CHAPTER III

DATABASE AND METHODOLOGY

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CHAPTER III

DATABASE AND METHODOLOGY

3.1 INTRODUCTION

Research database is a collection of reliable, accurate, authoritative information gathered together at one place. It provides convenience and quick access to the information. Every research is mainly based on data base. A database is an organized collection of data. The data are typically organized to model relevant aspects of reality in a way that supports processes requiring any information. Database is a backbone of any research work. The quality of data gives accurate results. The research data base involves use of various methods, techniques and tools for the study of urban sprawl. Geographic Information System and Remote Sensing used for to obtain spatial data base.

3.2 DATABASE

The present research work required variety of data. It includes SOI Toposheets, satellite images, and vast literature. The present study is a micro level study covering an entire city. Therefore, the analysis is purely based on qualitative and quantitative data collected from different sources**.** **Primary Data** is collected by field survey method. For that purpose detailed and comprehensive information is prepared and gathered and through interview from the government, non government offices.

Secondary Data is obtained from census handbook, district statistical department and socio- economic review of Solapur district, through the literature available, survey and field knowledge of cities scenario have been used to supplement the qualitative and quantitative analysis of the present study.

Table 3.1
Secondary Data Details for the Study Area

Segment	Type of data	Centre
Spatial data	Toposheet 47 O/14 1:50,000 Cadastral Map 1:10,000 Satellite imagery LANDSAT TM, ETM+ 1992,2002 IRS P6 LIS III 2012	Survey of India Solapur Municipal Corporation (SMC) National Remote Sensing centre(NRSA) ,Hyderabad
Non Spatial Data	Transportation (City Bus Service) Educational facilities Hospitals Fire brigade services Population Data	Solapur Municipal Corporation Solapur Municipal Transport Census Handbook Socio Economic Review

Source: Prepared by Researcher.

3.3 RESEARCH METHODOLOGY

Research methodology is a systematic, theoretical analysis of the methods applied to the field of study, or a theoretical analysis of the body of methods and principles associated with a branch of knowledge. It, typically, encompasses concepts such as paradigm, theoretical model, quantitative and qualitative techniques. (Irny S.I and Rose A.S, (2005) The research methodology does not provide solutions but gives direction for understanding. It also gives which method best suitable for the study. The study of methods is known as research methodology. (Baskerville, R. 1991) "The analysis of the principles of methods, rules, and postulates employed by a discipline is called methodology". (Merriam-webster.com) The present research work covers entire Solapur city. To understand the urban sprawl of Solapur city and its influence on Solapur various methodology are adopted. The research methodology is divided into various parts. These are as Follow.

3.3.1 LIBRARY WORK

The extensive review of literature survey is required for the present research investigation. It includes the published literature, unpublished literature and work, journals, magazines, gazetteers, census handbooks, socio-economic abstracts, Annual reports and some relevant data collected through the website by using Internet.

3.3.2 PRE FIELD PHASE

In this phase major focus is on to understand the concept of urban sprawl and its influence on Solapur city with the help of review of literature. The reviews of literature are related with the urban area, urbanization, urban Sprawl, and its impact on city. The use of advanced technique such as GIS, GPS, and RS are applied in the assessment of urban sprawl. To provide the accurate results and interpretation various maps are required. It includes the Toposheets, satellite imagery, city survey maps published by the Solapur Municipal Corporation etc.

3.3.3 FIELD WORK

The systematic observation and collection of data require field work. Geographical research is now increasingly based on secondary data, but the most research involves the integration of primary, secondary and tertiary data. Thus there is considerable overlap between field survey, remote sensing, GIS, and laboratory techniques. Field research included an element of exploration, acquisition of unavailable data from otherwise know areas, mostly to address specific problems and hypotheses. (Kish Leslie, 1965)

To acquire field data require maps of study area, instruments for measuring and processing and interviewing to obtain primary data. Field work includes the direct observation in study area, interview. It helps to understand the overall view of urban sprawl.

3.3.4 LABORATORY WORK

Laboratory works includes the classification and tabulation of data collected from field work. The collected data from primary; secondary and tertiary sources compiled in tabular form to prepare diagrams and it is used for statistical and

cartographic techniques. This collected data manipulated in Geographic Information System. The Geographic Information System and Global Positioning System provide thematic maps which gives rational and accurate interpretation.

3.3.4 SYNTHESIS OF THE DATA, REPORT WRITING AND SUBMISSION

The data generated during the field work, and in laboratory was studied carefully. The final outcome of the present research analysis used for drafting the thesis.

3.4 DATA PROCESSING WORK

3.4.1 SCANNING THE TOPOSHEETS

Topographical maps for the study area have been obtained from the Survey of India. These Toposheet were scanned for convert in digital format.

3.4.2 NORMALIZATION OF ATTRIBUTE DATA

The attribute data mainly obtained from the secondary and tertiary sources. The using of MS Office 2007 on the data converted into the digital format for the further research.

3.4.3 DEMARCATION AND AREA CALCULATION

The demarcation of urban area and sprawl area calculation maps are obtained from the Solapur Municipal Corporation and digitized with GIS. The assessment study of urban sprawl and built up area calculation, satellite imageries obtained from GLCF through internet. The changing land use pattern and trend of city sprawl is studied through the Remote Sensing and Geographic Information System techniques.

3.5 REMOTE SENSING, GEOGRAPHICAL INFORMATION SYSTEM AND IMAGE PROCESSING TECHNIQUES

An assessment of urban sprawl, three different date's images of Landsat TM 1992 December, ETM+2002 March and IRS LISS-III 2012 January were taken. The wavelength is 0.77-0.86 μm, spatial resolution is 23.5 m and swath width is 142 km.

on the basis of these images study of changing land use and urban sprawl analysis is highlighted.

Digital Image Processing is a technique which involves manipulation of digital image to extract information. The satellite images are manipulated in GIS, this technique is also referred to as satellite image processing. It involves combination of software-based image processing tools.

3.5.1 DIGITAL IMAGE PRE-PROCESSING

The satellite image contains errors in the form geometry and radiometry. The first step before interpretation satellite images rectifies the image. To remove the geometric distortions, radiometric corrections and calibration and noise removal from the image is the pre processing of rectification. (Reddy Anji, 2006)

3.5.2 DIGITAL IMAGE ENHANCEMENT

The image enhancement process involves use of statistics and image manipulation functions. It includes contrast enhancement, histogram equalization, density slicing, spatial filtering, image ratio, principal components analysis, colour transformations, image stacking and image fusion. (Galbaiti L.J, 1990)

3.5.3 DIGITAL IMAGE CLASSIFICATION

Digital image classification process involves automated information extraction and subsequent classification of multispectral satellite images. It also includes statistical decision rules which groups pixels in different feature classes. It is software based technique of image classification. Satellite images classified digitally with the help of supervised type of image classification. RS and GIS are very useful advanced techniques in the urban studies. It helps to identify, detect, demarcate the urban area and sprawl with using the satellite imageries. (rsgislearn.blogspot.com)

3.6 SATELLITE IMAGE PROCESSING

3.6.1 LAND USE/LAND COVER MAP

Land use means the human uses the land for various purposes such as, built-up area, recreation, commercial purpose, and transportation etc. land cover means the area covered by various physical or natural features such as water bodies, forest,

vegetation, hills etc. GIS and RS play vital role in mapping of urban area with rational land use and land cover.

3.6.2 CLASSIFICATION OF LAND USE / LAND COVER

The classification of land use and land cover system through remote sensing data should fulfill the following criteria

1. The accuracy in interpretation of land use and land cover system from remote sensing data should be 85 %.
2. The accuracy of interpretation should be equal in all categories. Such as built up area, vegetation etc.
3. The land use and land cover classification system must be applied in larger areas.
4. The land use and land cover classification system best suitable for remote sensing database for different years.
5. The ground surveys data and enhanced remote sensor data is useful for subcategory of land use and land cover classes.
6. The collection of all categories of land use and land cover data at one place is possible.
7. The land use and land cover data comparison possible in future.
8. The Multiple uses of land should be recognized when possible.

Some of these criteria should apply to land use and land cover classification in general, but some of the criteria apply primarily to land use and land cover data interpreted from remote sensor data. (Anderson, James R., 1971)

National Remote Sensing Agency, Government of India, has devised a generalized and land use land cover classification system with respect to the Indian conditions based on the various categories of earth features, resolution of available satellite data capability of sensors, present and future applications. Table 3.2 shows that the general legend adopted for land use / land cover categories. This system is used for the development of land use /land cover map for the present research work. Table 3.3 shows the appearance of features in false color composite image. It is useful for the satellite imageries interpretation as well as land use land cover classification.

3.6.2.1URBAN BUILT UP AREA

Urban built-up area is defined as land is characterized by buildings, asphalt, concrete, suburban gardens, and a systematic street pattern. It also includes the area under residential, commercial, industrial, transportation, communications. (NRSA, 1991) All places with a municipality, corporation, cantonment board or notified town area committee, etc. All other places which satisfied the following criteria:

i) A minimum population of 5,000;

ii) At least 75 per cent of the male main working population engaged in non-agricultural pursuits; and

iii) A density of population of at least 400 persons per sq. km. is included in urban built up area category. (Census of India, 2011)

3.6.2.2 AGRICULTURAL LAND

The land under the agriculture activities known as agricultural land. It also describes the area suitable for agriculture activities is called agriculture land. The standard classification of agriculture land divides by Food and Agriculture Organization of the United Nations into the following components, with their respective global land area in 2009. (Hussain Majid, 1996)

- **ARABLE LAND** The area under the annual crops, like, cotton, cereals. This land also includes land left temporarily fallow.
- **PERMANENT CROPS** The area under continuously plantation. It involves Orchards and vineyards
- **PERMANENT PASTURES** The areas under natural grass and area under grazing for livestock.

3.6.2.3 FALLOW LAND

The land that is not seeded for one season. The land plowed and unseeded for a season is known as fallow land. Land that has undergone plowing and harrowing has been left unseeded for one or more growing seasons. (thefreedictionary.com)

3.6.2.4 WASTELAND

The land area under uncultivated and barren. The Land area which is devastated and neglected is known as waste land. The area, which is useful for vegetative cover but not used, is called as wasteland.

3.6.2.5 WATER BODIES

The area under permanently water covered is known as water bodies. It includes oceans, seas, lakes, smaller pools of water such as ponds, wetlands. Rivers, streams, canals and other features of water from considered as water bodies. (Mitsch W.J and Gosselink J. G, 2007) These water bodies are natural as well as man-made. Reservoirs, canals, dams are the examples of man-made water bodies.

3.6.2.6 WET LAND

The area under saturated water is known as wetland. The water table is above the surface area for some time or a season. Wetland includes swamps, marshes, mudflats etc.

3.6.2.7 BARREN LAND

Barren land is defined the area under thin soil, sand, or rocks. Barren lands include dry salt flats, deserts, beaches, sand dunes, exposed rock, strip mines, quarries, and gravel pits. Barren land has some time sparsely vegetative cover. The barren land is dry throughout the year with few trees, shrubs. (dictionary.reverso.net)

3.6.2.8 TUNDRA LAND

Tundra land is area of treeless region. The term also applied to the area beyond the limit of the boreal forest and above the altitudinal limit of trees in high mountain ranges.

3.6.2.9 PERENNIAL SNOW OR ICE

The area under continuously snow covered is known as perennial snow area. The snowfalls in winter season remain constant throughout year without melting. The continuous snowfall results the formation of glaciers and icecaps.

Table 3.2

Land Use and Land Cover Classification System

For Use with Remote Sensor Data

Level I	Level II
1 Urban or Built-up Area	Residential Area Commercial and Services Industrial Area Transportation, Communications, and Utilities Industrial and Commercial Complexes Mixed Urban or Built-up Land Other Urban or Built-up Land
2 Agricultural Land	Cropland and Pasture Orchards, Groves, Vineyards, Nurseries, and Ornamental Horticultural Areas Confined Feeding Operations Other Agricultural Land
3 Rangeland	Herbaceous Rangeland Shrub and Brush Rangeland Mixed Rangeland
4 Forest Land	Deciduous Forest Land Evergreen Forest Land Mixed Forest Land
5 Water	Streams and Canals Lakes Reservoirs Bays and Estuaries

6 Wet land	Forested Wetland Nonforested Wetland
7 Barren Land	Dry Salt Flats Beaches Sandy Areas other than Beaches Bare Exposed Rock Strip Mines Quarries and Gravel Pits Transitional Areas Mixed Barren Land
8 Tundra	Shrub and Brush Tundra Herbaceous Tundra Bare Ground Tundra Wet Tundra Mixed Tundra
9 Perennial Snow or ice	Perennial Snowfields Glaciers

Source: National remote sensing Agency (NRSA), Hyderabad, Government of India.

Table 3.3
Appearance of Some Feature in MSS – FCC

Object	Colour in FCC
Healthy Vegetation	Red
Crop Area	Pink, Brown and Bright red
Wet Lands	Bluish to red
Fallow land	Yellow
Evergreen forest	Dark red to bright red
Deciduous Forest	Brown to red (refer to local season/ rainfall)
Scrub	Light brown with red patches
Urban /built up Area	Bluish green or blue mixed with red and white
Cloud / Snow	White
Shadow	Black
Clear water/ Deep water	Dark blue / Black
Silt / Disturbed water	Light blue
Reservoir water	Black / Dark blue to light
Windblown sand	White to yellow
Rock out crop/ Bare rock	White
River sand	White to bluish green

Source: -NRSA (1999) satellite data product from NRSA data centre, Hyderabad.

3.7 URBAN SPRAWL ASSESSMENT AND DEMARCATION

The Urban Sprawl pattern, direction and Assessment based on the Maps prepared using toposheets and satellite imageries. For the demarcation and measurement of urban sprawl Shannon's Entropy is applied.

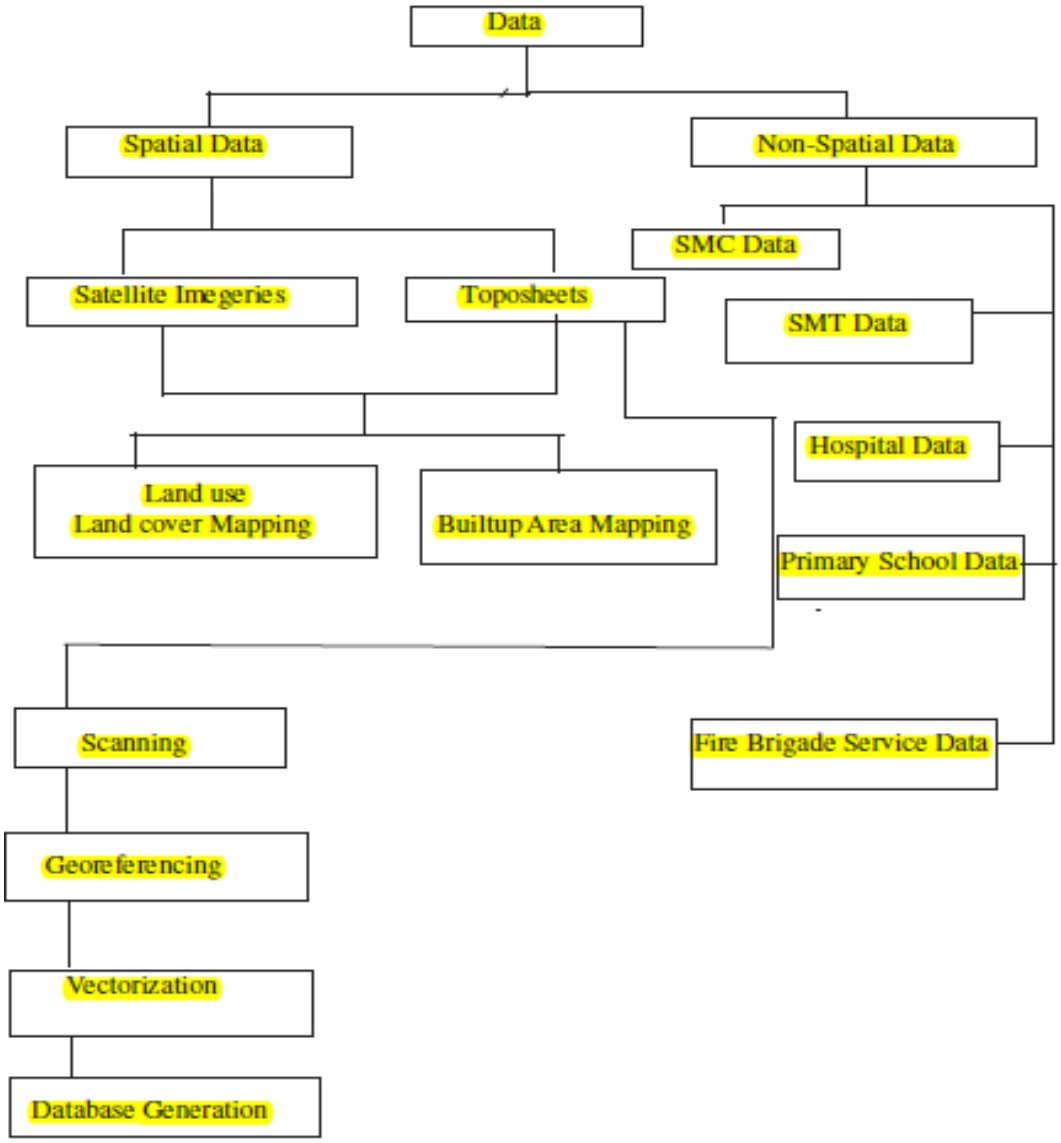
3.8 RESEARCH MATRIX

A research matrix is an analytical tool to help organize the information for research work into suitable manner. Table 3.4 shows research matrix outline of present work.

Table 3.4
Research Approach, Details of Data Sources,
Modes of Measurement and Method of Analysis

Research Objective	Research Approach	Data Sources	Tools and Techniques	Mode of Measurement	Method of Analysis
To study urban area in Solapur city	Exploratory approach	(Shaksavatsari Granth, City Development Plans)	Toposheets and City extension Maps of study area	-	Reviewing available literature and database.
To study urban sprawl of Solapur city.	Visual image interpretation approach	LANDSAT TM, ETM+ IRS LISS-III 1992,2002,2012 Satellite images	Arc GIS Erdas	Zone wise Built up area measurement is used for urban sprawl.	Shannon's Entropy Method analysis is used.
To find out pattern and directional expansion of urban sprawl.	Visual image interpretation approach	LANDSAT TM, ETM+ IRS LISS-III Satellite images	Arc GIS Erdas	Built up area calculated in each multiple ring	Multiple Ring Buffer Analysis
To study existing land use /land cover using various remote sensing data.	Visual image interpretation approach	LANDSAT TM ETM+ IRS LISS-III - 1992,2002,2012 Satellite images	Arc GIS Erdas	Land use and land cover area measured in sq.km	Land use classification Area wise with details compared to each other.
To study of various civic amenities	Quantitative approach	SMC Data, Census Handbook, Socio Economic Review	Arc GIS	To calculate zone wise city buses, number of fire brigade buses, Hospitals and Primary schools	Zone wise services are studied with Comparative data analysis. Multiple ring buffer analysis
To implement the utility and planning for future Urban Sprawl in terms of services.	Qualitative approach	City Development Plans	-	-	Descriptive Analysis
To study influence of Urban sprawl on Solapur city.	Explanatory approach	Field observation	-		Reviewing available data source with Descriptive Analysis.

3.9 ANALYTICAL FRAMEWORK



3.10 SUMMARY

This chapter consist the database and research methodology for the present research. It includes the library work, laboratory work, field work synthesis of the data, and report writing. It also deals digital image processing techniques and GIS application. The data base contains data processing to data attachment. To monitoring urban sprawl require knowledge of satellite image processing. For the understanding satellite image processing land use land cover mapping interpretation techniques is discussed in this chapter. Research matrix shows outline of present work.

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