Seismic risk zonation using geospatial tool: A case study over East and South district of Sikkim

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Seismic Risk

Risk = *f* (Hazard* Vulnerability)

- **Risk-** "It can be defined as the likelihood or probability of different levels of undesirable consequences due to the occurrence of earthquakes. Such consequences may include loss of life, injury, damage and collapse of buildings, economic costs, and business interruption, among others."(Julian, 2015)
- **Hazard**-It refers to any kind of natural phenomenon related to earthquakes such as ground shaking, liquefaction, landslides, and tsunami which are capable of imparting potential loss and damages.
- **Vulnerability-**Aggregated probability describing system's susceptibility to the disaster and its effect is called vulnerability.(Sinha, et al. 2016)

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Why do we require Seismic Risk Maps?

- Seismic risk mapping serves as an important tool for mitigating the risk associated with induced seismicity.

- Disaster management (or emergency management) is the creation of plans through which communities reduce vulnerability to hazards and cope with disasters. Disaster management does not avert or eliminate the threats; instead, it focuses on creating plans to decrease the effect of disasters.

Study Area

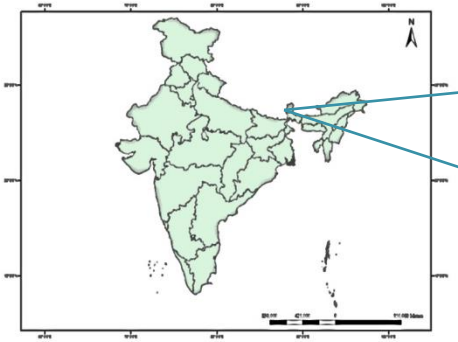


Fig1:Map of India showing location of Sikkim

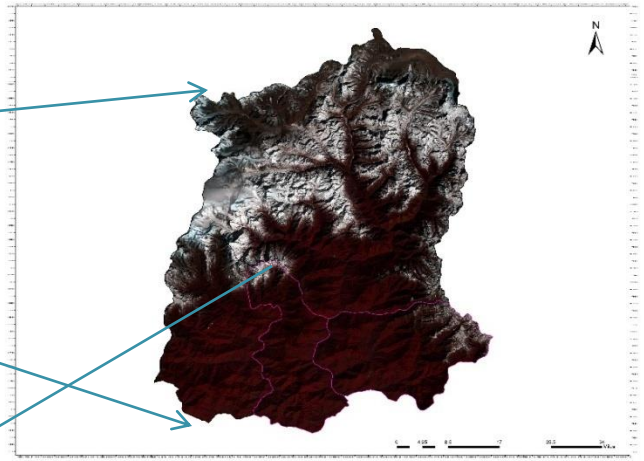


Fig 2: Standard FCC of Sikkim Showing location of East & South Districts

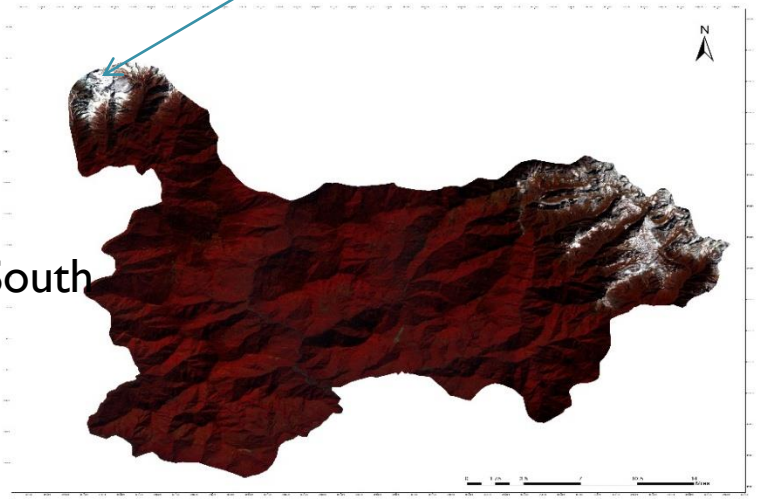


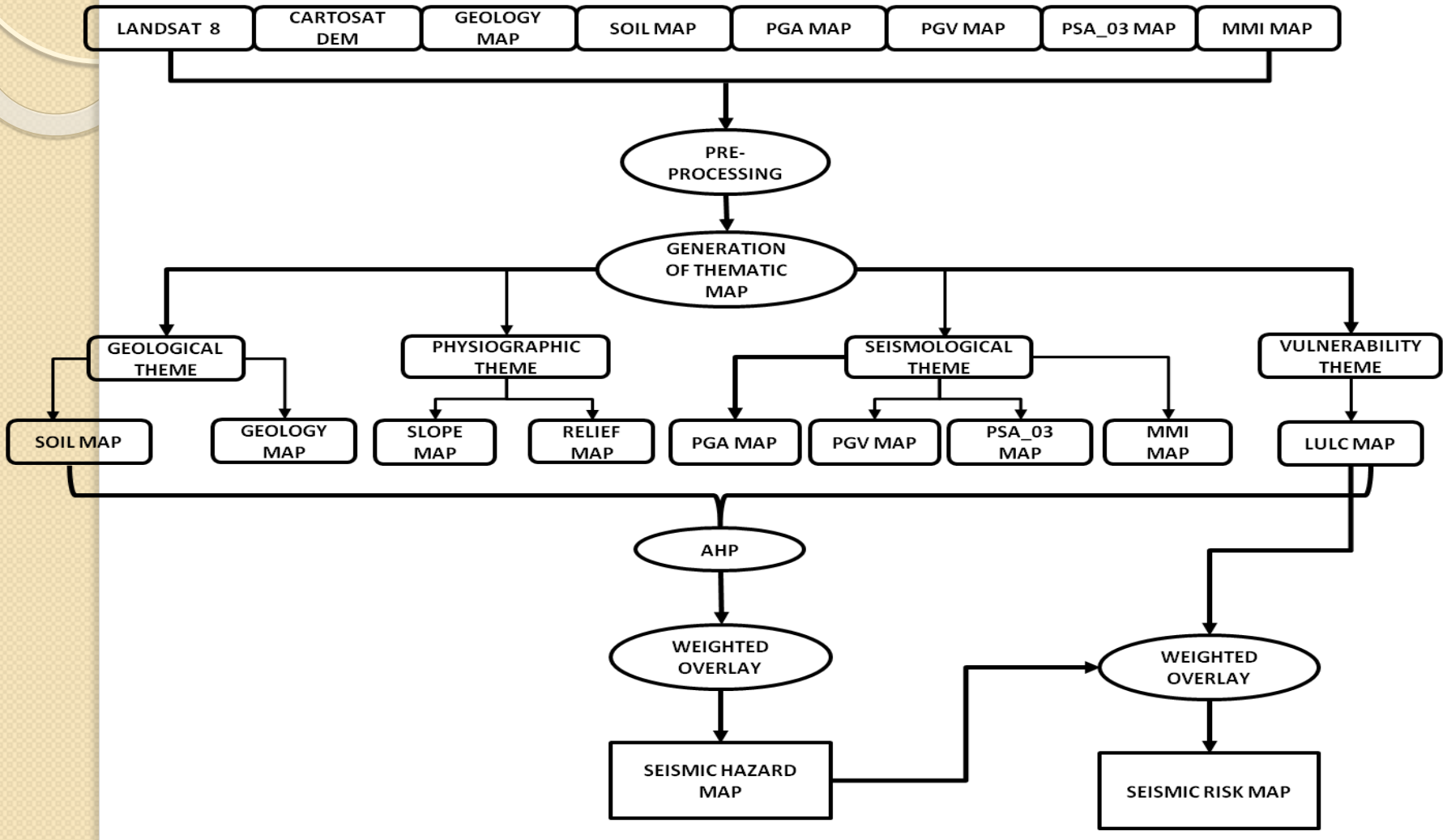
Fig 3:Standard FCC of East & South Districts Of Sikkim

Data Sets Used

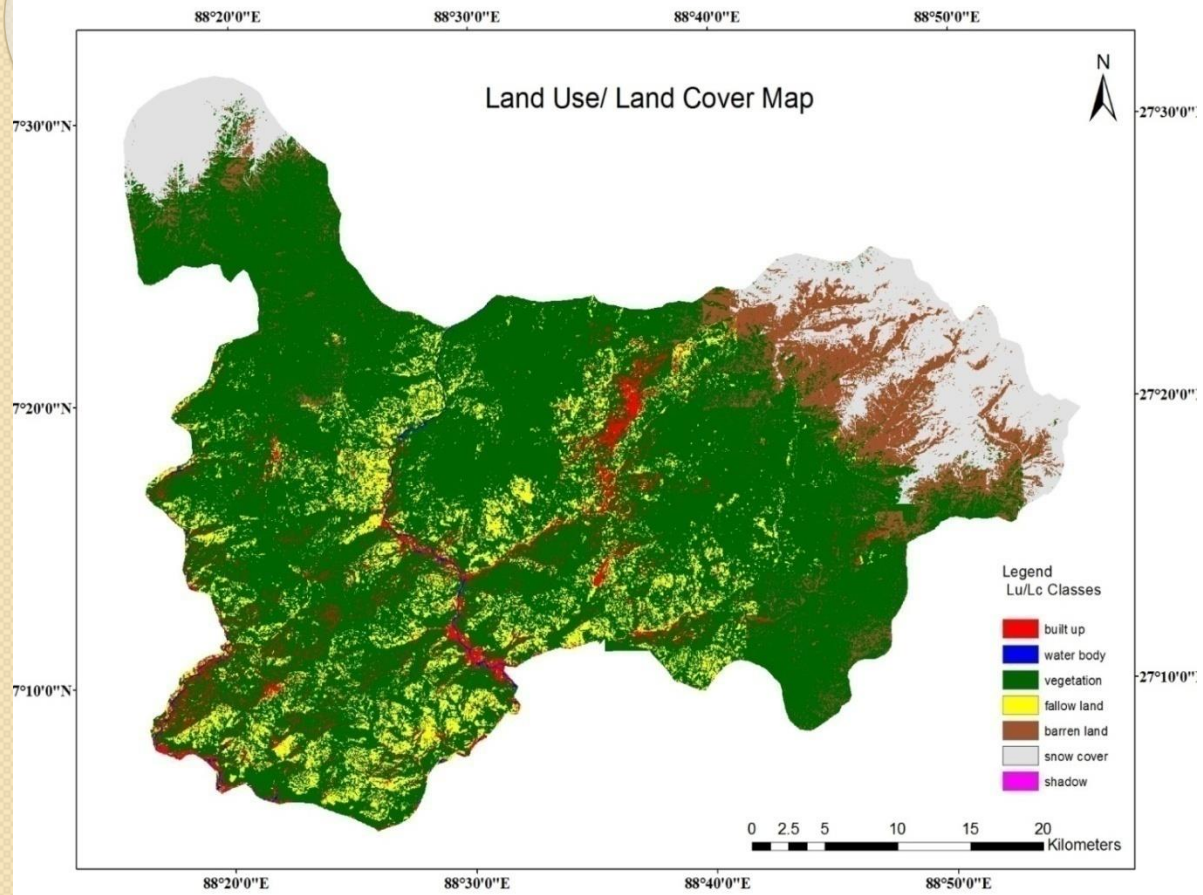
- LANDSAT 8 OLI TIRS (January 2017)
- CARTOSAT DEM
- Ground Motion Data

  from USGS for the event of Sikkim Earthquake (27.730°N,88.155°E), 18th September 2011.
- Geology map & soil type map obtained *from Geological Survey of India and Environmental Information System Sikkim,*

Methodology



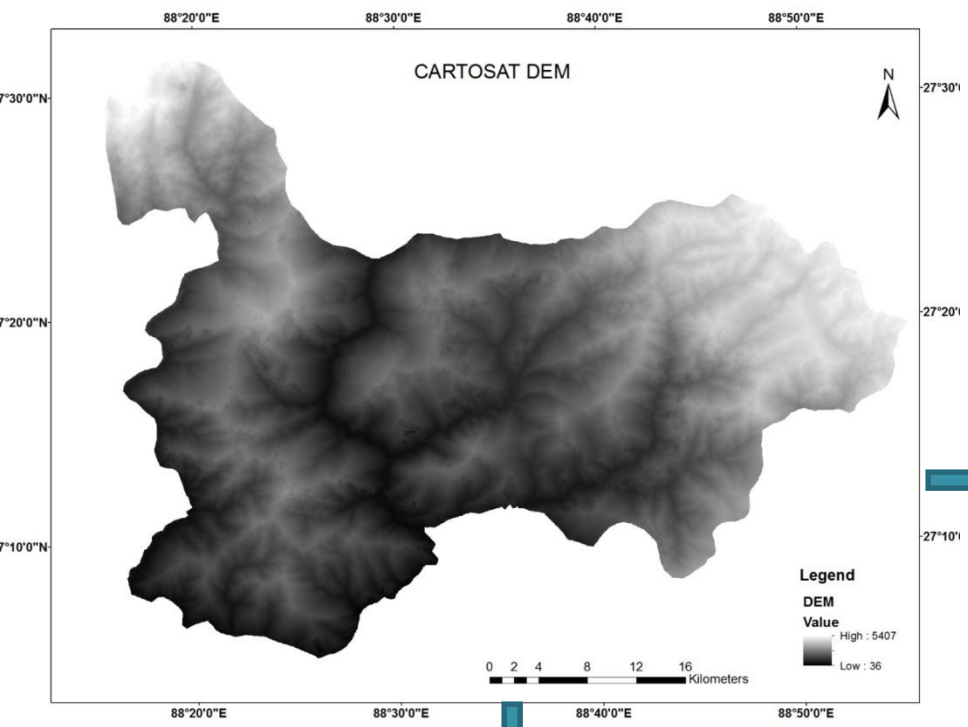
Data Preparation

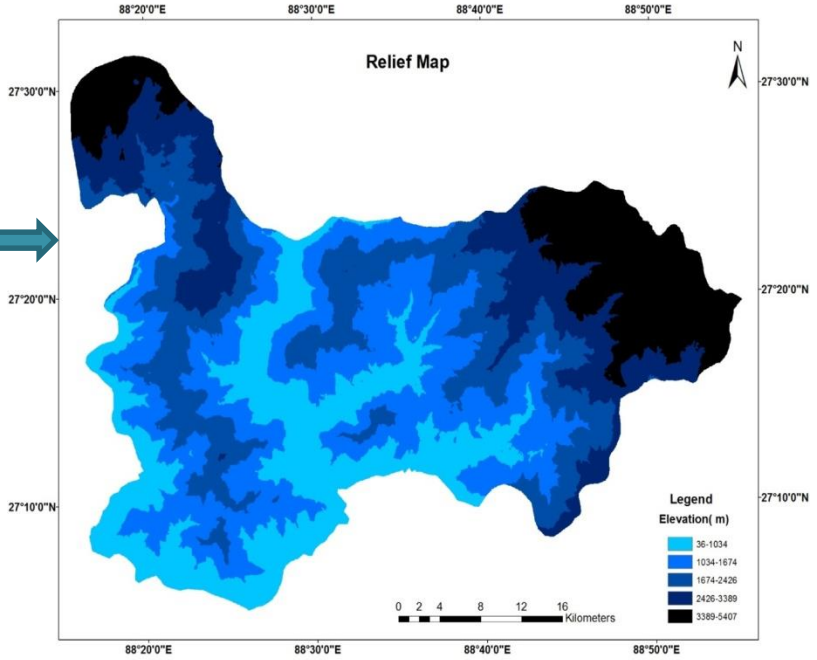


LU/LC Map of The Study Area Generated Using LANDSAT-8 (January 2017)

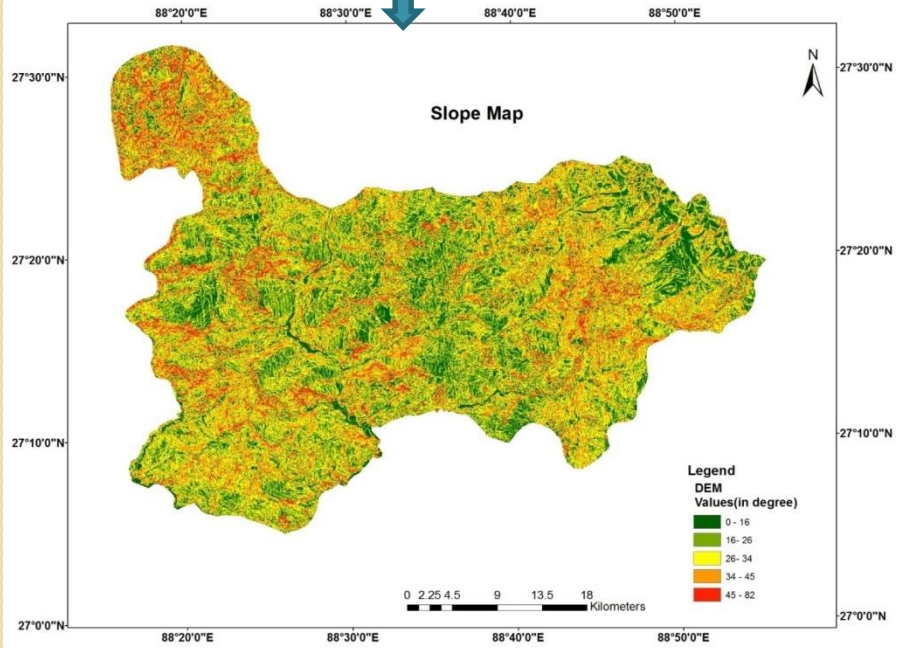
- LU/LC map obtained by performing supervised classification on Erdas Imagine 15
- Classified into 7 classes-
  - Built up
  - Waterbody
  - Vegetation
  - Fallow Land
  - Barren Land
  - Snow Cover
  - Shadow

CARTOSAT digital elevation model (DEM) of the study area

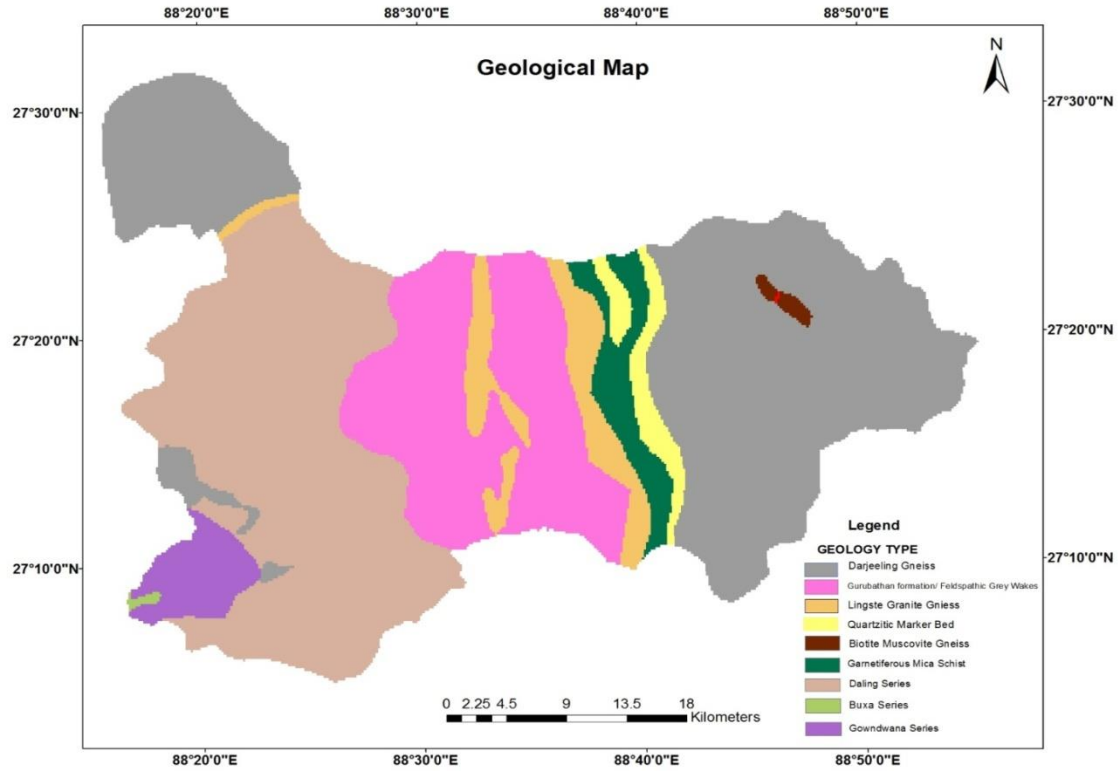




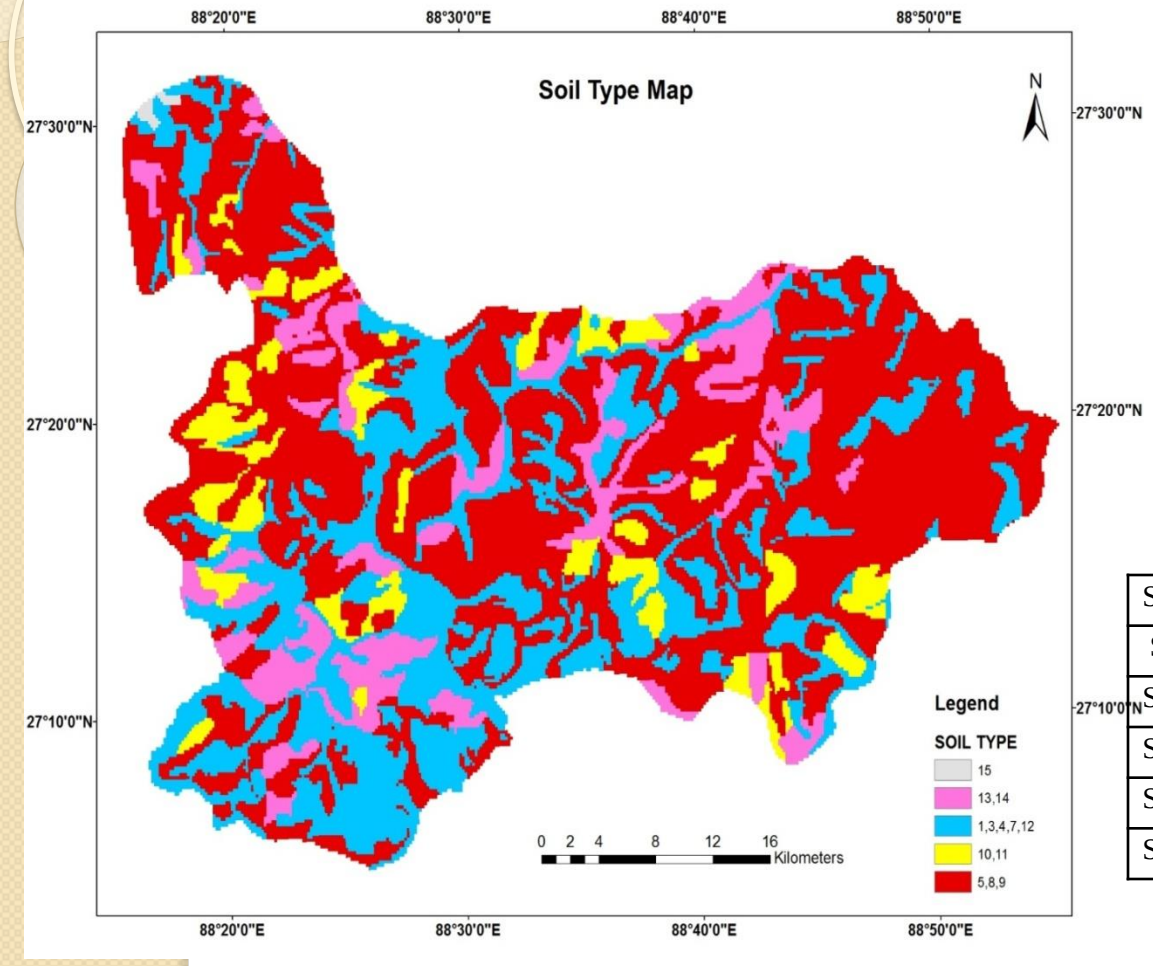
Releif Map of the study area generated from DEM.



Slope Map of the study area generated from DEM



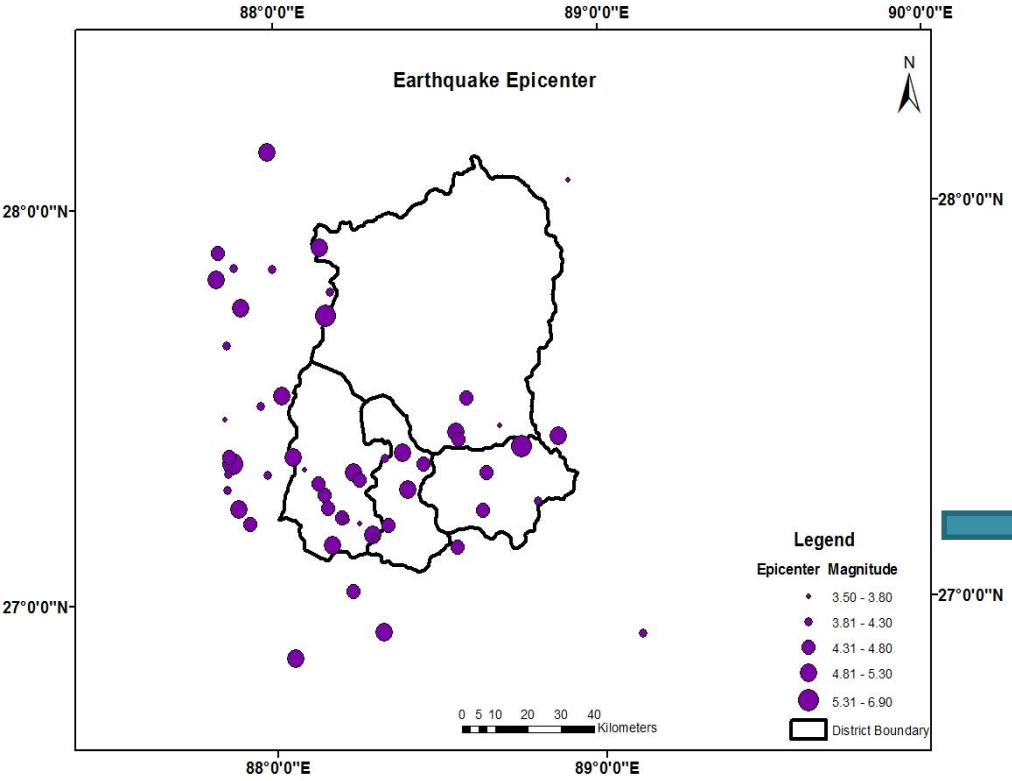
Geological Map of the study area



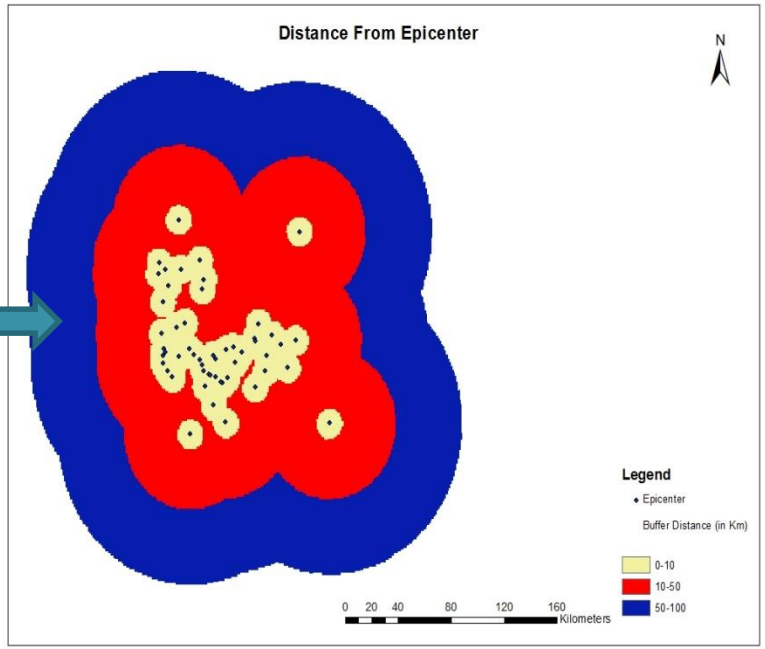
Soil Type Map of the study area

Soil Characteristics	Soil Type
Soils on Rocky Mountains	15 (Glaciers)
Soils on Slope >50%	14,13
Soils on Slope 50-30%	1,2,3,4,7
Soils on Slope15-30%	10,11,12
Soils on Slope <15%	5,6,7,8,9

Soil Type Classification

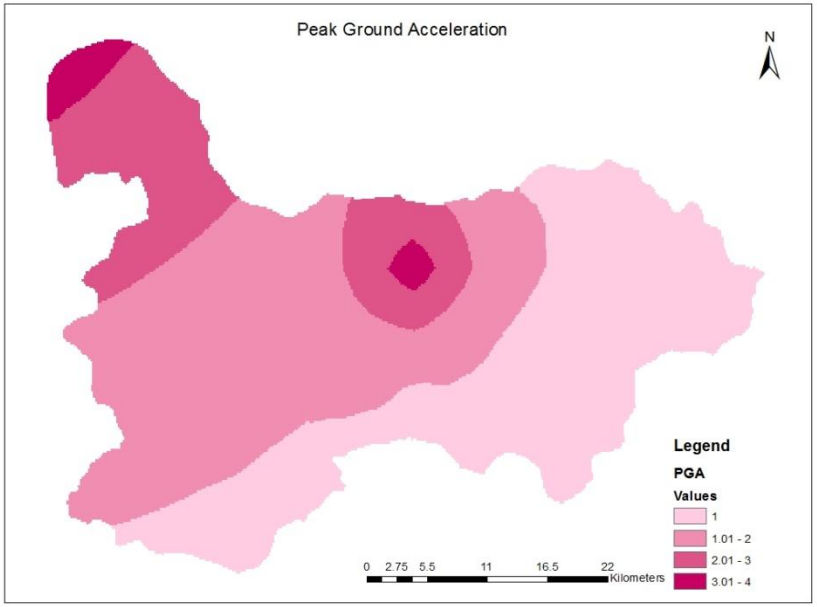


Map showing epicenters of past Earthquakes in and around Sikkim

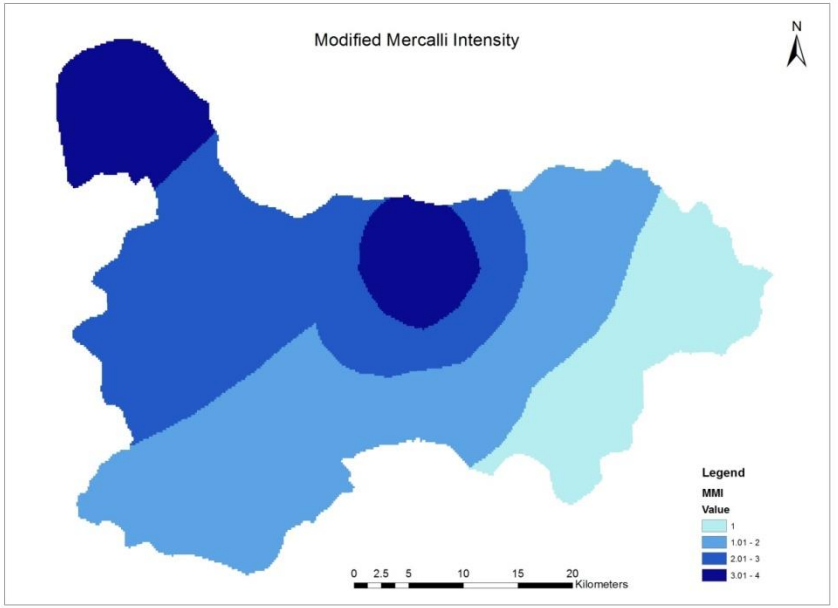


Map showing buffer from Earthquake Epicenter

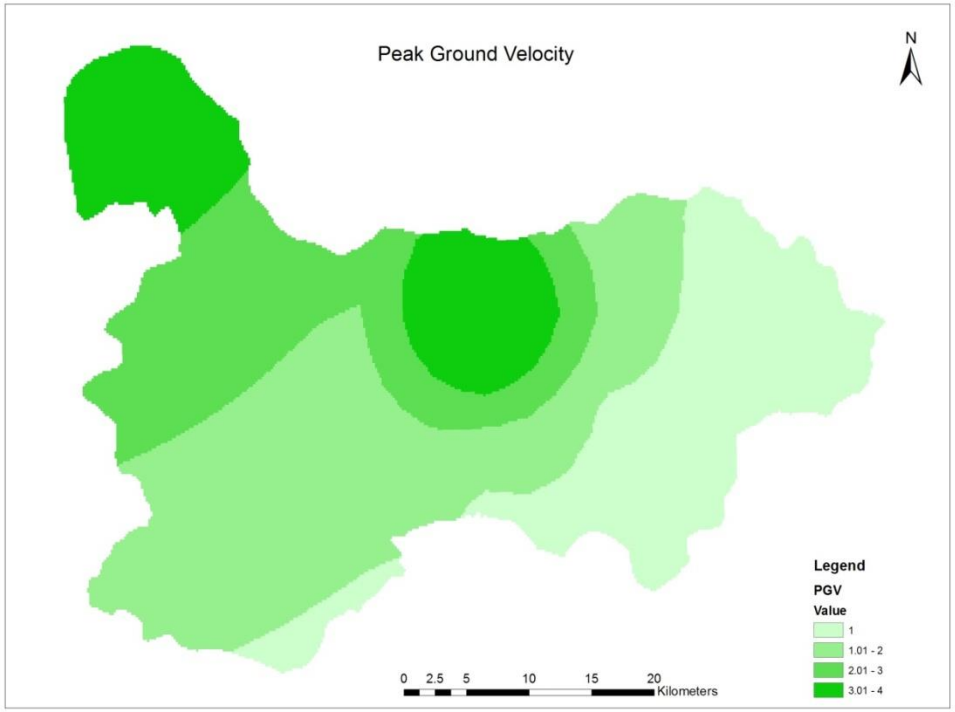
Map showing distance from faults in the study area



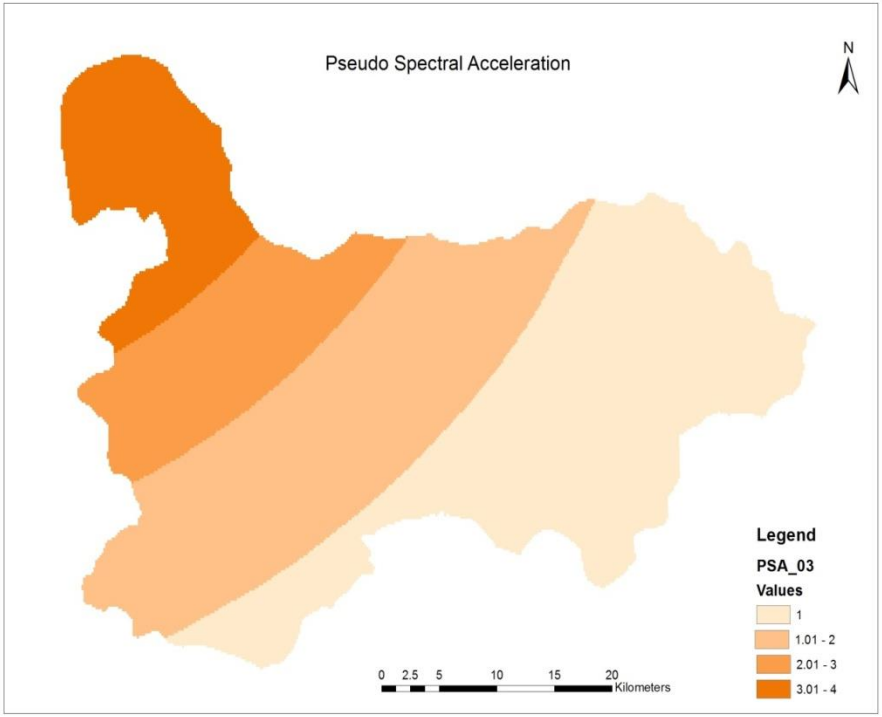
Map showing PGA in the study area.



Map showing MMI in the study area



Map showing PGV in the study area.



Map showing PSA_03 in the study area

AHP

Themes	GM	DF	DE	GEO	ST	RELIEF	SLOPE	LU/LC
GM	1.00	0.33	0.33	4.00	5.00	6.00	6.00	7.00
DF	3.00	1.00	1.00	8.00	7.00	8.00	8.00	9.00
DE	3.00	1.00	1.00	8.00	7.00	8.00	8.00	9.00
GEO	0.25	0.17	0.17	1.00	2.00	3.00	3.00	4.00
ST	0.20	0.14	0.14	0.50	1.00	2.00	2.00	3.00
RELIEF	0.17	0.13	0.13	0.33	0.50	1.00	1.00	2.00
SLOPE	0.17	0.13	0.13	0.33	0.50	1.00	1.00	2.00
LU/LC	0.14	0.11	0.11	0.25	0.33	0.50	0.50	1.00
SUM	7.93	3.00	3.00	22.42	23.33	29.50	29.50	37.00

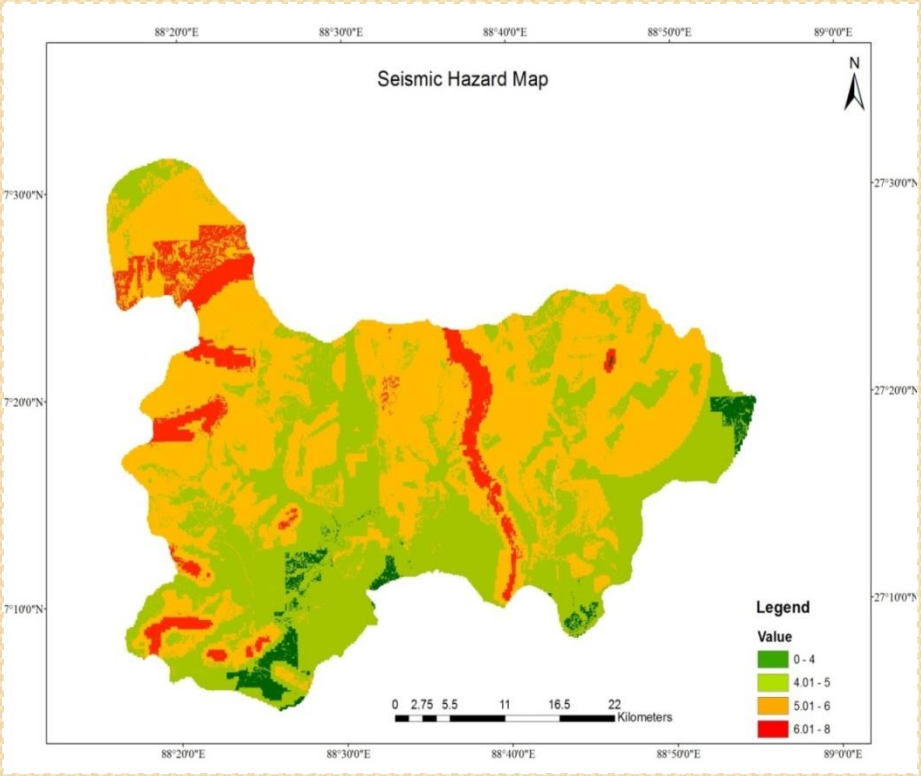
Pair-wise Comparison Matrix

Themes	% Influence
Ground Motion	17
Distance from Epicenter	31
Distance from Fault	31
Geology	7
Soil Type	5
Relief	3
Slope	3
LU/LC	2

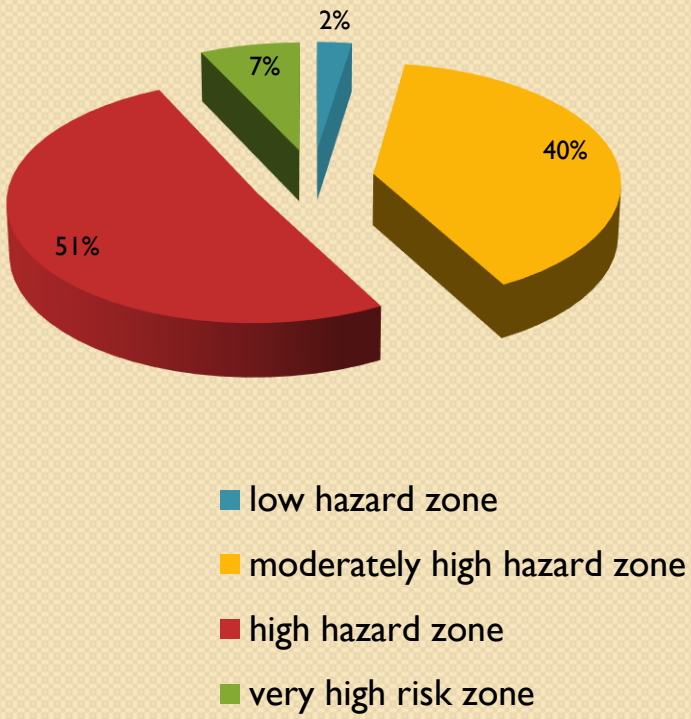
Table showing % influence of each theme

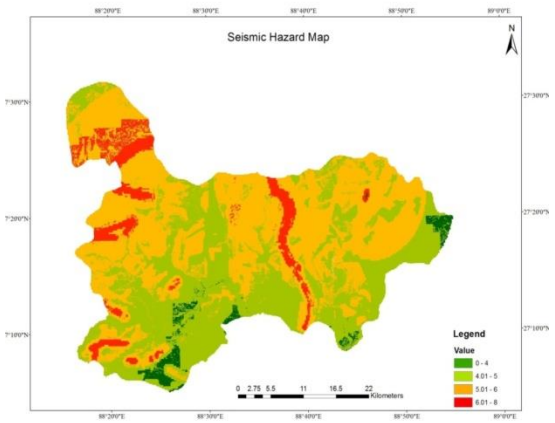
RESULT & DISCUSSION

Seismic Hazard Map of the study area using weighted overlay tool

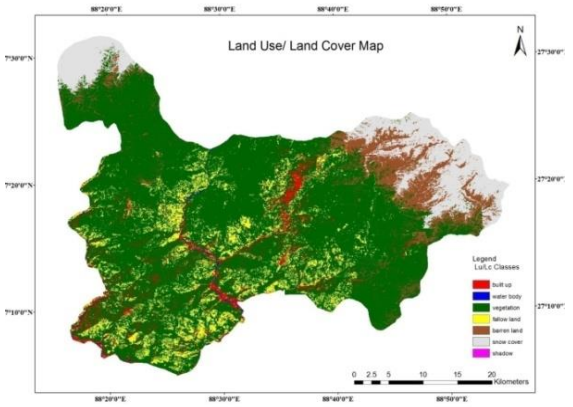


Percentage division of study area under hazard zones

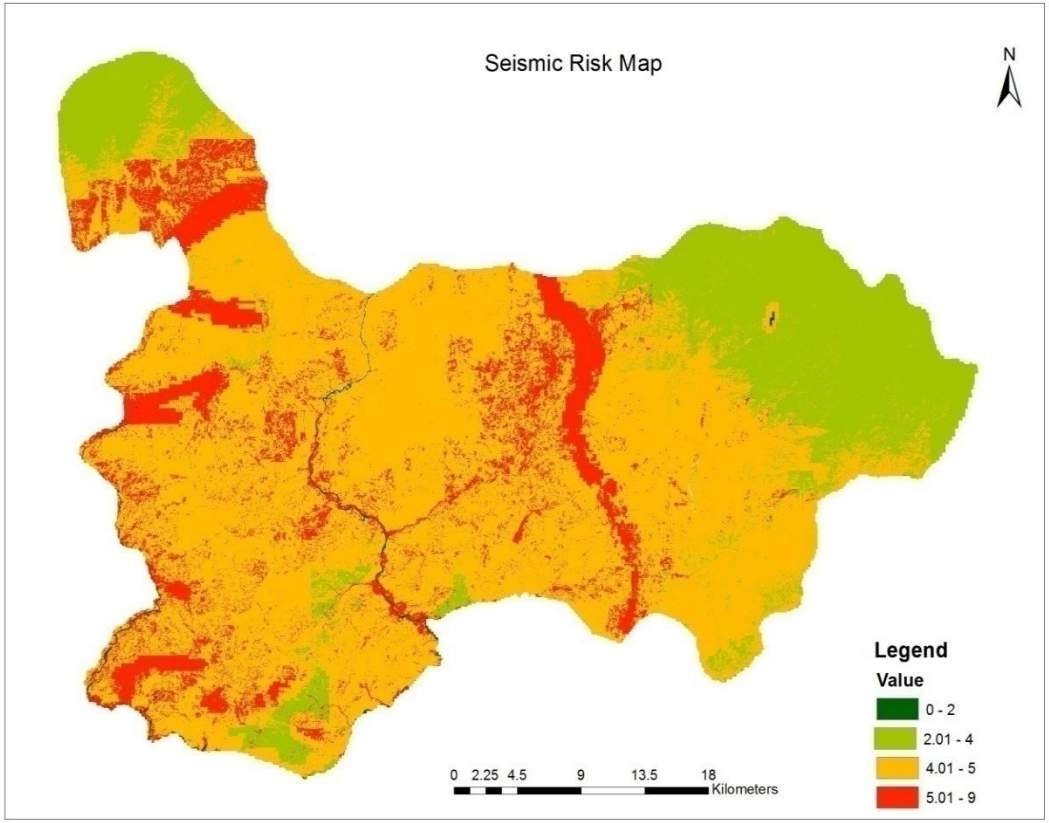




Hazard Layer



Vulnerability Layer



Seismic Risk Map of the study area

CONCLUSION

- Research investigations pertaining to natural hazards are important for formulation of policies in the direction of disaster management. This work aimed at the assessment of Seismic risk and hazard of the vulnerable areas of Sikkim.
- GIS overlay and AHP technique were employed to achieve the aforementioned objective.
- Weighted sum technique was applied to generate risk map. The hazard and risk map produced shows that nearly all the areas under study (about 66%) are under high risk zone.

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THANK YOU