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Bangkok- Thailand

Geographical Information System Based Landslide Probabilistic
Model with trivariate approach-A case study in Sikkim
Himalayas.

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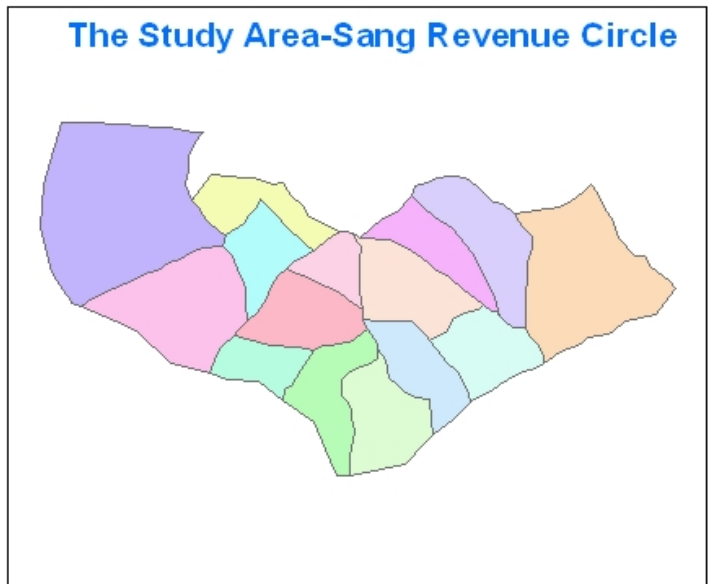
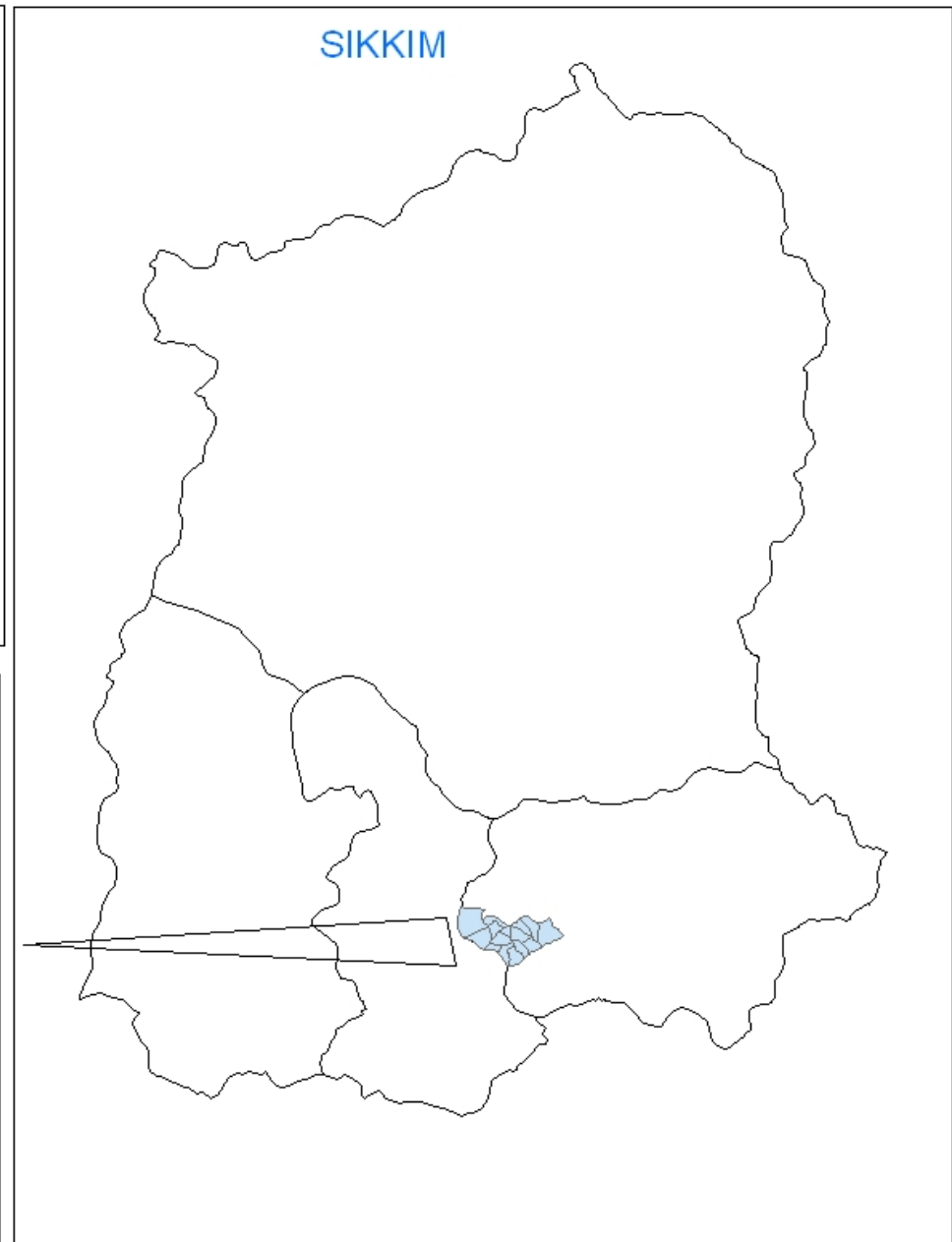
Professor & HOD, Computer Science Department
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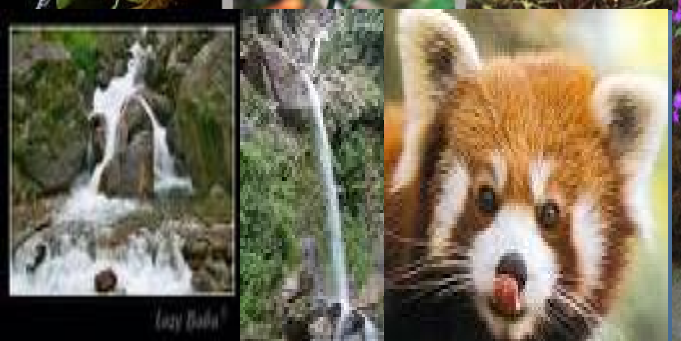
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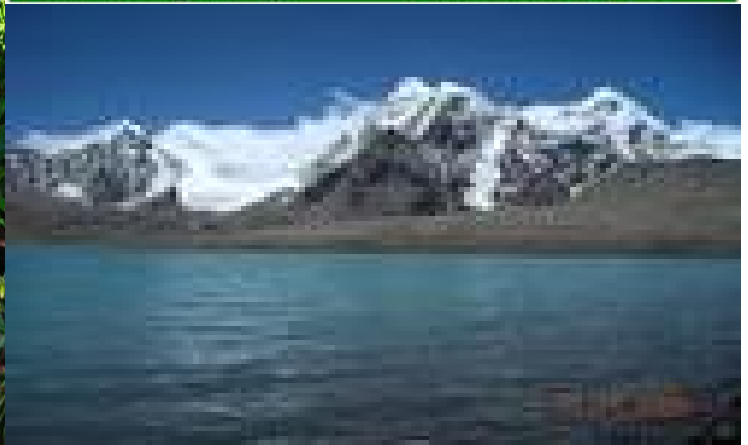
Study Area..



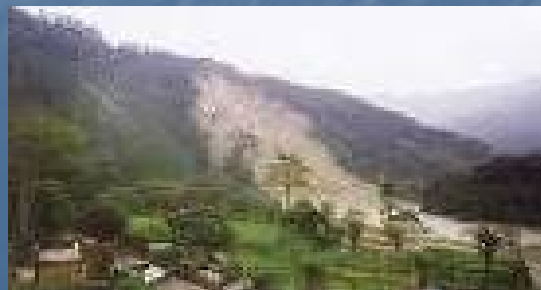
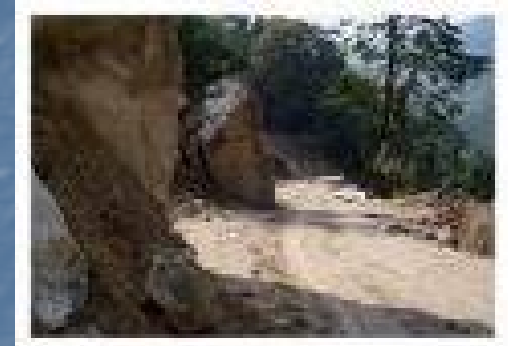
Sikkim – Land of Eternal Beauty



Yumthang Valley — Paradise on Earth



Such Natural Beauties are often disturbed by the Terror of Landslides



Landslides

- Landslide has been a disaster of Big Concern.
- In 1968 the state lost 3300 lives and properties worth rupees million when a prolonged monsoon triggered landslides in many places .
- Since then the Landslide has been disturbing the civil lives, public properties and private properties in many ways.
- Some times the infrastructure projects are washed away while at completion phases.
- The local governments are finding it tough to make the development activities sustainable and ensure safety to public from landslide hazards.

Characteristics..

- Average Slope > 60%
- Soil Texture is Mostly Coarse Loamy
- Weak Rocks like Chlorite, Phyllite/Sericite Mostly Prevail
- Average Rainfall up to 3000 mm per Annum.
- Lies in the boarder of Indian and Euroasian Plate and has high Seismic Threat.
- Civil Construction and Urbanization is rapid to meet the demand of growing Population.

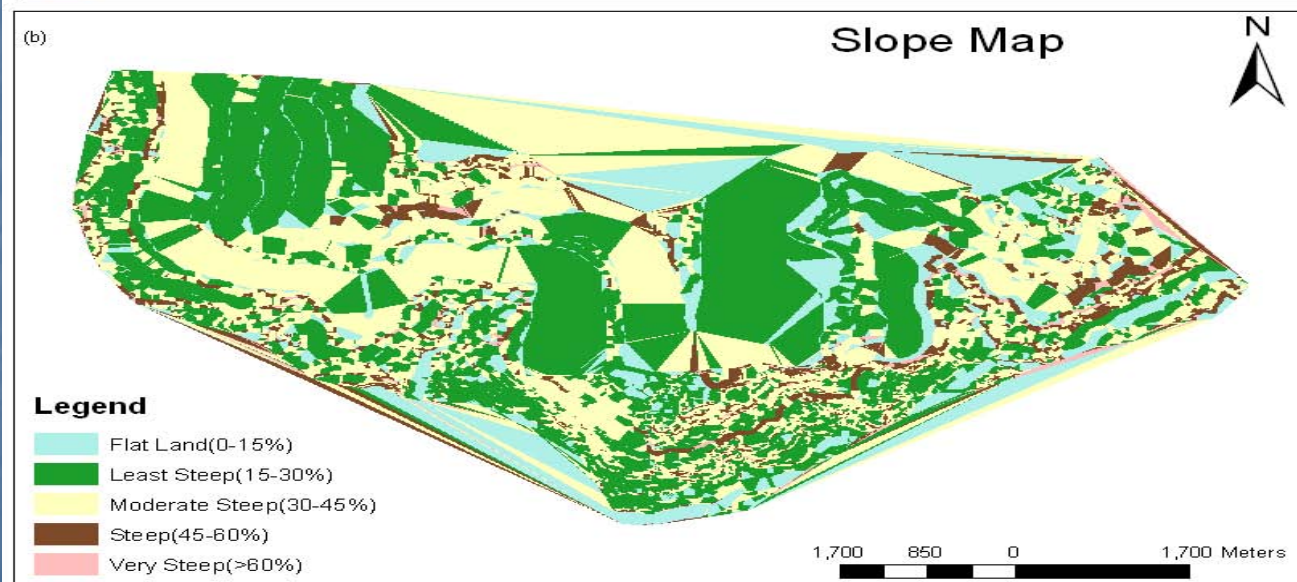
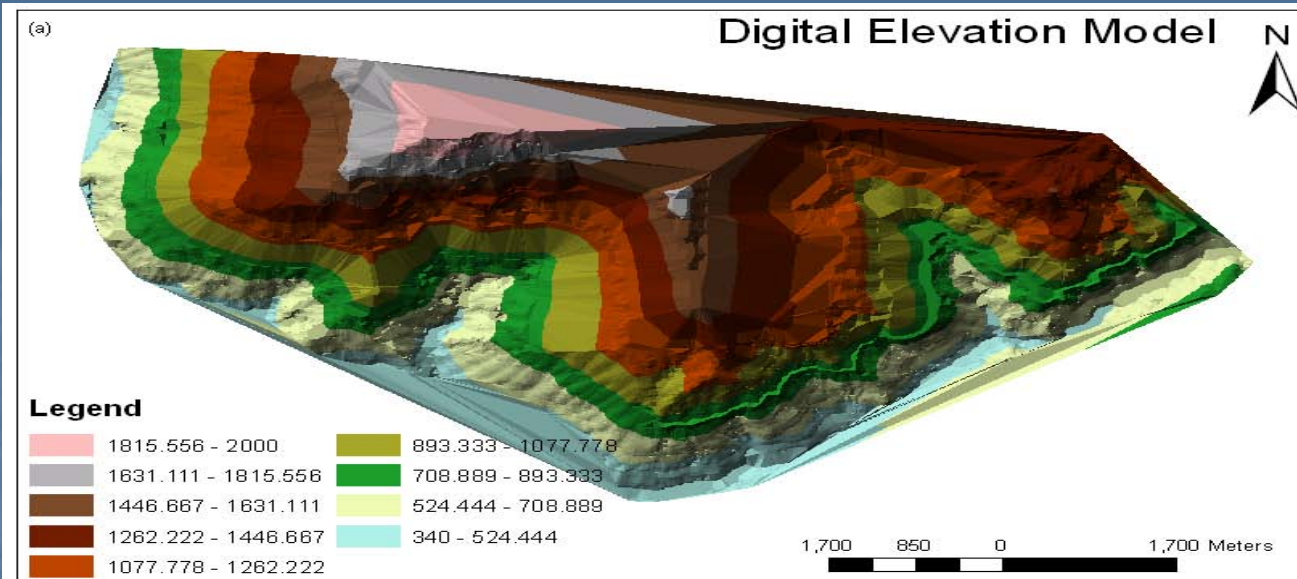
The Scope of this Study

- To explore the possibility of GIS based Landslide Vulnerability Study and to measure its accuracy.
- To delineate the highly Vulnerable Area within the Study Area for implementation of immediate precautionary measures.
- An attempt to demonstrate the technology driven Vulnerability Assessment as a replacement for Conventional Methods.
- An attempt to demonstrate the importance of spatial data.

Data Used for Study

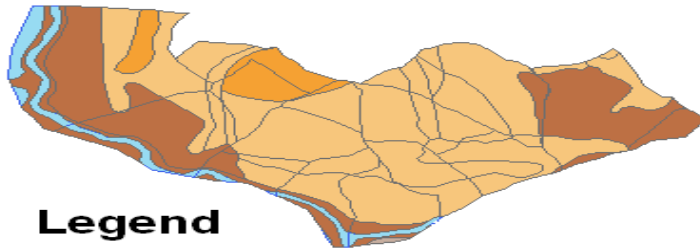
Table 1. List of Data Used in the Study

Sl. No.	Name of Thematic Layers	Original Map Scale	Data Source
1	Slope Map	1:50,000	DEM/50k Topographic Map
2	Land Use & Forest Map	1:50,000	NIC- GIS Databank
3	Geological Map	1:50,000	Geological Survey of India.
4	Soil Map	1:250,000	NIC- GIS/NBSS&LUP
5	Road Map	1:50,000	NIC- GIS Databank
6	Drainage Map	1:50,000	Digitized from Topographic Map
7	Topographic Map	1:25000	Rural Management Dev. Department, Govt. of Sikkim.
8	Cartosat Pan Image	2.5 m Res.	NRSA
9	Quick Bird Image	60 cm Res.	Wikimapia
10	Landslide Events Map	1:10,000	Digitized from cartosat/ wikimapia verified with field survey.



Soil Maps- Sang Revenue Circle

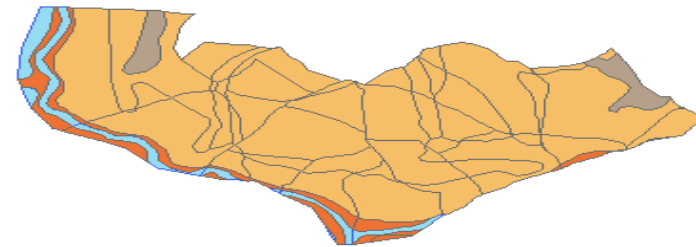
**Sang Revenue Circle
Soil Texture Map**



Legend



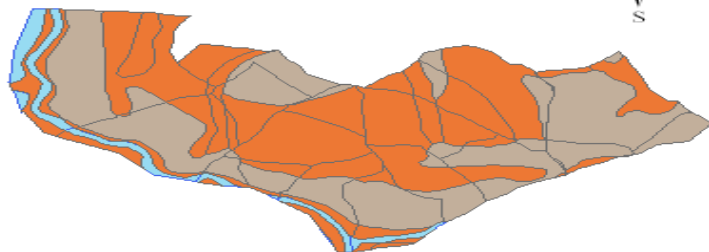
**Sang Revenue Circle
Soil Depth Map**



Legend



**Sang Revenue Circle
Soil Erosion Map**



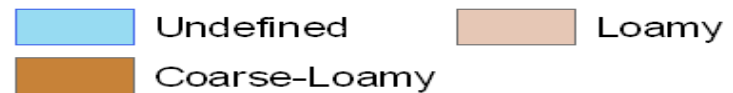
Legend



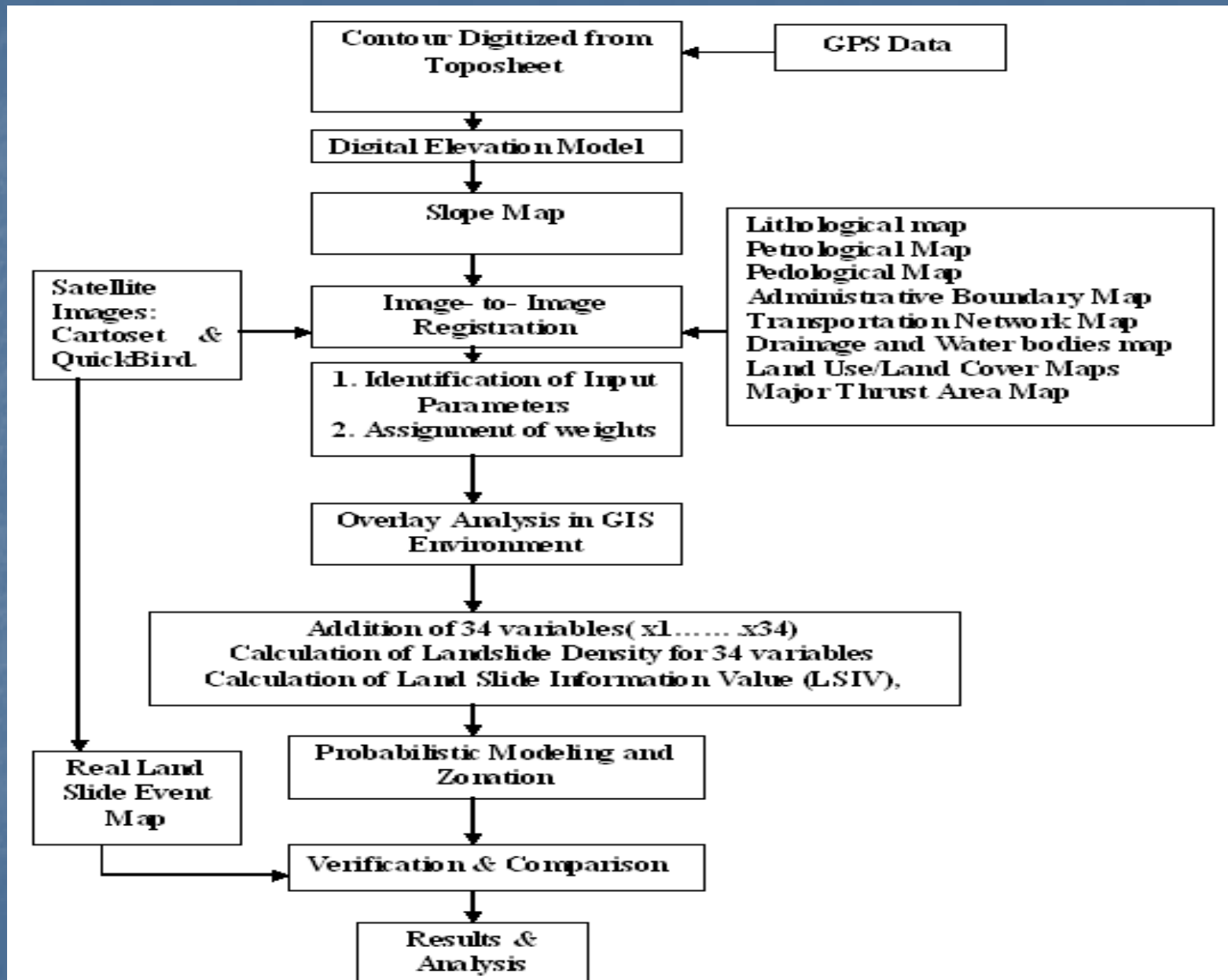
**Sang Revenue Circle
Surface Texture Map**



Legend



Methodology Flowchart



N1 Calculation of Landslide Information Value for Polygons

The Landslide Information Value for the jth polygon was calculated as:

$$\begin{aligned}
 LSIV_j = & W_{1j} \sum_{i(w1)=1}^{p(w1)} X_{ij}(w1) LD_{ij}(w1) + W_{2j} \sum_{i(w2)=1}^{p(w2)} X_{ij}(w2) LD_{ij}(w2) \\
 & + \dots \dots \dots W_{Nj} \sum_{i(Wn)=1}^{p(Wn)} X_{ij}(Wn) LD_{ij}(Wn)
 \end{aligned}$$

Where W_1, W_2, \dots, W_n are the expert based weights of the Nth identified parameters

$X_{ij}(W_n)$ is the variable value of Ith variable of the W_n parameter for Jth polygon.

$LD_{ij}(W_n)$ is the Landslide Density due to Ith variable of W_n Parameter for the Jth polygon.

Slide 13

N1

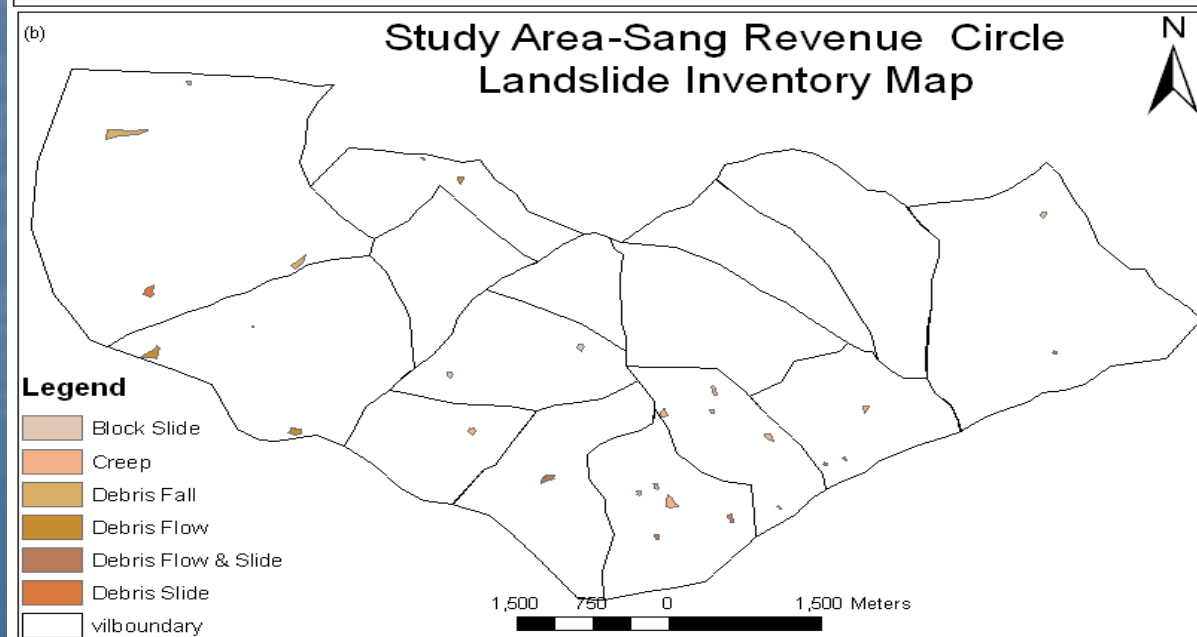
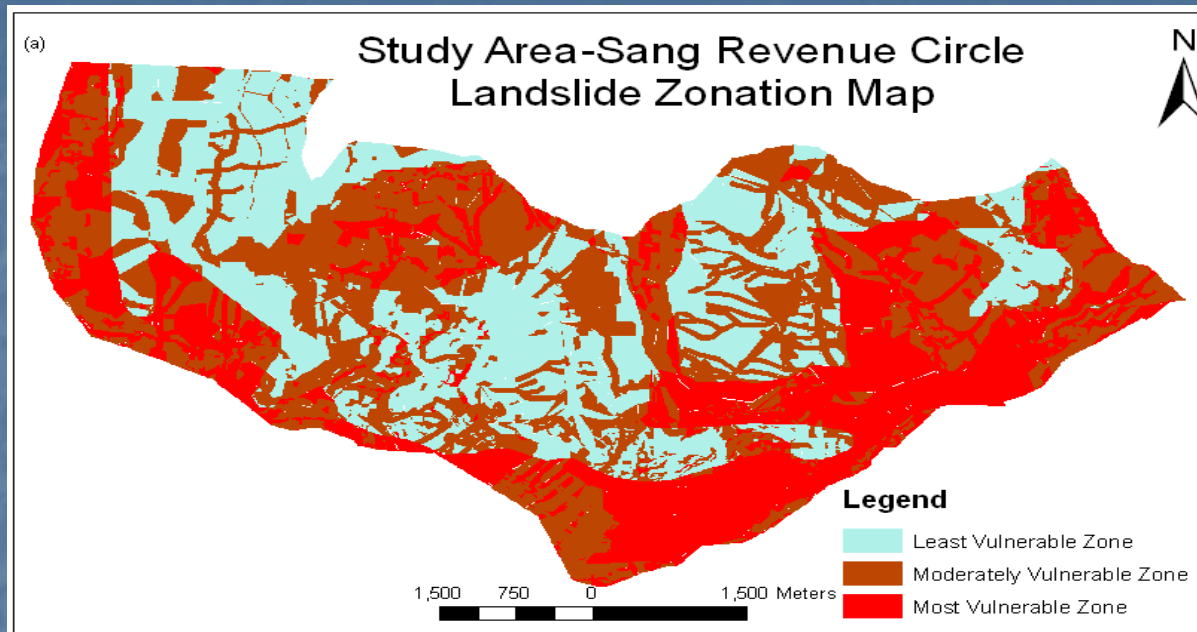
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NIC_LAPTOP, 17/10/2009

Classification of Parcels

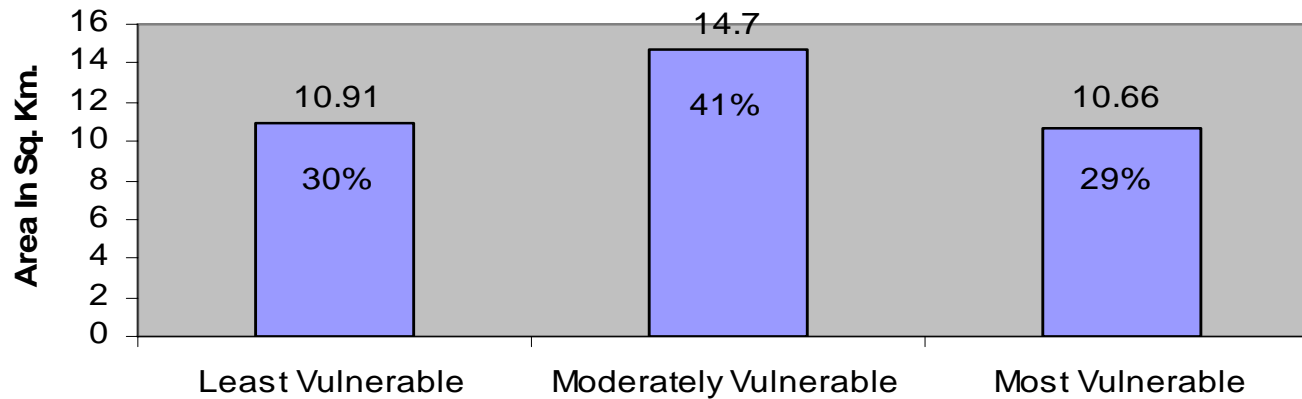
LSIV	No. of Polygons	Area(Sq. Km)	No. of Landslides	Vulnerability Zones
78-110	1309(13%)	10.91 (30%)	3(11%)	Least Vulnerable
111-144	3800(39%)	14.7(41%)	9(32%)	Moderately Vulnerable
145-328	4651(48%)	10.66(29%)	16(57%)	Most Vulnerable
	9760(100%)	36.27(100%)	28(100%)	

Production of Zonation Map

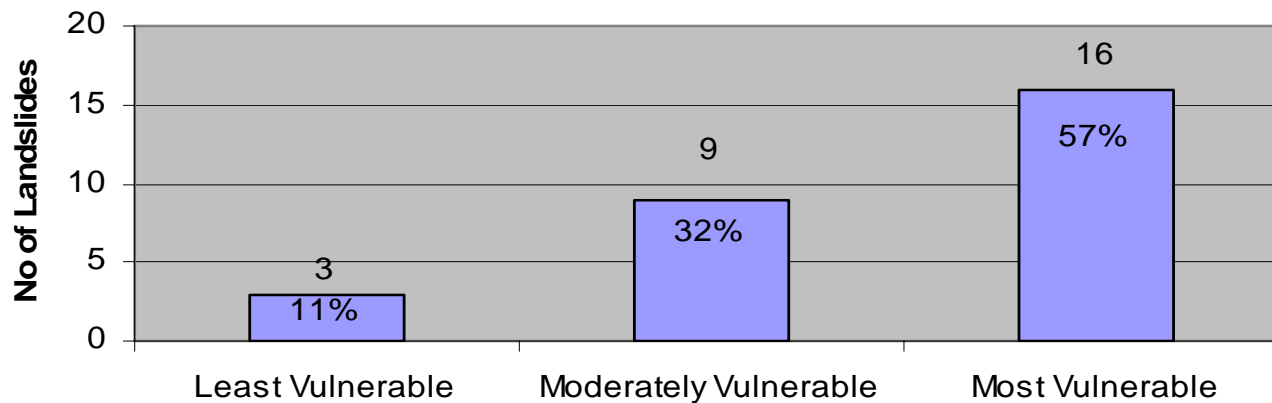


Bar Chart with Statistics

Bar Chart Showing Area Falling in Different Vulnerability Zones



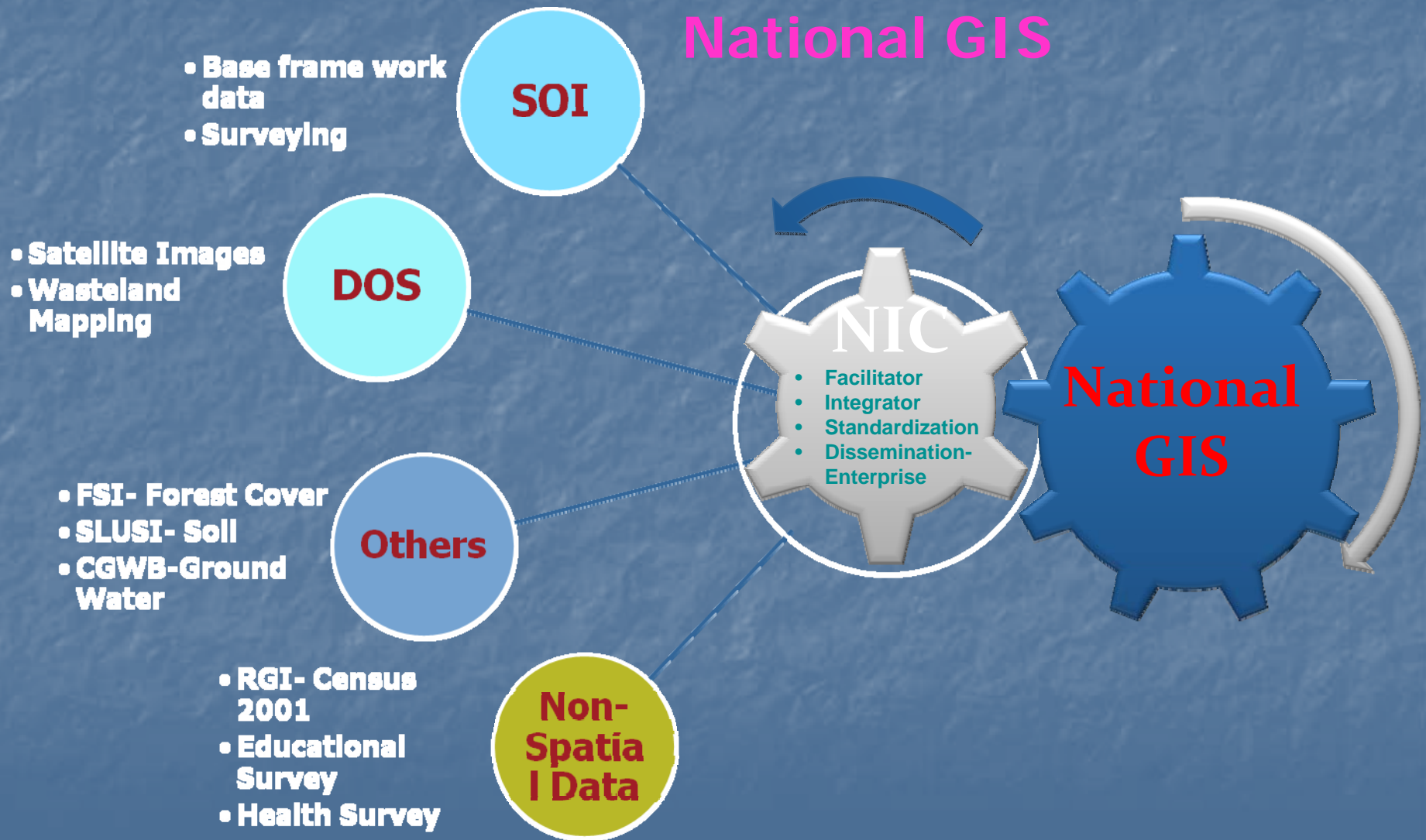
Bar Chart Showing No of Landslides in Different Vulnerability Zones



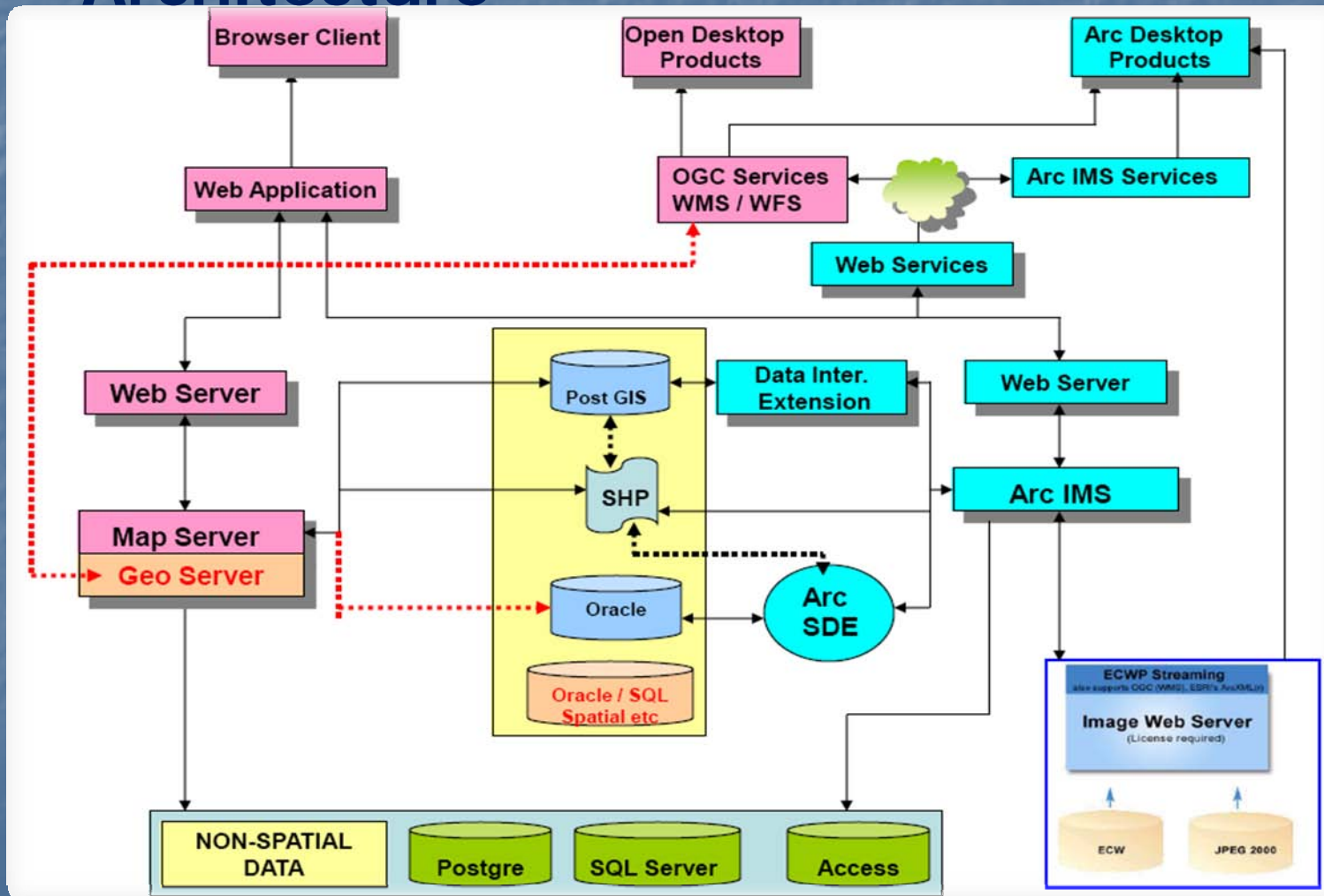
The Study Concludes

- Geographical Information System is very useful in assessing the vulnerability to landslide hazards.
- Using GIS accurate prediction of landslides is possible using highly accurate spatial data.
- The method of tri-variate approach is simple and gives around 70%-80% accuracy in assessing the landslide vulnerability.
- The application of GIS will go a long way in making our development activities sustainable.

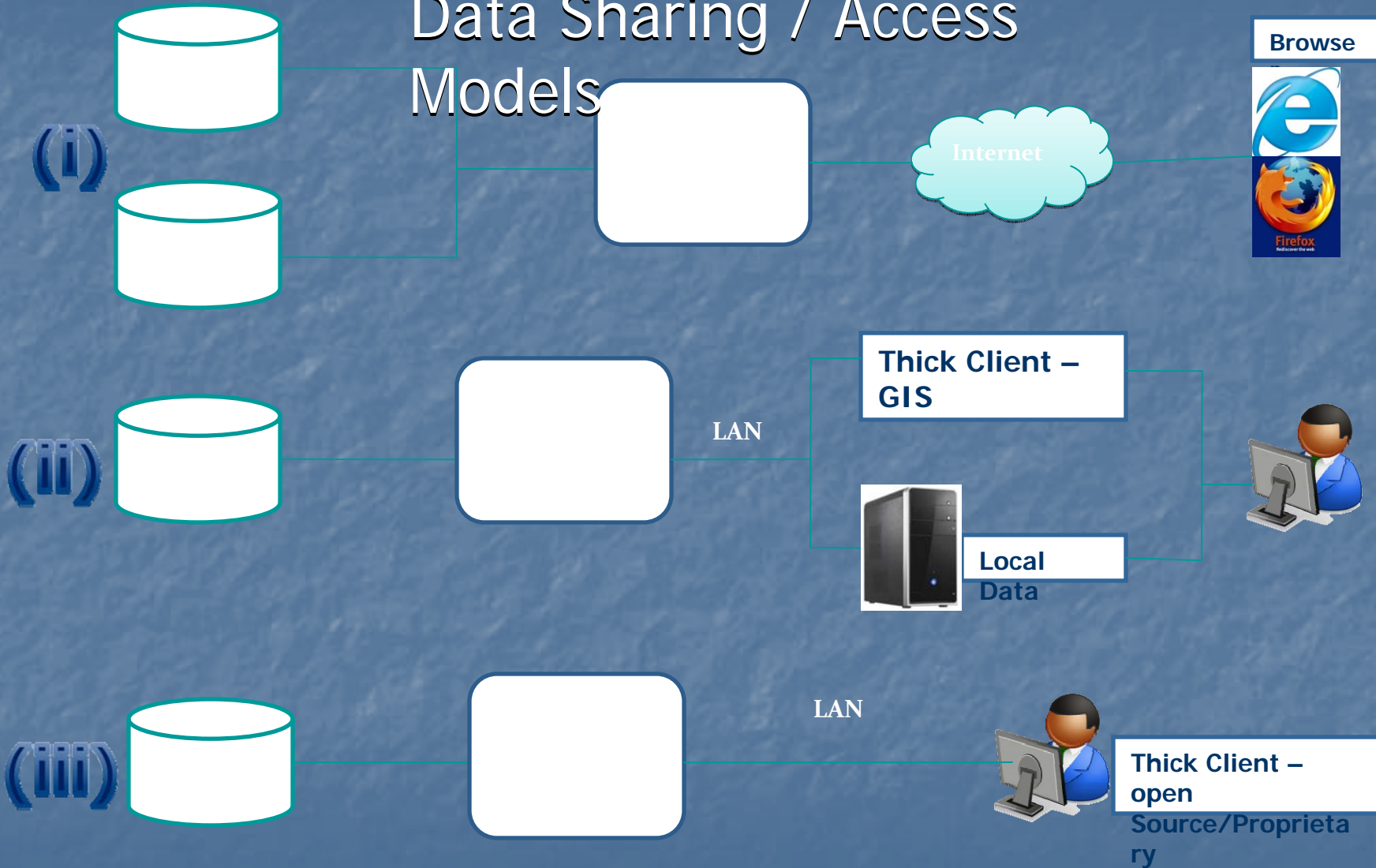
Stakeholders of National GIS



Enterprise Framework Architecture



Data Sharing / Access Models



Administrative Boundary Database

- Mapping of 6,38,387 Villages of India with other administrative units linked with Census 2001.
- Forms core data for e-governance applications.
- Socio-economic indicators and Demographic Studies.
- Verification, update, roll out plan in progress

National GIS - Web based Dissemination System with GIS functions like navigation, query, analysis , print.

The screenshot displays the NIC GIS WEBSERVER interface. At the top, there is a navigation toolbar and a 'Feed Back' link. The main map area shows India with district boundaries highlighted in various colors. An inset map of India is visible in the top-left corner. On the right side, there is a legend titled 'NIC-GIS' with a tree view of data layers. The 'Administrative Units' folder is expanded, showing 'States Of India', 'Districts Of India' (selected), 'Districts 2005', 'Tehsils Of India', and 'Blocks Of India'. Below the legend is a 'Refresh Map' button and a checked 'Auto Refresh' option. At the bottom, a table titled 'Districts Of India' displays data for the district of Mandla.

Rec	STATE CODE	DISTRICT CODE	DISTRICT NAME	TOTAL POPULATION	MALE POPULATION	FEMALE POPULATION	DECADAL GROWTH (81-91)	DECADAL GROWTH (91-01)	SEX RATIO (1991)	SEX RATIO (2001)	POPULATION DENSITY (1991)	POPULATION DENSITY (2001)	TOTAL POPULATION (0-6)	T	P
1	23	42	Mandla	893908	446487	447421	24.17	14.66	990	1002	134	154	155065	8	

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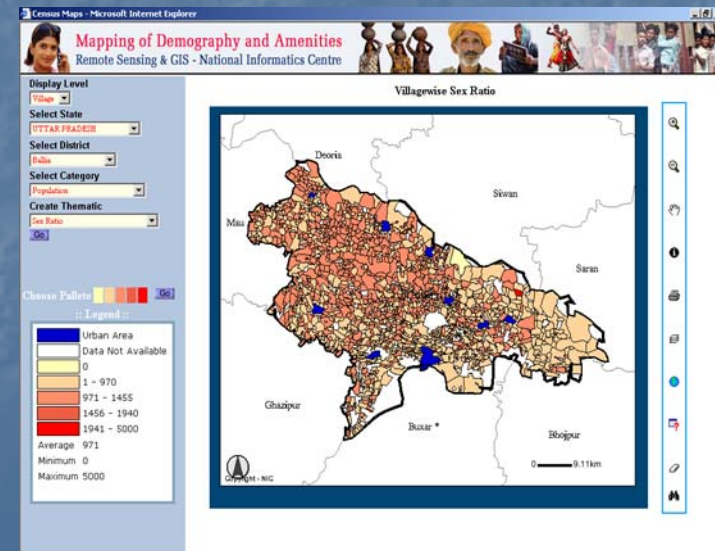
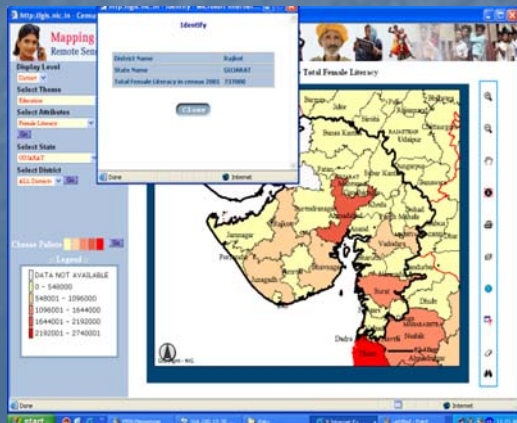
0 972km

Identify

Web GIS for Village Level Mapping of Demography and Amenities

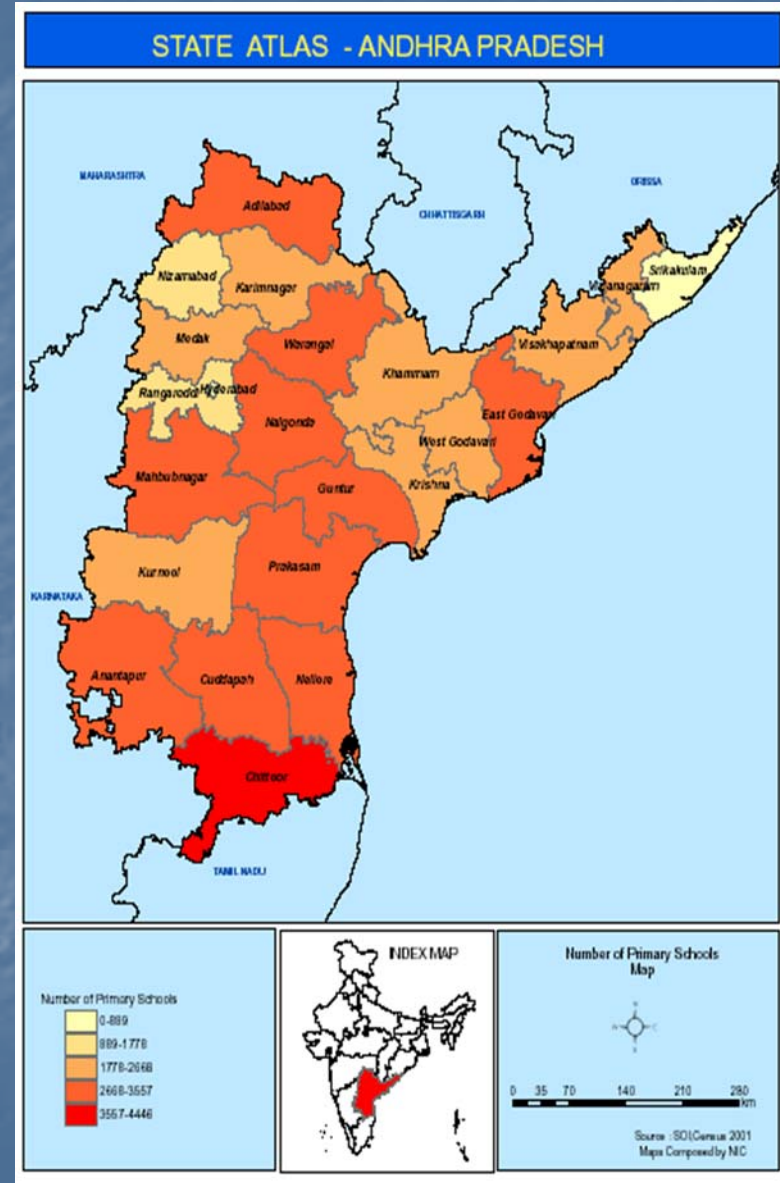
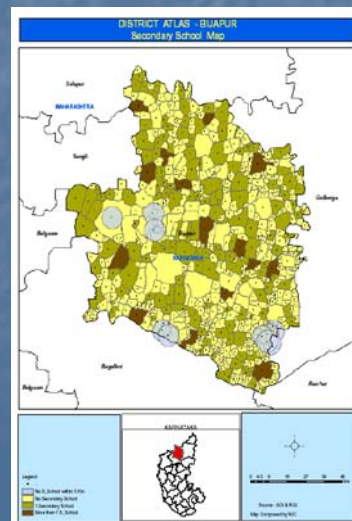
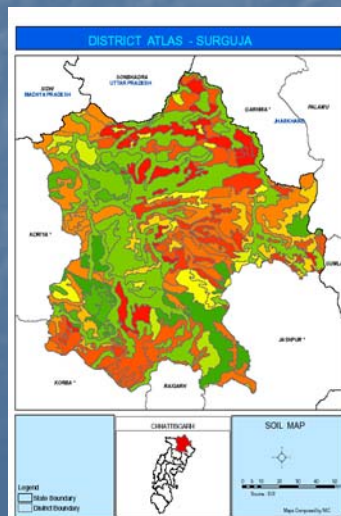


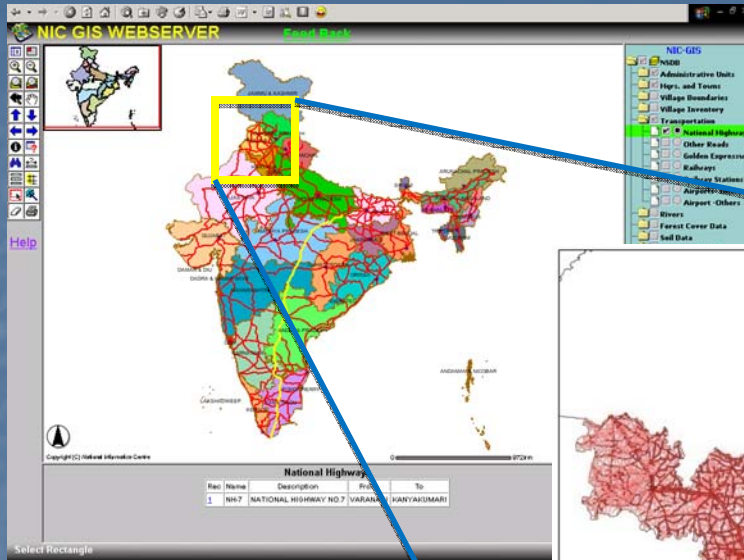
G2C Application



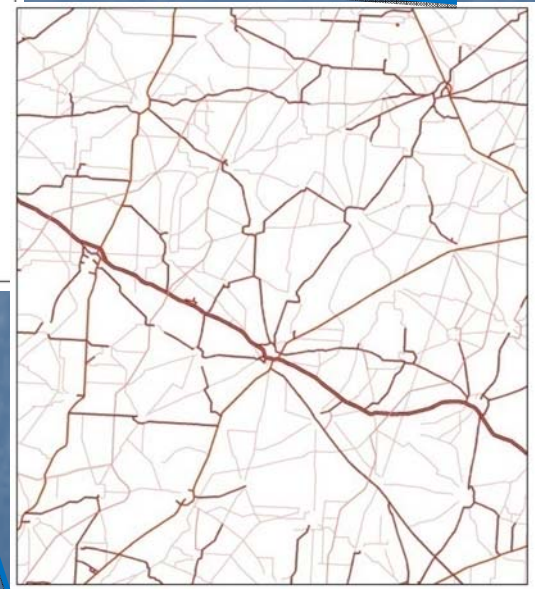
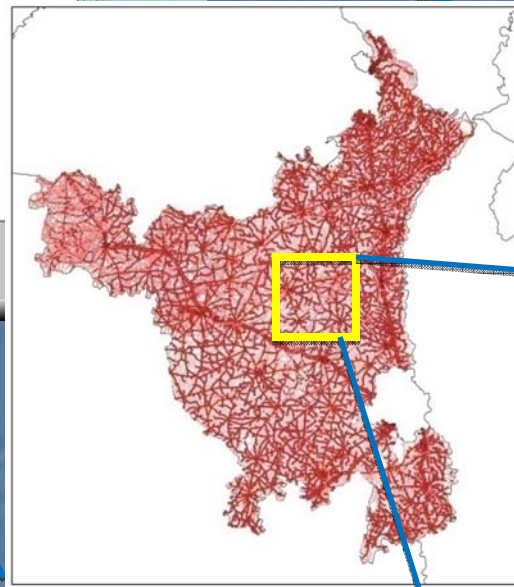
Thematic Atlas for the entire Country

National GIS Project

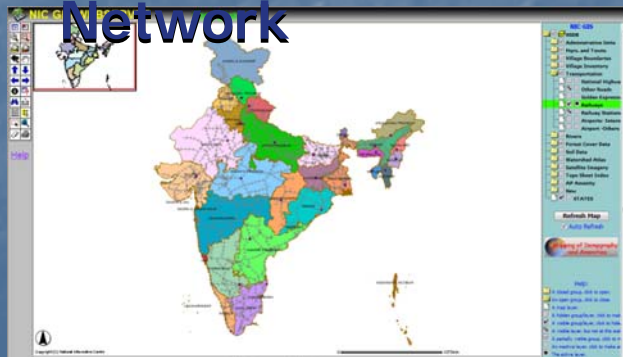




Road Network

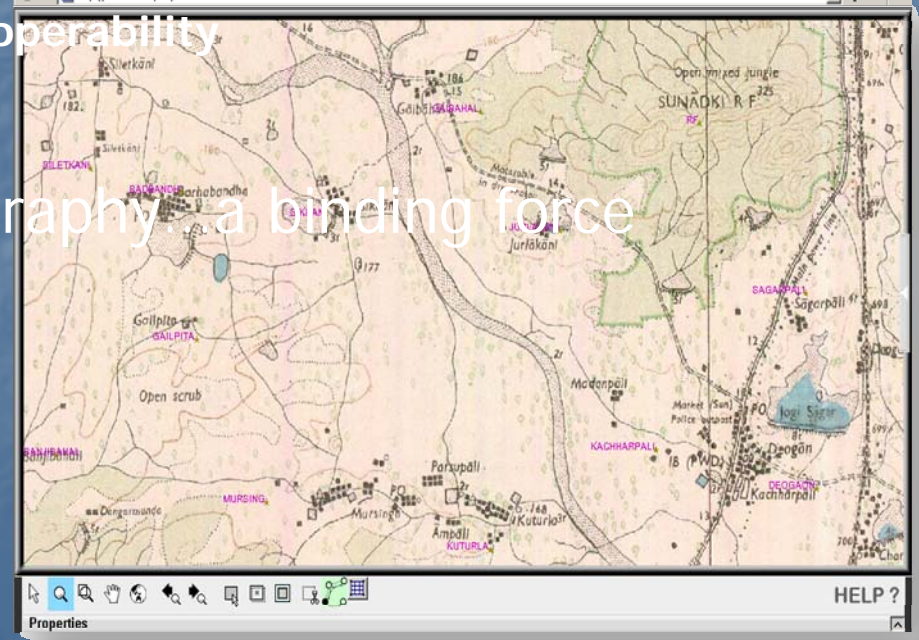
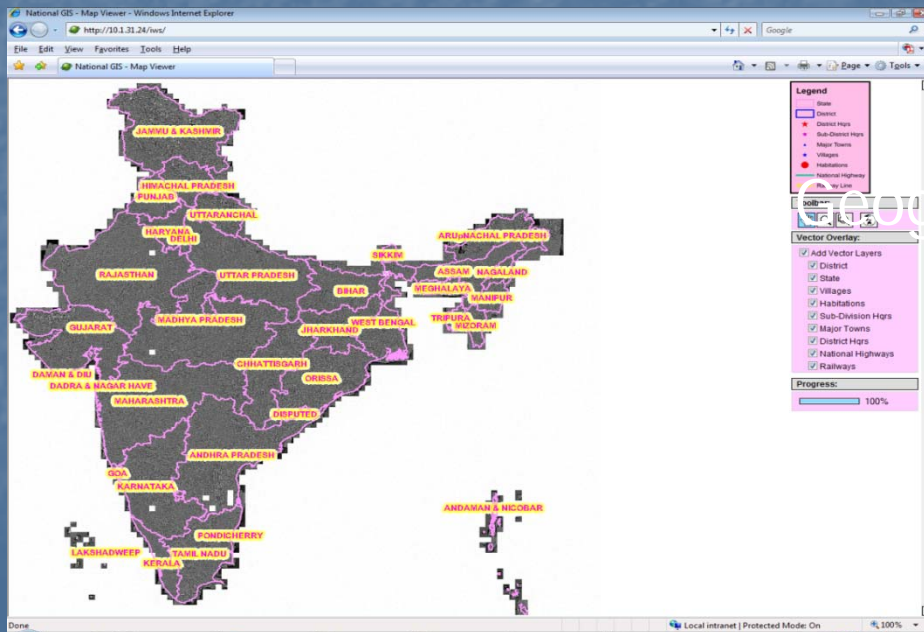


Railway Network



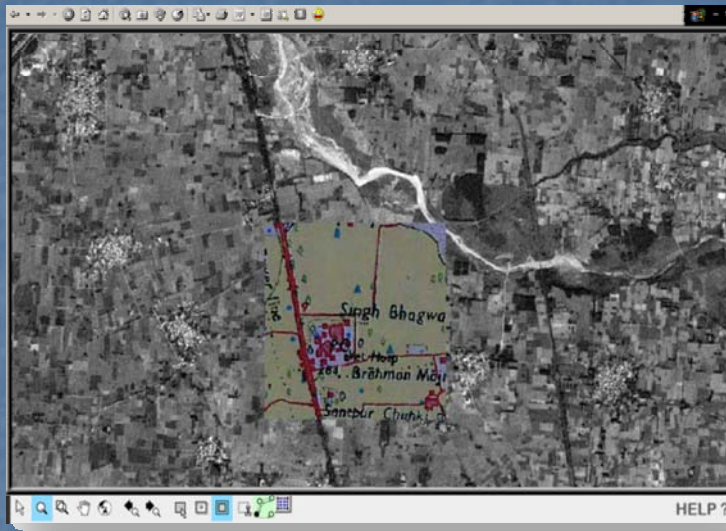
Raster Data Services

- Countrywide mosaic of Topo-maps
- Countrywide mosaic of Satellite images of various resolution upto 5m.
- Quick Bird (60 Cm) images for district Head Quarters.
- Image Classification and Infrastructure Mapping

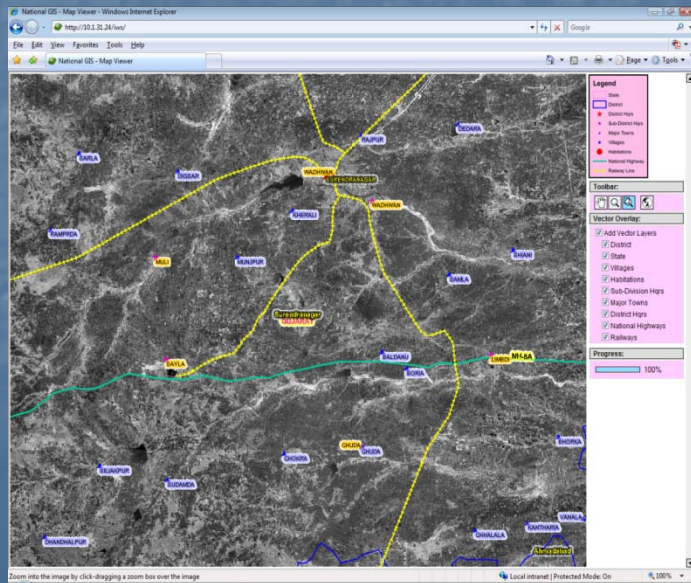


operability
Geography: a binding force

Visualization from maps/sat. images



PAN with Topo Maps



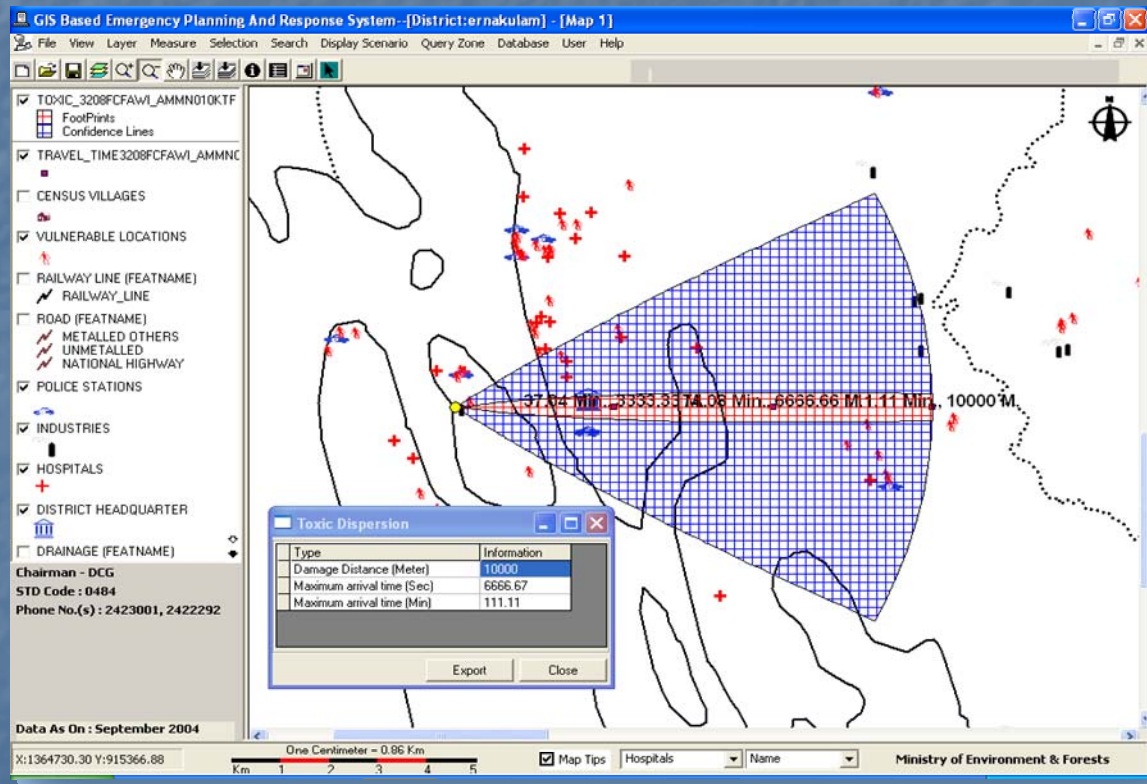
Quick Bird Image for
Rupnagar, Punjab

Key GIS Implementations

- Dissemination using Enterprise GIS Architecture
- Planning of mobile services across the country.
- Emergency Planning and Response system
- Watershed Management System
- Value Added services for operational MIS services.
- GIS based Election Management

GIS BASED EMERGENCY PLANNING & RESPONSE SYSTEM FOR MAJOR HAZARDOUS INDUSTRIES

- ❖ Offsite emergency planning tool developed using Map Objects.
- ❖ Chemicals modeling using ARCHIE/ ALOHA integrated with MO. Over 2000 footprints generated.
- ❖ Implemented in 40 districts & hazardous Industries.
- ❖ Response Inf. data sheets for 463 chemicals.



Value Addition to MIS

Agricultural Marketing Network

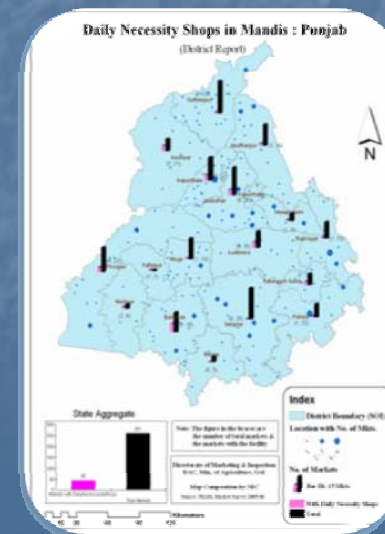
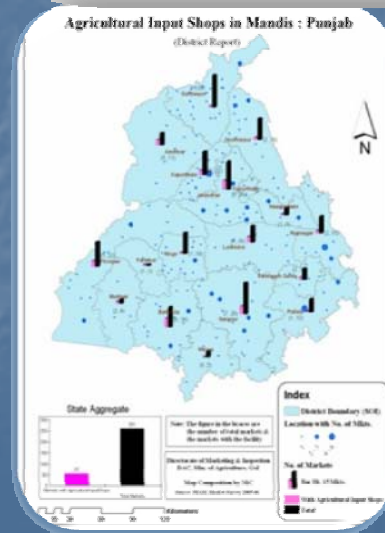
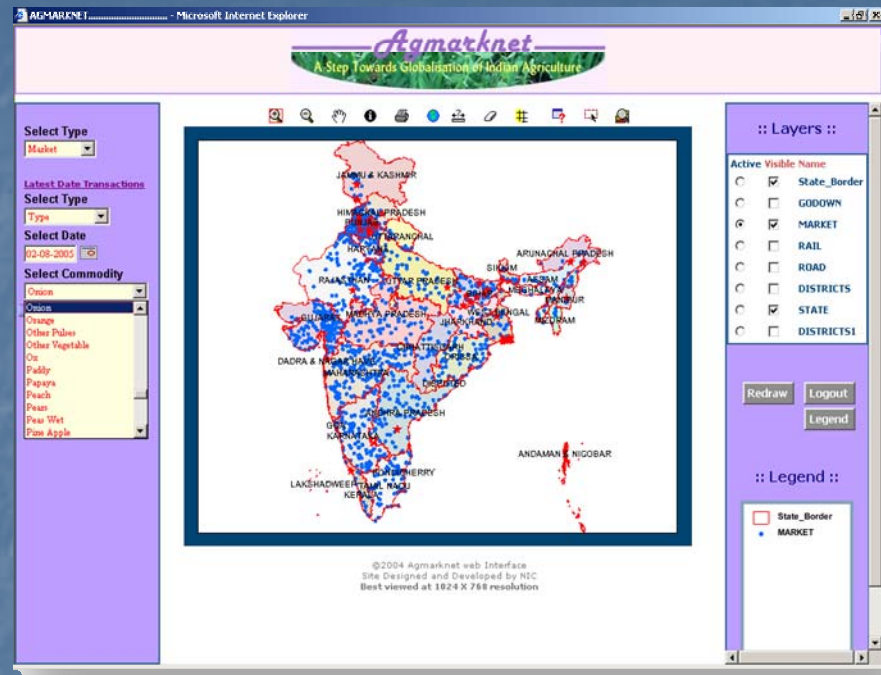
❖ Mapping of around 7000 agricultural Markets.

❖ Daily Arrival of commodities.

❖ Price Index

❖ Market Profile

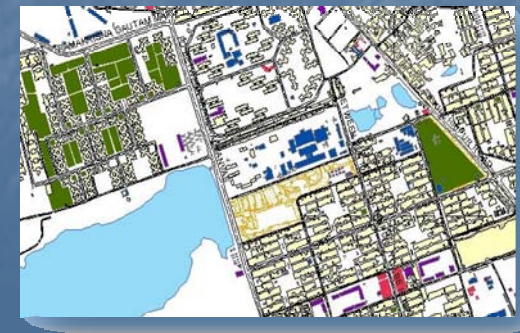
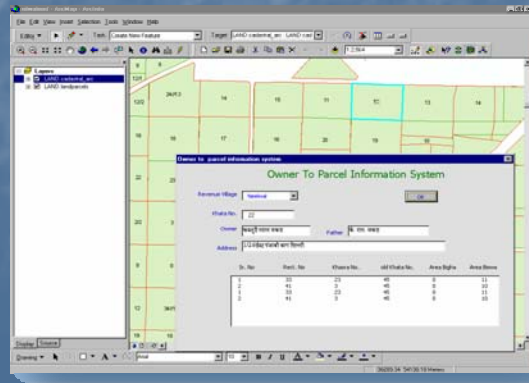
❖ Demand Supply Chain



Utility Mapping Services

Better civic services to citizens at large through computer assisted mapping of utilities

- Utility Mapping model implemented for Delhi.
- This model is further replicated in the six cities of Mumbai, Chennai, Kolkata, Bangalore, Hyderabad and Ahmedabad.



To summarize

- ✓ Integrated Services Delivery using GIS is an essential component to e-gov process.
- ✓ National GIS has triggered the process of integration of data from various sources.
- ✓ We continue to provide our support for evolving common standards and policies, human resources and knowledge sharing.
- ✓ Spatial Data Infrastructure accomplishes the delivery of effective and efficient implementation of e-governance programmes through GIS at grass root level



INDIA

Thank You

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