Space Tools and Applications in the Context of National Spatial Data Infrastructure in Nepal

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with contribution from

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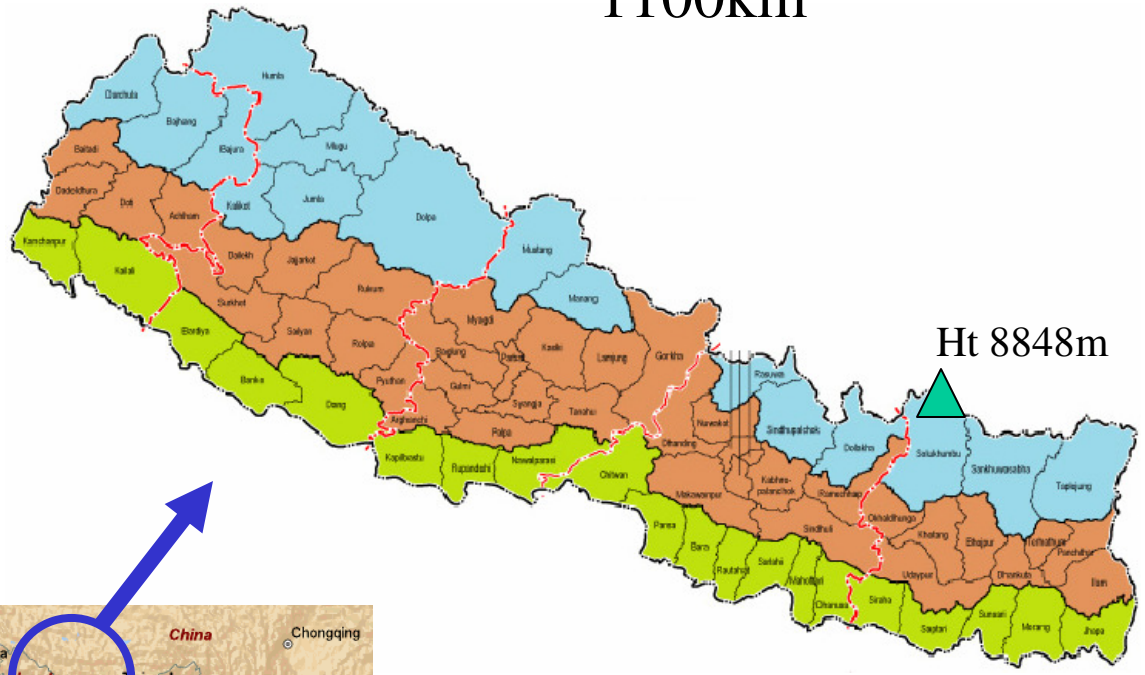
Nepal – Geographically diverse

1100km

200km



Ht 8848m

Ht 68m

- Diverse Geography
- Steep mountains
- Rapid Climate change

Basically agricultural economy

- Agriculture production based on climate
- Prone to natural hazards
- Hazards linked to atmospheric changes
- Monitoring of atmosphere and climatic changes is necessary for sustainable development of environment and economy

Monitoring of atmosphere and climatic changes need data

- **Need to know where do I have data I need !**
  - **WHO has the data?**
  - **MUST I create all my data?**
  - **WHAT data exists WHERE?**
  - **Can I SHARE data?**
- **A new area of study for optimizing of data handling**

Data do come from different sources

Important Data producers & users in Nepal

- Survey Department
- Central Bureau of Statistics
- Dept of Mines and Geology
- Department of Road
- Department of Irrigation
- Dept of Hydrology & Meteorology
- Dept of Water Induced Disaster Prevention
- Different NGO, INGOs
- Universities
- Research Organizations
- Etc, etc ...

Some examples of projects conducted with Partnerships of different Nepalese organizations using data from different sources and the support of institutes like AIT, JAXA, EC and Government of Nepal

Project - 1

2004-05

Survey Department

Topographical data, Land-use data
Aerial photos, Satellite imagery

Dept of Urban Development & Building Construction

Proposed ring road,
Existing buildings

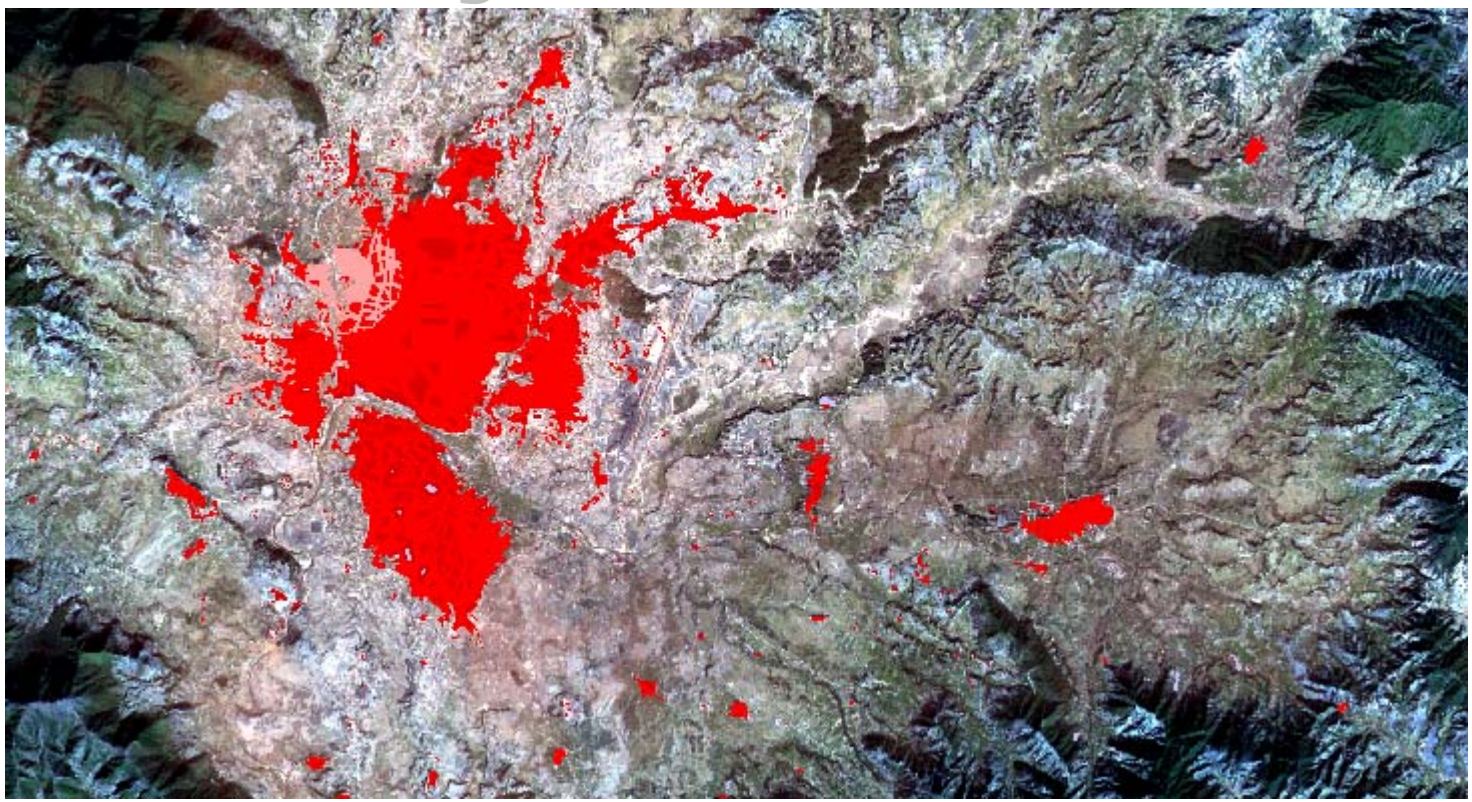
"Study of Change in Urban Land-use"

Urban growth prediction modeling for Kathmandu

Factors considered:

- Physical suitability
- Market oriented
- Urban-to-urban
- Access oriented
- Policy

Result – Project 1



- Urban growth predicted over a 30 year period
- Growth model compared with present urban areas
- Model useful for future urban scenario

Project - 2

2005-06

Survey Department

Topographical data, Land-use data
Aerial photos, Satellite imagery

Dept of Urban Development & Building Construction

Existing buildings,
Building bye laws

"Earthquake hazard mapping and vulnerability assessment for Kathmandu"

Objectives:

- Seismic Hazard Maps
- Vulnerability assessment
- Risk assessment
- Mitigation measures

Scenarios considered:

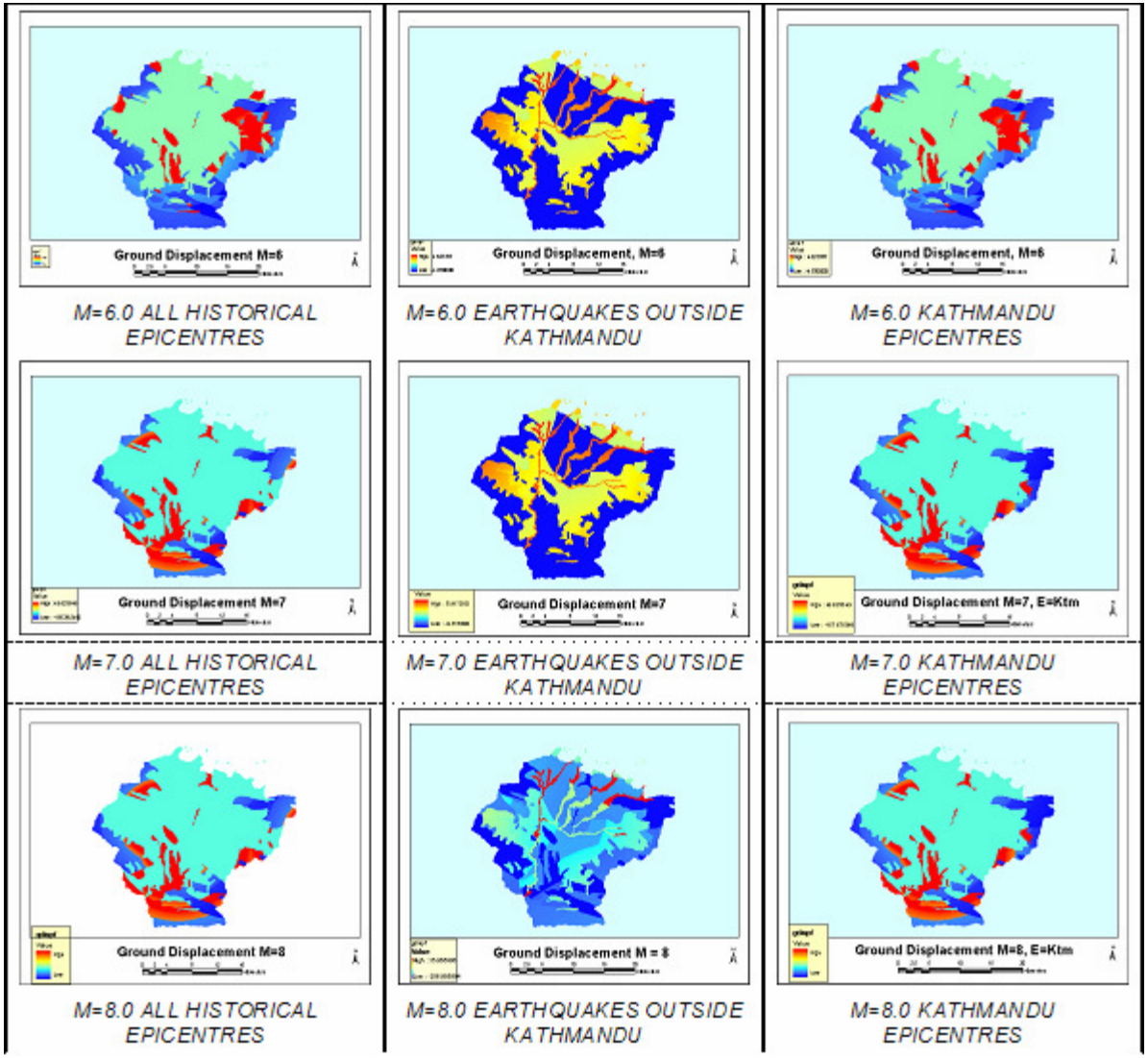
Epicenter:
- Inside Kathmandu
- Within 50 km
- Outside 50 km

Magnitude:
- 6.0 Richter
- 7.0 Richter
- 8.0 Richter

9 combinations

Project 2- Intensity hazard map

Results



Hazard map for all scenario combinations

Other maps produced:

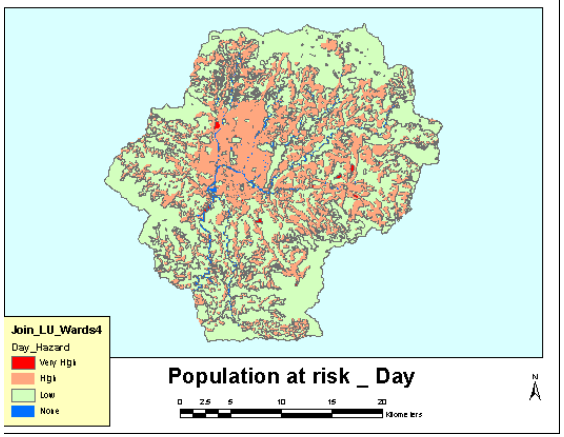
- PGA maps
- Liquefaction maps
- Displacement maps
- Buildings vulnerable
- Population vulnerable

Risk assessment for a small area

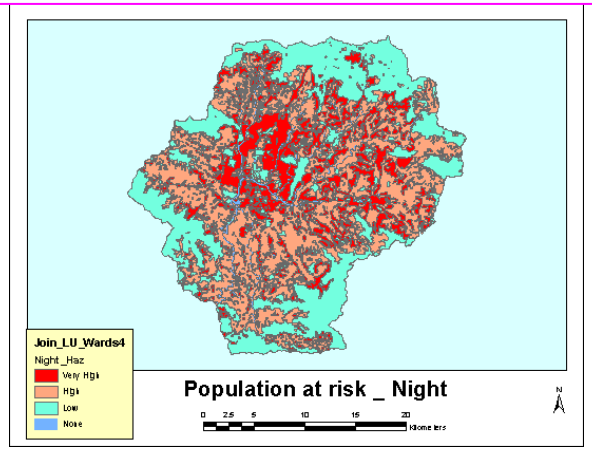
Project 2- Population vulnerability

Results

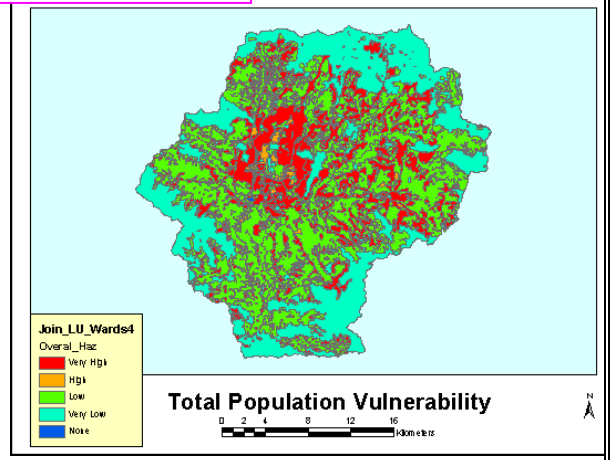
Assessed by landuse for day and night



POPULATION VULNERABLE – DAY TIME

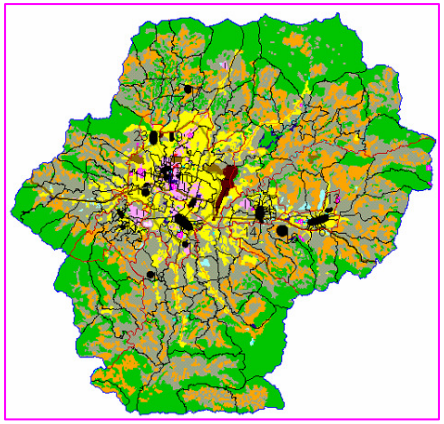


POPULATION VULNERABLE – NIGHT TIME



TOTAL POPULATION VULNERABLE

Landuse classes	Day	Night	Remarks
Agriculture / Mixed residential	1	2	
Commercial	3	1	
Forest	1	1	
Industry	3	1	
Institution	2	1	Very High = 3
Military	1	1	Medium = 2
Mixed residential / Commercial	2	2	Low = 1
Public Utilities	1	1	
Recreation / Open space	1	1	
Residential	2	3	
Rural settlement	2	3	
Special area	1	1	
Transportation	1	1	
Water Bodies	1	1	



Landuse Map

Source: KVMP

	Day	Night
Very High	12085	692884
High	802792	564816
Low	622107	179284
None	0	0

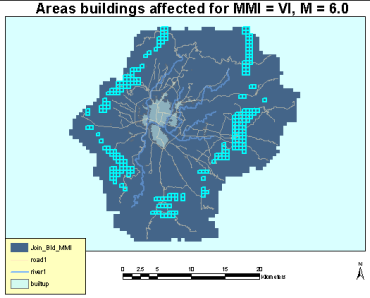
Number of population affected per landuse for day and night

Project 2- Building vulnerability

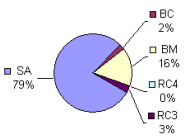
Results

Building Collapse MMI VI

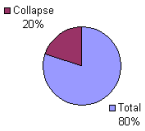
Areas buildings affected for MMI = VI, M = 6.0



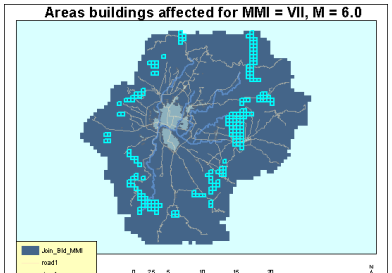
MMI VI Building Collapse category



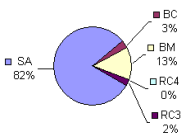
Building Collapse MMI VII



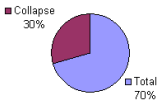
Areas buildings affected for MMI = VII, M = 6.0



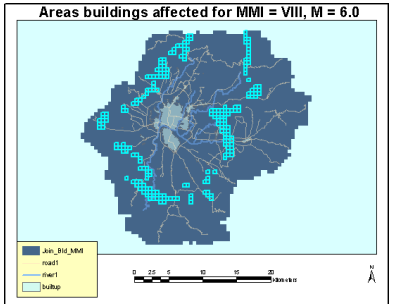
MMI VII Building Collapse category



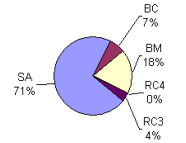
Building Collapse MMI VIII



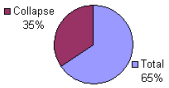
Areas buildings affected for MMI = VIII, M = 6.0



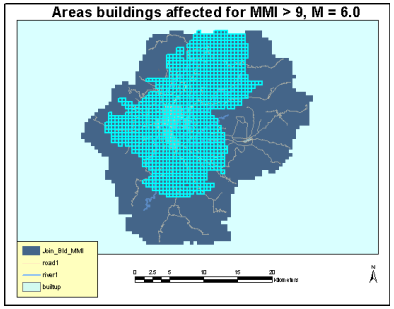
MMI VIII Building Collapse category



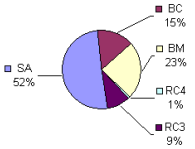
Building Collapse MMI > IX



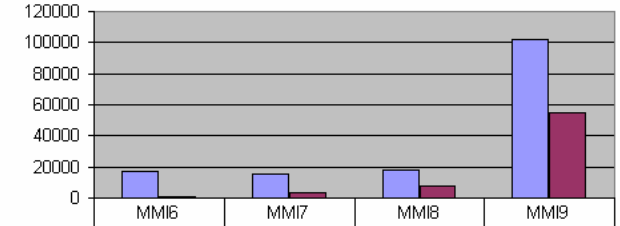
Areas buildings affected for MMI > 9, M = 6.0



MMI > IX Building Collapse category

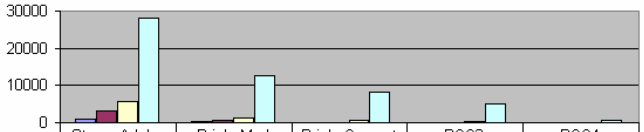


Collapse Comparision MMI VI - IX, M=6, KTM



	MMI6	MMI7	MMI8	MMI9
Total	16773	15098	18348	102285
Collapse	1200	3817	7797	54543

Building Collapse - Epicentre inside Kathmandu



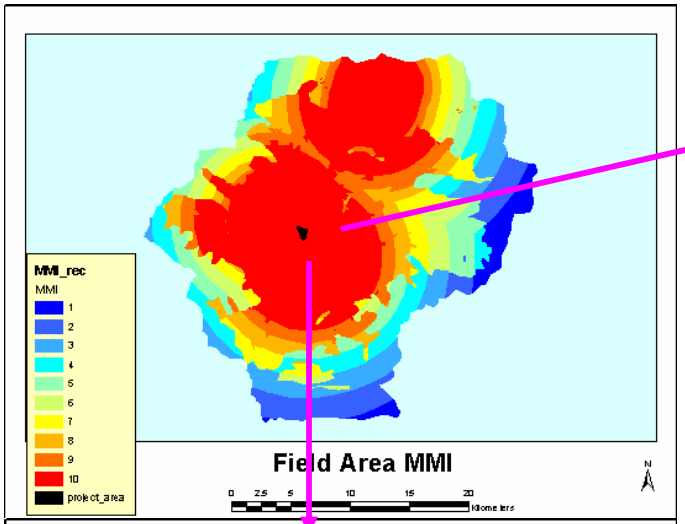
	Stone_Adobe	Brick_Mud	Brick_Cement	RCC3	RCC4
MMI6	949	190	27	34	0
MMI7	3095	501	124	93	4
MMI8	5592	1406	514	285	0
MMI9	28089	12636	8334	4989	495

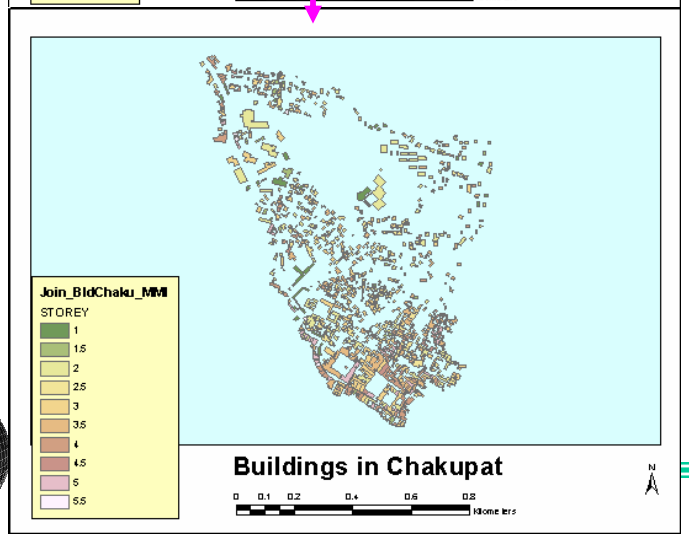
M = 6.0

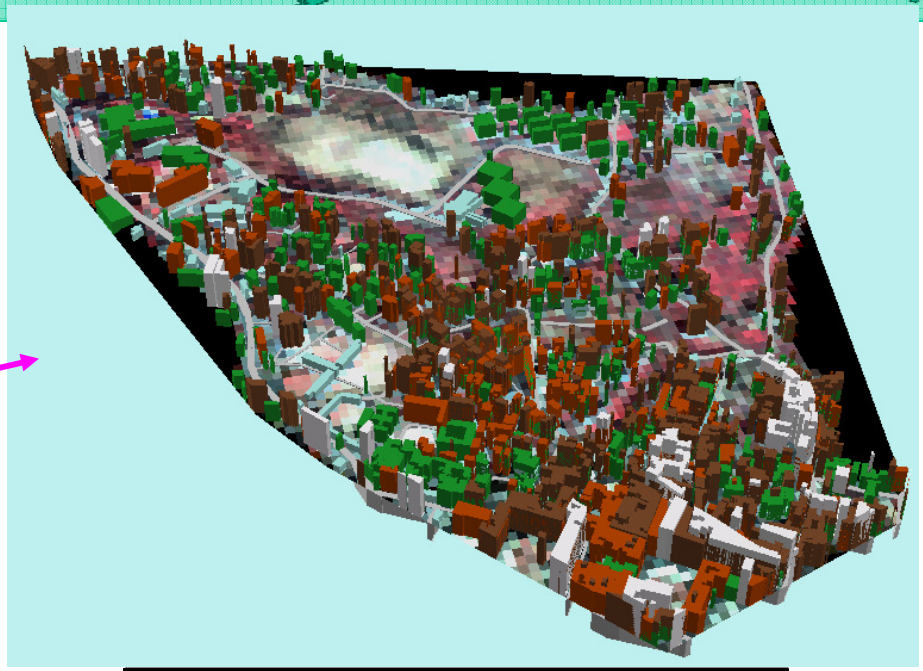
Project 2- Building risk assessment

Results

Risk = F[H, V, C]







Present construction cost rate	Rs. 1000/sq.ft.
Depreciated cost rate	Rs. 750/sq.ft.
Total buildings	1493
Total built area	6617321 sq.ft.
Total present cost	Rs. 6,617,321,000
Total depreciated cost	Rs. 4,962,990,750
Average building cost	Rs. 3324175
Collapsed buildings	448
Damage costs	Rs. 1,489,230,400
	OR $ 21,274,720

Total projected damage due to building collapse only – US$ 21 Million

Project - 3

2005-06

Survey Department

Topographical data, Land-use data
Aerial photos, Satellite imagery

Dept of Water Induced Disaster Prevention

Flood damage data,
Rating curve

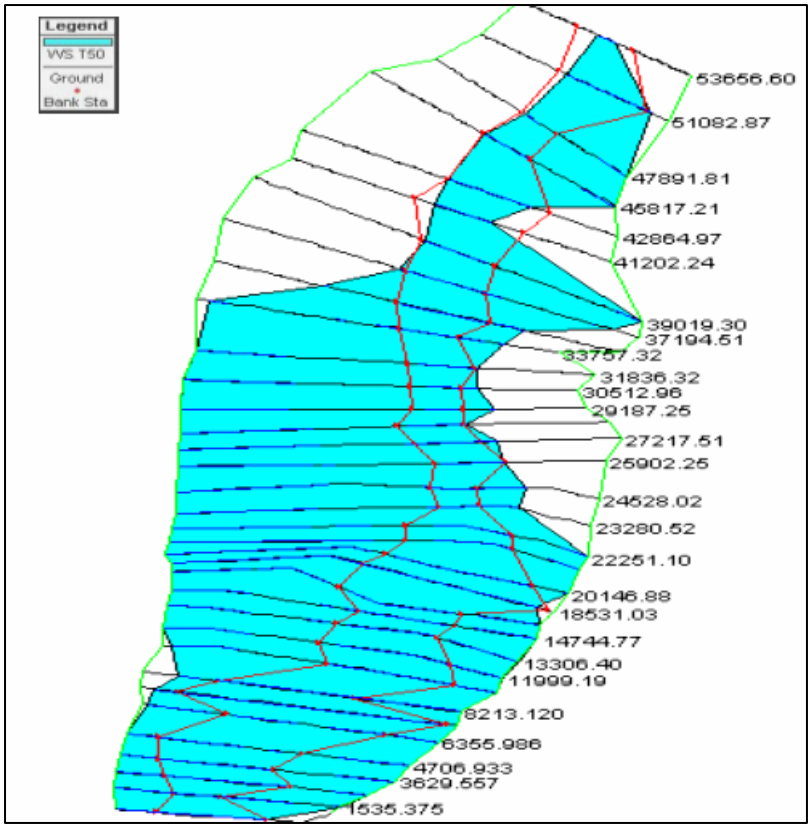
"Flood hazard mapping and vulnerability assessment for Sarlahi and Rautahat districts"

Objectives

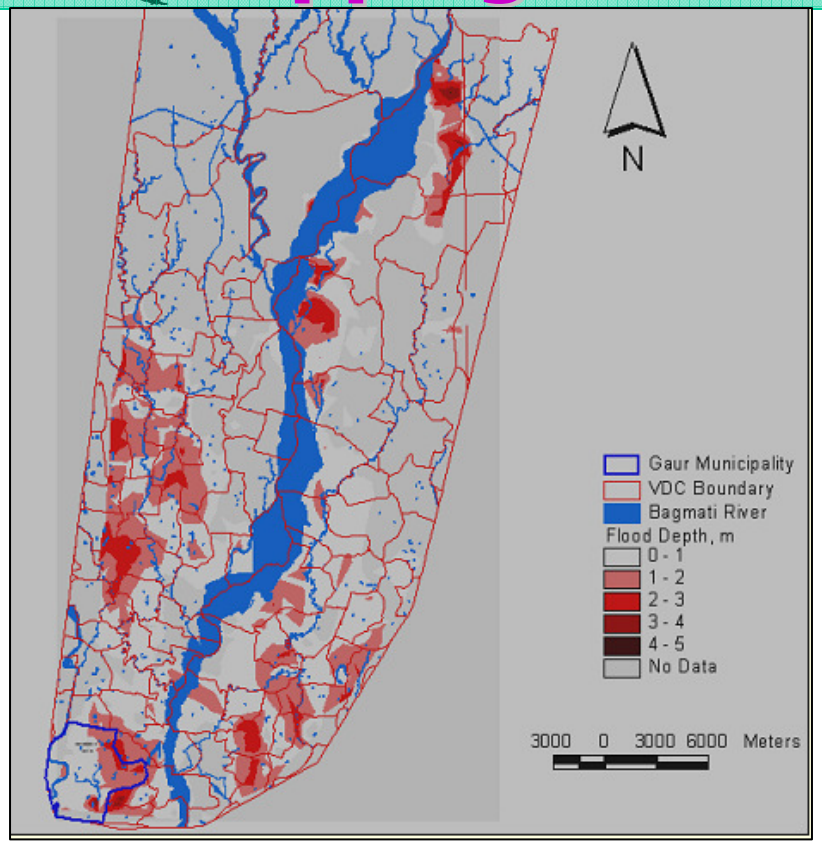
- Flood hazard maps
- Stage versus inundation for early warning
- Identification of overflowing reaches
- Population, area and land-use affected
- Mitigation measures

Project 3- Inundation area mapping

Results



Inundation area



Hazard map

Project - 4

Survey Department

Dept of Water Induced Disaster Prevention

Department of Hydrology & Meteorology

Meteorological data

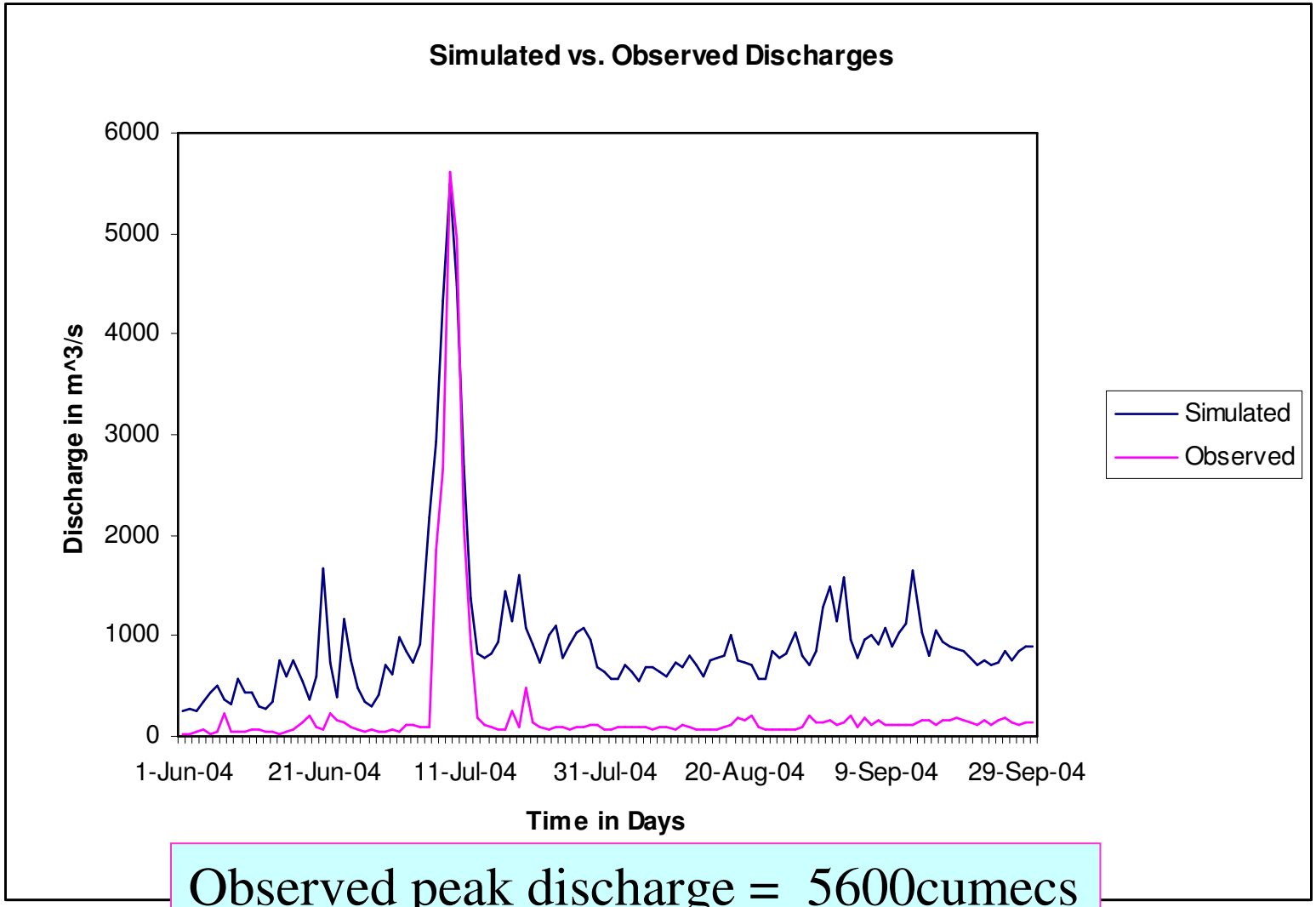
"Flood forecasting and Early Warning System for Bagmati River"

Objectives

- Rainfall runoff modeling
- Flood hazard maps for flood scenarios
- Direct flood damage/loss estimation
- Flood risk assessment
- Flood forecasting and early warning system

Project 4 - Rainfall-Runoff

Results



Observed peak discharge = 5600cumecs
Computed peak discharge = 5321cumecs

Project 4 - Flood maps

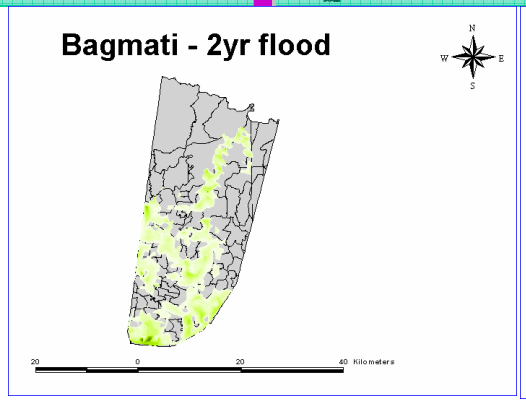
Results

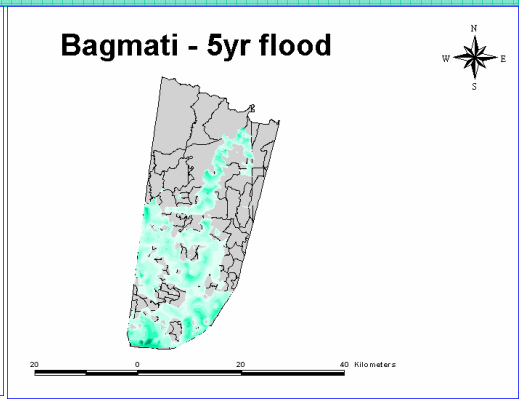
Input Discharge

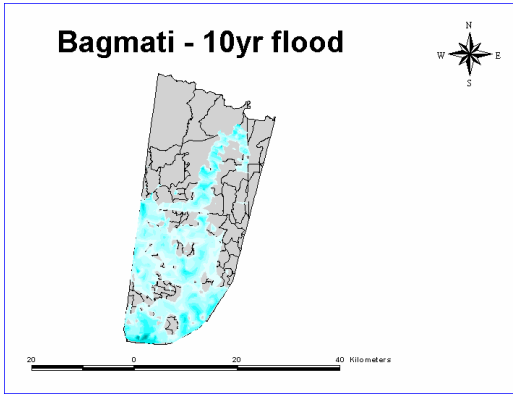
Return Period	Discharge
2 year	3750
5 year	6150
10 year	7750
20 year	9250
50 year	11250
100 year	12700

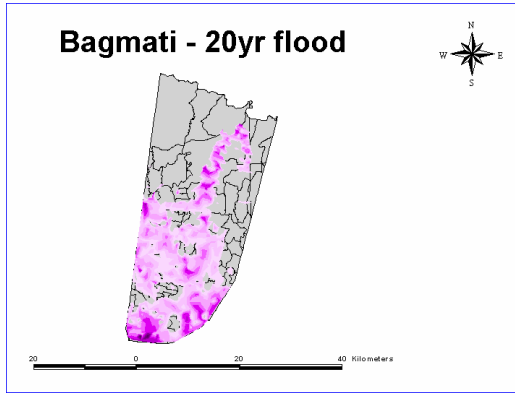
Inundated area

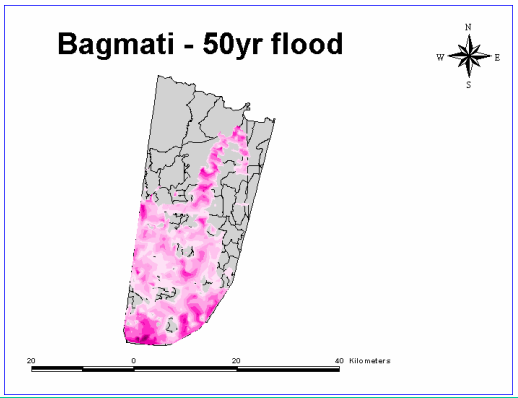
Return period	Area inundated	% area inundated
2 year	363.4	36.9
5 year	403.9	41
10 year	422.9	42.9
20 year	437.7	44.5
50 year	454.8	46.2
100 year	465.6	47.3

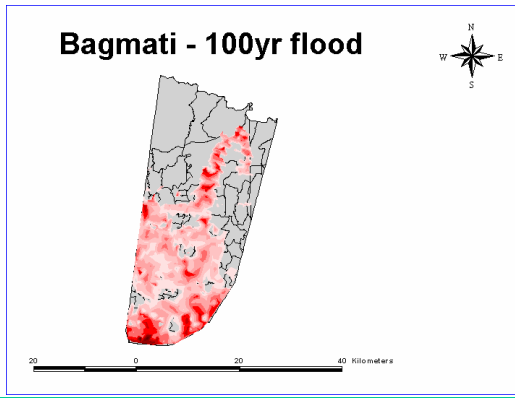






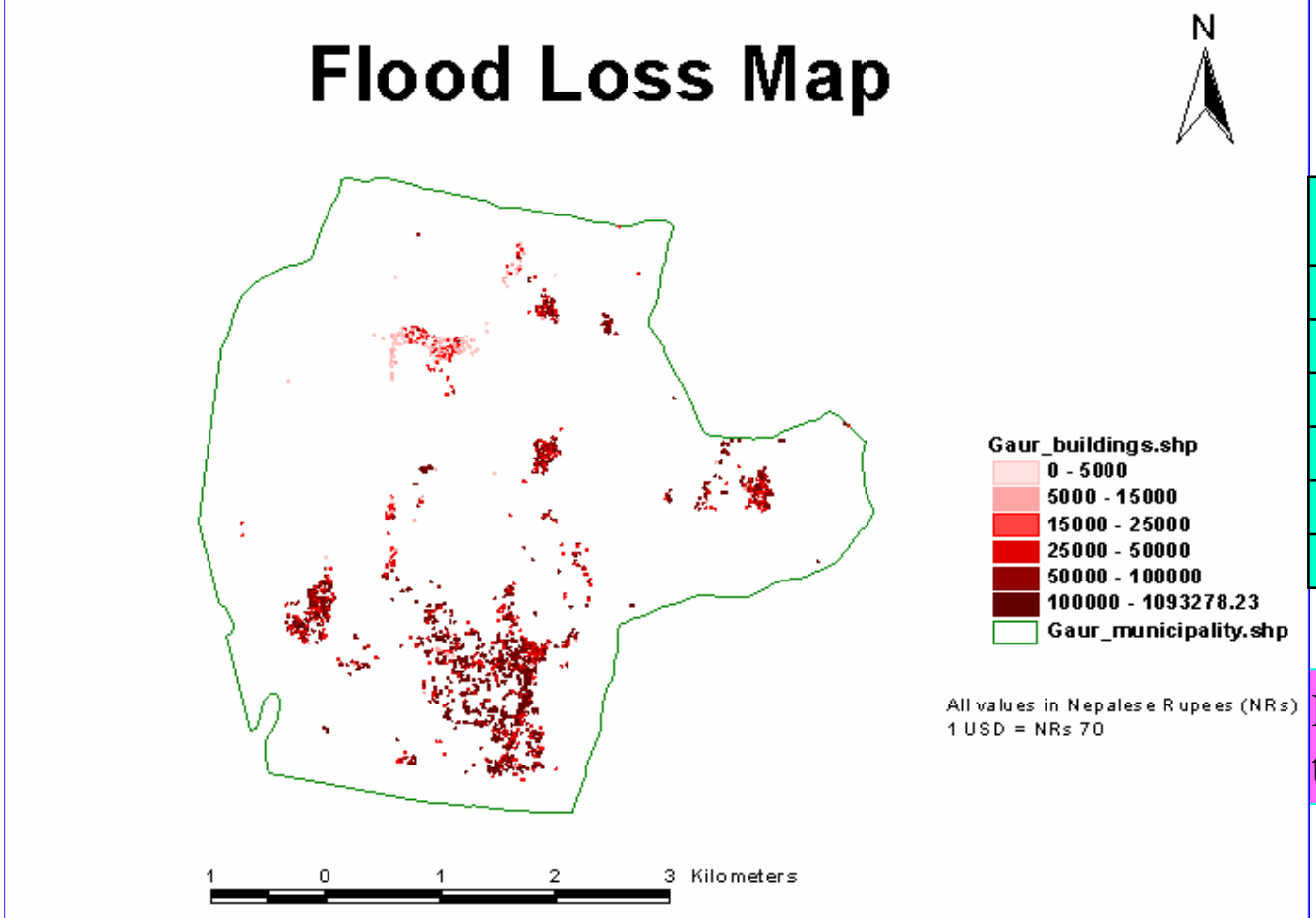






Project 4 - Flood loss estimation

Results



Damage values

Replacement Value Nepalese Rupees (NRs)	Number of houses
0 – 5,000	739
5,000 – 15,000	1083
15,000 – 25,000	827
25,000 – 50,000	1222
50,000 – 100,000	1040
>100,000	474

Estimated loss corresponding to Q_{50} = NRs 22.5 million

Damaged houses

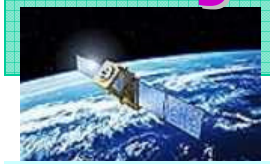
Type	Minimum	Maximum	Mean	Count
RCC	0	3.84	3.28	339
BM	0	11.04	8.44	3532
Adobe	0	39.33	29.13	1514

Construction rates

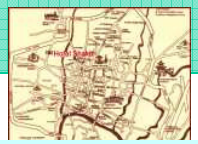
Type	Nepalese Rupees/sq ft	Nepalese Rupees/sq m
RCC	1100.00	11830.00
BM	700.00	7530.00
Adobe	200.00	2150.00

Project 4 – Forecasting Mechanism

Proposed



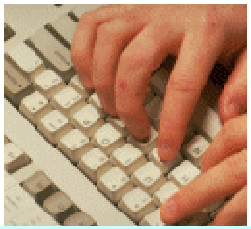
Satellite data



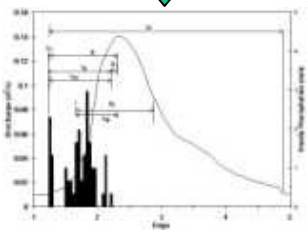
Maps - DoS

Receive data - DHM

Record rainfall



Data analysis



Rainfall threshold

High risk

Issue Warning

Evacuation, Rescue, relief

Low risk

Communicate to DWIDP, MOHA etc

Convey to Municipality, CDO, FMC, DWIDP, MOHA

Lessons learned

- Different departments produce different data
- Organizations can work together for a common objective

Need for a Spatial Data Infrastructure

National Geographic Information Infrastructure in Nepal

Objective = to facilitate data sharing :

Develop a platform to facilitate data sharing among CBS, SD and other participating agencies

NGII development model

- Availability of
  - Multi-resolution data
  - Metadata
- Technological framework
- Policy and Institutional framework
  - for data sharing

Data distribution

- **Efficient data exchange - international standards and formats**
- **Guidelines and compliance - on a national level**
- **Meta database - information on existing data on 3 Standard formats FGDC, ESRI, and XML**

Supporting Data accessibility……

www.dosm.gov.np

Search Criteria

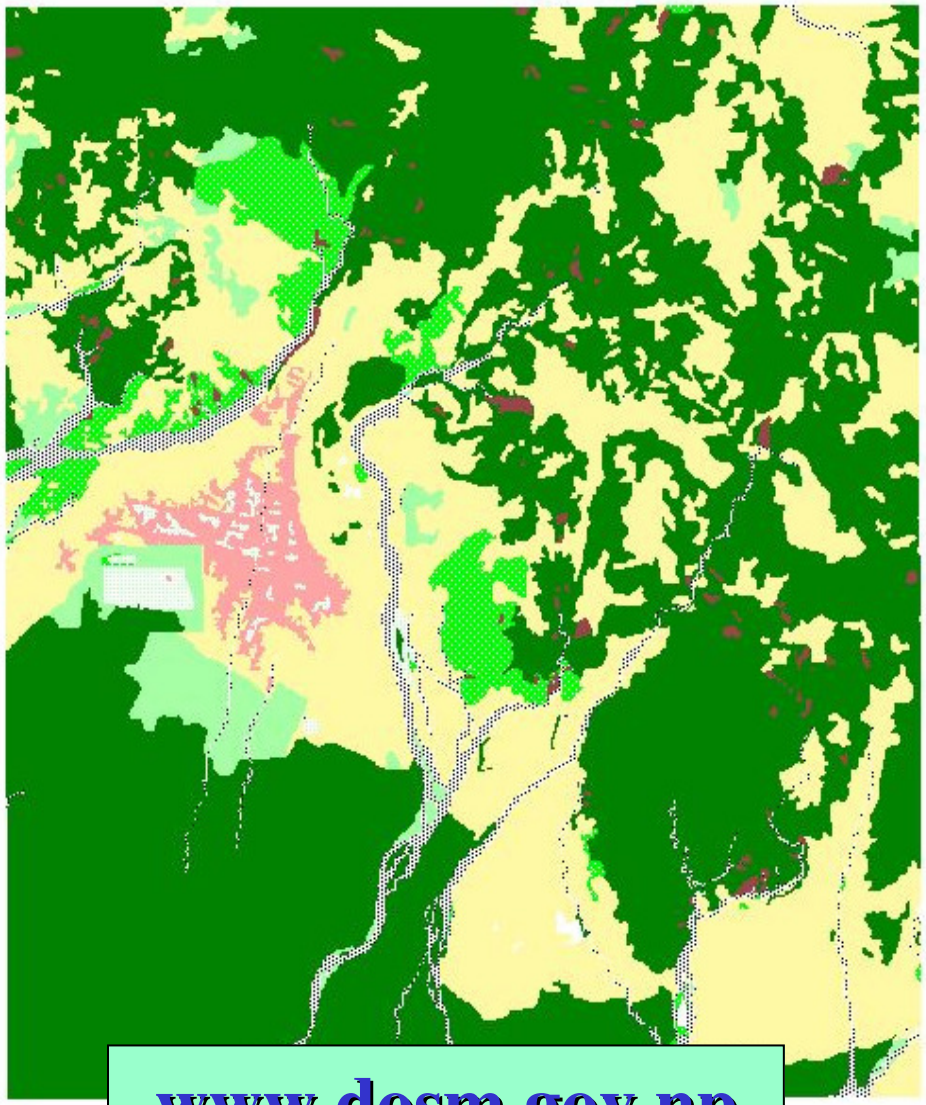
- **Geographic Coordinates**
  - Place names (coordinates actually built into list)
  - Bounding rectangle coordinates
  - Draw bounding box on interactive map
- **Time**
  - Published date
- **Full / Field Text**
  - Full text
  - Fielded search
- **Data Sources**
  - List of all registered nodes
  - Complete or selected list

NGII National Geographic Information Infrastructure

SEARCH BROWSE ORIGINATORS DETAILS REFRESH

Supporting Data accessibility……

2687 02C Landcover Area



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Done Internet

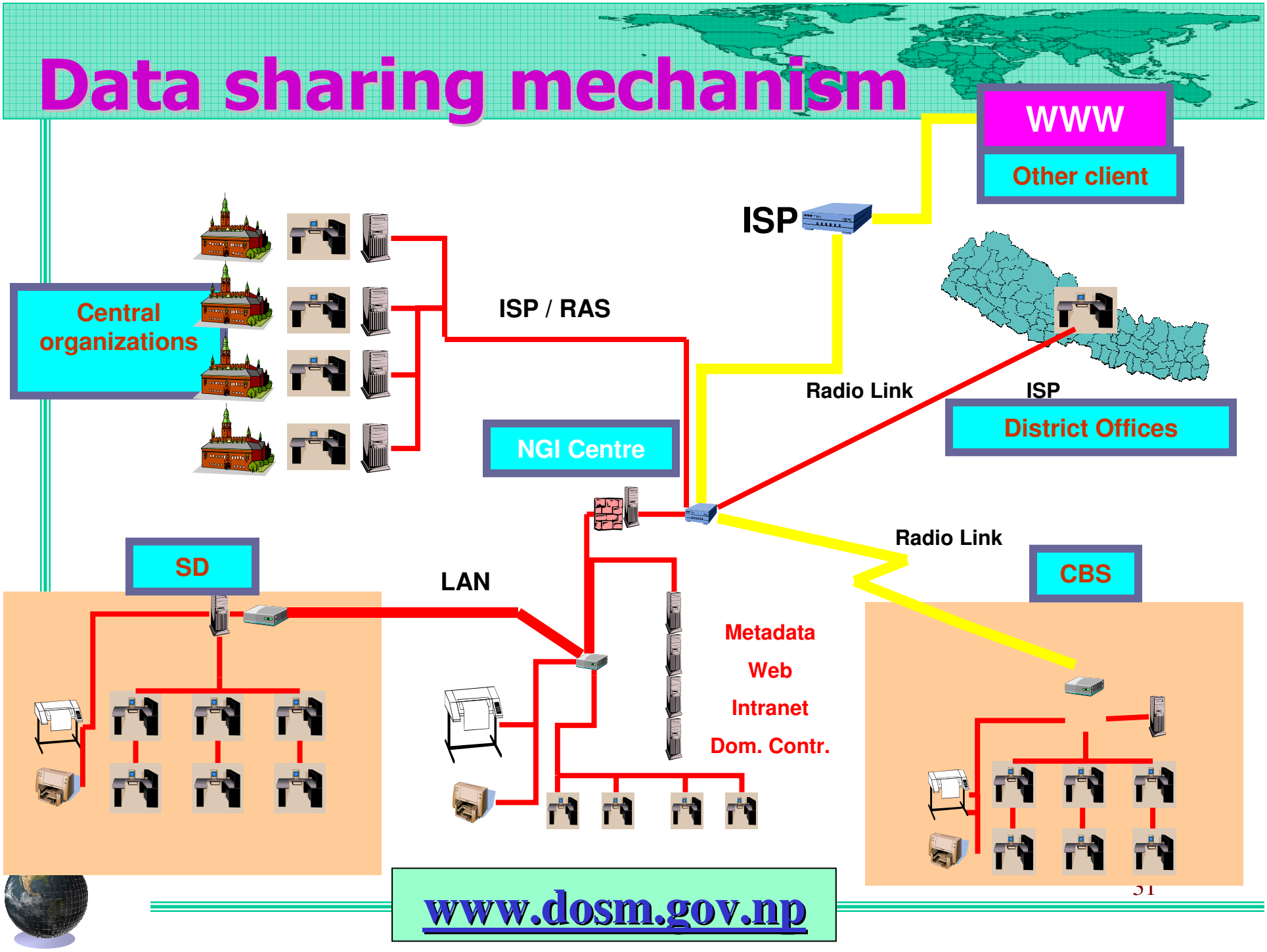
Data & services

- **Interactive mapping**
  - **make your own map up to VDC level**
- **Web Atlas – Interactive !!!**
- **Geographical names – pdf format**
- **Metadata search – for NTDB and other donor organizations**
- **Others can register – more are participating**

Clearing House & Metadata System

- Distributed service to locate geospatial data based on their characteristics expressed in metadata
- Clearinghouse allows user to pose a query of all, or a portion of the data available in a single session
- It's like a Spatial Google

Data sharing mechanism



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Importance of data sharing

- Minimize duplication of effort in spatial data collection and processing
- Provide means to disseminate data collection requirements, inventory, and quality

Conclusion – 1

- Nepal has limited resources in terms of facilities, expertise and data
- Different organizations when working together and sharing resources/ data can implement studies/researches successfully
- The NGII in Nepal is a platform for interagency networking and data sharing
- System of distributed database with a central depository of metadata for reference

Conclusion – 1 contd

- A single agency cannot collect, update, hold and disseminate such data
- Data sharing is necessary among agencies who create/use spatial data

Conclusion - 2

- Capacity for using GeoICT including GIS, RS and other space application tools are limited
- NGII supports in sharing data, information and knowledge as well as expertise and knowhow

Final Conclusion

Donors including UN should support the developing countries in acquiring and using space applications tools and knowhow and also support in the development of Spatial Data Infrastructures to share and maximise the benefits from these technologies.

Thank you for your kind attention