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A GIS Based Study of Land Use/Land Cover and Physiography of Siwani Area, Bhiwani

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ABSTRACT

The demand for land for the needs of growing population is greater than actual land resources available. The basic needs of the increasing population can be met through proper planning. This can only be met through bringing more area under use. For the purpose regular monitoring is essential for scientific management, to increase the area and regular monitoring of an area is easily solved by Remote Sensing and GIS tool. Remote Sensing and GIS becomes a powerful tool with following advantages for survey, mapping and regular monitoring of land use/ land cover of an area. The present study shows the simple example of this technique to prepare the base map, land use/land covers map and physiography of Siwani area, Bhiwani. In the present study digital image processing and visual interpretation techniques were employed to carry out Land use/Land cover classification using digital data and standard False Colour Composite (FCC) paper print of Indian Remote Sensing satellite. After this, field survey is also done, to get a general idea of the features environment and accessibility and make the ground truth verification with our pre field data. Finalization of land use map is done after incorporating necessary corrections and modifications after field check. The land use/land cover map is classified in various classes like as built-up area, agricultural area, waste land, water bodies and grassland. The results show that out of total area (603.45 sq. km), maximum area is come under the category of agricultural area (587.43 sq. km). Out of total agricultural area fallow land is spread over a large part of the study area i.e., cover 71 per cent of the total area. As per Physiography classification results, nearly 50 per cent area is covered by sand dunes complexes, which is the major cause of fallow land.

1. Introduction

The demand for land for the needs of growing population is greater than actual land resources available. The basic needs of the increasing population can be met through proper planning. This can only be met through bringing more area under use. For the purpose regular monitoring is essential for scientific management, to increase the area. Information on location, extent and growing pattern is required to develop effective land use management plans. This growing concern in population needs reasonably accurate and timely information which can from common database for integrated resource survey inventory for planning and analysis. The up to date information will enable the planner and decision makers in preparing in various programs. The traditional/conventional technology cannot be used to prepare such maps on near real time basis. The remote sensing becoming a powerful tool with following advantages for survey, mapping and regular monitoring of land use/ land cover. Remote sensing is the acquisition of information about an object without physical contact. The process of remote sensing can be explained via this diagram and the following points:

- Energy Source or Illumination
- Radiation and the Atmosphere
- Interaction with the Target
- Recording of Energy by the Sensor
- Transmission, Reception, and Processing
- Interpretation and Analysis
- Application

Geographical information system also known as a GIS, is an information system for capturing, storing, analyzing, managing and presenting data which are spatially referenced. GIS technology can be used for scientific investigations, resources management, environmental impact assessment, urban planning, cartography, criminology, geographic history, marketing etc. The major techniques used in GIS are following:

- Data creation
- Relating information from different sources
- Data representation.

2. Objective of the study

- To prepare base map of Siwani Area
- To prepare land use/land cover and physiographic map of study area
- To accustom with GIS techniques for preparing maps

3. Study Area

The study area constitutes a part of Siwani block of Bhiwani district, Haryana. The area lies between 28° 55' N to 29° 10' latitudes and 75° 30' to 75° 45' E longitudes. It is bounded in the north by Hisar district, in the west by Churu district of Rajasthan and the east and south by parts of Siwani

block shown in Figure.1.

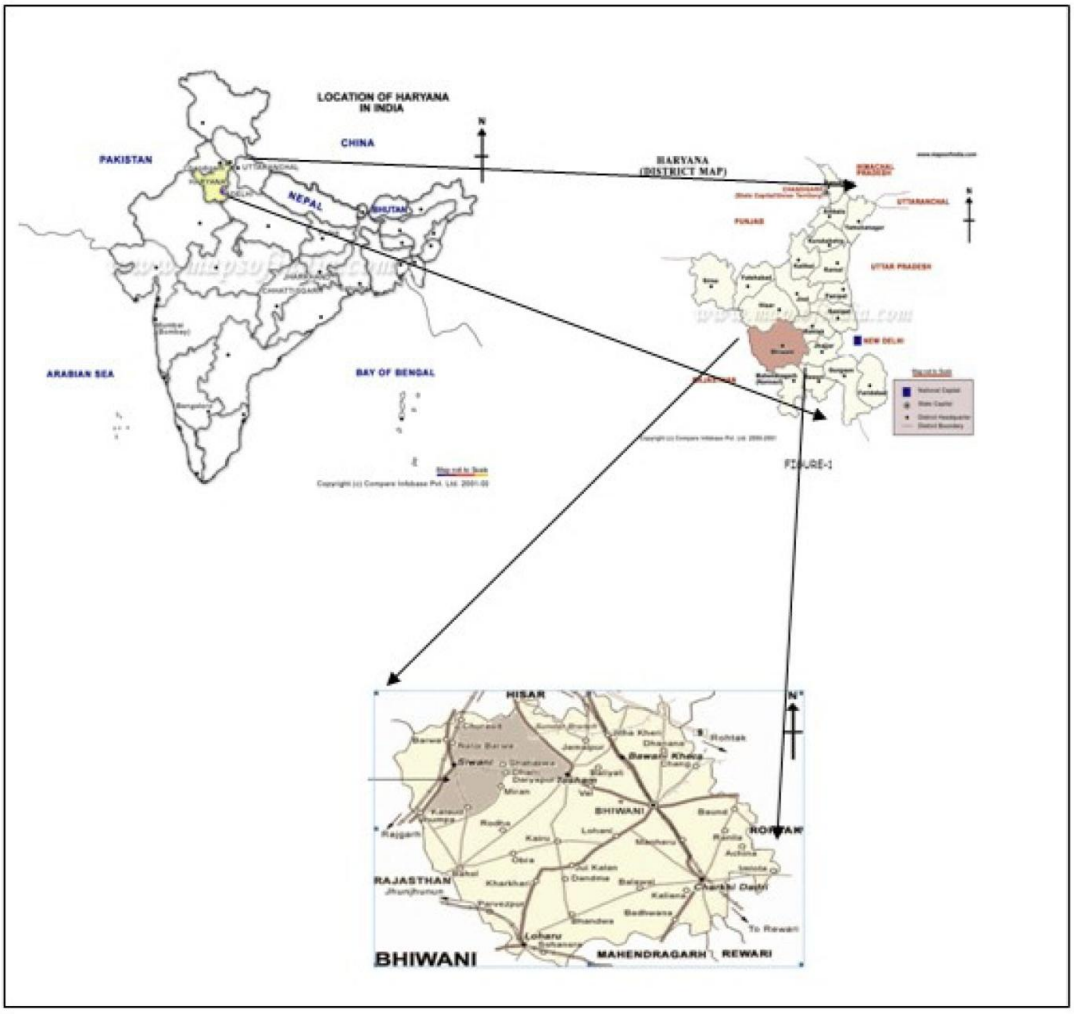


Figure 1. Location map of the Study area

In general the topography of the study area is uneven. However, a close examination of the relief reveals that north part of the study area is almost flat with occasional variations but southern half comprises of sand dunes and inter-dunal sandy area. The climate of the study area is characterized by extreme climatic conditions with hot summer and cold winter with scanty rainfall. The year may be broadly divided into four namely, summer from April to June, monsoon extending from July to mid September, from middle September to October may be considered as transition period. Winter season extends from November to March (Gazetteer, Bhiwani district, 1988).

The nearest meteorological observatory is situated at Hisar. The temperature ranges from 5° C to 45°C. Maximum temperature often touches 45°C by the end of June. Temperature starts falling with the onset of pre-monsoon showers. After the monsoon season, the day temperature remains same but nights remain cooler up to October. Day and night temperature starts decreasing rapidly in November. January is the coldest month with average monthly minimum temperature of 1.50°C and average monthly maximum temperature of 25.54°C.the average annual rainfall of the study area is 284mm. about 74% of the annual rainfall occurs during the monsoon period i.e. July to September more than half to rainfall occurs in July and August within 7 to 11 days.

The study area enjoys good transport facilities, national highway No.65 surges through the study area connecting it with Hisar city and other parts of the state. All the villages are interlinked with metalled roads. The study area is well connected with other cities, towns and villages of Haryana and Rajasthan. As of 2001 India census, Siwani had a population of 15,849. Males constitute 53% of the population and females 47%. Siwani has an average literacy rate of 57%, lower than the national average of 59.5%: male literacy is 66%, and female literacy is 46%. In Siwani, 17% of the population is under 6 years of age.

4. Data sources and methodology

The study is done through secondary data as well as primary data. The major sources of data are following:

1. IRS ID, LISS-III (FCC) data on 1:50000 scale.
2. Topographical sheet 44P/9
3. Available literature and reports of remote sensing and GIS
4. Ground truth data

The methodology used in this study for land use cover and physiographic mapping using visual interpretation has been given below.

1. Preparation of base map from FCC satellite imagery.

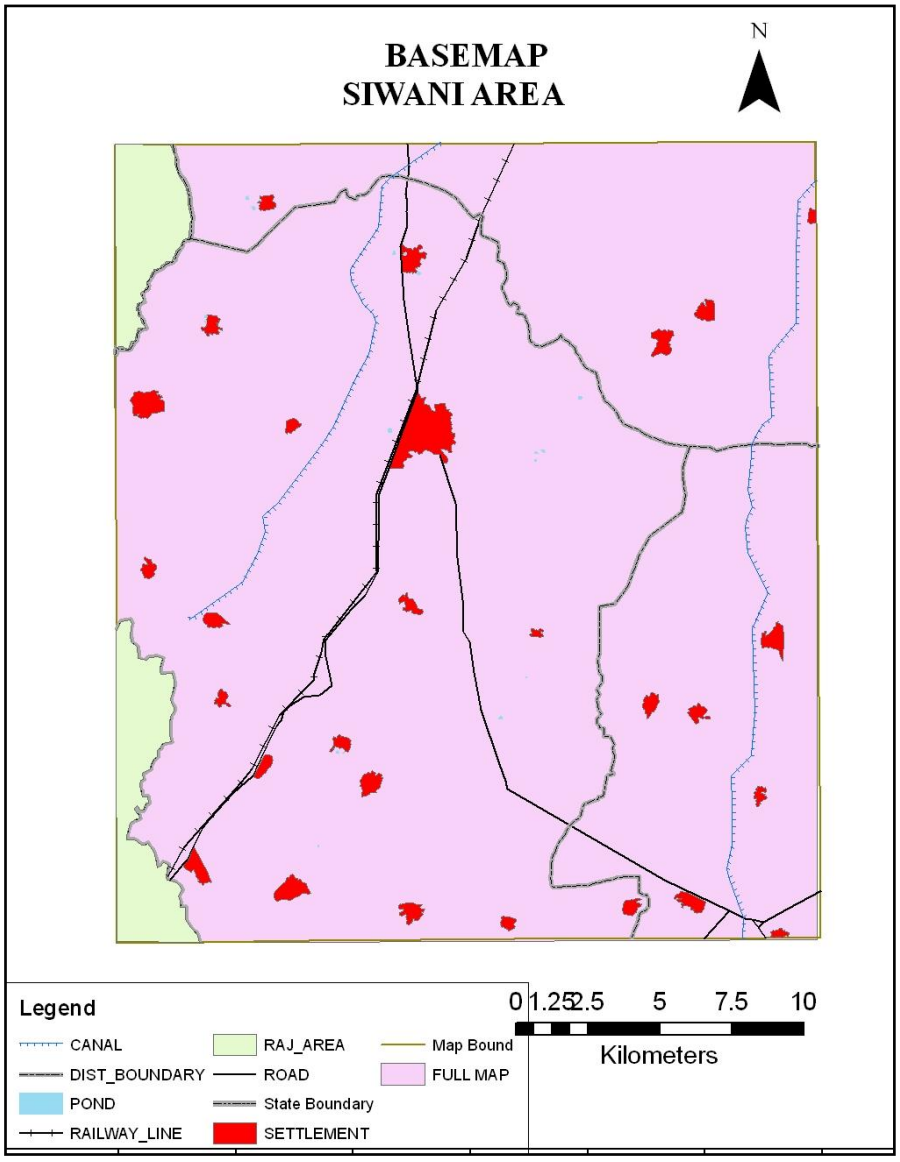
2. The land use/ land cover and physiographic classification.
3. Pre-field visual interpretation of satellite data.
4. Ground truth verification.
5. Post field modification and finalization of map.
6. Digitization of map.
7. Drafting and results.

In the present study digital image processing and visual interpretation techniques were employed to carry out Land use/Land cover classification using digital data and standard False Colour Composite (FCC) paper print of Indian Remote Sensing satellite. The major visual interpretation techniques are: shape, size, tone, texture, pattern, shadow, pattern, association etc. first, we are selecting the Satellite data IRS ID, LISS-III(FCC) image name 44 P/9 and understanding different land use/ land cover classes. Prepare the base map from SOI Toposheet no H43V9 and interpreted it with the help of visual interpretation of the remote sensing data by using the usual clues such as shape, size, pattern, texture, tone and associated features as well as local knowledge. After this we are going on field survey to get a general idea of the features environment and accessibility and make the ground truth verification with our pre field data. Checking the sample points and also checking of unresolved cases. Finalization of land use map is done after incorporating necessary corrections and modifications after field check. Making scanning/digitization of maps which are undated during the field survey. Calculate the area of with the help of Arc-Map software and analysis the land use/land cover and physiographic map of Siwani area. Prepare of final base map, land use/land cover and physiographic map in JPGH format and tables.

5. Results and discussion

Base Map of the Study Area

A map or chart showing certain fundamental used as a base upon which additional data of specialized nature are compiled or overprinted is called base map. Also a map contains all the information from which maps showing specialized information of an area is called base map. We make base map of Siwani area in Bhiwani district. The major features of Siwani area are represented by Figure 2.



Source: Compiled from IRS ID, LISS-III (FCC) imaginary data on 1:50000 scale.

Figure:-2 Base Map of the Siwani Area

6. Land Use/Land Cover Map of the Study Area

Land cover refers to the observed biotic and abiotic assemblage of the earth's surface and immediate subsurface. Examples of major land-cover types are forests, shrub lands, grasslands, croplands, barren lands, ice and snow, urban areas, and water bodies (including groundwater). ***Land use*** is defined as the way or manner in which the land is used or occupied by humans. In a nutshell, land cover represents the visible evidence of land use. A land covered by vegetation can be a forest as seen from the ground or through remote-sensing observations. Based upon the standard image characteristics like texture, tone, shape, size, association, pattern and site etc. the visual interpretation of IRS imagery, land use land cover (LU/LC) map was prepared as shown in Figure 3. The areal extent of the various land use/ land cover categories is given in Table 1.

Built up land

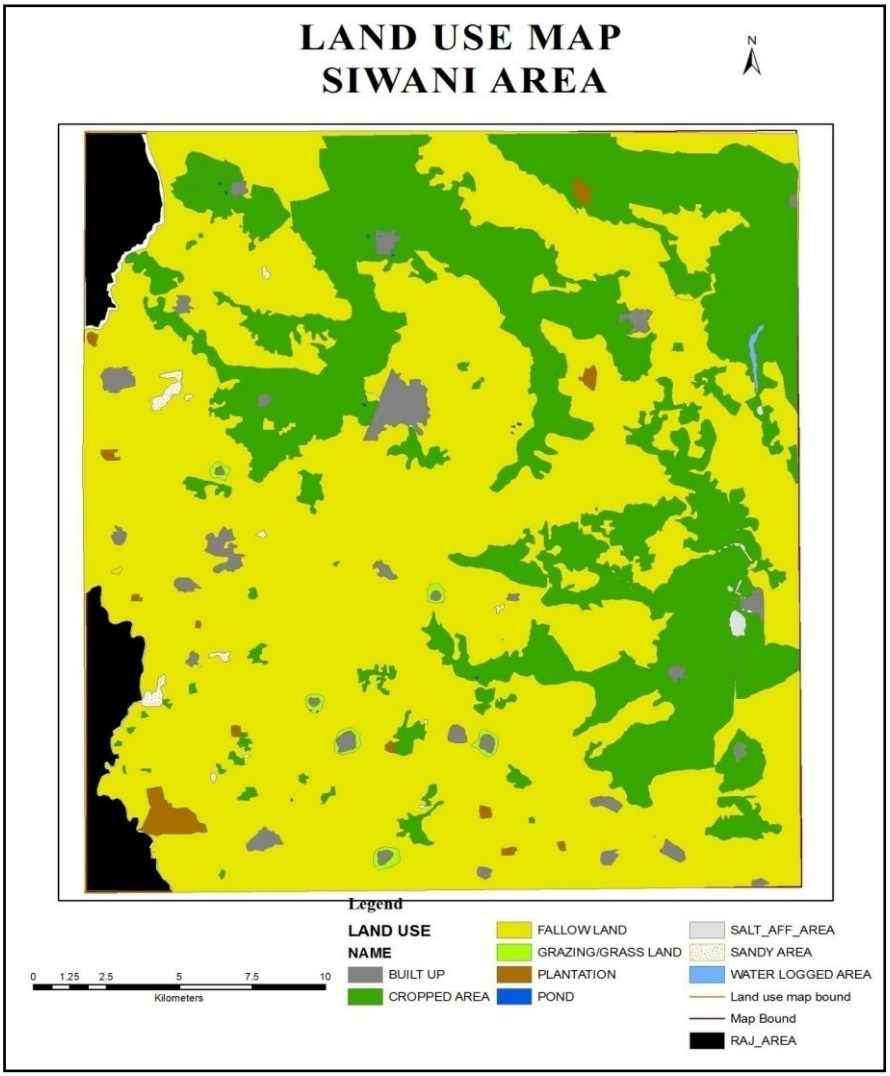
Built up land is divided into rural and urban categories. Siwani is identifying as an urban centre in the study area. Villages that are homogeneously distributed and associated with agricultural land were also identified and mapped. According to Table 1, Built up area comprises 11.778 sq km area.

Agricultural land

The major agricultural land is finding in the inter-dunal valley. Bajara, Jwar and Millets are major Kharif crops in this area. Agriculture land area comprises 587.403 sq km area. Three categories of agricultural land were found in this area namely, Plantation, Fallow land, Cropped area. Table 1 show that the most of Siwani area is found in fallow land category and its area is 432.935 sq. km. Cropped area is shown by green color in Figure 3 and its area is 150.423 sq. km. Siwani areas have also some part of the plantation. The area of plantation is only 4.045 sq.km.

Grass land/ grazing Land

The study area consists of semi arid deserted type of vegetation cover. This type of land mainly comes under social forestry plantation programmers. This category of land use/ land cover is found only around the built up area represented by conspicuous image characteristics in Figure 3. According to the Table 1, grassland/grazing area comprises 1.72 sq km area.



Source: Compiled from IRS ID, LISS-III (FCC) imaginary data on 1:50000 scale.

Figure:-3 Land Use/land Cover Map of Siwani Area

Wastelands

Three categories of wasteland were found in this area namely, Sandy area, Salt affected area, and Water logged land. Sandy area are identified on the imagery with the help of bright bullish tone and mapped in the figure 3. Waterlogged areas are confined only near the canal area and its area is 0.888 sq. km which shows by Table 1. Wastelands are spread over an area of 2.512s sq km

Water bodies

It includes smaller pools of water such as ponds, puddles or wetlands. Rivers, streams, canals, and other geographical features where water moves from one place to another are also considered bodies of water. But in our study area we identified only pond. According to the Table 1 the area occupied by water bodies is 0.138 sq km.

Table:-1. Land Use/ Land Cover of Siwani Area during 2014.

Sr. No	Name of Feature	Area(in sq.km)
1	**Built up area**	**11.678**
2	**Agricultural area**	**587.403**
	2.1 plantation	4.045
	2.2 fallow land	432.935
	2.3 cropped area	150.423
3	**Waste land**	**2.512**
	3.1 sandy area	1.571
	3.2 salt-affected area	0.053
	3.3 water-logged area	0.888
4	**Water bodies**	
	4.1 ponds	0.138
5	**Grassland/grazing area**	**1.72**
6	**Total area**	**603.451**

Source: Calculated by researcher based on Figure 3.

Physiographic Mapping of the Study Area

Physiographic Maps show the location of mountain ranges, valleys, and other physical features of the Earth's surface in two dimensions. It shows the entire country's physical shape or the State landform regions. The physiographic regions of the study area are represented by Figure 4. The area on the map is shown by different colours. Each colored area represents a different physical region. They are used to get general information of the relief features. The various categories in the Physiographic map are Alluvial Plain, Inter-dunal Valley, and Sand Dune Complexes.

Alluvial Plain

This an old flood plain situated in the eastern parts of the study area. It is low-lying nearly leveled and gently sloping plain. At some places the upland disrupts the linearity of the area. Table 2 shows that alluvial plain comprises 62.257 sq. km area.

Inter-dunal valleys

Inter dunal valley constitutes also the major part of this plain. In these depressions agriculture practices are being carried out. Gentle slopes of sand dunes are seemed to be under seasonal cultivations. In the Figure 4, inter-dunal valleys are shown by green color and Table 2 shows the total area of inter-dunal valleys is 196.524 sq. km.

Table:-2. Physiographic Regions of Siwani Area during 2014.

Sr. No.	Features	Area(in sq. km)
1	Alluvial plain	62.257
2	Inter-dunal Valleys	196.524
3	Sand dune complexes	332.219
4	Settlements	12.581
5	**Total**	**603.451**

Source: Calculated by researcher based on Figure 4.

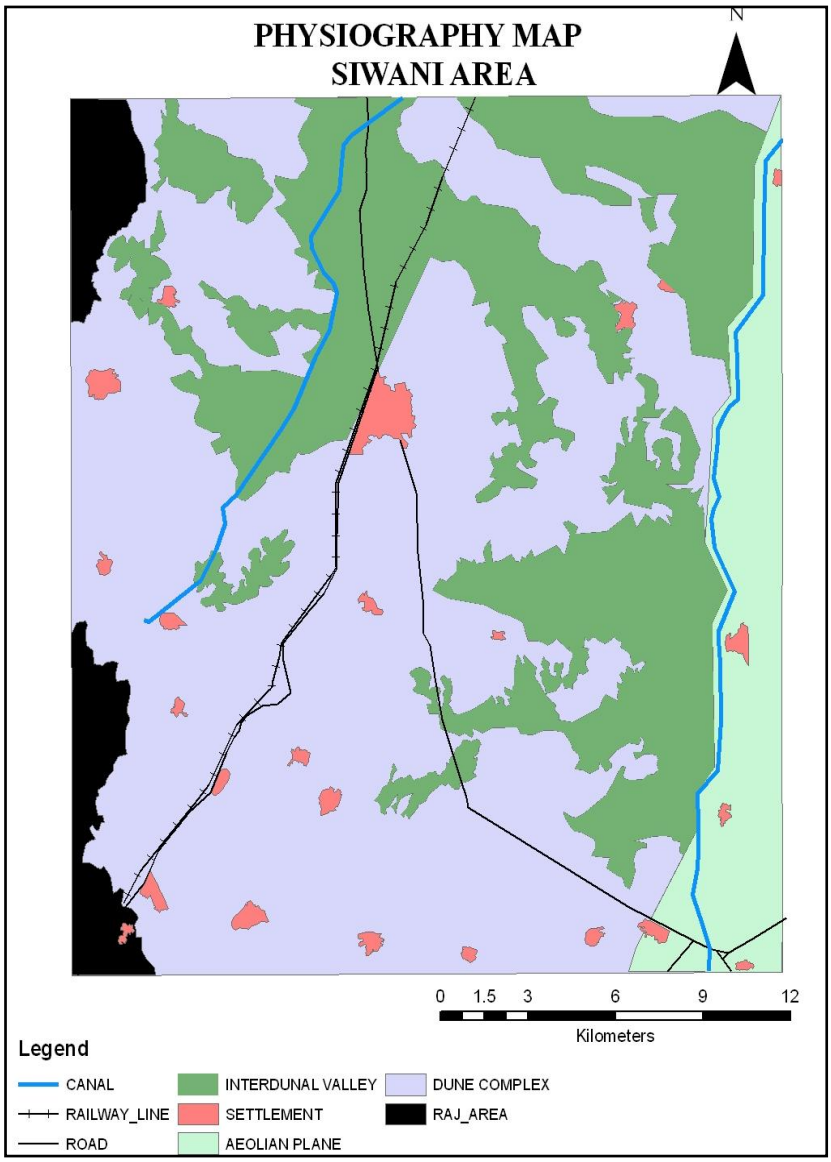
Sand Dune Complex

Another major category in physiographic map is sand dune complex. Figure 4 shows that the larger area of Siwani area is covered by the sand dune complex. Sand dune complex is the group of different dune. This area is not suitable for agriculture. The most of part is fellow land. Somewhere in this area some local vegetation also finds like as scrub, kiker etc. according to the Table 2, total area of sand dune complex is 332.219 sq. km.

7. Conclusion

The study establish the role of remote sensing and GIS for mapping, monitoring and continuous assessment of natural resources at local and regional level. The study indicates the

different type of map likes base map, land use/ land cover map and physiographic map of Siwani area. Base map show the linear feature of this area and major settlement of this area.



Source: Compiled from IRS ID, LISS-III (FCC) imaginary data on 1:50000 scale.

Figure-4 Physiographic Map of the Siwani Area

We find that Siwani is only one major town in the area Density of the road and rail network is also very low in this area. Land use/ land cover categories like cropped area, fallow land, plantation, waste land categories were identified. The larger area is find in the form of fellow land which is not suitable for cultivation. Cropped area is finding only inter-dunal valleys which are lies in the north and western part of Siwani area. This area is also facing the problems of waterlogged near the canal. Salt-affected land is also finding in this area. Physiographic map dividing in three major categories Alluvial Plain, Inter-dunal Valley, and Sand Dune Complex. Most of the part lies in the dune complex land of Siwani area. Alluvial plain find only near the canal which is flow in the eastern part of this area and a short canal also find in the direction of north to the south in the middle of Siwani area. The study reveals that most of area is covered by sand dunes and sandy plains and facing the problems of sand. The study area is also facing the problem of poor quality and quantity of ground water and low primary source of income. These problems decrease the biomass verities.

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