

Exploring landscape characteristics of urban green / blue infrastructure and its role in urban planning



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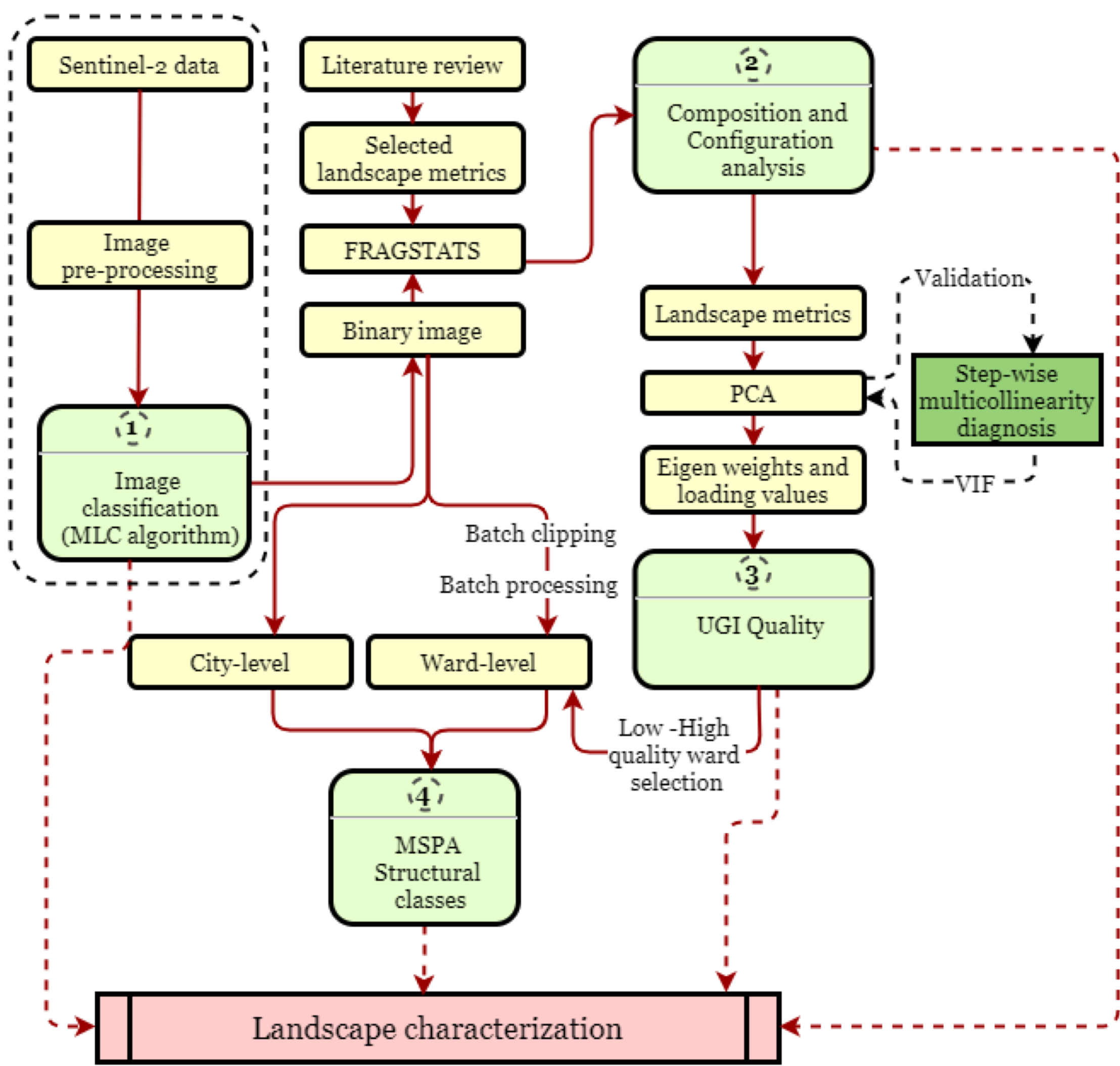
Background and Motivation

- Urban ecosystems* are highly complex systems, where a range of overlying processes interact with each other, and humans act as the main drivers of changes.
- Ecological changes* within urban ecosystems refer to the alteration in the landscape features of the vegetation cover and its associated ecological functioning.
- Due to the intrinsic link between structure and function of an ecosystem, changes in the landscape patterns influence ecological functioning. Landscape ecology plays a vital role in interpreting the relationship between spatial patterns and ecological processes.
- The concept of urban green/blue infrastructure (UGI) as a strategic planning approach is largely side-lined from India-specific studies. A major focus of the studies has been on quantifying and understanding the patterns of green spaces in cities. This provides a hollow measure of identifying the ecological quotient of a city as planners are only able to fulfil the quantitative targets of the city, while the quality of green spaces is ignored.
- Connectivity and shape characteristics of vegetation is an indicator of their quality as many ecological processes are influenced by them.
- Hence, while focusing on this important landscape aspect, the research investigates the landscape structure of existing UGI to develop a UGI quality index and morphological structural classes.

Research Questions

- How does composition and configuration of UGI vary within each selected city and among them?
- How do morphological patterns of UGI explain landscape characteristics and foster urban planning?

Methodological Framework

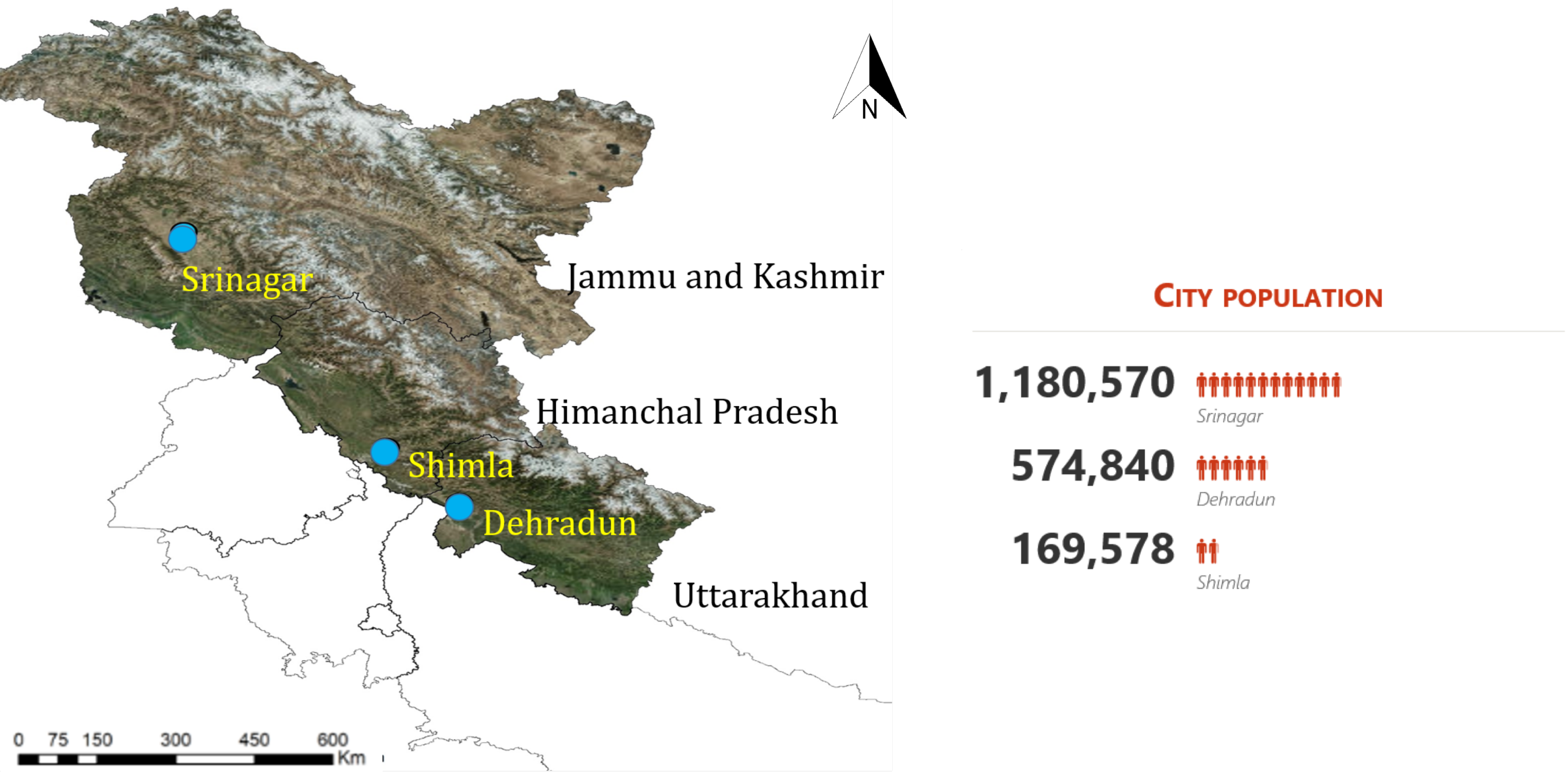


UGI Quality: A comparative measure of structural attributes of UGI that evaluate the size, shape, distance, relative positioning, and other fractal geometric dimensions. This informs about the key ecological functioning from a landscape ecological perspective.

MSPA (Morphological Spatial Pattern Analysis): Used to deduce structural links of UGI at a pixel-level using geometric arrangements and spatial patterns.

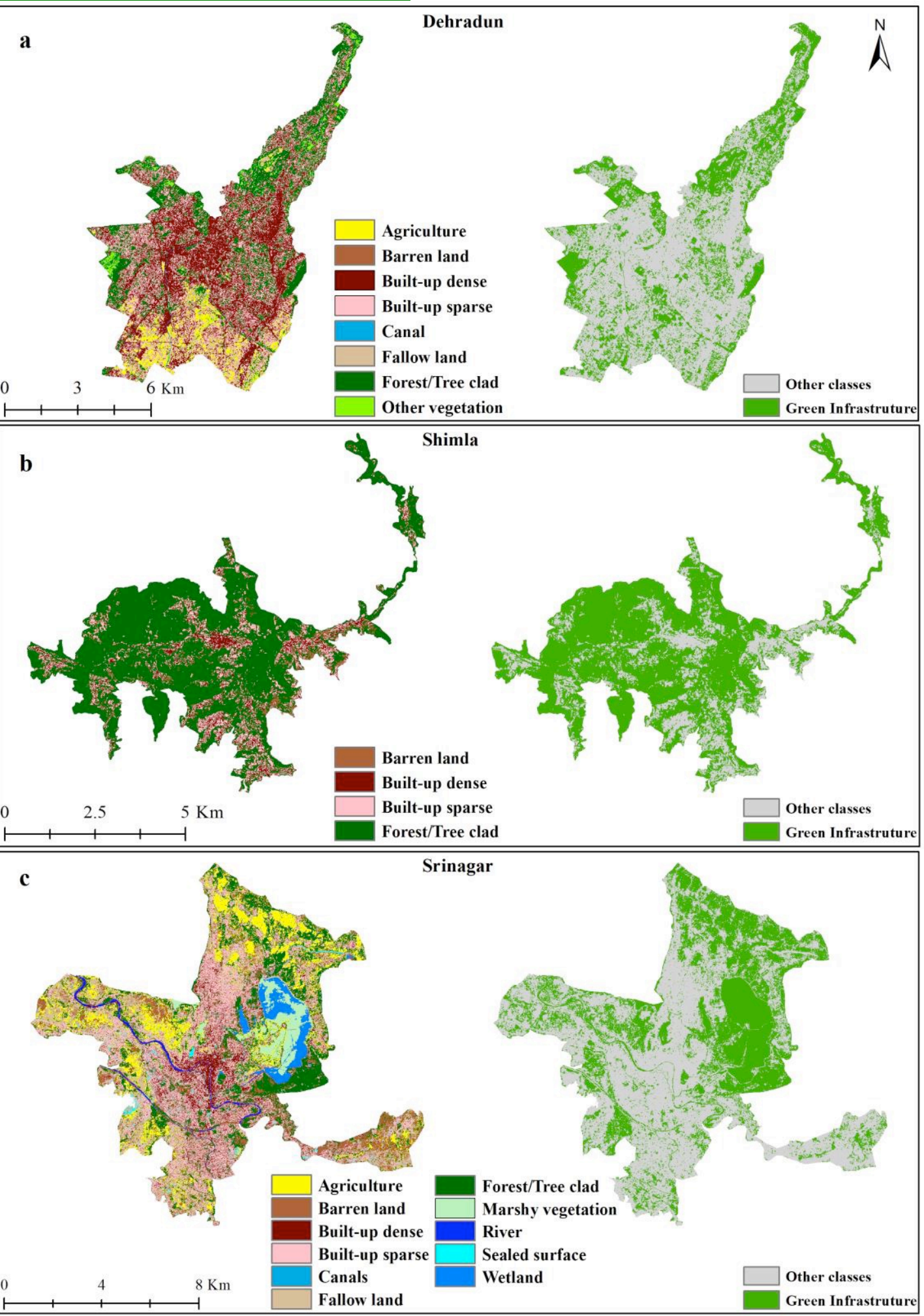
Data requirements	Sentinel-2 satellite data, city shape boundaries, ward boundaries	
Data analysis tools	GIS software	ERDAS, ENVI, ArcGIS, GuidosToolbox, and FRAGSTATS
	Statistical tools	MS Excel, R statistical package and SPSS

Study Region



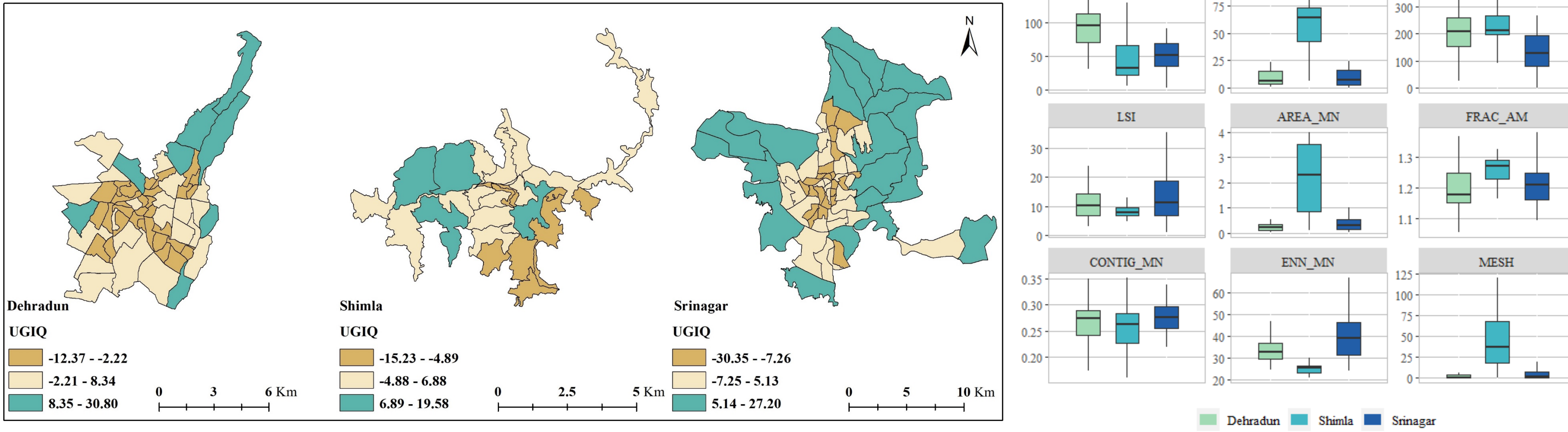
- The cities selected - Srinagar, Shimla and Dehradun represent three of the main urban centers in Indian Western Himalaya.
- Each of the cities is most populous in the respective states and is focal point for economic activity, tourism, urban planning and management..

Results

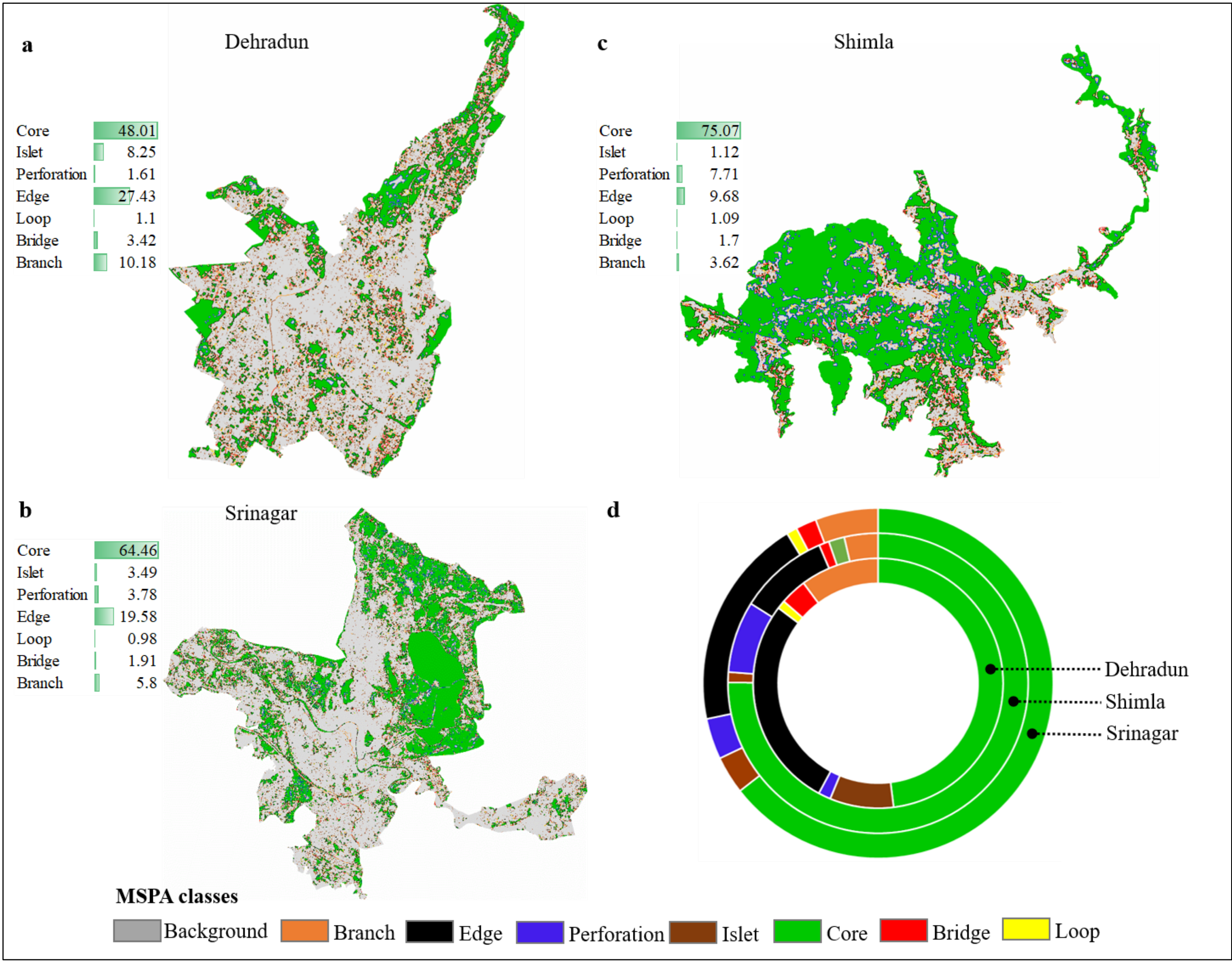


- Classification results obtained are further used to carry out landscape characterization and morphological analysis of UGI.
- General perception of lack of UGI class in the urban core is not true and can be detrimental in future planning of UGI focused on connectivity.
- In terms of spatial distribution, Dehradun has a mix of different UGI patches but is concentrated in few locations.
- Shimla is dominated by intact forest patches which received protection status and thus contribute to maintaining GI across the city.
- Srinagar has a wide variety of UGI classes such as forest/tree clad, river, canals, wetlands, agriculture, and marshy vegetation.

Results



- Spatial patterns of UGI quality are indicative of urbanization pattern in these cities and based on these categories the urban greening efforts in these cities can be upgraded
- Larger cities, Dehradun and Srinagar have similar landscape characteristics to an extent. Shimla, being the smaller and less urbanized city, holds a comparatively less fragmented proportion of UGI seen through the high LPI, AREA_MN and MESH size of the patches



- In all the cities, core and edge class are most prominent, whereas other classes vary according to the city.
- Srinagar has a comparatively better core class UGI than Dehradun, primarily attributed the presence of a huge wetland within the city. Shimla has the highest percentage of core class. Loop and bridge are minimal in all three cities.

Conclusions

- Urbanization has modified UGI structural landscape characters in all the cities. Highly urbanized cities (Dehradun and Srinagar) have severe scarcity of UGI; Shimla is better in quality and structure.
- UGI quality analysis** allowed differentiation of the wards into high, medium and low quality. This provides a tool for concentrating greening efforts in a more scientific way rather than just targeting for the green space area measure in cities.
- MSPA** results are complementary to the UGI quality assessment and can be directly used for urban planning.
- Poor UGI quality in urban center of cities indicate failure to accommodate UGI and this is where this research work would be relevant.