

## Environmental Appraisal of Pushkar Lake Catchment Area with Special Reference to Siltation- An Investigation

REEPUNJAYA SINGH\*

\*Reepunjaya Singh, Ph.D., Faculty of Geography, Government College, Ajmer, Rajasthan, India.

### ABSTRACT

Remote Sensing Data is used to assess the source of siltation in Pushkar Lake (6330 hectares area) at Pushkar Rajasthan (India). Three-dimensional view of catchment area was generated by using Digital Image Processing Techniques: Digital Terrain Model and Soil Brightness Index. The environmental degradation of lake and its surrounding area by silt and sand through Aeolian and fluvial activity in the area has been analysed. The result of the study indicates that due to siltation the lake (effective water area) is losing its original shape vertically and horizontally.

### Introduction

Pushkar Lake is situated at a distance of 11 km. to the west of Ajmer city. The terrain of Pushkar and its surrounding is of complex nature. To the west and south west of lake at a distance of about 1.5 km. lies the extended part of Thar desert with Semi Arid conditions. Aravalli hills locally known far *Nag Pahar* is in the east of lake, and have deciduous forest cover, These hills are insufficient to check silt flow. Presently, the Lake is facing a severe problem of siltation by transportation and deposition of Aeolian sand, through its streams in the rainy season and through winds in summer season. (Photo 1)



*Photo 1- Pushkar Lake with Silt*

It is also observed that numbers of tube wells are operating in the catchment area of lake through which ground water is being extracted for farming and orchards throughout the year, effecting water table of Pushkar Lake. This has not only adversely affected the quality of water (increase in turbidity) in lake but also shrunk the surface spaced and depth,

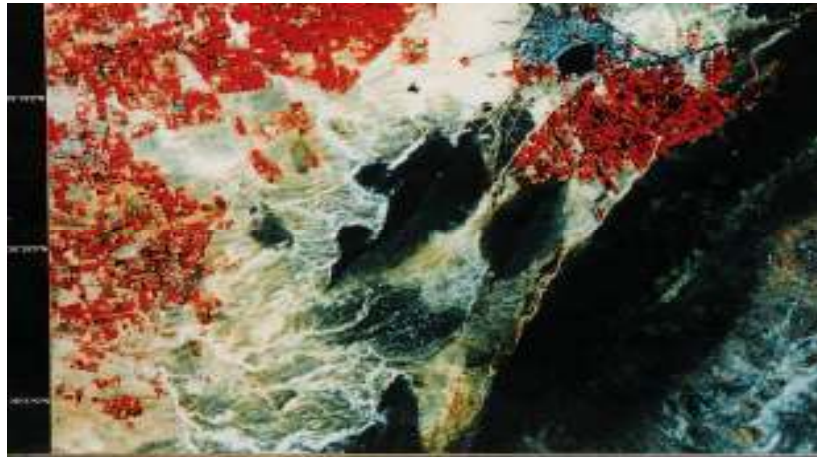
reducing its water storage capacity.

#### Study Area

The study is undertaken with the following objectives:

- Delineation of catchment of lake.
- To assess the source of siltation in the lake and characterization of the area where the treatment is required.
- Generation of 3 dimensional view by using Remote Sensing data and Digital Terrain Model to producing slope map.
- Identification of loose sand areas through Soil Brightness Index.

The study area is located in between 26°26' to 26°31' north latitude and 74°26' to 74°36' east longitude comprising of 6330 hectares of Pushkar Lake and its siltation zone; out of which 4030 hectares is wind-eroded area and 385 hectares is of water-eroded area. (Fig. 1)



*Fig. 1 Satellite Image of Pushkar (IRS 1D Liss III Feb., 2004)*

The average annual rainfall is 520 mm. (Ajmer station) and 90% of which is being received in between months of June and September. The area which is part of Aravalli ranges with undulating hill and sand deposition on older alluvium, surrounding hills and valleys have moderate to poor vegetative cover. (Photo 2 a, 2 b)



*Photo 2 a Pushkar and surrounding*



Photo 2 b Pushkar and surrounding

### Data Base

The study is based on two techniques of remote sensing data interpretation: Visual Interpretation, and Digital Processing. Satellite Images of IRS-1D at scale 1:50,000 dated Feb. 2006 were used. Digital Terrain Model (DTM) was generated through Digital Processing of IRS – 1A Liss II data. Base map was prepared by survey of India Toposheet No. 45-J/7, J/10 & J/11, supplemented with ground truth observation of the study area.

### Methodology

Satellite data & Survey of India GT Sheets helped in mapping units along with ridge line of catchments, units delineated on the tracing film, this was transferred on base map with the help of Optical Pantograph. The FCC imagery of the study area was studied visually, to update the interpreted outputs. Attempt is made to know the source of siltation by generating Digital Terrain Model and Soil Brightness Index. Digital Terrain Model of the study area was generated, where in height information was supplied by digitizing contours and point elevation (spot heights).

### Results/Output

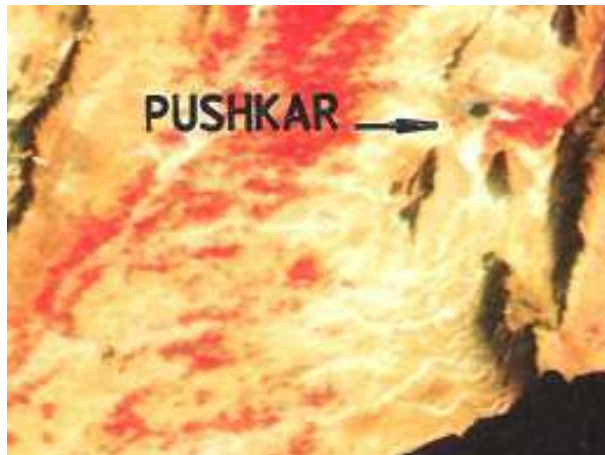
The study has revealed that main sources from where the silt and sand is being transported to the lake can conveniently be divide into following two broad classes.

1. **Sand transported by wind:** Sand dunes are prevalent in the south western part of the catchment, extending from the areas nearby villages namely Bhagwanpura, Koti, Bachan Singhji ki Dhani, Pabuji ki Dhani, Hajari ki Dhani and Motisar to the western banks of *Savitri* feeder and *Kharikheri* feeder or *Gori Nadi*, drawing their water from the southern part of the catchment area of the lake. Fresh sand from erosion affected area is carried by blowing wind and is deposited on the partially stabilized existing sand dunes of the western banks of streams. This process of wind erosion is more active during the period of February to July. (Fig. 2)



Fig. 2 Pushkar Lake Source of Siltation

**2. Silt and Sand Transportation by Water:** Three streams one flowing from north east (Pushkar Feeder) in between *Gorumba* and *Nag* hill and two flowing from southern part of the catchment area of the lake, (*Savitri* feeder and *Kharikheri* feeder or *Gori Nadi*) are the main source of silt and sand to the lake. All these streams are seasonal and flow during monsoon season. During this period flowing water comes with high velocity as the channel feeding to the lake is just adjoining to the *Nag* hills which results in transportation of already existing and freshly deposited sand on the western banks, to the lake resulting in its siltation. (Fig. 2) South westerly winds carrying sand, enters the catchment through funnel shaped inlet, formed by residual hills, is obstructed by hillocks and sand gets deposited at the foothills. During Monsoon runoff from upper reaches of catchment carried this sand into the lake. As depicted in images, loose sand in south west and near to inlet of the lake. Both Aeolian deposits of sand in catchment area and fluvial activity thus causes the siltation of the lake. (Fig. 3)



*Fig. 3 - Digital Elevation Model*

The DTM output show high *Nag Pahar* toward north-east which forms the ridge line of the lakes catchment. Sand carried by south-western wind is obstructed by the hillocks and carried by runoff from upper reaches. This sand gets deposited at the entrance of the lake and stops further inflow. (Fig. 4)



*Fig. 4 - Digital Terrain Model*

Soil Brightness Index of the study area was generated by linear combination of bands using appropriate coefficients. Density sliced soil brightness index image resulted into four categories viz. very loose sand, loose, moderate loose, stable and compact, showing their spatial distribution of various hills slopes. (Fig. 5)

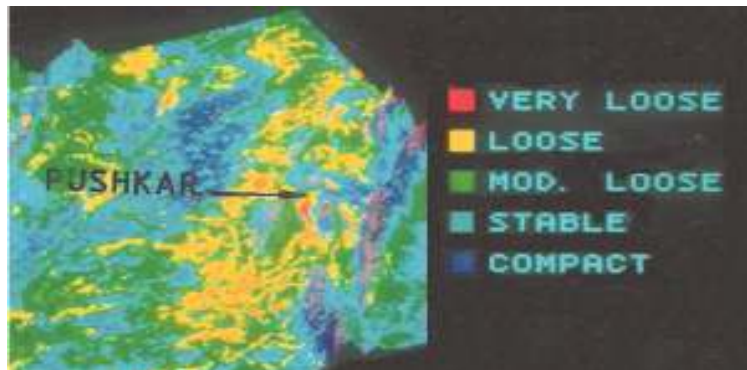


Fig. 5 – Soil Brightness index

Work of sand dune stabilization on a few sand dunes in the area by the Forest Department seems to have a very effective impact on reducing sand losses by water erosion from these treated areas. Similarly two check dams constructed by Irrigation Department on Pushkar feeder seems to have resulted in reducing the speed of flowing water as well the quantum of sand and silt flowing along with it.

#### Conclusion (Suggested Action Plan)

The study reveals that, the contribution of sand and silt into the lake is through Aeolian and Fluvial activity. Out of total 6330 hectares siltation zone, 4030 hectares is wind affected and 385 hectares is water affected eroded zone of which maximum erosion can be checked by stabilizing the sand hummocks through suitable vegetation cover in between *Savitri* and *Nag Pahar* hills, and afforestation measures in *Gurumba* hill and *Nag Pahar* hills. Dust storms (46 km/Hr.) are frequent in the area, this requires massive soil conservation, afforestation and gabion type of check dams on run-off area because all 3 feeders of the lake are adjoining to the surrounding hills through which water comes with high velocity bringing lot of sand and silt to lake, Plantation on barren hills and stabilization of sand dune require immediate treatment throughout the whole catchment area. Check is required on surrounding farm lands, which continuously use tube well water for cultivation, effecting water table of the lake. Also water is poured into lake by tube well from the surrounding area to maintain water table of the lake, but this is no solution to the problem. Offerings by pilgrims in lake also marginally contribute to the existing silt; this can be managed by rules and regulations. Grazing should be banned in the catchment area so as to stop biomass loss of the area.

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