

# THE URBAN ENVIRONMENTAL ENGINEERING CONDITION OF UDUPI TALUK: A GIS EVALUATION URBAN AMENITIES WITH A FOCAL POINT PREDICTION OF POTENTIAL IMPROVEMENT OF URBANIZATION

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## Abstract:

Urban Environmental Engineering is the application of science and engineering techniques to improve the natural environment to provide healthy water, air, and land for human habitation including infrastructure. The focal point is on the sustainable development of an urban entity where development of industrial and natural resources elevates and sustains energy needs of a civic population. This dissertation is aimed at developing a centralized system to carry out the analysis of urbanization of the Udupi Taluk with inputs from various interdisciplinary fields of demography, commerce, education, industries, health and tourism. To brawl with the problems of environmental degradation and to meet the challenges of sustainable development, it is suggested that the use of remote sensing and GIS in conjunction with geospatial data is of vital importance. There is need for the use of an urban information database that can be formulated using remote sensing data and GIS techniques. This is possible as GIS technology is unique in embracing spatial data of various parameters that could be modeled to bring out a multi-parametric relation in nature. The end result would provide spatial variations in the form of digital maps. These maps and their polygons would be imported in a GIS environment and the results would be used in query-models and thereby establishing the urban development of Manipal and the Udupi taluk. The output would shift the interpretations from single parametric to multi-parametric relation and this would enable the end users such as governmental agencies to pool data and adopt new strategies in dealing with urbanization in a comprehensive manner.

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**Key Words:** Urban Environmental Engineering, Geographic Information System, Spatial Data, Digital maps, Query-models

## Introduction

There is an asymmetrical urban growth, which is taking place all over the world, but the rate of urbanization is very fast in the developing countries, especially in Asia. In 1800 A.D., only 3% of the world's population lived in urban centers, but this figure ranged to 14% in 1900 and in 2000, about 47% (2.8 billion) people were living in urban areas. Statistics show that India's urban population is the second largest in the world after China, and is higher than the entire urban population of all countries put together barring China, USA and Russia.

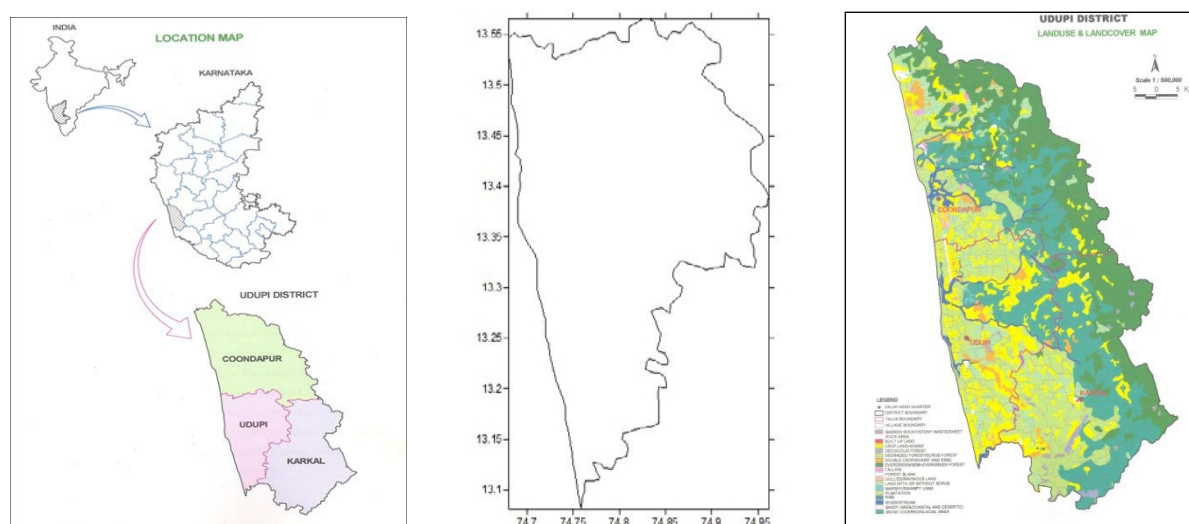
Every major city of India faces the same proliferating problems of urban expansion, inadequate housing, poor transportation, flawed sewerage, erratic electric supply, and insufficient water supplies. The level of air, water, and land pollution has increased because of abysmal environmental management. This has a direct impact on the quality of the urban environment, affecting labor productivity and the overall socio-economic development. The circumstance of the

urban environment all over India is deteriorating so fast that the sustainability of the cities is threatened.

The increasing demands for information in urban planning and management sectors necessitate the application of remote sensing for sustainable development of urban areas. Thus in this context integrated geo-spatial technologies such as remote sensing (RS), geographic information system (GIS) and global positioning system (GPS) can tally up to interactive operations that would be an asset for assessing, understanding, and mapping utility and service facilities, as well as solving complex urban environmental problems. By utilizing remote sensing data and implementing GIS mapping techniques, changes in urban extent can be monitored and mapped for explicit developmental projects. The situation is grave in India due to unplanned growth of the cities in all directions. The current study will prove to be useful to assess some of the urban environmental issues which Manipal and Udupi taluk is currently facing with the help of geo-spatial tools.

### Study Area

Udupi district is a fairly new one, carved out from the erstwhile Dakshina Kannada district of Karnataka in 1997. It lies between  $74^{\circ}34'45''\text{E}$  to  $75^{\circ}12'20''\text{E}$  longitudes and  $12^{\circ}59'40''\text{N}$  to  $13^{\circ}48'50''\text{N}$  latitudes. The district is covered in the Survey of India toposheet references of 48K and 48O series on 1:250,000 scale. **Udupi taluk** is in the Udupi District of the Indian state of Karnataka.



**Figure 1:** Study Area- Udupi Taluk with Geographical Co-ordinates

### Role of Geo-information systems in sustainable urban development

The role of GIS in its decision making power in the field of sustainable urban development seems to be ideal. This would requisite the availability of 'sustainable indicators' to provide a solid basis for the study, which include health, education, employment, air quality, traffic, housing facilities and economic prosperity. Creating a powerful centralized information system describing the data and their locations would be necessary for the grass-root level planning of a city or district.

Remote sensing and GIS could serve as tools for monitoring and updating the changes. Therefore, 'geoinformation technology' is a means to integrate the sustainable indicators for suitable modeling, thereby helping in the evaluation of results and implementing an effective planning of an urban area.

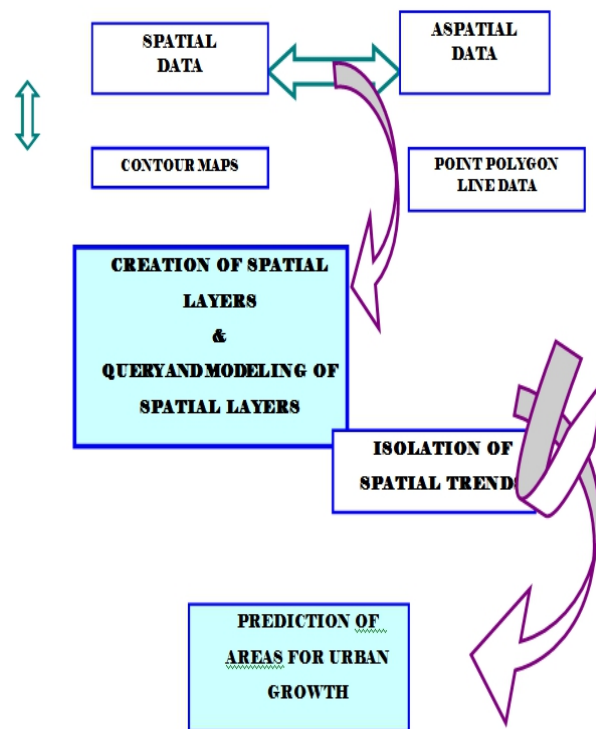
### Objective of the Work

The project aims to appreciate the spatial relations of population, schools, banks, urban facilities, worship places, tourist centers, and how it can be related to effectively managing the environmental resources. The objective of this work is the need to infuse GIS technology in conventional environmental engineering. The end result would provide spatial variations in the form of digital maps. These maps and their polygons would be imported in a GIS environment and the results would be used in query-models focusing on the urban development of Manipal and the Udupi taluk.

## Methodology

The Udupi Taluk map is first digitized and Arc coverage of taluk map, a vector layer of stations and the attribute table are made. Following blanking process in Golden Surfer, the Contour Maps are drawn after gridding the dataset (point, line, area). Also, in this GIS platform, the incomplete polygons of the contour map are completed. In the ArcGIS environment, the selected polygon layer shows the corresponding polygon and its attribute table. All the polygons created are thus made to intersect, depicting all attribute values at once.

Query modeling of the created spatial layers is accomplished by assigning suitable conditions. Multiple queries can be established for the same spatial layer.



*Figure 2:* A Flowchart of the intended project program

## Tools Required

The following is a short-list of details required:

- i. Primary and Secondary data on various spatial parameters.
- ii. Geospatial processing tools are used for fusing and integrating geospatial source content into software applications for the creation and update of geospatial data and information products. GIS software ESRI products such as the following are used:
  - i. ArcView10
  - ii. ArcGIS9.31
  - iii. ERDAS 9.1
  - iv. Golden Surfer 9.8

## Data Collected

For determining the Urban Environmental Engineering status of Udupi Taluk, the data available for adjoining places in the taluk was analyzed. It included information on

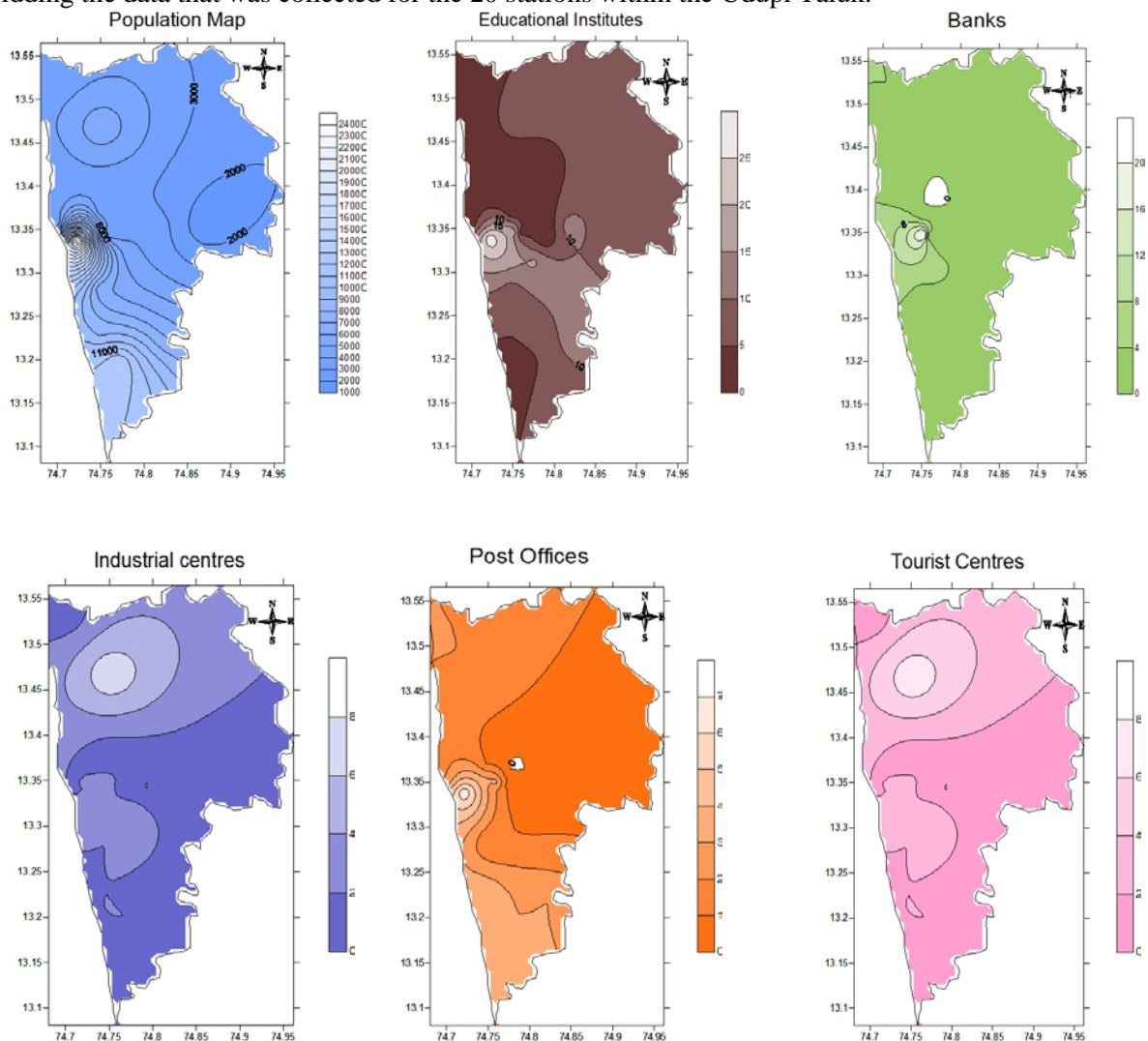
- i. Population statistics
- ii. Industrial networks
- iii. Educational Institutes
- iv. Worship places
- v. Banks
- vi. Post offices
- vii. Tourism centers

### The following 20 stations were identified for data sampling

Manipal, Rajeev Nagar, Indralli, Kalsanka, Saagri, Parkala, Hiriyadka, Badagabettu; Udupi city; Barkur; Katpadi; Shirva; Padubidiri; Malpe; Ambagilu; Kaup; Saralabettu; Alevoor; Kota and Chitpady.

### Results and Discussions

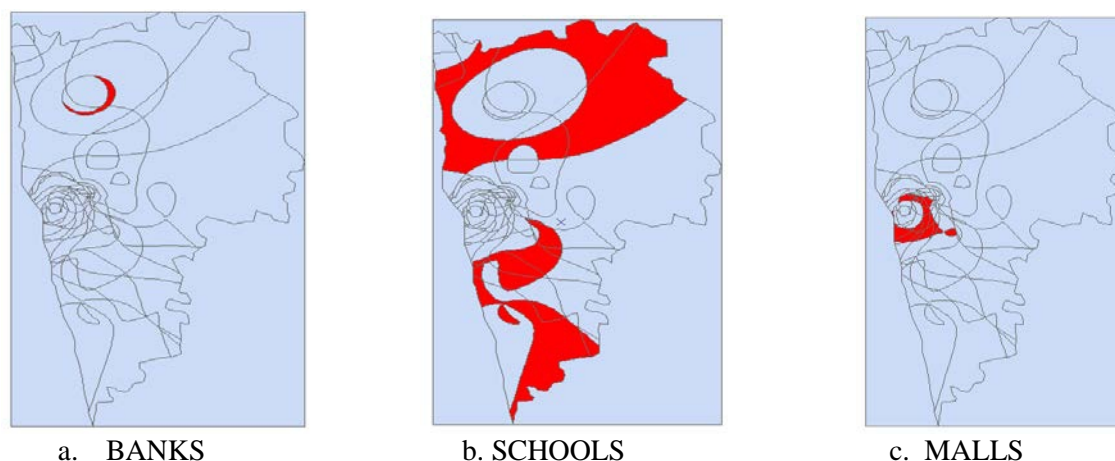
The contour maps for different data were obtained using Erdas Imagine and Golden Surfer by gridding the data that was collected for the 20 stations within the Udupi Taluk.



Query modeling is the most critical step of the study that leads to the prediction of future pockets of growth and development in a town, city, taluk, district, state or country. Querying of the data for different conditions yielded the following results.

- Query 1:* "Population" = '<5000' AND "Industry" = '6-8' AND "Banks" = '<4'
- Query 2:* "Banks" = '<4' AND "Industry" = '2-4' OR "Population" = '9000-13000' AND "Institute" = '5-10'
- Query 3:* "Industry" = '2-4' AND "Institute" = '15-20' OR "Banks" = '16-20' AND "tourist\_pl" = '6-8'

The query will output results that incorporate the required conditions and the highlighted areas shows the corresponding region most suitable to set up the below mentioned urban facility.



### Conclusions

The major problem associated with urban centers in India is that of unplanned expansion. From this study it is evident that using GIS techniques, an assessment of urban environmental issues can be done as they are important tools to map, assess, and monitor the changes in the urban environment. The deterioration of urban environmental quality is due to a combination of a growing population and rising urbanization levels, the consequences of which can be effectively monitored and assessed by using geo-spatial tools. GIS would help city planners to assess and set up urban facilities as per the requirements of the growth of the place. The officials of various government departments should be given thorough exposure and training of GIS for its application and implementation in the urban environmental management plans.

### References:

- Boyd, D.S., G.M., Foody, *Ecological Informatics*, 6(1):25-36, (2011)
- Christine L. Rioux, David M. Gute, Doug Brugge, Scott Peterson, Barbara Parameter, Characterizing Urban Traffic Exposures Using Transportation Planning Tools: An Illustrated Methodology for Health Researchers. *Journal of Urban Health* 87:2, pages 167-188, (2010)
- David Briggs, *Journal of Toxicology and Environmental Health, Part A* 68:13-14, pages 1243-1261, (2005)
- H. Merbitz, M. Buttstädt, S. Michael, W. Dott, C. Schneider, GIS-based identification of spatial variables enhancing heat and poor air quality in urban areas. *Applied Geography* 33, pages 94-106, (2012)
- Javed, A, and Pandey, S “Land Use/Land Cover Analysis for Waste Disposal”, *GIS Development*, 8(6), Delhi, (2004)
- John Gulliver, Kees de Hoogh, Daniela Fecht, Danielle Vienneau, David Briggs, Comparative assessment of GIS-based methods and metrics for estimating long-term exposures to air pollution. *Atmospheric Environment* 45:39, pages 7072-7080, (2011)
- Jones, C. E., Vaughan, L., Haklay, M., Griffiths, S. GIS enhances collaboration: using the line to draw disciplines together. *Proceedings of the GIS Research UK 18th Annual Conference*. ( pp.29-34). London: UCL, (2010).
- Keita Ebisu, Theodore R. Holford, Kathleen D. Belanger, Brian P. Leaderer, Michelle L. Bell, Urban land-use and respiratory symptoms in infants. *Environmental Research* 111:5, pages 677-684, (2011)
- Lata, K M, Sankar Rao, C H *et al.* “Measuring Urban Sprawl: A Case Study of Hyderabad”, *GIS development*, 5(12), (2001)
- Liu, Y., Ellul, C., Haklay, M. Planning Alerts for Community Maps. *Proceedings of the GIS Research UK 18th Annual Conference*. ( pp.363-368). London: UCL, (2010).
- Paskins, J., Bell, S. J., Croxford, B., Haklay, M., Julier, S. Crossing Disciplines to Address Urban Sustainability. *European Association for the Study of Science and Technology (EASST)*. (2010).
- Small K & Song S, Population and employment densities: structure and change. *J. Urban Econ.* 36: 292-313, (1994)