Journal of Global Resources Volume 4 (02) July 2018 Page 62-70
ISSN: 2395-3160 (Print), 2455-2445 (Online)

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QUALITY ASSESSMENT AND MEASURES FOR DRINKING WATER RESOURCES - A CASE STUDY OF UDAIPUR CITY

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Abstract: *Water is a very precious resource which is very essential not only for development of agriculture, industries and domestic purposes but also for the very existence of human beings, animals, other organisms and vegetation on the earth. Hardly one percent of water on the earth is available in the land area. With increasing population, urbanization, industrialization and irrigation, there is an increasing pressure on the water resources. As a result, both the quantity and quality of water is becoming a major issue of prime concern. Udaipur city known as a city of lakes is dependent upon lakes for more than seventy percent of its drinking water supply. With increasing population, the demand of water for drinking purposes has consistently increased and at the same time the quality of water in lakes has deteriorated. The present study is an attempt based on secondary data analysis to assess the demand of water for drinking purposes and the quality of water available in the lakes, and measures having been undertaken to maintain and improve the quality of water as well as to enhance intake of water in lakes.*

Key words: Hydro system, Water quality, Overdraft, Lake treatment, Catchment area treatment

Introduction

Water is very precious and essential resource for the survival of life on the earth. It seems at first that water is abundant on the earth but actually usable water is very limited and people realise its actual importance only in case of its scarcity. Even at places where water is available in abundance, we face problem of water pollution in lakes, rivers and also in underground water. The intolerable burden of human and chemical waste products has become a threat to human and aquatic life. The quality of drinking water depends on the quantity of harmful elements present in it. Water should be clean, odourless, tasteless, and the presence of these elements should be within the permissible limits. Udaipur city is mostly dependent on Lakes as they are principal source of drinking water. Economy of the city is more or less dependent on tourism which in turn is due to placid beauty of lakes and surrounding landscape. Hence, water resources are of vital importance for Udaipur city.

Objectives

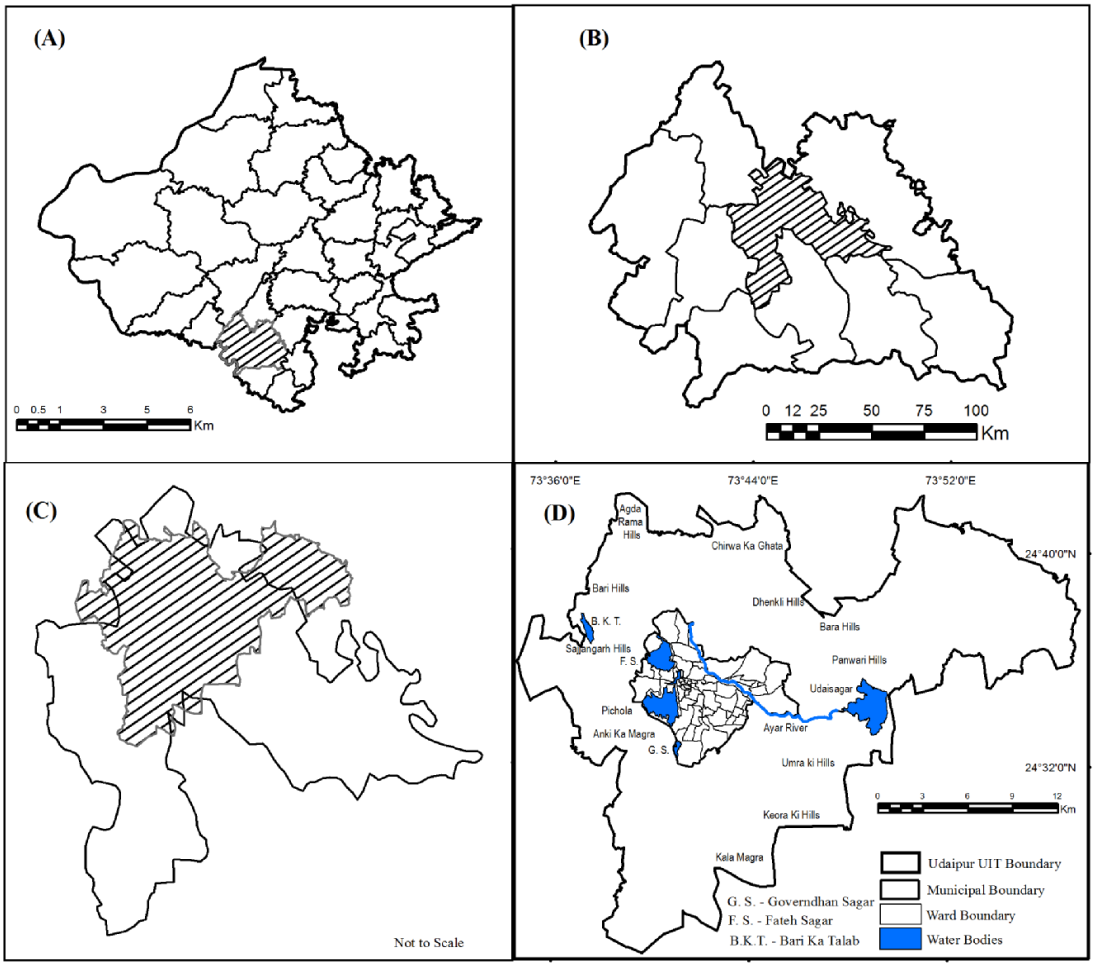
The paper aims to study the status and sources of drinking water in Udaipur city. The quality of water of lakes of city has been discussed in detail. The measures undertaken by various government agencies for integrated water resources management and drinking water management in Udaipur city have also been studied.

Study Area

Udaipur city lies between 24º 28'49"and 24º 42'56" North latitude, and from 73º 36'51" to 73º 49'46" East longitude at a general elevation of about 598 meters above mean sea level and is surrounded by the hills. It is a district as well as divisional headquarter spreading over a geographical area of 37 sq km. The total population of the city as per census 2011 was 4,51,735 with a literacy rate of 90.66 percent. As per population projection it is expected to exceed 8.0 lac by 2022. The ancient civilisation of Ahar developed on the banks of the Ayar River which flows through the Udaipur city (figure 1). The lakes of the city being interconnected form a lake system which supports and sustains the ground water recharge, water availability for drinking, agriculture, industries and is a source of employment through tourism. The lake system includes three main lakes - Chhota Madar and Bada Madar in its upper catchment area, six lakes–Bari, Pichola, Fateh Sagar, Rang Sagar, Kumharia Talab, Goverdhan Sagar within its municipal

boundary and one Lake Udai Sagar in the downstream. All the lakes of Udaipur form a chain in the saucer shaped Udaipur valley and are an integral component of the upper Berach basin. The Ayar River finally merges into Banas which is a tributary of Chambal River.

Figure 01: Location map



Material and Methods

The study is based on secondary data obtained from Regional Office of Rajasthan Pollution Control Board (RPCB), Departments of Water resources, Public Health and Engineering, Government of Rajasthan, Urban Improvement Trust, Udaipur, District Collectorate, Udaipur and data downloaded from various internet sites. The data have been compiled, classified and analysed with suitable tables and graphs. The qualitative assessment is based on the specification of the Bureau of Indian Standards (1991) for potable water. Measures taken by various agencies to improve the condition of water resources in Udaipur city have been discussed in detail and suggestions have been given for improvement of lake water quality.

Review of Literature

Udaipur city and its environs was geologically first mapped by Heron et al. (1953, Geological Survey of India). During the period of 1961-64, systematic hydro geological surveys and ground water investigations were carried out by Geological Survey of India. Thereafter, various surveys have been carried forward by Central Ground Water Board after its inception in 1972. Various scientific/hydro geological studies have been undertaken in the district by Central Ground Water Board between1977-78 and 1988-89. An Udaipur based society named Jheel Sanrakshan Samiti is fighting legal battle from late 90's by filing Public Interest Litigations in Honourable High Court of Rajasthan for various issues related to conservation of Lakes of Udaipur. The report on 'Ground water resources and development potential of Udaipur district' was brought out by

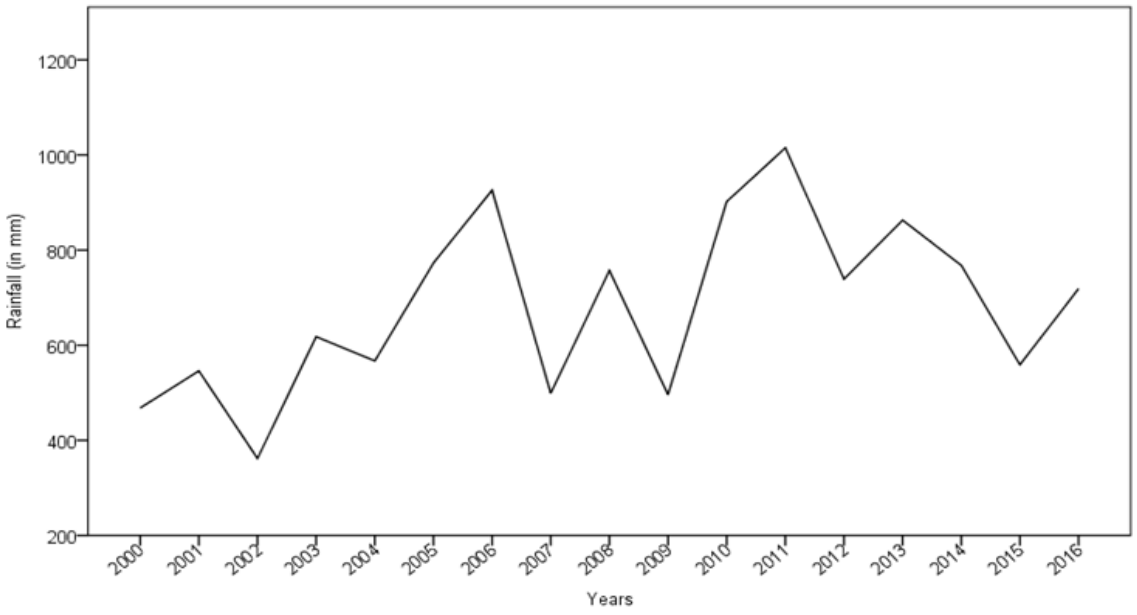
Central Ground Water Board in the year 1991. Revised District report was published in the year 2013 (CGWB, 2013). Khandelwal et al. (2014) studied Antibacterial activity of lactobacilli against aeromonas veronii isolated from Pichola Lake. Rawal et al. (2014a) carried out an analysis of physical, chemical and bacteriological parameters of Lake Pichhola. Rawal et al. (2014b) conducted a study of water quality of Pichola. Bhojiya et al. (2014) studied plasmid mediated transfer of heavy metal tolerance gene to escherichi coli isolated from Fateh Sagar Lake. Further, Mangal and Pathania (2015) have carried out a study on aquatic resources of Udaipur city.

RESULTS AND DISCUSSION

Hydro system

Drinking water supply of Udaipur city depends upon the surface and underground water sources such as lakes, step wells, tube wells and wells. These sources are recharged during rainy season. Average annual rainfall of Udaipur district has been 637 mm since 1970. However normal annual rainfall for the period from 1901 to 1970 had been 633.50 mm. Annual rainfalls at Udaipur city from 2000 to 2016 has been represented in figure-2.

Figure 02: Annual average rainfall in Udaipur city, 2000-2016



Source: Land records section, district collectorate, Udaipur

The annual rainfall has been quite fluctuating during the last 16 years. The fluctuation ranges between 362 mm in 2002 to 1015 mm in the year 2011.It is notable that since 2010 the annual rainfall has been above the average of 637mm except the year 2015.A successive study of the pre-monsoon underground water levels indicates that the water table is declining with few exceptions in spite of the fact that rainfall has been average and above average during the period. Post monsoon ground water levels during the last 10 years have improved and ground water levels are showing a rising trend. However, a comparative study of pre-monsoon and post monsoon ground levels indicate that ground water draft is increasing in the wake of increasing demand due to a host of factors including population increase.

Status of Pollution in Lakes (1974-1994)

The lakes are natural drainage of Udaipur city and nearby areas. Natural drainage brings with it all sorts of pollutants. Most of the hotels and nearby residential houses located on the lake slopes release all sorts of dirt and drain water into the lake complex. Even the garbage collected from the roads, dirt thrown from the houses, debris and remains of dead animals were used to be thrown in the lake water. The city lacked an organised sewerage system and treatment facility for the solid waste and sewage. With an absence of waste segregation, processing and scientific disposal facilities, the lakes in city have been facing increasing levels of pollution,

thereby threatening an ecological degradation. Hence, this situation required urgent remedial measures. The data in terms of pH, Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) relating to the major lakes i.e. Pichola and Fateh Sagar are contained in table 1.

Table 01: Pollution Levels in Lakes

Lake	Year	pH	DO	B.O.D.	C.O.D.
Pichola	1974-76	7.7-7.8	4.4-11		2.8
	1984-86	7.8-8.7	9.2-23.2	6.4-13.5	
	1994	8.0-8.7	5.0-8.4		
Fateh Sagar	1974-76	7.4-9.2	0.5-12		0.8
	1984-86	7.8-9.5	8.0-22.8	4.6-12.0	
	1994	8.2-8.7	4.4-9.4		

Source: Jheel Sanrakshan Samiti Report, Udaipur, 1997

It has been observed that the variation in dissolved oxygen content in the lakes have been quite wide ranging from almost zero values in the bottom water to values as high as 23 ppm. During 1984-86 the levels of B.O.D. in surface waters of Udaipur lakes ranged between 4.6 -13.5 ppm. The COD test performed in 1974-76 on the water samples of Pichola, Fateh Sagar and Dudh Talai indicated the levels of 2.8, 0.8, and 6.0 respectively. As indicated earlier that over 70 percent of daily water supply from Public Health and Engineering department pumping stations is drawn from lake systems which are highly polluted by anthropogenic activities increasing the risk of water borne diseases. Thus, the health delivery system is under extreme stress owing to unabated pollution of drinking water sources.

Lake Water Quality (2012 – 16)

The Udaipur lake system comprises of Lake Pichhola, Rang Sagar, Swaroop Sagar, Fateh Sagar, Badi, Madar and Udai Sagar. Udaipur is dependent on its lake system, which is directly, or indirectly the life source of the city in terms of surface water resources, tourism and the ecosystem at large. Most of the tourists visit the city primarily because of placid beauty of the lakes. The tourists specially the foreign tourist provide foreign exchange and thus strengthen the local economy. The lake water quality is being monitored by Rajasthan State Pollution Control Board (RSPCB) under National Water Management Plan (NWMP). The main parameters for quality assessment of water are the levels of presence of pH, temperature, Total Dissolved Solids (TDS), Dissolved Oxygen (DO) Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Nitrate (N), Iron, Conductivity (COND), Fluoride Content, Faecal Coli forms (FC) and Total Count of Coli forms (TC). The presence of these elements is necessary but their excess or deficit presence with respect to the optimally desired content is harmful for the health of human beings, aquatic life as well as animals and vegetation. The data relating to the presence of some of these components have been summed up in table 2.

The pH is a measure of acidity of an aqueous solution. Most of the biochemical and chemical reactions are influenced by the pH. The desirable pH range essential for drinking water is between 6.5 and 8.5 (BIS 1991). The pH of water affects the solubility of many toxic chemical. When acidity increases most metals become more water soluble and more toxic (Patel and Parikh, 2013). The pH ± 7.35 to 7.45 in the blood may cause health problems. Headache, nausea, fever, skin infection, osteoporosis are some of the symptoms due to lower level of pH (Kanchan, et al, 2012). The pH in Udai Sagar Lake is more than 8.5 and therefore is not fit for drinking purpose & for aquatic life. The pH in the water of Pichola Lake is between 7.6 and 8.5 whereas it is between 8.0 and 8.5 in Fateh Sagar Lake. Thus, the quality of water of both Pichhola and Fateh Sagar lakes are also approaching the upper tolerance limit of 8.5.

Table 02: Quality Status of Lakes at Udaipur City

Station	Year	pH	Temp ^{0}C	DO mg/l	BOD mg/l	Nitrate N mg/l	COND µS/cm	FC MPN/ 100ml	TC MPN/ 100ml
Permissible Limits		06.5-8.5	-	4	2	45	30-1500	undetectable	10-100
Pichola Lake	2012	7.6	23	5.2	1.12	0.42	660	7	30
	2013	7.9	25	5.0	1.65	0.58	620	8	400
	2014	8.5	27	5.4	1.82	0.60	560	5	80
	2015	8.3	25	7.7	1.68	1.09	472	6	60
	2016	8.4	26	6.8	1.78	1.01	490	6	80
Udai Sagar Lake	2012	8.2	24	4.4	3.72	1.4	1630	14	125
	2013	8.8	25	4.2	3.22	0.84	1585	20	645
	2014	8.6	26	4.8	3.78	0.62	1510	16	1600
	2015	8.5	25	6.2	3.14	0.90	1156	26	581
	2016	8.8	25	6.4	3.19	0.96	1150	24	560
Fateh Sagar Lake	2012	8.0	24	5.2	1.47	0.42	650	4	9
	2013	8.2	24	5.0	1.17	0.54	620	<3	17
	2014	8.5	26	5.2	1.28	0.56	600	4	47
	2015	8.4	25	7.5	1.21	1.21	610	4	27
	2016	8.2	24	7.2	1.19	0.98	615	4	30

Source: Rajasthan State Pollution Control Board, Regional Office, Udaipur, 2017

Dissolved oxygen in water of Udai Sagar Lake was measured around 4.2 – 6.5 mg/L in the years 2013 and 2016 respectively. The Dissolved oxygen in Pichhola lake water was measured around 5.0 and 7.7 mg/L in the years 2013 and 2015 respectively. Likewise, the dissolved oxygen in Fateh Sagar fluctuated between 5.0 in 2013 and 7.5 in 2015. The tolerance limit for dissolved oxygen is 4 mg/L. Thus, it is well evident that the presence of dissolved oxygen in the water of all these 3 lakes is more than the tolerance limit. Accordingly, the water of these lakes attains drinkable quality only after disinfection.

The Biochemical Oxygen Demand (BOD) in Udai Sagar ranged from 3.14 in 2015 to 3.78 in 2014 which indicates that there is a continuous influx of pollutants in it. The BOD in Pichola Lake ranged between 1.12 mg/L in 2012 and 1.82 mg/L in 2014. Likewise, the BOD in Fateh Sagar Lake was between 1.17 mg/L in 2o13 and 1,47 mg/L in 2012. The threshold limit of BOD for drinking water is 2 mg/L. Thus, the study of water quality in terms of BOD concentration in these three lakes reveals that the BOD water of Udai Sagar Lake has already exceeded the threshold limit where as the water of Fateh Sagar and Pichola lakes are well within the tolerance limit. In fresh water Nitrate concentrations seldom exceeds 0.1 mg/L. Higher concentrations indicate the effect of human activities. Concentrations greater than 5 mg/L indicate significant level of pollutions. Nitrates in all the three water bodies ranged between 0.42 in both Pichola and Fateh Sagar Lakes in the Year 2012 and 1.4 in Udai sagar lake in year 2012. A summary study of Nitrate concentration in the water of all these three lakes indicates that it is well within the desirable limit of 2 mg/L.

Total count of coliforms (TC) in unpolluted water generally varies between10 and 100 MPN/100 mL. The values higher than 100 MPN/100 mL indicate contamination due to pollution. A study of readings of TC in table 2 indicates that Udai Sagar lake having about 645, 600, 581 and 560 MPN/100 mL in the years 2013,2014,2015and 2016 respectively was the most pollutant lake in an around Udaipur city. The reading of 400 MPN/100 mL obtained from Pichola Lake in year 2013 seems to be an exception otherwise the values in other 4 year is well below 100 MPN/100 mL. The values of TC in Fateh Sagar Lake ranged between 9 and 47 and therefore this Lake is well within the permissible limit. Faecal Coliforms (FC) values relating to 3 lakes are contained in table 2. The values in Pichola and Fateh Sagar lakes during the period of 2012 – 2016 are recorded to be less than 8 and 4 respectively. The FC values obtained from Udai Sagar lake range between 14 and 26 in 2002 and 2014 respectively. After treatment the FC should not be detectable in 100 ml sample for water to be potable.

Electrical Conductivity (EC) is a measure to the capacity of water to conduct electrical currents and it is directly related to the concentration of salts dissolved in water. The permissible limit of electrical conductivity for drinking water is up to 1500. Pichola Lake during the period of 2012 – 2016 oscillated between 472 and 660 µS/cm. The readings of EC in Fateh Sagar ranged from 600 to 650µS/cm during the same period. The readings of EC in Udai Sagar Lake ranged between 1150 and 1630 µS/cm. This study indicates that the EC is presently within the desirable limit.

Development Stage of Underground Water

Stage of ground water development in the city is already above 110 percent and is categorised as overexploited which indicates that there is no further scope for ground water development. Ground water resources need to be used judiciously. The ground water in many areas is hard and also brackish. Almost entire city is facing problem of ground water scarcity. Some areas are vulnerable to pollution and depleted water table. Ayar River around Kanpur has already dried up during the last decade. The industrial and mining areas need constant monitoring for any water quality deterioration. Water scarcity is a perpetual phenomenon in Udaipur city in spite of many man-made lakes. The lakes which were used for domestic and irrigation purpose are now used exclusively for drinking purpose. The degradation of catchment and rapid urbanization has reduced the capacity of lakes. Revival of traditional ground water storage system i.e. Baori, open wells, etc. for rainwater conservation for use in day to day life may help reduce ground water draft. Now most of dug wells and Baoris are not used by public because of pumped supply available. Taking advantage of uneven topography of the area, small earthen dams at suitable sites upstream in the catchment may be constructed to store rainwater. This will increase recharge to ground water and would ultimately result in increase of yield of wells.

Status of Underground Water Quality

Ground water contamination is mostly due to absence of sewerage pipelines in many parts of the city. Presently RSPCB is monitoring ground water at five locations under NWMP. The results of the studies conducted in this regards at five stations are given in table 3. The pH values obtained from all five stations during the period of 2012 – 2016 are under 8.5 mg/L and therefore are within the permissible limit for drinking purposes. The DO values at four stations are almost around the permissible limits. It is only at Subhash Nagar station that the values ranged between 4 and 4.6 mg/L. The BOD values at all five stations are within the permissible limit. Similarly, the Nitrate readings at all stations except 3.04 at Subhash Nagar in 2012 are also within the permissible limits. The FC readings at all stations except 4 near railway station Rana Pratap Nagar in the year 2012 and 4 at Subhash Nagar in Year 2013 are within the permissible limit. The TC values at all five stations are within the desirable limits. The electrical Conductivity at HP near UIT Bridge ranges between 810 and 1430. The values of EC at HP near Fatehpura fall between 1666 and 2200 µS/cm. The EC values near Aloo Factory are between 1466 and 2000 µS/cm. Likewise the values near Railway Station Rana Pratap Nagar fall between 1660 and 2300. Subhash Nagar has recorded the values between 1395 and 2100. Thus, the study in terms of Electrical Conductivity leads to conclude quality of water has already approached the desired limit.

Government Initiatives for Maintaining and Improving Quality of Water

Five of the major lakes namely Fateh Sagar, Pichola, Swaroop Sagar, Rang Sagar and Doodh Talai have been included under the restoration project of the National Lake Conservation Project (NLCP) by the Government of India in order to preserve the cleanliness of the water bodies in the city. Presently, a District Level Lake Conservation Committee headed by District Collector is monitoring the progress of ongoing works under the National Lake Conservation Project (NLCP). State government has enacted The Rajasthan Lakes (Protection and Development) Authority Act, 2015. Works are being carried out for municipal solid waste management, diversion of sewage away from the lakes by installation of new sewer lines and repairing of existing ones, stringent actions against unauthorized construction around the lakes, developments of Ayar river and establishment of sewage system in entire city of Udaipur, construction of earmarked Dhobi ghats, toilets and idol immersion points, cleaning of lakes manually and through de-weeding machine, forestation in the catchments area of Pichola Lake. There is a continuous monitoring

for maintaining quality of water in the lakes by departmental team. Proposal for plying of solar/electric powered boats in the lakes are also under way. Under the NLCP emphasis has been given to ensure the desirable quality of water in lakes as well as to increase the inflow of water to the lakes from its catchment. The conservation and management of lakes includes the treatment of its catchment so that the quality of water can be improved right from its origin. The NLCP consists of:

Table 03: Status of Underground Water Quality at Udaipur City

Station	Year	pH	Temp ^{0}C	DO mg/l	BOD mg/l	Nitrate N mg/l	Cond µS/cm	FC MPN/ 100ml	TC MPN/ 100ml
HP, Near UIT Bridge	2012	7.93	24	3.9	1.09	1.1	1050	<3	<3
	2013	7.24	24	4	1.04	0.72	810	<3	<3
	2014	7.23	25	4.4	1.44	0.62	890	<3	<3
	2015	6.97	27	2.75	1.56	0.61	1430	<3	<3
	2016	7.15	26	3.0	1.42	0.60	1390	<3	<3
HP near Fatehpura	2012	7.89	24	3.8	1.83	0.38	2200	<3	4
	2013	7.12	24	4	1.01	1.24	2200	<3	4
	2014	7.25	25	4	1.06	1.1	2000	<3	<3
	2015	7.06	27	2.6	0.67	1.77	1715	<3	<3
	2016	7.01	25	2.8	0.70	1.67	1666	<3	<3
Near Aloo Factory	2012	6.88	24	3.8	1.68	1.74	1900	<3	4
	2013	7.1	24	3.7	1.2	1.02	2000	<3	4
	2014	7.0	25	4	1.15	0.84	1900	<3	<3
	2015	7.15	26.5	2.3	1.61	1.4	1495	<3	<3
	2016	7.12	25	2.8	1.66	0.96	1466	<3	<3
Near Railway Station, Rana Pratap Nagar	2012	7.85	24	4.1	1.58	1.24	2300	4	9
	2013	7.01	23	4.2	1.36	1.4	1910	<3	4
	2014	7.04	25	3.8	1.25	1.6	1660	<3	<3
	2015	6.89	27	2.8	1.56	1.37	1790	<3	<3
	2016	6.98	26	2.6	1.48	1.26	1860	<3	<3
Subhash Nagar	2012	6.92	24	4.3	1.16	3.04	1530	<3	7
	2013	6.96	24	4.4	1.12	2.8	2100	4	4
	2014	7.0	26	4.6	1.25	2.28	1530	<3	4
	2015	6.95	26	4.4	1.44	1.45	1395	<3	5
	2016	7.0	25	4.0	1.38	1.98	1420	<3	4

Source: Rajasthan State Pollution Control Board, Regional Office, Udaipur, 2017

Lake Treatment: De-silting the mud and waste filled in Lake Bottom. De-weeding machine has been procured in 2014 for removal of aquatic weeds from the lakes and it has been successful insubstantially reducing the weeds from lake system in Udaipur. Floating fountain scum aeration at five main locations in Fateh sagar has been installed. Installation of floating fountain-cum-aeration at eight locations in Pichola group of lakes is under way. For biodiversity conservation earthen mounds have been developed out of excavated silt in the Fateh Sagar lake and special emphasis is being given to protect the habitat of migratory birds in addition to an island namely Rang Sagar which was already existing in Pichola Lake. Department of Fisheries, Government of Rajasthan through their existing contractors is feeding different varieties of seeds of fish in Fateh Sagar and Pichola lakes each year. Water quality monitoring of all the lakes through accredited laboratory established by the Ministry of Environment and Forests, Government of India has been in places since 2011.

Catchment Area Treatment: For improving the lake water quality and quantity, treatment of Lake Catchment is equally important. For interception and diversion of Sewerag**e,** sewer lines have been laid in about 8.50 km in length which is presently being maintained by Municipal Corporation Udaipur. Further Sewer lines for another 60 km in length for lake peripheral area is in progress. Hindustan Zinc Limited (HZL) has established a Sewerage Treatment Plant (20 MLD) at Eklingpura and is also extending financial support towards laying of the main trunk line up to STP site.Catchment area improvement by plantation, soil and moisture conservation works have been done in and around both the lakes. Solid waste management around the Pichola

Lake has been in operation to reduce the accumulation of solid waste. Catch water drains are constructed to collect the storm water and at specified locations silt traps are being provided to trap the silt. For hydraulic improvement of feeders and inlets encroachment from the major feeders/tributaries of Pichola group of lakes and Fateh Sagar lake have been removed. For lake front development works such as shoreline demarcation and protection, island development, face lifting and overall environmental improvement, community toilets, renovation of roads/pavement, beautification and renovation of Ghats and conservation of heritage.After the ban imposed by the Rajasthan High Court and National Green Tribunal in 2015 on immersion of idols, garlands, Tajiyas, coconuts and all such materials in lakes in year 2015,the District administration, Municipal Corporation and Urban Improvement Trust have successfully taken steps for providing alternate immersion sites and immersion of idols on Durga Puja and Ganesh Chaturthi and Tajiyas on Moharram have completely stopped.

Existing Drinking Water Supply Situation

Fateh sagar, Pichola (including flow from Dewas-I and II), Jaisamand Lake and Mansi Wakal Dam are the major sources of water for Udaipur city. 53 tube wells and 29 open wells supplement this water supply. Around 2100 hand pumps are also installed in various localities of the city. The production of water was 70 MLD against the demand of 86 MLD in 2011. Total 111 MLD water was available in 2016 from all above sources and the water demand of Udaipur city for all sectors i.e. domestic, industrial, institutional, tourists etc was 128.6 MLD. The estimated demand of water in domestic sector would be 101 MLD in 2021, 122 MLD in 2031 and 148 MLD by 2041. The entire city is divided in two transmission and distribution divisions, 9 zones and 38 water supply sub zones. The length of pipeline network is more than 900 km and the transmission main line is approximately 250 km. The city has 10 water treatment plants. There are 30 clear water reservoirs (CWR)/ ground water reservoirs (GWR) with storage capacity of 26738 kilolitres. There are 35 over head service reservoirs (OHSR)/service reservoirs (SR) with a total storage capacity of 66001 kilolitres. The per capita supply of water in 2011 in the city was 74 lpcd against the target of 135 lpcd. At present the supply is around 124 lpcd. Water is supplied once in 48 hours. The drinking water sources were inadequate until the water of Dewas-I and Mansi Wakel dam was made available. At present the lakes of Udaipur city can be filled with water at any time during the year from water of above dams available in upstream. The infrastructure of transmission and distribution of drinking water is old, inadequate and inefficient. Udaipur city is one of cities selected as smart city under the Smart City Mission (SCM) of Government of India with an objective to develop city with core infrastructure and decent quality of life for its citizens, a clean and sustainable environment and application of “smart” solutions. Under Udaipur Integrated Infrastructure Project under smart city project, the improvement in water supply infrastructure is also proposed. This project aims to improve the reliability and quality of water supply in the walled city area by enhancing the per capita water supply to 135 lpcd, improving the frequency of water supply from 48 hours to 24 hours and gradually migrating to 24X7 system and reducing the non- revenue water to 15 percent. The project aims to replace, renovate and strengthen the water supply infrastructure.

Conclusion and Suggestions

Undoubtedly more than seventy percent of drinking water supply in Udaipur city is dependent upon water from the lakes. Simultaneously, the underground water resources which were already scarce are depleting at an alarming rate. The population is increasing very fastly by way of both absolute increase and influx of immigrant population. The increasing demands of drinking water from the lakes, the pressure from the tourist and the local people on lakes have led to deterioration in the quality of water in the lakes. Now a lot of steps have already been undertaken and some more steps are in pipeline to maintain and improve the quality of water in lake system for drinking purposes. Efforts are being made to increase the intake of water in the lakes by water harvesting in catchment area. Regular cleaning of weeds and garbage in and around lakes needs to be undertaken. The domestic waste water drains and sewerage drains falling in the lakes needs to be identified and remedial measures needs to be taken to divert them away from lakes in the sewerage system. The Fateh Sagar and Picchola lakes being the primary source of drinking water for Udaipur city has been receiving attention from time to time from the administration and Courts of law. Undoubtedly Udai Sagar has become very polluted

and neglected. Environmental degradation and denudational processes in the hills around the lakes are to be properly monitored and treated. Mass awareness programs needs to be launched to create awareness for preservation and conservation of lakes of Udaipur. All legal provisions and orders of the courts to the effect of conservation of lakes need to be implemented in letter and spirit. Proper implementation of integrated infrastructure project under smart city has become the need of the hour.

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