Effectiveness of landscape Spatial Metrics with reference to the Spatial Resolution of Remote Sensing data

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- Landscape metrics based on category, patch, and class representations developed in late 80's are quantitative spatial measures of landscape pattern exhibiting spatial characteristics.
- Understanding the role and capability of spatial metrics with the remote sensing data of various spatial resolutions for quantifying landscape patterns is crucial in assessing the potential of spatial metrics.
- The integrity of the analysis of landscape depends on the selection of appropriate spatial metrics, the resolution of spatial data apart from careful interpretation of the results

Objective

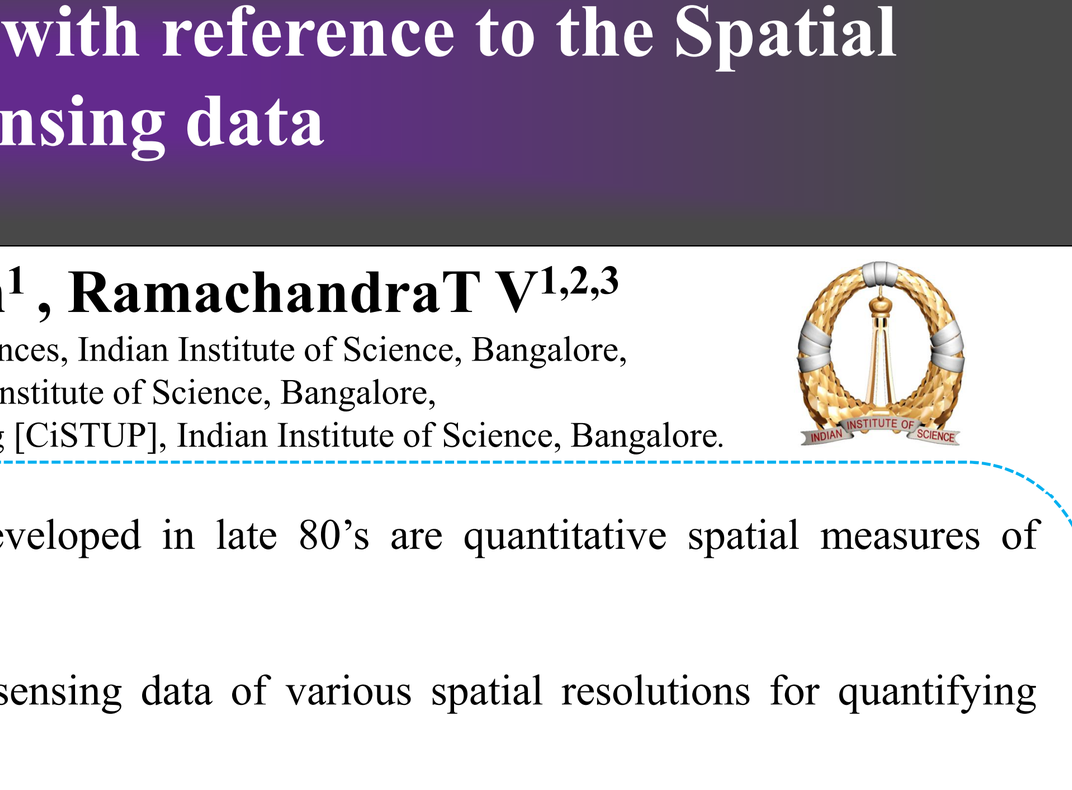
To understand the role of spatial resolution while assessing landscape dynamics through spatial metrics and the effectiveness of the landscape metrics in supporting landscape planning and management decisions.

Data

Multi-resolution remote sensing data includes,

- ❑ IKONOS data (4m),
- ❑ IRS P6 LISS IV Mx sensor (5m),
- ❑ Landsat Series Enhanced Thematic mapper sensor (28.5m) &
- ❑ Modis (500m).

Base layers were digitized with a negligible error count of 0.001 from the city map (procured from Bruhat Bangalore Mahanagara Palike), Survey of India toposheets (1:25000, 1:50000 and 1:250000 scales). Ground control points to register, geo-correct remote sensing data and Validate the results were collected using handheld pre-calibrated GPS, Bhuvan, Google earth and Survey of India Toposheet,.

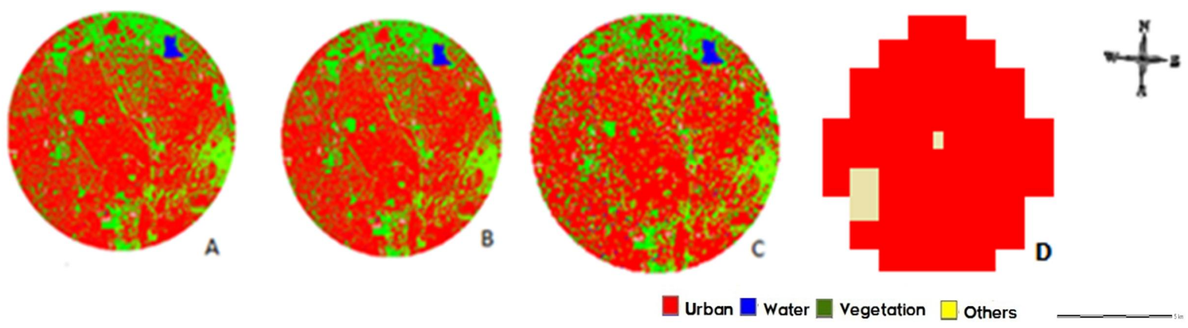


Study area: Sample space of Greater Bangalore , India

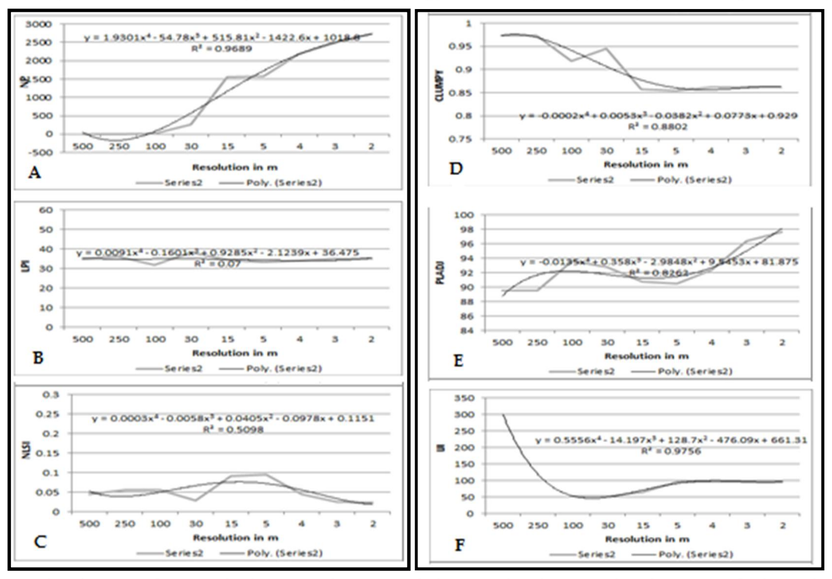
Analysis:

- The remote sensing data obtained were geo-referenced, rectified and cropped pertaining to the study area. Landsat ETM+ bands of 2010 were corrected for the SLC-off by using image enhancement techniques, followed by nearest-neighbour interpolation.
- Land use analysis was done using Gaussian Maximum Likelihood Classifier (GMLC). The temporal data was classified into four categories (built-up, vegetation , water, other (rock, open space)).
- This data has been analysed using a free and open source GIS software – GRASS **(http://ces.iisc.ernet.in/grass)**
- Application of this method resulted in accuracy of about 74% using MODIS data 88% using Landsat data, 91% accuracy using IRS-P6 data and 94% accuracy using IKONOS data.
- MODIS data (500 m) was resampled to 250 m and 100 m. Landsat resampled to 30 m and 15m, Ikonos of 4m resampled to 3m 2m and 1m respectively. Landscape metrics were computed for multi-resolution data
- Landscape metrics were computed using FRAGSTAT and correlation analysis was done for the quantified values of each metrics across resolutions of multi-resolution data.

Land use analysis of Greater Bangalore for a sample space



Class →	Urban		Vegetation		Water		Others	
Resolution ↓	Ha	%	Ha	%	Ha	%	Ha	%
500 m	1677.25	95.55	---	---	---	---	59.90	3.45
30m	1034.89	59.01	390.12	22.23	2.74	0.18	325.43	18.55
5m	1125.75	64.20	370.712	21.14	3.09	0.18	253.90	14.49
4m	1145.33	65.31	350.76	20.09	3.04	0.17	254.29	14.50



Correlation of spatial matrices with varied resolutions of the data

Findings:

- Increase in urban area shows the landscape is rapidly urbanizing and constitute a dominant class.
- The results reveal that landscape metrics based on patch (NP, PLADJ, IJI, CLUMPINESS) are sensitive to spatial resolution whereas metrics that are based on shape and neighborhood (NLSI) are not sensitive and behave similarly across all resolutions.
- Comparison of the landscape metrics of various resolutions provides explicit knowledge of their sensitivity and also helps to decide the effectiveness of the spatial metrics in the landscape analysis.
- Landscape metrics are apt indicators of landuse development and environmental status and there is a need to incorporate these indices in spatial environment monitoring and information systems to achieve sustainable management of the natural resources.

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