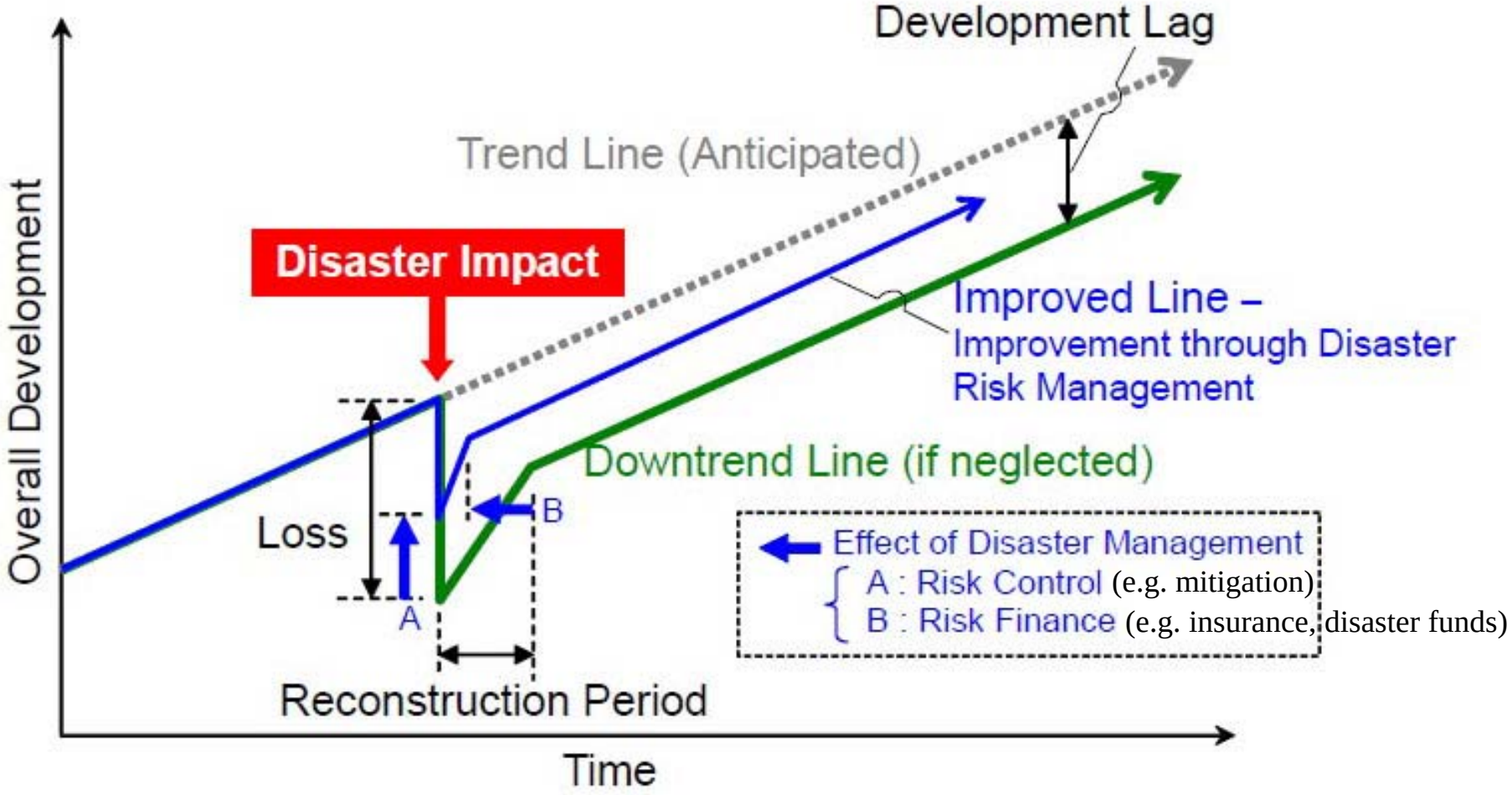
Climate Change and Vulnerability

- Climate change impacts are related to vulnerability of different types: **social, cultural, economic** etc.
- Important issues are: where are the vulnerable areas, and who are the most vulnerable
- Climate change impacts should be seen at **different levels** (like international, national and local), and at **different issues** (like eco-system, settlements, food, health and water)
- Climate change impact and capacity assessment
- Climate change vulnerability can be assessed in different ways: through **stakeholder, resource mapping, and sustainable livelihood analysis**

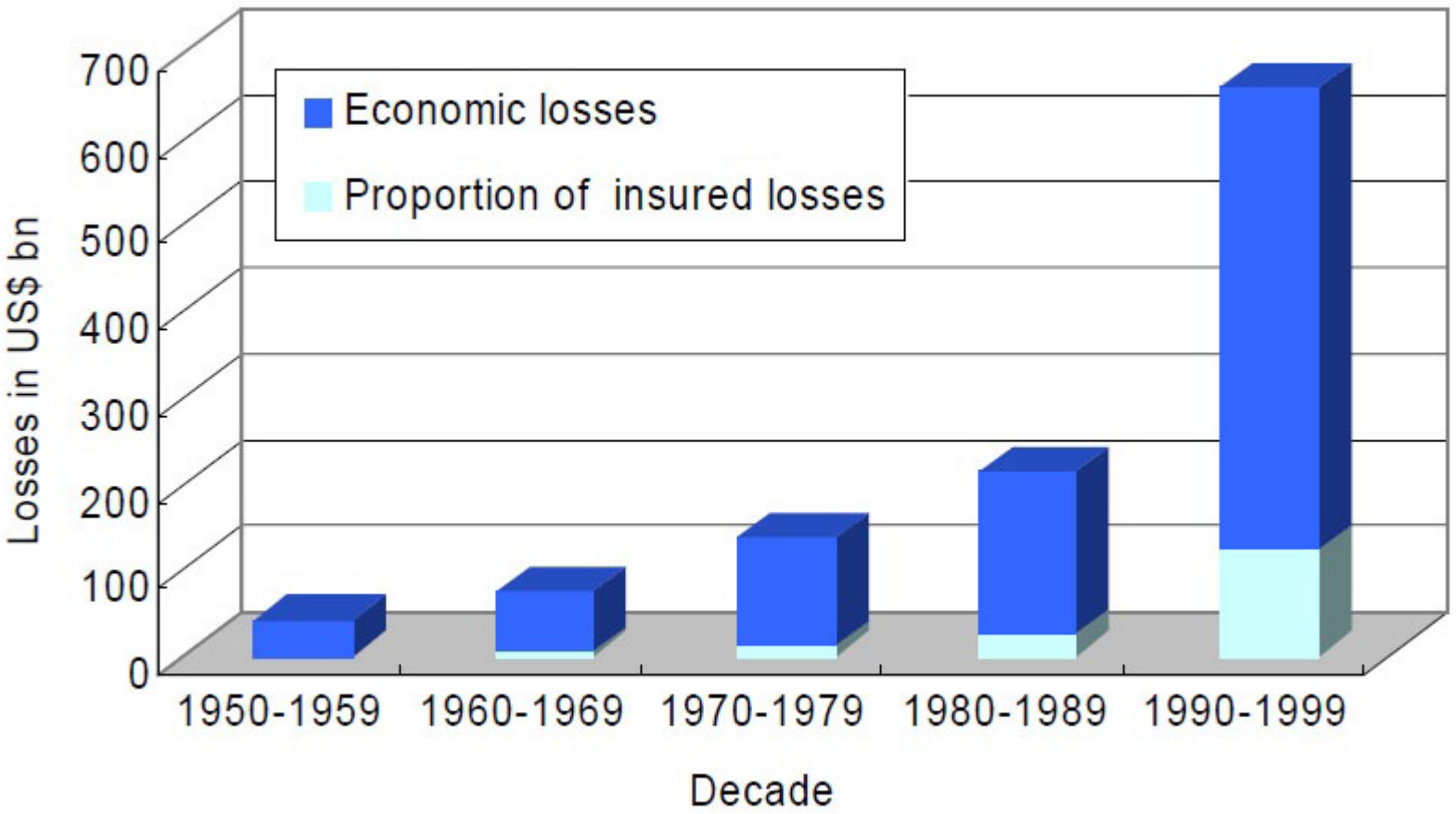
Disaster Risk Management for SD



Impediments to Sustainable Development



Correlation in Disaster Risk Management



Source: Munich Re 2002

Losses: 2002 values

Great Natural Catastrophes 1950-1999

Concept of Disaster Risk Management (DRM)

Centered around two basic principles

Involvement of All Stakeholders

Implementation at all Phases of DRM

Essence of DRM

1) Disaster Risk Management Cycle

Four phases: Prevention/Mitigation, Preparedness, Response, Rehabilitation/Reconstruction

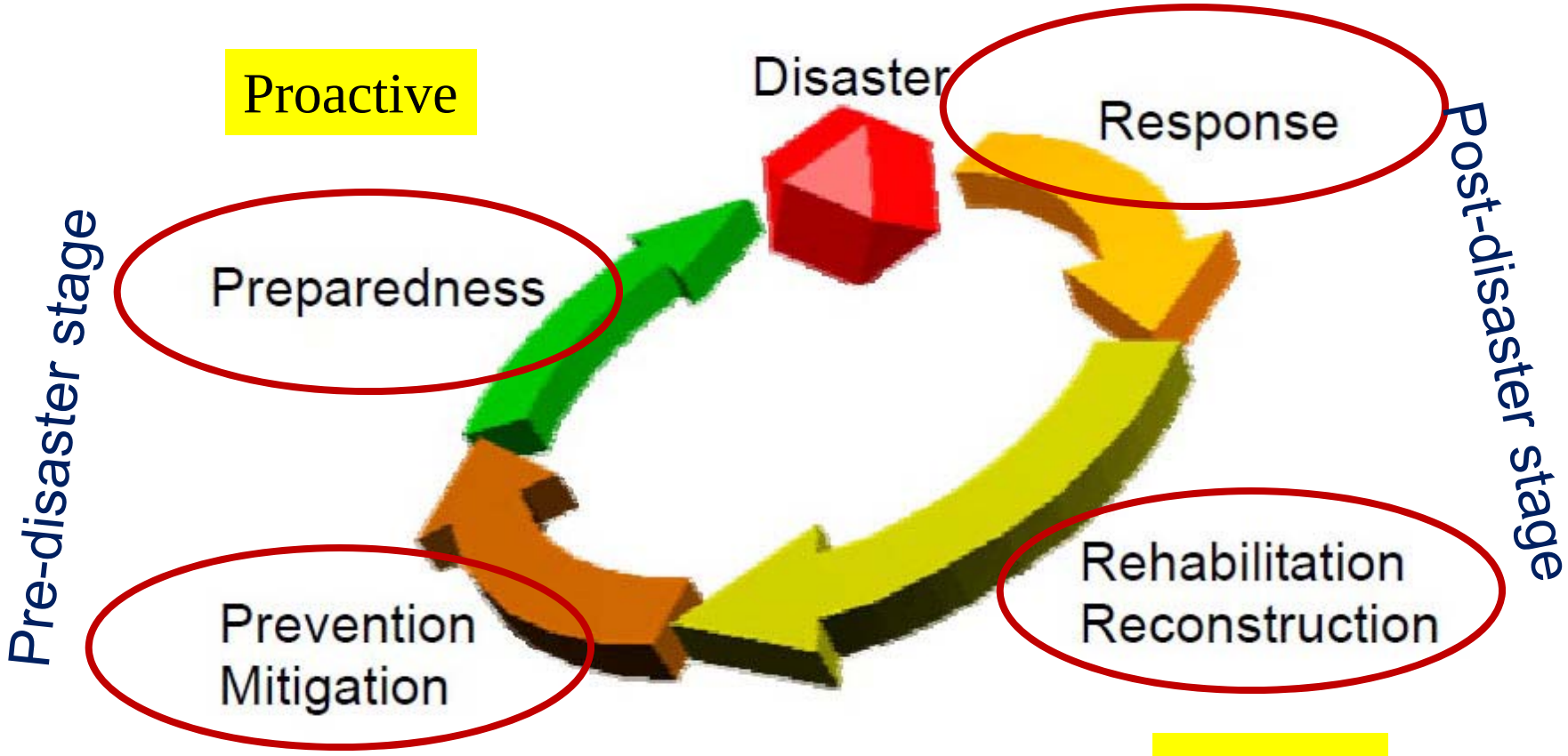
2) Risk Management Flow

Specific methodology of risk management

3) DRM Strategy

- Establishment of coordination mechanisms and legal framework for disaster reduction
- Integration of disaster reduction concept into development planning
- Improvement of information sharing and management
- Promotion of education and public awareness
- Development of multi-stakeholder partnerships and citizen participation

Disaster Risk Management Cycle



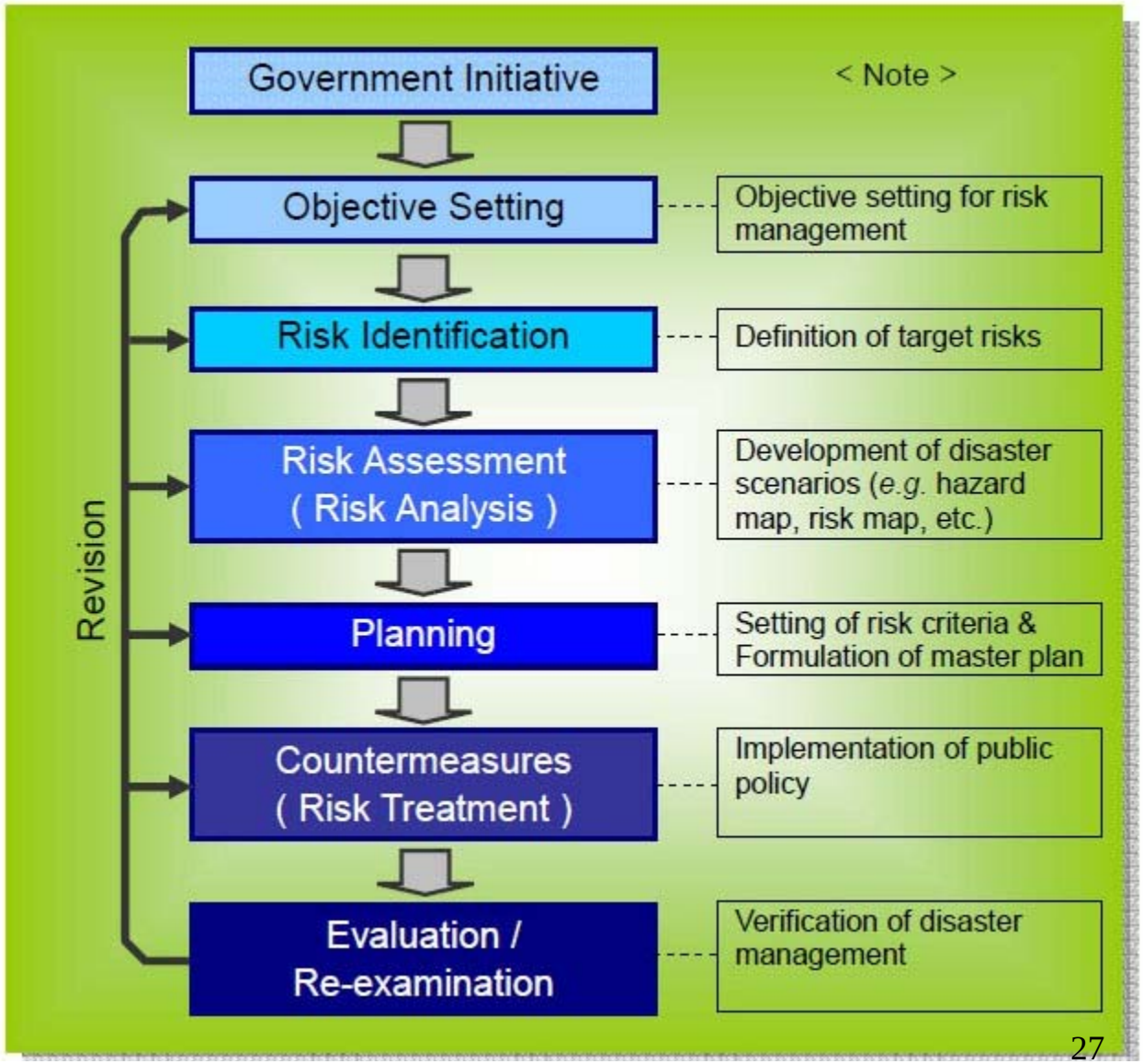
Example of Measures in each DRM Phase

	Disasters			
Phase	Earthquake	Flood	Storm*	Landslide
Prevention/ Mitigation	- Seismic design - Retrofitting of Vulnerable buildings - Installation of Seismic isolation/ Seismic response control systems	- Construction of dike - Building of dam - Forestation - Construction of flood control basins/ reservoirs	- Construction of tide wall - Establishment of forests to protect against storms	- Construction of erosion control dams - Construction of retaining walls
Preparedness	- Construction and operation of earthquake Observation Systems	- Construction and operation of meteorological Observation systems	- Construction of shelter - Construction and operation of meteorological Observation systems	- Construction and operation of meteorological Observation systems
	- Preparation of hazard maps; - Food & material stockpiling; - Emergency drills; - Construction of early warning systems; and - Preparation of emergency kits			
Response	- Rescue efforts; - First aid treatment; - Fire fighting; - Monitoring of secondary disaster; - Construction of temporary housing; and - Establishment of tent villages			
Rehabilitation/ Reconstruction	- Disaster resistant reconstruction; - Appropriate land use planning; - Livelihood support; and - Industrial rehabilitation planning			

*(cyclone, typhoon, hurricane)

Risk Management Flow

- To reduce disaster risk, it is important to implement risk management procedures step by step.
- The salient steps in implementing disaster risk management, termed as Risk Management Flow is illustrated in the Figure



Journey in Risk Management

- All Hazards Approach
- We are the Users
- Disaster Risk Management Process

Why Engage in a Disaster Risk Management Process?

- Reduce loss of life
- Reduce costs associated with disaster and from chronic hazards & repetitive loss
- Maximize limited resources for research, planning, mitigation, response

What is the objective of Hazard (leading to Disaster) mitigation planning ?

taking action to permanently reduce or eliminate long-term risk to people and their property from the damaging effects of natural hazards

Mitigation Planning is Easy

but only if…

You Have First Conducted

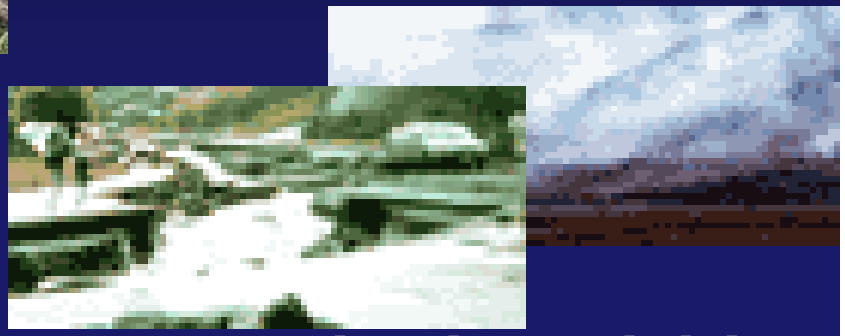
a Risk and Vulnerability Assessment

Do you know…

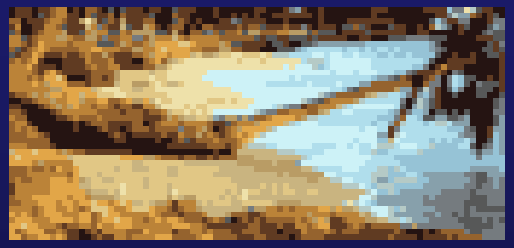
- what your most costly hazards are?
- where your highest risk locations are?
- which of your critical facilities are most vulnerable to hazards?
- where your most vulnerable populations live?
- how susceptible your local economy is to hazards?
- what environmental resources are most at risk?
- what your best opportunities are to mitigate future impacts from natural disasters?

Impacts from… Storms

Floods

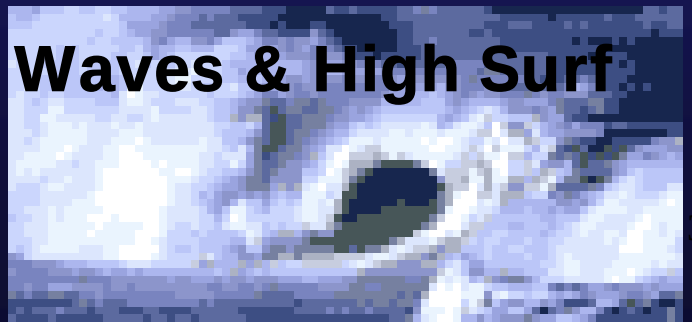


Seismic Activities



Erosion

Droughts & Fires



Waves & High Surf

Risk and Vulnerability Assessments:

- **Identify Multiple Hazard Risks**
- **Identify Critical Facilities & Infrastructure**
- **Identify other Critical Assets for Protection (Economic, Environmental, Social, Cultural, Governmental)**
- **Identify gaps, synergy, and opportunities**

starts

Disaster ⟷ A Hazard : known or unknown

↓

Natural, technical, man-made, nuclear, ecological

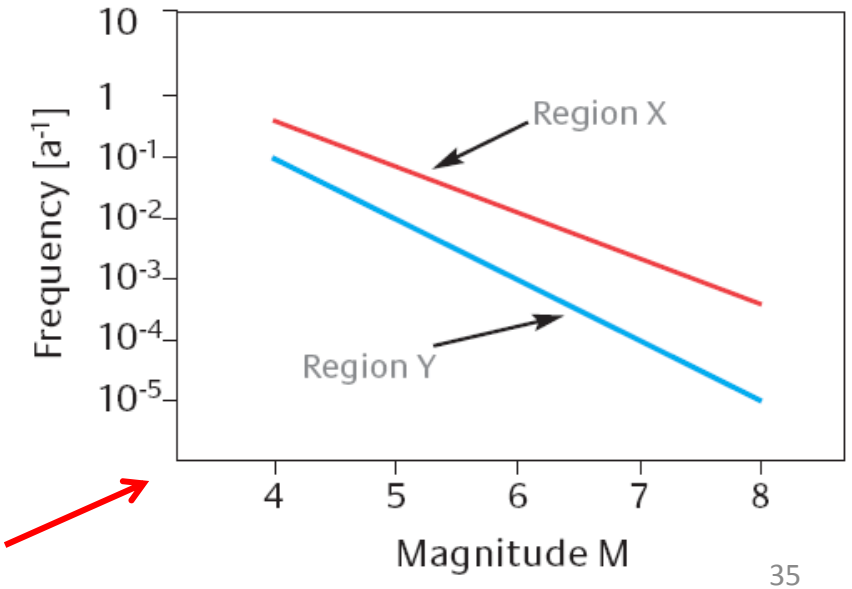
↓

All have in common the potential to cause the severe effects that are at the bottom of every emergency, disaster & catastrophe

Hazard: has a notion of probability or a likelihood of occurring; it is a threat , not the actual event – an inherent characteristic of a specific locality or region

To quantify hazard, its magnitude is tied to a specific return period or frequency (Magnitude – Frequency Relationship)

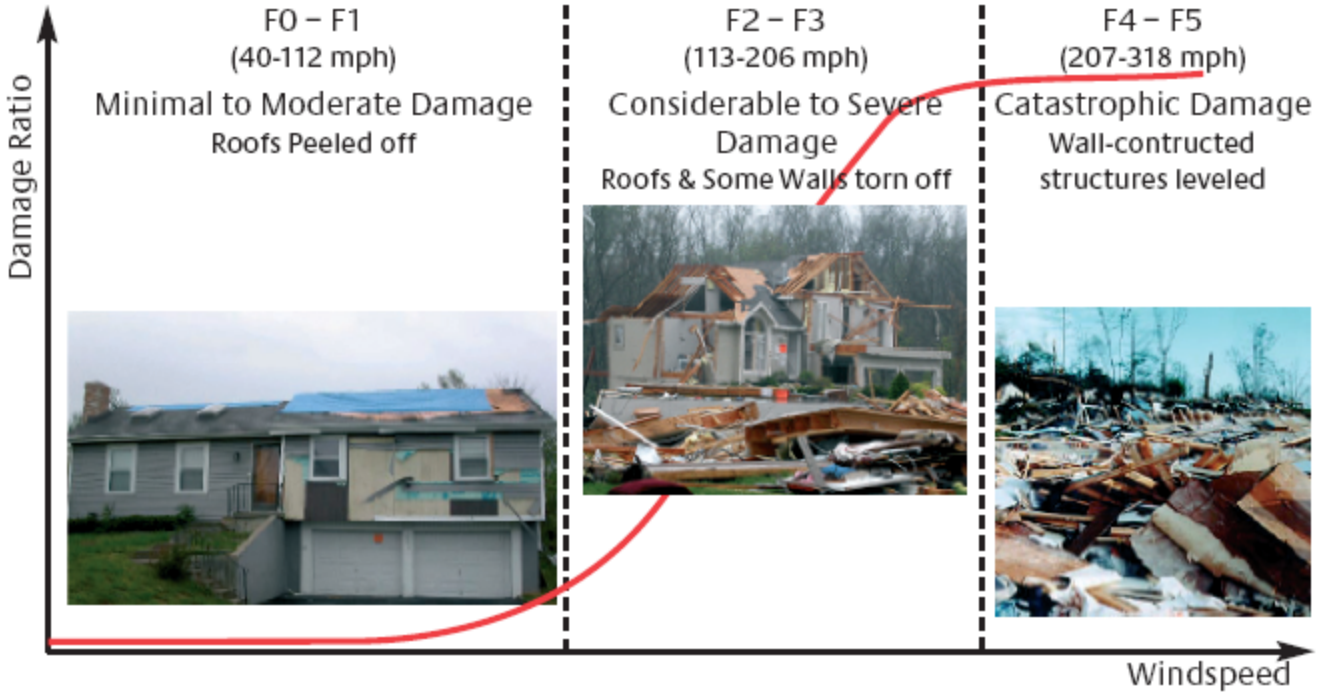
Earthquake Hazard for two fictitious regions, X and Y shown here



Vulnerability – indicates a damage potential

a dynamic and intrinsic feature of a community that comprise of a multitude of components, a permanent and dynamic feature that is revealed during an event to an extent that depends on the magnitude of the harmful event

What is normally seen if the aftermath of a disaster is not the vulnerability per se, but the harm done. Seeing the damage pattern of a community without knowing the magnitude of the event does not allow conclusions regarding the community's vulnerability. In that sense the magnitude-damage relationship reflects the vulnerability of an element in risk



Sample residential damage function for the hazard of tornado illustrates the progression of wind damage. Tornado intensities are marked from F0 to F5 on the Fujita scale. The full relationship characterizes the physical vulnerability of a certain building type.

Implication of this example is to put forward vulnerability in a more encompassing way so that it includes exposure and coping capacities of a community.

Exposure – Together with vulnerability and hazard exposure is another prerequisite of risk and disaster. Exposure is understood as the number of people and/or other elements at risk that can be affected by a particular event.

Vulnerability determines the severity of the impact an event will have on the elements at risk, it is the exposure that drives the final tally of damage or harm.

Coping Capacity and Resilience

Coping Capacity encompasses those strategies and measures that act directly upon damage during the event by alleviating or containing the impact or by bringing about efficient relief, as well as those adaptive strategies that modify behavior or activities in order to circumvent or avoid damaging effects.

Resilience is all of these things, plus the capability to remain functional during an event and to completely recover from it. So, resilience includes coping capacity but at the same time goes beyond it.

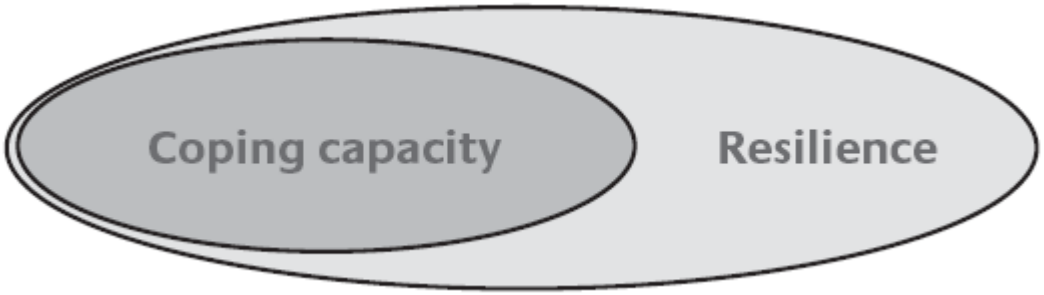


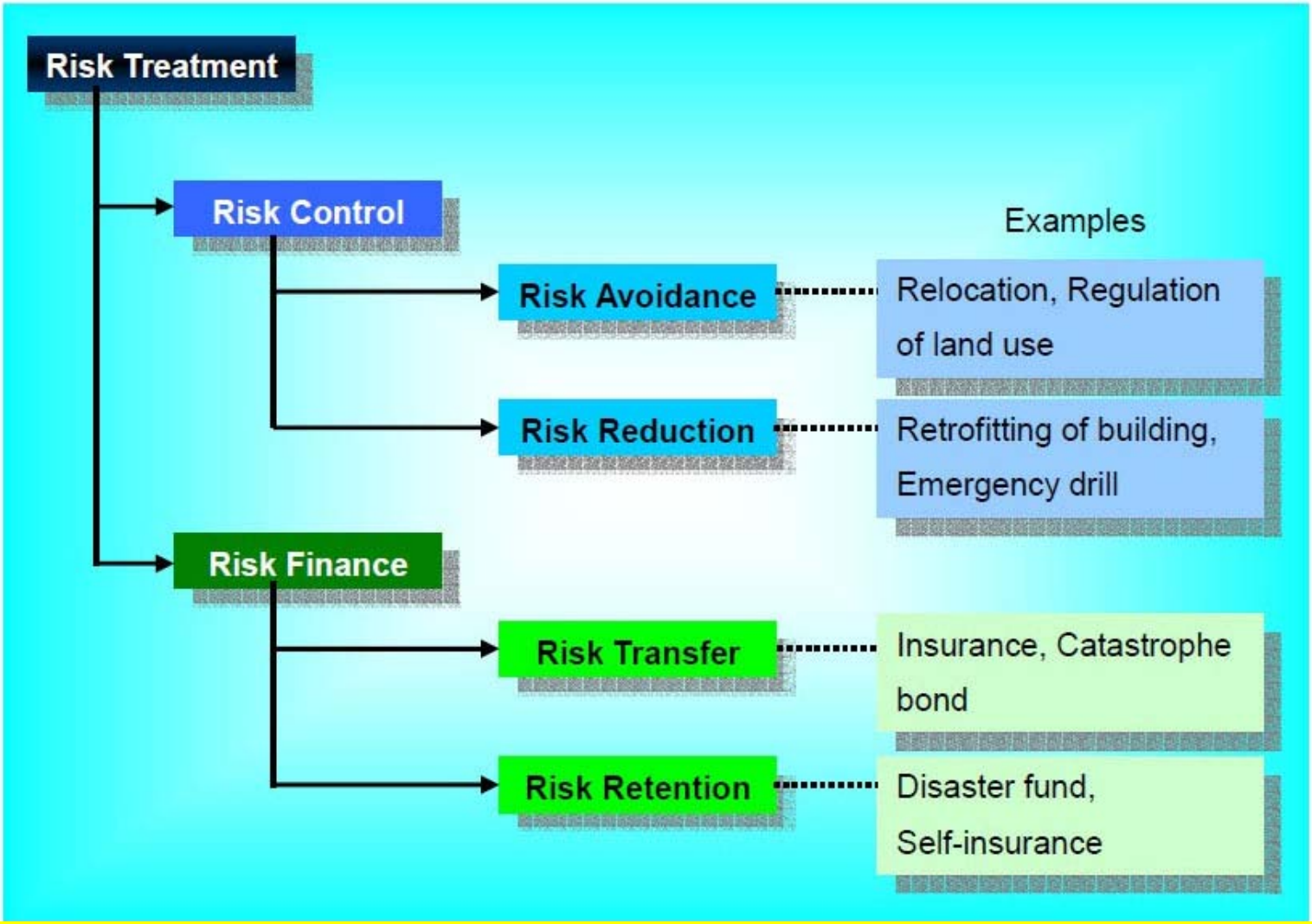
Figure 3. Coping capacity and resilience are hard to delineate. Resilience is understood to be the more encompassing term.

Risk

Risk = f (hazard, vulnerability, exposure, resilience)

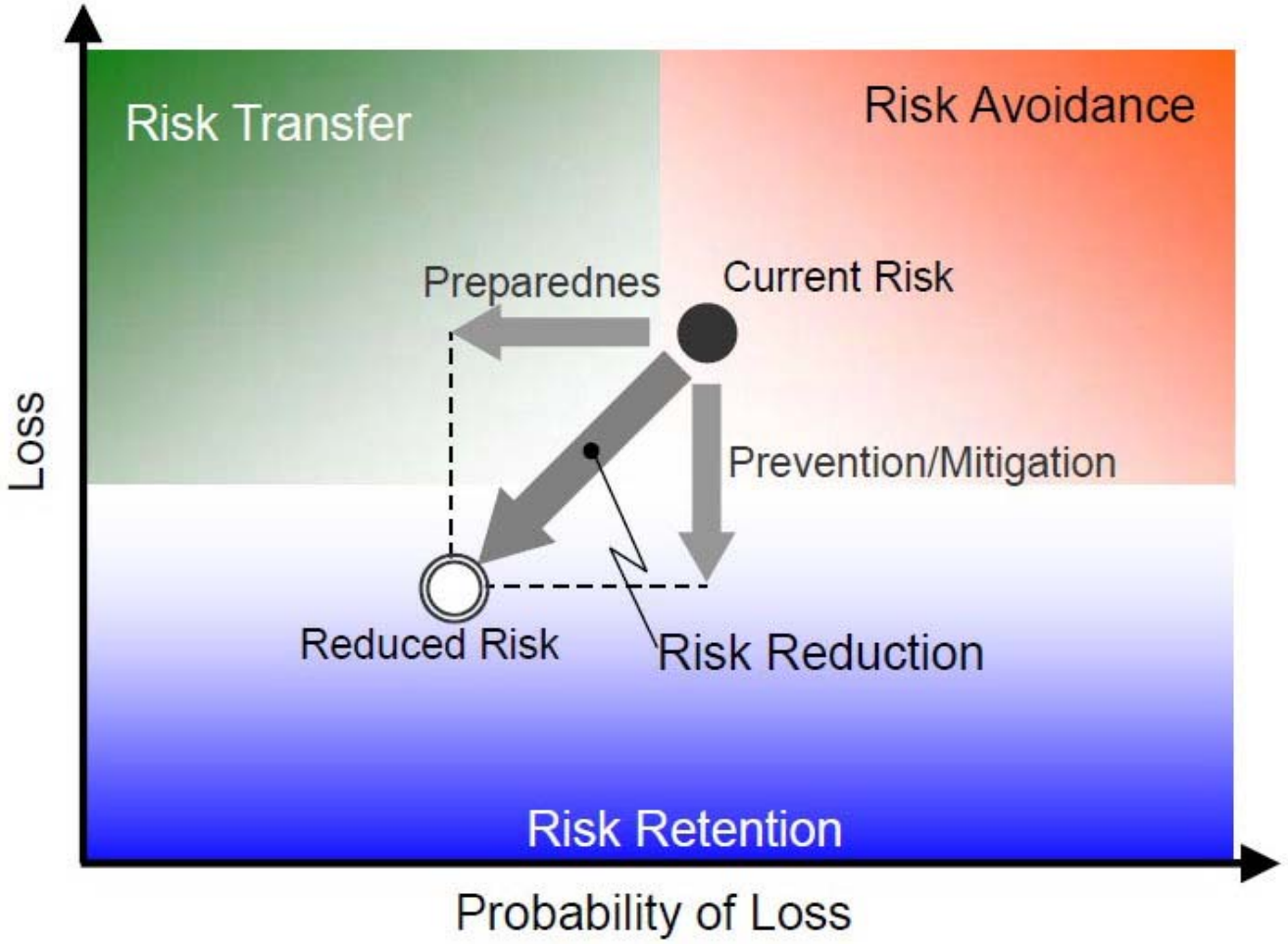
Figure 4. Risk seen as a function of hazard, vulnerability, exposure, and resilience, while the mathematical relationship between the variables is unknown.

Countermeasures (Risk Treatment)



Classification of Risk Treatment for Natural Disasters

Countermeasures (Risk Treatment)



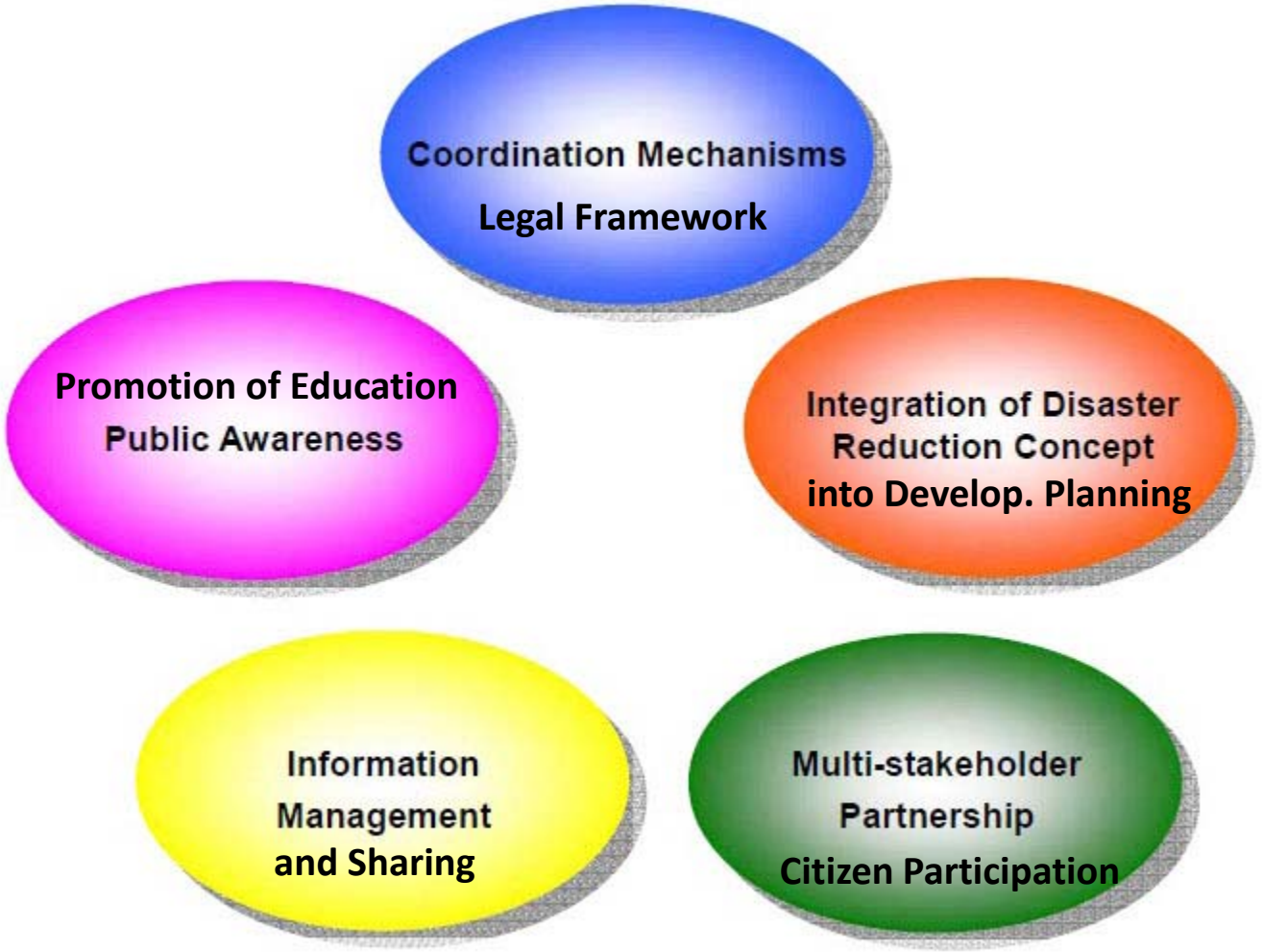
Risk = (Probability of Loss) x (Loss)

Concept of Disaster Risk Treatment

Countermeasures (Risk Treatment)

Best Matching of Risk Treatment Elements

Strategy for DRM



Key Elements of Strategy for Disaster Reduction

Concept to Practice

- Is this Concept Adopted in Practice fully or partially?
- What could be the hindrances if not adopted in practice?
- What are the follow-up actions?

What we find in Reality ?

- lack of a master plan for disaster management;
- lack of activities for proactive approach including prediction and warning for disaster occurrences;
- no specific responsible unit;
- slow decision making in national level for emergency relief activities;
- unclear line of command from top to provincial level authorities;
- logistic problems for distributing goods for emergency relief;
- lack of effective collaboration among institutions in different levels;
- lack of encouragement for participation of local and international NGOs;
- lack of education and knowledge in potential disaster effected communities; and
- lack of information management or database system.

Water-Related Disasters
(floods, droughts, tropical storms)

Not completely controllable

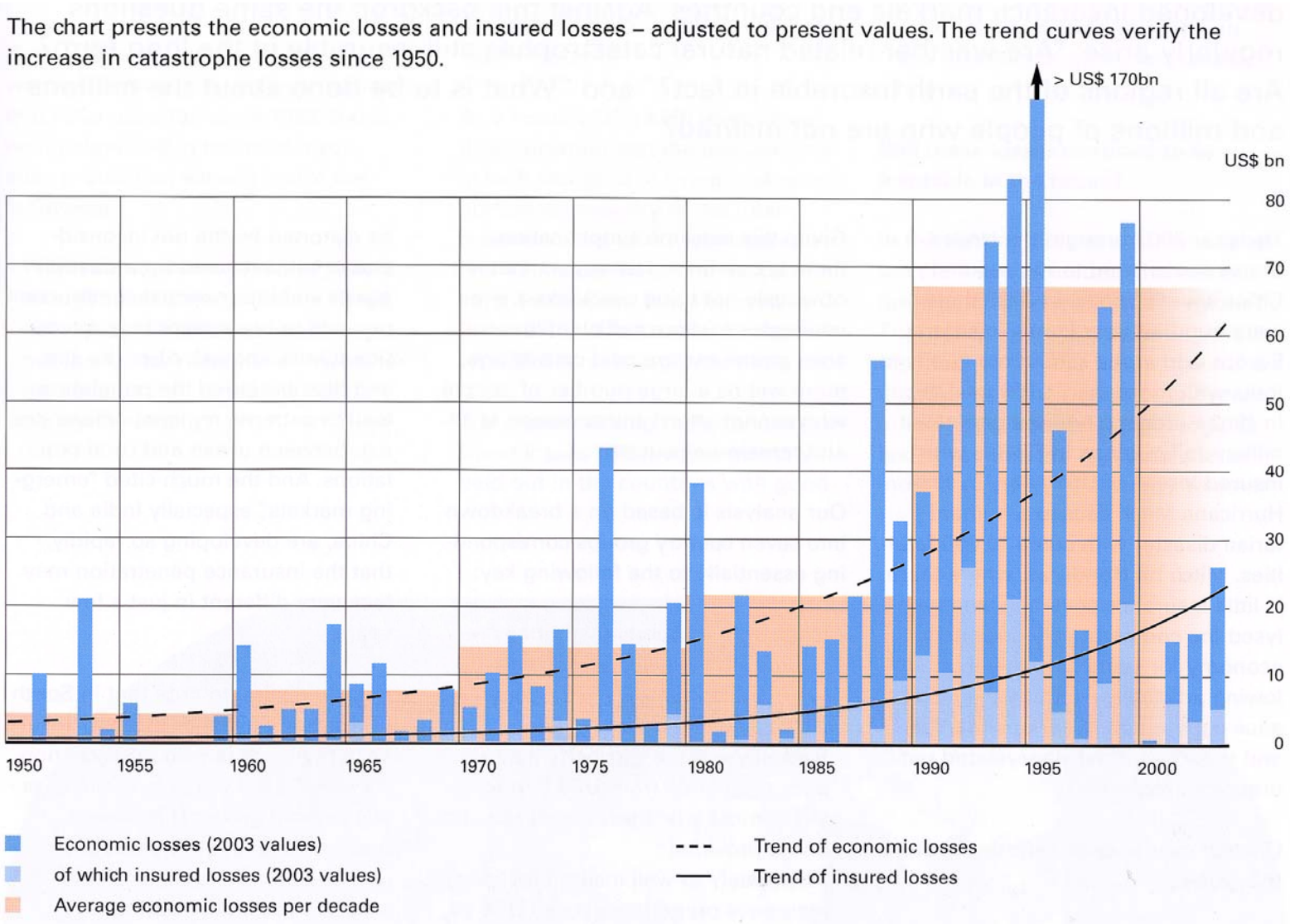
Large scale socio-economic losses

Disaster Management

should emphasize

Risk Management

Flood damages are increasing…



Traditional Flood Management Options

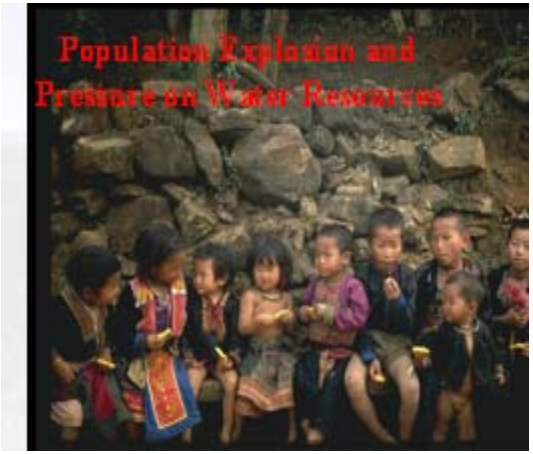
- Storing runoff: Reservoirs; Detention basins;
- Separating floods and the population;
- Increasing the carrying capacity of rivers;
- Source control to reduce runoff;
- Emergency responses; and
- Recovery and Rehabilitation.

Shortcomings of current FM Practices in many countries

- **Ad-hoc and stand alone**
- **Reactive rather than proactive**
- **Emphasis on structural measures**
- **Monodisciplinary**
- **Failure to learn from past**

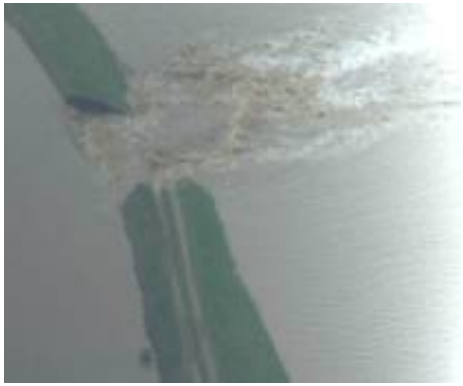
Flood policy is a neglected water policy issue on the international as well as, in many cases, at the national level

Challenges of Flood Management



Population increase

Securing livelihoods



Absolute safety from flooding is a myth

Challenges of Flood Management

Changes in decision making processes

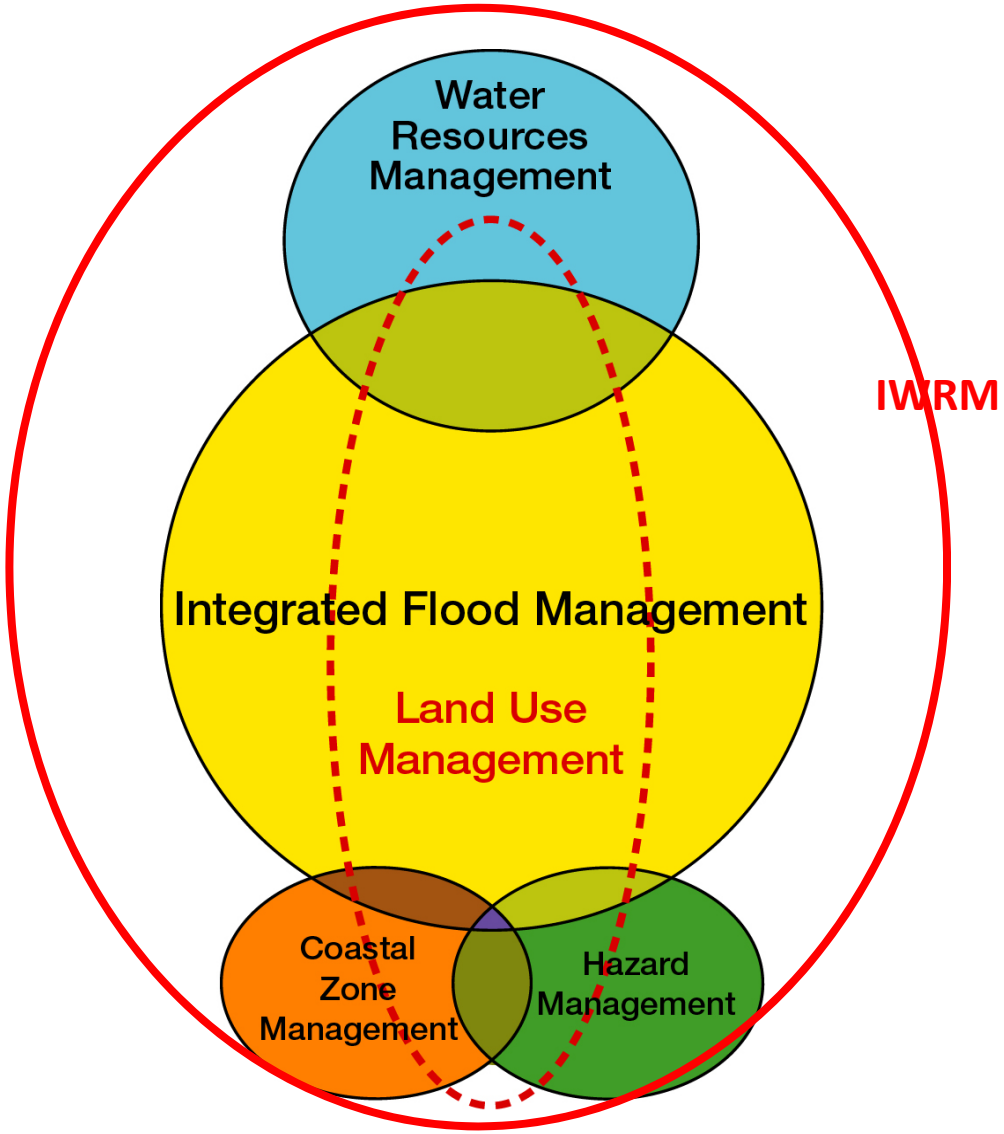
cumulus.geol.iastate.edu/

Ecosystem Conservation

Climate variability and change

www.awitness.org

Flood Management in the context of WRM
Integrated flood management



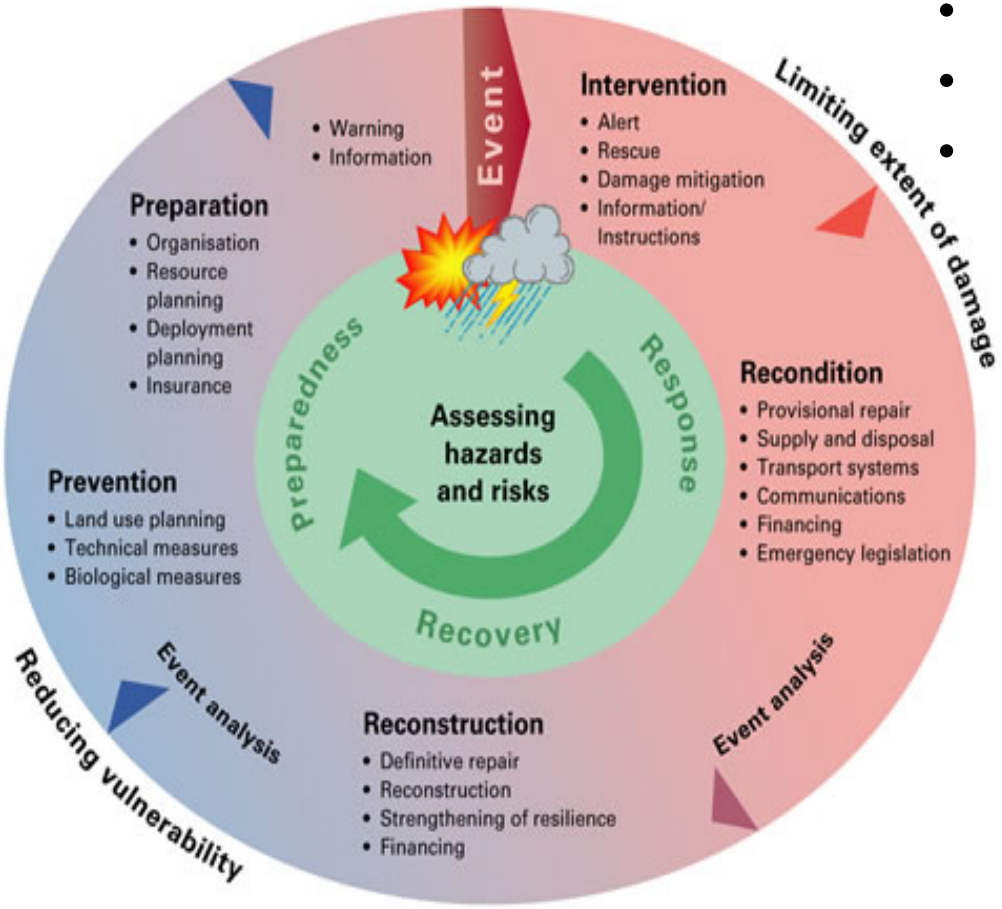
Integrated Flood Management (IFM)

Objectives

- Sustainable development: balancing development needs and flood risks
- Maximising net benefits from floodplains: ensure livelihood security and poverty alleviation thereby reducing vulnerability
- Minimising loss of life
- Environmental preservation

IFM: Principles

Risk Management



- Preparedness
- Mitigation and Response
- Recovery and rehabilitation

IFM: Principles

Risk Management

Water Cycle as a whole

- Flood and drought management
- Effective use of flood waters
- Ground water and surface water interaction in flood plains

IFM: Principles

Risk Management

Water Cycle as a whole

Multi-hazard approach

- Cross-sectoral integration of disaster management strategies
- Disaster risk assessment
- Early warning and forecasts

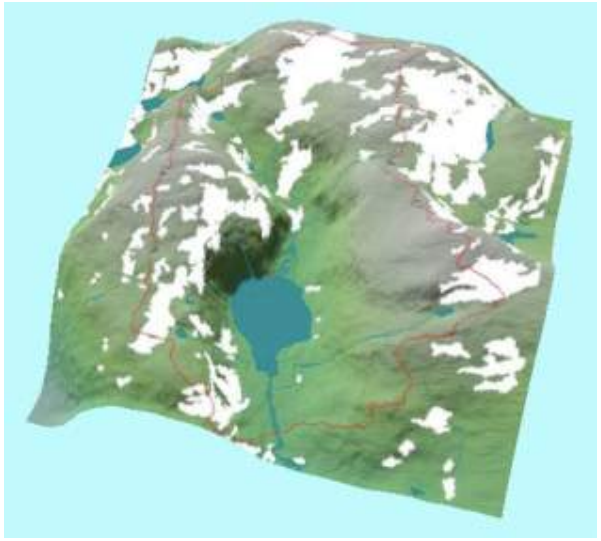
IFM: Principles

Risk Management

Water Cycle as a whole

Multi-hazard approach

River Basin approach



IFM: Principles

Risk Management

Water Cycle as a whole

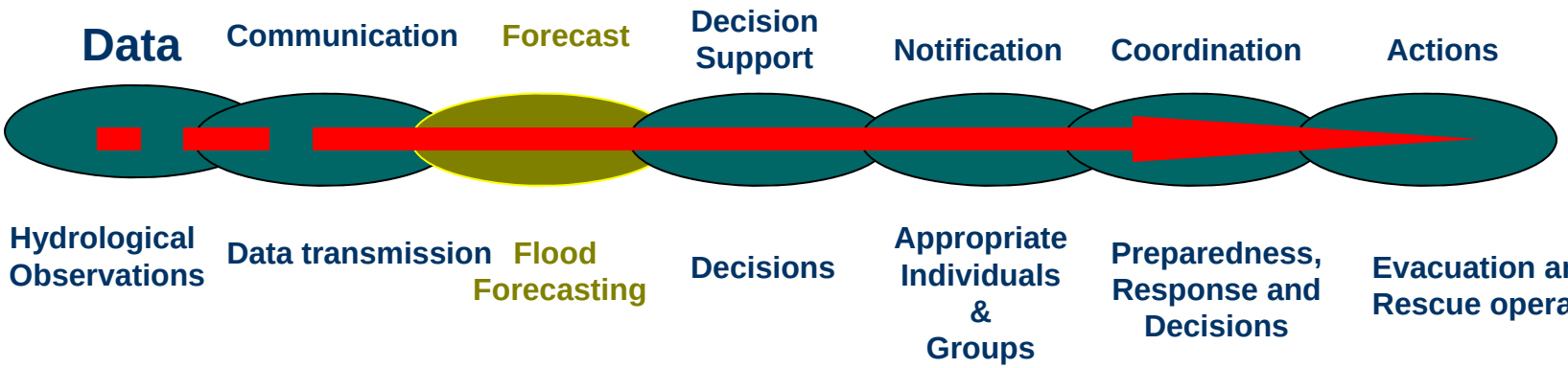
Multi-hazard approach

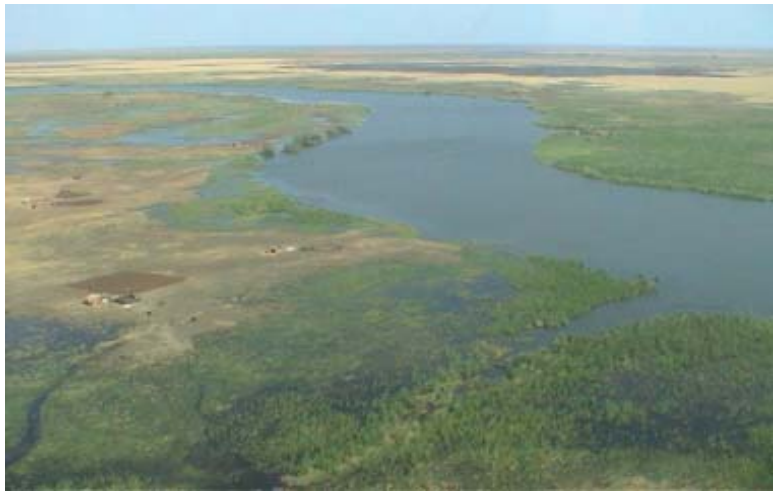
River Basin approach

Public Participation

Flood forecasting, risk zoning, warning and response system

a Critical Chain of Events and Actions





IFM: Towards an

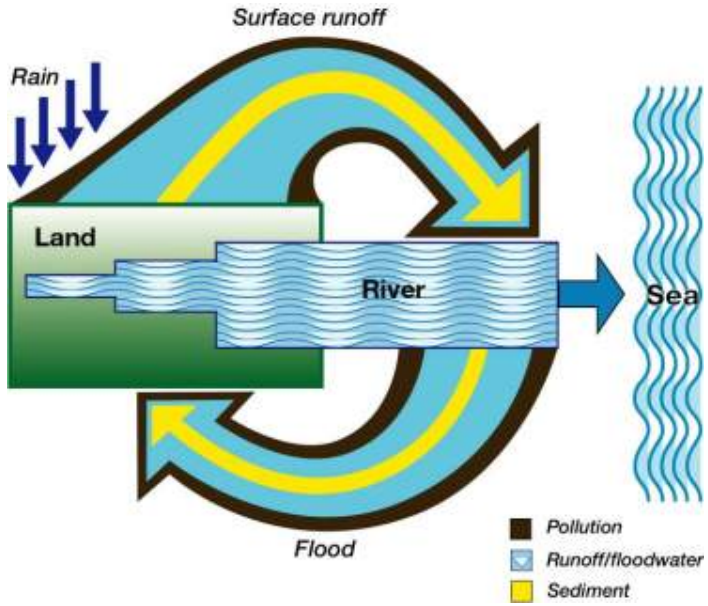
- **Integration of**
  - Land and Water Management
  - Upstream and Downstream
  - Structural and Non-structural
  - Short term and Long-term
  - Local and basin level measures
  - Top down and Bottom up decision making
  - Development needs with ecologic and economic concerns
  - Functional Integration of Institutions

Characteristics of IFM

- **Adoption of a "layered" approach of complementary options with regard to time and space:**
  - Pre-, inter-, and post flood measures
  - Head reaches, middle reaches and lower flood plains
  - Short-, mid- and long-term strategies

Characteristics of IFM

Recognition that a river basin is a dynamic system with many interactions/fluxes between land and water bodies



Improvements in the functioning of the river basin as a whole without just fixing local problems

Characteristics of IFM

Managing the water cycle as a whole

- Flood management should be intertwined with drought management through the effective use of floodwater
- Measures to change the runoff regime should consider effects holistically (e.g. link between deforestation, urbanisation, runoff and landslides)
- All floods should be “managed” and not just the ones up to a certain design standard

Characteristics of IFM

Participatory Approach

- Involvement of a good representative range of stakeholders in the dialogue/decision-making process
- Decentralization of decision-making with full public consultation
- Optimal mix of bottom-up and top-down approaches (extreme bottom-up risks fragmentation)
- Effective conflict resolution mechanisms

Characteristics of IFM

Integrated hazard management approach

- Cross-sectoral integration to implement disaster management plans and ensure consistency in approaches to all natural hazards
- “Multi-hazard” emergency planning and management on appropriate institutional levels (including riverine and coastal floods/tsunamis)
- Effective dissemination of forecasts and early warnings of all natural hazards by a single designated authority

Requirements of IFM

Clear and objective policies with a multidisciplinary approach

supported by appropriate

- Legislation and regulations;
- Institutional structures for proper coordination and appropriate linkages;
- Economic instruments;
- Enabling participatory processes; and
- Information management and exchange mechanisms.

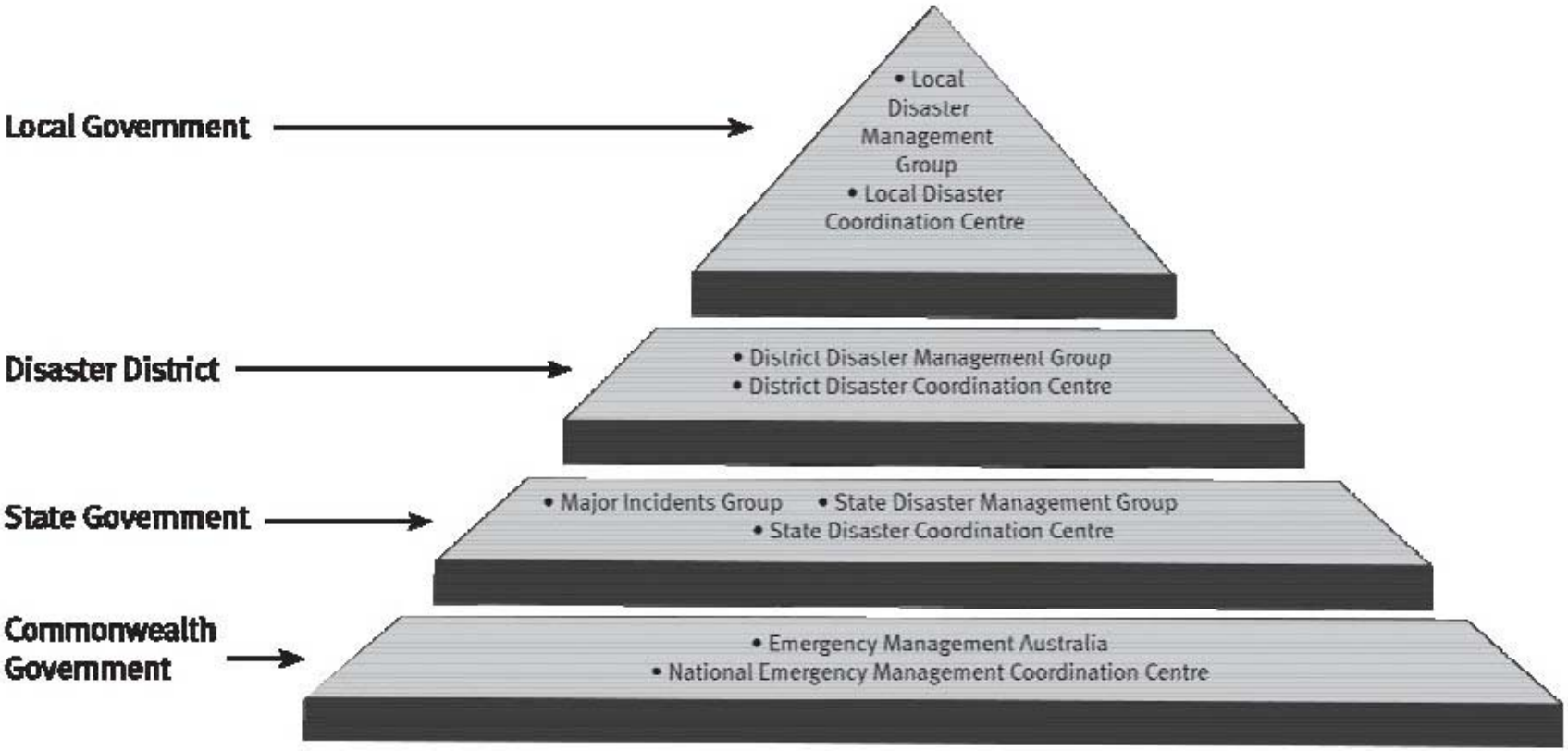
Queensland Disaster Management System

http://www.lgaq.asn.au/web/guest/qld-disaster-management-system

An Overview

- The *Disaster Management Act 2003* (the Act) provides the legislative basis for disaster management arrangements in Queensland. It makes provision for the establishment of Disaster Management Groups for State, disaster districts and local government areas.
- The Act also provides the legislative basis for the preparation of disaster management plans and guidelines, including the State Disaster Management Plan, which records agreed management arrangements for coordination of disaster prevention, preparedness, and response and recovery operations.
- The Act establishes the State Disaster Management Group (SDMG) as the Queensland body responsible for the development of disaster management policy and to coordinate the resources necessary to ensure that all steps are taken to plan for and counter the effects of disasters.

The Queensland Disaster Management System



Principle Structure

- Disaster Management Groups that operate at State, District and Local levels and which are responsible for the planning, organization, coordination and implementation of all measures to mitigate/prevent, prepare for, respond to and recover from disaster situations
- Coordination Centers at State, District and Local levels that support Disaster Management Groups in coordinating information, resources and services necessary for disaster operations;
- State Government Functional Lead Agencies through which the functions and responsibilities of the State Government in relation to disaster management are managed and coordinated;
- State Government Threat Specific Lead Agencies responsible for the management and coordination of combating specific threats; and
- Committees, either permanent or temporary, established under the authority of the Disaster Management Groups for specific purposes relating to disaster management.

Major Incident Group

Established to provide high level Ministerial guidance and support in the event of a significant incident with major community consequences.

Functions

- provide high level decision making and leadership to the disaster management response and recovery operations associated with extreme events;
- provide appropriate State resources to expedite the disaster management response and recovery operations;
- determine the State Government public information and media strategy; and
- liaise with the State Crisis Centre (if activated) to ensure effective integration of crisis and consequence management strategies.

State Disaster Management Group

The State Disaster Management Group is the peak policy and planning group for disaster management in Queensland.

Functions

- developing a strategic policy framework for disaster management for the State;
- ensuring effective disaster management is developed and implemented for the State;
- ensuring effective disaster management arrangements between the State and the Commonwealth are established and maintained;
- identifying resources, in and outside the State, that may be used for disaster operations;
- providing disaster management and disaster operations reports and recommendations to the Minister; and
- preparing the State Disaster Management Plan (SDMP).

State Disaster Coordination Group

(1)

The State Disaster Coordination Group (SDCG) is the working body of the SDMG at State level. This Group is the primary mechanism through which coordinated whole-of-Government State-level support is provided to disaster-stricken communities.

Functions

- examine and recommend measures to enable Queensland's communities to better cope with the effects of disasters;
- assist in coordinating the provision of State level support to disaster affected communities;
- assist the development and implementation of public disaster management education and awareness strategies in Queensland;
- review disaster response and recovery operations in Queensland and recommend remedial action on lessons learnt;

State Disaster Coordination Group

(2)

The State Disaster Coordination Group (SDCG) is the working body of the SDMG at State level. This Group is the primary mechanism through which coordinated whole-of-Government State-level support is provided to disaster-stricken communities.

Functions (contd.)

- prepare an annual report of activities for presentation to the State Disaster Management Group (SDMG);
- perform other tasks as requested by the SDMG; and
- establish and coordinate the activities of working parties and sub-committees as necessary.
- *Note: The SDCG is a non-legislated group*

State Disaster Mitigation Group

(1)

The SDMC provides advice, with a whole-of-Government focus, to the Minister for Emergency Services and the SDMG, on disaster mitigation issues.

Functions

- lead development and implementation of Queensland's disaster mitigation strategy;
- shape government policy on all-hazard disaster mitigation including land use planning and infrastructure design based on research and hazard risk assessments throughout Queensland;
- advocate and assess priority funding for cost-effective mitigation measures, activities and research;

State Disaster Mitigation Group

(2)

The SDMC provides advice, with a whole-of-Government focus, to the Minister for Emergency Services and the SDMG, on disaster mitigation issues.

Functions (contd.)

- coordinate whole-of-Government activities to improve disaster mitigation and support agency implementation of disaster mitigation measures and methodologies; and
- provide a forum for multi-agency and multi-jurisdictional collaboration on mitigation measures and issues.
- *Note: The SDMC is a non-legislated group*

Hyogo Framework for Action (2005-2015)

Building the Resilience of Nations and Communities to Disasters

The World Conference on Disaster Reduction (WCDR) convened in Kobe, Japan in 2005 identified five priorities in its action plan – the Hyogo Framework for Action (HFA):

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

www.unisdr.org/2005/.../**Hyogo-framework-for-action**-english.pdf

Cha-am Hua Hin Statement on EAS Disaster Management

We, the Heads of State and Government of the Member States of the Association of Southeast Asian Nations (ASEAN), Australia, People's Republic of China, Republic of India, Japan, Republic of Korea, and New Zealand, on the occasion of the 4th East Asia Summit (EAS) in Cha-am Hua Hin, Thailand, on 25 October 2009;

Expressing grief at the recent loss of life, properties and livelihoods from the impact of disasters that have been experienced by countries in the East Asia Summit (EAS) and in the Asia-Pacific region; and also expressing deep concern at the long-term negative social, economic and environmental consequences for nations which hamper the achievement of their sustainable development, particularly in achieving the internationally agreed development strategies, including the Millennium Development Goals and regional integration processes;

Reaffirming the commitment of countries in the EAS to pursue effective disaster risk reduction in the spirit of partnership and cooperation in order to reduce the vulnerabilities and enhance the capacities of peoples to be more resilient and self-reliant in mitigating the impact of disasters; and recalling that disaster risk reduction is one of the priority areas of cooperation identified in the 2nd EAS in January 2007; . . . . . .

www.dfat.gov.au/asean/**eas/statement-disaster-management**.pdf

Thailand's Disaster Management System

Presentation by

Areerat Wijitpatcharaphon
ADRC Visiting Researcher

www.**adrc**.asia/aboutus/vrdata/countryreport/**areerat**2009_cr.pdf

Thailand Disaster Management Structure and Links to the ASEAN Agreement on Disaster Management and Emergency Response and Beyond

ASEAN DEFENCE ESTABLISHMENTS AND CIVIL SOCIETY ORGANISATIONS (CSOs) COOPERATION ON NON-TRADITIONAL SECURITY (Disaster Management)

28 June 2010

Royal Orchid Sheraton Hotel & Towers, Bangkok

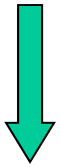
www.adpc.net/cso/.../CD/...**Presentation**/.../Adthaporn_**Thailand.ppt**

Concluding Remarks

disaster management system development

Risk Management

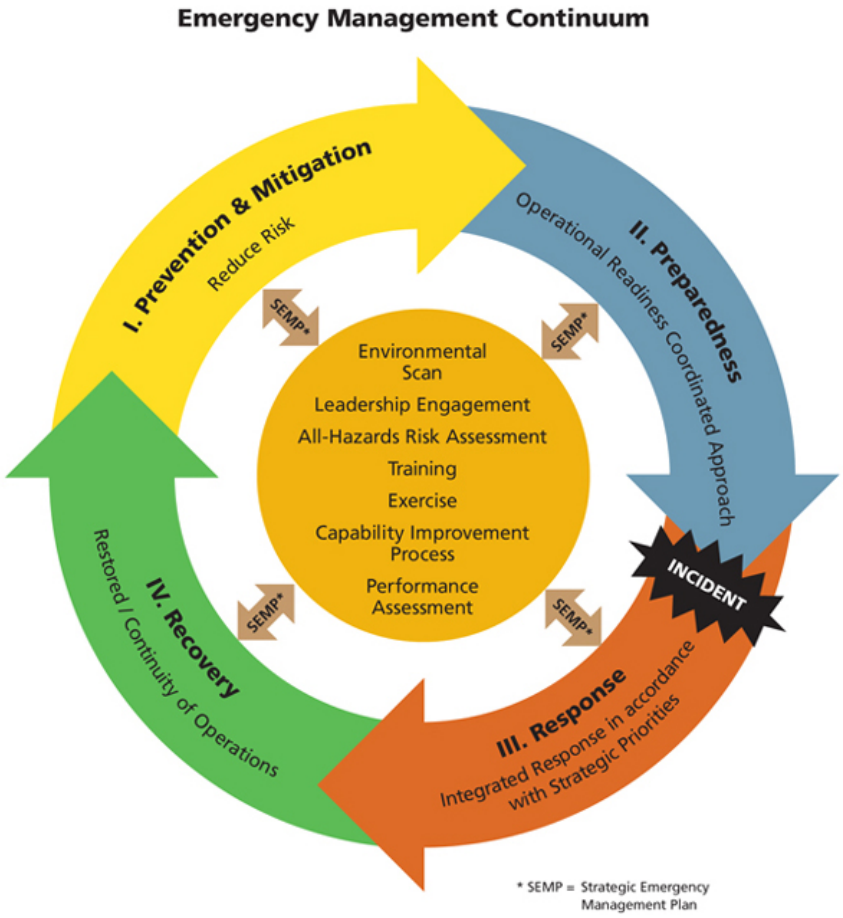
Measures adopted to minimize potential loss when the system fails to perform as expected



Risk measures Sustainability

Risk is a Cost Measured in Units of Money, Ecosystem Productivity, Public Health Incidents or any other Measure of Success or Failure

How do we respond to Hazards & Disaster Risk?



Risk Assessment

Prevention

Preparedness

Response

Recovery

Emergency Management

"PPRR" Framework

Effective Institutional Strengthening Needed…….

(1)

- *appropriate legal frameworks that address integrated disaster management approaches based on risk management strategies with due consideration to the development processes;*
- *informed decision-making based on sound scientific knowledge, as well as local, indigenous knowledge using tried and tested techniques and evaluating all promising innovations;*
- *an information base that supports planning and a proactive response to disaster mitigation and reduction;*
- *a participatory and transparent approach that includes a representative range of stakeholders in the decision-making process;*
- *regional and sub-regional approaches, strategies and cooperation arrangements where rivers span two or more national boundaries for a harmonized approach;*

Effective Institutional Strengthening Needed…….

(2)

- *partnerships among different levels of government, civil society, private sector groups and communities;*
- *decentralized decision-making through local authorities and basin committees, including the provision of adequate resources and clarifying the division of responsibilities at various levels;*
- *effective policies to regulate further growth of human settlements in risky areas including appropriate economic policies, such as fiscal incentives for orientation of economic activities away from disaster-prone areas;*
- *shifting from top-down, predominantly engineering approaches, say for flood management to a more integrated and proactive approach.*

Better Understanding of Risk and Vulnerability……..

- Risk and vulnerability assessments, involving all sections of society, are needed to identify the areas at greatest risk and the most appropriate risk management measures for a given region or community.
- Risk maps should be used to notify all development authorities of areas exposed to hazards.
- Very important to understand the interplay between hazards, the development process and poverty in order to ascertain how current and future development planning and implementation can increase vulnerability and risk.
- Continued collaboration between climate scientists and water managers is crucial to make available the best prediction and forecasting tools to water managers.

Public Awareness Programs…….

- The process starts with formal educational programs including curricula revision, teacher training and development of resource centers.
- However, the process needs to expand to training activities for all levels of society, especially targeting professionals and community-based leaders and organizations.
- Training is just one element; consideration should be given to the development of awareness-raising material such as pamphlets and fliers.
- Strengthening mechanisms for sharing of information, knowledge and experiences, in particular on good practice in reducing the risk of vulnerable communities to floods and droughts, at the international, regional and national level are also required.
- Emphasis should be on the adoption of flexible strategies tailored to each region recognizing the importance of evaluating differing options and their relative advantages and disadvantages.

Monitoring, Forecasting and Early Warning……..

- Monitoring hazards is very essential as the local hydrological and meteorological data are the basis for risk assessment, giving feedback for development and planning adhering to the necessary safety criteria and ensuring the continuity of economic activity.
- Data and information need to be government-funded and made available as a public good. The extent to which a hazard becomes a disastrous event has much to do with the planning, early warning and protective measures taken.
- An efficient early warning system should deliver accurate information on likely events in a timely manner. This requires an integrated approach encompasing monitoring, forecasting, risk mapping and warning as an important tool to assist decision-making process.