

## Bridging the gap between the existing and the necessity: Role of geospatial technology in decentralized planning

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### Abstract

Despite concerted efforts to improve database, problems regarding availability and organization of data especially in a developing country like India continue to persist. In this context, building reliable and accurate database enabling information flow is indispensable for planning and monitoring of various government schemes. The available database in India is not fully geared up to support the local level decision making processes due to major problems like inadequate accessibility to geospatial data by user agencies, non-availability of data of desired resolution and currency and lack of user friendliness in geospatial data processing. In view of the above, the study is undertaken to demonstrate the huge potential of geospatial techniques of RS, GIS and GPS in formulation of strategies and its implementation and monitoring for sustainable development. This is done by building the database for a part of Cuttack Municipal Corporation and its suburban areas. While the GPS was used for positional accuracy of various ground control points, the acquired satellite image, top sheets and other secondary maps were geo-coded and digitized for the generation of various thematic layers. These extracted thematic layers and collected attributes can be used to build topologies between different natural and cultural features which can be analysed and used by the stakeholders in their decision making endeavours.

**Keywords:** Geospatial, Remote Sensing, GIS, GPS, Database.

### 1. Introduction

Despite significant strides made in the field of industrialisation and rapid urbanisation over the last few decades, nearly six-tenths of population still resides in the rural areas. Therefore, provision and maintenance of basic services and infrastructure to the rural dwellers assumes prime significance planning processes for sustainable growth and development of the economy of the country. The urban centres of the country more so in Odisha are facing acute space scarcity towards for further development. In the wake of growing population these urban centres are expanding beyond their boundaries, a process often termed as 'urban sprawl'. This needs appropriate supervision and administration. For the sustainable growth of these cities, the need of the hour is to up-date, coordinate and integrate database for information sharing between various government, private and public institutions. This will undoubtedly help in the proper planning, execution, monitoring and policy making decisions. In other words, the existence of a spatial database for the suburban and rural areas becomes a necessity rather than an option. Geospatial or geo-coded database which includes explicit geographical positioning of particular attributes becomes an integral input of planning strategies (Bedard, 1999) [5]. In this context, geospatial technologies of Remote Sensing, Geographic Information System (GIS) and Global Positioning System (GPS) assume utmost significance in building the geospatial database for these targeted rural areas.

While the technology of remote sensing has brought a boon in collecting enormous volume of unbiased spatial data within determinable accuracy and precision, GIS gives the power of managing, analyzing and displaying these collected data in a very efficient manner (Batini, *et al* 1992; Sheldon, 1993;

Elmasri and Navathe, 1989) [4, 11, 6]. Spatial geographic positional accuracy is added to all these collected and analyzed data with the help of GPS. Moreover, with the advancement of the technology it is now possible to make all these spatial information available to not only decision makers located at different places but also to the common users on the web platform of internet (Abdelmoty *et al*, 1993; Abel, 1989; Abdelmoty 1993) [1, 3].

#### 1.1 The Present Study

In view of this, the present study intends to demonstrate how geospatial database for the Cuttack urban and adjacent suburban localities can be built to help plan, manage and monitor various development activities. This forms part of a project financed by the Department of Science and Technology, Government of India. As a part of this project, a pilot study was undertaken in one Ward of Cuttack Municipal Corporation (CMC) and its adjacent suburb to include both urban and u rural land-use. The present article reports the geospatial database built for the pilot study area as a precursor to that of the CMC and its suburban provinces.

#### 1.2 Objective

The main objective of the study is to demonstrate the potential of remote sensing and GIS & GPS in creating a geospatial database for decentralized governance of a city and its suburban areas taking Cuttack as an example. The main focus, therefore, is on methodological framework towards building a geospatial database for urban-local bodies. In order to meet the objective a pilot study has been carried out in Ward No. 3 of Cuttack Municipal Corporation (CMC).

## 2. Study Area

The present pilot study area i.e. Ward 3 forms the westernmost part of the city of Cuttack and is one of the 59 wards that comes under the jurisdiction of CMC, Odisha. The spatial

extent of the study area is approximately from 20° 28' 33.10" to 20° 29' 32.43"N latitudes and 85° 46' 38.50" to 85° 49' 29.10"E longitudes and covers an area of approximately 4.09sq.km. (Fig.1).



Fig 1: Location of the pilot study area Ward 3, CMC, Odisha

The study area is in fact sandwiched between the rivers of *Kathajodi* a distributor of *Mahanadi* on the south and *Mahanadi* on the north. Compared to the other wards of CMC, the present study area is less densely populated and the human habitation is primarily restricted in the eastern part which has witnessed a lot of urbanization and anthropogenic activity. Rest of the study area displays a typical rural environment with most part covered by dense vegetation, barren land and isolated scattered huts. A prominent paleochannel runs across the study area in a SW-NE direction and divides the region into two halves. The expansive urbanization of the CMC is witnessed in the central t of the Ward where the planned plots for new settlements can be recognized from the satellite imagery. Because of the two rivers bordering the study area on three sides, extensive earth embankments can be seen along the periphery of the Ward.

## 3. Methodology

The creation of the geospatial database for any region involves both primary and secondary sources of data. In the present case, primary source of data involved the establishment of ground control points (GCPs) for the pilot study area which were then used for geo-coding of all the collected maps and related attribute information along with the acquisition of positional information of various physical and cultural features. In this regard a preliminary reconnaissance survey of the study site was carried out using Survey of India (SOI) Toposheet number F45T15 with a scale of 1:50,000. For this the assistance of some local people was also taken. The survey established possible site locations for the establishment of GCP. The tentative locations thus identified are primarily permanent and static in nature pertaining to various natural and manmade objects such as intersection of major roads, old monuments (fort) etc. The final selection of GCPs from possible site locations was based on the presence of the concerned features on the collected maps. Primary data

collection involved extensive field visits and use of the technology of Global Positioning System (GPS). Secondary sources of information involved the acquisition of geospatial maps and attribute data from various government and non-government agencies. The organizations which were visited for this purpose were Cuttack Municipal Corporation (CMC), Public Health Department (PHD), Public Work Department (PWD), Settlement Office, District Education Office, Cuttack Development Authority (CDA), District Information Office (DIO), Bharat Sanchar Nigam Limited (BSNL), office of the Superintendent of India Post, State Transport Authority Office, office of the Superintendent of Traffic Police, Chief District Medical Office (CDMO), Central Electricity Supply Unit (CESU), Airtel Communication, ORTEL Communication, Reliance Communication, Cuttack Malgadam Association, Chhatrabazar Association and Badambadi Bus Owner's Association. For all the geospatial analysis and logic building the SOI Toposheet F45T15 was used as the base map. This toposheet was georeferenced in GIS environment with WGS84 World Geographic Coordinate System by 1<sup>st</sup> order polynomial (Affine) transformation. For the sake of homogeneity, all the acquired and collected data were geo-referenced with the above coordinate system and transformation procedure. The spatial maps collected from the CMC was used for the demarcation of ward boundaries whereas, other secondary sources primarily furnished various attribute information of the city features and management. All the above gathered information was then spatially analyzed to create various thematic layers of the pilot study area. Creation of thematic spatial features involved the process of manual digitization in GIS environment (Abel *et al*, 1995; Esperança and Samet, 1997; Hjaltason and Samet, 1995)<sup>[2, 7, 9]</sup>. The digitized spatial objects were validated by ground-truthing as well as by visual interpretation of Digital Globe Quick Bird image of Google Earth Web Map Service. The satellite image formed an integral part for the interpretation of

various physiographic and geomorphic units of the study area in conjunction with detailed field survey.

#### 4. Discussion

The geospatial database created for the pilot study area took into account the various physical and cultural features existing

on the concerned landscape. As described earlier (Section II), the urbanization is cardinaly concentrated along the eastern part of the study region. No wonder, cultural features dominate this part with dense road network. The westernmost part is covered with dense vegetation and the central portion of the study area displays the existence of vast barren land.

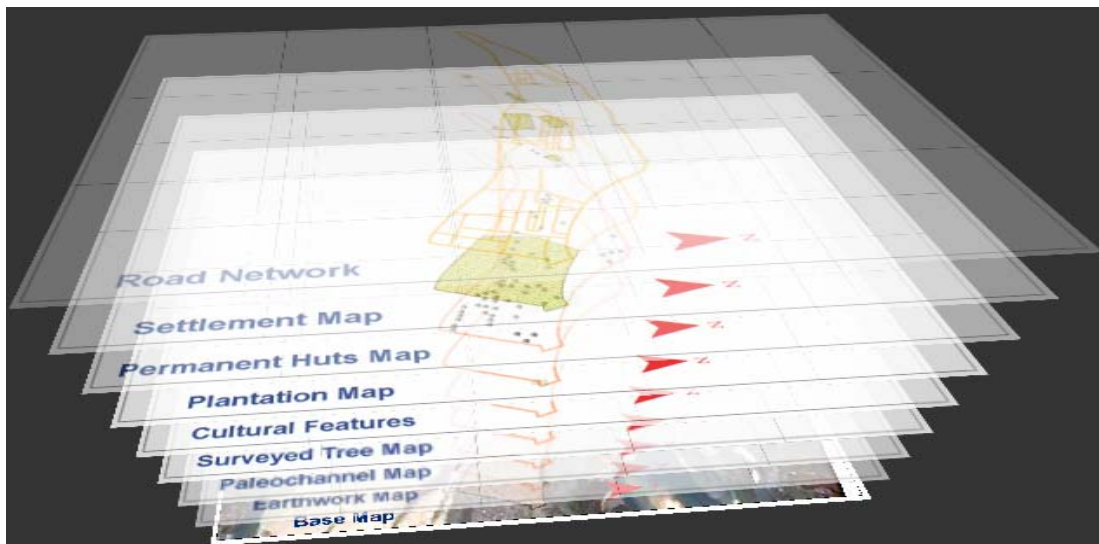


Fig 2: Extracted thematic layers of the study region

Hence the different spatial feature that were extracted from the satellite image as well as SOI toposheet were road network, settlements, permanent huts, plantations, various manmade architectures, surveyed trees, paleochannels and earth embankments. These extracted features formed the concerned thematic layers of the landscape (Fig 2). These extracted features of the study area assume prime importance in decentralizing the planning of the urban activity. Overlay analysis of the features can be used by various line departments for their new endeavours as well as for the proper management of the existing infrastructure. Similarly futuristic development planning of the region can be accomplished by thorough site selection from GIS analysis. The biggest

advantage of this spatial database is the common referencing of all the features with respect to a common base map which is accurate and unbiased. This has a greater impact on the coordination between different institutions. More often than not, it is the lack of proper coordination between various public departments that brings the chaotic nature of city urbanization. However, from the capability of periodic updating of spatial data, the biggest question of urban development i.e. 'where' can be answered. While the topographic map for the region (Fig. 3) of the pilot study area gives an overall synoptic view of the region, the extracted feature layers from GIS analysis gives specific objective oriented solutions that can be utilized for human prosperity.

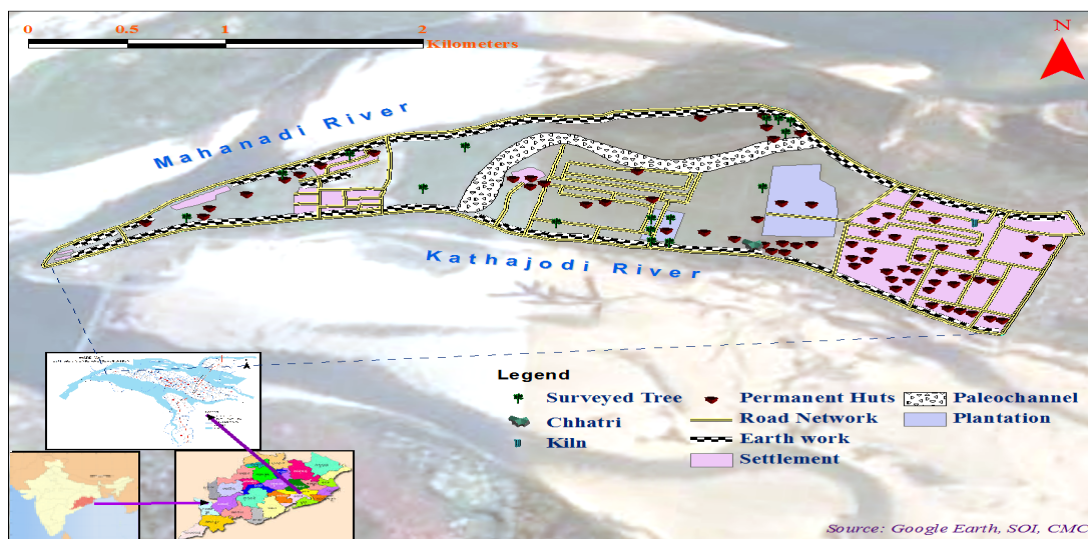


Fig 3: Physical and cultural features of the study area

## 5. Conclusion

Geospatial database creation assumes significant importance in the sustainable development of urban-local bodies. A pilot study has been carried out for the Ward 3 of CMC, Odisha wherein spatial database for the area has been established to add to the different government, private and public entities working for human development. The work establishes various thematic layers of the landscape which significantly portrays a combination of urban and rural environment. Applicability of the database shows enormous potential towards greater coordination and integration between various line departments, planning agencies and public forums. However, the study is with respect to a pilot project area and extension of the research needs to be critically evaluated when applied to a larger spatial entity.

## 6. Acknowledgement

The study is a part of the project awarded by DST, New Delhi. The authors sincerely thank DST for its financial support. They also wish to thank Prof. M.I. Hassan for his valuable comments. Mr. Nihar Ranjan Sahoo and Mr. Subrat Acharya also extended their help at different stages.

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