Base Map Preparation with Multi-Source Datasets for Urban Landscape Analysis

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Abstract:

On a global scale, the urban landscape gradients are caused by the geometry or topography of the location. These variations primarily caused by well-predictable topographic parameters are now strongly modified with respect to the changing landscape conditions. In this regard, the base map of any landscape provides a very crucial role, as this varying landscape affects the predictability and manageability of the available resources. The main objectives of the work are to generate an improved base map consisting of required geospatial information for further analysis. These base maps will provide the required information on landforms, roads, landmarks, political boundaries etc. to provide a platform for overlaying additional thematic information or layer. It will form the basis as well as the primary building block for generating any map. With the development of technologies, these maps were then re-drawn over large scales in the digital form with the use of cartography and further digitization process come into place. In this proposed method

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of the base maps generation, a new innovative method has been introduced to generate more reliant and accurate base maps, as these methods encompasses the multiple data sources including surveyed data, ground truth data, aerial, satellite imageries with coarse resolution etc. using ArcGIS 10.x software. The current paper also proposes to utilize the datasets from crowdsourcing for the better urban landscape analysis.

Keywords: *Base-Map, Crowd-Source, Multi-Source, Landscape, Urban Analysis.*

Introduction:

In the developing countries, urban areas cover most of the world's population and this increase in urban sprawl is resulting in degradation of the environment with worst air and water quality, inefficiency in the transportation system, shortage of housing and much more, transforming various land use into urban land.[1] The urban landscape needs to be analyzed for the proper planning of urban area so as to obtain sustainable management of all the resources present on the surface.

For such analysis, the most important and primary approach is the base map generation. The map contains all the geographic / reference information of an area using which the location on a map can be oriented. It provides the foundation as well as the initial building block for map generation and depicts the information regarding landforms, waterways etc. over which thematic information is overlaid. In this paper, base maps are generated through various sources and are compared to accomplish the better and more relevant base map with appropriate information. This is performed by digitization using remote sensing or GIS techniques and also the open source data, Open Street Map (OSM) is suggested to prepare a base map at the block level. This is the no-cost data that can be used by anyone for their respective purpose in comparison of the other geoinformation available to access.

The work had the following objectives to be achieved:

1. To explore the multiple sources for the base map preparation.
2. To study the urban landscape.
3. Base map preparation for landscape analysis.

Software/Datasets Used

a. ArcGIS 10.x software is used for digitization and further base map generation processes.

b. Sentinel Satellite Imagery of 10m resolution is proposed to overlay the respective layers to see the relation to the real world and also for the accuracy check of the layers generated.
c. Open Street Map data is used as it is the crowdsourcing data with all freely available shapefiles required for the base map preparation.
d. Toposheet 1:50,000 (Source: Survey of India) has been taken to show the traditional map study and digitize the Delhi state boundary.

Study Area

Delhi, Capital of India covering 1,484 square km area is the metropolitan and most populated city with over 16.6 million population, which is the second most populated city in India after Mumbai and most massive in North zone. In this paper, the base map preparation for landscape analysis is done on Delhi state located between 28°52'58"N, 76°50'E and 28°24'36" and 77°21'E so as to analyze the unplanned urban spread affecting other features present on the land surface in that particular area. The study area is shown in fig. 1.

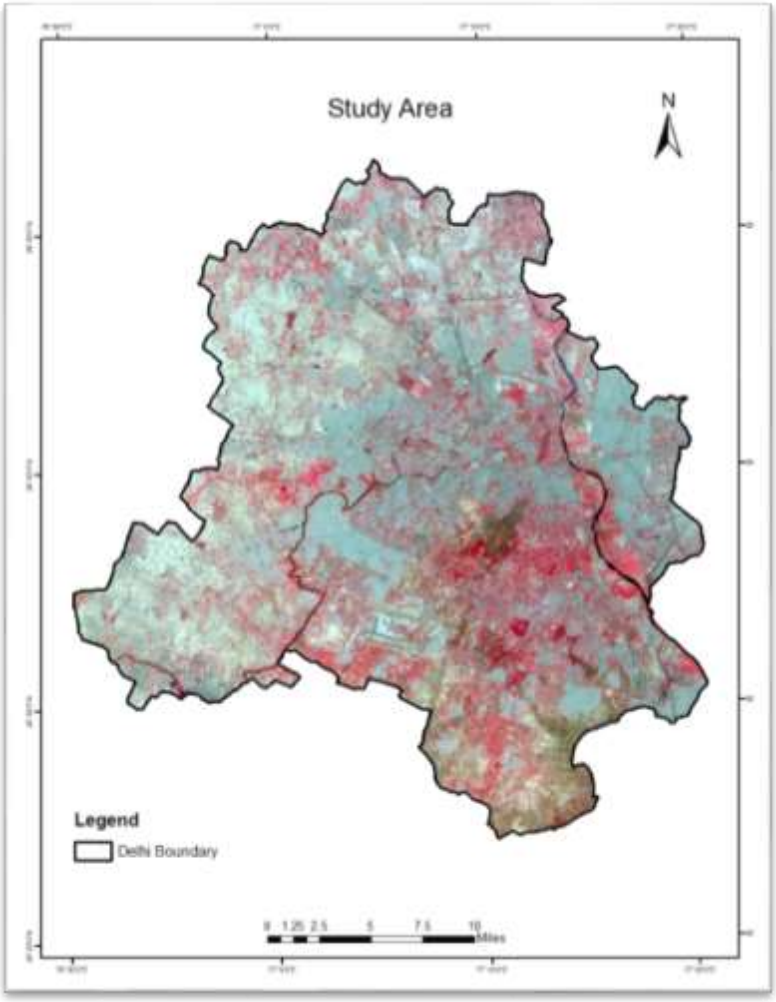

Figure 1: Location of Study Area

Methodology:

Data Used

A moderately detailed land cover map was required for the study, so data retrieved from Sentinel 2B was brought to use.

Table 1: Specification of Sentinel 2B

Number of Bands	13
Spatial Resolution	10m, 20m and 60m
Field of View	290kms
Instrument	MSI- Multi Spectral Instrument
Revisit (Days)	5- under same viewing angles

Table 2: Specification of Sentinel 2B data

Specifications	**Years**	
	2018	**2017**
Date of acquisition	2018.06.19	2017.03.21
Platform	Sentinel 2B	Sentinel 2B
Orbit	105	105
Datum	WGS84	WGS84
UTM Zone	43	43

Table 3: Specification of LANDSAT 8 data 2015

Date of acquisition	2015.11.11
Map Projection	UTM
Datum	WGS84
UTM Zone	43

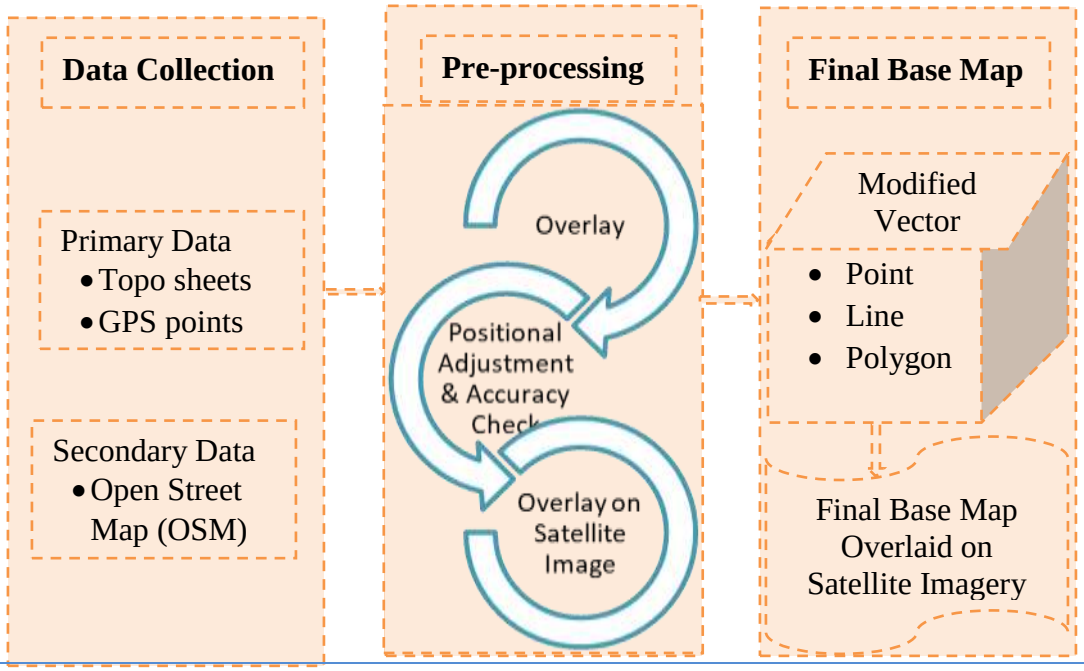

Figure 2: Flowchart of the Comprehensive Methodology

Data Collection

For the study two types of data are collected:

1. **Primary Data:**
   In this type of data, we have obtained toposheets of 1:50,000 scale and the GPS points from the field. All the toposheets are then georeferenced to relate with the ground surface and mosaicked to digitize the boundary of the study area. Some blocks of the city, resulting in polygon/area vector file are further digitized and GPS points are also exported to ArcGIS resulting in point shapefile.
2. **Secondary Data:**
   In this type of data, OSM data is obtained. Here data is downloaded and extracted from Open Street Map which is then converted into shapefile providing block-level data (polygon/area), point and polyline vector files denoting buildings, roads etc. Since the following data is collected from the other source, therefore it is considered as secondary data.

Pre-processing

Both the primary and secondary data obtained from different sources are processed and then both these layers are overlaid on each other to compare the positional distortion among them. Further, positional adjustment and accuracy check is conducted on the same to check the percentage of the accurate product obtained from the two and further re-checking is done by overlaying the vector files on the satellite imagery.

Final Base Map

The modified and accurate vector layer obtained after the processing and comparison of multi-sources used for the base map generation is presented in three shapefiles altogether: point, line and polygon and the final base map obtained from this is then overlaid on the satellite imagery.

Result

Base map generated using Topographic map is shown in figure 3.

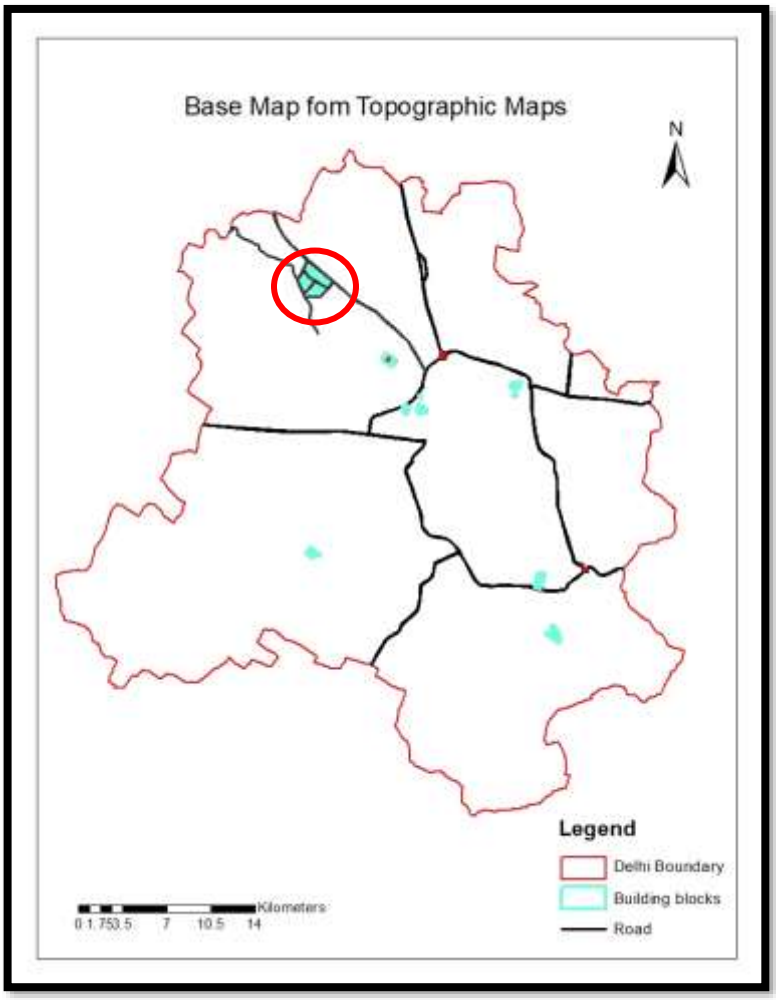

Figure 3: Base Map generated from Topographic Map

The base map is then overlaid on the satellite imagery. The red circled part in fig.3 is enlarged & show in fig. 4.

Figure 4: Base map from topographic map overlaid on imagery

The base map generated from Open Street Map data is shown in figure 5.

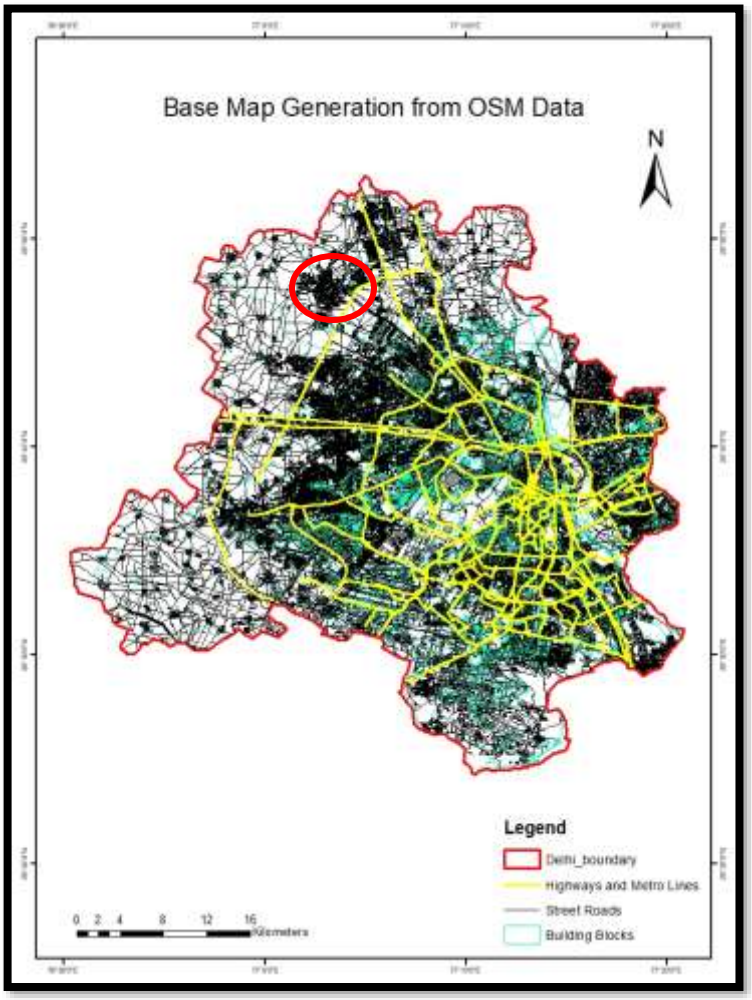

Figure 5: Base Map Obtained from Open Street Map

The base map obtained from open street map is then overlaid on imagery and the red circled part shown in figure 5 is enlarged and all the vector files including blocks and roads are shown in figure 6.

Figure 6: Base Map Obtained from Open Street Map overlaid on imagery

Base map obtained from OSM data containing all geographical information in vector forms of point, line and polygon is finally overlaid on Sentinel imagery and is considered as the more accurate result and is very time efficient with no cost accessibility. So final base map prepared is overlaid on satellite imagery, Sentinel after the accuracy check and is shown in figure 7.

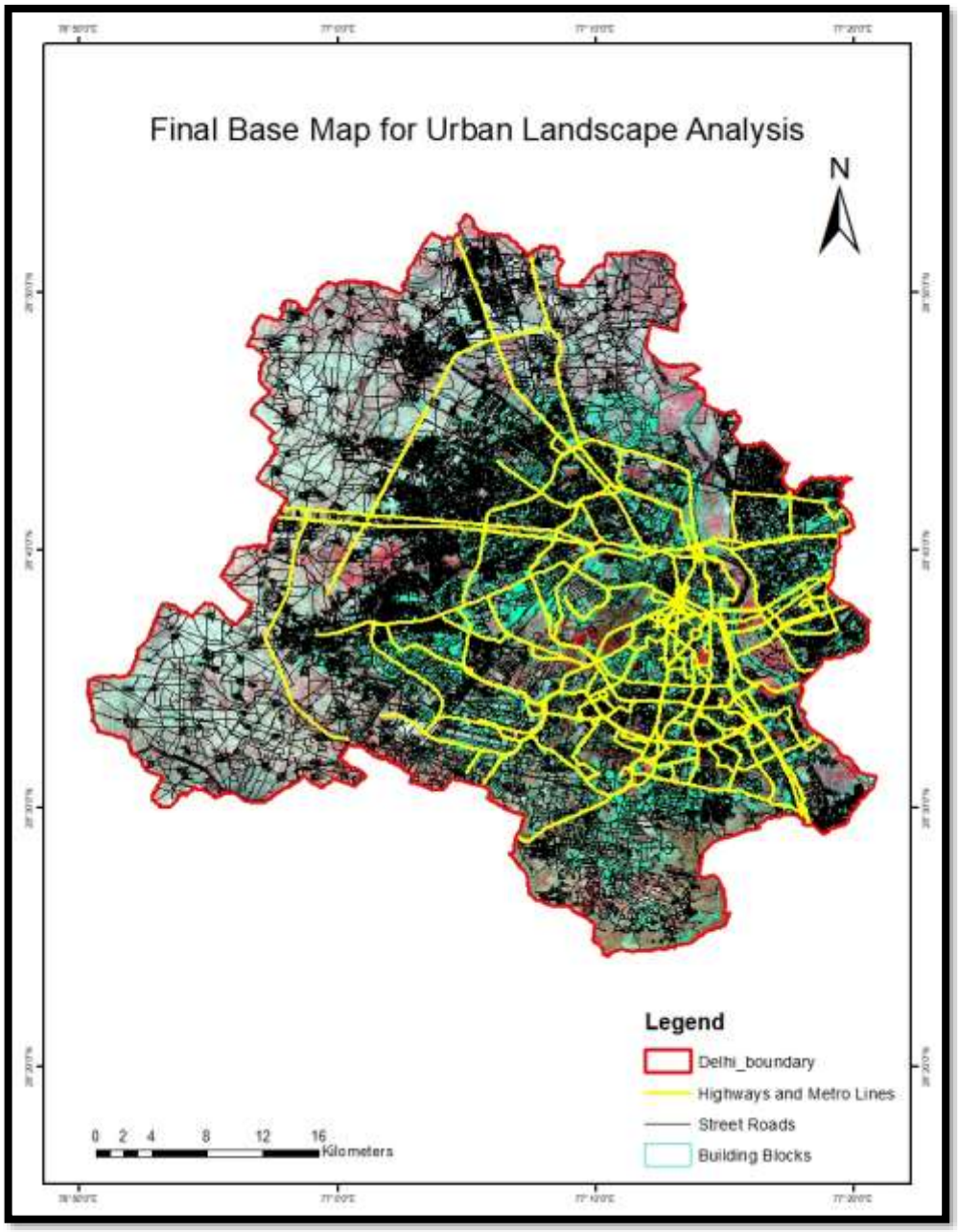

Figure 7: Final Base Map

Conclusion:

This paper deals with the existing challenges of reliable or up-to-date data, where the availability of geographic information is not easy for access. This approach is mostly the automated approach for mapping land use at a larger scale. This paper results in favor of the crowdsource data to efficiently handle the large dataset with recently updated geographical information.

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