APPLICATION OF SPATIAL DATABASE FOR RURAL DEVELOPMENT AND PLANNING IN INDIAN CONTEXT – A THEORETICAL OVERVIEW

Dr. Sumana Sarkar
Assistant Professor, Department of Geography, The University of Burdwan, Burdwan
Golapbag-713104, West Bengal.

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ABSTRACT In today's changing world, spatial data with its unique database features is considered as a vital and inseparable component in any developmental planning process. Rural development is also not an exception one. Advancement in geo-spatial technology has provided a platform for the creation, up-gradation, storing and sharing of spatial database in a speedy and cost effective way. As India is a country of villages with 6, 40,867 villages or rural settlements inhabited with 68.84 per cent population (2011 census), the development of the entire rural sector paves the way for development of the whole nation. The focus of the present article is to provide a theoretical overview about the application of spatial database for rural development and planning in India.

Keywords: Spatial data, Rural development, Geospatial technology, Spatial database, Planning

Introduction
Rural development has now become accepted as sine qua non of national development and social welfare giving special emphasis on programmes which benefits the weaker sections of the population. In this context, a number of planning approaches, methods and schemes were introduced time to time to improve the lifestyle of people in rural areas. The technological advancement in domain of planning is of prime importance for countries like India with varied geographic pattern, socio-economic and cultural activities.

It is well recognized fact that the strategy of rural development and planning requires a huge amount of reliable datasets about the available physical and cultural resources and related aspects. The age-old traditional tools and techniques are not well equipped for collection, management, storage, retrieval as well as up gradation of spatial data to achieve the goal and objectives within a stipulated time period. Again the problem with the conventional system is that it is very difficult to handle the voluminous and scattered datasets which creates a lot of troubles against the efficient use of datasets. Hence, an urgent need is felt for intact dynamic Spatial Database (SDB) system with sophisticated data management capacities (Sarkar, 2013).

Easy access of advanced Geographical Information System (GIS) equipped with modern Geospatial tools and techniques helps in this regard a lot by facilitating a database feature which makes the planning process quick and easier. It also facilitates an added dimension for data analysis and visualisation of the complex pattern and interrelationship pertaining to real world problematic issues related to planning. Visualization of spatial pattern also supports temporal analysis and monitoring of socio-economic indicators that is in turn reset the improved need assessment.

In short, the attachment of statistical and other attribute information within geo-spatially referenced framework attached with SDB features under GIS domain enable analyser and planners to extract the required information which were earlier too expensive or impossible to perform. In this context, GIS can rightly be defined as a system of hardware, software and procedure designed to support the capture, management, manipulation, analysis, modelling and display of spatially referenced data for solving complex planning and management problems (USGS, 1997). It adds tremendous volume in terms of data capture, storage, management, retrieval, analysis and up-gradation as well as representation of the real world phenomena with respect to a particular spatio-temporal framework. The content of the present paper has been divided into three sections. These are viz. conceptual part of rural development and planning, concept of spatial database and application of remote sensing and GIS in regional planning.

Concept of Rural Development and Planning
The term ‘rural development’ as per the Rural Development Sector Policy Paper of World Bank (1975) is a strategy designed to improve the economic and social life of a specific group of people i.e. the rural poor. It involves extending the benefits of development to the poorest living in rural areas. Chamber (1983) had
added the dimension of gender component, family condition and right of rural mass to the above mentioned definition of rural development (RD) given by World Bank and redefined it as a strategy to enable a specific group of people particularly poor rural women and men to get fulfilled their basic needs. 

Another definition of RD was as the set of activities and actions of diverse actors - individuals, organizations, groups which have taken together, lead to progress in rural areas (Shepherd, 1998).

Mishra (2005) had rightly pointed out that the main objectives of overall rural development should be targeted to enhance the agricultural productivity and output along with bringing efficiency in improving the use of scarce land and water resources, to increase the supply of capital resources, maximization and creation of employment opportunities, redistribution of income and raising the standard of living of rural population.

Historically, rural development started as agrarian revolutions to the complex socio-political issues of traditional farming throughout the world. However, in the modern set-up, it is very difficult to define the term ‘rural development’ as it has moved too much from its basic meaning as ‘development of rural areas’ to ‘integrated rural development’, to the present form of ‘sustainable rural development’ (Naithani, 2000). Now, there are three key terms, i.e., rural, development and planning.

The term ‘rural’ is broadly referred to the area(s) whereby people are usually engaged in ‘farm activities’ or production of foods, fibres, ores and raw materials.

The term ‘development’ is a process of gradual growth or advancement through progressive changes. Development has been described as a generic term meaning growth, evolution, stage of inducement or progress.

The development concept is very much dynamic as it has been taking different shapes and dimensions since the beginning of civilization. The present nature of development is totally different from the nature of development during 1950s. It is a process of improving the well being of the rural people by raising the standard of living, improving their education and health and also opening the equal opportunities for a richer and more varied life. Development process is complex and multi-faceted. The components of the process primarily include the socio- economic, politico- administrative and cultural dimensions which constantly interplay with the total development process (Pandit, 2001).

The term ‘planning’ is something more than the articulation of goals and formulation of a strategy. It stands for coordinated use of all available resources-material and non-material for realizing certain predetermined or preferred and gradually evolving goals through creation or adaptation of an institutional framework that can support sustenance to developmental efforts. Therefore, the goals and parameters should be operationally defined and identified properly so that they could easily be realized for action – oriented procedures.

In the light of the above definitions, Rural Development may be outlined as a process facilitation through policy changes and strategic interventions in rural areas to help the rural community for their gradual socio-cultural, political and economic advancement. It may be defined as a process leading to sustainable improvement in the quality of life of rural people, especially the poor (Singh, 1999). However, it is to be noted that every definition has its own meaning and can be interpreted in a variety of ways. But, the dominating factor of these definitions speaks for the holistic development of rural areas and rural people in terms of positive and constructive changes in their cultural, social, spiritual, ethical, political and economical conditions. The objectives of rural development encompass improved productivity, increased employment and higher income as well as minimum acceptable levels of food, clothing, shelter, education and health for the people.

Rural development, therefore, can be described as a process aiming at improving the well-being of people living outside the urbanized areas. It is not merely the agricultural development but transformation of entire rural systems. Therefore, rural development has to be viewed in its totality rather than fragmented approach. Agriculture being the most important and major component of the rural system, the emphasis has to be laid on this aspect only to identify some important issues in rural development programmes.

**Concept of Spatial Database (SD)**

A database is an organized collection of logically related data designed to meet the information needs of one or more users. It tends to be long term resource of an organization that could be used for planned as well as unplanned applications without great difficulty (Bhatta, 2012). The term ‘Spatial’ is originated from ‘spatium’ which means space. It refers to something very much linked with geographic space, i.e., a particular location in terms of latitude and longitude. When the two terms ‘spatial’ and ‘data’ are combined, it forms ‘Spatial Data’ that may be defined as observations made from real world comprising of entities marked by geographic coordinate system or become geo-framed under a particular projection
system. Spatial database is one of the important components of GIS. It is based on the fundamental key concept that every object on the earth surface can be geo-tagged in the GIS environment. It may be defined as the collection of information about spatial or geographical entities and their relationship with each other. According to ESRI (Environmental Space research Institute) among the three components of GIS, database is first one then map and model component. GIS itself is a unique kind of database of the World. Fundamentally, GIS based structured database describes the real world in geographic terms acting as an infrastructure or say ‘Spatial Data Infrastructure’ (SDI) coined in 1993 by US National Research Council which helps to assess resources and strategic planning. The Spatial database allows a range of functions for storing, processing, analyzing, and visualizing real world data. Data are organized in database tables. A table is an important part of database in which data elements are organized using a model of horizontal rows and vertical columns. The column are known as fields or attributes identified by name and other numerical information. The rows are called as records or tuples that indicate the values appearing in a column subset. Spatial database possess two interlinking components, i.e., Location (latitude and longitude) and Attributes (characteristics).

SD forms the foundation of planned human activities. Management of natural resources, infrastructure development and planning, land use planning etc. are just a few example of area in which decision making is contingent on availability of accurate and high quality of spatial data. Recent advancement in geospatial technology especially in remote sensing and GIS has added more values in mapping and analysis of geographical facts with quite precision. Development of spatial database (SD) is the recent advancement in the field of GI Sciences that support to solve the various complex problems of human being including development and planning. The creation of SD requires digital database obtained from remote sensing and others sources including field investigation after encoding different geographical data-sets.

The emphasis was given to generate digital database in all Government organizations at different levels and data sharing to form a master database. Most of the states in India and several Ministries and Departments of Central and State Governments have initiated for geo-database creation through special GIS programme relating to ground water studies, cadastral mapping, power transmission and transportation infrastructure. As the demand of integrated data sources for socio-economic and spatial planning is increasing, the institutional infrastructures have been developed across the country catering local, regional and national needs. Some of the institutions with sophisticated capabilities are National Remote Sensing Centre (NRSC) Hyderabad, Indian Institute of Remote Sensing (IIRS), Dehradun; Space Application Centre (SAC), Ahmadabad; Central Arid Zone Research Institute (CAZRI), Jodhpur; Regional Remote Sensing Application Centre (RRSAC) at Bangalore, Nagpur, Jodhpur, Institute of Remote Sensing at Anna University, Chennai and SOI Training Institute, Hyderabad. These institutes offer a variety of training programmes relating to remote sensing and GIS besides undertaking or supporting large scale application projects. Apart from these organizations, various Universities, IITs and private institutions also support to popularize RS and GIS by offering certificate, P.G. diploma /Degree courses. Some of important projects are worth to mention such as launching of spatial database for ground water through internet on world water day by P.K. Bansal, Union Ministry for Water Resources, e-kiosk for farmers query on ground water information on e-panchayat. The Jharkhand Space Research Application Centres launched a live GIS for water resource measures likewise, hi-ambitious projects regarding development of digital database for land resources have been started in Maharashtra, Tamil Nadu, Uttar Pradesh, Himachal Pradesh, Orissa, Karnataka etc.

National Land Records Modernization Programme (NLRMP) has been conceptualised as a major initiative for the generation of SD. It is concerned not merely with computerization, updating and maintenance of land records and validation of titles, but also as a programme that will add value and provide a comprehensive database for development planning and disaster management, location-specific information and citizen services. Under the National Land Record Modernization Programme (NLRMP), the three layers of data are integrated on a Geographic Information System (GIS) platform viz. spatial data from satellite imagery/aerial photographs, Survey of India and Forest Survey of India maps, and Revenue records with detailed cadastral maps. All cadastral maps will be digitized and data would be included with plot numbers and unique id for each land parcel. The Programme will be of immense use for both Central and State Governments – who can utilize these information for modernizing and bringing efficiency to the land revenue administration. It can also support as a comprehensive tool for planning land-based development and disaster management by providing location-specific information. Even the private sector will be able to benefit from this comprehensive tool for planning business and economic activities.
Application of Remote Sensing and GIS Technique in Regional Planning

Remote sensing and GIS technique are the basic tools in the creation of spatial database (SD). Remote sensing is a modern and sophisticated technique of catching information in the form of images with utmost accuracy. Ultimately, it serves both as a data input source for GIS and interpretation techniques to extract for different uses according to the attributes. It all aims at accomplishing the aims and objectives of the researcher, planners, decision makers etc. Both GIS and remote sensing have a degree of mutuality; GIS provides means for increasing the utility of remote sensing data. New information can be regularly updated. GIS makes it possible to improve the interpretation and analysis of remotely sensed image. This is achieved by combining referenced data from spectral sources. A GIS integrated with image processing capabilities is a powerful tool for computer assisted resource mapping and creation of resource database under database management features.

Realizing the importance of spatial database in planning process, National Spatial Data Infrastructure (NSDI) came into existence in 2002 in India with task force of SOI and ISRO. GIS is a tool for storing, manipulating, retrieving and presenting both spatial and non-spatial data in a quick, efficient and organized way. Since, most of land information elements have a geographic connotation; geographically referenced data with GIS techniques come to the fore in such and application. The term 'Geographic' in GIS refers to the locational attributes which define the spatial positioning of the piece of information on the surface of earth. Preparation and maintenance of data in the form of maps and referenced tabular files itself can be considered as a primitive form of GIS. However, the advent of digital computers with high data processing speed and analytical tools have made flexible and easy handling of vast geographically referenced data. Such systems generally dealt with data classified/segregated into the spatial type (locationally referenced), attribute type (without locational connotation) and the time variant or repetitive types of data. The three components are location, attributes and time-representing the content of most GIS.

Recent advancement in GIS and Computer technique have proved to be excellent tools for supporting large scale planning and allocation by allowing easy aggregation, overlaying and integration of information pertaining to different resources (Keser and Bogardi,1993). Geospatial information system provides essential technology for visualizing and interpreting the interaction of spatially distributed resources (Sowmya, 2009). Database integration capabilities of GIS largely helps planner and resource manager to understand and visualize the complex interrelationship between physical, biological, cultural, economic and demographical considerations around specific resources. Under GIS environment, different thematic layers and their attribute information are stored in spatial database format, which offer an integrated analysis and transfer the data into required information as per need of the planners and decision makers for monitoring and managing natural resources. A large number of researchers have done a lot of work regarding application of RS and GIS in regional planning. Some of them mentioned here are Baburanganj and Mohammad (1991), Mukherjee(1991), Stalin (1996), Sood et al.(2001) Banerjee(2002),Bal (2003), Dasgupta (2003), Georgiadou (2003), Phansalkar (2003), Rao et al.(2003), Mallick(2004), Bernard et al.(2005), Mishra,(2005,2006) etc.

Conclusion

Although spatial database is a useful tool in natural and cultural resource management and analysis with its unique features of storage, retrieval, interpretation and analysis of the resource data and development of resource management plans but its initial cost of acquiring, georeferencing and integrating data on which geospatial information system is based that remains the greatest challenges in the process of database creation in a developing country like India with limited digital infrastructural capacities.

References

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