

SHRINKAGE OF UDAIPUR LAKES STUDY USING REMOTE SENSING & GIS ANALYSIS

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ABSTRACT

In the recent years, Udaipur, the city of lakes is facing a major problem of insufficient water reaching to the lakes from the catchment during rains and consequently drying of lakes. This has resulted in economic losses to the tourist industry as well as this has emerged as major environmental problem. The present study has been attempted using Satellite Remote Sensing data over last 30 years and compared with the base details available from existing maps on 1:25,000 scale surveyed during 1959-60.

Six subcatchments were studied for cropped areas using multi – temporal data of *rabi* season pertaining to 1975, 1996 and 2004 to observe the changes in terms of aerial extent. Potential causes linking hydrogeological setup with shrinkage in the area of the lake were also studied, supplemented with ground truth data. Digital Elevation Model of the area was generated to study the terrain characteristics of the catchment. Existing and depicted drainage have also shown discrepancy. Upstream areas have shown the trends of higher intensity of cropping. Action plan is to be implemented, translated on large scale by district authorities with people's participation.

MATERIALS

1. Survey of India toposheet on 1:25,000 scale surveyed in 1959-60.
2. Survey of India toposheet on 1:50,000 scale surveyed during 1967-72
3. Landsat MSS data of 3rd March, 1975 of 80 meter resolution.
4. IRS data of LISS-I of 18th February, 1996 having 72.5 meter resolution.
5. IRS data of LISS-III of 8th February, 2004 having 23.5 meter resolution.
6. IRS data of LISS-IV of 7th June, 2004 having 5.6 meter resolution.
7. Geological Survey of India map of 1997 showing lithological formation in the region.

METHODS

1. All the satellite data have been geo-referenced, catchment boundaries are overlaid and using Digital Image Processing techniques, crop area has been separated, for

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the calculation of crop area statistics at different point of time (1975, 1996 and 2004).

2. The crop area as depicted in Survey of India toposheet has been measured to arrive at extent of cropland in 1959-60.
3. Geological map has been referred to see the lithological composition in the entire catchment area of Udaipur lakes.
4. Digital Elevation Model was generated of the area to study terrain characteristics.
5. The satellite data have been visually interpreted to map the lineaments in the region.
6. Finally a composite output has been made, which depicts the catchment boundaries, lineaments, drainage, important settlements and roads.

THE CATCHMENT

Udaipur lakes region has catchment area including extended catchments, 33424.87 hectares as per Survey of India toposheets on 1:25,000 scale. The lakes region catchment can be divided into six sub catchments viz.

1. Bada Madar	:	8780.48 hectares
2. Chhota Madar	:	2987.23 hectares
3. Fateh Sagar	:	4325.35 hectares
4. Bari ka Talab	:	1906.55 hectares
5. Pichhola	:	14610.63 hectares
6. Goverdhan Sagar	:	814.63 hectares

CROP AREA IN THE REGION

The lakes catchment region has many valleys and some flat areas where the cultivation is in practice and as per Survey of India toposheets in 1959-60 the total crop area in the region was 2881.20 hectares.

A comparative study has been done for the *rabi* seasons using satellite data of last 30 years.

1. 03 March, 1975
2. 18 February, 1996
3. 08 February, 2004

The study shows that the crop area, which was 2881.20 hectares in 1959-60 increased to 2887.79 hectares in 1975 over a span of 15 years and it became 3981.08 hectares in 1996 over a span of 21 years. Further in 2004, it reduced to 3134.36 hectares.

The catchment-wise increase and decrease over a period of time is depicted in the table 1.

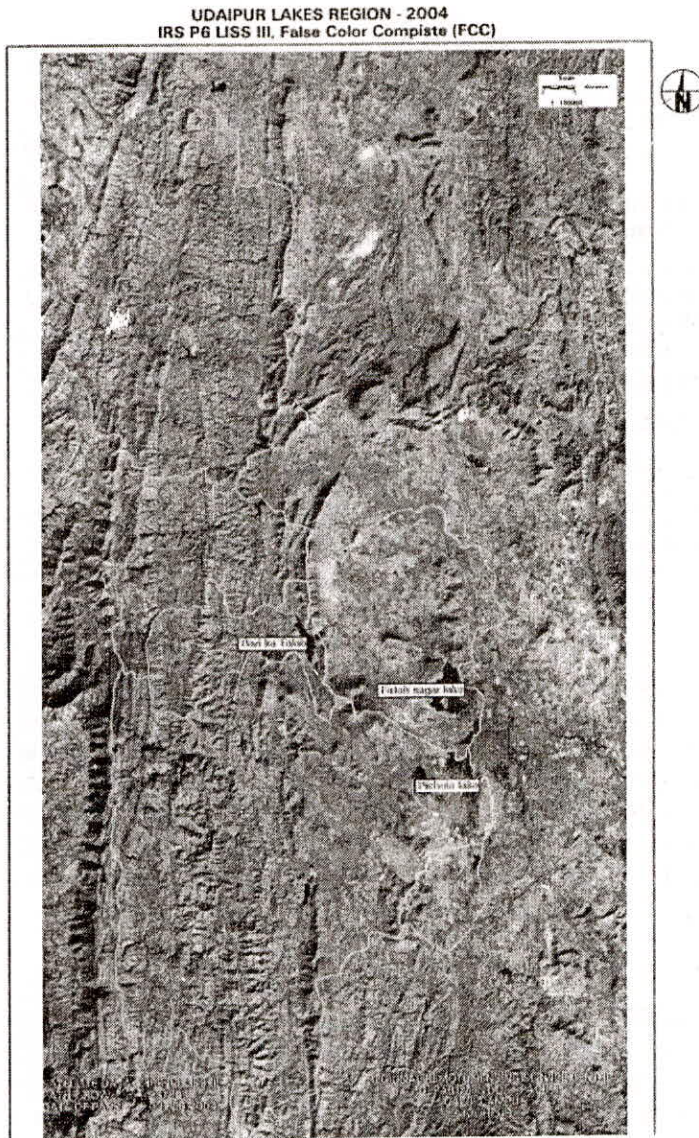


Fig. 1 Study Area
(The coloured photograph is given at the end of the book)

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Table 1. Catchment area (in hectares)

Catchments		Crop area				
S.N.	Catchment Name	Catchment area	Topo Map Crop area (1959-60)	Based on satellite data		
				3 March 1975	18 Feb. 1996	8 Feb. 2004
1	Bara Madar	8780.48	335.00	397.37	608.67	509.76
2	Chhota Madar	2987.23	205.20	117.74	293.30	276.48
3	Fateh Sagar	4325.35	841.80	1187.39	1279.90	631.07
4	Bari ka Talab	1906.55	117.70	43.63	124.05	204.88
5	Pichhola	14610.6 3	1283.9 0	1102.76	1604.73	1480.84
6	Goverdhan Sagar	814.63	97.60	38.90	70.43	31.33
Total area		33424.8 7	2881.2 0	2887.79	3981.08	3134.36

GEOLOGY

The area of study around Pichhola and Fateh Sagar Lakes of Udaipur city is comprised of Aravalli Supergroup rocks of Lower Proterozoic age (2500-1600 My). The main city area lies on soft and cleaved metamorphic rocks of phyllite, schist and metagraywacke. The catchment area lies in the west of the lakes, which is mainly fed by the drainages of Aravalli Hill Ranges. The rocks of upper catchment area are composed of phyllite, schist, basic volcanics and pyroclastics with enclaves of metaconglomerate and dolomite marble. The drainages are mainly controlled by the lineaments (fractures) cutting across the hill ranges. The stratigraphy with major rock types of the area is given in table 2.

LINEAMENT

Satellite image (IRS P6) of February, 2004 shows prominent three sets of lineaments, trending NE-SW, NW-SE and E-W directions around Udaipur city. A few lineaments along N-S direction, sub-parallel to the Aravalli Hill Ranges, are present in the west of Udaipur city. These lineaments represent fracture/weak zones in the area and act as conduits for water seepage/recharge in and out of the Pichhola and Fateh Sagar Lakes.

CONCLUSION

The analysis of summer 2004 satellite data shows 1143.01 hectares area under crop. These are basically vegetable crops and are high water demanding and sustain only on ground water exploitation. These have resulted in increase in the intensity of cropping in the valley. Because of extensive cultivation in all the three seasons, large amount of ground water is extracted from the aquifer in the catchment area. The same catchment is also one of the sources of drinking water supply to the city by PHED through number of tube-wells drilled. It is also learnt that

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number of small size anicuts have been constructed in the catchment area in the last 25-30 years resulting in reduction in runoff. It is also observed that land has been encroached in the riverbed and new fields have emerged as agricultural area, responsible for the excessive withdrawal of ground water from the catchment area. The rainfall data shows insufficient rain in general and intensity in particular, which enable flow of rainwater into the lakes. Over a period of time because of the increasing demand, there has been more withdrawal of water from lakes for the city supply. Agriculture in general also increased in the down-stream of the lakes, the recharging of the down-stream wells is from the lake water due to base flow direction and the lineaments.

Table 2. Stratigraphy with geological formations around udaipur city
(after Geological Survey of India, 1997)
(Litho units are given in bracket)

Lower Proterozoic (2500-1600Ma)		Synorogenic granite and gneiss – (6)	
	Aravalli Supergroup	Nathdwara Group	Phyllite, Chlorite mica schist – (10)
		Bari Lake Group	Chloritic phyllite / meta tuff – (11)
			Basic volcanics and pyroclastic with enclaves of metaconglomerate and marble – (12)
			Quartzite, pebbly arkose and metaconglomerate – (13)
		Udaipur Group	Phyllite with enclaves of dolomite and chert – (15)
			Phyllite, metagraywacke and mica schist – (16)
			Quartzite and metaphelite – (17)
			Phyllite and metagraywacke – (18)