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Development of different thematic maps of the micro-watershed using geospatial technique

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Abstract
The research study was undertaken to generate various thematic maps for Dhangaon micro watershed of Bemetara district. The base maps such as watershed boundary, drainage network were prepared with the help of Survey of India topographical map. The satellite data of IRS –P6 LISS-IV of 10th October 2014 of the study area were used for generating various thematic maps such as land use/land cover, soil, hydro geomorphology and slope map. Total 15 ha comprising of 28 farm fields of current fallow under *Bhata* farming situation can be brought under cultivation, total 60 ha comprising of 250 farm fields of current fallow under *Matasi* farming situation can be brought under cultivation, total 40 ha comprising of 112 farm fields of current fallow under *Dorsa* farming situation can be brought under cultivation due to its good soil health, and total 30 ha of barren land comprising of 80 field can be brought under cultivation.

Keywords: Thematic map, watershed, remote sensing and GIS

Introduction
Athematic map focuses in a specific idea or theme. Thematic map illustrates a particular subject andcontrasts the general map, in which the variety of geological and geographical phenomena regularly appears together. Thematic maps also emphasize spatial variation of one or a small number of geographic distributions. These distributions may be physical phenomena such as climate or human characteristics such as population density and health issues. Thematic maps serve three primary purposes. First, they provide specific information about particular locations. Second, they provide general information about spatial patterns. Third, they can be used to compare patterns on two or more maps. A thematic map is a map that emphasizes a particular theme or special topic such as the average distribution of rainfall in an area. They are different from general reference maps because they do not just show natural features like rivers, cities, political subdivisions and highways. Instead, if these items are on a thematic map, they are simply used as reference points to enhance one's understanding of the map's theme and purpose.

Remote sensing and GIS are the handiest and accurate tools to measure the various earth resources and their potentials. Using satellite based remote sensing various resources maps can be generated and using GIS tools these maps can be further analyzed to derive a composite maps with numerous information, which finally derives new maps like land capability and land suitability maps. To make any developmental programme successful, site specific management plan has to be generated and implemented depending on the needs of the field (Khalkho et al., 2014).

Cadastral is normally a parcel based, and up-to-date land information system containing a record of properties in land. Cadastral maps show the relative location of all parcels in a given village or tehsil or district. They are commonly range from scales of 1:4000 to 1:8000. Information in the textual or attribute files of the cadastral, such as land value, ownership, or use, can be accessed by these unique parcel codes (survey numbers) shown on the cadastral map (Raghavendran, 2002).The present study was undertaken with a specific objective of developing different thematic maps of the micro watershed. The study was carried out at Dhangaon micro-watershed situated in Bemetara block of Bemetara district

Materials and Method
The information provided by the satellites in combination with other sources of information can be integrated through GIS to quantify the various parameters for efficient management of land and water resources in watershed.

Dhangaon micro-watershed of Bemetara block of Bemetara district and located between 21^0 49'0"and 21^0 51'0" N latitudes and 81^0 33'30" and 81^0 35'30" E longitudes was adopted for the study (Figure 1). It falls in SOI topographical map no. 64G/9 on scale- 1: 50,000. The study was carried out in the department of soil and water engineering. The geographical area of micro-watershed was found to be 573.44 ha. The general elevation of the study area ranges from 262 m to 278 m above mean sea level (MSL). The annual average rainfall of the area is 1140 mm. The predominant soil of watershed is clay though sandy loam, sandy clay loam, loam and clay loam were also found in the watershed. The watershed receives an average annual rainfall of 1140 mm. The daily mean temperature ranges from 40.0°C to 3.0°C. The daily mean relative humidity varies from a minimum of 40% in the month of April to a maximum of 88% in the month of July. The overall climate of the area can be classified as sub-tropical. Dhangaon is situated 10 km from the district headquarter Bemetara,which is well connected to Jabalpur, Raipur, Bilaspur, Durg and Kawardha by road network. The nearest railway station is Tilda railway station under SECR which is about 40 km from Dhangaon. The nearest airport is Raipur which is about 77 km from Dhangaon.

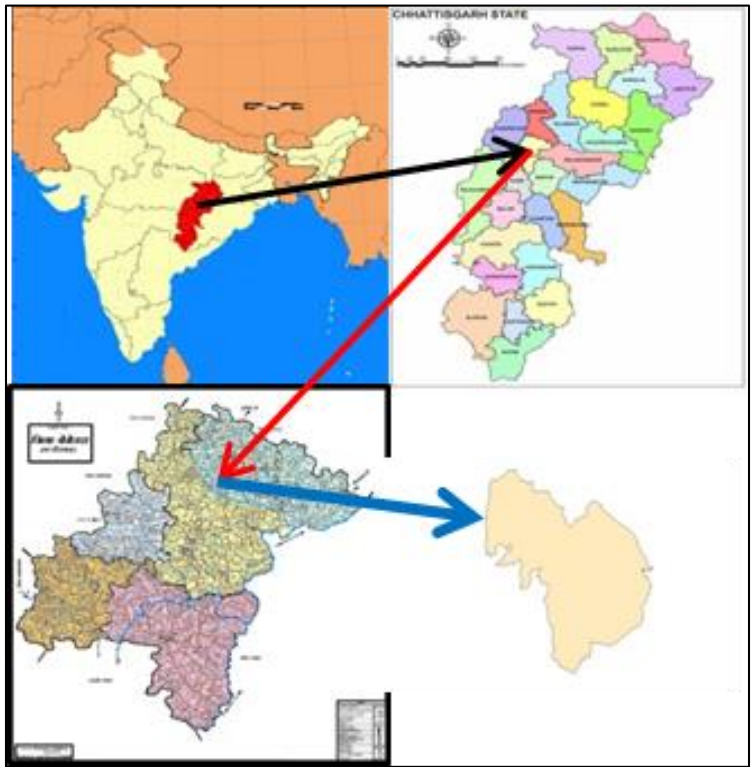

Fig 1: Study area

IRS-P6 (LISS-IV) satellite data of 10thOctober 2014 (path/row: 102/57) was used in this study. Survey of India (SOI) toposheet 64-G/9 of 1:50000 was used to prepare base map of the study area. Various thematic maps like drainage, water bodies were extended from base map, field work and ground truth verification. The cadastral map of the 1:4000 scale was acquired for the Department of Land Revenue, Government of Chhattisgarh, for the field level information of the Dhangaon village. The toposheet and cadastral map is digitized and georectified. The database of field level information from the land records and cadastral map was generated to give the clear picture about the land holdings of the inhabitants. ERDAS IMAGNE 11 and ArcGIS 10 software were used for image processing and GIS work. Pixel based classification was adopted for the classification of land use/ land cover form the satellite image. Digitized revenue or cadastral map was used to delineate each and every field with the creation of digital database of the land records.

Following resampling and geometrically corrected near-infrared, red and green band of the LISS IV data was used to generate a false color composite (FCC) of the study area. Supervised classification was used to identify the various land cover pattern of the area and delineation of water bodies. Data obtained by ground truthing using GPS (Global Positioning system) were used for pixel based image classification. Various thematic maps were generated like soil texture, land use, land cover, drainage network and DEM. Grid based soil sampling was done to get representative of the four farming situations for analyzing the profile of the study area. The soil sampling of the village was analyzed for giving the field condition of Micro-watershed in perspective of the farming situation and fertility. The methodology adopted for the study is presented in the form of flow chart in (Figure 2).

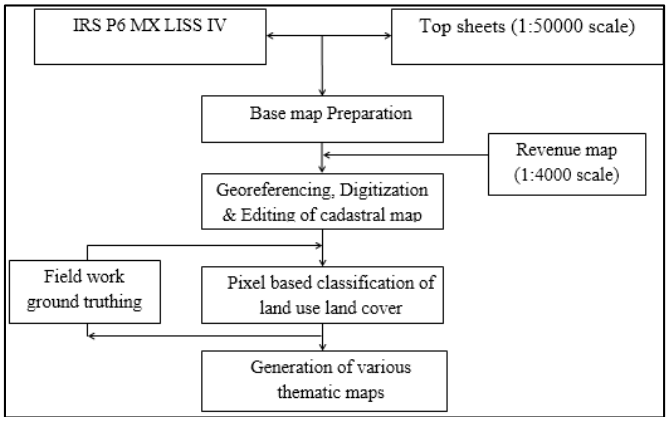

Fig 2: Layout showing the methodology of the study

Results and Discussion

The topography of the present micro watershed area is gentle and undulating. Major soil types found in the micro-watershed are; *Entisols* (Sandy loam) *Inceptisols* (Sandy clay loam) *Alfisol* (Loam) *Vertisols* (Clay). Lands are fertile having moisture retention capacity with monsoonic rain and good vegetation. Agriculture lands in the area are productive but some where it is unproductive due to biotic-interference and soil erosion. Paddy is the dominant agriculture crop along with soybean &pigeon pea in *kharif* and followed by chickpea, wheat 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. 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. 1st and 2ndorder stream were found at Dhangaon micro-watershed with 4.14 km and 3.3 km length respectively. The total length of the stream found was to be 7.17 km. In Dhangaon micro watershed, Hampriver flows from its northenboundary which effects mostly the drainage pattern in the micro watershed. The drainage density was found to be 1.28 km/km^2. (Figure 3)

Land Use/ Land Cover

Based on the pixel based classification and image characteristics eight land use classes (Figure 4) were identified in the watershed Table 1 indicates the land resource use pattern of micro watershed with major part of the study area dominated by paddy crop (199.37 ha) which is 33% of the total area. This is followed by Soybean (124.07 ha), which is 21.54% current fallow (113.08 ha) which is 19.64% of the total area pigeon pea (54.439 ha) which is 9.45% of the total area. Deep water body contributes 2.15% of the total area and small water body by 0.015% of the total area

Table 1: Land Resources use pattern of micro watershed.

Sl. No.	Land Use	Area in ha	Percentage area
1	Deep Water Body	12.4	2.15%
2	Shallow Water Body	9.0	0.015%
3	Pigeon Pea	54.4	9.45%
4	Low Land Paddy	118.6	20.60%
5	Mid Land Paddy	80.7	14.02%
6	Soybean	124.0	21.54%
7	Current Fallow	113.0	19.64%
8	Barren land	63.3	11.00%
9	Total	575.7	100%

Soils

The soil texture of the Dhangaon Micro-watershed (Figure 5) varies from sandy loam to clay. Four classes of soil texture were identified with Inceptisols (sandy clay loam) contribute 309.84 ha, which is 60.86% of the total area followed by Alfisol covering 161.826 ha, along with vertisols and Entisols covering (72.69 ha) and (46.74 ha) respectively. Soil erosion depends much on the infiltration rate of a soil. The infiltration rate depends on the soil textureas in sandy soil the infiltration rate is higher than silty soil. In a clayey soil it may be initially high (for heavy black clay with cracking), but becomes low when the soil is moist to wet.

DEM and slope

Digital Elevation Model (DEM) was generated (Figure 6) using the contour map along with the field surveys and done using global positioning system (GPS). The elevation of the project area was found to be in the range of 534-661 m above mean sea level. The DEM was generated by the classifying the relief in four class.

The Slope map played the major role in delineating the farming situations for preparation the site specific management plan

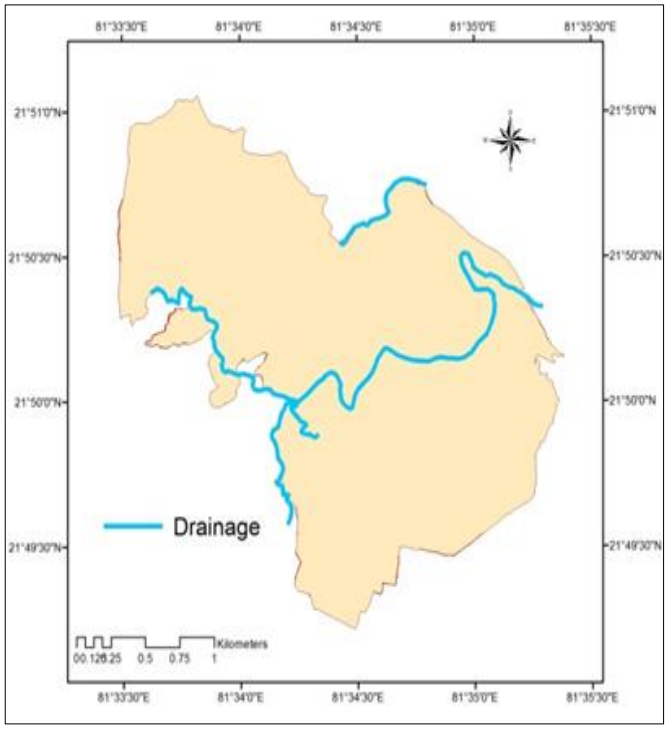

Fig 3: Drainage map of the study area

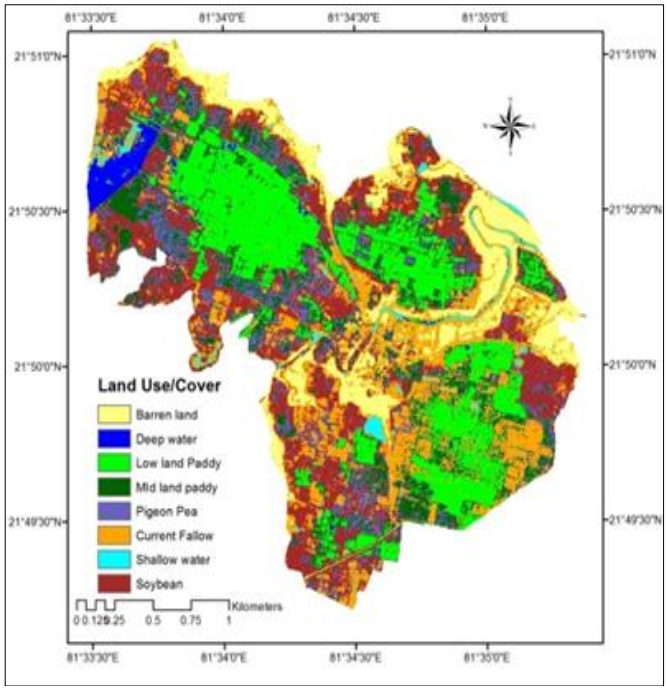

Fig 4: LUCC of the Dhangaon Micro-watershed

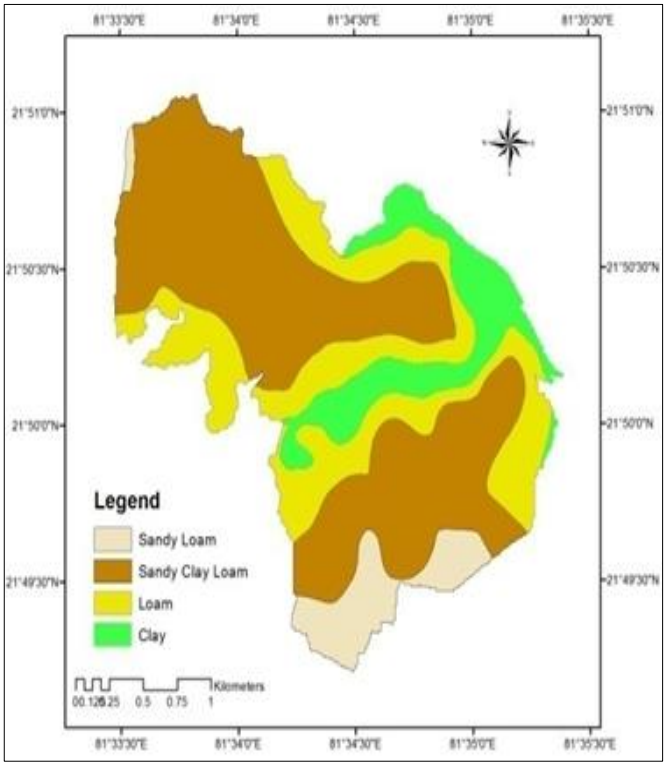

Fig 5: Soil texture map of study area

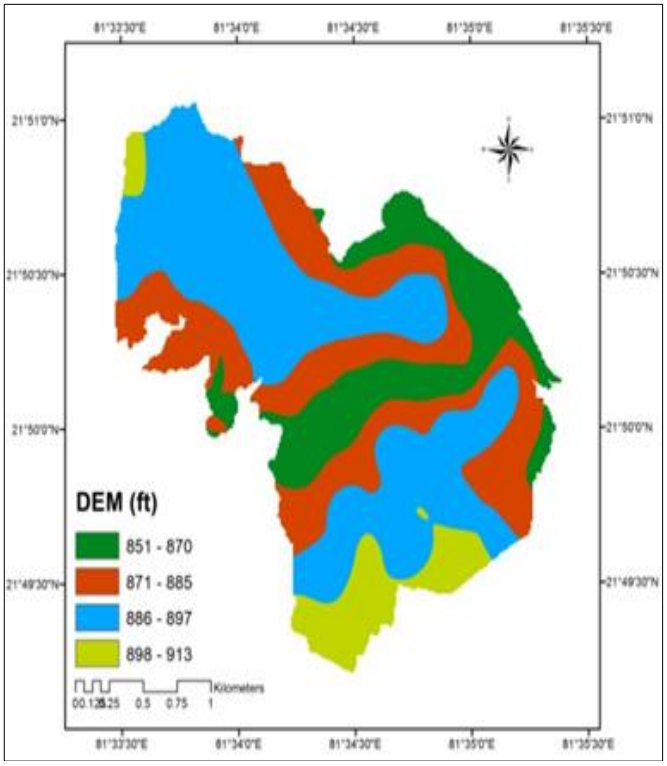

Fig 6: Digital elevation model of study area

Conclusion

The Remote Sensing and GIS technique can be effectively used for the development of various thematic maps such as land use/land cover, soil series, hydro geomorphology, slope, drainage etc. The land use/land cover map indicates that major part of the study area is dominated by paddy crop (199.37 ha) which is 33% of the total area. This is followed by Soybean (124.07 ha), which is 21.54%current fallow (113.08 ha) which is 19.64% of the total area pigeon pea (54.439 ha) which is 9.45% of the total area. Deep water body contributes 2.15% of the total area and small water body by 0.015% of the total area. Four classes of soil texture were identified with Inceptisols (sandy clay loam) contribute 309.84 ha, which is 60.86% of the total area followed by Alfisol covering 161.826 ha, along with vertisols and Entisols covering (72.69 ha) and (46.74 ha) respectively.

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