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# Aquatic Resources: A Case Study of Udaipur 'City of Lakes', Rajasthan

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## Abstract

Aquatic resources refer to water and its multiple roles as a natural resource and in supporting all human, animal and plant life. It has a meaning that is broader than that of water resources alone, in that it encompasses all the possible roles for water, including human survival needs, supporting aquatic ecosystems and as an essential component of economic development. It considers both the quantity of available water and its quality for its intended uses. Aquatic resources also encompass the linkage between fresh water systems and the downstream coastal areas into which it drains, where it sustains biologically rich and commercially important coast as ecosystems. This chapter highlights the aquatic resources of Udaipur City, and the study is based on secondary data collected from various government and nongovernment organizations.

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## Keywords

Aquatic • Biodiversity • Lakes • Rajasthan

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## Introduction

The total water resources of the earth equal to 326 million cubic mile; only 2–5 % of water is fresh water; 97.5 % is salt water. Almost 69 % of fresh water resources are tied in glaciers and ice

caps, about 30 % is ground water and a mere 0.27 % is surface water ([www.drinkingwater.com](http://www.drinkingwater.com)). Water resources are important for the survival of a planet. As water is a prime resource, a basic need, it is essential to realise its full potential. It has always played a very important role in human life since its existence. All human activities are affiliated to water. Water is a supreme economic wealth besides its biological importance. It serves as an ideal medium for biochemical reactions so necessary for life. Thus water sustains life and regulates all important economic activities because of which it has been termed as the richest of all economic resources. Nearly 70 % of the

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world's population that is concentrated in the river valleys and deltas, around lakes and in the coastal areas speaks volumes of utility of aquatic resources for man. It seems that water is abundant, but usable water is very limited and creates a serious conservation problem in many places where it is needed. While plants and animals living in oceans are called marine resources, those living in flowing water like rivers as well as inland standing water like reservoirs and ponds are called aquatic resources (fresh water resources). This chapter highlights the present scenario of aquatic resources in Udaipur City, Udaipur being the Kashmir of Rajasthan, Lake City or Venus of India.

## Methods

This chapter has been prepared with the help of secondary data collected from various government and nongovernment organizations and various websites. Maps are prepared on Corel Draw.

## Study Area

**Site** Udaipur City is located in the southern part of Rajasthan. It is actually lying in the centre of a bowl-shaped basin surrounded by the Aravalli hills and is drained by the Ayad river.

**Location** Its latitudinal location is from 23° 9' to 25° 28' N and longitudinal extension is from 73° 1' to 75° 49' E. Its geographical region is 12,499 km<sup>2</sup> and is about 577 m above sea level. Udaipur evolved as a result of a decline in political power. The decision to site the new capital was favoured by a number of factors including having the temple of Eklingji close by, its isolated position caused by a hilly and forest-covered terrain, availability of water in abundance and the area having a quality of defence, to name a few. The increase in the municipal area of the town was primarily in response to the increase in population. Except for the two consecutive decades, 1891–1901 and 1901–1911, when the

population recorded decline due to natural calamities, it has otherwise registered a steady and continuous growth, except that of 1941–1951 when it had the highest growth due to various reasons of which the post partition being the most significant. Besides this the growth rate in Udaipur City had been in accordance with Udaipur's economic and cultural growth. Udaipur being an important tourist centre has a floating population of considerable size (Fig. 2.1).

Though demographically it is a class I city, functionally it is only a medium-sized regional city without having any major or metropolitan function (Bhattacharya 2000). Till 2011 Udaipur continues to develop and expand its commercial, administrative, educational, cultural, recreational and tourist interests. Thus, this throws light on the fact that with the rapid increase in population, the area of city is also increasing.

## Aquatic Resources of Udaipur City

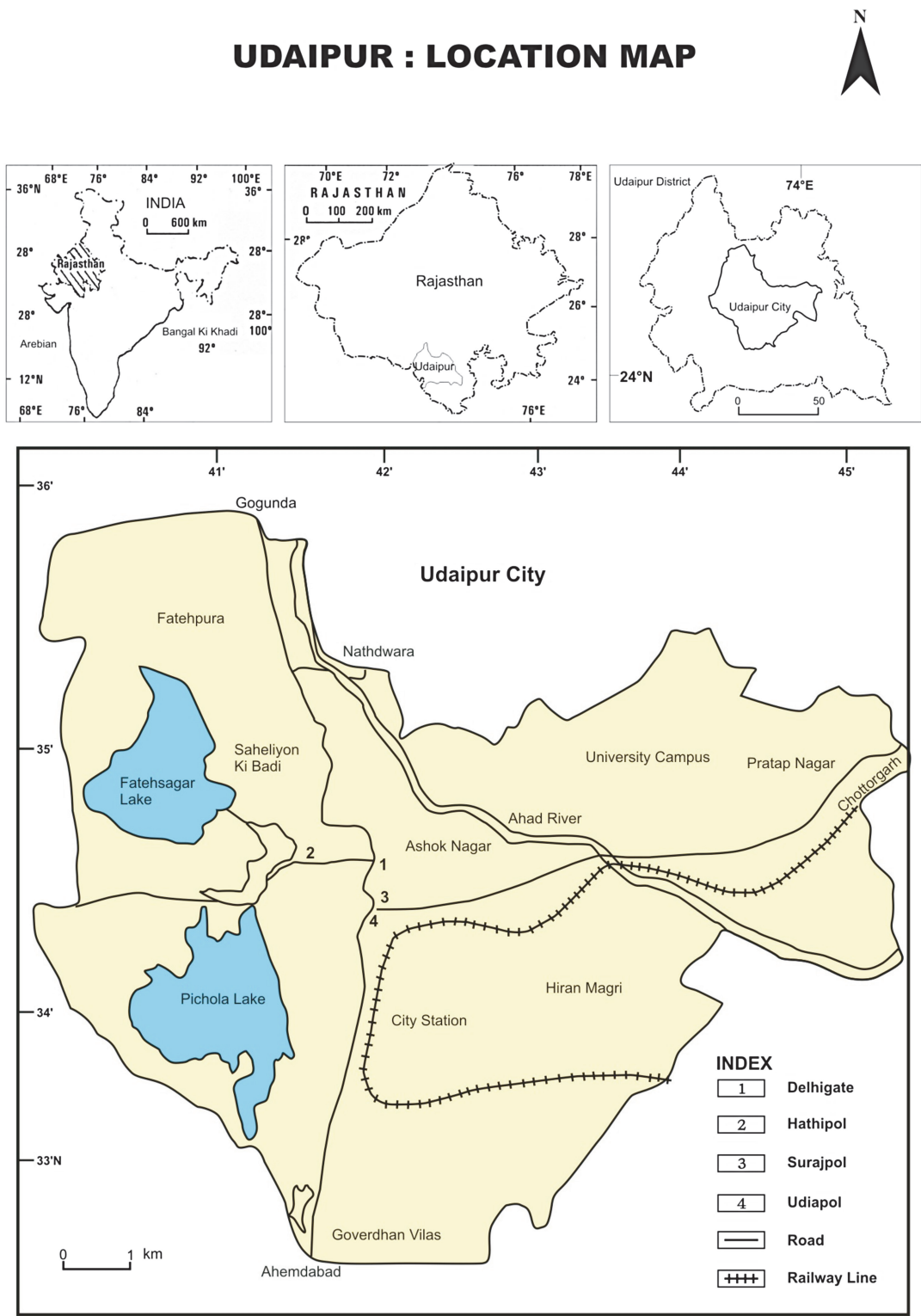
Rain water remains reserved in nature in various forms called water reservoirs. They can be broadly classified into surface sources and underground sources.

### Surface Water Sources

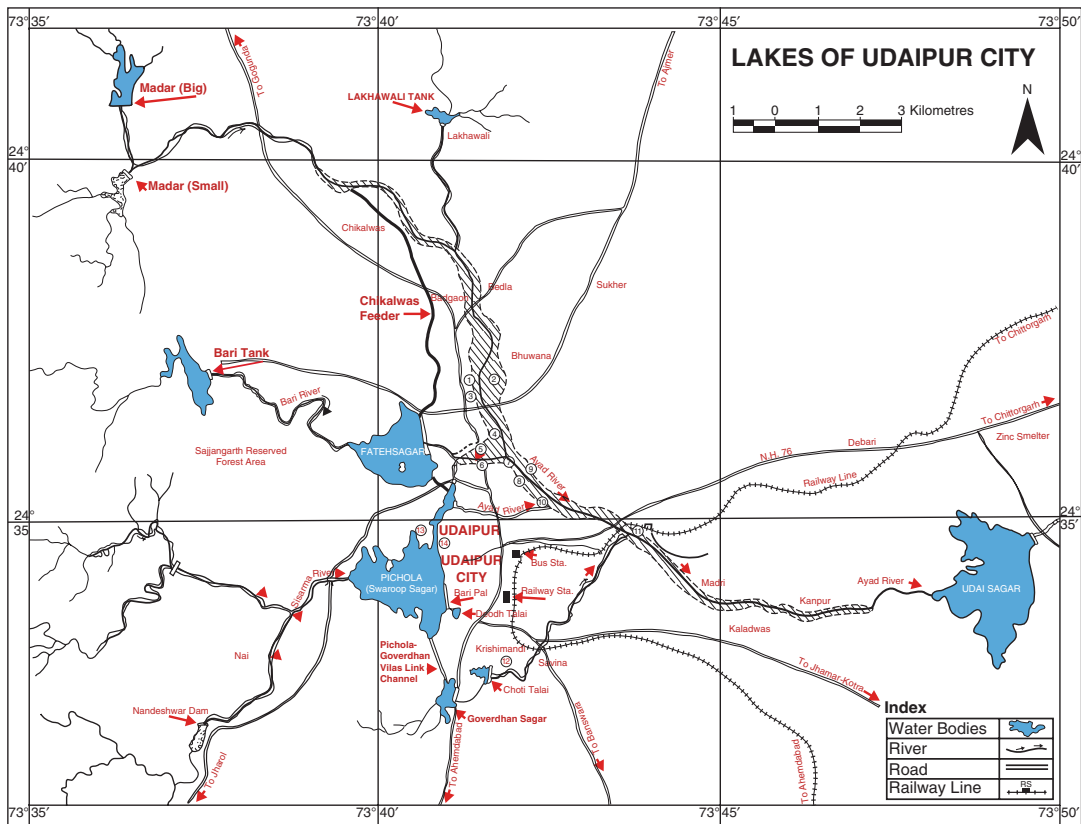
Udaipur, famous as 'City of Lakes', includes rivers, lakes and ponds that are surface water sources, namely, Fateh Sagar, Pichhola Lake, Swaroop Sagar, Nandeswar Talab, Badi, Madar, Choti Madar, Ayad river, etc. Figure 2.2 gives a clear picture of all the surface water sources of Udaipur City (Babel and Gupta 1994). Besides these, there were 121 baovries of which 83 have dried up.

### Ayad

Berach the main tributary of river Banas rises originates from the Girwa ranges of Aravalli situated to the north of Udaipur City. It is called Ayad river from its fountainhead through Bedla up to Udai Sagar Lake, in which it falls. It is the principal river of the Udaipur basin. Beyond Udai Sagar up to Dabok village, the river passes through a distance of about 75.5 km and is named



**Fig.2.1** Map of Udaipur City with major water bodies



**Fig.2.2** River of Udaipur City

as Udaipur Sagar ka nala. Afterwards known as Berach it runs for another 70 km towards the northeast and finally merges into river Banas, near Bigod in the Bhilwara district, which is a tributary of Chambal river; Chambal again is a tributary of river Yamuna, and Yamuna is the principal tributary of the holy river Ganga. Near the town of Chittorgarh, it receives the water of Gambhiri river, then it turns northeast, and after flowing for about 190 km, it joins river Banas at the place acclaimed as Triveni Sangam near the village Bigod (Gupta 1991).

### Lakes of Udaipur City

#### Pichhola Lake

Pichhola Lake is in Udaipur, was originally constructed by some Banjara, in the fourteenth century A.D., and later on was extended to Rang

Sagar and Swarnop Sagar and finally was connected to Fateh Sagar by the successive rulers of the princely state of Mewar. Pichhola lies to the west of the majestic 'City Palace' providing them with unique and water frontage which enchants every tourist's heart and soul. It is roughly triangular in shape with its base along the palace ridge. It was renovated and enlarged in 1559 A.D. along with the establishment of Udaipur itself; it enjoys a water spread of 10.8 km<sup>2</sup> and a maximum depth of 9.15 m. The gross, live and dead capacities of the lake is 13.67 mcm, 9.00 mcm and 4.67 mcm, respectively, while the gauge height above and below sill level is 3.35 and 5.2 m. The lake has a net catchment area of 142 km<sup>2</sup>, and it has an average yield of 493.5 mcf of water. Presently 13.50 mld of water is drawn from this lake by the PHED to serve the thickly

populated areas of the old city lying around this lake. The lake is extended towards the north and south forming smaller lakes, viz. Doodh Talai and Swaroop Sagar, as shown in map 2 which gives a detailed picture of the lakes of Udaipur (Sujaś 2010).

#### Swaroop Sagar

It was constructed during 1845–1850 A.D. Its intermediate position has sluice gates and canal to feed water to Fateh Sagar Lake which is towards the north and linked with Pichhola through Rang Sagar Lake in the south.

#### Rang Sagar

It has an average depth of 7 m, but its width is about 245 m, whereas its westward extension is known as Kalaliya tank.

#### Fateh Sagar

It is situated in the northwestern part of the city and almost in the central west of the basin covering an area of 12.88 km<sup>2</sup>. It has a pear-like shape, covering about 4 km<sup>2</sup> areas and gross, live and dead capacity of 12.0 mcm, 7.00 mcm, and 5.09 mcm, respectively. Nearly 20.71 km<sup>2</sup> of its catchment area yields annually 71.87 mcf of water, evidently lower than that of Pichhola. The daily drawl of water for domestic purposes has been recorded as 30 lakh litres in 2004 which was 0.00 in 2008, that is, no water was taken from Fateh Sagar for supply for domestic purpose which serves about 40 % of the population residing in the northern and western part of Udaipur City.

#### Bari

Bari ka talab or Lake Bari is lying 10 km away towards the west from Udaipur City. This lake was constructed by Maharaja Raj Singh in 1643 A.D. for recreation purpose. The lake is formed by damming the river Ubheswar coming from the west. The total length of the canal is measured as 3,300 m which is constructed for supplying water to the nearby areas, namely, Bari, Liyo ka Guda, Hawala Khurd and Dewali villages. The full gauge of the lake is 9.76 m. Almost no supply of water is rendered from this lake.

#### Lakhawali

It is located at a distance of 10 km from the centre of the basin in the north direction. It ranks fifth from the point of view of capacity, yield water level, catchment area and command area of the six lakes of the region. Its nearby terrain provides no scope for bed cultivation area. The lake is comprised of a good canal system spread over a length of 7.5 km of irrigation about 1,012.50 km<sup>2</sup> of land per year. The water of this lake is also used for domestic purposes.

#### Goverdhan Vilas

It is the smallest water reservoir of all the major lakes of the basin lying in the south. The length of the canals of this lake is also meagre extending over an area of only 3,750 m.

#### Udai Sagar

It is one of the largest lakes of the Udaipur basin constructed by Maharana Udai Singh in 1559 A.D. and named after him; this lake is situated in the far south-east of this basin. The lake was formed after damming river Ahar, particularly for the strategic and water source point of view.

#### Vallabh Nagar

Vallabh nagar is in Udaipur, on river Berach. The total catchment area is 1,188 km<sup>2</sup>. Its gross, dead and live capacity is 31.14 mcm, 3.54 mcm and 27.60 mcm, respectively. Its full tank level is 492.71 mcm. Its water is used for irrigation as well as for drinking purpose (Sujaś 2010).

#### Badgaon

Badgaon is in Udaipur, on river Berach. Its catchment area is 1,698.3 km<sup>2</sup>. Its gross capacity is 31.50 mcm, with its dead and live capacity of 1.34 mcm and 30.16 mcm, respectively. Its water is used for irrigation as well as for drinking purpose.

#### Jaisamand

Also known as Dhebar, Jaisamand is located 51.48 km south-east of Udaipur. It was made by Maharaja Raj Singh in 4 years from 1687 to 1691. It is more than 14.48 km long, and its breadth is more than 9.65 km. The dam on this

lake is made of marble and is in between two mountains. It is 1,000 ft long at a height of 95 ft. Behind this another water reservoir at the same height was constructed which according to Dr. O.J. Ojha remained empty for about 184 years. In the year 1875, being afraid of heavy rainfall, Maharana Sajjan Singh spent Rs. 2 lakh to fill the two third gap in between the two dams; the remaining work was completed afterwards (Raju et al. 2004). Jaisamand is the world-famous artificial lake. Its catchment area is 1,813 km<sup>2</sup> and gross capacity is 414.60 mcm followed by dead and live capacity of 118.46 mcm and 296.14 mcm, respectively. Its water is used for supplying drinking water to Udaipur and also for irrigation. All these water bodies stand endangered today because of their misuse.

### Baovries of Udaipur City

There are 121 baovries in Udaipur out of which 83 have dried up (Goswami and Mathur 2000). Most of these baovries are situated in the Sajjan Niwas Garden area. Maximum load was recorded on Sarvaritu vilas Baovri and lowest was on the Chowk Wali Baovri. The other baovries of Udaipur are Sagasji Ki Baovri, Tarkari Wali Baovri, Garden Wali Baovri, Nalaka, Chhatrivali, Jalijiwali, Maji, Ayurvedic Hospital, Satyanarayan, Toranwali and Om Prakashji Ki

Baovri, Customwali, Ramdas Colony, Dore Nagar, Goverdhan Vilas, Phoolji, Jethji, Maliwali, Bhanbagh, Kalanwali, Khilonawali, Delhi Gate and Maszidiji Baovri.

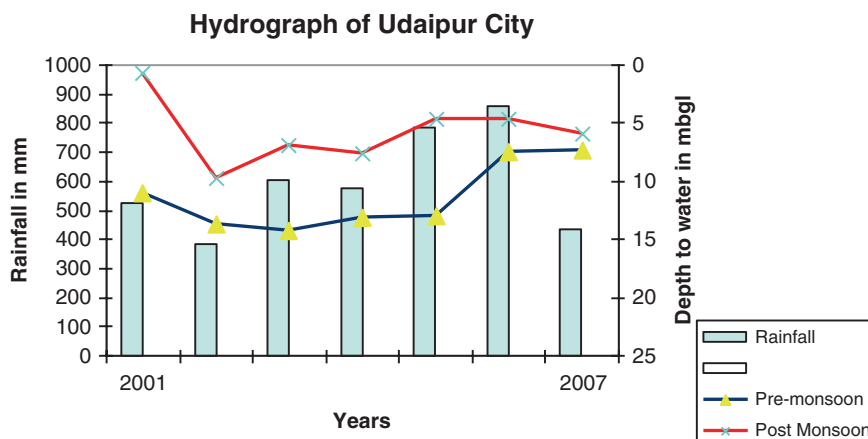
### Underground Water Sources of Udaipur City

The Udaipur City average water level pre-monsoon was 11.44 mbgl and post-monsoon was 6.87 mbgl. All the years show a rise in post-monsoon water table which was less in 2007 in comparison to other years as shown in Fig. 2.3.

It becomes clear how rainfall affects the underground water availability. In the years when rainfall in two consecutive years had been above mean average, the underground water level pre-monsoon and post-monsoon observed a lesser gap which has been minimized in the year 2011. Although the post-monsoon water level has fallen down in comparison to 2010, water demand has been increasing every year, thus resulting in Udaipur City lying in an over-exploited zone because of overharvesting of underground water (Swati 2003).

### Water Quality

The water quality of the lakes has a high sodium and bicarbonate content, which is attributed to



**Fig. 2.3** Underground water sources of Udaipur City

continental weathering due to anthropogenic pressure, intense development activities in the basin area and untreated effluent from municipal and domestic sewage into the lake. The semiarid conditions of the area, saline and alkaline soil/groundwater conditions and weathering of the silicate rock exposed in the drainage basin are assessed as the reasons for the supply of major ions (Ramesh and Ramachandran 2005).

The assessment of the pollution parameters recorded at random intervals determined that water is polluted and needs remedial measures (Kumar et al. 2004). Water hyacinth growth has been found and the lake bottom is also covered with a thick mat of submerged vegetation, with the presence of floating microalgae which are detrimental to the public health.

pH value varies from a maximum of 8.4 on the surface to a minimum of 7.8 at the bottom. Maximum nitrogen concentration is 0.941 at 1 m below the surface and 0.523 at the bottom of the lake. The lake water is reported to be polymictic, and there is a lack of true thermocline. The lake water temperature varied from a minimum of 19 °C in January to 29.4 °C in June at the surface and correspondingly 16.8 °C and 28.5 °C at the bottom of the lake. Eutrophication has occurred in the lake due to algae bloom (dominant species are microcystis on the surface and macrophytes submerged). Urbanisation around the lakes has

increased in nutrients on account of leaching from agricultural activities (Pamecha 2000).

The fauna recorded in the lake are 200 planktons, benthos and fishes. Macrophytes that merged in the lake are floating macrophytes, the submerged macrophytes and the phytoplanktons. The lake surroundings have sparse vegetation cover, but several species of plants in the periphery of the lakes. Lake Bari at one end touches Sajjangarh Wildlife Sanctuary. This lake acts as a mega water hole for the spillover animals of the surroundings. It was named Jiyan Sagar after Maharaja Raj Singh, its mother name Jana Devi by whom this lake was built, but because it is in close vicinity of village Bari, it is popularly known by this name. The lake has a surface area of 1.25 km<sup>2</sup> and has an embankment 180 m long and 18 m wide. The maximum depth of the lake is 150 m.

A total of 32 bird species belonging to 18 families were found; among these, 20 species were resident, 2 species were summer migrants and 10 species were counter migrant. An attempt has been made to analyse and compare the habitats of three lakes in order to understand as to why the number of bird species in all the lakes is almost similar, in spite of the fact that there is a lot more anthropogenic activity in lakes Fateh Sagar and Pichhola as compared to Lake Badi (Singh et al. 1990).

Sl. no.	Parameter	Status in Pichhola	Status in Lake Fateh Sagar	Status in Lake Bari
1.	Presence of tall trees in the vicinity of water bodies	Common	Common	Less common
2.	Presence of island	Many	Many	NIL
3.	Presence of seeds	Patchily present at few places	Patchily present at few places	Absent
4.	Width of water body	Quite more	Quite more	Narrow
5.	Depth of water at water line	Shallow zone is quite spread	Shallow zone is quite spread	Less shallow zone restricted towards the southern tip only
6.	Presence of crocodiles	None	None	Few
7.	Presence of railing	Present	Present	Absent
8.	Algae blooms	Present	Present	Interestingly absent



## Conclusions

- The lake is polluted due to disposal of sewerage directly into surface drains of surface water bodies.
- Large-scale and uncontrolled mining of marble and other minerals leading to heavy deformation of hill slopes.
- Catchment area degradation and soil erosion causing deposition of sediments and disturbance of the ecosystem of the area.
- Encroachments.
- Dumping of solid, liquid waste, destruction of submerged areas and over-exploitation of aquatic resources of Udaipur City.
- Poor governance.
- Lack of citizens' and stakeholders' participation in the management of the lakes.
- Due to deteriorated water quality, out of 42 species of fishes including mahseer and all major carp fishes, only 17 species of fishes have survived.
- In the catchment area of Fateh Sagar Lake, Pichhola effluents from synthetic fibre mills and soft drink plants, hotels, etc. are discharged. Apart from bathing and washing, vehicles are also washed in Lake Fateh Sagar and Pichhola. There is prolific growth of foul-smelling blue-green algae, which is neurotoxic and cannot be eradicated by normal filtration.
- No policy implementation for boring in the city.

## Suggestions

- Anthropogenic activities should be controlled like motor boating, bathing, washing, etc.
- Public awareness to be made by various local means of communication like radio, TV, street play and banners.
- Syllabus in primary, secondary, senior secondary and at higher education should be framed keeping the education of the area among them.

- Garbage cans should be placed away from the lake areas.
- Solid water should not be disposed in the lakes.
- Sewerage water from hotels, industries and houses needs to undergo ETP before being disposed in lakes.
- Strict policy-making and its implementation is required as it will help in maintaining the biodiversity of the lakes of Udaipur City.

Thus aquatic resources at Udaipur City can be maintained if anthropogenic activities are checked by educating Udaipurites through various awareness programmes. It is not a day's task but needs a joint effort of all. Only aquatic resources in the form of various species of fauna and flora will add to the beauty of Lake City – the Kashmir of Rajasthan. Aquatic resources are a bliss; they should be conserve. Policy-making is not enough, but their proper implementation is the need of the hour.

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