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Integrating Space-Based Information And Geographical Information System In Microlevel Planning For Sustainable Development Of Hill Areas

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Abstract:
Effective managernent of natural resources, both renewable and non-renewable, is vital for the existence of mankind in general and the developing world in particular. With the growing population and the consequent demand on the natural resources, it is imperative to adopt a comprehensive and integrated view for the managelnent of these resources. Further, there is an urgent need to pron)0te sustainable and environmentally sound development efforts to preserve eco system of hill area. Resource management practices borne out of ignorance, negligence or lop sided priorities established by power groups, coupled with natural calamities and the complex behavioral pattern of the natural systems, compound the problem in hilly terrain. While, both the urban and rural landscapes will suffer, the major brunt will be borne by the population living in the rural areas.
Stuart.L.Hart (1997) Observed that the greatest threat to sustainable development is the depletion of world's renewable resources; water, soils, forests and fisheries are all being pushed beyond their limits by the growth of human population and rapid cutting of forest for agriculture development. Insufficient drinking water may prove to be the most vexing problem in the hilly terrain over the next decade, as agricultural, conunercial and residential uses increase. Water tables are being drawn down at an alartning rate, especially in the most heavily populated nations. More than 10% of the world's topsoil has been seriously eroded. The available cropland and rangeland are shrinking. "Me existing crop varieties are no longer responding to increased use of fertiliser. The world's 1 8 major oceanic fisheries have now reached or actually exceeded their sustainabil ity yields. By some estitnates, the human kind now uses more than 40% of the planet's net primary productivity. If, as predicted, the population doubles over the next 40 years, human kind lilay out-compete most of the animal species for food, driving many to extinction. The non renewable resources such as oil, metals and other mineral resources are finite. We must ensure that the non renewable resources are harnessed at a rate, which ensures that their cost is not prohibitive by the time the society has developed alternatives. Also we need to explore new sources.

Introduction:
India is predominantly rain fed; it is drought prone; the tree cover is depleting in many areas; soil erosion and land degradation is very severe; the ground water table is going down; the agricultural productivity is quite low. The current projections indicate that the country's population may stabilise at I .8 billion around AD 2060, calling for an annual food production of about 400 million tons of grains, which is more than double of what it is today.
Hence it is imperative to adopt a scientific management system for our natural resources, for monitoring the environmental and ecosystems as well as for responding to natural disasters and calamities in a systcn)ic Inanncr. Titncly and reliable information on the extent, state and
distribution of natural resources in spatial and temporal domain, is essential for decision making at various levels. Spacc bascd remote sensing data has ability to provide synoptic, reliable and accurate information at frequent intervals even, in inaccessible areas. Thc succcss of planning at macro and micro levels for developmental activities depends on the quality and quantity of information available on both natural and socio economic resources. It is, therefore, essential to devise ways and means of organising

computerised information systems. These systems must be capablé of handling vast amount of data collected by modem techniques and produce up to date information. The availability of remote sensing data on natural resources such as dynamics of crop, land use, soils, forests, wastelands, water bodies etc. oh regular basis facilitate the information system a most up to date in real time under GIS environment for temporal evaluation and assessment.

METHODOLOGY :

the methods adopted to create a database of the entire sirsa kheri village using survey , gps and other mapping software tools also discussed in details. In this study , both primary and secondary data is used to develop the information system. Methodology is the central part of any research. It is the process used to collect data and to convert this data into meaningful information that fulfil the needs of our research purpose by applying different techniques.The data is a collection of facts such as values or measurements. It can be numbers, words, measurements, observation or even just description of things. Geographical data shows both the location and characteristics of spatial features on earth. Data as a general concept refers to the fact that some existing information is represented isome form suitable for better uses.Data is a set of values of qualitative and quantitative variables. Mainly two types of data is being used: Primary data and Secondary data.

Primary

A primary data uses first hand information about the study area which is collected by the researcher himself. There are several methods for collecting this data. This data is so reliable as it is collected for specific purpose and totally meets the needs of research question. But, the collection of primary data is a difficult and sometimes it may be very expensive also. By doing the household survey the minute information had collected from each household.

Secondary Data:

secondary data is the data that has been collected by the reading available from other sources. Secondary data is obtained from outside sources. Secondary data can provide a baseline for primary research to compare the collected primary data results. The sources of secondary data are Census surveys, organizational records and data collected through qualitative methodologies or qualitative research etc. Such as the census data and cadastral map were taken from the concerned departments.

Role of GIS in planning:

GIS has computational capabilities, analytical facilities , facilities for queries and interface for inputs and outputs at high speed, capabi lities of integration or split up, automatic cartographic presentation and can accept interdisciplinary inputs . It helps to avoid redundancy by using the relevant data and spatial features, reduces cost in terms of time, storage and production of output; improves standardisation and identifies information gaps, relevant for better allocation of resources and decision making. The GIS is a versatile user friendly computer based tool which can be efficiently utilised by the various sectoral departments.

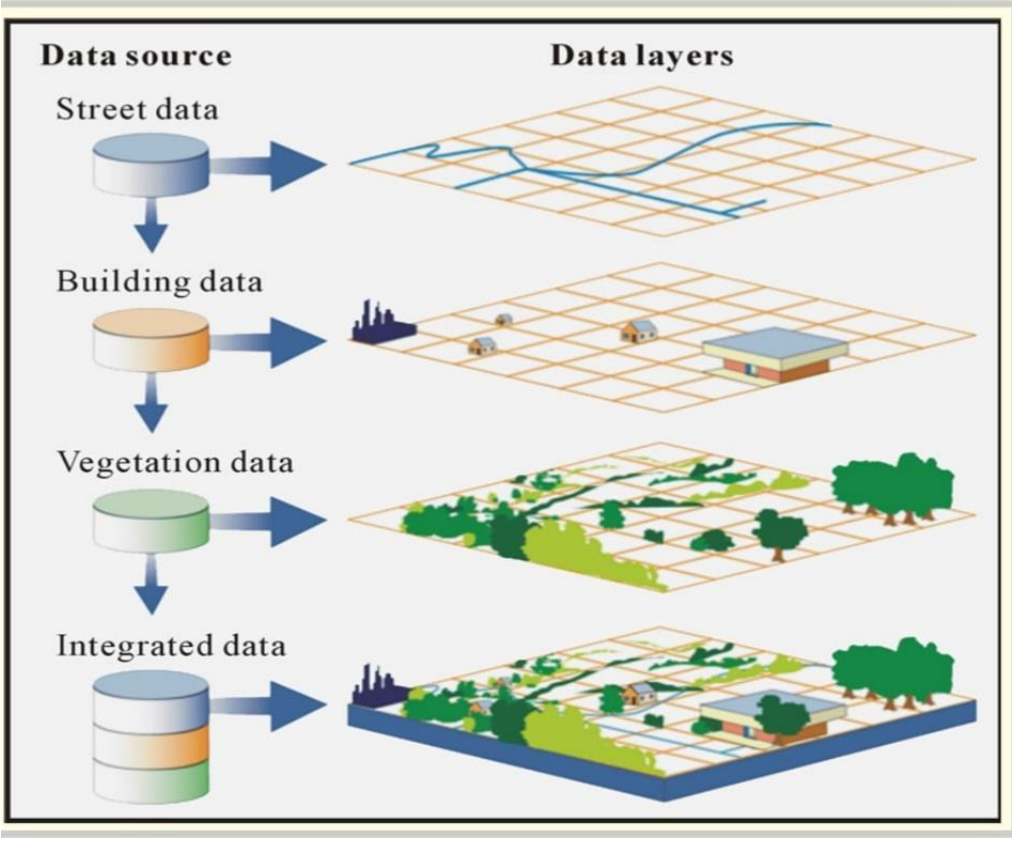
The linking of physical characteristics of an area with numerical socio economic, natural resource and demographic parameters has proved to be of great significance, for various planners and decision makers, to optiinise the resource allocation and to initiate developmental process. GIS
has the capabilities of interfacing field realities with socio economic data for the planners and

decision makers, which has great relevance in data handling, management and generating models for decision making. The advancement in computer hardware and efficient software and their cost effectiveness has made GIS a state of art technique which is within the reach of the users. Computer based systems designed to store and analyse geographical data have existed for a few decades, but their development has been shaped by certain perceived needs of their capabilities, by technological opportunity, and by methodological and institutional constraints. Their invention stemmed from the growing involvement of governments in location specific planning, the resulting need to handle the data in a timely manner, and future technological opportunities offered by the development of computers and their peripherals as information processors.

Indian Remote Sensing Satellites and Geographical Information System:

The guiding vision for the Indian Space Programme has been the application of space technoloy for finding to the problems of man and society. IRS-IA was launched and operationalised successfully in March 1988. Today we have a constellation of many sensing

Also, we acquired the national capability to launch the IRS satellites using our from India. IRS IC and ID are the [nost scphisticatcd civilian satellites in the world .oday, providing multispcctral data with a spatial resolution of 23 meters in visible and infrared •egion and 70 meters in short wave infrared region. Thsc Panchromatic data with a spatial •esolution of 5.8 mctcrs and stereo viewing capability enables generation of digital terrain nodels, better contour 'napping and thctnatic tnapping at I • 12,500 scale. The Wide Field Sensor (WiFS) with 1 88 meters resolution enables monitoring of vegetation every 3 days for he whole country. IRS IC and IRS-ID have opened up new vistas in applications especially large scale mapping, infrastructure planning, engineering applications etc Presently we tre developing three IRS satellites namely IRS P4, (Oceansat), IRS P 5 (Cartosat) and IRS '6 (Resourcesat)."GIS



consist of geometric (spatial) and non geometric (non spatial) entities, geometric Entities being location,

shape, size and dimensions of points, lines, polygon and surface features Ind non geometric being the description of the characteristics (Attributes) of these features, vhich is the structure of the database for GIS" (Martin, 1990). The matrix of database tructure presented in Fig. I , illustrates the sources of data, leyel of data inputs and the tatter-n of outputfrom a GIS (Pradhan AX & Tripathy, K, 1996). The basis of any GIS is the nap on which one can display spatially related data. These maps can either be inputted nanually or through digitisation or more effectively by scanning. Other data sources include ligital satellitédata, video images and scanned aerial photographs.The digitised inputs are usually in the vector form i.e. by inputting the co ordinates xc,yi) to locate a point on the surface. These points form the location features viz., a •illage, school, dispensary etc. Many such points placed very near each other form the line eatures viz., roadways, railways, rivers, boundary etc. The line features when used to form closed polygon, represent the area features viz., the district, the block and the village. The nost significant feature of GIS is that the nulnerical data, which is available in the statistical orm, from various agencies and can be easily interfaced with these geometric features, to how different aspects and attributes of the arca both spatially and temporally. Pictorial 'presentation of statistical information related to location/surface spread helps in having a ptter insight and explanation to a particular phenomena, in spatial mode, which has so far 3en often missed in the planning process.The other method of inputting data is by the Raster i.e. by images or by hotographic pictures which are usually obtained from satellites in the form of remotely >nsed images and aerial photographs. A raster may be defined as a cellular organisation of patial data i.e. the basic data unit is a cell or a pixel. These pixel scan store colours or an pectrum of tones of a single colour. In the raster fortn the Inap is an array of pixels. The hape, size, colour texture and the tone determines the basic picture element and the esolution, and thus the map itself.The ability to overlay various geometric and non geometric features in an interactive node through layers in GIS and the ability to calculate the area and distance and undertake.

Implementation of GIS at grassroot level:

There are today a nuniber of agencies and disciplines engaged in collection Of data at village or grassroot level pertaining to such items as physical features Of land, natural resources, man-made features, enviromnental features and socio-economic aspects. Data collection for the devcloptncnt of GIS should bc at the lowest possible administration level i.e. villagc level that has the technical ability to collect it accurately and efficiently (refer Fig. 2). Such information system can then be aggrcgated to form thc higher Icvcl information systems to meet the district, ning and control Incasures cannot be impiernented unless the people in rural areas and at all levels of Government have easy access to

information. Comprehensive information, characteristics and use should be collected and continuously updated so that all citizens and levels o' Government can bc assisted in planning various development progratnmcs.

In order to ensure effective planning of various' rural development programmes, it is essential that comprehensive information be generated in widest possible spectrum, continuously temporally updated and spatially madc available to the people of rural areas and at all levels of the government.

Land Information System (LIS)

GIS dealing in various quantitative and qualitative aspects of land resource is termed as Land Information System or LIS. "A Land Information System is a tool for legal, administrative and economic decision making and an aid for planning and development, which consists on the one hand of a data base containing spatially referenced land related

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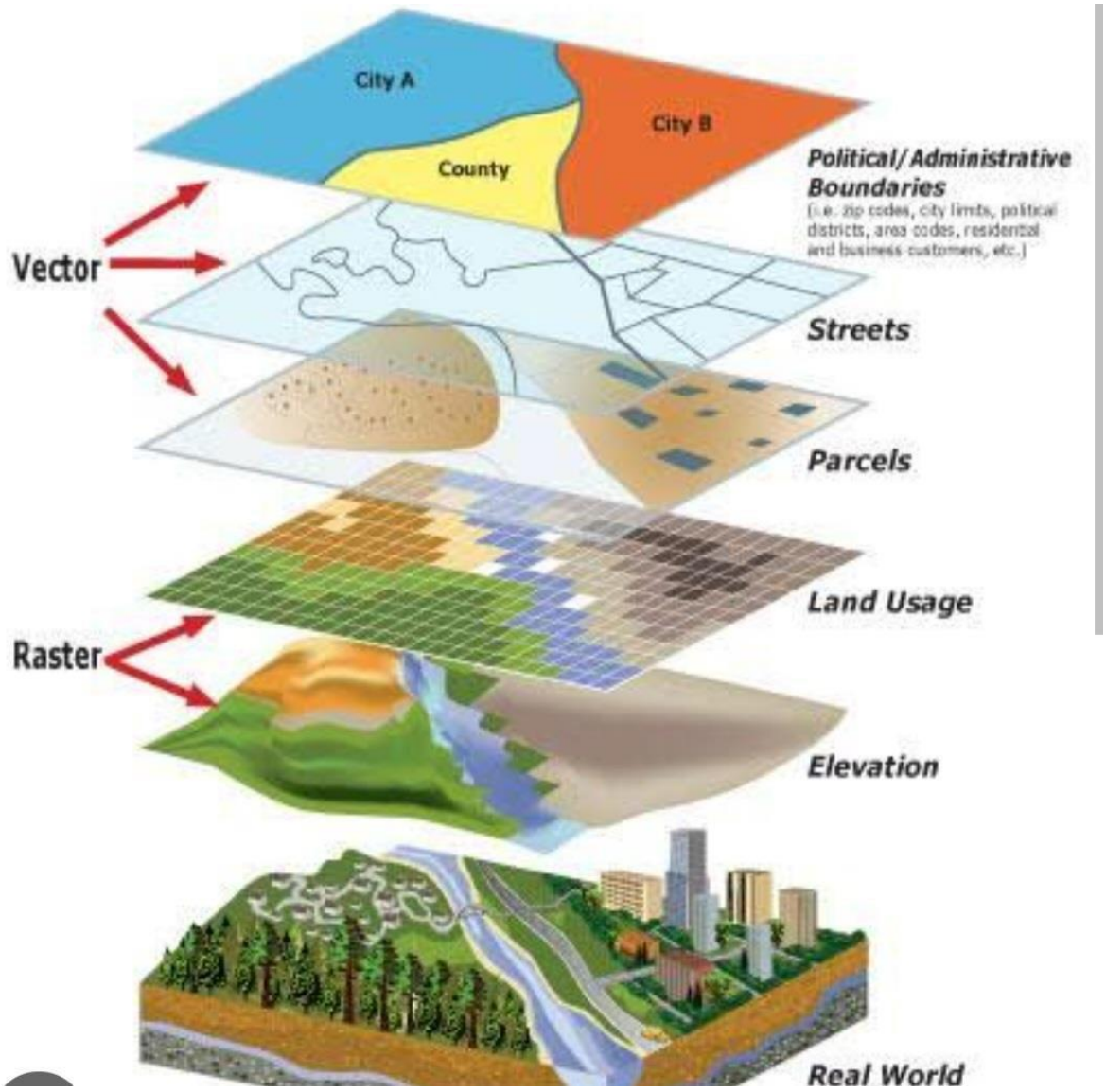

Céntrol Himalaya: Environment

-data for a definite area, and on the other hand, of procedures and techniques for systematic collection, updating, processing and distribution of data. The base of the Land Information System is a uniform spatial referencing systeill for the data in the system, which also facilitates the linking of data within the system with other land related data" (Federation International des Geometre quoted in Abuja, A.K.,

1996).

Land is the base for all development. The quality of each plot of land has to be properly understood and then appropriate land development plan has to be made for each plot. Only this type of care can bring in good dividends in terms of yield. Thus, micro level planning at grassroot level can solve specific problems of an area and categorisation and prioritisation help meet the requirements of the people. (Rao,1994).

The data structure of LIS as illustrated in Fig.4 indicates a hierarchical structure with national level LIS being on the top of the hierarchy with maps of I •250,000 being used and the revenue. village with maps, of I for rural areas being used at the lowest end of the hierarchy. This structure is developed for all the states, districts and blocks of the country. (Roy, B.C., 1996).

Development Alternatives

By utilising GIS and Remotely Sensed Data it is possible to generate mathematical models of different scenarios, manipulate spatial interaction models in resource planning, use dynamic models in water resources, hill slope erosion and sediment deposit models used for watershed planning, drought prone area planning, agricultural planning and planning for forestry sector and disaster proofing.By overlaying of various infrastructure facilities with the natural resources and physical features of a particular area, it is possible through GIS to plan for the promotion of thc agriculture, social facilities and appropriate sustainable industries in that region more effectively.

Like wise the analysis of birth rate, literacy, school locations, agriculture data. social forestry etc. wh ich are required for day to-day decision making at district , block and village level can be undertaken with the help of GIS and the convergence of developmental efforts and plans can be facilitated in a more comprehensive fashion.Due to increasing pressure ofpopulation, there is an increasing demand for more land both for agricultural and non agricultural purposes, thereby leading to creatidn ofvast stretches of wastelands with the attendant deleterious consequence on the ecosystem resulting in socio economic crisis thereof. These trends could be halted effectively with the help of GIS. The available maps on wastelands, at different scales and different periods, about the increase in wastelands helped formulate policies and strategies for wasteland management. Lately, such wasteland maps are being used for prioritization of the watersheds with a view to ensuring ecological development of the area.The land-use statistics compiled fronl village records is time consuming and suffers from the inherent operator bias. There is need for spatial validation of cadastral level maps
and establish statistical reliability of the information. The GIS can play a major role in the validation of data collected through conventional revenue surveys with a view to preparing a sound accurate data base with least turnaround for planning reclamation of

degraded wastelands.Rapid increase in population, urbanization, agriculture, construction, have resulted in increasing demands for water and has resulted in extensive degradation of forest land thereby causing adverse effects on environment in hill region. Accurate and timely mapping, monitoring and assessment of the states of watershed are essential for assessing the water resources, and its optimum utilization for sustainable development through GIS and Remote Sensing techniques.

Conclusion

The objectives of decentralised planning can best be achieved with the help of GIS tools, which helps to visualize the various alternative development scenarios that can be easily understood by the common people. It would encourage participatory planning and a better expression of the felt needs of the people. Modem techniques of data collection and updating with the help of tools and facilities like remote sensing and Global Positioning Systems, strengthens GIS further and helps the system to be used very effectively by development planners and decision makers. The requirement of the future should be for having more trained manpower at lower levels to effectively harness GIS as a development tool and

develop an intelligent knowledge based expert systems with least user intervention in the operation of GIS.

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