GEOINFORMATICS IN DISASTER MANAGEMENT:
Scope, Examples & Advancements
Training Workshop on Use of Space Technology for Disaster Risk Reduction

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GEOINFORMATICS TECHNOLOGY
• Remote Sensing
• Geographic Information Systems (GIS)
• Global Positioning System (GPS)
• Information Technology
• Communication Technology

DISASTER MANAGEMENT
Disaster Management comprises all forms of activities including structural and non-structural measures to avoid (prevention) or to limit (mitigation and preparedness) adverse effects of disasters in the pre-disaster phase and post-disaster stage (Response, Relief, Recovery, Reconstruction).

PRE DISASTER APPLICATIONS IN DM
Pre disaster Examples: hazard mapping, Vulnerability and Risk Assessment, Preparedness Plans; Early Warning and monitoring, Risk Modelling etc

DURING DISASTER
Examples: public warning systems; emergency operations; search and rescue, evacuation planning, distribution of relief

POST DISASTER
Examples: damage assessment, temporary shelters; claims, processing and grants; reconstruction

REMOTE SENSING
Remote Sensing means deriving information about objects from measurements made from distance i.e. without actually coming into contact with them.

Such measurements require a medium of interaction. Medium of interaction is Electromagnetic radiation

Visible, infrared, and microwave portions of the spectrum are used for remote sensing

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**GEOGRAPHIC INFORMATION SYSTEM (GIS)**

GIS is a system of hardware, software, data and personnel to efficiently capture, store, update, manipulate, analyze and display all forms of geographically referenced information.

**GLOBAL POSITIONING SYSTEM**

A network of satellites that continuously transmit coded information, which makes it possible with help of an instrument (hand held or vehicles) to precisely identify locations on earth by measuring distance from the satellites.

**APPLICABLE FOR ALL DISASTERS**

Conventional Tools in Disaster Management - Some Issues

- Conventional Maps - Outdated
- Scattered databases not easy to collate in short time
- Difficulty in assessing damage
- Difficulty in getting an overview of situation
- Difficulties in sharing data

**Comparison between geospatial information management with and without GIS.**

**MULTIHAZARD VULNERABILITY MAPPING AND RISK ASSESSMENT**
169 districts were identified as multi hazard prone by overlaying individual hazard Maps and district boundary maps (Source of hazard maps is BMTPC atlas, 1997)

241 districts were classified as multi-hazard prone as per the revised Atlas (2006)
**Vulnerability Analysis**

**Orissa Case Study**

- Having a long coast line
- Prone to all the hydro-meteorological disasters
- High Vulnerability
- Previous studies were having more of a hazard centric approach

**Study Area**

**Approach to Risk Assessment**

**Inductive Approach**
- Inductive approaches have been used to determine disaster risk using an overlay of detailed hazard maps, and the level of exposure (population density, infrastructure etc.) to vulnerable elements
- However, in most situations, this can be very expensive and time consuming.
- Models are based on assumptions.
- For validating models, disaster inventory is required
- Multi-hazard approach is not there in most of the existing models/methodologies

**Deductive Approach or Disaster Inventory Mapping**
- Systematic tracking of occurrence of small medium and large disasters at the lowest possible administrative level
- Identifying the events and categorizing
- Preparation of Risk Matrix based on sectoral impacts and frequency
- Overlaying of different hazard maps and impact layers
- Map key socio-economic and vulnerability indicators from Census, HDI and Economic Survey
- Identify the most vulnerable areas at the lowest possible spatial unit based on the weighted average method.
- Methodology was a combination of spatial and non-spatial Analysis

**Preliminary Analysis**

**Typological Analysis:** Objective is to identify the major hazard based on the number of recorded events

**Distribution of Various Disastrous Events**

**Distribution of Deaths Due to Various Disasters**
**IDENTIFYING MAJOR HAZARDS**

Based on the preliminary analysis the following hydro-meteorological hazards were taken for detailed analysis:

- Cyclone
- Floods and Heavy Rain
- Thunderstorms and Lightening
- Drought

**SPATIAL ANALYSIS**
Spatial distribution of Sectoral Impacts of Cyclone

Weighted average for the multi-component vulnerability Analysis

Spatial distribution of Sectoral Impacts of Floods

Weighted average for the multi-component vulnerability Analysis

Spatial distribution of Sectoral Impacts of Drought

SPOT Vegetation Data
NDVI Difference Imagerys
Based on 2001 data
MULTI HAZARD VULNERABILITY ANALYSIS

<table>
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<th>S.No</th>
<th>Hazard</th>
<th>Class</th>
<th>Weight</th>
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<td>Cyclone</td>
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<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
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<td>2</td>
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<td></td>
<td>High</td>
<td>3</td>
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<tr>
<td></td>
<td></td>
<td>Very High</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>Floods</td>
<td>Least prone</td>
<td>1</td>
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<tr>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Very High</td>
<td>4</td>
</tr>
</tbody>
</table>
RESULTS OF ANALYSIS

- Orissa is prone to all the hydro-meteorological disasters enlisted in HPC Report and IMD Report
- Major hazards are Cyclone, flood, drought, heavy rainfall and thunderstorms
- Direct relation between HDI indicators and impact particularly in the case of drought
- In the case of Hymet disasters phenomenal increase in impact although frequency not increased that much.
- Death due to disasters showing decreasing trend but impacts are increasing
- Helped in identifying spatial distribution of impacts of various disasters (individually and in combination)
TOTAL NUMBER OF DEATHS REPORTED DUE TO DISASTERS AND ITS COMPARISON WITH VULNERABILITY ATLAS

Districts like Rayagada, Koraput, Kalahandi have low multi-hazard vulnerability (BMTPC ATLAS). Most of the deaths are due to Famine, epidemics etc. But the loss of life due to various disasters are high in these districts.

This real time data uncovers the hidden vulnerabilities like lack of awareness, low economy level, poor health facilities, environmental degradation etc.

BENEFITS
• As a Policy Advocacy Tool – Evidence based
• HVR is key component of DMP
• Key inputs for EWS
• Identification and Prioritization of Mitigation Measures
• Helps in identifying the sectoral impacts
• Identifying the underlying causes of vulnerability
• Validating Models and methodology changes
• As a monitoring and Evaluation Tool : How the development/mitigation measured increased or reduced disaster Risk
• Reducing disparity in Relief distribution
• Key input for Insurance/ reinsurance sector

CHALLENGES
Strategic
• Reliability and Credibility of data sets
• There is no well established system of collecting disaster databases similar to census.
• Reports of GSI, IMD, CWC etc are having hazard centric approach
• Political Issues
Methodological
• Segregation and aggregation of data.
• Series of associated events
• Potential in assessing futuristic risk scenarios
CONTINGENCY PLANS IN GIS

Community Contingency Plans in GIS

Clicking inside a state through Hyperlink tool will link to respective state details.

Map Showing Natural Disaster Risk Management Programme States of India

Click here

Map of Orissa showing the DRM Districts.

Statistical Information of Puri District

Source: District Disaster Management Plan, Puri

Administrative Boundary of Puri District

Description about the Analysis

Layers Taken for Analysis:
1. Health Centres
2. Multipurpose Cyclone shelters
3. Storage Facilities
4. Buffer zones
5. Location of Boats
6. River systems
7. Roads

Information can be retrieved up to village level.
Block to Village can be zoomed in to view the geographical location of resources.
Details about item/resource can be seen and query based resources finding is possible.
Flexibility of moving macro to micro level in a same window.

LINKAGE HAS BEEN ESTABLISHED TO
1. District Disaster Management Plan (DDMP)
2. Block Disaster Management Plan (BDMP)
3. Gram Panchayat Disaster Management Plan (GPDMP)
4. Village-CCP
Next Slide: Map extent zoomed further to a scale of 1:1,50,000 and greater to obtain location of health centres in the GP Level

Location of Health Centres [Block Level]

Next Slide: Map extent zoomed further to a scale of 1:40,000 or greater to obtain location of health centres in the Village Level

Location of Health Centres [GP Level]

Next Slide: Map extent zoomed further to a scale of 1:40,000 or greater to obtain location of health centres in the Village Level

Location of Health Centres [Village Level]

Location of Multipurpose Cyclone Shelters [Block Level]

One can view the location of existing resources in the block by clicking the layers ON.

Location of Multipurpose Cyclone Shelters [GP Level]

Particular resource can be viewed from District to Village level by changing the scale in the same window. To view more than one resource select the desired layer as shown in the next slide.

Location of Multipurpose Cyclone Shelters [Village Level]
Location of Storage Facilities, Boats and River system [Block Level]

Puri district - Coastal area Buffer Zone

Buffer zones at a distance of 5, 10, 15, 20, 25, and 30 Kms from the Sea coast to locate the vulnerable villages under each zone. Resources can also be identified under each zone.

Location of resources in the respective Coastal area Buffer Zone [Block Level]

Location of resources in the respective Coastal area Buffer Zone [GP Level]
Location of resources in the respective Coastal area Buffer Zone [Village Level]

Database of resources can be obtained at all levels

Database of cyclone shelters at various levels

Linkage of Disaster Management Plans

Linkage of District Disaster Management Plan

Web-page showing the DDMP of Puri District.
Linkage of Block Disaster Management Plan

Web-page showing the BDM of Puri District.

Linkage of GP Disaster Management Plan

Web-page showing the GPDMP of Puri District.

Linkage of Community Contingency Plan

The CCP document of a village can be linked to the geographical location in this way.