



# Disaster Management for Dams

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## CE 285: Disaster Management for Dams (3:0) (jointly with Prof V.V. Srinivas)

**Syllabus:**  
 Overview of disaster management and flood mapping, Flood risk associated with various types of dams, Dam hazard classification systems, Dam failure modes and assessment of consequences, Dam breach modelling, Hydrologic, Hydraulic and breach outflow routing, Remote Sensing and Geographic Information Systems (GIS) applications for emergency preparedness and flood mapping, Dam hazard classification framework in India, Emergency action plans preparation and implementation.

**References:**

- Guidelines for Developing Emergency Action Plans for Dams, Dam Safety Rehabilitation Directorate (DSRD), Central Water Commission (CWC), 2016.
- Guidelines for Mapping Flood Risks Associated with Dams, DSRD, CWC, 2018.
- Heywood, L., Cornelius, S., and Carver, S. An Introduction to Geographical Information Systems, Pearson Education, 1998.
- Lillesand T.M. and Kiefer R.W. Remote Sensing and Image Interpretation, John Wiley & Sons, 2000.
- Singh, V. P. Dam Breach Modeling Technology, Springer Science & Business Media, 2013.

<http://www.civil.iisc.ac.in/~nagesh/dmd.htm>

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## Disaster Management for Dams

**NPTEL Material**

Remote Sensing - Web  
 By D. Nagesh Kumar  
<https://nptel.ac.in/courses/105/108/105108077/>

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## Evaluation

- **Assignments - 10%**
- **Two Class Tests - 2x15%**
- **Mini Project - 20% (+ Seminar - optional)**
- **Final Test - 40%**
- **Attendance <80%- -5%**

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## Framework for Disaster Management

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## Conceptualizing Disaster and Emergency Management Evaluation

- Disaster and emergency preparedness, response, and recovery are complicated often chaotic, and driven by countless impulses
- The respective life cycles of disaster and emergency response, performance management, and evaluation activities connect with and influence each other
- One way to represent this complexity is to organize the many elements into a multidimensional framework

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## Conceptual Framework for Disaster and Emergency Management Evaluation



Source: Ritchie, L. A., & MacDonald, W. (2010). Enhancing disaster and emergency preparedness, response, and recovery through evaluation. In L. A. Ritchie & W. MacDonald (Eds.), *Enhancing disaster and emergency preparedness, response, and recovery through evaluation. New Directions for Evaluation*, 126, 3-7.

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## Evaluation Strategies

- Evaluation efforts use an intraagency, interagency (nongovernmental organizations, donor governments), or systemwide (United Nations) approach.
- Physical scope of a disaster event
  - local, regional, national, and international levels.
  - Micro (Hurricane Katrina),
  - Mezzo (Haiti), or
  - Macro (southeast Asia tsunami) context
- can be a collaboration between responding systems

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## Intended use of Evaluation Findings

- Scanning
- Strategic planning
- Policy development
- Program design
- System alignment
- Program implementation
- Monitoring and measurement
- Closing and reporting
- Processes such as audit and evaluation
- Validity and reliability

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## Context

- Social, political, economic, legal, environmental, and technological factors
- Failure to recognize, accommodate, and address these factors is likely to result in an evaluation that produces results that are of little use or, perhaps even worse, evaluation findings that are ultimately irrelevant

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## Definitions

**Hazard:** A potentially damaging physical event, phenomenon or human activity that may cause the loss of life or injury, property damage, social and economic disruption or environmental degradation. **Natural hazards** can be classified according to their geological (earthquake, tsunamis, volcanic activity), hydro-meteorological (floods, tropical storms, drought) or biological (epidemic diseases) origin. Hazards can be induced by human processes (climate change, fire, mining of non-renewable resources, environmental degradation, and technological hazards) Hazards can be single, sequential or combined in their origin and effects.

**Disaster:** A serious disruption of the functioning of a community or a society causing widespread human, material, economic or environmental losses which exceed the ability of the affected community or society to cope using its own resources. A disaster is a function of the risk process. It results from the combination of hazards, conditions of vulnerability and insufficient capacity or measures to reduce the potential negative consequences of risk.

Source: Definitions from ISDR Terminology version 2007 ([www.unisdr.org/terminology](http://www.unisdr.org/terminology))

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## Definitions

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

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

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

Source: Definitions from ISDR Terminology version 2007 ([www.unisdr.org/terminology](http://www.unisdr.org/terminology))

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### Disaster Risk Management Framework (DRMF)

The purpose of **Disaster Risk Management** is to reduce the underlying factors of risk and to prepare for and initiate an immediate response should disaster hit.

Source: Disaster risk management systems analysis: A guide book  
Boas S, S Ramasamy, J D de Pryck, F Battista, FAO, UN, Rome, 2008

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### Hyogo Framework for Action (HFA) 2005-2015

- HFA elaborates the five priorities for action adopted by the World Conference on Disaster Reduction to achieve its strategic goals by 2015.

- 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.

Source: Hyogo Framework for Action 2005-2015: Building the Resilience of Nations and Communities to Disaster  
(available at [www.unisdr.org/eng/hyofa.htm](http://www.unisdr.org/eng/hyofa.htm)).

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### Hyogo Framework for Action (HFA) 2005-2015

Expected outcome, strategic goals and priorities for action 2005-2015

**Expected Outcome:** The substantial reduction of disaster losses, in lives and in the social, economic and environmental assets of communities and countries

**Strategic Goals:**

- The integration of disaster risk reduction into sustainable development policies and planning
- Development and strengthening of institutions, mechanisms and capacities to build resilience to hazards
- The systematic incorporation of risk reduction approaches into the implementation of emergency preparedness, response and recovery programmes

**Priorities for Action:**

- Ensure that disaster risk reduction (DRR) 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
- Strengthen disaster preparedness for effective response at all levels

**Key Activities:**

- DRR national mechanisms (national planning, coordinated responsibilities, DRR part of development policies and planning, sector wise and subsector)
- Legislation to support DRR
- Dissemination of information and resources
- Resource and financial commitment
- Community participation
- Risk assessments and maps, national education and dissemination
- Inclusion of DRR and vulnerability
- Data and statistical risk information
- Local warning, public interest, information systems, public policy
- Development of disaster management data sharing, space-based early observation, climate modeling and forecasting, early warning
- Regional and emerging risks
- Information sharing and cooperation
- Human science disciplines and regions, disaster
- Use of disaster/DRR vulnerability
- Inclusion of DRR into school curricula, formal and informal education
- Training and learning on DRR
- Disaster risk reduction at the community level, local authorities, targeted sectors, rural areas
- Research capacity building, scientific, economic, application
- Public awareness and media
- Sustainable ecosystems and environmental management
- DRR strategies integrated with climate change adaptation
- Food security to resilience
- DRR integrated into health sector and safe hospitals
- Protection of critical public facilities
- Resilience of agriculture and water supply networks
- Vulnerability reduction with improved income options
- Financial services mechanisms
- Disaster risk reduction
- Land use planning and building codes
- Rural development plans and DRR
- Disaster management capacities, public, national and national capacities
- Disaster coordination, information exchange between disaster managers and development actors
- Regional approaches to disaster response, with risk reduction focus
- Review & test emergency preparedness and emergency plans
- Institution & participation

**Cross Cutting Issues:**

- Multi-hazard approach
- Gender perspective and cultural diversity
- Community and volunteer participation
- Capacity building & technology transfer

Contributing to the achievement of the internationally agreed development goals (including the MDGs)

Source: [www.unisdr.org/eng/hyofa/hyofa.htm](http://www.unisdr.org/eng/hyofa/hyofa.htm)

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### Sustainable Livelihoods Framework adopted to DRM

Source: Disaster risk management systems analysis: A guide book, Boas S, S Ramasamy, J D de Pryck, F Battista, FAO, UN, Rome, 2008

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### Diagnostic Study of DRM Institutional Systems - Flowchart

Source: Disaster risk management systems analysis: A guide book, Boas S, S Ramasamy, J D de Pryck, F Battista, FAO, UN, Rome, 2008

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### National Disaster Management Guidelines - India

Source: National Disaster Management Guidelines: Preparation of State Disaster Management Plans, National Disaster Management Authority, Government of India, Magnus Books Pvt Ltd., July 2007

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## Disaster Risks in India

- Disaster risks in India are further compounded by increasing vulnerabilities due to
  - Ever growing population
  - Disparities in income
  - Rapid urbanisation
  - Increasing industrialisation
  - Development within high-risk zones
  - Environmental degradation
  - Climate change, etc.
- Future disasters seriously threaten India's population, national security, economy and its sustainable development

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## National Committee on Disaster Management

- National Committee on Disaster Management (NCDM) was set up after the Gujarat earthquake under the Chairmanship of the Prime Minister
- National Vision
  - The national vision is to build a safer and disaster resilient India by developing a holistic, proactive, multi-disaster and technology driven strategy for DM.
  - This will be achieved through a culture of prevention, mitigation and preparedness to reduce the impact of disasters on people.
  - The entire process will centre stage the community and will be provided momentum and sustenance through the collective efforts of all government agencies supported by Non-Governmental Organisations (NGOs).
- Disaster Management Act, 2005 (DM ACT, 2005)

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## Disaster Management Act, 2005 (DM ACT, 2005) - A Paradigm Shift

- From a response and relief-centric approach to a proactive, and comprehensive mindset towards DM covering all aspects from prevention, mitigation, preparedness to rehabilitation, reconstruction and recovery
  - Creation of a policy, legal and institutional framework, backed by effective statutory and financial support
  - The mainstreaming of multi-sectoral DM concerns into the developmental process and mitigation measures through projects
  - Planning, organising, coordinating and implementing policies and plans in a holistic, community based participatory, inclusive and sustainable manner

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## National Disaster Management Authority (NDMA)

- NDMA will concentrate on prevention, mitigation, preparedness, rehabilitation and reconstruction and also formulate appropriate policies and guidelines for effective and synergised national disaster response and relief
- It will coordinate the enforcement and implementation of policies and plans

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## State Disaster Management Authority (SDMA) State Executive Committee (SEC)

- Section 23 of the DM Act 2005 provides that there shall be a DM plan for every state
- State plans shall be prepared by the SEC in conformity with the guidelines to be issued on related matters by the SDMA having regard to the guidelines laid down in this regard by the NDMA
- Vulnerability profile of different areas of a state, including information contained in the **Vulnerability Atlas of India**

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## Levels of Disasters - L0, L1, L2 and L3

- **L0 Planning Stage**
  - Normal times which are expected to be utilised for close monitoring, documentation, prevention, mitigation and preparatory activities.
  - Training on search and rescue, rehearsals, evaluation and inventory updating for response activities
- **L1 Local Level**
  - Disasters that can be managed at the district level
  - state and centre will provide assistance, if necessary
- **L2 State Level**
  - Require assistance and active participation of the state
- **L3 Center Level**
  - Largescale disasters requires central government assistance

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## Framework for Disaster Mitigation Part I – General

- Vulnerability Assessment and Risk Analysis
- Preventive Measures
- Mainstreaming DM Concerns into Developmental Plans/ Programmes/ Projects
- Preparedness Measures
- Response
- Partnership with other stakeholders
- Financial Arrangements

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## Framework for Disaster Mitigation Part II – Disaster Specific Action Plan

- Floods
- Cyclone
- Earthquakes
- Landslides
- Chemical Disasters (including emphasis on off site plans - Preparation and rehabilitation)
- Nuclear Disasters
- Biological Disasters
- Oil Spills and Mine Disasters
- Tsunami

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## Framework for Disaster Mitigation Part III – Cross-cutting Issues

- Review and updation of plans
- Coordination and Implementation
- **Annexures**
  - Relief codes
  - Damage/need assessment format
  - Emergency telephone directory
  - State river basin/road/transport networks
  - List of NGOs at national, state and district/ sub-district level
  - List of training/technical institutions.

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Thank You

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