Parcel Level Resource Mapping to Panchayat Level Planning using RS & GIS Technology

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Abstract— **Natural resources management is indispensable in ensuring environmental sustainability and reducing the risk associated with climate change and increasing demand for ecological goods and services. Natural resources planners need to have at their disposal tools that can objectively help in prioritizing land use allocation. Cadastral System is defined to the limit of land parcel based on laws, rights and title/deed registration for the parcel or property, traditionally. This is used for legal, administrative and economic decision making as well as an aid for planning and development.**

The PLRM database was created for different thematic and legacy layers. The Legacy layers viz. slope, ground water, soil maps were made with help of already available database on 1:50,000 scales after its integration with HRSI on 1:10,000 scales. The thematic layers viz. land use/land cover, road, and drainage maps were prepared with the help of Cartosat-1 and LISS-IV merged data product. The cadastral mapping was done with the help of scanning of Mussavi.

The PLRM database study was made for Uklana block. It is lies in the north of Hisar district. Its geographical location is 29°40'0" N to 29° 34' 30"N latitude and 75° 45' 0" E to 76° 00' 01" E longitude. It covers an area of 227.6 km^2.

***Keywords* — PLRM Database, Panchayati Raj, Remote Sensing & GIS, Natural resources and decision making.**

1. INTRODUCTION

The socio-economic development of any country is based on land resources and water resources. Due to increase in population, these resources are over stretched often leading to resource depletion. There is therefore need to prudently manage these delicate resources. Remote Sensing and GIS techniques can be applied effective measure to generate data and information for sustainable development. After more than twenty five years of satellite-based land remote sensing experimentation and development, these technologies reached almost all sectors of Earth science application.

The digital land cadastral maintains the official records pertaining to land parcels, their position, shape, size, land use, and ownership. This forms a basis for property taxation that remains one of the main purposes of developing digital land cadastral. The information derived/retrieved from digital cadastral maps can serve administration in many different ways, in addition to contributing to a comprehensive, equitable, and efficient land tax system. In the light of the evolving digital technology, traditional cadastral maps on paper are not enough flexible and not suitable for the needs of the emerging information society.

Panchayati Raj, a synonym of democratic decentralization, was introduced in India in the late 1950s and early 1960s to restore to the erstwhile institution of Panchayat the pristine glory that it enjoyed in ancient India. It represents a political ideal and is reflected in the rural local-self-government in its institutional form. The concept as such is not new to India. The plea for greater autonomy to the rural bodies received conceptual strength with the advent of Mahatma Gandhi on the national scene and his enunciation of the doctrine of the national development through autonomous rural organizations which he drive to model on the lines of Panchayat system as it prevailed in ancient India. He envisaged five-tier system of Village Panchayats, Taluka Panchayats, District Panchayats, Provincial Panchayats, and All-India Panchayats.

2. STUDY AREA

Uklana block lies in the north of Hisar district. Its geographical location is 29°40'0" N to 29° 34' 30"N latitude and 75° 45' 0" E to 76° 00' 01" E longitude. It covers an area of 227.6 km^2. It is bounded by Fatehabad district in north, Jind district in east, Agroha in west and Barwala block in the southern part of the block. Placed in urban part of district, it is one of the 9 blocks of Hisar district. According to the government revenue records, the block number of Uklana is 71. The block has 18 Panchayats and there are total 20377 homes in this Block.

Climate of Uklana block is semi-arid to arid and hot, which is mainly dry with very hot summer and cold winter except during monsoon season when moist air entered. The summer starts from mid-March to last week of the June followed by the south- west monsoon, which lasts till September.

The transition period from September to October forms the post-monsoon season. The winter season starts late in November and remains up to first week of March. The normal annual rainfall is 373 mm. The south west monsoon sets in from last week of June and withdraws in end of September, contributed about 80% of annual rainfall. July and Rest 20% rainfall is received during winter in the wake of western disturbances. During winter i.e. December and January, the temperature goes down below 1ºC. The location map of the study area is shown in figure-1.

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3. OBJECTIVES

This paper demonstrates the usefulness of PLRM database in conjunction with Remote Sensing & GIS for Panchayat level planning and its management for enhancing to decision-making capabilities for local peoples.

Fig.-1

4. MATERIALS & METHODOLOGY

The study was made to utilizing High Resolution Ortho-Rectified Satellite data Cartosat-1(PAN) and Resourcesat-1(LISS-IV Mx). The PAN sensor has spatial resolution of 2.5m and the LISS-IV Mx has a resolution of 5.8m. The primary elements of the PLRM database are as follows:-

Land use/Land cover

The LU/LC of the study area was prepared with the help of LISS IV & Cartosat-1 PAN merged fused data by visualization interpretation and the LULC classes' schema was adopted from SIS-DP manual of NRSC.

Soil Map

The different Soil texture map at 1:10,000 scales was prepared by already available the themes as an output of pervious mapping exercise on 1:50,000 scale. The layer was integration with Cartosat-1 HRSI on 1:10,000 scales.

Ground Water Map

The Ground water Prospectus map at 1:10,000 scales was also prepared by already available the themes as an output of pervious mapping exercise on 1:50,000 scale. The layer was also integration with HRSI on 1:10,000 scale.

Slope Map

The slope map at 1:10,000 scales was also prepared by already available the themes as an output of pervious mapping exercise on 1:50,000 scale. The layer was integration with HRSI on 1:10,000 scale.

Drainage Map

The Drainage map was prepared with the help of Cartosat-1 PAN data by visualization interpretation on 1:10,000 scales.

Transportation Map

The Transportation map was prepared with the help of Cartosat-1 PAN data by visualization interpretation on 1:10,000 scales.

Cadastral Map

The parcel level mapping is the main thrust of the present work. The cadastral mapping was done with the help of scanning of Mussavi (Parcel level record of revenue). After the digitization all parcel data was overlaid on HRSI. The parcel level data was also integrated with thematic maps for PLRM database.

5. RESULTS

The PLRM database was created for different thematic and legacy layers. The Legacy layers viz. slope, ground water, soil maps were made with help of already available database on 1:50,000 scales after its integration with HRSI on 1:10,000 scales. The thematic layers viz. land us/land cover, road, and drainage maps were prepared with the help of Cartosat-1 and LISS-IV merged data product. The cadastral mapping was done with the help of scanning of Mussavi.

5.1 Land use/ Land cover

Based on the interpretation of IRS P6 LISS-IV & Cartosat-1PAN merged data satellite data, the land use/ land cover categories identified in this block were cropped area, agricultural plantation, mining/industrial, forest plantation, salt affected, peri-urban , scrub land open & dense, grassland/ grazing land, lakes/pond etc. The interpreted satellite map of LULC is shown as figure-2. The areal extent of these categories is given in table-1.

Table-1 Land use/ Land cover classes of Uklana Block

LULC Classes	Description	Area (Sq.km.)	Area (%)
AGCR	Crop Land	213.18	90.5
AGPL	Agriculture Plantation	1.33	0.6
BUMN	Mining/Industrial	1.35	0.6
BURH	Hamlets	1.16	0.5
BURV	Village	7.22	3.1
TPRBG	Railway	0.58	0.2
BUUC	Core Urban	2.50	1.1
BUUP	Peri-Urban	0.81	0.3
FRPL	Forest Plantation	0.66	0.3
GRGR	Grassland & Grazing land	3.46	1.5
WBLP	Lakes/Ponds	0.55	0.2
WBRT	Reservoir/Tanks	0.12	0.1
WLSP	Scrub Land Open	0.05	0.0
WLSD	Scrub Land Dense	0.21	0.1
WLSA	Salt-Affected	1.98	0.8
CANM	Main Canal	0.51	0.2

The brief description of various classes is as follows:

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Agricultural Land

Agricultural land may be defined broadly as land used primarily for the production of food grains and fodder. This category is further divided into crop land and Agriculture Plantation.

Crop Land

These are the areas with the standing crop as on the date of satellite overpass. Crop Land is the dominant category in Uklana block. The crop land covering 213.18 sq. km. area and 90.5% total mapped area of the block.

Agricultural Plantation

These are the areas under agricultural tree crops planted by adopting certain agricultural management techniques. It includes tea, coffee, rubber etc. which are normally grown in the hilly regions and closely associated with forest cover. The Agriculture plantation covers 1.33 sq. km. area of the block.

Land with Open Scrub

Scrublands are associated with moderate slopes in plains and foot hills and are generally surrounded by agricultural lands. These lands generally occupy topographically high locations and possess sparse vegetation. The Scrub Land Open covers an area of 0.05 sq. km. in the Uklana block.

Land with Dense Scrub

These areas possess shallow and skeletal soils, at times chemically degraded, extremes of slopes, severely eroded and lands subjected to excessive aridity with scrubs dominating the landscape. They have a tendency for intermixing with cropped areas. The Scrub Land Dense covering 0.21 sq. km. area and 0.1% total mapped area of the block.

Other Land use/ Land cover classes in the block are built up rural (villages) which is a second dominant category of the block, in which village's covers an area of 7.22 sq. km. Grazing/ Grassland class cover 3.46 sq. km. area of the block and peri-urban cover 0.81 sq. km. area of the block respectively. The remaining LULC classes are hamlets, mining/industrial, salt affected, forest plantation, lakes/ponds and reservoir tanks etc. covered the remaining area of the block.

5.2 Infrastructure

Infrastructure can be defined as the services and facilities necessary for an economy to function. The term typically refers to the technical structures that support a society, such as roads, rail, water supply, sewers, power grids, telecommunications, and so forth. This category is further divided into transportation (road & rail) and drainage (river, stream, & canal). Uklana block is well connected by road network. Transportation major category like state highway, major district roads and rail are well connected in the block. The transportation network map is shown in figure- 3 and the drainage map of the block are shown in figure- 4.

5.3 Legacy data integration

5.3.1Soils

The soil texture is fine loamy in the almost area of the Uklana block. The coarse loamy soil texture was observed in the south-western part and in the surrounding area of Faridpur village. The loamy sand soil texture was observed in the surrounding area of Pabhuwala, Kanaal and Pabra villages. The soil texture map of the block is shown in figure- 5.

5.3.2 Ground water

Ground water forms a part of the *hydrological cycle* and acts as a dynamic system. It comes into existence with the process of infiltration at the surface followed by percolation into the ground comprising of different rock types / geological material. Based on the interpretation of Ground Water Cell Haryana data, the ground water categories identified in this block were moderate and moderate to poor. The ground water prospectus map of the block is shown as figure-6. The ground water quality wise area is given in table-2.

Table- 2 Ground water quality of Uklana Block

Ground Water Quality	Area (sq. km.)	Area (%)
Moderate	229.05	96.95
Moderate to poor	3.1	1.31
Water Body	0.79	0.33
Settlement	3.32	1.41

The ground water quality is moderate in almost Uklana block. This category covers an area of 229.05 sq. km. of the block. In the south-western part of the block have Moderate to poor water quality which covers 3.1 sq. km. in the surrounding area of Kanala village.

5.3.3 Slope

The slope layer was generated from Carto-DEM or SRTM based on the suitability and availability criteria for the Uklana block by using GIS software. The entire block is flat area and falls in 0-1% slope range. The slope map of the block is shown as a figure- 7.

5.4 Cadastral Mapping

The cadastre is a public record of location, extent, value and ownership of land in a district for the purpose of taxation. In the present study address, an individual farmer with parcel number as the unique identity derived from the cadastral map and integrated with thematic maps and action plans generated in other information systems. According to SDD of National Land Record Modernization Program (NLRMP) the village's viz. Chamar Khera and Sahu village of the Uklana were mapped. After that, both villages were overlaid on high-resolution satellite data. The overlaid of cadastral data of Sahu village's shown as figure-8.

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6. DISCUSSION

In the present study, an attempt has been made to create the PLRM database for panchayat level planning. The PLRM database of land use /land cover themes information and its utility for panchayat level planning is shown in table-2.

Table-2 Resource Maps: Land use/Land cover

Theme	Information Available	Utility
Land use/Land cover	**Existing landuse- parcel wise details:-** Crop land, Agriculture plantation, Grassland/Grazing land, scrub land dense, Mining/Industrial, **Built-up**- Hamlets, Village	To assess existing landuse parcel wise which help the in making decisions Help in to find out increase of village sprawl

The PLRM database of infrastructure and drainage themes information and its utility for panchayat level planning is shown in table-3.

Table-3 Resource Maps: Infrastructure& Drainage

Theme	Information Available	Utility
Infrastructure	**Road network-** state highway, major district roads, village road, cart track & footpath	Its helped the local people and planners to make connectivity studies and proposed new roads in the Panchayat
Drainage Network	Branch canal & Distributory canal	Its helped the local peoples to plan water harvesting structures and check dams

The PLRM database of soils and underground water themes information and its utility for panchayat level planning is shown in table-4.

Table-4 Resource Maps: Soils & Under Ground Water

Theme	Information Available	Utility
Soil	**Texture- Fine,** Fine loamy, loamy sand & Coarse loamy	helped the planners to suggest the sustainable land use plan for example in any parcel the soil is loamy and water quality is good so the famers can be adopt Agri- horticulture and horticulture plantation in that particular parcel
Ground Water	**Ground water quality-** Moderate & Moderate to poor	

7. CONCLUSION

The generated themes can be implemented for further planning of the panchayat and rural area .The action plan report can be created using the PLRM database and total decision support system can be developed to depict location and type of action / control measures recommended for sustainable development plan of natural resources available in Panchayats. Zonal and Community wise soil resource development plan, Water resource development plan, vegetation resource development plan, Land use and Land cover plan can be developed using the PLRM database of the respective Theme.

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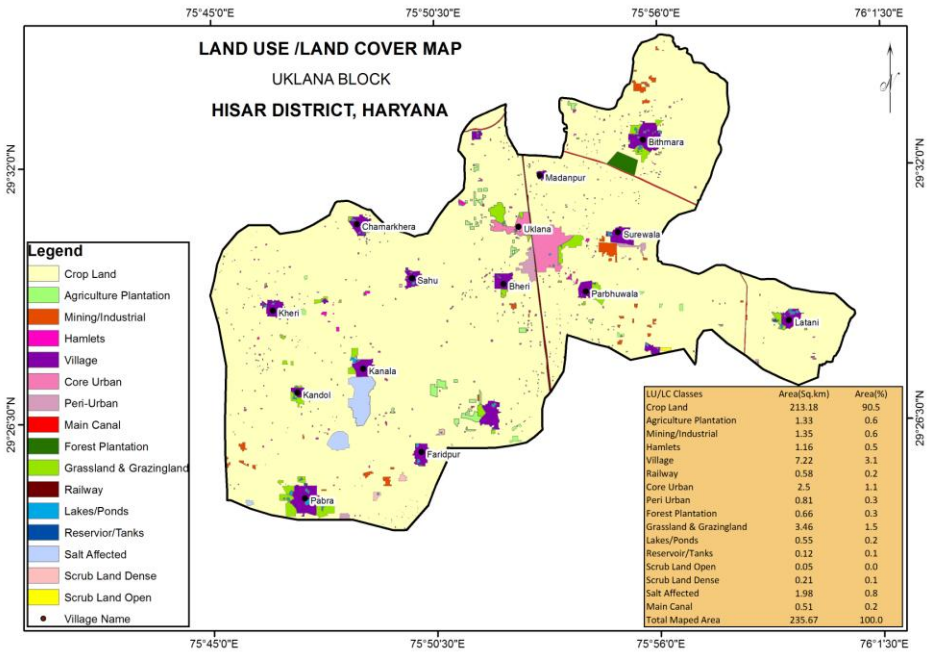
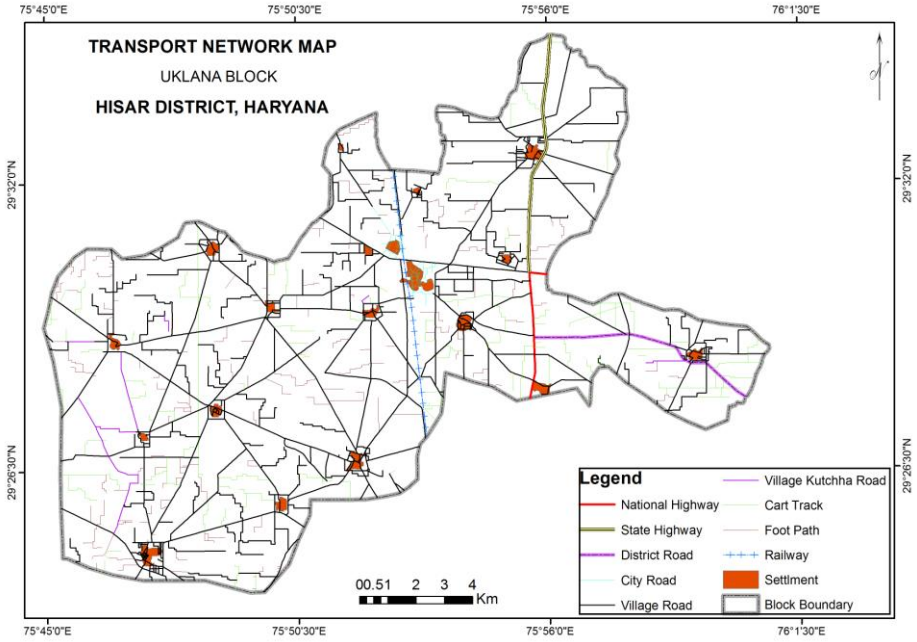


Fig.-2



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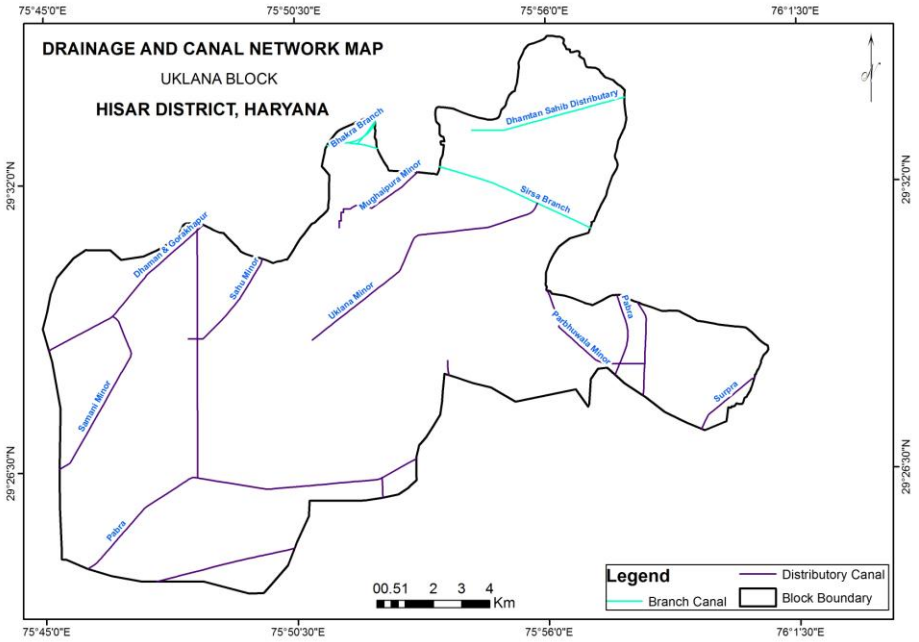

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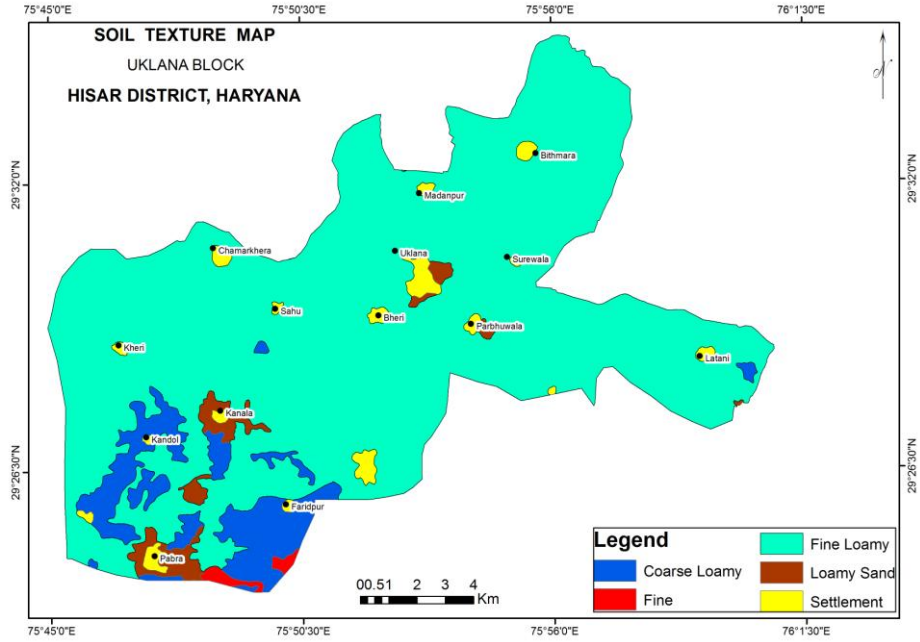

Fig.-5

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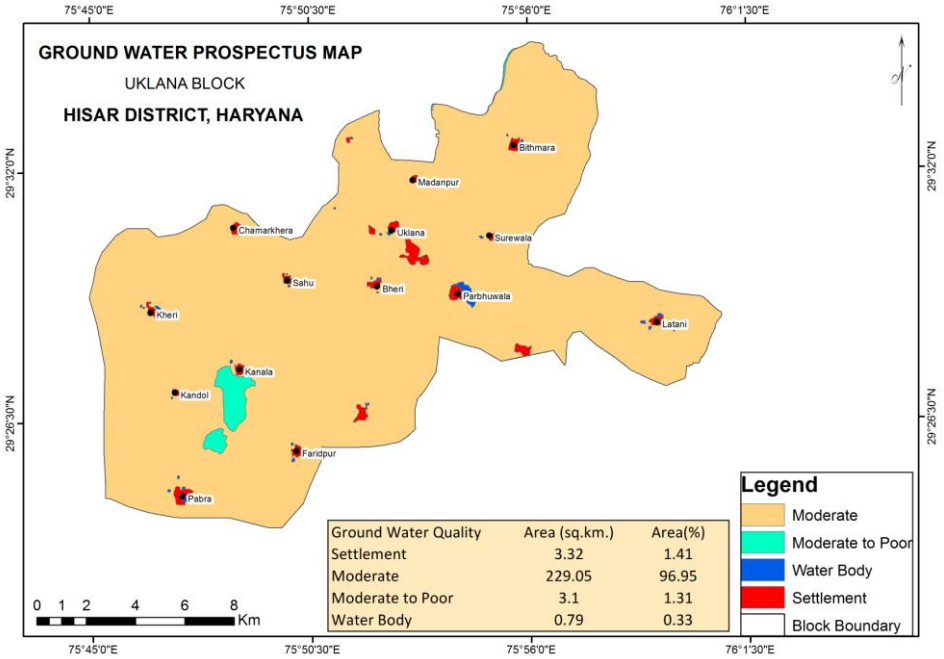

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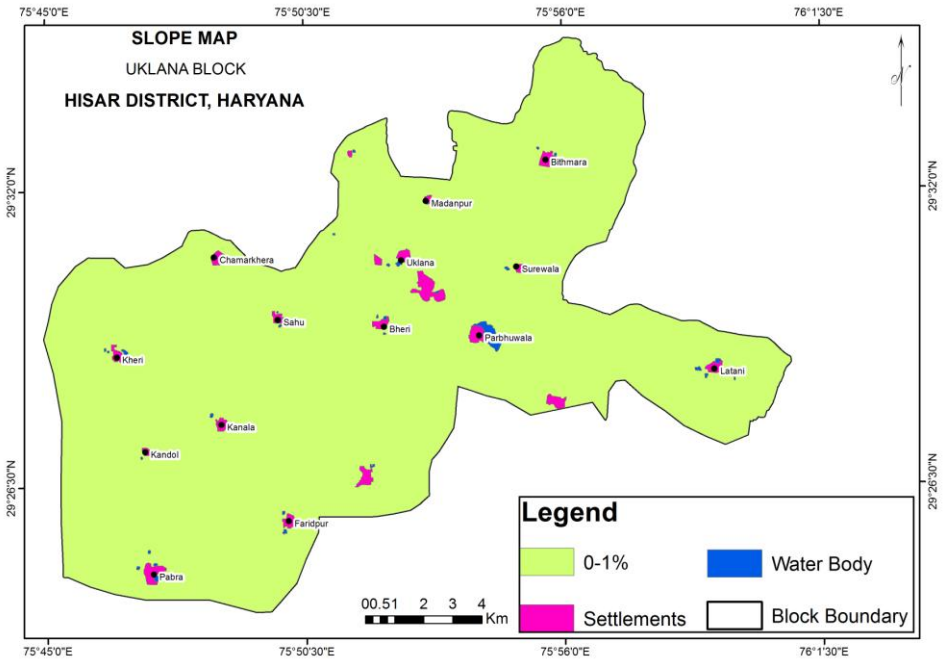

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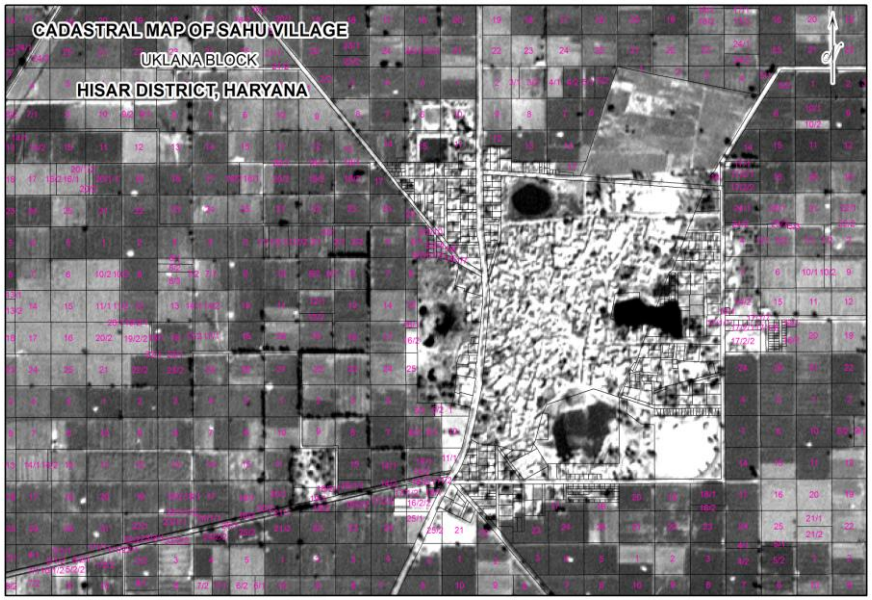

Fig.-8

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