International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2018; 6(5): 1156-1164

Received: 22-07-2018
Accepted: 23-08-2018

Simmi
Department of Soil Science, Chaudhary Charan Singh Haryana Agricultural University, Hisar, Haryana, India

Sukirtee
Department of Soil Science, Chaudhary Charan Singh Haryana Agricultural University, Hisar, Haryana, India

VS Arya
Haryana Space Applications Centre, Hisar, Haryana, India

Dinesh
Department of Soil Science, Chaudhary Charan Singh Haryana Agricultural University, Hisar, Haryana, India

Mohammad Amin Bhat
Department of Soil Science, Chaudhary Charan Singh Haryana Agricultural University, Hisar, Haryana, India

Correspondence
VS Arya
Haryana Space Applications Centre, Hisar, Haryana, India

Geoinformatics for the physiographic and land use/land cover mapping of Siwani area, Bhiwani district (Haryana)

Simmi, Sukirtee, VS Arya, Dinesh and Mohammad Amin Bhat

Abstract
Geoinformatics is a modern technology playing very important role in the study and monitoring of the natural resources in any part of the world. This technology can be used for generating valuable information about the land use/ land cover (LULC) changes, physiography, forest cover, vegetation type and landforms of any particular area. The study area falls in the toposheet no. H43V9 and three maps were formed such as base map, LULC map and physiographic map. Information collected from these maps will help in land use planning at micro level. The main aim of this paper is to determine and quantify the effect of different aspects responsible for deteriorating the agri-economic importance of land. The paper also establishes the relationship between landforms and land-use. The relation is not one-to-one but rather one landform may be under several land use types and vice versa. The results revealed that the area under landforms of Siwani block was found 676.36 km^2, dominated by plain area (582.13 km^2) followed by sandy dunal area (42.35km^2) and 475.91km^2 under land use/land cover with maximum of its area under fallow land (304.06km^2) and (82.37km^2) area under cropland. The maps prepared will furnish first-hand information to authorities and devisers about the land use land cover and landforms of the study area.

Keywords: Geoinformatics, LULC map, siwani, physiography, base map

Introduction
Geoinformatics is defined as the collection, integration, management, analysis, and presentation of geospatial data, models and knowledge that support disciplinary, multidisciplinary, interdisciplinary, and transdisciplinary research and education (Prakash, 2006; Bhatta, 2011) [1, 2]. Geoinformatics uses combination of three technologies viz. remote sensing, GIS (geographic information system) and Information and Communication technology (ICT). This technology is still underused for regional planning and for analysing the land use/land cover and physiographic changes of any region. Physiographic map shows various types of land forms in an area with different elevation. Several studies have been conducted in the past to understand the characteristics of soil and to classify sand dunal areas of Haryana (Khanna *et al*., 1974, Sangwan, 1978; Ahuja *et al*., 1979; Ahuja *et al*., 1997) [3, 4, 5, 6]. Studies related to dunal toposequences are not emphasised till now which is crucial for the management of these areas. All over the world, 1964.4 million ha of land is severely degraded only due to its poor and unscientific human use (Dwivedi, 2002) [7]. Keeping in view its importance the present study was conducted as topography is counted as major factor influencing the soil characteristics and thereby its usage by human. With an isohyet of even less than 500 mm, the western zone of Haryana faces numerous problems as sand dunal area cover an area around 18.7 percent (Ahuja *et al*., 1979) [5]. For the development of agriculture, it is necessary to gain information about land resources which justifies the need for physiographic-soil map. Moreover, variation in soil type, water content in soil and type of vegetation in any area owe to difference in landforms. The topographic complexity and variation is directly responsible for different agricultural potential of different landforms as a function of slope, elevation, aspect etc. Due to over burgeoning population of developing countries like India, there is continuous cutthroat demand for the utilization of natural resources mainly for land thereby resulting in LULC change. Urban land use plan will guide policy makers regarding development of urban area away from endangered ecosystems (Musaoglu, 2002) [8]. Rao and Narendra (2006) [9] and Boakye *et al*. (2008) [10] used the ERDAS imagine software and prepared land use land cover change map using unsupervised

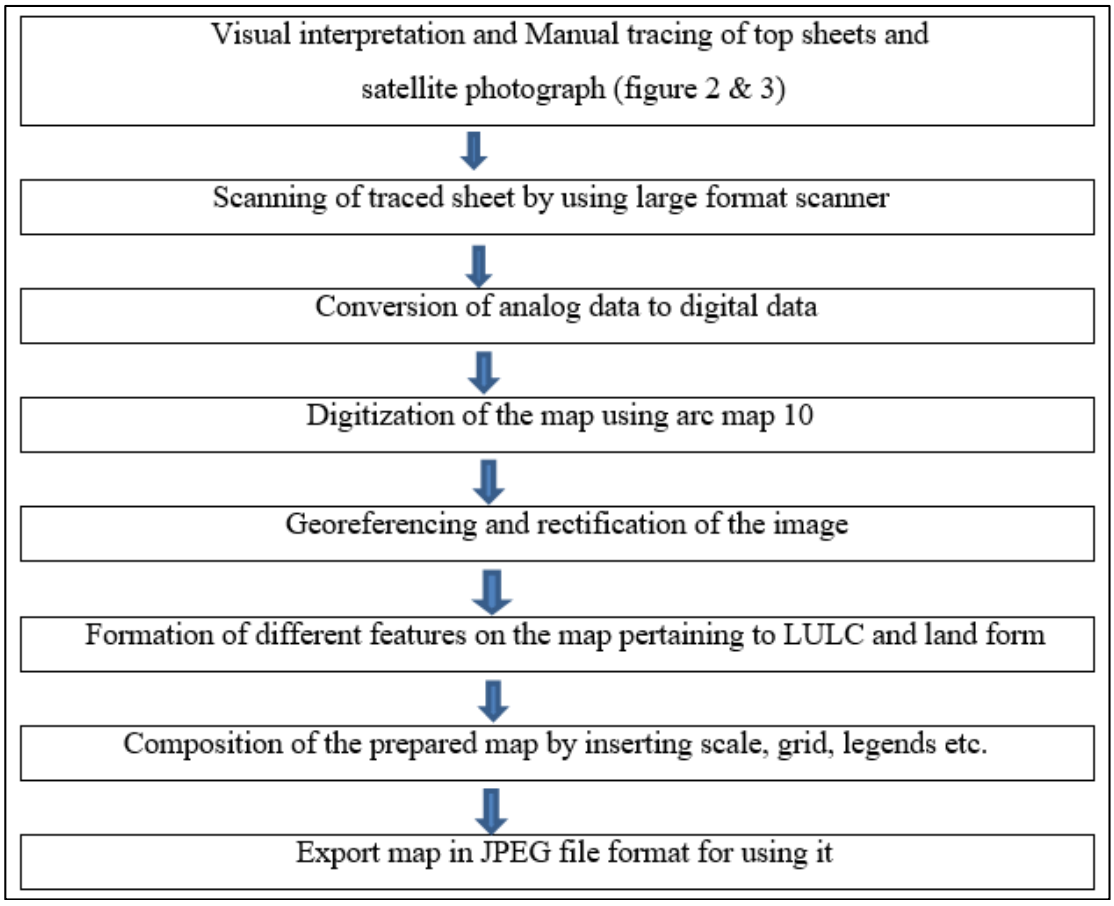
classification. ERDAS imagine is used by various researchers for classification of any area. Though the terms land use and land forms are used interchangeably but they are not alike. Land cover term indicates physical features of ground whereas land use corresponds to usage of land like if it is used for habitation, agriculture, and industrial land or grazing area. Moreover with the help of conventional techniques it is not possible to get in depth information about the on-going LULC change of any area. The information generated will supplement in keeping an eye on the changing trends of land use due to changing demands of increasing population (Zubair, 2006) [11].

Studies related to Siwani area are very limited and literature related to land use/land cover and landforms using geoinformatics is very scarce. Hence, this study first of its kind with the objective to study relation of LULC with landform using modern technology along with exhaustive ground verification. Corollary of this research will help in developing recommendations for the sustainable use of land. Therefore, it is necessary to undergo multidisciplinary approach to obtain reliable and accurate information pertaining to LULC and landforms of the area by integrating remotely sensed data with the ground truth data.

Materials and Methods

The study area falls in north western part of Haryana, Siwani a small city located in district Bhiwani with latitude 28.9084°N and longitude 75.6121°E (Figure 1) where agriculture provides employment to the majority of the population. It is at 210 m elevation above mean sea level. There are mainly guar gum factories in this area. Only after the introduction of sprinkler irrigation for uneven fields, the agriculture production has increased as the land of this area is mainly sandy. The climate here is a local steppe climate. During the year there is little rainfall. The average temperature is 25 °C with about 402 mm of annual precipitation. Most of the precipitation falls in July with an average of 127 mm.

Flow chart of methodology



Software Used In Preparing Maps

ARC MAP 10- This software is used for cartographic production of map. ArcMap is a geographic information system which is collection of many layers and other elements in a map like north arrow, title, text, legend, scale bar, graticule etc. In this software layers can be turned on and off to explore more information and geographic information can be visualized. Microsoft Excel- This spread sheet is used for calculation of the area under various features, preparation of graphs and charts and computation of various statistics.

Results and Discussion

Based on the 1:50,000 scale, base map is prepared using Survey of India (SOI) toposheet no. H43V9 and by digitization basic man-made and natural features on the land were shown like roads, habitation area, rail line, boundaries of Siwani area etc. to provide basic background information for the preparation of other thematic maps (Figure 4). It also helps in determining the location of any area in the map.

Land use/ land cover mapping helps government in framing policies for sustainable development of the area preventing the disturbance to productive land and deforestation. The information collected from such mapping is utilized for urban planning, estimation of population and to monitor environmental changes. Land use/ land cover mapping serves as the inventory of land resources which can be used by environmentalists, government and industries for judicious development of the area. (Kaul and Sopan, 2012) [13] reported

that out of the total 11,765 km^2 geographical area of Jalgaon district, Maharashtra, 291.7 km^2 (2.48%) were under forest, 258.83 km^2 (2.2%) under water body in postmonsoon season, 211.77 km^2 (1.8%) in pre monsoon season and 175.2 km^2 (1.49%) under settlements. The study conducted clearly shows that area under fallow land 304.06 km^2 is maximum followed by cropland 82.37 km^2 with total area under LULC area of Siwani 475.91 km^2. Priyanka (2017) [14] reported that 383.84 km^2 of the area was under fallow land followed by 261.41 km^2 under crops with total LULC area of 673.00 km^2 in Siwani block. Areendran (2013) [15] reported that apportionment of each LULC class has changed severely during the years from 1978 to 2010. More of the forested area is being converted to cropland, habitation area (Singh *et al*. 1991; Das *et al*. 2007) [16, 17] and mining area (Singh *et al*. 1991; Singh *et al*. 1997; Greenpeace 2011) [16, 18, 19] (Figure-5, 6 & 7 and Table 1). The results of the present study reveal that agricultural land develops over old alluvial land with gentle slope. This area is mainly located in northern part of the map. Somewhere there are sand dunes also which disrupts the linearity of the area. The study conducted claims that 582.13 km^2 is under plain agriculture. Sand dunes were also present somewhere in the plain area which were not permanent features but rather wind-blown and keep changing their location. Sand dunes covered a total area of 42.35 km^2. Valley or interdunal valley was located in 31.07 km^2 area with total physiographic area 676.36 km^2. Kumar (2013) [20] reported that 135.99 km^2 under alluvial plain, 81.92 km^2 under interdunal valley and 3.75 km^2 under sand dunes with total physiographic area of 679.84 km^2 in Siwani. Priyanka (2017) [14] reported that 277.14 km^2 under alluvial plain, 3.51 km^2 under interdunal valley and 8.23 km^2 under sand dunes with total physiographic area in Siwani being 676.87 km^2.

Physiographic map (fig-8) of Siwani is classified into four classes viz. agricultural land, wasteland, sand dunes and valley. Area under different land forms is shown in the table 2 and figure 9 &10.

Description of physiography of Siwani area

Top of Sand dune: These areas keep shifting at higher elevation and are unstabilized and barren in nature and not suitable for agriculture production.

Slope of Sand dune: They are sparsely cultivated dunal areas partially stabilized and medium in position with respect to height with moderate erosion.

Base of Sand dune: These areas are aeolian covered and very gently sloping with low intensity of erosion and lower in position with respect to height and are stabilized in nature.

Plain area: These are nearly level to very gently sloping plain areas with negligible erosion. Most of the plain area is alluvial plain. This area is located in northern parts of the study area.

Alluvial Plain: This an old flood plain situated in the northern parts of the study area. It is low-lying nearly levelled and gently sloping plain.

Ahuja *et al*. (1997) [6] described the toposequence of Balawas and Balsamand based on topography, vegetation pattern, cultivation pattern, stabilization and erosion status of the sand dunes and sand dunes were further categorised as Sand dune top, Sand dune slope, Sand dune base and Plains. Kumar (2013) [20] classified the physiographic area of Siwani into four major classes viz. Alluvial Plain, Interdunal Valley, Sand Dunes and Sand Dune Complex. Widyatmanti (2016) [21] reported structural composition of volcanic landform which comprises mainly three dominant land features which are ridge (13-15%), ravine (15%), convex hillside (14%), saddle hillside (16%), concave hillside (13%), and inflection hillside (17%).

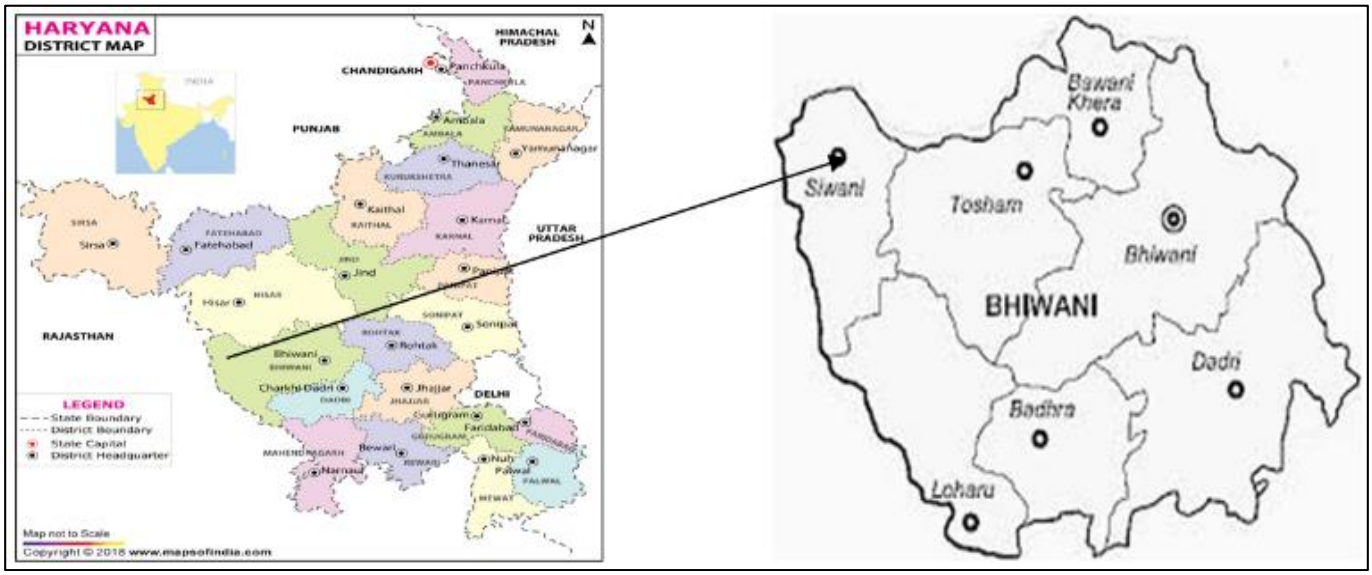


Fig 1: Location map of study area

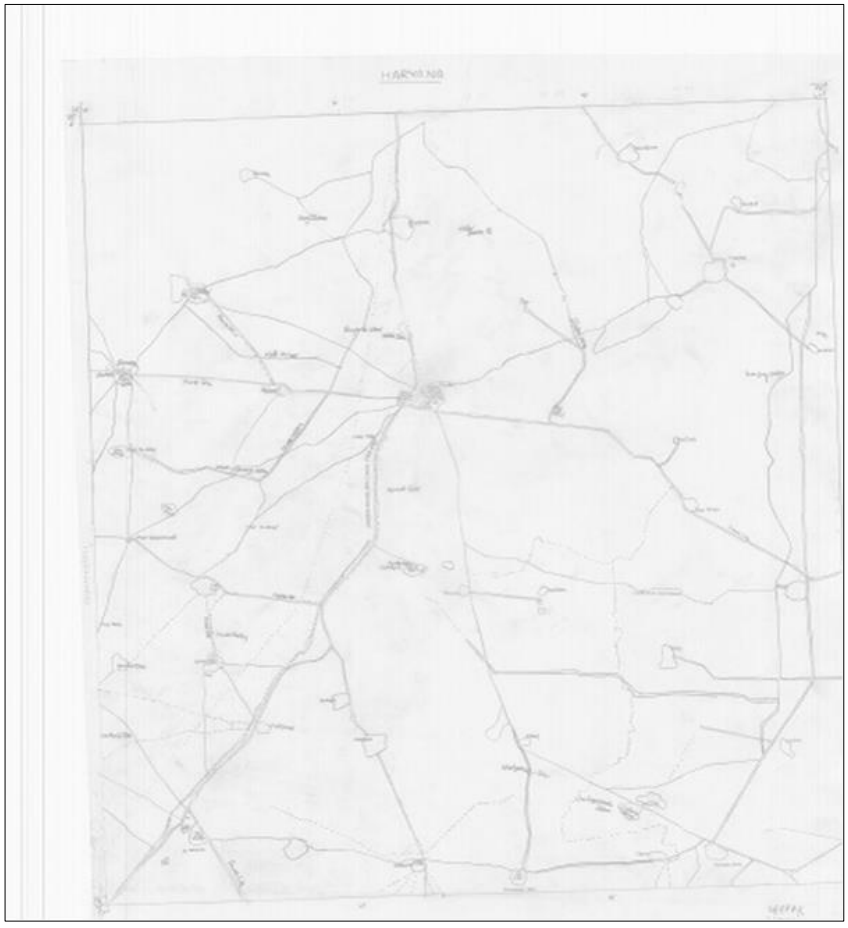


Fig 2: Scanned Base Map of Siwani Area

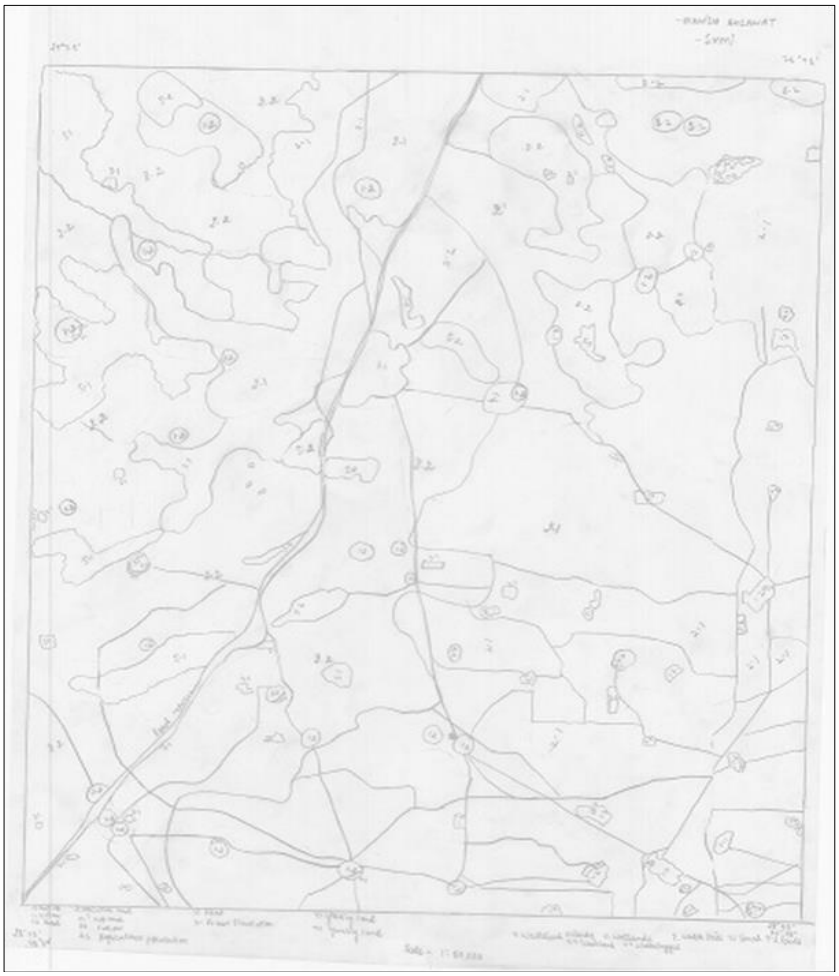


Fig 3: Scanned land form map of siwani area

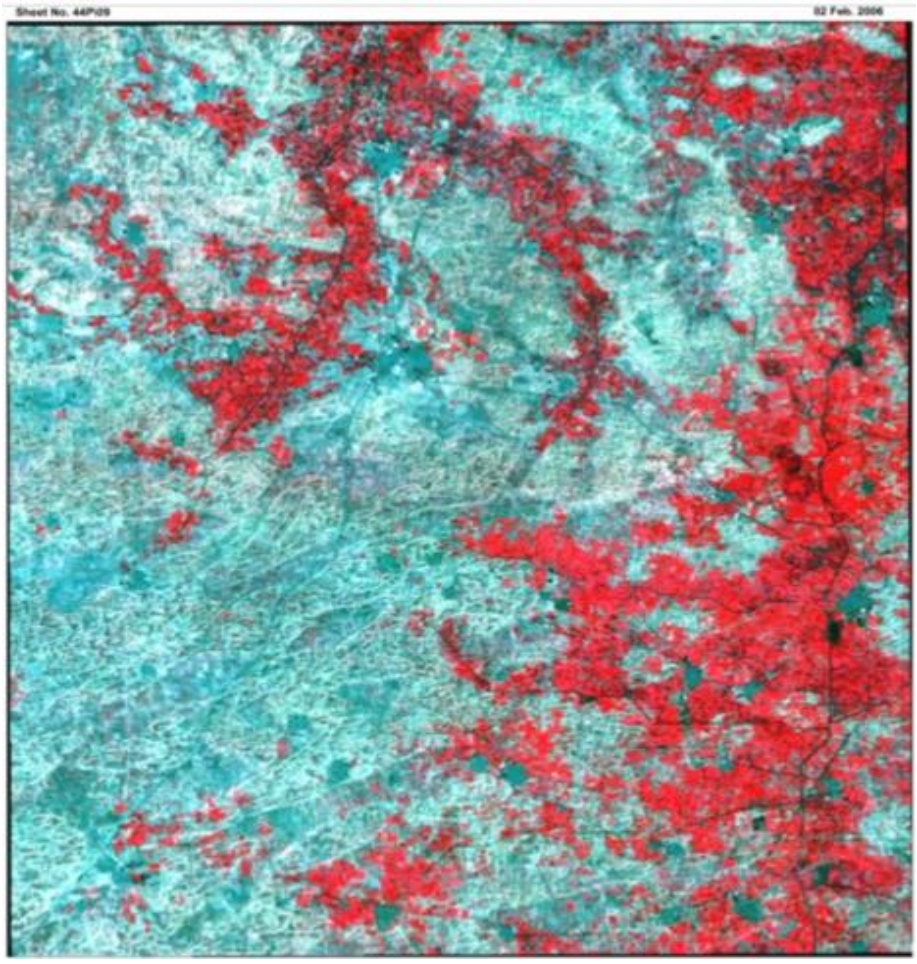


Fig 4: FCC image of study area

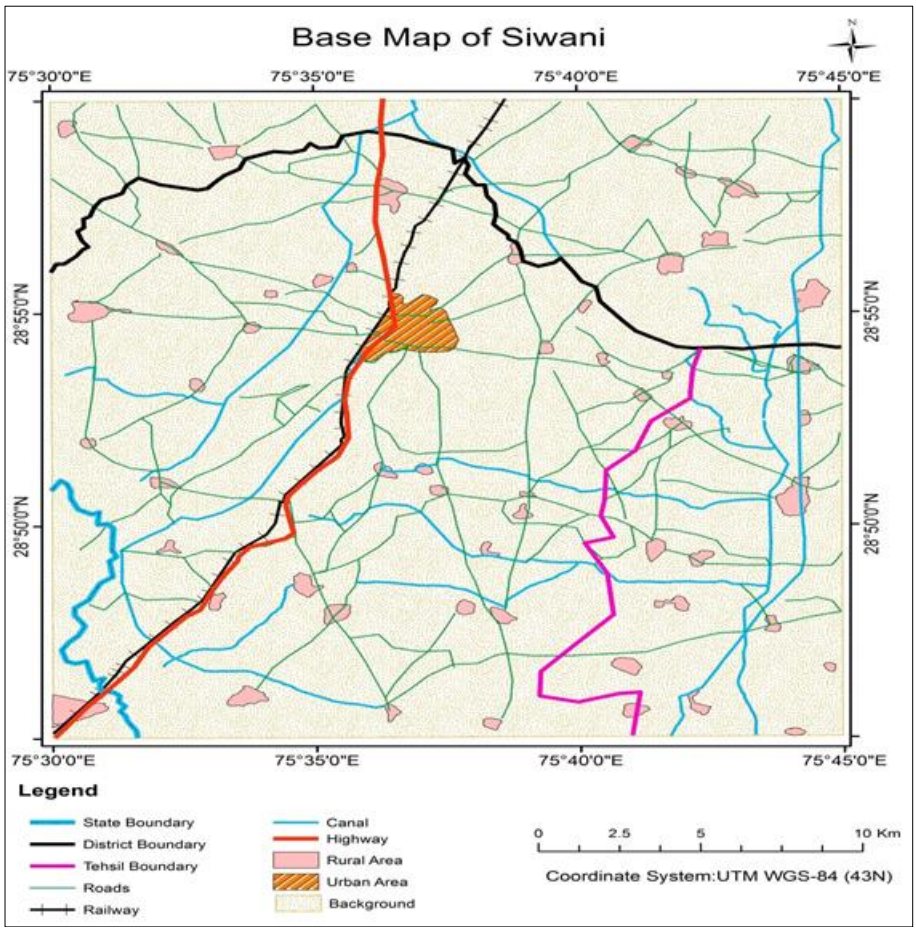


Fig 5: Base map of siwani area

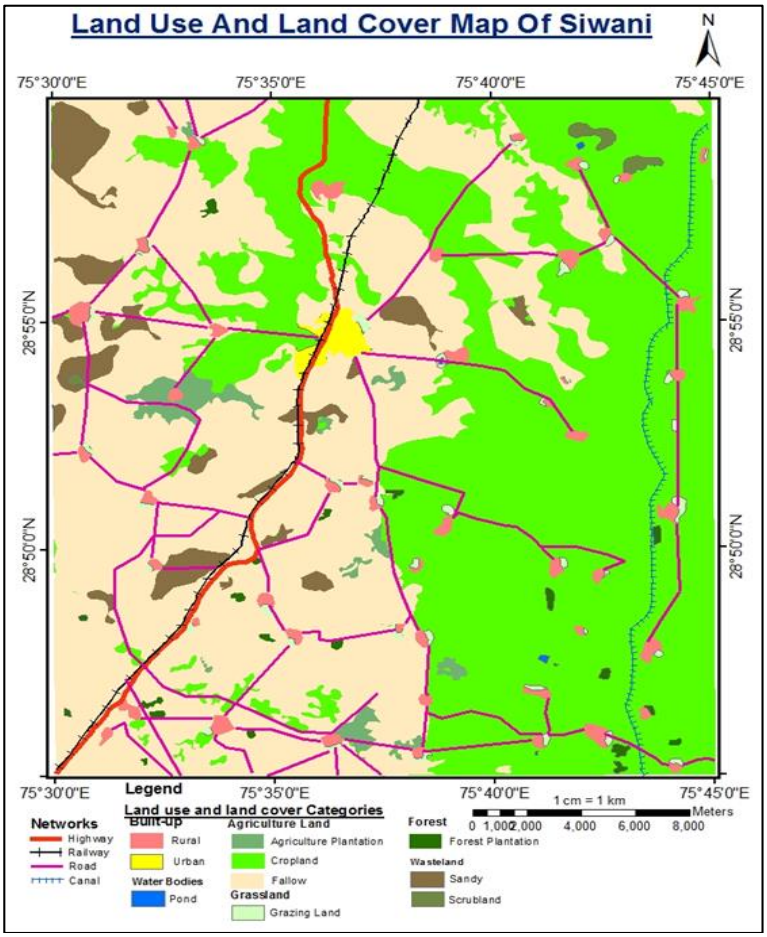


Fig 6: LULC map of siwani

Table 1: Area Covered Under Different Lulc in the Siwani Area in the Year 2017

LULC	AREA in Km^2
Sandy area	25.78
Cropland	82.37
Grazing land	4.84
Urban area	4.04
Rural area	12.80
Fallow land	304.06
Agricultural plantation	10.21
Forest plantation	3.41
Sandy wasteland	26.33
Scrubland	1.89
Water body pond	0.18
Total	475.91

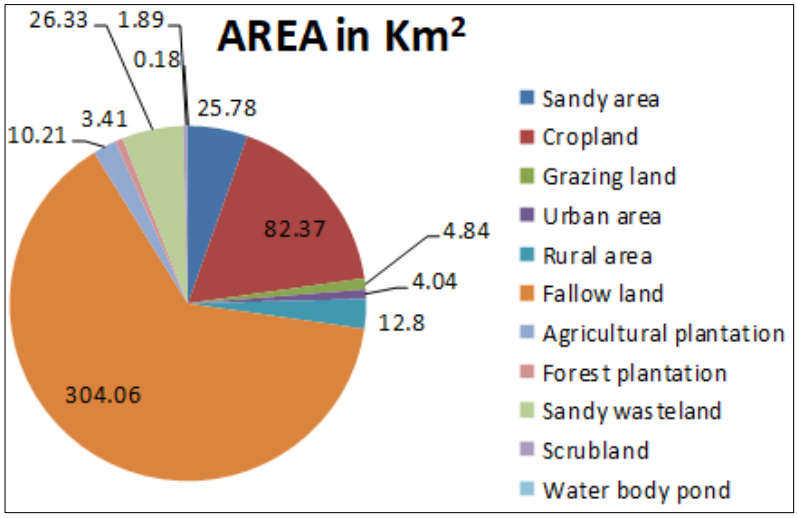


Fig 7: Pie Diagramme of Area Covered Under Different Lulc in the Siwani Area In The Year 2017

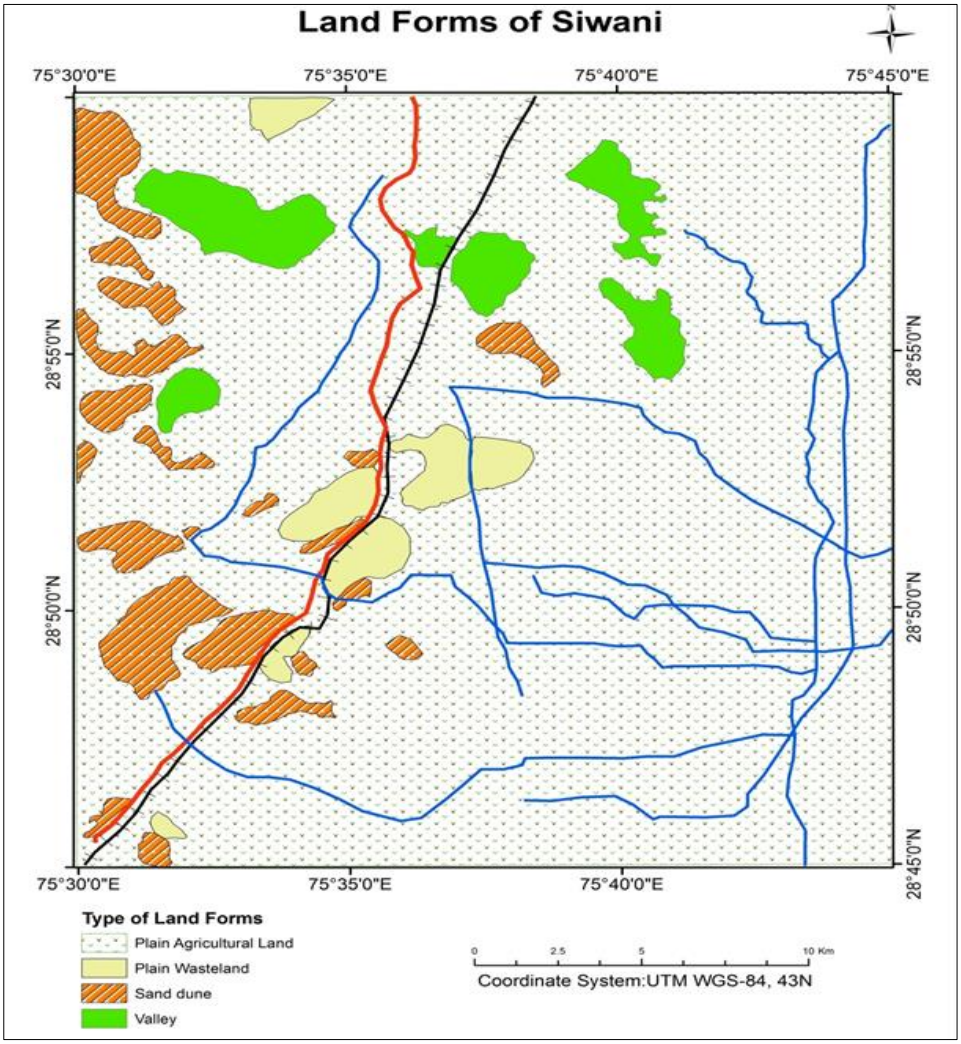


Fig 8: Land form map of siwani

Table 2: Areas Covered By Different Land Forms in the Siwani Area in the Year 2017

Land Forms	Area (sq km)
Plain agricultural land	582.13
Plain wasteland	20.81
Sand dune	42.35
Valley	31.07
Total	676.36

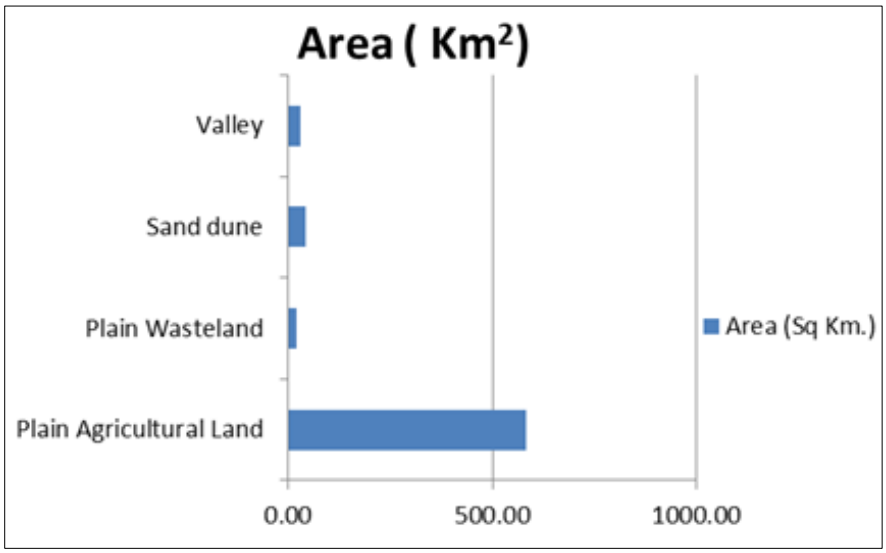


Fig 9: Area covered by different land forms in the siwani area in the year 2017

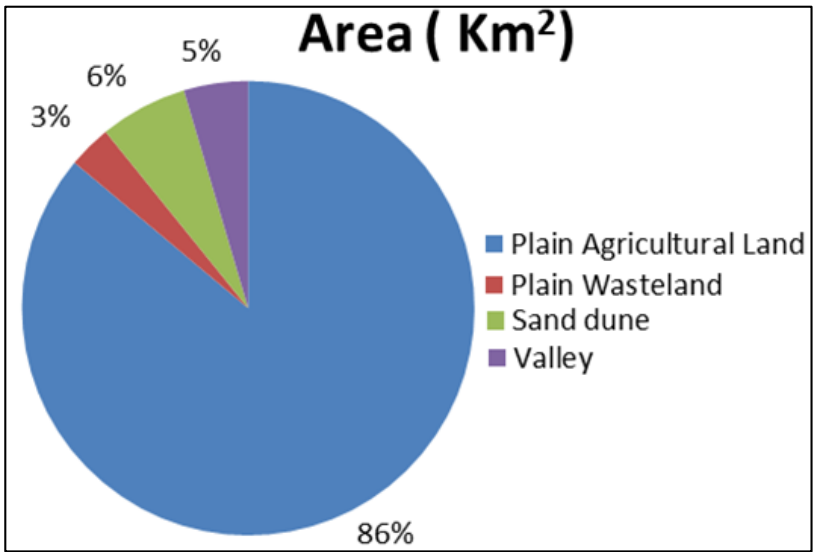


Fig 10: Pie chart showing percentage of land forms

Details of Ground Control Points taken on the site

Sr. No.	Name	Location
1	Canal crossing on NH 65	28° 59' 530"N 75° 36'0294"E
2	Railway Road Crossing ,Near Siwani	28° 69'349"N 75° 36' 334"E
3	Sand dunes, Near Siwani	28° 56'080"N 75° 37'874"E
4	Sandy area with plantation of kikar ,Jumpa	28° 46'221"N 75° 32'365"E
5	Water purification tank , Isharwal	28° 45'920"N 75º49'971"E
6	Siwani feeder canal in Saharwa village	28º 54'740"N 75º 43'85"E

Image Characteristics of Different Land Features

S. No	Image Features	Image Characteristics
01	Agriculture	Red patches are Rabi grown crops and maroon patches of definite shape are agricultural plantation
02	Settlements	Grey colour indicate rural and urban settlements with urban settlements appearing in large sized patches and discrete patches of rural settlements
03	Waterlogged Area	Deep blue patches nearby villages
04	Forest Area	Dense forests are identified by deep red colour patterns whereas sparse forests are identified by whitish coloration in between red colour
05	Sandy Area	Light grey and whitish patch
06	Valley	In between two sand dunes there are slight green patches of valley

Conclusion

The remote sensing and GIS served as the integrated system to establish the relationship between LULC and landforms. Geomorphological analysis of any area is done by using geoinformatics. The study conducted reveals the potential of this modern technology in delineation of different landform elements. Landform units serve as the basic indicators in vegetation and soil mapping. From the landform map it is concluded that this area possess great potential for agricultural plantation if irrigation is scheduled judiciously by sprinkler. Moreover, due to high temperature of this area prevailing almost throughout the year, this area serves as the ideal place for harnessing solar energy. Land use/ land cover mapping is required for the correct planning of many activities. The accuracy of LULC map depends on deep knowledge about geography of that area as well as interpretation of satellite imageries along with the ground truthing. The need of the hour is to disrate the conversion of agriculturally productive land to habitation area in addition to properly plan human activities in a very scientific way for the sustainable use of land resources. Siwani area is backed by large latent area under wasteland which can be exploited for agricultural plantation, installing solar panels, for forest plantation, human habitation or for industrialisation.

Acknowledgement

The authors are thankful to Dr. R.S. Hooda, Chief Scientist at Haryana Space Applications Centre (HARSAC). We express our heartful thanks to all the team members of HARSAC under whose generous guidance, encouragement and supervision the study was conducted and completed successfully.

References

1. Prakash A. Introducing Geoinformatics for Earth Science Education. Journal of Geo-science Education. 2006; 54(5):555-560
2. Bhatta B. Remote Sensing and GIS. Edn 3, Oxford University Press, India, 2011, 449-451
3. Khanna SS, Ahuja RL, Manchanda ML, Sangwan BS, Goyal VP. Soil landscape relationship of dune infected Precambrian pediplain area in South-western part of Haryana. Ann. Arid Zone. 1974; 16:201-212.
4. Sangwan BS. Pedogemc characterization of the soils of southern Haryana. Dissertation Ph.D. Agri. Univ. Udaipur, Rajasthan, 1978.
5. Ahuja RL, Garlapuri VN, Khanna SS. Soils of the desert area of Haryana. Bulletin on desert management of

Haryana. Directorate of Project-cum-Plan formulation. Haryana Agricultural University, Hisar, 1979, 21-41.
6. Ahuja RL, Singh P, Nath J, Dinesh. Characterization and classification of soils on sand dune toposequences of Haryana. Agropedology. 1997; 7:1-13.
7. Dwivedi RS. Spatio-temporal characterization of soil degradation. Tropical Ecology. 2002; 43:75-90.
8. Musaoglu N, Kaya S, Seker DZ, Goksel C. A Case Study of Using Remote Sensing Data and GIS for Land Management; Catalca Region, International Congress Washington, D.C. USA, 2002.
9. Rao KN, Narendra K. Mapping and Evaluation of Urban Sprawling in the Mehadrigedda Watershed in Visakhapatnam metropolitan region using Remote Sensing and GIS. Current Science. 2006; 91(11):1552-1557.
10. Boakye E, Odai SN, Adjei KA, Annor FO. Landsat Images for Assessment of the Impact of Land Use and Land Cover changes on the Barekese Catchment in Ghana. European Journal of Scientific Research. 2008; 22(2):269-278.
11. Zubair AO. Change detection in land use and land cover using Remote Sensing data and GIS (A case study of Ilorin and its environs in Kwara State.), Department of Geography, University of Ibadan, 2006.
12. https://en.wikipedia.org/wiki/Siwani
13. Kaul AH, Sopan I. Land Use Land Cover Classification and Change Detection Using High Resolution Temporal Satellite Data. Journal of Environment. 2012; 1(4):146-152.
14. Priyanka. Thematic Mapping in Siwani Area, District Bhiwani using Remote Sensing and GIS. International Journal of Research in Geography. 2017; 3:12-17.
15. Areendran G, Rao P, Raj K, Mazumdar S, Puri K. Land use/land cover change dynamics analysis in mining areas of Singrauli district in Madhya Pradesh, India. International Society for Tropical Ecology. 2013; 54:239-250.
16. Singh JS, Singh KP, Agrawal M. Environmental degradation of the Obra - Renukoot - Singrauli area, India and its impact on natural and derived ecosystems. The Environmentalist. 1991; 11:171-180.
17. Das MK, Awasthi AK, Pandey R, Dwivedi A, Koul M. Mapping of forest types and land use/ land cover of Singrauli coal field area using satellite remote sensing techniques. Journal of Tropical Forestry. 2007; 23:141-150.
18. Singh NP, Mukherjee TK, Shrivastava BBP. Monitoring the impact of coal mining and thermal power industry on landuse pattern in and around Singrauli coalfiled using remote sensing data and GIS. Journal of the Indian Society of Remote Sensing. 1997; 25:61-72.
19. Greenpeace. Singrauli the Coal Curse - A Fact Finding Report on the Impact of Coal Mining on the People and Environment of Singrauli. Greenpeace India Society, 2011.
20. Kumar S. Physiographic Mapping of Siwani Area, Bhiwani District, (Haryana) Using Remote Sensing and GIS Techniques. International Journal of Research in Management, Science & Technology. 2013; 1:12-15.
21. Widyamanti W, Wicaksono I, Syam PDR. Identification of topographic elements composition based on landform boundaries from radar interferometry segmentation (preliminary study on digital landform mapping) IOP Conf. Series: Earth and Environmental Science. 2016; 37:012008.