How to Cite:
Madan, Y., & Jain, S. (2022). Assessment of surface water from physicochemical parameters: A detailed study of a selected portion of the Jaipur district. *International Journal of Health Sciences*, *6*(S2), 8368–8397. https://doi.org/10.53730/ijhs.v6nS2.7150

Assessment of surface water from physicochemical parameters: A detailed study of a selected portion of the Jaipur district

Yogita Madan
Assistant Professor, Department of Chemistry, Amity School of Applied Sciences, Amity University Rajasthan, NH 11C Jaipur Delhi Highway, Jaipur, 303002, Rajasthan
Email: madan.runa@gmail.com

Surbhi Jain
Research Scholar, Department of Chemistry, Amity School of Applied Sciences, Amity University Rajasthan, NH 11C Jaipur Delhi Highway, Jaipur, 303002, Rajasthan
Corresponding author email: sjain9681@gmail.com

***Abstract*---**Unwanted changes in the physical, chemical, and biological features of air, water, and soil pose a serious hazard to people all over the world. Water is highly polluted with various dangerous chemicals as a result of the rising human population, industry, fertilizer use, and man-made activity. Weathering of rocks and leaching of soils, mining processes, mixing of different domestic contaminants (detergents), and other factors contaminate natural water. Because of the usage of contaminated drinking water, various water-borne diseases affect human health; therefore it is vital to monitor the quality of drinking water at regular intervals. This study comprises a water assessment using Physico-chemical parameters. This research data has been collected from Jamwa-Ramgarh, Virat Nagar, Bassi, and Amber tehsil in the Jaipur district during the study period (2019-2022). This paper has included appropriate methodologies for the determination of Physico-chemical parameters. Temperature, acidity, hardness, pH, sulfate, chloride, DO, BOD, COD, alkalinity, and other physicochemical parameters are calculated because they all are necessary to analyze water quality. the determination of the concentration of certain heavy metals(Fe, Zn, Cd, Cu), is also included in this paper because these heavy metals are dangerous to water species and also produce poison inside the water. Water analysis reports with physico-chemical parameters have compared to standard values for water quality assessment provided by reputable agencies.

International Journal of Health Sciences ISSN 2550-6978 E-ISSN 2550-696X © 2022.
Manuscript submitted: 9 March 2022, Manuscript revised: 18 April 2022, Accepted for publication: 1 May 2022

Keywords---BOD, COD, heavy metals, hardness, physicochemical parameters, surface water.

Introduction

Surface water is an important source of freshwater for human consumption, agriculture, and industrial usage in many parts of the world. However, anthropogenic activities such as residential, industrial, commercial, agricultural, and other anthropogenic activities, when combined with natural conditions, typically degrade Surface water quality, which is why a complete assessment of Surface water quality is vital for society(Abbasnia et al., 2019). The water quality assessment includes an examination of the physical, biological, and chemical components of water in relation to the natural quality, intended use, and human activities that can affect the health of aquatic systems. Freshwater makes up only 3% of the total amount of water on the planet, 2% stored taking the form of ice caps and glaciers the remaining 1% accounts for all available water supplies for the survival of all living creatures. Lakes, rivers, ponds, springs, and water wells are the most common sources of available freshwater/surface water(Akhter & Brraich, 2020). Water quality has deteriorated as a result of the unrestricted and injudicious use of natural resources for economic development, industry, and agricultural operations. Scientists and social activists around the world are concerned about the deterioration of water quality. Surface water, which covers around 4–6% of the earth's surface, is one of the most productive and complicated aquatic ecosystems(Modrick & Georgakakos, 2015). The quality of water, as a major ingredient of surface water, not only shows its fitness for human and industrial use but is also critical to its survival support Other ecosystem functions, such as biodiversity. Most of the surface water in agricultural catchments is saturated with excessive nutrients and other toxins as a result of significant anthropogenic pressure(Lemieux et al., 2015). Surface water becomes a source rather than a sink as a result of the increasing pollution intake, and it is unable to tolerate changes in land-use practices and changes in hydrological balance. As a result, surface water is regarded as one of the world's most fragile ecosystems. However, surface water can purify water through reduced flow rates, organic matter decomposition, nutrient retention by bacteria, and plant uptake(Hemmings et al., 2015). However, deforestation and conversion of wetland catchments into agricultural and industrial regions reduce the potential of these catchments to retain water in the environment, which increases water runoff with a high pollution load, causing water quality to worsen over time(Johnson & Belitz, 2015). Surface water loses its ecological activities due to poor water quality caused by an overabundance of fertilizers. Surface water sources in the research locations (Jamwa-Ramgarh, Bassi, Virat-Nagar, and Amber Tehsil of Jaipur district); includes both man-made and natural sources. The water demand for water has risen dramatically over time as agricultural operations, industry, population, and urbanization have all expanded. According to recent studies, the ecological quality of much surface water in the study areas has been gradually worsening. The majority of the surface water area in the research locations has been turned into agricultural fields where wheat, mustard, pearl millet, and other crops are grown as seasonal crops(Pistón et al., 2012). The environment, which increases water runoff with a high pollution load, causing water quality to worsen

over time. Surface water loses its ecological activities due to poor water quality caused by an overabundance of fertilizers. Surface water sources in the research locations (Jamwa-Ramgarh, Bassi, Virat-Nagar, and Amber Tehsil of Jaipur district); include both man-made and natural sources. The water demand for water has risen dramatically over time as agricultural operations, industry, population, and urbanization have all expanded. According to recent studies, the ecological quality of much surface water in the study areas has been gradually worsening. The majority of the surface water area in the research locations has been turned into agricultural fields where wheat, mustard, pearl millet, and other crops are grown in recent years; water quality evaluation has become a crucial concern around the world, as the quality of life has been threatened by projections of future drinkable freshwater scarcity. Monitoring water quality on a regular basis is required in order to establish strategies for improving ecological conditions and safeguarding the status of water bodies(Naubi et al., 2016). Because environmental conditions change throughout the year, any water body's water chemistry is subject to geographical and temporal changes. Routine water sampling and analysis of a maximum number of the water body's physicochemical properties are essential for reliable monitoring of water quality conditions. The water body's regular spatial and temporal monitoring provides a vast, complex dataset that is required to convert information into a form that is easily predictable and effective to interpret. Around the world, the water quality index (WQI) is a widely used technique for monitoring the quality of both surface and groundwater(Soleimani et al., 2018). It's a way of combining various physical and chemical variables into a single, easily comprehendible number(Cebecauer & Buzna, 2018). The purpose of this research has to determine the current water quality condition and spatiotemporal patterns of selected surface water in a selected region of the Jaipur district, as well as provide a mechanism for synthesizing all water quality conditions in a form that policymakers could understand. We hope that this study will provide detailed, useful information that will aid policymakers and other interested parties in initiating restoration efforts to improve the water quality in the study region.

Materials and Methods

Study Area

Jaipur is a district in Rajasthan, India, with a total area of 11,143 km2 that includes 10,353.48 km2 of rural land and 789.52 km2 of urban land. According to 2011 statistics, Jaipur has a population of 66, 26,178 people, with 34, 71,847 people living in the city and 31, 54,331 people living in the countryside. In the district, there are approximately 11, 77,096 dwellings, including 6, 69,293 urban houses and 5, 07,803 rural houses. We chose a few Tehsils in the Jaipur district, including Jamwa-Ramgarh (27.0192° N, 76.0018° E), Virat Nagar (27.4310° N, 76.1900° E) ,Bassi (26.8419° N, 76.0521° E), Amber tehsil(26.9880° N, 75.8610° E), to assess the likely impact of domestic pollutants (detergents) on water quality for drinking and irrigation. An investigation/study of eco-chemicals chosen areas has been completed by investigating of surface water samples for different physicochemical boundaries/parameters. The research has been done for three consecutive years (2019, 2020, and 2021). The subtleties of various strategies took on regions under:

Water Sampling

The sampling was carried out according to the normal procedure for chemical analysis, and samples were obtained according to APHA guidelines(Pistón et al., 2012).

Sites for Sampling

For surface water samples, four testing areas from one tehsil and five regions from each of the three tehsil were chosen.

Containers for Samples

Along with the samples, exceptional quality tight mouth screw cap polypropylene holders/bottles of 2-liter were used. Containers were first rinsed in a weak nitric corrosive/acid solution before being cleaned in Demineralized water. Before the test/sample assortment bottles were examined, they were rinsed three times with water, and then the tests were gathered and carefully screwed.

The volume of samples

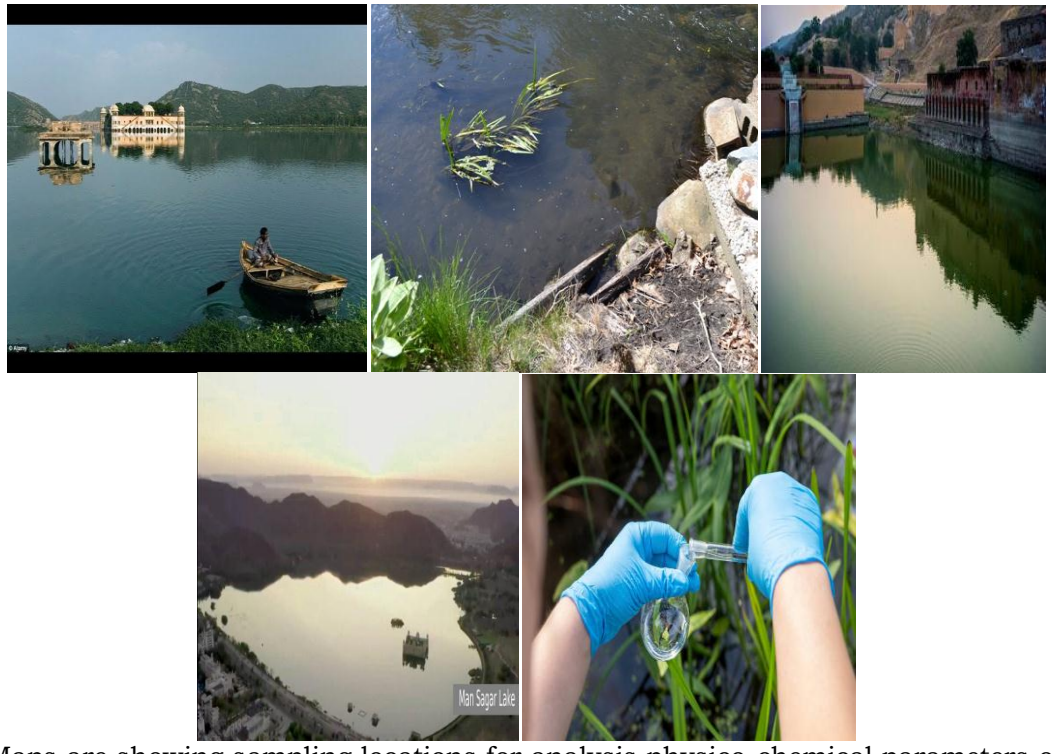
For the purpose of determining the physicochemical properties of water, an obligatory sample of at least 2 liters of water was collected at a time from each testing region. The collected sample volume for considerable metal assurance was 500ml.

The Sample's Labeling

To avoid any disarray and blunders/errors, each sample was bodied enough and checked code on sample bottles by an indelible marker in two spots/places, entered all the facts concerning the name of the examining region, source, and date of assortment in field book.

Sample Collection

The samples were taken from selected surface water bodies' tanks/talab/waterways/channels. The samples were taken throughout the morning (between 7:00 and 9:00 a.m.) and evening (between 5:00 and 7:00 p.m.) hours of four separate seasons: winter, spring, pre-storm, and post-rainstorm. For examining and gathering information, the following cycles were used. The samples were gathered as fundamental samples, at every site tests were gathered from 4 focuses and afterward blended. Test bottles flushed/rinsed thrice with the water to be gathered and afterward loaded up with the sample water to stay away from infringement of any air pocket and brought to the research facility. The samples were saved in the cooler at 4 degrees Celsius shielding them from any external contamination. The waste water samples used to calculate DO and BOD were collected immediately into dark DO bottles, with a few drops of manganese sulphate solution added to fix dissolve oxygen. They were kept at room temperature after collection.



Maps are showing sampling locations for analysis physico-chemical parameters of water

Methods

Determination of physiochemical parameters and heavy metals

For verification of various physicochemical parameters of area water sample, standard methods from "standard methods when it comes to analysis of water and wastewater, 17th edition, 1989, ready and published jointly by US community health association(Pistón et al., 2012)(APHA), American Water Works Association (AWWA), and water pollution control federation(WPCF)" were used. The following is an explanation of techniques:

1. PH- electrometric technique was utilized.
2. Conductivity- Laboratory Method was utilized.
3. Total Dissolved Solid- Estimation technique was utilized.
4. Total Alkalinity- The titration strategy for assurance of bicarbonate carbonate and all-out alkalinity was followed.
5. Total Hardness- For assurance of absolute hardness titration technique was utilized.
6. The Calcium Hardness- EDTA titration strategy was utilized for the assurance of calcium hardness.
7. A Magnesium Hardness- Computation technique was utilized for the assurance of magnesium hardness.

8. The Sodium- Fire emanation photometry technique was utilized for the assurance of Sodium.
9. Potassium- Fire photometric strategy was utilized for the assessment of potassium
10. Chloride- Specialist to the metric strategy was utilized
11. Sulphate- Turbid metric strategy was utilized
12. Nitrate- Ion-specific nitrate anode technique was followed
13. Fluoride- Ion-particular cathode technique was utilized for assessment of fluoride
14. Dissolved Oxygen Demand- Technique with Azide Modification was followed
15. Chemical Oxygen Demand- Shut Reflux titrimetric strategy was utilized for assessment of synthetic oxygen interest
16. Biological Oxygen Demand- BOD determined by keeping an sample of water containing a known measure of oxygen for five days at 20 degrees centigrade.
17. Boron- Colorimetric or spectrophotometric utilizing various reagents (Carmine/Azomethine) was utilized.
18. Surface Tension- The surface strain was estimated by the Drop count strategy utilizing a stalagmometer. The estimations were made in an indoor regulator at 25± 0.2 degrees centigrade at time frames a few moments until the qualities concurred inside point .5 dyne/cm. As a rule, their estimations were needed to acquire consistent qualities.
19. The Determination Of Heavy Metal- It is refined by the atomic absorption spectrophotometric strategy, a broadly utilized technique for the assurance of substantial metals present either in high or low fixation in water tests because the method is moderately straightforward, adaptable, precise, and liberated from the significant impedance. Obviously, in the assurance of certain metals, impedances are there however they can be assessed by some light substance treatment. With remarkable accuracy, 68 elements may be identified directly from an Atomic absorption spectrophotometer over a wide range of fixations from ppm to ppb marks. The instrument is first set up with the conventional arrangement of metal to be tested, which is illuminated by the metal's empty cathode light(Hong et al., 2020). Samples were drawn in 500 mL sample vials and transferred to a clean glass beaker, where they were acidified with strong nitric acid. More concentrated nitric acid was added and digested to a volume of 25mL. The digested sample was chilled at room temperature before being filtered through a Millipore slurry with a cutoff size of 0.45 micrometers and collected into a 50 ml volumetric flask, which was then made up to mark with DM water. The sample is now ready to be analyzed. The standard system for assessment of water and wastewater, 17th edition, 1989, produced and published jointly by APHA(Pistón et al., 2012), AWWA, and WPCF was used to analyze trace heavy metals such as iron, zinc, copper, and cadmium using an absorption spectrophotometer(Jehan et al., 2020).

Results and Discussion

The surface water were collected from 19 locations during morning and evening hours of four seasons, after collecting, the samples were analyzed in laboratory and results are shown in tabular and graphical form of physicochemical

parameters and heavy metal concentration, which is shown below. After obtaining the results, results were compared with standard value of prescribed by authentic agencies (WHO(Sayato, 1989)(Yousefi et al., 2018), BIS(Pistón et al., 2012)).

Table: 1 Surface Water Physico-Chemical Parameters Of Jamwa-Ramgarh Tehsil, Location Andhi

S.No.	PARAMETERS ⇩	MORNING				EVENING			
	YEAR ⇨	2019	2020	2021	AVERAGE	2019	2020	2021	AVERAGE
1	pH	7.7	8.2	8.1	8	8.0	8.4	8.2	8.2
2	Conductivity	190	220	232	214	180	240	210	210
3	TDS	118	142	145	135	118	154	133	135
4	Total Alkalinity	262	345	317	308	310	290	330	310
5	Carbonate Alkalinity	ND	ND	ND	ND	ND	ND	ND	ND
6	Bicarbonate Alkalinity	260	340	315	305	300	290	322	304
7	Total Hardness	217	314	306	279	315	260	280	285
8	Calcium Hardness	120	180	201	167	160	160	160	160
9	Magnesium Hardness	97	134	105	112	155	100	120	125
10	Sodium	70	101	90	87	50	114	100	88
11	Potassium	3	6	9	6	2	3	4	3
12	Chloride	17	42	58	39	29	33	43	35
13	Sulphate	62	120	97	93	60	140	85	95
14	Nitrate	30	20	22	24	23	40	27	30
15	Fluoride	0.20	0.30	0.10	0.20	0.10	0.10	0.10	0.10

NOTE: Except pH and conductivity (µS/cm), all parameters are in mg/L.

Table: 2 Surface Water Physico-Chemical Parameters Of Jamwa-Ramgarh Tehsil, Location Bhawni

S.No.	PARAMETERS ⇩	MORNING				EVENING			
	YEAR ⇨	2019	2020	2021	AVERAGE	2019	2020	2021	AVERAGE
1	pH	8.0	7.9	7.8	7.9	8.2	8.0	8.1	8.1
2	Conductivity	400	600	716	572	280	540	650	490
3	TDS	260	378	460	366	182	356	404	314
4	Total Alkalinity	445	475	565	495	410	445	525	460

5	Carbonate Alkalinity	ND	ND	ND	ND	ND	ND	ND	ND
6	Bicarbonate Alkalinity	420	462	540	474	400	440	522	454
7	Total Hardness	570	492	255	439	510	450	240	400
8	Calcium Hardness	290	252	145	229	360	290	160	270
9	Magnesium Hardness	280	240	110	210	150	160	80	130
10	Sodium	91	190	214	165	90	180	240	170
11	Potassium	8	13	9	10	6	6	9	7
12	Chloride	82	110	60	84	80	100	90	90
13	Sulphate	180	250	44	158	154	225	92	157
14	Nitrate	40	47	42	43	45	47	40	44
15	Fluoride	0.12	0.13	0.20	0.15	0.01	0.10	0.10	0.07

NOTE: Except pH and conductivity (µS/cm), all parameters are in mg/L.

Table: 3 Surface Water Physico-Chemical Parameters Of Jamwa-Ramgarh Tehsil, Location Gurha-Harooka

S.No.	PARAMETERS ⇩	MORNING				EVENING			
	YEAR ⇨	2019	2020	2021	AVERAGE	2019	2020	2021	AVERAGE
1	pH	7.7.	7.8	8.1	7.9	8.1	8.0	8.3	8.1
2	Conductivity	140	159	210	170	100	140	211	150
3	TDS	91	106	135	11	65	91	135	97
4	Total Alkalinity	442	425	622	497	400	360	470	410
5	Carbonate Alkalinity	ND	ND	ND	ND	ND	ND	ND	ND
6	Bicarbonate Alkalinity	439	420	620	493	395	355	465	405
7	Total Hardness	350	193	320	288	300	200	160	220
8	Calcium Hardness	200	110	195	168	180	110	100	130
9	Magnesium Hardness	150	83	125	120	120	90	60	90
10	Sodium	120	190	200	170	140	161	211	170
11	Potassium	3	6	9	6	3	4	8	5
12	Chloride	61	50	60	57	75	60	65	67
13	Sulphate	55	81	29	55	60	75	45	60
14	Nitrate	40	45	32	39	47	40	20	36
15	Fluoride	0.12	0.21	0.21	0.15	0.01	0.10	0.10	0.07

NOTE: Except pH and conductivity (µS/cm), all parameters are in mg/L.

Table: 4 Surface Water Physico-Chemical Parameters Of, Jamwa-Ramgarhtehsil, Location Pawta

S.No.	PARAMETERS ⇩	MORNING				EVENING			
	YEAR ⇨	2019	2020	2021	AVERAGE	2019	2020	2021	AVERAGE
1	pH	7.6	7.8	8.2	7.9	8.1	8.0	8.1	8.1
2	Conductivity	450	630	450	510	400	500	481	460
3	TDS	293	415	288	332	265	324	307	299
4	Total Alkalinity	212	164	358	245	211	200	310	241
5	Carbonate Alkalinity	ND	ND	6	2	ND	ND	3	1
6	Bicarbonate Alkalinity	210	160	351	240	200	180	311	231
7	Total Hardness	214	174	268	219	181	200	250	210
8	Calcium Hardness	134	100	140	125	94	111	140	115
9	Magnesium Hardness	80	74	128	94	85	91	111	94
10	Sodium	48	130	197	125	60	100	171	111
11	Potassium	2	6	4	4	2	3	4	3
12	Chloride	24	35	36	32	30	35	40	34
13	Sulphate	60	211	241	170	41	143	200	127
14	Nitrate	20	42	61	41	25	30	71	42
15	Fluoride	0.12	0.12	0.14	0.13	0.01	0.10	0.10	0.07

NOTE: Except pH and conductivity (µS/cm), all parameters are in mg/L.

Table: 5 Surface Water Physico-Chemical Parameters Of Jamwa-Ramgarh Tehsil, Location Chak-Dantli

S.No.	PARAMETERS ⇩	MORNING				EVENING			
	YEAR ⇨	2019	2020	2021	AVERAGE	2019	2020	2021	AVERAGE
1	pH	7.7	8.1	7.9	7.9	8.0	8.1	8.1	8.1
2	Conductivity	310	341	292	314	300	310	290	300
3	TDS	200	221	193	204	186	204	186	192
4	Total Alkalinity	184	322	431	312	221	290	360	290
5	Carbonate Alkalinity	ND	ND	ND	ND	ND	ND	ND	ND

6	Bicarbonate Alkalinity	181	320	430	311	215	280	360	285
7	Total Hardness	90	123	115	110	140	111	80	110
8	Calcium Hardness	60	74	76	70	121	80	40	80
9	Magnesium Hardness	30	49	40	40	20	30	40	30
10	Sodium	90	157	238	162	81	142	225	149
11	Potassium	1	3	2	2	1	2	3	2
12	Chloride	30	61	91	60	34	54	95	61
13	Sulphate	37	30	41	35	24	40	44	36
14	Nitrate	21	44	44	36	24	14	40	26
15	Fluoride	0.12	0.14	0.13	0.13	0.10	0.12	0.11	0.11

NOTE: Except pH and conductivity (µS/cm), all parameters are in mg/L.

Table: 6 Surface Water Physico-Chemical Parameters Of Virat-Nagar Tehsil, Location Chhitoli

S.No.	PARAMETERS ⇩	MORNING				EVENING			
	YEAR ⇨	2019	2020	2021	AVERAGE	2019	2020	2021	AVERAGE
1	pH	7.9	7.6	8.1	7.9	8.0	7.9	8.1	8.0
2	Conductivity	250	241	321	270	260	200	291	250
3	TDS	164	158	207	177	170	131	189	164
4	Total Alkalinity	144	165	164	158	166	145	155	156
5	Carbonate Alkalinity	ND	ND	ND	ND	ND	ND	ND	ND
6	Bicarbonate Alkalinity	141	159	160	153	160	140	149	150
7	Total Hardness	141	172	185	166	140	150	156	149
8	Calcium Hardness	60	69	80	70	81	100	86	89
9	Magnesium Hardness	81	102	106	96	59	49	69	60
10	Sodium	50	37	32	40	44	41	38	42
11	Potassium	1	2	5	3	2	4	3	3
12	Chloride	41	32	30	34	19	41	30	30
13	Sulphate	34	26	31	31	19	15	24	20
14	Nitrate	20	22	24	22	29	31	24	29
15	Fluoride	0.1	0.2	0.1	0.2	0.1	0.1	0.1	0.1

NOTE: Except pH and conductivity (µS/cm), all parameters are in mg/L.

Table: 7 Surface Water Physico-Chemical Parameters Of Virat-Nagar Tehsil, Location Bhojpura At Lakhawala

S.No.	PARAMETERS ⇩	MORNING				EVENING			
	YEAR ⇨	2019	2020	2021	AVERAGE	2019	2020	2021	AVERAGE
1	pH	8.0	8.1	7.9	8.0	8.4	8.2	8.0	8.2
2	Conductivity	300	240	241	260	310	200	210	240
3	TDS	194	158	159	171	204	130	134	156
4	Total Alkalinity	300	264	211	258	323	245	220	263
5	Carbonate Alkalinity	ND	ND	ND	ND	ND	ND	ND	ND
6	Bicarbonate Alkalinity	300	258	210	255	321	240	221	260
7	Total Hardness	180	310	200	231	173	224	241	213
8	Calcium Hardness	150	241	134	175	149	141	161	150
9	Magnesium Hardness	30	70	64	55	23	84	80	64
10	Sodium	145	54	81	93	149	70	81	100
11	Potassium	5	4	6	5	4	2	3	3
12	Chloride	90	64	64	72	70	64	75	71
13	Sulphate	55	51	61	55	60	29	61	50
14	Nitrate	21	29	25	24	30	20	40	31
15	Fluoride	0.12	0.13	0.14	0.13	0.14	0.14	0.01	0.09

NOTE: Except pH and conductivity (µS/cm), all parameters are in mg/L.

Table: 8 Surface Water Physico-Chemical Parameters Of Virat-Nagar Tehsil, Location Bhrampur

S.No.	PARAMETERS ⇩	MORNING				EVENING			
	YEAR ⇨	2019	2020	2021	AVERAGE	2019	2020	2021	AVERAGE
1	pH	8.0	8.2	7.9	8.0	8.0	8.1	8.2	8.1
2	Conductivity	461	410	240	370	510	420	300	410
3	TDS	300	270	155	241	335	268	195	266
4	Total Alkalinity	420	441	315	392	430	405	369	402

5	Carbonate Alkalinity	ND	ND	ND	ND	ND	ND	ND	ND
6	Bicarbonate Alkalinity	420	441	311	390	420	400	364	395
7	Total Hardness	300	149	150	200	340	210	214	255
8	Calcium Hardness	165	110	129	135	200	121	130	150
9	Magnesium Hardness	134	40	20	65	141	90	84	105
10	Sodium	154	202	212	189	137	184	190	170
11	Potassium	4	6	5	5	6	4	5	5
12	Chloride	40	40	84	55	60	40	64	55
13	Sulphate	140	85	150	125	113	121	140	125
14	Nitrate	30	20	30	27	20	40	30	30
15	Fluoride	0.13	0.10	0.12	0.12	0.10	0.11	0.12	0.11

NOTE: Except pH and conductivity (µS/cm), all parameters are in mg/L.

Table: 9 Surface Water Physico-Chemical Parameters Of Virat-Nagar Tehsil, Location Sothana

S.No.	PARAMETERS ⇩	MORNING				EVENING			
	YEAR ⇨	2019	2020	2021	AVERAGE	2019	2020	2021	AVERAGE
1	pH	7.6	8.0	7.7	7.8	8.0	8.2	8.1	8.1
2	Conductivity	154	200	135	163	160	211	140	170
3	TDS	100	132	86	106	105	135	90	110
4	Total Alkalinity	245	311	426	327	200	265	360	275
5	Carbonate Alkalinity	ND	ND	ND	ND	ND	ND	ND	ND
6	Bicarbonate Alkalinity	240	300	420	320	201	261	356	272

7	Total Hardness	170	274	252	265	180	260	352	264
8	Calcium Hardness	120	150	211	160	111	160	210	160
9	Magnesium Hardness	50	124	142	105	70	100	142	104
10	Sodium	100	130	205	144	114	134	151	133
11	Potassium	3	4	5	4	2	4	6	4
12	Chloride	40	70	100	70	66	62	73	67
13	Sulphate	85	135	204	141	120	170	190	160
14	Nitrate	10	20	30	20	20	32	42	31
15	Fluoride	0.12	0.14	0.10	0.12	0.01	0.11	0.03	0.05

NOTE: Except pH and conductivity (µS/cm), all parameters are in mg/L.

Table: 10 Surface Water Physico-Chemical Parameters Of Virat-Nagar Tehsil, Location Kankrana Chhota

S.No.	PARAMETERS	MORNING				EVENING			
	YEAR	2019	2020	2021	AVERAGE	2019	2020	2021	AVERAGE
1	pH	7.7	7.9	7.9	7.9	7.8	7.9	8.0	7.9
2	Conductivity	231	191	221	214	341	180	260	260
3	TDS	154	124	144	141	210	114	167	164
4	Total Alkalinity	200	315	231	248	211	271	336	272
5	Carbonate Alkalinity	ND	ND	ND	ND	ND	ND	ND	ND
6	Bicarbonate Alkalinity	200	310	221	244	201	265	333	267
7	Total Hardness	270	315	176	253	260	291	206	252
8	Calcium Hardness	132	155	123	240	140	160	150	150
9	Magnesium Hardness	138	148	54	114	121	130	56	102
10	Sodium	84	155	163	134	121	139	170	144
11	Potassium	2	3	7	4	1	5	6	4
12	Chloride	70	84	60	70	79	59	40	60
13	Sulphate	141	203	190	177	175	211	160	182

14	Nitrate	20	22	33	24	30	41	32	34
15	Fluoride	0.16	0.12	0.12	0.12	0.02	0.11	0.02	0.05

NOTE: Except pH and conductivity (µS/cm), all parameters are in mg/L.

Table: 11 Surface Water Physico-Chemical Parameters Of Location Ram-Ratanpura

S.No.	PARAMETERS	MORNING				EVENING			
	YEAR	2019	2020	2021	AVERAGE	2019	2020	2021	AVERAGE
1	pH	7.8	8.2	8.0	8.0	8.0	8.3	8.2	8.2
2	Conductivity	560	420	430	470	620	440	411	490
3	TDS	364	269	285	306	384	286	258	309
4	Total Alkalinity	315	335	415	355	300	330	314	315
5	Carbonate Alkalinity	ND	ND	ND	ND	ND	ND	ND	ND
6	Bicarbonate Alkalinity	310	330	410	350	320	261	411	330
7	Total Hardness	510	310	446	422	460	290	390	380
8	Calcium Hardness	300	190	245	245	260	180	220	220
9	Magnesium Hardness	217	120	202	177	200	111	170	160
10	Sodium	65	145	169	127	70	145	119	113
11	Potassium	1	4	4	3	2	6	4	4
12	Chloride	84	70	140	98	79	80	110	90
13	Sulphate	172	159	178	170	155	135	155	147
14	Nitrate	50	42	34	42	60	40	35	45
15	Fluoride	0.12	0.13	0.11	0.12	0.10	0.01	0.01	0.04

NOTE: Except pH and conductivity (µS/cm), all parameters are in mg/L.

Table: 12 Surface Water Physico-Chemical Parameters Of Bassi Tehsil, Location Borai

S.No.	PARAMETERS	MORNING				EVENING			
	YEAR	2019	2020	2021	AVERAGE	2019	2020	2021	AVERAGE
1	pH	7.8	8.1	7.8	7.9	8.0	8.1	8.2	8.1
2	Conductivity	300	420	450	390	310	400	400	370
3	TDS	192	277	293	254	200	264	256	240
4	Total Alkalinity	215	194	248	219	225	165	225	205
5	Carbonate Alkalinity	ND	ND	ND	ND	ND	ND	ND	ND
6	Bicarbonate	210	190	245	215	220	160	220	200

	Alkalinity								
7	Total Hardness	270	240	195	235	260	190	180	210
8	Calcium Hardness	160	162	170	164	190	120	140	150
9	Magnesium Hardness	110	78	25	71	70	70	40	60
10	Sodium	76	80	120	92	60	80	112	84
11	Potassium	3	2	4	3	2	3	4	3
12	Chloride	72	80	85	79	55	68	60	61
13	Sulphate	90	72	54	72	65	72	82	73
14	Nitrate	42	42	42	42	31	47	42	40
15	Fluoride	0.12	0.11	0.10	0.11	0.10	0.10	0.04	0.08

NOTE: Except pH and conductivity (µS/cm), all parameters are in mg/L.

Table: 13 Surface Water Physico-Chemical Parameters Of Location Nangal-Bohra

S.No.	PARAMETERS	MORNING				EVENING			
	YEAR	2019	2020	2021	AVERAGE	2019	2020	2021	AVERAGE
1	pH	8.0	7.9	7.8	7.9	8.1	8.2	8.0	8.1
2	Conductivity	300	450	284	345	310	441	240	330
3	TDS	198	293	183	225	204	280	152	212
4	Total Alkalinity	154	145	227	176	200	160	210	190
5	Carbonate Alkalinity	ND	ND	ND	ND	ND	ND	ND	ND
6	Bicarbonate Alkalinity	150	140	219	170	160	110	240	170
7	Total Hardness	210	190	321	240	210	210	295	235
8	Calcium Hardness	180	140	191	170	140	160	149	150
9	Magnesium Hardness	30	50	129	70	40	40	145	85
10	Sodium	60	92	70	74	85	76	81	81
11	Potassium	4	5	3	4	2	6	1	3
12	Chloride	60	80	64	67	40	60	80	60
13	Sulphate	88	102	115	101	75	79	110	88
14	Nitrate	20	42	42	34	46	60	53	53
15	Fluoride	0.12	0.13	0.11	0.12	0.10	0.11	0.12	0.11

NOTE: Except pH and conductivity (µS/cm), all parameters are in mg/L.

Table: 14 Surface Water Physico-Chemical Parameters Of Bassi Tehsil, Location Gwalni

S.No.	PARAMETERS ⇓	MORNING				EVENING			
	YEAR →	2019	2020	2021	AVERAGE	2019	2020	2021	AVERAGE
1	pH	8.1	7.9	8.0	8.0	8.3	8.0	8.2	8.2
2	Conductivity	220	310	190	240	200	341	210	250
3	TDS	143	204	126	157	125	222	135	161
4	Total Alkalinity	188	255	251	232	195	246	267	235
5	Carbonate Alkalinity	ND	ND	ND	ND	ND	ND	ND	ND
6	Bicarbonate Alkalinity	180	250	248	225	190	240	261	230
7	Total Hardness	180	275	309	225	190	242	385	272
8	Calcium Hardness	80	120	161	119	110	121	221	150
9	Magnesium Hardness	100	154	149	134	80	122	165	122
10	Sodium	90	102	125	106	90	100	101	97
11	Potassium	1	2	6	3	2	6	4	4
12	Chloride	30	38	51	39	40	48	50	46
13	Sulphate	112	140	211	155	90	122	220	144
14	Nitrate	45	63	70	59	60	41	60	54
15	Fluoride	0.14	0.11	0.08	0.11	0.11	0.10	0.06	0.09

NOTE: Except pH and conductivity (µS/cm), all parameters are in mg/L.

Table: 15 Surface Water Physico-Chemical Parameters Of Bassi Tehsil, Location Barwa

S.No.	PARAMETERS ⇓	MORNING				EVENING			
	YEAR →	2019	2020	2021	AVERAGE	2019	2020	2021	AVERAGE
1	pH	8.2	7.8	7.8	7.9	8.3	8.2	8.0	8.2
2	Conductivity	430	210	410	350	440	250	361	350
3	TDS	280	140	264	228	277	165	225	222
4	Total Alkalinity	300	242	199	247	270	231	220	240
5	Carbonate Alkalinity	ND	ND	ND	ND	ND	ND	ND	ND
6	Bicarbonate Alkalinity	300	240	195	245	264	220	214	233
7	Total Hardness	270	203	142	205	360	240	180	260

8	Calcium Hardness	210	100	110	140	200	110	141	150
9	Magnesium Hardness	60	110	32	65	159	130	40	110
10	Sodium	100	90	110	100	59	88	95	80
11	Potassium	3	3	3	3	2	3	4	3
12	Chloride	55	40	55	50	60	46	50	52
13	Sulphate	100	70	76	82	111	120	70	100
14	Nitrate	30	40	42	34	30	20	34	28
15	Fluoride	0.10	0.12	0.08	0.10	0.05	0.01	0.03	0.03

NOTE: Except pH and conductivity (µS/cm), all parameters are in mg/L.

Table: 16 Surface Water Physico-Chemical Parameters Of Amber Tehsil, Location Maota Lake

S.No.	PARAMETERS ⇩	MORNING				EVENING			
	YEAR ⇨	2019	2020	2021	AVERAGE	2019	2020	2021	AVERAGE
1	pH	8.0	7.9	7.8	7.9	8.0	8.1	8.1	8.1
2	Conductivity	410	345	388	381	399	379	210	330
3	TDS	8.0	7.9	7.8	7.9	248	247	135	210
4	Total Alkalinity	270	254	175	233	290	311	345	315
5	Carbonate Alkalinity	300	340	380	340	ND	ND	ND	ND
6	Bicarbonate Alkalinity	ND	ND	ND	ND	288	299	340	310
7	Total Hardness	300	310	320	310	140	150	175	155
8	Calcium Hardness	119	160	155	145	79	85	120	9 5
9	Magnesium Hardness	80	85	120	95	60	65	55	60
10	Sodium	40	75	35	50	140	134	145	141
11	Potassium	130	155	189	158	2	4	6	4
12	Chloride	2	3	4	3	60	50	40	50
13	Sulphate	45	55	62	54	40	32	66	46
14	Nitrate	20	40	72	44	39	54	35	43
15	Fluoride	0.12	0.13	0.11	0.12	0.11	0.00	0.10	0.07

NOTE: Except pH and conductivity (µS/cm), all parameters are in mg/L.

Table: 17 Surface Water Physico-Chemical Parameters Of Amber Tehsil, Location Mansagar Lake

S.No.	PARAMETERS ⇩	MORNING				EVENING			
	YEAR ⇨	2019	2020	2021	AVERAGE	2019	2020	2021	AVERAGE
1	pH	7.8	8.0	8.2	8.0	8.0	8.1	8.2	8.1
2	Conductivity	220	320	270	270	200	290	230	240
3	TDS	145	205	178	176	138	185	145	156
4	Total Alkalinity	182	165	145	164	165	150	135	150
5	Carbonate Alkalinity	ND	ND	ND	ND	ND	ND	ND	ND
6	Bicarbonate Alkalinity	177	160	140	159	160	145	130	145
7	Total Hardness	200	140	134	158	220	190	151	187
8	Calcium Hardness	10	110	74	98	120	140	100	120
9	Magnesium Hardness	90	30	60	60	100	50	51	67
10	Sodium	44	52	33	43	40	50	48	46
11	Potassium	2	1	3	2	1	2	3	2
12	Chloride	42	32	25	33	60	42	60	54
13	Sulphate	20	21	13	18	18	56	16	30
14	Nitrate	42	30	24	32	55	40	34	43
15	Fluoride	0.13	0.10	0.09	0.11	0.01	0.05	0.09	0.05

NOTE: Except pH and conductivity (µS/cm), all parameters are in mg/L.

Table: 18 Surface Water Physico-Chemical Parameters Of Amber Tehsil, Location Shisiyawas

S.No.	PARAMETERS ⇩	MORNING				EVENING			
	YEAR ⇨	2019	2020	2021	AVERAGE	2019	2020	2021	AVERAGE
1	pH	7.9	8.1	7.7	7.9	8.1	8.3	8.0	8.1
2	Conductivity	300	260	340	300	310	240	320	290
3	TDS	198	170	214	194	203	156	211	190
4	Total Alkalinity	240	266	340	282	220	260	330	270
5	Carbonate Alkalinity	ND	ND	ND	ND	ND	ND	ND	ND
6	Bicarbonate Alkalinity	231	256	334	274	215	254	323	264
7	Total	200	170	212	194	190	155	195	180

	Hardness								
8	Calcium Hardness	160	100	130	130	140	100	120	120
9	Magnesium Hardness	40	70	83	64	50	55	75	60
10	Sodium	86	120	160	122	90	120	150	120
11	Potassium	1	2	3	2	2	3	4	3
12	Chloride	60	68	85	71	70	60	80	70
13	Sulphate	42	26	55	41	40	40	55	45
14	Nitrate	30	50	55	45	32	40	36	36
15	Fluoride	0.12	0.10	0.11	0.11	0.10	0.05	0.06	0.07

NOTE: Except pH and conductivity (µS/cm), all parameters are in mg/L.

Table: 19 Surface Water Physico-Chemical Parameters Of Amber Tehsil, Location Maila-Bagh

S.No.	PARAMETERS ⇩	MORNING				EVENING			
	YEAR ⇨	2019	2020	2021	AVERAGE	2019	2020	2021	AVERAGE
1	pH	8.6	8.7	8.1	8.5	8.7	8.3	8.3	8.5
2	Conductivity	190	120	260	190	200	140	260	200
3	TDS	126	78	171	125	130	87	170	129
4	Total Alkalinity	142	260	324	242	160	235	274	223
5	Carbonate Alkalinity	ND	ND	ND	ND	ND	ND	ND	ND
6	Bicarbonate Alkalinity	140	250	321	237	154	230	270	218
7	Total Hardness	200	310	318	276	210	245	263	239
8	Calcium Hardness	160	160	157	159	160	160	160	160
9	Magnesium Hardness	40	150	161	117	50	85	102	79
10	Sodium	32	40	66	46	40	50	90	60
11	Potassium	6	2	4	4	2	5	8	5
12	Chloride	50	34	42	42	60	30	60	50
13	Sulphate	40	55	61	52	40	54	80	58
14	Nitrate	25	42	29	32	14	32	35	27
15	Fluoride	0.11	0.12	0.13	0.12	0.10	0.10	0.04	0.08

NOTE: Except pH and conductivity (µS/cm), all parameters are in mg/L.

Table: 20 Physico-Chemical Properties Of Surface Water Of Jamwa Ramgar

S.NO.	LOCATION	DAY HOURS	PARAMETERS								
			Fe	Zn	Cd	B	Cu	DO	COD	BOD	Surface Tension
1	ANDHI	Morning	0.65	0.06	ND	0.01	ND	5.20	6.10	0.60	70.20
		Evening	1.00	0.01	ND	0.02	ND	6.10	7.20	1.20	68.40
2	BHAWNI	Morning	0.70	0.03	ND	0.01	ND	5.20	6.40	1.20	71.20
		Evening	0.80	0.01	ND	0.02	ND	7.40	7.10	2.31	68.40
3	GURHA-HAROOKA	Morning	2.80	0.01	0.01	0.02	ND	4.10	5.20	0.80	71.40
		Evening	0.90	ND	ND	0.04	ND	6.20	7.10	2.40	67.80
4	PAWTA	Morning	1.15	0.01	ND	0.02	ND	4.10	6.10	0.30	70.40
		Evening	2.10	ND	ND	0.02	ND	5.20	6.60	1.20	68.50
5	CHAK- DANTLI	Morning	0.80	0.02	ND	0.01	ND	4.20	6.30	0.14	71.20
		Evening	0.60	ND	ND	0.03	ND	5.60	6.70	0.86	69.40

NOTE: Except for surface tension, all parameters are in mg/L.

Table: 21 Physico-Chemical Properties Of Surface Water Of Tehsil Virat-Nagar

S.NO.	LOCATION	DAY HOURS	PARAMETERS								
			Fe	Zn	Cd	B	Cu	DO	COD	BOD	Surface Tension
1	CHHITOLI	Morning	0.60	ND	ND	0.01	ND	4.20	5.60	1.02	71.40
		Evening	1.40	ND	ND	0.02	ND	5.00	6.20	2.30	68.20
2	BHOJPURA AT LAKHAWALA	Morning	1.05	ND	ND	ND	ND	3.20	6.20	0.61	72.40
		Evening	0.80	ND	ND	ND	ND	4.60	6.80	1.31	69.60
3	BHRAMPUR	Morning	0.83	0.06	ND	0.02	ND	2.90	6.00	0.81	71.90
		Evening	0.90	0.01	ND	0.03	ND	3.40	6.90	1.23	68.60
4	SOTHANA	Morning	1.00	0.03	ND	0.01	0.03	2.80	6.20	0.76	72.50
		Evening	1.40	ND	ND	0.02	ND	3.20	7.00	1.40	71.20
5	KANKRANA-CHHOTA	Morning	1.75	0.07	ND	0.01	0.01	2.90	6.10	0.69	71.60
		Evening	2.10	0.02	ND	0.03	ND	3.40	7.20	1.40	69.70

NOTE: Except for surface tension, all parameters are in mg/L.

Table: 22 Physico-Chemical Properties Of Surface Water Of Tehsil Bassi

S.NO.	LOCATION	DAY HOURS	PARAMETERS								
			Fe	Zn	Cd	B	Cu	DO	COD	BOD	Surface Tension
1	RAM-RATANPURA	Morning	0.90	0.20	ND	ND	ND	4.20	5.20	0.30	71.50
		Evening	2.00	ND	ND	ND	ND	5.10	6.30	0.80	69.60
2	BORAI	Morning	1.80	0.12	ND	0.02	ND	5.10	4.60	0.40	71.80
		Evening	1.40	ND	ND	0.03	ND	6.10	5.80	1.20	71.40
3	NANGAL-BOHRA	Morning	1.70	0.04	ND	0.10	ND	4.30	4.90	1.40	71.50
		Evening	1.80	ND	ND	0.03	ND	5.60	5.80	1.80	69.70
4	GWALNI	Morning	2.40	0.17	ND	ND	ND	4.50	4.60	0.90	71.80
		Evening	0.60	ND	ND	0.01	ND	5.80	5.90	1.40	69.90
5	BARWA	Morning	2.00	0.05	ND	0.01	ND	4.90	6.20	0.90	71.60
		Evening	0.70	ND	ND	0.03	ND	5.20	7.10	1.80	69.40

NOTE: Except for surface tension, all parameters are in mg/L.

Table: 23 Physico-Chemical Properties Of Surface Water Of Amber

S.NO.	LOCATION	DAY HOURS	PARAMETERS								
			Fe	Zn	Cd	B	Cu	DO	COD	BOD	Surface Tension
1	MAOTA-LAKE	Morning	0.70	ND	ND	ND	ND	5.20	6.70	1.02	71.40
		Evening	0.92	0.01	ND	0.01	ND	6.40	8.40	2.30	68.20
2	MANSAGAR-LAKE	Morning	1.10	ND	ND	0.01	ND	5.20	5.40	0.61	72.20
		Evening	0.20	ND	ND	0.02	ND	5.10	5.90	1.31	69.60
3	SHISIYAWAS	Morning	0.70	ND	0.01	0.01	ND	5.30	4.90	0.81	71.90
		Evening	0.40	ND	ND	0.03	ND	5.60	5.10	1.23	68.60
4	MAILA-BAGH	Morning	1.05	0.03	ND	0.01	ND	5.90	6.40	0.76	72.50
		Evening	0.60	ND	ND	0.02	ND	5.20	6.60	1.41	71.20

NOTE: Except for surface tension, all parameters are in mg/L.

Table 24. After The analyses of Physico-chemical parameters of the surface water, the data compared with the International standard APHA(Pistón et al., 2012), Indian Standards(Chakraborty & Dey, 2022) and WHO(Jehan et al., 2020)(Sayato, 1989), standard value is summarized as

Physico-chemical parameters	Indian standard BIS 10500	WHO	International standard (APHA)
Ph (on scale)	6.5 to 8.5	7.0 to 8.0	7.0 to 8.5
Conductivity (µs/cm)	-	-	-
TDS (mg/L)	500	500	500
Total Alkalinity (mg/L)	200	-	-
Carbonate Alkalinity (mg/L)	-	-	-
Bicarbonate Alkalinity (mg/L)	-	-	-
Total Hardness (mg/L)	300	100	100
Calcium Hardness (mg/L)	75	75	75
Magnesium Hardness (mg/L)	30	80	30
Sodium (mg/L)	-	200	-
Potassium (mg/L)	-	-	-
Chloride (mg/L)	250	200	200
Sulphate (mg/L)	200	200	200
Nitrate (mg/L)	45	45	45
Fluoride (mg/L)	1.0	0.9	0.7
Fe (mg/L)	0.3	0.1	0.1
Zn (mg/L)	5.0	5.0	5.0
Cd (mg/L)	0.01	-	0.01
B (mg/L)	-	-	-
Cu (mg/L)	0.05	0.05	0.1

DO (mg/L)	-	-	-
COD (mg/L)	-	-	-
BOD (mg/L)	30	6	-
Surface tension (dyne/cm)	-	10	-

To determine the WQI of a water sample, three approaches are used. Each of the 24 criteria was assigned a weight (wi) based on its relative importance in determining the overall quality of drinking water in the first phase (Table 25). The parameter fluoride has been given a maximum weight of 5 because of its importance in determining water quality. Magnesium, which has a minimum weight of 2, may not be harmful in and of itself.

$$W_i = \frac{w_i}{\sum_{i=1}^{n} wi}$$

Other in the second stage, the relative weight (Wi) is computed using the following equation: Where Wi stands for relative weight, wi for parameter weight, and n for the number of parameters. The estimated relative weight (Wi) values for each parameter are also included in Table 25. In the third phase, each parameter is given a quality rating scale (qi) by dividing its concentration in each water sample by its BIS-approved standard and multiplying the result by 100:

$$qi = (Ci / Si) \times 100$$

Table 25

PARAMETERS	WIGHT (w_i)	RELATIVE WEIGHT (W_i)
PH (on scale)	4	0.12121
TDS (mg/L)	4	0.12121
Total Alkalinity(mg/L)	2	0.06061
Total Hardness(mg/L)	2	0.06061
Ca^{+2} (mg/L)	3	0.06061
Mg^{+2} (mg/L)	2	0.09091
Cl^{-} (mg/L)	3	0.09091
SO_4(mg/L)	4	0.12121
NO_3(mg/L)	4	0.12121
F^{-}(mg/L)	5	0.15152
total	33	1.000

Where qi stands for the quality rating, Ci stands for the concentration of each chemical parameter in each water sample in milligrams per liter, and Si is for the Indian drinking water standard in milligrams per liter, as determined by the BIS7 10500, 1991 standards. To compute the WQI, first determine the SI for each chemical parameter, then use the equation below to calculate the WQI.

$$\mathbf{S_{Ii} = W_i * qi}$$

$$\mathbf{WQI} = \sum \mathbf{SI_i}$$

SIi is the sub index of ith parameter; qi is the rating based on concentration of ith parameter and n is the number of parameters. The computed WQI values are classified into five types, “excellent water” to “water, unsuitable for drinking.

WHO WQI Standard	Grade	Water Quality
<50	A	The water quality is excellent.
50-100	B	The water is of good quality.
100-200	C	The water quality is extremely poor.
200-300	D	Water quality is Very poor.
>300	E	The water quality is unfit for human consumption.

Discussion

According to the findings of this investigation, the physicochemical levels of the pH values show that all samples exhibited alkaline properties as predicted for surface water, despite the fact that all values are well within the WHO norm. Although pH has no effect on human health, it does have an effect on water hardness. Although there are no specific health requirements for major ions or TDS in drinking water, high calcium and magnesium levels can induce scaling, and excessive salinity can impact odor and taste. Despite the fact that all TDS values are within below WHO guidelines, the high TDS value renders the water unsafe for domestic use. TDS for the main ions of sodium, chloride, and sulphate increased moderately from 2019 to 2021, were found within the WHO standards and for calcium hardness all values are well above the WHO standard exception chak-dantli village of Jamwa-Ramgarh tehsil and Chhitoli village of Virat-nagar tehsil and magnesium hardness, exception Chak-dantli, Chhitoli Bhojpura@Lakhawala, Bahrampur, Bohra, Barwa, Shisiyawas, mansagar lake, all samples of surface water not follow Who guidelines. Potassium levels are moderate and all fall within or close to WHO guidelines. With the exception of Gwalni village water sample and Nangal-Bohra village water sample, Nitrate ion values were determined to be within the WHO standard. High amounts of nitrate in drinking water are undesirable because they can trigger the formation of nitrite, which is hazardous to health, especially in infants and pregnant women. Furthermore, nitrate in surface water is primarily caused by pollution, such as fertilizer or manure leaching, wastewater discharge, septic tank leaks, and so on, implying the presence of other potentially dangerous elements such as bacteria or pesticides. The nitrate levels in the water samples are almost all within WHO standards and other investigations have discovered widespread nitrate pollution of surface water. Some metal ion concentration concentrations, such as iron, zinc, copper, cadmium, and boron, have been shown to be outside of the acceptable range (Because of the high levels of toxic heavy metals present, this waste water may not be suitable for irrigation in order to avoid metal accumulation in soils, and if the effluent is released into the environment without proper treatment, it may have an adverse effect on underground water and aquatic life.) and certain values are within the recommended limits of the World Health Organization (WHO) and the Bureau of Indian Standards (BIS) (shown in table number 20,21,22,23 throughout study time). The WQI was calculated using the Bureau of

Indian Guidelines' drinking water quality index standards, as recommended by the World Health Organization (WHO) (BIS). According to the WQI study, some water samples are of poor quality, while others are of acceptable quality and others are of middling quality, necessitating some basic treatment for drinking and domestic purposes. According to the findings of the study, waste water utilized for irrigation and agricultural reasons in these nearby areas is highly polluted, making it unsuitable for agricultural and aquatic uses. The contamination is discovered to be caused by the release of routine domestic pollutants (synthetic detergents) into surface water bodies, which produces a toxic effect and also produce pollution. All physiochemical parameters and metal concentration for water sample of selected sites were presented in graphical form.

Fig.1 Morning hours study of physico-chemical parameter during four seasons of three year study

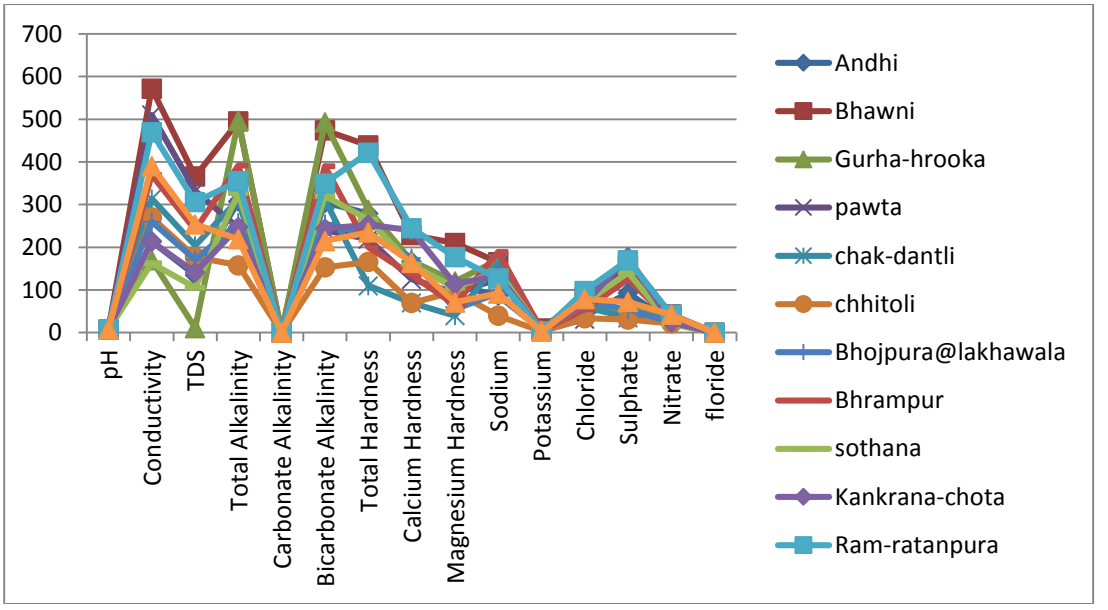


Fig.2 Morning hours study of physico-chemical parameter during four seasons of three year study

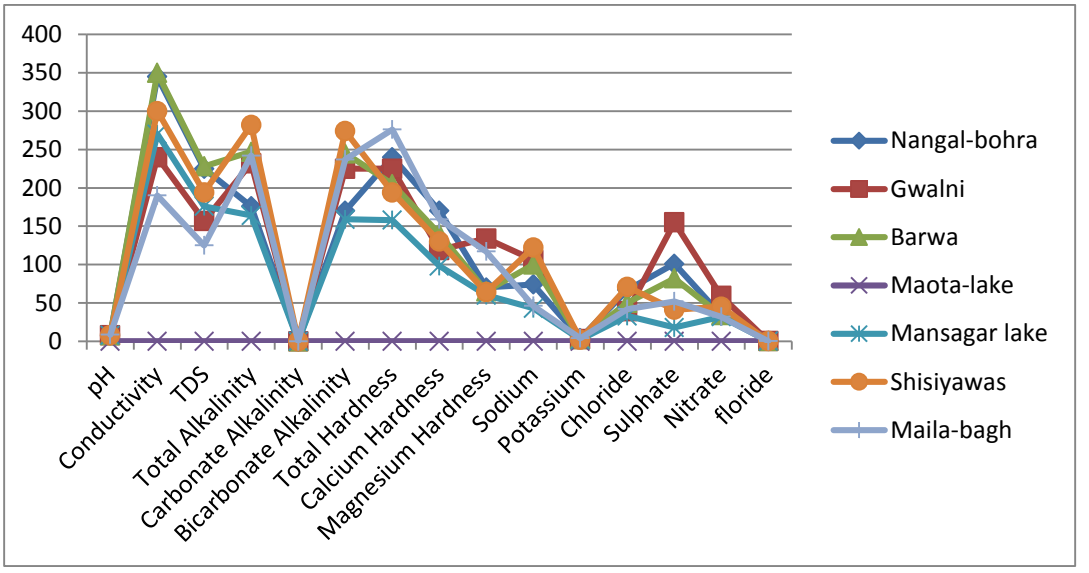


Fig.3 Evening hours study of physico-chemical parameter during four seasons of three year study

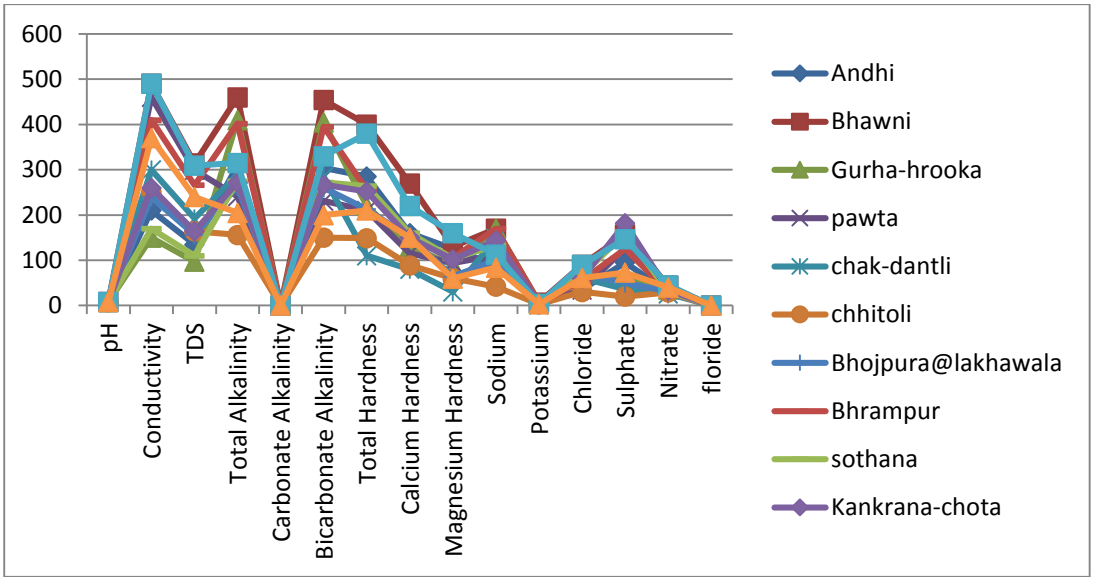


Fig.4 Evening hours study of physico-chemical parameter during four seasons of three year study

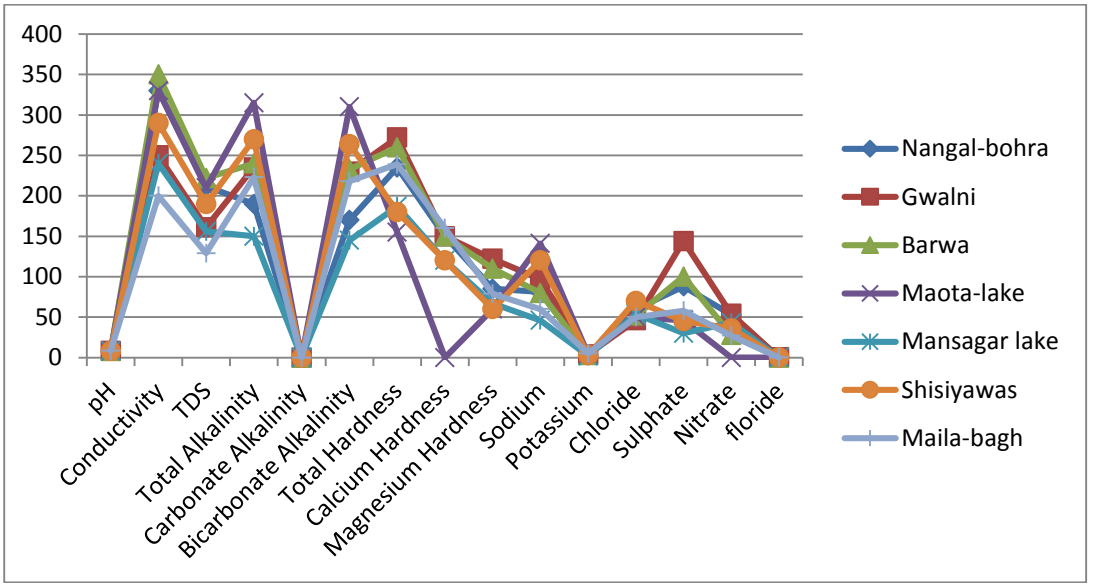


Fig.5 Physico-chemical properties of surface water of Jamwa-Ramgarh tehsil.

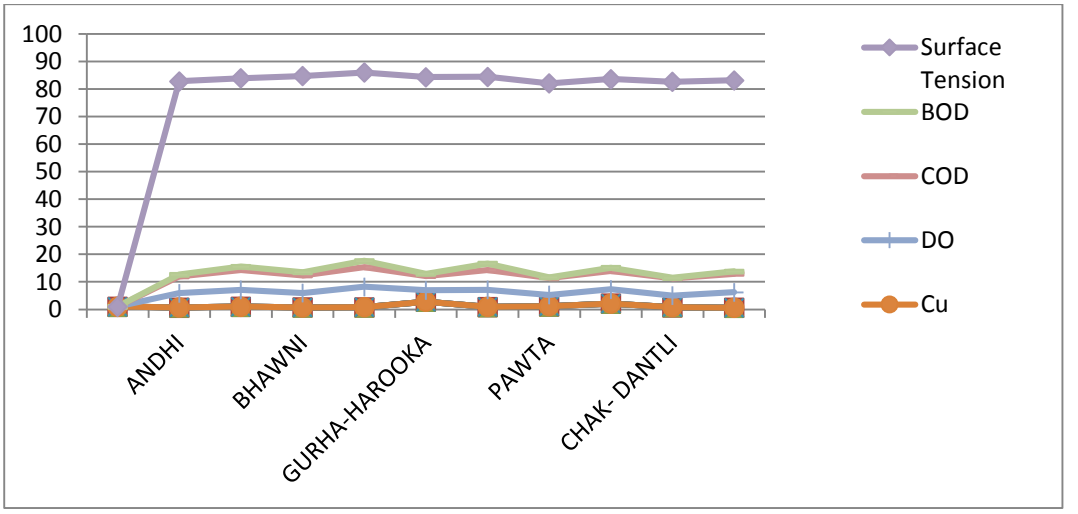


Fig.6 Physico-chemical properties of surface water of Virat-Nagar tehsil.

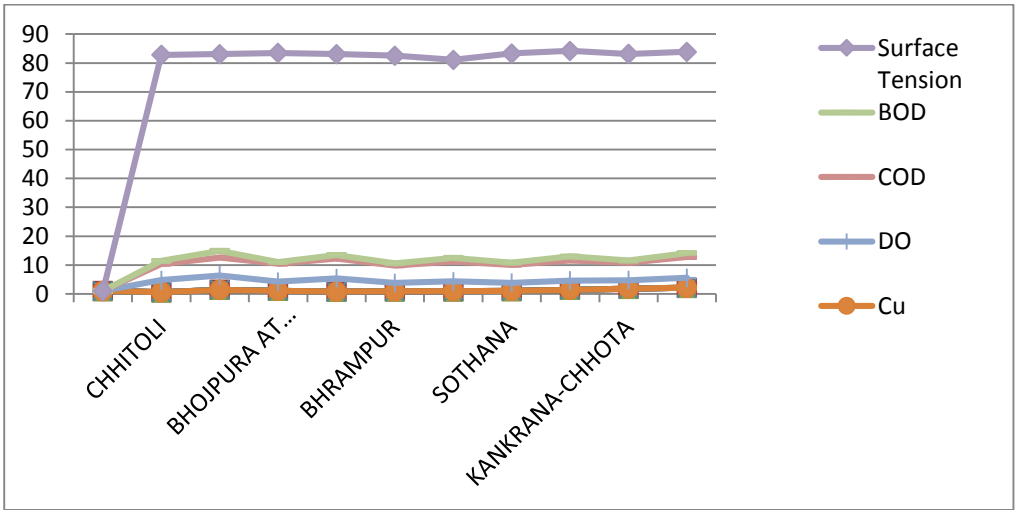


Fig.7 Physico-chemical properties of surface water of Bassi tehsil.

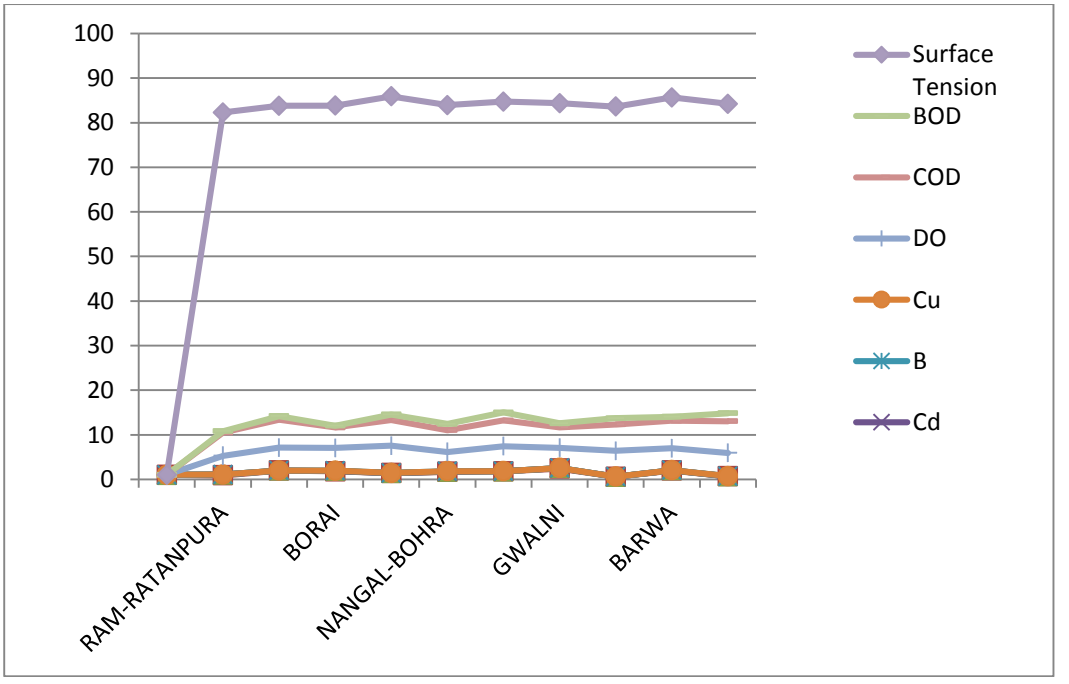
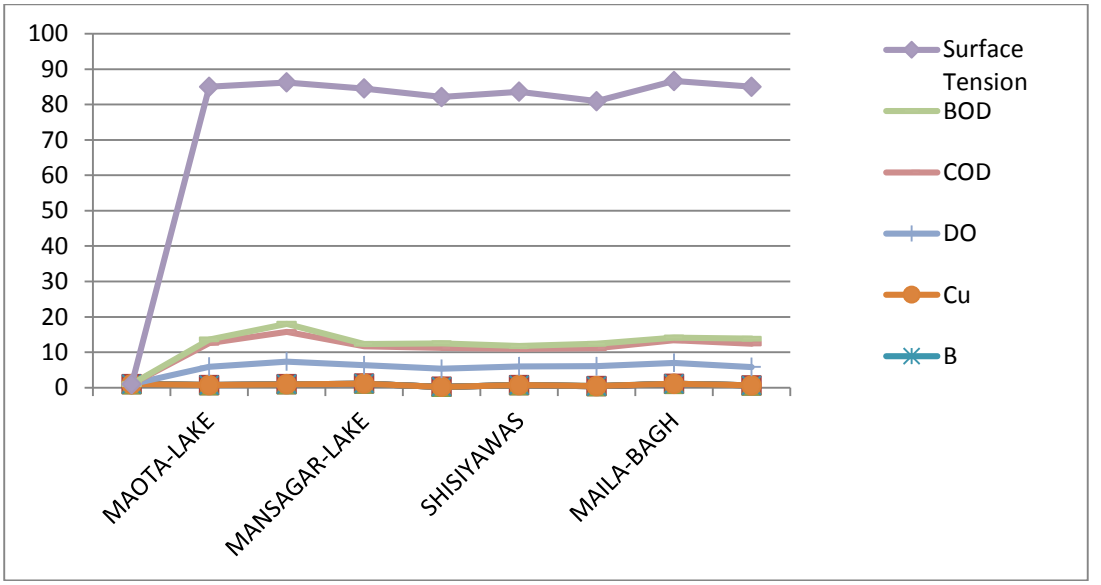


Fig.5 Physico-chemical properties of surface water of Amber tehsil



Conclusion

- This research paper contains all observations and results of Eco-chemical studies carried out for the area in tabular and graphical form with suitable statically analysis of data obtained for morning and evening hours of four different seasons of three consecutive years (2019, 2020,2021). Data so obtained were compared with standards value prescribed by authentic agencies (WHO, BIS,INDIAN STANDARDS) to evaluate load of domestic pollutants (synthetic detergents) in domestic use on environment and suitability of surface water for intended purposes. These parameters were calculated are as follows:
- Physiochemical parameters such as, sodium, potassium, alkalinity, hardness, softness, PH, water quality index (WQI),DO,BOD,COD and metal ion concentration Zn, Cd, Fe, Cu, B etc.

Acknowlegements

This paper was financially supported in part by the research committee in amity university of Jaipur Rajasthan. I would like to thank my supervisor assistant professor Dr. Yogita Madan in department of chemistry, amity school of applied sciences, amity university Jaipur, for her useful advice for improving quality of this paper.

Funding
For the research, authoring, and/or publication of this article, the author(s) received no financial funding.

Interest Conflict

There are no conflicts of interest among the authors.

References

Abbasnia, A., Yousefi, N., Mahvi, A. H., Nabizadeh, R., Radfard, M., Yousefi, M., & Alimohammadi, M. (2019). Evaluation of groundwater quality using water quality index and its suitability for assessing water for drinking and irrigation purposes: Case study of Sistan and Baluchistan province (Iran). *Human and Ecological Risk Assessment*, *25*(4), 988–1005. https://doi.org/10.1080/10807039.2018.1458596

Akhter, S., & Brraich, O. S. (2020). Physico - Chemical Analysis of Fresh Water of Ropar Wetland (Ramsar Site), India. *Current World Environment*, *15*(1), 117–126. https://doi.org/10.12944/cwe.15.1.15

Cebecauer, M., & Buzna, Ľ. (2018). Large-scale test data set for location problems. *Data in Brief*, *17*, 267–274. https://doi.org/10.1016/j.dib.2018.01.008

Chakraborty, R., & Dey, A. (2022). Probabilistic assessment of seismic response of toe-excavated hillslopes retained using anchored sheet-pile-wall. *Ain Shams Engineering Journal*, *13*(5), 101736. https://doi.org/10.1016/j.asej.2022.101736

Hemmings, B., Whitaker, F., Gottsmann, J., & Hughes, A. (2015). Hydrogeology of Montserrat review and new insights. *Journal of Hydrology: Regional Studies*, *3*, 1–30. https://doi.org/10.1016/j.ejrh.2014.08.008

Hong, Z., Zhao, Q., Chang, J., Peng, L., Wang, S., Hong, Y., Liu, G., & Ding, S. (2020). Evaluation of water quality and heavy metals in wetlands along the yellow river in Henan province. *Sustainability (Switzerland)*, *12*(4), 1–19. https://doi.org/10.3390/su12041300

Jehan, S., Ullah, I., Khan, S., Muhammad, S., Khattak, S. A., & Khan, T. (2020). Evaluación de la calidad del agua del río Swat, en el norte de Pakistán, mediante técnicas estadísticas multivariantes y un modelo de índice de calidad del agua (WQI). *Environmental Science and Pollution Research*, *27*(31), 38545–38558.

Johnson, T. D., & Belitz, K. (2015). Identifying the location and population served by domestic wells in California. *Journal of Hydrology: Regional Studies*, *3*, 31–86. https://doi.org/10.1016/j.ejrh.2014.09.002

Lemieux, J. M., Hassaoui, J., Molson, J., Therrien, R., Therrien, P., Chouteau, M., & Ouellet, M. (2015). Simulating the impact of climate change on the groundwater resources of the Magdalen Islands, Québec, Canada. *Journal of Hydrology: Regional Studies*, *3*, 400–423. https://doi.org/10.1016/j.ejrh.2015.02.011

Modrick, T. M., & Georgakakos, K. P. (2015). The character and causes of flash flood occurrence changes in mountainous small basins of Southern California under projected climatic change. *Journal of Hydrology: Regional Studies*, *3*, 312–336. https://doi.org/10.1016/j.ejrh.2015.02.003

Naubi, I., Zardari, N. H., Shirazi, S. M., Ibrahim, N. F. B., & Baloo, L. (2016). Effectiveness of water quality index for monitoring Malaysian river water quality. *Polish Journal of Environmental Studies*, *25*(1), 231–239. https://doi.org/10.15244/pjoes/60109

Pistón, M., Silva, J., Pérez-Zambra, R., Dol, I., & Knochen, M. (2012). Automated method for the determination of total arsenic and selenium in natural and drinking water by HG-AAS. *Environmental Geochemistry and Health*, *34*(2), 273–278. https://doi.org/10.1007/s10653-011-9436-9

Sayato, Y. (1989). WHO Guidelines for Drinking-Water Quality. *Eisei Kagaku*, *35*(5), 307–312. https://doi.org/10.1248/jhs1956.35.307

Soleimani, H., Abbasnia, A., Yousefi, M., Mohammadi, A. A., & Khorasgani, F. C. (2018). Data on assessment of groundwater quality for drinking and irrigation in rural area Sarpol-e Zahab city, Kermanshah province, Iran. *Data in Brief*, *17*, 148–156. https://doi.org/10.1016/j.dib.2017.12.061

Yousefi, M., Saleh, H. N., Yaseri, M., Mahvi, A. H., Soleimani, H., Saeedi, Z., Zohdi, S., & Mohammadi, A. A. (2018). Data on microbiological quality assessment of rural drinking water supplies in Poldasht county. *Data in Brief*, *17*, 763–769. https://doi.org/10.1016/j.dib.2018.02.003