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INTEGRATED SUSTAINABLE PLANNING FOR INDUSTRIAL REGION USING GEOSPATIAL TECHNOLOGY

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ABSTRACT

The Geospatial techniques and its scope of applications have undergone an order of magnitude change since its advent and now it has been universally accepted as a most important and modern tool for mapping and monitoring of various natural resources as well as amenities and infrastructure. The huge and voluminous spatial database generated from various Remote Sensing platforms needs proper management like storage, retrieval, manipulation and analysis to extract desired information, which is beyond the capability of human brain. This is where the computer aided GIS technology came into existence. A GIS with major input from Remote Sensing satellites for the natural resource management applications must be able to handle the spatiotemporal data, supporting spatiotemporal quarries and other spatial operations. Software and the computer-based tools are designed to make things easier to the user and to improve the efficiency and quality of information processing tasks. The natural resources are a common heritage, which we have shared with the past generations, and our future generation will be inheriting these resources from us. Our greed for resource and our tremendous technological capacity to exploit them at a much larger scale has created a situation where we have started withdrawing from the future stocks. Bina petrochemical region had attracted the attention of the planners from the beginning of the five-year plan strategy for Industrial development. However, a number of projects were carried out in the individual Districts (Sagar, Vidisha, Guna and Ashoknagar) which also gave fruitful results, but no serious efforts have been made to involve the entire region. No use of latest Geospatial technique (Remote Sensing, GIS, GPS) to prepare a well structured computerized data base without which it is very different to retrieve, analyze and compare the data for monitoring as well as for planning the developmental activities in future.

Keyword:- Geospatial techniques, Amenities and Infrastructure, Natural resources.

1. Introduction

Planning is a widely accepted way to handle complex problems of resources allocation and decision-making. It involves the use of collective intelligence and foresight to chart direction, order harmony and make progress in public activity relating to human environment and general welfare. In order to provide more effective and meaningful direction for better planning and development necessary support of the organization has become essential. Hence the need for a suitable information system is increasingly being felt in all planning and

developmental activities, whether these are for urban or rural areas.

Urban areas of today are more exactly described as sprawling regions that become interconnected in a dendritic fashion (Carlson and Arthur, 2000). The positive aspects of urbanization have often been overshadowed by deterioration in the physical environment and quality of life caused by the widening gaps between supply and demand for essential services and infrastructure.

The sustainable planning means "development that meets the need of the Present without compromising the ability of future generations to meet their own Needs" (**The Brundtland Commission**).

This can be achieved by taking care of ecological, social and Economic aspects of development. It includes conservation of resources for the Future generations. Integrated sustainable planning deals with the efficient placement of land use activities, infrastructure and settlement growth across a significantly larger area of land than an individual city or town. Sustainable planning addresses problems of economic, social and political transformations at geographical scales greater than a municipality.

The Region is connected and united by cultural identity, economic interests, geographic features, as well as common developmental and environmental concerns. Since the independence, the need for regional planning has arisen from changing social and economic phenomena affecting local communities and regions throughout the country. In other term is region is a delineation of areas with several common characteristics, be they geographical or functional that enable activities to be coordinated towards achieving efficient management of the areas.

The need for regional planning is seen as filling in the gap between national planning and local planning. It is thus a species of 'intermediate planning'. Regional planning is "an exercise in persuasion, seeking to encourage those agencies with the power to act and manage regional development, to adopt and use agreed strategies and to follow particular guidance in the interests of achieving identified goals or vision and consensus on net regional benefit" (Glasson in Noble, et. al., 1998).

Therefore, in this approach the present research work is to integrated sustainable planning to utilize the resource potential both natural and human resources in a sustainable manor. There are limitations pertaining to resources availability alternative systems will be proposed for regional development of the area. The morden geospatial technology in conjunction with the conventional technology is proposed. To be used in effective manor so that sustainable regional plan can be achieved.

Impression of Sustainable Development Planning

Earth, across all scales, is comprised of interconnected, life giving ecosystems that include **Nature** and **Humanity**. There are limits to Nature and its ability to sustain life. In the relationship between Nature and Humanity,

Sustainability — a balanced relationship between natural and human systems dictates the need for sustainable development.

Sustainable Development achieves harmony between human development and natural systems by efficiently using existing built environments and integrating new development with the natural context. Sustainable Development strives for no net loss to Nature. Fig. No.1 Sustainable planning interacts with different fields.

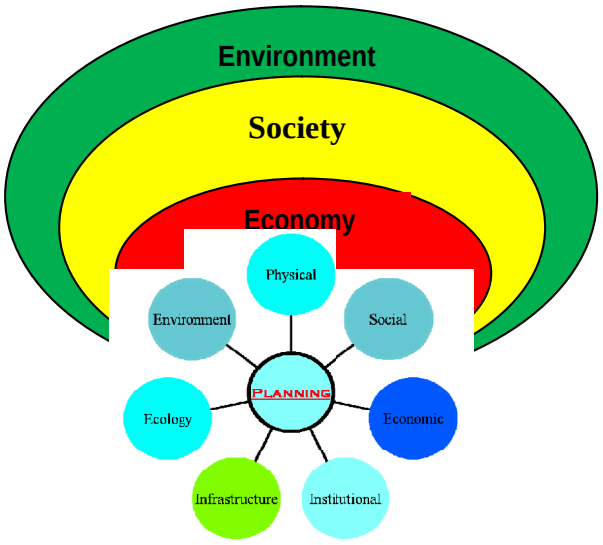

Fig. No.1 Sustainable development concept.

2. Role of Geospatial Technology in Sustainable Planning

Geospatial technology, commonly known as Geomatics, refers to technology used for visualization, measurement, and analysis of features or phenomena that occur on the earth. This terminology has become in the united state, synonymous with Spatial Information Technology.

Geospatial technology includes three different technologies that are all related to mapping features on the surface of the earth. These three technology systems are GPS (Global Positioning System), GIS (Geographical Information System), and RS (Remote sensing). Planning and information is closely linked. Information is needed to assist decision making in planning activities. The monitoring of urban and regional development may result in new planning actions. Information is considered as one of the important element of settlement planning & activities crucial for the economic, social and environmental advancement of all countries. There have been continuous efforts of improve the database for planning and development of any human settlement. Still serious problems regarding availability and organization of data especially in developing countries are presenting.

The new Geospatial Technology based on satellite data products and computer techniques is found to be very useful and has got potential to generate desired database for planning. Settlements are being spatially located. Thus, these are geographical in nature. Geographic information at settlement level is used for plan preparation, monitoring, & forecasting changes, planning services, managing resources, protecting the public developing properties, etc. over the last two decades the steady growth in information technology has provided planners and other related professionals with new tools to process analyze and present spatial data. One set of such tools is known as Geographical Information System (GIS) that means a particular form of information system applied to geographical data.

A Geographical Information System uses geographically reference data as well as non-spatial data and includes operations that support spatial analysis. In this context GIS can be broadly described as a system of hardware, software and procedures designed to support, capture, manage, manipulate, analyze, integrate, retrieve, update and display of spatially referenced data for solving complex planning and management problems.

This is normally considered to involve a spatially referenced computer database and appropriate applications software. The definition of GIS lays emphasis on the technical aspects of handling spatial data. Spatial data since ancient times are collected and presented in the form of maps. General maps (topographical) and thematic (special purpose) maps have become over the time more and more important.

Geospatial technology has increased the capability and accuracy of map making. The demand from different professionals like planners, geographers, soil scientists, geologist, cadastral mapping, etc. for more and combination of land related information was an important motivation to apply computer technology for map making. A map prepared by conventional techniques has several restrictions like:

- Time-consuming to make the maps.
- Reduction of classes to make a map readable.
- Scale, especially large-scale maps cover an area in many different map sheets.
- Retrieval and combination of information difficult.
- No frequent update, which is a problem wherever information (themes) changes fast.

Due to these limitations, spatial analysis to combine maps is too expensive in terms of time and cost. In this background, geospatial Technology is play vital role in solving these problems. **(**Burrough, P.A. 1988**)** quoted a list of reasons to use computer-based technologies in map making. A few of these reasons mentioned are:

- To make existing maps for more quickly and cheaply.
- To make maps for specific user needs.
- To facilitate map making and updating when the data are already in digital form.
- To facilitate analysis of data that demand interaction between statistical analysis and mapping

- To create maps that is difficult to make by hand e.g. 3D maps or stereoscopic maps.

3. Research Area

According to Madhya Pradesh, Gram Nivesh Adhiniyam Act of 1973 Madhya Pradesh has seven regions. However, due to rapid development of Bina and area around Sagar district, a new region was formed in 1999 by including Sagar District of Jabalpur forest region and Vidisha district of Bhopal capital Region. These four districts sagar, Vidisha, Guna and Ashoknagar become a new region, named as Bina Petrochemical Region. The total Geographical area is **28661** Sq. km. and total population is **4902380** lack. The region is best accessibility by road and rail network. The climate is suitable for the agriculture and there is an opportunity to develop the region due to presence of petrochemical region and gas plant. Geospatial technologies provide the best methods to plan not only the natural resources but also helps to study the socio- economic conditions of the research area (Bina petrochemical region) together with the spatial data.

4. Location of the Research Area

The Bina Petrochemical Region lies between the latitudes 23^{o} 0` to $25^{o}$ 10` N and longitudes 76^{o} 50` to $79^{o}$ 10` E and covering an area around 28661 Sq. km. in four district of Madhya Pradesh (Sagar, Vidisha, Guna, and Ashoknagar) has been selected for the present research (Study). It is covered by the 65 Survey of India (SOI) toposheets.

The region mainly in the Madhya Pradesh North - situated in the western region is located on the plateau of Malwa. Wetland characterized by physical appearance, Dhasan, Bewas, sonar, copra and Bamner flows in parallel valleys. The sea level height is 683.4 meters. It is located on Junction of national highway number 3, 26 and 26A. Bina town is the major junctions of Central Railway's.

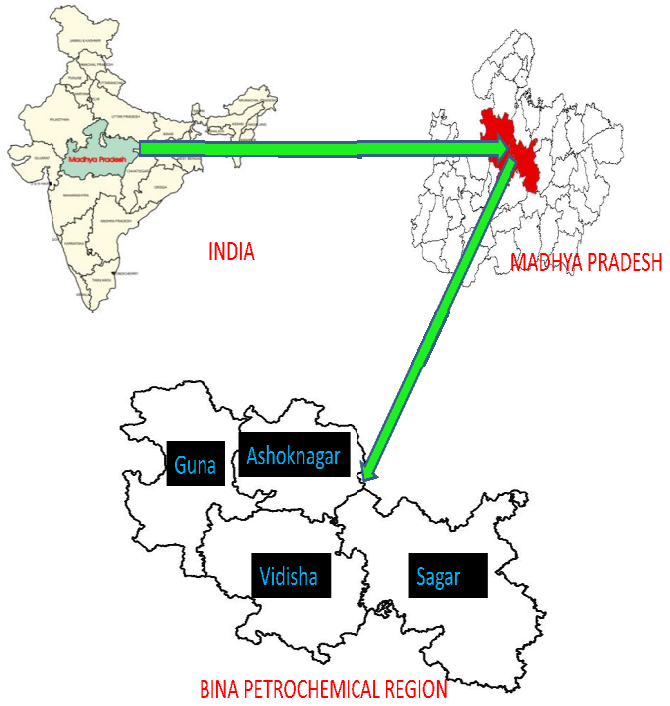

Fig. No. 2 Location Map of the Research Area

5. Data Used

The data is collected both from primary and secondary data sources. The primary data collected are Survey of India (SOI) toposheet at a scale of 1:50,000 and Indian Remote Sensing satellite (IRS-P6) LISS-IV MX Data for the years 2008, and 2009. Respectively the secondary data collected includes the demographic details (from the primary census abstracts for the years.1971, 1981, 1991, and 2001 from the Directorate of Census Operations, Census of India). Groundwater quality, pre-post monsoon data availability of groundwater is proposed to be collected from Central Groundwater Board (CGWB) and state groundwater board (SGWB). To study the variation of rainfall, rain depth data from various rain guage station from Indian meteorological department (IMD). Drainage map, Road and Railway network map has been obtained from the concern departments. In addition to this, ancillary data from various reports and publications will be collected different sites and library.

Satellite	Sensor	Resolution	Date	Type	Source
IRS-P6	**LISS-IV**	**5.8 m.**	**2008 & 2009**	**CD**	**MPCST & NRSC**

Table No.1Satellite data used in the present Research

S.No.	Toposheet No.	Source
1	**54C/16**	**MPCST and SOI Jabalpur**
2	**54D/13, 14, 15, 16,**	**‘’**
3	**54G/4, 8, 16**	**‘’**
4	**54H/1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16**	**‘’**
5	**54L/1, 2, 3, 4, 6, 7, 8, 11, 12, 15, 16**	**‘’**
6	**54P/3, 4, 7**	**‘’**
7	**55E/1, 5, 9, 10, 11, 13, 14, 15**	**‘’**
8	**55I/1, 2, 3, 5, 6, 9, 10, 11, 13, 14, 15, 16**	**‘’**
9	**55M/1, 2, 3, 4, 5, 6, 7**	**‘’**

Table No.1Details of Survey of India Toposheets

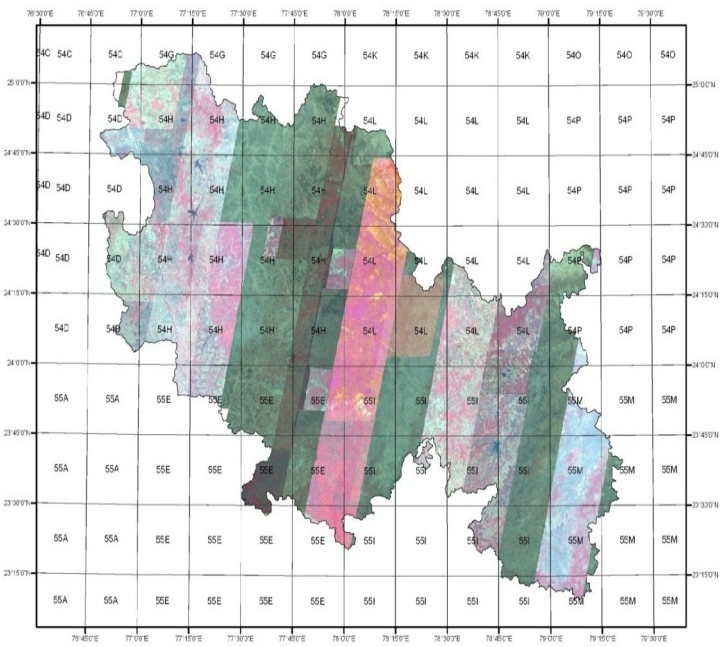

Fig. No.2Bina Industrial Region Satellite Data

4. Aims and Objectives

Although geospatial information is increasingly becoming a part of information, need. The technology provides integrated interoperability environment for any kind of planning, therefore to plan a region in a sustainable manner applications from complex spatial models with integration of spatial and non-spatial details can be effectively generated.

Regional planning is very old subject and still planning can be done using conventional methods of surveying. The present research work is aimed to prepare a sustainable regional plan using geospatial technology (Remote Sensing + GIS+ GPS+ Non-Spatial data) in an integrated manner and same model can be applied elsewhere for similar kind of research.

Since 1999 offer declaration of the area as industrial region rapid urbanization and industrialization growth will be much more then part decides. The establishment of indo-Oman refinery and J.K. power plant at Bina and Vijaypur gas pipeline and refilling station near guna also attracts all allied supporting small & large industries in this region. There activities will aggravate unplanned development in the region. To manage and generate the region sustainable region plan will be at most necessary to plan the growth of urban sites, transportation, management of environment, and conservation of green area, (Forest and Agriculture), development of facilities and amenities, education, drinking water and water for irrigation, allocation of land for hazards industries and human resource development. To active, this appropriate regional plan will help to develop the region in a sustainable manner.

The main objectives of the proposed research are as fallowing:

1. Evaluation of the resource potential of the area in terms of Landuse/Landcover.
2. Hydrogeomorphological mapping for evaluating water resources of the research area.
3. Assessment of Facilities and Amenities of the research area using geospatial technology.

4. Integration and analysis of all above studies by applying standard planning indicators, Geospatial environment to suggest sustainable Regional Plan.

5. Proposed methodology

The broad methodology adopted during the present investigation for terrain characterization, different thematic maps such as (Base map, Drainage map, geological map, Geomorphological map, Watershed map, slope map, Soil map, Groundwater prospect map, Landuse/Landcover map, Population Density map Village boundary map, Etc.). Based on digital analysis of satellite data in conjunction with available ancillary data and ground survey the thematic maps and relevant information related to the research area will be integrated with GIS using Arc-GIS 9.2 software.

The methodology adopted in the present research is presenting schematically in methodology flowchart.

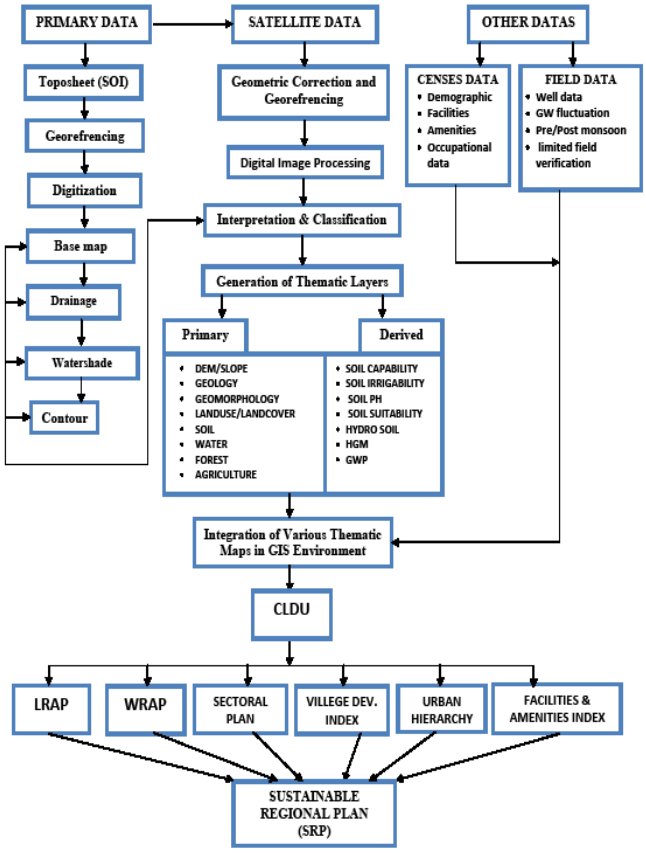

Fig. No.3Flowchart of the proposed methodology

CLDU (Composite Land Development Plan)
LRAP (Land Resource Action Plan)
WRAP (Water Resource Action Plan)
HGM (Hydrogeomorphological Map)
GWP (Groundwater Prospects)

6. Expected outcome of the proposed work

A practical approach in Regional Planning, directed at preservation, conservation, development, management and exploitation of the natural resources of the region for benefit of the people has to operate within the framework of physical and biological attributes, socio-economic conditions, infrastructure, amenity & facility constructs.

The modern Geospatial technology of Remote Sensing which includes both aerial as well as satellite based systems, allow us to collect physical data rather easily, with speed and on repetitive basis, and together with GIS it helps us to analyze the data spatially, offering possibilities of generating various options (modelling), thereby optimizing the whole planning process. Industry contributes to economic growth, but it also degrades the environment, poses health risk and alters land-use. Hence, to ensure environmental soundness of the industrial development of the region, this research work will achieve desired development from economic and social angle while safeguarding the environment and maintaining good quality living conditions on the other.

The outcome of present research work in to apply Geospatial technology to prepare a sustainable regional plan by applying sustainability models by given Weightage to natural resources, infrastructure, socio-economic conditions, facilities and amenities. This will help to assure the region inters of it potential and limitations. The approach adopted in the present research work will be helpful for similar type of studies in elsewhere.

Considering the present industrial scenario and future industrial development in the region problem related to environment pollution, health risks would need major attention to ensure the clear environment. The proposed regional plan will address the area for green belt conservation, proposed and allocation of land for hazards industrial establishment in such a manner to limit and manage chemical pollution in the drainage systems at both point and non point sources.

Presently Bina industrial region is mostly agricultural dominant region and 70% of the population is engaged in agriculture activities. In coming years rapid urbanization and growth of urban centres due to industrial establishment will cause migration and population growth in this region. The growing population will need better conditions for living, pollution for environment, and rapid transport system (RTS) along with facilities for education, medical, drinking water and infrastructures. The research will address all above factors in prepared for regional plan for the industrial region. The plan will address the requirement of land for various proposals for next 20 years i.e. year 2031.

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