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A Case study using GIS-based Evaluation of watershed managementMedak District, Telangana state, India

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Abstract

The Information Technology is one such significant creation which has changed the dimensions of man's thinking and made him very powerful for the capabilities of IT on information, analysis, storage, sharing, transmission, presentation and decision making anytime anywhere. The GIS being closely linked to IT rather ICT(Information Communication and Technology) is adding spatial dimension to the database and make man's understanding of the earth features more meaningfully and why and how of situations and changes taking over time and space. Village Information System is the management of village related information's in a technological environment, which will help the rural planners for the planning and implementation of plans in rural areas. It basically reduces the time and cost involved with the creation of data base for the planning. It comprises of all the information related to the facilities, infrastructure, population, building type, etc. This information is needed to analyze the existing scenario at the development stage in the village. The emergence of Remote Sensing and Geographic Information System as a powerful tool for spatial analysis and storage has in effect alleviated the problem by computerization of the spatial data. It has been developed in order to generate maps, which would provide relevant information for developmental activities and also act as source information authentication about the village.The details of the above work are discussed in the paper.

Key words: Geomorphology, spatial analysis, GIS, DEM, Medak.

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1. Introduction:

A well known fact that India lives in her villages and would continue to do so. But rapid urbanization and consequent haphazard growth of cities has resulted in neglecting of villages. It leads to deterioration of infrastructure facilities, health hazards, loss of agricultural land and water bodies, besides many micro-climatic changes disturbing the ecological balance. Further, there is exodus of population, driven by lack of adequate facilities/opportunities in villages, from rural to urban areas. Though the urban regions have developed faster as compared to rural, the basic objective of a balanced development of different regions has still remained a distant dream. Instead, this has widened the gulf between the developed (urban) and the less developed regions (rural), thereby creating islands of prosperity. Hence there is an urgent need to reduce the cleavage between the rural and the urban areas through appropriate development planning for the villages.

The advent of space technology all pervading and the pace of ICT(Information Communication and Technology) facilitating the data acquisition on almost real-time mode gives opportunity for judicious decision making at all levels of governance for the developing world for reduction of redundancy and time and for optimum utilization of the scarce resources. The planning process has undergone a drastic change in recent years where decentralized participatory decision-making is resorted to ensure sustainability. However for this participatory decision-making, accessibility to a comprehensive data base which is easy to access and understanding of land records, topography, resources, settlement patterns and infrastructure new methodology and technology are needed. This is an area where spatial technologies play a key role in generating timely and reliable information for planning and decision-making at all levels. The use of GIS for a micro administrative unit for planning and implementation was tested in an Action Research Project in one of the Panchayats in India, where the knowledge base is developed up to cadastral level (land parcel level) and the house hold socio economic data is embedded on this layer on a GIS platform, with all graphic features of house type and house hold linked, to enable stakeholders take decisions in a dynamic mode.

Planning requires association and integration of various activities with spatial (geo-referenced) and non-spatial characteristics. Facility planning and management is one such an important area. Geomatics-based approaches to facility planning and management have, of late, gained prominence as they offer rational, efficient and effective solutions. Further, the rapid advances in the hardware and software technologies coupled with a growing competition among the related vendors have brought down the cost of Geomatics

/GIS technology by manifold, making it affordable for deployment on a large scale for use in decentralized planning.

Several attempts were made by the National Informatics Centre (NIC), Ministry of Communications and Information Technology, Government of India, and also by several other Corporate Sector and Space Organizations for developing GIS applications at local level use but these could not address the exact needs of local self-governments for local applications. Even web-based applications were developed for wider applications in States like Madhya Pradesh and West Bengal but they also remained for limited applications.

Even though it is widely recognized that the Geographic Information System (GIS) has the capacity to analyze both spatial and temporal data on a cost effective manner for effective planning and management, its application at the micro level for participatory planning and management is limited.

In view of this scenario, an attempt has been made to actually apply the GIS Package, simple, user friendly, customized, local need based, interactive and can be handled by the local youth and Village functionaries. It could be called Panchayat GIS, which has all inbuilt features of various decisions at the village level integrating various layers of information both spatial and attribute pertaining to the village.

2. Experimental Analysis:

1. Integrated resource surveys (Natural resources and Human resources) and mapping at the Village level involving local volunteers, Panchayat officials etc.
2. Surveys relating to basic infrastructure of the village roads, drinking water resources, schools etc.
3. Household information, housing structure, type of material used in house construction, basic amenities like electricity, water, telephone etc.
4. Photographs of the house and its members.
5. Household wise collection of data relating to house tax, water tax etc.
6. The resource surveys using cadastral map in the scale of 1: 5000. Plot wise information was collected.

3. Methodology:

The following methodology and Procedure is Adopted in the Present study Area:

1. Collection of satellite data and Survey of India Topographical maps, collection of rainfall and temperature data and other collateral data covering the study area.
2. Preparation of base map on 1:50000 scale using Survey of India Topographical Maps.
3. Preparation of Settlement and Transport network map using SOI 1: 50,000 topographical maps.
4. Preparation of Drainage and watershed using SOI topographical maps and updating with the satellite data (Using ArcGIS 9.3 software).
5. Preparation of contour map of 5metres contour interval using SOI 1: 50,000 topographical maps.
6. Preparation of DEM (Digital Elevation Model) from contour map (Using 3D Analyst Module of ArcGIS 9.0 software).
7. Preparation of slope map using contours from SOI toposheet 1:50,000 scale.
8. Preliminary pre-field interpretation of Hydro geomorphology, soils and land use and land cover maps using Satellite data on 1: 50,000 Scale.
9. Ground truth data collection, verification of doubtful areas.
10. Correction, modification and transfer of post field details of Hydro geomorphology, soils and Land use / Land cover on to original maps.

For the present study IRS LISS IV MX data was procured from NRSA. This data was used in the preparing of thematic layers like Land Use Land Cover map, Hydrogeomorphology Maps, Ground Water Potential Maps, Soil Map. The information related to the contours and drainage was generated form the survey of India Toposheets on 1:50,000 Scale.

4. Study Area:

The study area consists of entire village. The coordinate system for the study area needs to represent the geographic features in true shape and size. Since the capture of the spatial features is based on Survey of India (SOI) toposheets (Scale-1: 50,000), UTM projection system has been followed for the coordinate system as adopted by SOI. For convenience, the same coordination system is used for Registration points also, thereby allowing proper integration of data sets.

Cadastral maps were integrated with the spatial coordinates of the Village.Revenue maps (Scale-1: 8,000), SOI toposheets and Block road maps (Scale-1: 50,000) formed the source maps for the spatial data. Since non-overlapping covers the study area multiple maps of varying types and scales, it became necessary to adopt a standard procedure for registration of Ground Control Points (GCP's). This is a shared method of points where each TIC is a part of more than one map sheet to facilitate the map joining/ mosaicing and sheet-by-sheet data digitization.Base map isprepared from Survey of India toposheets on 1:50,000 scale comprising drainage system, settlements, village administrative boundaries and road network within the watershed. The base map comprising of drainage network has been prepared using Survey of India topographical maps on 1: 50,000 scale. The study area is having streams, which are sparsely located over the region and has one river.These streams are further classified based on stream ordering. Firstly, Survey of Indiatoposheets on 1:50000 should be scanned using Ao size flat bed scanner and converted to Tiff raster format. These maps should be projected to real world coordinate system. Contours (poly lines of equal elevation) are to be digitized using Arc Info GIS software. After digitization editing should be done to remove pseudo nodes, overshoots and undershoots. Arc topology has been created by 'Clean' command. The coverage has to be projected toUTM projection after establishing tics to generate TIN which is an essential parameter in surface modeling.In order to establish flow accumulation raster and possible stream network an elevation raster has to be created. For this contour datathus generated in the vector format has to be used to generate TIN using Arc Map 3D analyst functions. Later this TIN has to be converted to DEM (Elevation raster) raster form by using spatial analyst functions. Slope map can be generated from the elevation raster by surface analysis tools under spatial analyst functions. Similarly, aspect map can also be prepared from the slope map in the same method mentioned.

5. RESULT & DISCUSSION:

Land use planning in rural areas has received scant attention in comparison with town planning until recently. This can hardly be justified in a country like India, which is predominantly agricultural. The planning of agricultural sector in rural areas has been carried out in laissez faire manner. Very few deliberate and cautious attempts were made to improve the countryside. The development of land use planning is not recent in its origin but its practice is truly recent. A land use map gives thorough and clear picture of land to the planners for the determination of future use and planning the agricultural sector to maintain the land potentials. In this way, land use planning is concerned with the future use of the land and the changing demands of the society.

The strength of GIS is the integration of multi-layered data from different sources and various scales. The integration of different layers of information has been a difficult task manually until the maps were drawn on a transparent film. With the availability of GIS, which takes the data into digital space, the ability to see through maps, which are overlaid one over the other digitally and analyze the maps is achieved. Database management systems integrated with graphic interface have a powerful query capability. This will finally give the analytical ability to pose complex query and extract information spatially.

Remote sensing data is the final solution for large area coverage and temporal coverage of land area. It is an important source of input to GIS. Different layers of information generated from remotely sensed data provide an authentic input when used in a GIS. The analysis carried out in the present study uses primarily information generated from remotely sensed data. Layers were generated for land use, soil, ground water potential, slope, along with base map.

The present study brings out the different classes of land use/land cover identified on the basis of satellite imagery and validated by ground checks. While identifying the areas under different land use classes, the ecological principles of land use have been considered as the guiding criteria. Nature of terrain, availability of moisture and vegetative characteristics of the area has been chosen as prime factor. The land use classes thus interpreted would help in identification of the lead sectors and formulation of development strategy

It is a non-agricultural entity developed for human habitation comprising residential and transportation network. The total areal extent of built-up land is about 8.36sq.km, which is 2.12% of the total study area

Agricultural land use is dependent on land system and land units. It shows wide variations in the land units. It shows wide variations in the land use patterns in different part of the area. The agricultural land classes delineated in, crop and fallow land which constitute an area of about 143.5sq km, i.e. about 36.5% of total geographical area.

Cropland left un-cropped during both the kharif and rabi season fall under this class. The total estimated fallow land area is 42.1sq.km, which constitute 10.7% of total study area.

Wastelands are described as, degraded lands which can be brought under vegetative cover with reasonable effort and which are currently under utilized and lands which are deteriorating due to lack of appropriate water and soil management or on account of natural causes. Wastelands can result from inherent/imposed disabilities, such as locations, environment, chemical and physical properties of the soil or financial or management constraints. The total estimated wasteland area is 92.2sq.km, which constitute 23.4% of total study area.

They occupy relatively higher topography like uplands or high grounds. These lands are generally prone to degradation or erosion. The total land with / without scrub area is 6.38sq.km, which constitute 1.62% of the total geographical area.

There are no prominent surface water bodies in our study area.The area has high productivity potential, which can be achieved through optimum land use planning. This forms the purpose in achieving India's planning goals of national self-reliance in food production, improved economic efficiency, equity and social justice. Unwise use of land leads to the degradation of the natural resource base. The total estimated waterbody area is 18.82sq.km, which constitute 4.78% of total study area.

Forest Lands have a tree-crown area density (crown closure percentage) of 10 percent or more, are stocked with trees capable of producing timber or other wood products, and exert an influence on the climate or water regime. Forest Land generally can be identified rather easily on high-altitude imagery, although the boundary between it and other categories of land may be difficult to delineate precisely. Lands from which trees have been removed to less than 10 percent crown closure but which have not been developed for other uses also are included. The total area covered with forest land is 81.69 sq.km which constitute 20.8% of total study area.

Table 1.Areal Extent of Various Land use/Land cover

Mapping Unit	Land use/Land cover category	Area in Sq.Km	% Area
1	Built-up land	8.36	2.12
2	Agriculture Land	143.5	36.5
3	Fallow Land	42.1	10.7
4	Waste Land	92.2	23.4
5	Land with / without scrub	6.38	1.62
6	Water bodies	18.82	4.78
7	Forest	81.69	20.8
Total:		393.05	100

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Table 2.Areal extents of Hydrogeomorpology mapping units

Map Unit	Area in sq .km	Area in (%)	Ground water potential prospects
MPC3	235.2	59.73	Moderately poor
Floodplain	25.9	6.577	Good
HDP	62.2	15.79	Poor
MBP	52.5	13.33	Moderately poor
waterbodies	0.97	0.246	Good
Inselbergs	0.24	0.06	Poor
Sandyarea	1.39	0.35	Good
Inselbergs	14.09	3.57	Poor
Waterbodies	0.29	0.073	Good
RH3	1.28	0.325	Poor
	393.76	100	

Table 3.Areal extents of Land Capability

S.No	Land use/Land cover category	Land capability	% Area in sq.km	Area in %
1	Crop Land	II	143.5	36.5
2	Fallow Land	III	42.1	10.7
3	Scrub	IV	6.38	1.62
4	Forest	VI	81.69	20.7

Table 4.Areal extents of Land Irrigability

S.No	Land use/Land cover category	Land Irrigability	% Area in sq.km	Area in %
1	Crop Land	II	143.5	36.5
2	Fallow Land	III	42.1	10.7
3	Scrub	IV	6.38	1.62
4	Forest	V	81.69	20.7

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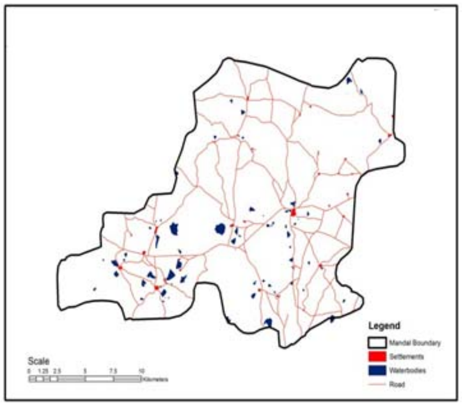


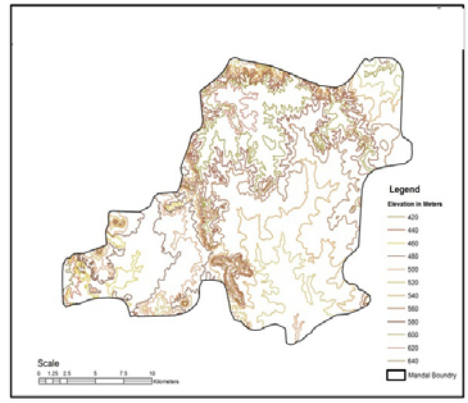
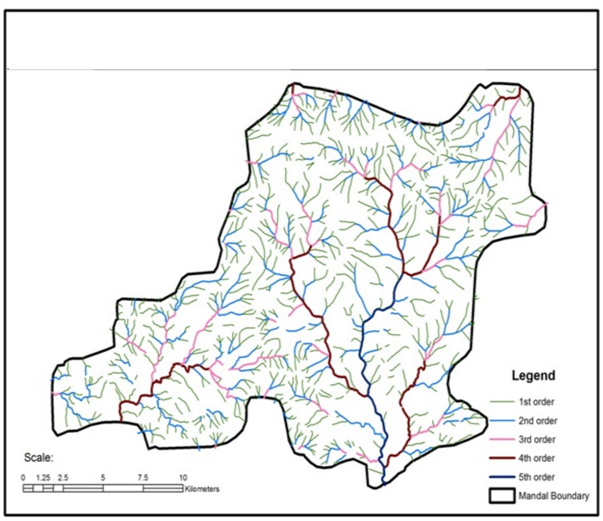


Fig 1.Contour map of MedakT.S

Fig 2.Base map of Medak,T.S



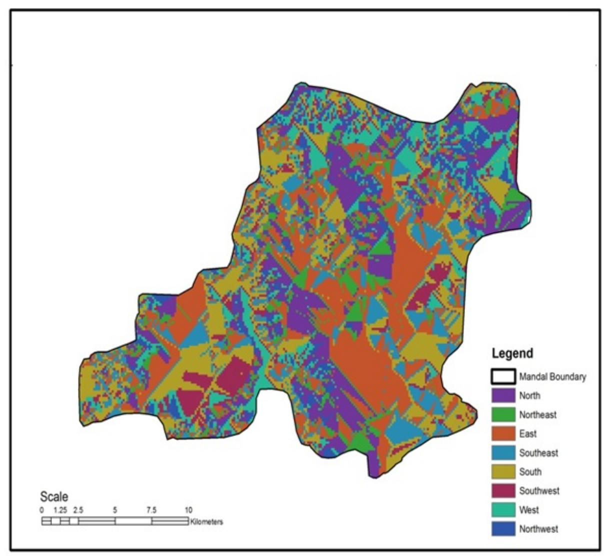
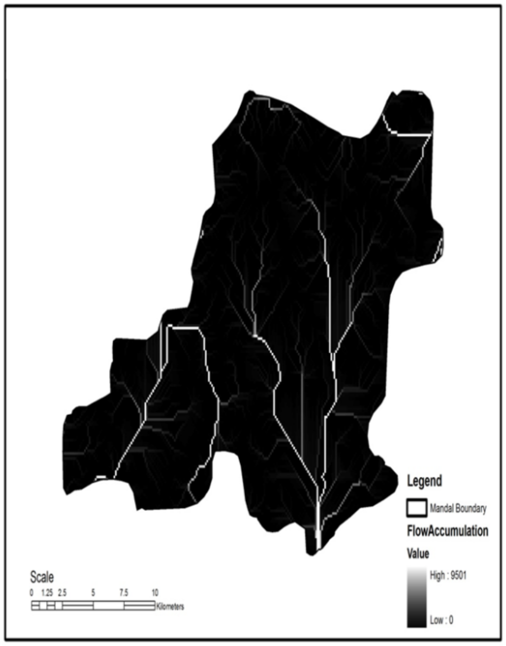


Fig.3 Drainage map of medak district T.S

Fig4.Flow accumulation map of Medak, T.S



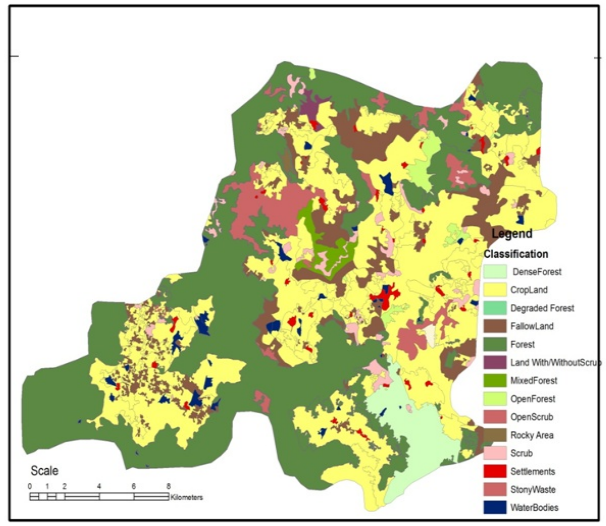
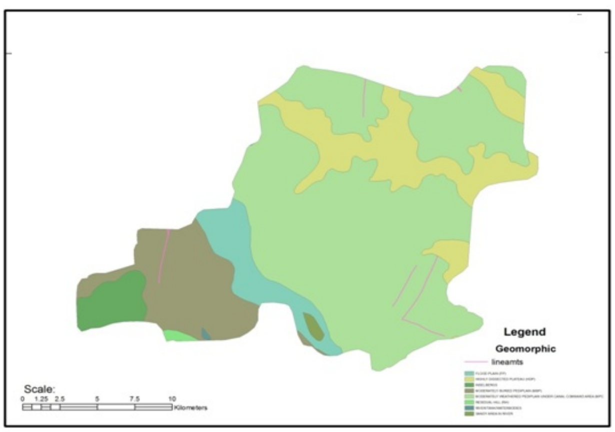


Fig.5 Flow direction map Medak T.S

Fig6.Land Use Land Cover of Medak, T.S



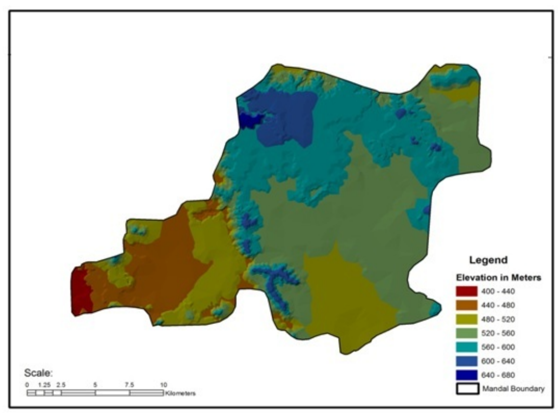


Fig7.Hydrogeomorphology of Medak, T.S

Fig8.Triangulated Irregular Network of MedakT.S

6. CONCLUSION:

It is apparent from the fore going that there is a tremendous scope for frontier technologies in developing a data base of resources. The study concludes that remote sensing and GIS technologies can be used for scientific planning and management of natural resources. The generation of alternative land use/land cover practices for natural resources management involves careful study of thematic maps both individually and integrated basis as well keeping in view the conservation and improvement of the available arable and non –arable land, action plans are generated in an integrated way for different land use systems based on systematic assessment of physical capability, economic viability and technical feasibility.

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REFERENCES:

1.Ashok G and K. RamachandraPotti, 2004, Building Land Information Systems from cadastral maps page No:220-228.

2.B.A.U.I.Kumara,2008, Application of Participatory GIS for Rural Community Development and Local Level Spatial Planning System page No:250-275.

3. Cheng Nga-fong, Tang Hong-wai Conrad, 2003, An Analysis and Implementation of Cadastral Survey System page No:302-313.

4.Demers,M.N.1991,"Classification and purpose in automated Vegetation maps".

5. Herrmann.S, 1999, Planning sustainable land use in rural areas at different spatial levels using GIS and modelling tools page No:225-290.

6.Inés Santé-Riveira, 2007, GISbased planning support system for rural land-use allocation page No:295-305.

7.Lillesand,T.M.,and R.W.Kiefer,1995 "Remote sensing"

8.Michael K. McCall, 2002, Seeking good governance in participatory-GIS: a review of processes and governance dimensions in applying GIS to participatory spatial planning page No:365-410.

9. MamtaDahiya, KhushpalDahiya&Subhan Khan, 2008, Geo-Spatial

Technologies Application in Micro-Level Planning for Rural Development page No:450-475.

10..Peuquet.T,and n.Chrisman,1975 "Cartographic Data Structures"

11.L. R. A. Narayanan, Land Information System page No:220-235

12.Ravindran.A,jaishankar.J,GIS based information system for village level planning page No:320-335.

13..Robinson,A.H.j.L.Morrision,P.C.mcrehrcke,A.J.Kinerling,and S.C.Guptill,1995

14.Vrana,R-1989,"Historical Data as an Explict Component of Land Information System".

15.http://www.support.esri.com

16.http://www.gisdevelopment.net

17.http://en.wikipedia.org/wiki/information_system

18.http://msdn.microsoft.com/en_us/library/