

# Remote Sensing and G.I.S.: How it Changed the Traditional Planning System.

Prachi Gupta (M.Arch., F.O.A., Lucknow)  
Prachi2709@gmail.com

**Abstract**— Urbanisation is an index of transformation from traditional rural economics to a modern environment. Today half of the country population lives in cities, due to which the urban population is rising which is increasing pressure on the urban land. Thus, proper planning is required for the city to develop. In India, in the year, 306.9 million Indians (30.5%) were living in nearly 3700 towns and cities spread across the country, and it is expected to increase to over 400 million and 533 million by 2011 and 2021.[4] Remote sensing and G.I.S. is a tool that helps the planners in extracting the data in a systematic manner, timely and accurately. It generates spatial data and provides satellite image and aerial photography which helps in generating data like land use, land cover, transport, energy conservation, infrastructure etc. It is an analytical tool to calculate the growth scenario of a particular place by overlapping the different map layers and creating relationship among different map layers.

**Index terms**- Urbanisation, Urban population, Aerial photography.

## 1 INTRODUCTION

Majority of the population in India resides in the urban environment, so it is necessary to maintain the standards of living of that place. The availability of urban land cover is difficult for planners to find and construct policies because of the ability to monitor the policies, direction of urban growth development of the area.

Urban land cover in the cities / urban areas changes over time and space and it can be updated in the data base of the local government to reflect the current land use of the area. Hence, the traditional method of obtaining the data requires a great time and money. Remote sensing and G.I.S. plays a key role in providing an important source data for urban land use / landcover mapping and environmental monitoring.

Planning is a widely accepted way to handle resource allocation problems. Planning involves intelligence and directions in order to progress public activity related to humans and other resources and development. Hence, there is a great increase in the department for providing information whether urban area or rural area.

Urbanisation is increasing which is increasing pressure on land, urbanisation is a principle of manifestation and tool of growth in development countries. Due to the unplanned growth, it is responsible for many problems which our cities are facing like noise, air pollution, fresh drinking water, traffic issues etc. to decrease such issues technological development should be addressed to these problems caused by rapid urbanisation. Aerial and satellite imagery are incorporated in the modern technology i.e. remote sensing, allows us to collect the physical data and combined with G.I.S., it helps us to analyse the data specially which helps in generating various options and optimizing the whole planning process.

This system also offers interpretation of physical data and socio-economic data, which provides special linkage in planning process and making it more viable. Finally, it is important to know, about the characteristics and capabilities of remote sensing and G.I.S. available to urban planners.

## 2 MASTER PLAN APPROACH

Master plans help in working about the requirements of land and infrastructure for various urban / rural areas and help in allocating land for various harmonies and sustainable distribution of activities within an area and provides a form and structure with which they can perform their economic and social activities. The purpose of a master plan is to promote growth and guide and determine the present and future generation development for next 25 – 30 years.

The plan helps as a guide to the physical development of the area, involves long term planning. It encompasses all the physical functions such as transport, land use, housing etc for a community to work.

## 3 TRADITIONAL METHOD USED BY PLANNERS

Till G.I.S. and remote sensing was introduced it was difficult for the planners to plan an area. Due to improper planning many urban and rural areas have been created as mess. Due to migration from rural to urban areas, it resulted in housing shortage and urban areas were congested due to this park, open areas, urban areas, recreational areas etc started lacking. To get rid of this condition and for welfare of the citizens in respect to health and comfort there was a need a city to be planned i.e. master plans.

Making of master plans require geographic information of the area. The information was extracted from topography, Land use, cadastral map, soil type, physical infrastructure, industry commerce, vegetation etc. Traditional methods use old topographic maps, and physical survey, which could not incorporate. Survey of India (SOI) maps and ground surveys were used in traditional style of master plan. Due to visual error there were drawbacks in the maps and maps were limited to a single scale. It simultaneously took lot of time and money to do this, due to increased time there was a gap between the actual condition of the area and the proposed plans.[5]

#### 4 MASTER PLAN AND REMOTE SENSING APPROACH

Remote sensing helps in the analysis of urban growth trend like land use and land cover mapping. With the help of temporal data provided by the satellite, change in land use pattern can be studied. With the help of this the overall sprawl of the city can be monitored and it helps in analysing the different types of land use on the ground level.

Satellite images received with the help of remote sensing helps in development of the infrastructure. It provides an imaginary view of the area in a high spatial resolution format. In the recent years, remote sensing has brought an output in providing high resolution data. It helps in mapping cadastral map, land use map, urban sprawl, etc. The data received can also be used in 3-dimensional for analysis, it helps in generating the building height. It helps to receive data of the same area over different time and also helps in providing information during the disaster period.

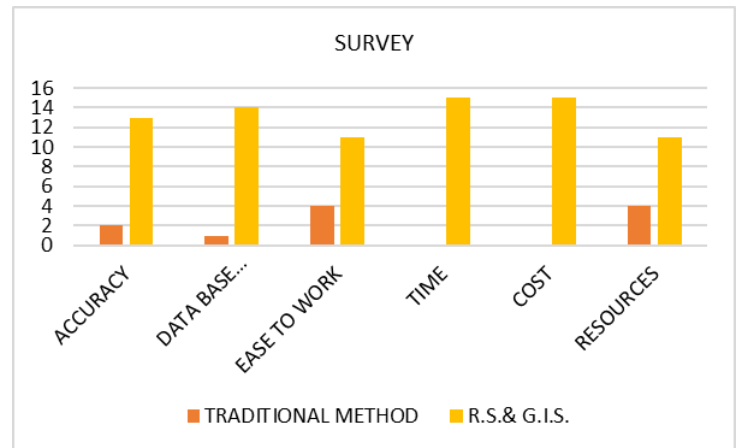
#### 5 MASTER PLAN APPROACH WITH G.I.S.

Geographical information system uses non-spatial attributes associated with spatial attributes. It consists of bulk of data which should be properly stored and managed which help in analysing at different level. The images received with the help of remote sensing can be viewed at different scale irrespective of the image received. G.I.S. has overlapped the traditional method of urban planning because it helps in data accuracy, integrated data management, easy to update the data, monitoring the area, creating and retrieving multiple files with the help of overlay mapping. It helps in providing information which helps the planners in analysing, making decision and planning processes. G.I.S. has included data management system, spatial analysis, monitoring and decision making. It provides the data in the form of maps and tables, figures which can be easily understood.

#### 6 COMPARISON BETWEEN TRADITIONAL MASTER PLAN APPROACH AND MASTER PLAN APPROACH THROUGH R.S. & G.I.S.

Traditional urban planning methods consist of rules and procedures which were based on planning values, which were derived from the experiences of the planners thus resulting that the planning proposals were not subjective and even sometimes biased. In the traditional master plan approach, the plans were prepared by the visual surveys due to which errors occurred as how much a person can visualise and compute it on a paper. As this method was based on visual interpretation, the data were not accurate, it was time consuming, costly, data management was not an easy task. A huge area of land can not be planned over a single unit, small patches planning to be carried out which was the major issue to the planners at the time of merging the plans.

In developing countries, the complexity of urban development is so dramatic that it needs special attention at both micro and macro level. After the introduction of remote sensing and G.I.S. in the field of planning has helped the planners. Data extracted with the help of remote sensing and G.I.S. are more accurate and it provides real time data, easy to understand, data base management is easy and the data can be stored in different copies, easy to work for a large area of land, time and cost efficient.



#### 7 APPLICATION OF REMOTE SENSING AND G.I.S. IN URBAN PLANNING

In India, the condition of urban development is so pathetic that it requires a special attention, physical planning of cities and towns at micro and macro level, because of such reasons it is important for planners to fuse remote sensing and G.I.S. with urban planning.

Traditional techniques were inadequate tool to deal with metropolis. So, it requires to attain new tools and techniques. Till 1970's maps like – topography, land use, cadastral, flood hazards etc and land surveys were used for urban studies. But in new technology digital, multispectral images acquired by the sensors are used.

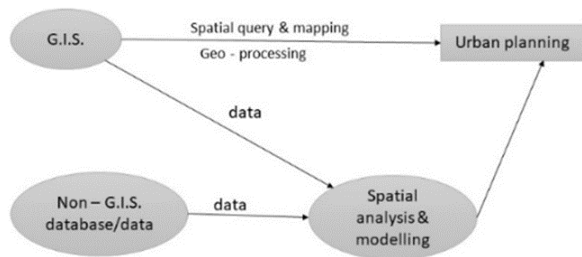
The first remote sensing data began in the first-generation satellite sensors such as Landsat MSS and was given impetus by a second-generation satellite: Landsat TM and SPOT. The third generation has a spatial resolutions satellite sensor. The high-resolution data of IRS 1D PAN III, LISS III and RESOURCE-SAT – I can be merged together for effective urban studies and are useful in analysis.

Due to the advancement in technology it has brought a miracle in the availability of higher resolution satellite imageries. For example: IRS – P6 resource-sat imagery with 5.8m resolution in multispectral mode, quickbird imagery with 6.1 m resolution in panchromatic mode, CORONA with spatial resolution of 4.5m etc. Cartographic resolution IRS -ID – LISS IV (P-6) data is of great value in cadastral mapping, national topographic data base, planning and other G.I.S. applications needed for urban area study. [4]

The satellites generally provide information up to 1:5000 scale and will be useful for making contour map (NRSA – 2005). The output of remote sensing is an image representing a scene being observed. New techniques are required for digital image processing and modelling to extra information from image. Since, remote sensing cannot provide all information, so it requires other spatial attributes from different sources which are fused with remote sensing data. This fusion of data is analysed through a technique of G.I.S. It is a computer assisted system for capture, storage, retrieval, analysis and display of spatial data and non-spatial attribute data. The data can be extracted from alternative sources like survey data, different maps etc.

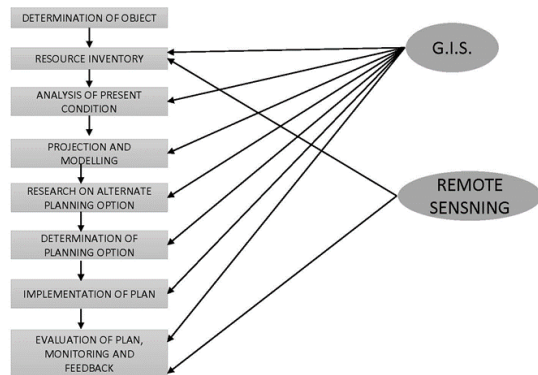
G.I.S. techniques play a vital role in facilitating integration of multi – layer spatial information with statistical attribute data to arrive at alternate developmental scenarios. It is an analytical tool, to calculate the growth scenario of a particular place by over

lapping different maps and creating relationship among different map layers. The data collected is not only helpful in representation but also helps in the analysis and generating an output which is helpful for planners in planning. [3]



Relation between G.I.S. and urban planning [7]

## 8 THE USE OF G.I.S. IN DIFFERENT STAGES OF PLANNING



## 9 ELEMENTS IMPACTING THE UTILIZATION OF G.I.S. IN URBAN PLANNING:

The use of G.I.S. in urban planning does not only depends on the software and hardware of new G.I.S. but some considerations may be less important but influence the use of G.I.S. for the urban planning of an area.

The linkages between staff and organisation, data, planning and staff are important factors for the use of G.I.S. in planning.

**ORGANISATION:** - No matter how sophisticated and advanced it is but is useless if decision makers do not support this. Studies shows that the link between the staff and organisation is more important than the technology for the successful implementation of G.I.S. [7]

**PLANNING:** - In developing countries the use of G.I.S. has not been advance and is not used widely used by planners. Planners could employ G.I.S. in their system which could help them out to better diagnose the issues and find a solution to the problem.

**STAFF:** - With a use of G.I.S., it lacks in the human resources. This software requires a skilled and well-trained person to operate. In developing countries, it lacks due to skilled trainer's and fund issues. Learning this software is an expensive task as it requires well educated and trained staff and computers with high configuration.

## DATA:

Table 8.1 Satellite and their data

| S. No | SATEL-LITE                             | SEN-SOR    | SPATIAL RES-OLUTION | MAP-PING SCALE           | INFOR-MATION EX-TRAC-TION                                                          |
|-------|----------------------------------------|------------|---------------------|--------------------------|------------------------------------------------------------------------------------|
| 01    | LAND-SAT IRS -1A & B (LISS - I)        | MSS        | 80 M.<br>72 M.      | 1:1,000,000<br>1:250,000 | Broad land use / land cover and urban sprawl                                       |
| 02    | LAND-SAT TM IRS - 1A & 1B (LISS - II)  | MSS        | 30 M.               | 1:50,000                 | Thematic data for broad structural plans and spatial strategies                    |
| 03    | LAND-SAT TM IRS - 1A & 1B (LISS - II)  | LISS - II  | 36 M.               | 1:50,000                 | Thematic data for broad structural plans and spatial strategies                    |
| 04    | LAND-SAT TM IRS - 1C & 1D (LISS - III) | LISS - III | 23 M.               | 1:50,000                 | Thematic data for broad structural plans and spatial strategies                    |
| 05    | IRS-ID (LISS IV)                       | LISS - IV  | 5.8 M.              | 1:5,000                  | Thematic data for broad structural plans and spatial strategies                    |
| 06    | IRS - 1C & 1D                          | PAN        | 5.8 M.              | 1:10,000                 | Data for land use / landcover                                                      |
| 07    | CAR-TOSAT - 1                          | PAN        | 2.5 M.              | 1:4000                   | Large scale cartographic maps and infrastructure development maps                  |
| 08    | CAR-TOSAT - 2                          | PAN        | 1.0 M.              | 1:1,000<br>1:2,000       | Large scale cartographic maps and infrastructure development maps                  |
| 09    | IKONOS                                 | PAN        | 1.0 M.              | 1:4000                   | Cadastral map, detailed information for urban planning and infrastructure planning |
| 10    | IKONOS                                 | MSS        | 4.0 M.              |                          | Cadastral map, detailed information for urban planning and infrastructure planning |

|    |                   |                |         |                     |                                                                                    |
|----|-------------------|----------------|---------|---------------------|------------------------------------------------------------------------------------|
| 11 | QUICK-BIRD        | PAN            | 0.61 M. | 1:2,000             | Cadastral map, detailed information for urban planning and infrastructure planning |
| 12 | RE-SOURCE SAT - I | LISS - IV      | 5.8 M.  | 1:10,000<br>1:4,000 | Monitoring the urban growth, land use and land cover map                           |
| 13 | GEO EYE - I       | MULTI-SPECTRAL | 1.56 M. | 1:1,500             | Land use planning, infrastructure planning, Surveying, civil engineering           |
| 14 | GEO EYE - I       | PAN            | 0.41 M. | 1:1,500             | Land use planning, infrastructure planning, Surveying, civil engineering           |
| 15 | WORLD VIEW - 2    | PAN            | 0.46 M. | 1:1,500             | Urban planning, telecommunication, environmental assessment, surveying             |

The gap lies when the data is not properly available. G.I.S. needs textual and graphic data to function. No life exists in G.I.S. without application and no application exist without any data.

## 10 HOW G.I.S. HELPS IN ANALYSING ANY DATA?

Remote Sensing (RS) is the process of acquiring information about earth's surface from a distance without directly coming physically into contact with it [2]

In ArcGIS layer overlay helps the planner to study any area. ArcGIS is a software that provides a platform to overlay different relevant multiple layers, one over the other. It allows the visualisation of different information at the same time. Data can be extracted by superimposing different layers, final output can be concluded by this.

For example: If we need to calculate the sprawl of an area the data required to analysis are:

Primary data it consists of topographic sheets, survey of India etc. they are also required to prepare the base map of an area.

Secondary data it consists of aerial photography i.e. satellite data, thematic maps are made by this data.

Different year data sets are required to map the sprawl area, topographic sheets are helpful in providing data for this type of data. By overlapping the layers using G.I.S. change in detection can be formulated which gives the pattern of sprawl data and the % of increase in sprawl.

**CONCLUSION:** - G.I.S. and remote sensing is a kit used by planners to accurately work and manage the data and is used in developing and developed countries. Many agencies have shifted from traditional mapping system to this kit because of its accuracy and user-friendly, it helps to manage relationship among different map layers. G.I.S. hardware's are affordable and operational now a day. Remote sensing data provides reliable, timely and accurate data, if there is no technical issue and the data is easily available. G.I.S. allows determination of spatial distribution features and objects and the relation among spatial distribution correlation of multiple spatial variables. This information system not only helps in representing the data but also helps in analysis.

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