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Comparative Study of Ground Water Quality of Udaipur and its Surrounding Areas

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Abstract

Ground water is considered one of the country's most important natural resources. It's responsible for approximately 40% of the water utilized for all other purposes except for the generation of hydropower and the cooling of electric power plants. Interestingly, it's resources that are commonly utilized and have a significant impact on the country's health and economy. Ground water is the natural gift to humanity, it is valued at around 210 billion m3 and includes the volume of recharge as well as the volume of water that evaporates and falls to the earth. One third of the water is used for irrigation, the remaining two-thirds are domesticated and industrially utilized. The majority of the water is re-circulated into rivers. Today, the rapid rate of development, increased industrialization, and population density have all contributed to an increased burden on water resources. The process of groundwater pollution is different from the pollution of surface water; the resource is imperceptible and recovery is difficult at the current state of technology (MacDonald and Kavanaugh 1994). As part of the international effort to understand the functions, structures, and processes within the CZ, a variety of investigations have been conducted that contribute to our understanding of the flow and evolution of groundwater (Sawyer et al. 2016; Goldhaber et al. 2014). Water pollutants in groundwater are typically odorless and colorless. Additionally, the adverse effects of polluted groundwater on human health are long-term and are extremely difficult to recognize (Chakraborti et al. 2015). Around one third of the world's population is dependent on groundwater for drinking water (International The association of hydrogeologists is dedicated to promoting the study of water-related issues. Groundwater is water that is particularly significant in arid and semiarid regions. where precipitation and surface water are confined (Li et al.2017a).

Materials & Methods

Climate of Udaipur city is characterized by sub-tropical monsoon climate as the tropic of cancer passes through Banswara district which is about 145 kms in south of Udaipur city. The climate

of the region is modified to some extent by the altitude, the orientation of hills and the presence of water bodies in the form of lakes. The region experiences three diverse seasons, viz. hot summers (March to June), cold winters (November to February) and annul certain rainy season from the middle June to the end of September. Udaipur city occupies a typical geographic location within the sheltered lap of Aravali and is relatively free from the hot sandy storms, viz, and sunstroke and it seldom experience the high temperature variations of common in other parts of Rajasthan. By virtue of the layout of Aravali, if it is on one hand is unable to check the Arabian Sea branch of the Indian monsoon and on the other hand it successfully receives occasionally but valuable share from the easterly Bay of Bengal. The South North and the East – West oriented river valleys provide easy access to the incoming monsoon winds which account for higher mountains in surroundings.

Laboratory analysis

The aim of the present investigation is to study the accumulation of the studies on ground water characteristics of certain areas of Udaipur district with special reference to pollution. The present study incorporates many such issues which have not been studied earlier, especially with reference to physico-chemical assessment of heavy metals (Cd, Cr, Pb and Zn) in ground water, total coliform bacteria (MPN) in ground water, fluoride, Dissolved oxygen and Biological oxygen demand in ground water of the Udaipur city and its surrounding areas. For the present study water samples were collected regularily for 0ne year from January, 2021 to December, 2021. Seasonally water samples have been collected in 2.5 liter capacity cans after rising is properly from each location. In general, the shorter the time that elapses between collection of a sample and its analysis the more reliable will be the analytical results. Various Physico-chemical and metallic parameter like pH, dissolved oxygen, total hardness, alkalinity, Chloride, C.O.D, total dissolved solids, phosphate, nitrate, were analyzed. (APHA, 1995, Manivaskam 1986, NEERI, 1988). The heavy metals concentration was determined by digesting the water samples with concentrate HNO_3 and the analyzed by atomic absorption spectroscopy.

Result:

The comparison between the water quality standards and the various water samples of Udaipur and its surrounding areas determines their potability. The results presented represent the average data collected over a year of study. This study describes the potential concentration, distribution, and effects of these parameters. The pH value recommended for drinking water by the Indian drinking water quality standards (BIS standards) is between 6.5 and 8.5. In the year 2021 the pH value of ground water samples of Udaipur and its surrounding areas varied from minimum 7.4 to maximum 7.8 and samples were in the range of pH 7 to 8 and none touched the undesirable level. The turbidity values of ground water samples show a wide variation. The value of turbidity in Pre-monsoon was 2 to 6 NTU. See table (1). The total alkalinity values of ground water samples show wide variations. The total alkalinity ranges from 130 to 753. The present investigation reveals that the chloride concentration is distributed and varies at low 18.09 mg/l

to high at 910.78 mg/1 in the 2021. Water hardness is a crucial parameter to consider, particularly for drinking water. When water has excessive hardness, it is unsuitable for drinking as it can lead to health issues such as urolithiosis, cardiovascular disorders, kidney problems, and cancer. Human health, environmental quality, and socioeconomic development can be impacted by groundwater contamination. Present investigation total hardness in ground water samples shows a wide 210 mg/l to maximum 590 mg/l. The chemical analysis of the ground water samples of the study area show wide variation in the TDS concentration. the TDS values ranges from 230 to 1560 mg/l. The sulphate values ranges 6.8 mg/l to 910.2 mg/l. The present study reveals that EC values in ground water samples show a wide variation. The electrical conductivity ranges between 320 umhos/cm to 2380 umhos/cm. Indian drinking water quality standards states that a value of 45 mg/l of nitrate is considered as the safe limit. The study period nitrate concentration in the ground water resources show a wide variation. During pre- monsoon sampling, 2021 the nitrate concentration varies from 3.88 to 75.22 mg/l. As per the Indian water quality standards of drinking water a value of 0.1 mg/l of phosphate is considered as the safe limit. A relaxation was given in the maximum permissible limit as the higher concentration of

Sample No.	**Colour & Odour**	**Tur (NTU)**	**pH**	**EC (µmhos/cm)**	**TDS**	**Alkn.**	**Th**	**Cl^-**	**DO**	**BOD**	**SO_4^{2-}**	**NO_3^-**	**PO_4^{2-}**	**F^-**	**MPN (100/ml)**	**Cd**	**Cr**	**Pb**	**Zn**
1	Colourless&Odourless	2	7.4	795	488	230	350	39.7	4.3	5.1	12.4	7.34	0.38	0.34	3	0	0.458	0	0.011
2	,,	6	7.6	2350	1556	732	570	308.25	5.7	6.4	108.6	37.68	0.26	0.24	6	0	0	0	0
3	,,	2	7.2	320	230	622	1220	830.45	3.5	6.8	282.4	46	0.52	0.97	9	0	0	0	0
4	,,	4	7.7	1190	780	360	266	150.12	8.1	2.3	87.4	36.54	0.52	0.35	4	0	0	0.004	0.574
5	,,	4	7.7	1306	930	345	443	190.35	7.4	1.2	96.4	45.35	0.64	0.45	6	0	0	0	0.416

Sample No.	**Colour & Odour**	**Tur (NTU)**	**pH**	**EC (µmhos/cm)**	**TDS**	**Alkn.**	**Th**	**Cl^-**	**DO**	**BOD**	**SO_4^{2-}**	**NO_3^-**	**PO_4^{2-}**	**F^-**	**MPN (100/ml)**	**Cd**	**Cr**	**Pb**	**Zn**
6	,,	5	7.8	2090	1560	670	430	186.35	8	2.1	84.1	56.43	1.23	1.2	4	0	0	0	0.392
7	,,	5	7.6	1215	803	580	435	135.75	7.1	7.6	100.8	35.4	0.112	0.11	15	0	0	0	0.174
8	,,	3	7.4	1120	675	430	296	100.09	6	2.5	96.8	26.43	0.26	0.26	13	0	0	0	0.23
9	,,	4	7.5	980	670	450	1280	910.78	10.3	1.3	910.2	68.4	0.52	0.39	<3	0	0	0.007	0.192
10	,,	4	7.6	2380	1500	680	530	310.57	4.4	3.2	18.4	10.1	0.38	0.57	<3	0	0	1.3	1.76
11	,,	4	7.6	1190	840	455	590	120.67	9.8	1.4	51.4	23.98	0.38	0.25	<3	0	0	0	0.074
12	,,	3	7.4	310	207	130	170	18.09	8.5	2.3	6.1	3.11	0.64	0.57	3	0	0	0.006	1.462
13	,,	3	7.4	560	430	270	635	71.34	9.1	1.3	63.4	21.45	0.34	0.12	<3	0	0	1	0.732
14	,,	3	7.5	890	450	245	153	18.33	8.9	1.2	6.8	3.88	0.34	0.24	<3	0	0	0	0.026
15	,,	2	7.4	790	610	397	350	46.13	5.3	2.5	18.4	8.76	0.38	0.56	3	0	0	0	0.029

Sample No.	**Colour & Odour**	**Tur (NTU)**	**pH**	**EC (µmhos/cm)**	**TDS**	**Alkn.**	**Th**	**Cl^-**	**DO**	**BOD**	**SO_4^{2-}**	**NO_3^-**	**PO_4^{2-}**	**F^-**	**MPN (100/ml)**	**Cd**	**Cr**	**Pb**	**Zn**
16	,,	4	7.7	1275	845	470	510	184.64	6	3.2	9.8	5.3	0.21	0.32	6	0	0	1.1	0.179
17	,,	4	7.5	900	560	470	320	21.01	7.4	1.9	20.4	7.11	0.52	0.38	<3	0	0	0	0.228
18.	,,	6	7.8	1780	1350	720	310	70.45	8	1.4	60.8	22.85	0.46	0.34	<3	0	0	1.3	0.321
19.	,,	4	7.6	2160	1540	753	938	635.34	7.2	1.7	246.6	75.22	2.34	2.31	<3	0	0	0	1.139
20	,,	3	7.5	911	798	440	308	64.34	8.2	2.3	36.4	16.1	0.64	0.23	<3	0	0	0.026	0.134
21	,,	4	7.6	1460	980	510	928	536.09	7.5	5.6	47.4	54.32	2.31	0.56	9	0	0	0.032	0.02
22	,,	3	7.5	930	593	421	385	68.34	4.9	3.8	55.2	22.31	1.21	1.12	<3	0	0	1.4	0.162

Table 1 :Assessment of Ground Water Quality of Udaipur and its Surrounding Area 2021.

phosphate to 2.0 mg/l. In sampling the phosphate concentration varies from 0.12 to 2.34 mg/l. The fluoride concentration ranges from 0.11 to 2.31 mg/1. The dissolved oxygen ranges from 3.5 to 10.3 mg/l. Biological oxygen demand varies from 1.2 to 7.6 mg/1. Table 1 Cd The result that samples having concentration below 0.002 mg/l to 0.165 mg/l. In the concentration varies from 0 to 0.005mg/l. Lead of the samples having concentration below 0.00 mg/l, to 0.076 mg/1. Zinc is an essential growth element for plants and animal but at elevated levels it is toxic to some species of aquatic life. The United Nations Food and Agriculture Organization recommended level for zinc in irrigation waters as 2 mg/l. The samples having range below 0.01 mg/l. to 1.462 mg/l of the concentration.

Concentration of Various Physico-Chemical Parameters

Statistical Analysis

Coefficient of correlation (r) among various physico-chemical characteristics of ground water samples of Udaipur and its surrounding areas were calculated (indicated in bracket against each).In the year 2006 turbidity and pH (r+0.817), EC (r+0.722), TDS (r= +0.584), alkalinity (r= +0.452), total hardness (r+0.043), chloride (r=- sulphate (r=-0.037), nitrate (r= +0.018), fluoride (r=-0.131), DO (r= +0.159). -0.030), BOD (r=-0.073), MPN (r= +0.012), and Zn (r= +0.082). In post-monsoon season nurbidity and pH (r= +0.772), EC (r+0.607), TDS (r= +0.615), alkalinity (r = + 0.542), total hardness (r= +0.444), chloride (r= +0.218), sulphate (r = +0.202). nitrate (r=0.032), phosphate (r=-0.114), fluoride (r = 0.090), DO (r = -0.079), BOD (r= +0.109), MPN (r = -0.021), cadmium (r = +0.057) and lead (r = +0,007).

Discussion:

Studies have shown that elevated levels of fluoride, nitrate, metals, and persistent organic pollutants pose health risks to human populations. Groundwater quality has been affected by intensive human activities, which in turn affects human health. This study evaluates the quality of groundwater in an alluvial plain (China) with intensive agricultural and industrial activities to better understand the extent of contamination and potential risks to local residents. The assessment includes the use of a comprehensive water quality index for drinking water and sodium adsorption ratio, Na%, and residual sodium carbonate for irrigation water. The evaluation also assesses the health risks associated with oral and dermal exposure to contaminated groundwater. The results indicate that most of the water samples are suitable for irrigation, but more than 60% of them are unfit for drinking. The main contaminants affecting its suitability for drinking are total hardness, NO_3^-, NO_2^-, TDS, SO_4^{2-}, and F^- (Wu et al., 2020). The results show that there are 20 major provinces//autonomous regions (about 60%) in China suffering from high-arsenic groundwater, and these high-arsenic groundwater provinces are mainly located in the fluvial/alluvial-lacustrine plains and basins located in arid/semi-arid regions and alluvial plains/basins and river deltas in humid/semi-humid regions He et al. (2020b) This is especially critical for infants and children who are more susceptible to the efects of these contaminants than adults (Wu and Sun 2016; Karunanidhi et al. 2020; Mthembu et al. 2020; Ji et al. 2020; Subba Rao et al. 2020; Zhou et al. 2020. The results of the present study provide information that can be useful for the water resource management in the Udaipur area particularly with respect to anthropogenic stress.

Conclusions

To prevent the direct consumption of groundwater in these regions, it is necessary to treat any form of liquid or solid waste before discharging it into the tank. It is imperative for local authorities, NGOs, and government sectors to enhance their efforts in controlling the contamination in the area.

References

American Public Health Association, (APHA), (1995). Standard Method for Examination of Water and Wastewater. 19th Edn., Published by E and FNSPON, Washington DC., pp: 2-56.

Goldhaber MB, Mills CT, Morrison JM, Stricker CA, Mushet DM, LaBaugh JW (2014) Hydrogeochemistry of prairie pothole region wetlands: role of long-term critical zone processes. Chem Geol 387:170–183.https://doi.org/10.1016/j.chemgeo.2014.08.023

He X, Li P, Ji Y, Wang Y, Su Z, Elumalai V (2020b) Groundwater arsenic and fuoride and associated arsenicosis and fuorosis in China: occurrence, distribution and management. Expo Health 12:355–368. https://doi.org/10.1007/s12403-020-00347-8.

International Association of Hydrogeologists (2020) Groundwater—more about the hidden resource. ttps://iah.org/education/ general-public/groundwater-hidden-resource. Accessed 13 Nov 2020n

Ji Y, Wu J, Wang Y, Elumalai V, Subramani T (2020) Seasonal variation of drinking water quality and human health risk assessment in Hancheng City of Guanzhong Plain, China. Expo Health, 12:469–485.

Karunanidhi D, Aravinthasamy P, Deepali M, Subramani T, Bellows BC, Li P (2020) Groundwater quality evolution based on geochemical modeling and aptness testing for ingestion using entropy water quality and total hazard indexes in an urbanindustrial area (Tiruppur) of Southern India. Environ Sci Pollut, Res. https://doi.org/10.1007/s11356-020-10724-0

Li P, Tian R, Xue C, Wu J (2017a) Progress, opportunities and key fields for groundwater quality research under the impacts of human activities in China with a special focus on western China. Environ Sci Pollut Res 24:13224–13234.

Manivasakam, N. (1996). Physicochemical examination of water sewage and industrial effluents.

Mthembu PP, Elumalai V, Brindha K, Li P (2020) Hydrogeochemical processes and trace metal contamination in groundwater: impact on human health in the Maputaland coastal aquifer, South Africa. Expo Health 12:403–426

Sawyer AH, Michael HA, Schroth AW (2016) From soil to sea: the role of groundwater in coastal critical zone processes. WIREs Water 3:706–726

Subba Rao N, Dinakar A, Kumari BK, Karunanidhi D, Kamalesh T (2021) Seasonal and spatial variation of groundwater quality vulnerable zones of Yellareddygudem watershed, Nalgonda

district, Telangana State, India. Arch Environ Contam Toxicol https://doi.org/10.1007/s00244-020-00783-2.

Wu J, Sun Z (2016) Evaluation of shallow groundwater contamination and associated human health risk in an alluvial plain impacted by agricultural and industrial activities, mid-west China. Expo, Health 8:311–329

Wu J, Zhang Y, Zhou H (2020) Groundwater chemistry and groundwater quality index incorporating health risk weighting in Dingbian County, Ordos basin of northwest China. Geochemistry, 80(4):125607. https://doi.org/10.1016/j.chemer.2020.125607

Zhou Y, Li P, Chen M, Dong Z, Lu C (2020) Groundwater quality for potable and irrigation uses and associated health risk in southern part of Gu'an County, North China Plain. Environ Geochem Health. https://doi.org/10.1007/s10653-020-00553-y.