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Research Papers

INTEGRATED WATERSHED MANAGEMENT BY USING REMOTE SENSING AND GEOGRAPIC INFORMATION SYSTEM

R. S. MORE , V. GHODAKE AND N. J. SATHE
Sinhgad College of Engineering, Department of Civil Engineering, Pune.

Abstract

This paper discusses the role of Remote Sensing and Geographic Information System in management of watershed for the purpose of placement of Water Harvesting Structures like Check Dams, Percolation Tanks, Farm Ponds, Bore Well, Dug well,etc. In this paper, examples of 10 projects are included which presented to illustrate the initiaves the Watershed Management that have been implemented for the Placement of Water harvesting structures. The various thematic maps like soil map, land use map, slope map and DEM map were prepared for the placement of water harvesting structures. Also they have studied the subsurface Resistivity sounding test which provides the subsurface Information regarding subsurface resistivity distribution and thickness of layers which can be correlated with the local geology of the study area.

KEY WORDS:
Watershed Management, Remote Sensing, Geographic Information System, Electric Resistivity, Water Harvesting structure, Ground water

INTRODUCTION

Watershed management is defined as development of an area through watershed approach using natural resources and taking into consideration needs of the inhabitants with sustainable and integrated approach. Watershed management can convert degraded areas into high productive zones and thereby improve the status of inhabitants.

Watershed Management is the revolutionary program for fulfilling the water needs in the water scarce area as well as it is a process of creating and implementing plans, programs, and projects to sustain and enhance watershed functions that affect the plants, animals and human communities within watershed boundary (Mrs. Vidula Swami, Dr. Mrs. Sushma Kulkarni, International Journal of Engineering Science and Technology,Vol.3, March 2011).

Remote sensing techniques can be used to make observations and measurements of land features which in turn are used to prepare thematic maps. Geographic Information System is a useful tool for Watershed Management . GIS software and hardware tool applied to geographical data for integration of collection, storing, retrieving, transforming and displaying spatial data for solving complex planning and management problems(Sankar P, Hermon R. R.. ,Alaguraja P, Manivel M, Hyderabad , August 2012).This tool (software and hardware) has made the data handling and analysis much easier with meaningful research outcomes(Sankar P,HermonR. R., Alaguraja P, Manivel M, Hyderabad , August 2012). It stores both spatial and non spatial data layer by layer either in raster or vector format.(Sankar P, Hermon R. R., Alaguraja P, Manivel M, Hyderabad , August 2012).

The main objectives can be achieved in watershed by implementing the watershed management programmes in three stages. The First main objective is providing water harvesting structures such as check dams, percolation tanks etc. These structures make water available to the crops during no rain period, provide opportunity for the rain water to percolate down to replenish ground water, reduce runoff

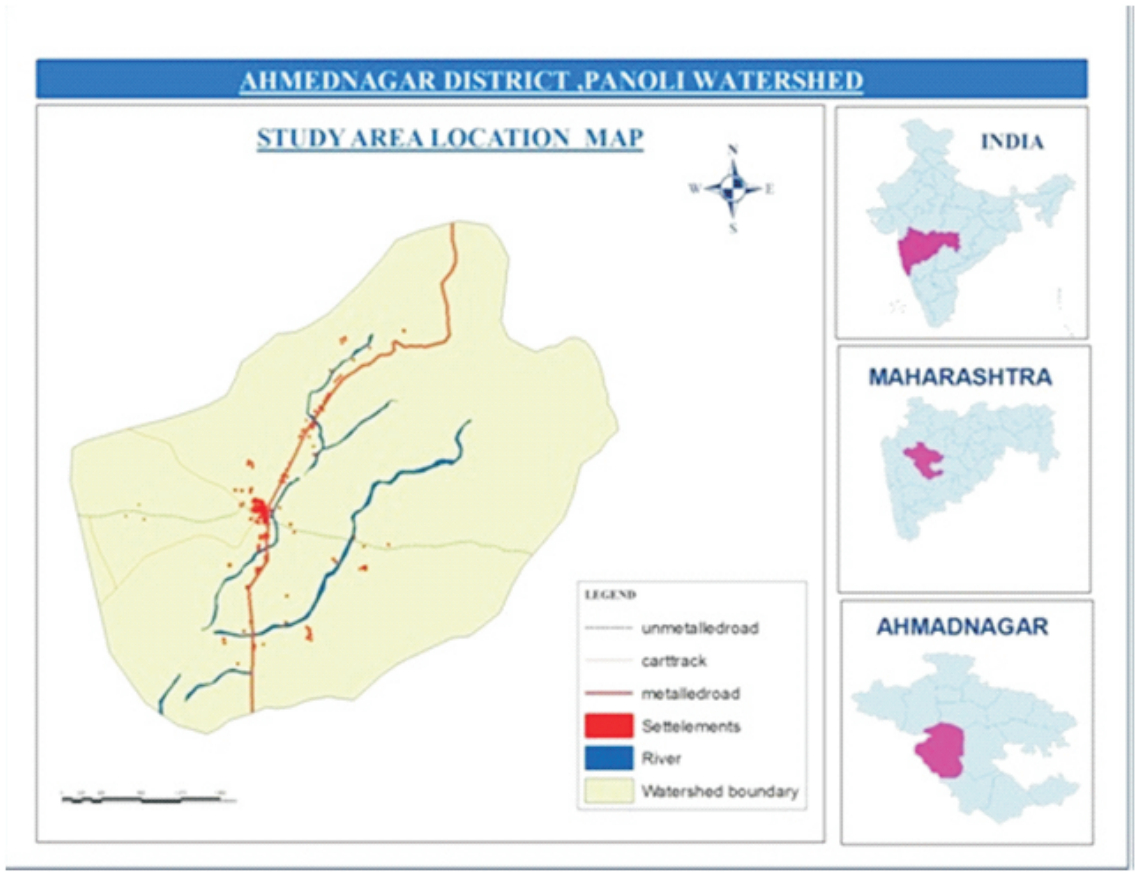
volumes, reduce the velocity of flow and stop soil erosion.Second objective is improving the quality and quantity of natural resources such as soils and water by implementing soil and water conservation measures. And third objective is adopting alternative land use systems so as to use resources optimally.

Water Harvesting Structure consists of collection, storage and subsequent use of collected water(Fewkes, 2006).The objectives of water harvesting structures are to arrest runoff and act as storage structures as well as to arrest sediment and silt flow out of the watershed, to facilitate infiltration of water, to supply life saving irrigation to the crops, to provide for recreation and allied agricultural use.

PREVIOUS CASE STUDIES:

STUDY AREA FOR SITE SUITABILITY OF WATER HARVESTING STRUCTURE

The study area is "Panoli village", Parner Taluka, Ahmednagar District. It is located between 19007'00"N - 25054'00"N latitudes. Ahmednagar is the biggest district of Maharashtra in terms of area and population. The total geographical area of the district is 17.41 lakh ha. The net cropped area is 12, 56,500 ha, out of which an area of 3, 30,000 ha. (26.27 %) is under canal (84,000 ha) and well irrigation. About 9, 26,500 ha. (73.73 %) area is rain fed. The area under Kharif crops is 4, 60,000 ha. (36.6 per cent) while 7, 58,000 ha (60.32 per cent) area is under Rabi crops. A multiple cropping system is followed on 1, 10,500 ha. Area. A total of 8.73 per cent area of the district is under forest. Role Model of water conservation work can be seen at Ralegan-Siddhi and Hivare Bazar which are also called ideal Villages. The western hilly part of Ahmednagar district has forests (Sankar P, Hermon R. R., Alaguraja P, Manivel M,Hyderabad, Int. Journal of Advances in Remote Sensing and GIS, Vol. 1, No. 1, August 2012).



MATERIALS AND SOFTWARE USED

In this case study, they used toposheet no. 47J/5/NE of scale 1:25,000.They were collected the various data like satellite data, rainfall data, Temerature data, other collateral data and topographic map for study area.

They were used softwares like Arc GIS 9.3 and ERDAS IMAGINE 9.1 for the same purpose.

METHODOLOGY USED

In this study, they werw collected satellite data , Rainfall data, Topographic maps and other collateral data for their study. Then, they were prepared a map like Base map, drainage on 1:25000 scale by using topographic map of survey of india. Further, they were prepared a digital contour map and created a DEM i. e., Digital elevation model. Then, by using 3D analyst module of Arc GIS 9.0 software, they hwere prepared a DEM from contours and DEM of watertable from watertable contours. After this, they were prepared a slope map using contours. By using satellite data, they were prepared a land use / land cover map on 1:25000 scales. Then , they have done a correction , modification and transfer of post field details of Geomorphology, land use/ land cover on to original maps and then they were generated a development plan for land and water resources(Sankar P, Hermon R. R., Alaguraja P, Manivel M, Hyderabad , Int. Journal of Advances in Remote Sensing and GIS, Vol. 1, No. 1, August 2012).

Overlaying of all these maps like soil map, slope map, geological map, Geomorphological map, etc was carried out for the selection of of site for water harvesting structures. They were used some criteria for placement of water harvesting structures.

ELECTRIC RESISTIVITY

The Electric resistivity is the resistance offered by the opposite faces of unit cube of material to direct current is called Resistivity(Sriniwasan K, Chidambaram S, Poongothai S, European Scientific Journal, edition vol. 9, No. 17,June 2013).It provides valuable information with respect to distribution thickness and depth of ground water bearing formations(Stephen O. Ariyo, Gabriel O, Adeyemi , Nigoria, Volume 10, No. 1, (Spring) May 2009).

The main aims of Electric resistivity are to determine the Geological and Hydrological characteristics of the aquifer, to correlate the Vertical Resistivity Soundings curves with various rock types and relate them to the aquifer potential and to establish the usefulness of Electric Resistivity methods as a potential tool in solving the complex geohydrological problems associated with groundwater occurrence and its development in typical Hard Rock(Stephen O. Ariyo, Gabriel O, Adeyemi , Nigeria, Volume 10, No. 1, (Spring) May 2009).

CASE STUDY

The study area was Dhubdhubi basin which is in South Solapur and Akkalkot Taluka of Solapur District, Maharashtra. It is located in on survey of India toposheet no. 47 O/14, 47 O/15, 56 C/2, 56 C/3 on the 1:25000 scales. It lies between Latitudes 17˚ 21' to 17˚ 41' N and Longitudes 76˚ 00' to 76˚ 11' E . The total area is 450 sq. Km. (A. B. Narayanpethkar, S. M. Sabale and V. R. Ghodake, vol. 13, No. 4, October 2009)

METHODOLOGY

Firstly , the Resistivity Sounding curves were first interpreted by the curve matching techniques (Bahttacharya and Patra 1968).Using thes eparameter so obtained ,the interpretation was further refined by computer –aided technique by changing the layer parameter in an interactive manner to archieve better match between the observed and the compound curves.(Koefoed 1979). Then, they were prepared a contour maps for the subsurface interfaces of different layers obtained from resistivity soundings. These contour maps on different layer interfaces called structure contour maps which provides qualitative regional correlation between the subsurface geology and the electric resistivity(A. B. Narayanpethkar, S. M. Sabale and V. R. Ghodake, vol. 13, No. 4, October 2009).The flow systems or patterns for each of the aquifer in a multiple aquifer system are also visualized (A. B. Narayanpethkar, S. M. Sabale and V. R. Ghodake, vol. 13, No. 4, October 2009).

CONCLUSION

After studying all papers, we can say that Remote Sensing and GIS is very efficient tool for Watershed Management as it is time saving tool. Using Remote Sensing and GIS, we can get results in very less time and less human efforts. Remote Sensing provides satellite imagery which provides the forest map and Land use/ land cover map. Overlying of maps like soil map, slope map, drainage map, etc is carried out by using GIS software which is useful in site selection for Water Harvesting Structures like Check dams, Percolation tanks, etc.

Electric Resistivity Sounding provides the information about rock type, thickness of that rock layer of subsurface. Also, it gives idea about the Groundwater zone and it can be use for the selection of sites for artificial recharge.

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