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STUDY OF DIGHORA MICROWATERSHED, CHHATTISGARH THROUGH REMOTE SENSING & GIS

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Abstract

An integrated watershed management planning of land use is always taken a primary source. The Earth Resource Technology Satellites and the Indian Remote Sensing Satellites have been extensively used for deriving information on geological and hydrogeomorphological features, soil resources, land use/land cover and forest resources. The present study signifies the effective use of Remote Sensing and GIS for watershed monitoring and impact assessment on the Dighora micro watershed area which has located in Janjgeer-Champa district of Chhattisgarh. The Landsat TM satellite data of 2009 and Survey of India toposheet were used to prepare base map, drainage layer, water bodies map and Land Use Land Cover map. The study indicates that the maximum 62.16% land cover was recorded for agriculture whereas the scrub land, settlement area and water bodies covers 9.59%, 4.91% and 23.34% respectively.

Introduction:

Watershed programs in India mainly focused on natural resource planning, landuse and water resource management in rural areas. Watershed management approach has been mainly adopted to conserve and improve the rainwater recharge, minimize land degradation, increase crop intensity and productivity (Wani *et a1*. 2002). Integrated watershed management helps to create a voice and stake for the landless, poor and women. Poverty alleviation through processes that involve and empower the poor and women will sustain. An integrated watershed management planning of land use is always taken a primary source. Now a day due to increasement of population, land resource becomes a scarce resource. Hence, land use information and their optimal use are essential for the selection, planning and implementation in integrated watershed management (Bansal *et al.* 2012). During the 1920s and early 1970s, aerial photographs were used for deriving information on various natural resources including land subject to degradation by various processes. The Earth Resource Technology Satellites and the Indian Remote Sensing Satellites have been extensively used for deriving information on geological and hydrogeomorphological features (Reddy *et a1*.2004), soil resources (Dwivedi *et al.* 2004), landuse/landcover (Landgrebe 1979, Rao *et al*. 1996, Singh et al 2011, Nayak and Mandal 2012) and forest resources (Singh and Singh 2012). Several studies in the recent and the past have been done on prioritization of watershed (Chakraborty 1991, Prasad *et al.* 1997, Biswas *et al*. 1999, Nooka Ratnam *et al.* 2005, Katiyar *et al.* 2006). The present study signifies the effective use of Remote Sensing and GIS for watershed monitoring and impact assessment on the micro watershed area. The present approach essentially aim at understanding physical framework of watershed with the help of remote sensing, field data and link this information to existing cadastral information in order to assess the impact of watershed program in remote village of Chhattisgarh.

Study area:

The present study area Dighora micro watershed is located in Janjgir-Champa district of Chhattisgarh. It is located in $21^{0}51'34.5"N$ latitude and $82^{0}20'36.2"E$ longitude and situated in Pamgarh (21^{0} 52'42.41' N: $82^{0}27'5.6$ E, 200 msl) tehsil. The total area of Dighora micro watershed is 716.82 hac (fig 1). The topography of the micro watershed is gentle and undulating. Two major soil types are found in the micro watershed viz; silt clay and sandy loam. The tree species like *Albizia lebbek, Albizia procera, Beutea monosperma, Acacia nilotica, Madhuca indica, Azadiracta indica, Embelica officinalis, Cesium cumini, Mangiferous indica, Aegle marmilose, Gmelina arborea, Ziziphus mauritiana, Ficus religiosa* etc. An agriculture land in the area is productive but some where it is unproductive due to biotic-interference and soil erosion. Paddy is the dominant agriculture crop with gram, wheat, chickpea, mustard etc.

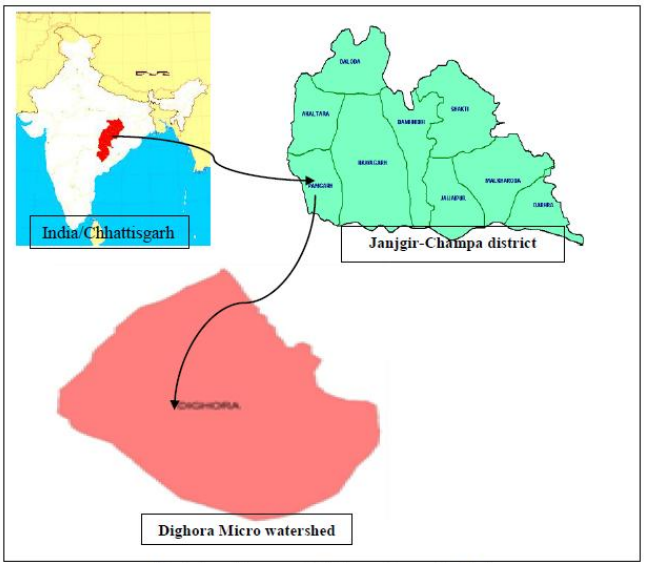


Fig 1: Location map of Dighora micro watershed

Materials and Methods:

Landsat TM satellite data of 16th November 2009 (path/row: 142/44) was used in this study (source: www. globis.com). Survey of India (SOI) toposheet 64-K/5 of 1:50000 was also used to prepare base map, drainage layer, water bodies map, field work and ground truth verification.

The visual interpretation technique and ground truthing were used for the mapping of land use/land cover. Prior to interpretation of spatial data, a brief reconnaissance survey of the study area was done to develop a classification scheme based on local knowledge and ancillary information. Entire area was visited to get information of different ground features and cover type with respect to satellite data. Preliminary interpretation of satellite data was analysed through ERDAS IMAGINE 9.0 software. ArcGIS software was applied for making cartographic quality output in the form of maps and generation of statistical tabular reports. The spatial data is organized using topographical data model while the non-spatial attribute data is stored using a data base management package. The final maps were prepared and area statistics was generated using Arc GIS.

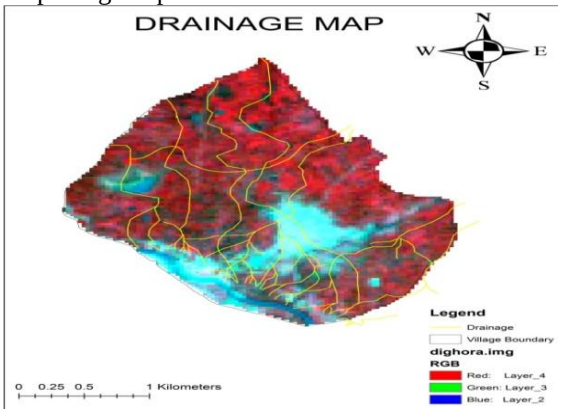
Results and Discussion:

Topography and Vegetation status:

The topography of the present micro watershed area is gentle and undulating. Two major soil types are found in the microwatershed viz; silt clay and sandy loam. Lands are fertile having moisture retention capacity with monsoonic rain and good vegetation. The tree species like *Albizia lebbek, Albizia procera, Beutea monosperma, Acacia nilotica, Madhuca indica, Azadiracta indica, Tectona grandis, Terminalia arjuna, Embelica officinalis, Cesium cumini, Mangiferous indica, Terminalia belerica, Aegle marmilose, Gmelina arborea, Ziziphus mauritiana, Ficus religiosa, Pongamia pinnata* etc. Agriculture lands in the area is productive but some where it is unproductive due to biotic-interference and soil erosion. Paddy is the dominant agriculture crop with gram, wheat, chickpea, mustard, Safflower etc.

Drainage Map:

Drainage map comprises of various streams that are flowing in the area. Drainage patterns and textures are dissection signatures and very important terrain recognition elements, used as criteria for identification of geological and geomorphological phenomena.



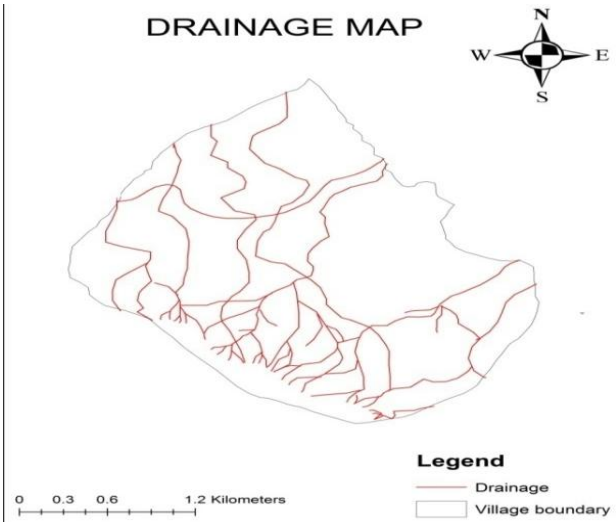


Fig 2. Drainage Map of Dighora micro watershed

The figure 2 indicates the drainage distribution pattern in Dighora micro watershed. In this pattern, the smallest finger-type tributaries are designated order1; where two first order channels join, a channel segment of order 2 is formed; where two channels of order 2 join, a segment of order 3 is formed and so forth. This happens due to the land slope pattern and also the characteristics of soil. In Doghora micro watershed, Lilagar river flows from its southern boundary which effects mostly the drainage pattern in the micro watershed. Bifurcation ratio characteristics range between 3 to 5 in this micro watershed. The slope counts near the river is <10 cm.

Demographic study:

As per 2011 census, the district Janjgir -Champa had a population of 16,20,632. The population distribution in Dighora micro watershed on the caste basis is detailed in diagram (fig 3). The total population of Dighora micro watershed is 730 (Male: 431 and Female: 299) in 110 families. Literacy percentage has recorded as 15.06%. Schedule Caste population especially Satnami community (30.02%) is highest in the micro watershed area.

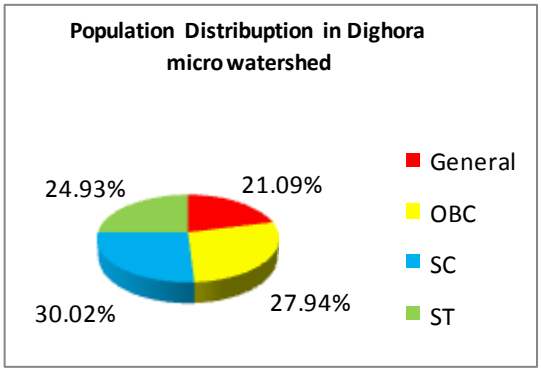


Fig 3. Distribution of population in Dighora micro watershed

Socio-economic status study:

In the Dighora micro watershed, Only 98 (13.42%) peoples of the total population are engaged in livelihood protection. The 66% populations have been engaged in agriculture, 18% works as labour in different localities near or far from Dighora (fig 4). The only 6% peoples are government servant from the micro watershed. The socio-economic

status of the local populace is not upto the mark. Electricity is the only facility which is availed by the all 110 families of micro watershed. Only 35 families have sanitation facilities, 5 families have television facilities; one family has refrigerator, 3 families have LPG facilities and 6 families have vehicles (fig 5). Due to high illiteracy percentage most of the peoples are unemployed and unskilled. So, they are unable to provide the economic support to their families and the poverty percentage is still growing in the micro watershed.

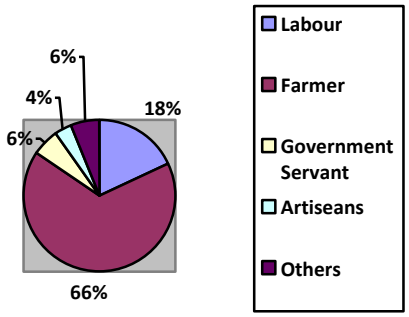


Fig 4: Working population status in Dighora micro watershed

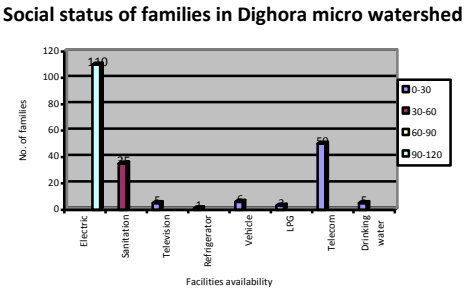


Fig 5: Social status of families in Dighora micro watershed

Water bodies status:

In Dighora micro watershed hand pumps, wells and borings are the source of drinking and irrigation for the local population. The pH of the ground water is in between 7.5 to 7.8. Most of the hand pumps and wells have been constructed by government authority. Natural streams and artificial Ponds are the other sources of daily works and irrigation. In summer season drinking water scarcity is also seen in some part of the micro watershed (fig 6).

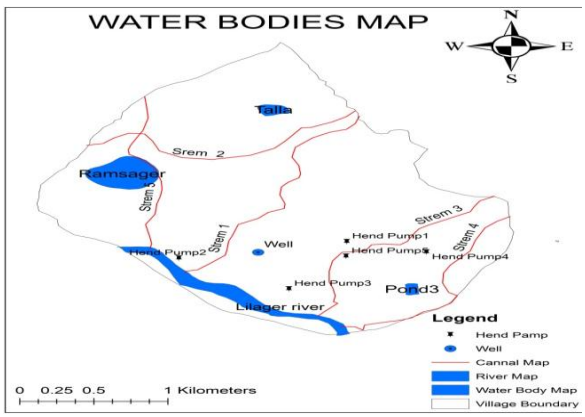


Fig 6: Water bodies status in the micro watershed

Spatial analysis of Land Use/ Land Cover for Dighora micro-watershed:

The False Color Composite (FCC) map of the micro watershed was prepared by Landsat TM image (fig 7). The supervised classification has been done and four major land use/ land cover classes were defined (fig 8). These include: Agriculture land, Scrub land, Settlement area and Water bodies. The land cover classes, the magnitude and the percentage for year 2009 is presented in Table 1.

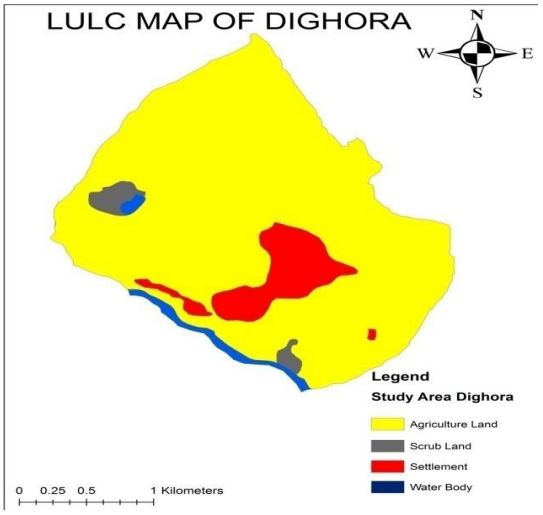


Fig 7. FCC map of Dighora micro watershed

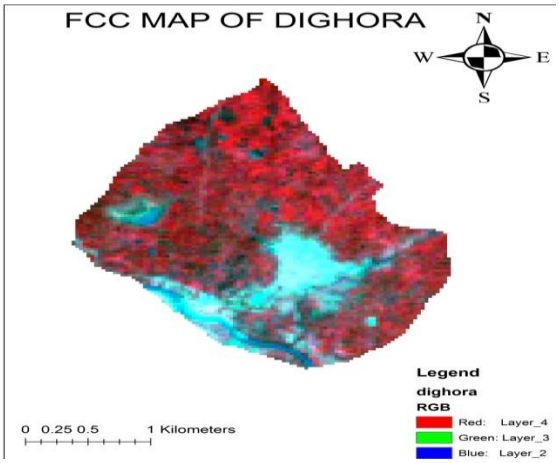


Fig 8. LULC map of Dighora micro watershed

Table 1: LULC of Dighora Micro watershed

S.N.	LULC Classes	Area (hac.)	% age
1.	Agricultural Land	253	62.16
2.	Scrub Land	39	9.59
3.	Settlement area	20	4.91
4.	Water bodies	95	23.34
	Total	407	100

Table 1 indicates that agriculture land is 253 hac (62.16%) of total land use/ land cover. However, the scrub land, settlement area and water bodies has recorded as 39 hac (9.59%), 20 hac (4.91%) and 95 hac (23.34%) respectively.

Conclusion:

The current study gives the information through extensive ground truthing and micro analysis for the Dighora micro watershed. Spatial and non-spatial data analysis approach was adapted during the study. The above results aim for optimum development of land and water resources and to meet the basic minimum needs of people there by improving their socio-economic conditions and may be applied by the decision makers and planners for sustainable development of the Dighora micro watershed area.

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