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Water Quality Investigation by Physicochemical and Biological Parameters of Various Sources in District Shimla (Himachal Pradesh)

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Abstract
The present study reports the water quality of various resources in Shimla district of Himachal Pradesh (erstwhile summer capital of British India). Floating population (tourist) 75,000 and permanent population of Shimla city is increasing day by day, So that water consumption is also increasing rapidly. The city has a population of 142,161 spread over an area of 19.55 km2 according to the 2011 censes. In this work, samples of water were collected from different sources of Shimla city (Satluj river, Pabbar river, Tap water, spring, Bore well, Artificial lake &Natural lake). All the water parameter was performed on various samples at "Water Testing Laboratory Jal Shakti Vibhag

[1] . INTRODUCTION

Water is one of the most important natural resource for all living organisms. Water covers about 71% of the earthsurface. Most of the water volume about 96.5%covers with oceans and seas. Water plays an important role in ecological systems, human health, food production and economic development. Water is the core of sustainable development, Critical for socio economic development, agriculture, health. The five major applications of water are Hydropower, Domestics uses, Irrigation, Industrial uses, Commercial uses. The safety of drinking water is important for the health. The quality of drinking water is affected by various human activities and natural contaminants (like heavy metals, microbial growth). Such contaminants can cause serious health problems (like jaundice, hepatitis A&E, polio, blue baby syndrome and lead poisoning). Not only to human health, but these contaminants also cause serious environmental problems (soil degradation, Eutrophication, bioaccumulation).So to avoid any health problems, the quality of water must be tested for both the chemical and microbial contaminants. In the last three decades, growing water shortage and water pollution in both the developed and developing countries have driven the world into a water crisis. The world's finite supply of fresh water is being threatened by increasing population, rising standards of living and pollution. Already there are millions of people without access to drinking water and proper sanitation [1]. In this context, the water quality management is a very important subject to discuss. As someone from engineering background, we want to go for technical side of water quality rather than economic and social issues. This is the main reason that we selected this topic as our major project. Water quality determines the goodness of water for a particular purpose. Parameters and standards are also created to check out this quality. In our country the water quality standards are determined by three organizations [11].BIS (Bureau of Indian standards) CPHEEO (Central public health and environmental engineering organization) ICMR (Indian council for medical research)

C&M Division Tutikandi Shimla-4".Physicochemical& Biological parameters of water were analyzed. Indian Standards 10500 (Drinking water specifications) was referred to in order to check the acceptability of water. Most of the parameters were not found to be in the desirable range for drinking water and hence, appropriate measures were suggested to improve the quality of water.
Keywords: *Satluj river, Pabbar river, Spring, Artificial lake, Natural lake, Tap water, Water Quality, Physicochemical, Sampling Station, DO,BOD, COD, Turbidity, Chlorides*

We here checked out about twenty-five parameters, like physical parameters, chemical parameters, bacteriology pH, Conductivity, Turbidity ,Temperature, TDS, Alkanity, Total Hardness, Ca Hardness, Mg Hardness, Ca++, Mg++, Na+, K+, cl^-, Co^{3-},Hco^{3-},Do, CoD, BoD, Nitrate Color, Odor, Residual Chlorine, Phenophatlinealkanity, MPN Index. These parameters are mainly used for a first levelanalysis. It is quite enough to determine the usual issues and remedies, if the situation is more fatal even remedies can't withstand, next level or research level remedies want to be tried.

1.2 WATER AS INDIAN SCENIRO

In India, it is estimated that sectoral water requirements by 2010 are 85%, 7%, 5% and 3% for agriculture, domestic, industries and energy, respectively. The geographical area of India is about 329 million hectares (2.45 % of the earth's land mass) and population is 1.324 billion in 2016, which is 16% in the world. Also, the distribution pattern due to geographical variation is difficult to both by space and time. To mange this unevenness the inter basin transfer of water emerged as an important strategy [1]. The Indian programme of river linking and transfer of huge volume of water from one basin to other basins also in progress. In India, water conservation implies improving the availability of water through augmentation by means of storage of water in surface reservoirs, tanks, soil and ground water zone. It implies the need to modify the space and time availability of water to meet the demands. This concept also highlights the need of judicious use of water. There is a great potential for better conservation and management of water resources in its various users.. A variety of economic- administrative- community based measures can help conserve water. In urban sector 30% of water is wasted due to leakage and carelessness [2].By 2050, India's total water demand will increase 32% from now. Industrial and domestic sectors will account for 85 per cent of the additional demand. Over-exploitation of groundwater, failure to recharge aquifers and reduction in catchment capacities due to uncontrolled urbanization are all causes for the precarious tilt in the water balance. If the present rate of groundwater depletion persists, India will only have 22 per cent of the present daily per capita water available in 2050, possibly forcing the country to import its water. Increase population increased to 1.7 billion by 2050 will have integrated water efficient practices into their daily lives. If the ambitious water sustainability goals set by global industries and governments are testament, we dare say that the world has begun to recognize water as a resource after all Water efficient technologies will continue to be developed like they already are today, but more importantly, it is the renewed understanding of water as a shared commodity that will help these technologies find acceptance with industries, agriculture, and individuals alike. Agriculture will continue to be the mainstay of India in 2050.However, what is going to markedly change is the utilization of water by the sector - efforts of which have already begun to take shape, reflected in the country's 'per drop-more crop' mantra. Industries will be judged by their shareholders and customers on environmental sustainability practices integrated into core business operations. As a result, industries will reduce their dependency on freshwater altogether. Treatment of waste water and the use of recycled water in manufacturing products will be prevalent across industries. Water availability will be treated as a national security issue, like in the case of Israel, thus providing the impetus to make it a priority. Coastal regions will be more dependent on sea water by using desalination technologies [3]. Water demand in India will reach 1.5 trillion cubic meters in 2030, currently 740 billion cubic meters. The availability and quality of fresh water resources around the world are of growing concern to the international community. Human well being, ecosystem health and functioning and economics and politics all depend on how much, when and where the water is available. Human activities are changing the earth's climate and this is having an impact on all ecosystems. Need to study more about the impact of human activities on aquifers. By 2025, 1.8 billion people live in areas with water scarcity. 2/3rd of the world's population living in water stressed regions.On average, high- income countries treat about 70% of the municipal and industrial waste water they generate. That ratio drops to 38% in upper middle income countries and to 28% in lower middleincome countries. In low income countries only 8% undergoes treatment of any kind. The extremely low level of waste water

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treatment reveals an urgent need for technical upgrades and safe water reuse options to support the achievements of UNO- Agenda 2030 for SD. The AQUASTAT database of FAO estimates global freshwater withdrawals at 3,928 km^3 per year. An estimated 44% of this water is consumed, mainly by agriculture through evaporation in irrigated cropland. The remaining 56% is released into the environment as waste water in the form of municipal and industrial effluent and agricultural drainage waste. Globally over 80% of waste water released to the environment without adequate treatment [4]. The future goal is to be utilizing the waste water as a resource. Hydrological modeling is the state of art. Preserving important fully coupled interactions between atmosphere, ocean, land and sea-ice. The development of modeling will be an answer for water stress for a limit.

1.3 STUDY AREA

Shimla Planning Area (Shimla City) is the study area .It comprises Shimla Municipal Corporation area, Dhalli, New Shimla. Tutu, Kufri, Shoghi and Ghanahatti, which is the only Class I city in the state of Himachal Pradesh.

It is the capital city of the state of Himachal Pradesh with a permanent and a floating population (Census of India of 205,405 and 128,307 persons, respectively. Geographical area is 100 km2 and population density is 236 persons/km^2. Due to uneven topography, altitude of the city varies from 1,507–2,454 m above mean sea level. The average annual rainfall is 1,577 mm with an average of 84 rainy days [14].

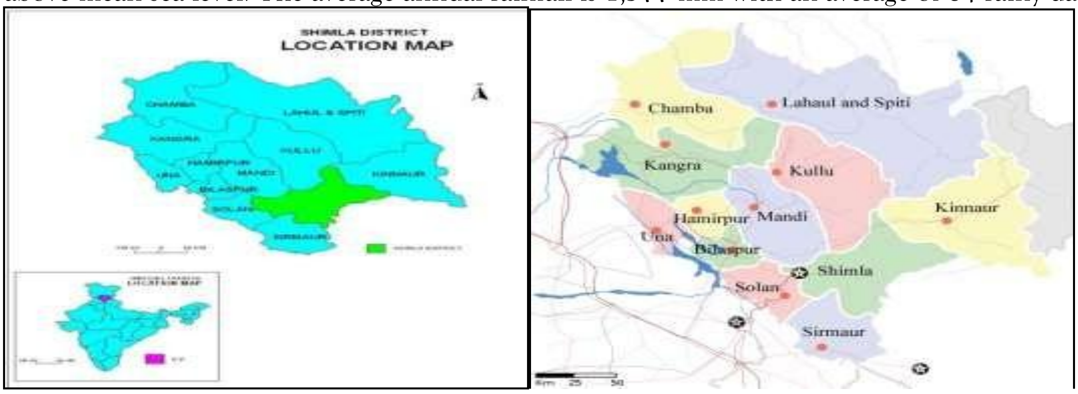

Figure 1. Study Area

Water supply for Shimla was initially planned and installed by the British in 1875. With the passage of time city they grew both geographically and demographically and water demand increased manifold resulting into a vast expansion of Shimla water supply system [19]. Operating cost of the existing system is about $12.72 million (INR763.5 million) per annum. Authority is supplying water costing $0.89 (INR 53.44) per kilolitre (kL), whereas only $0.25 (INR 15.24) per kL (average) is being charged rom the consumers.

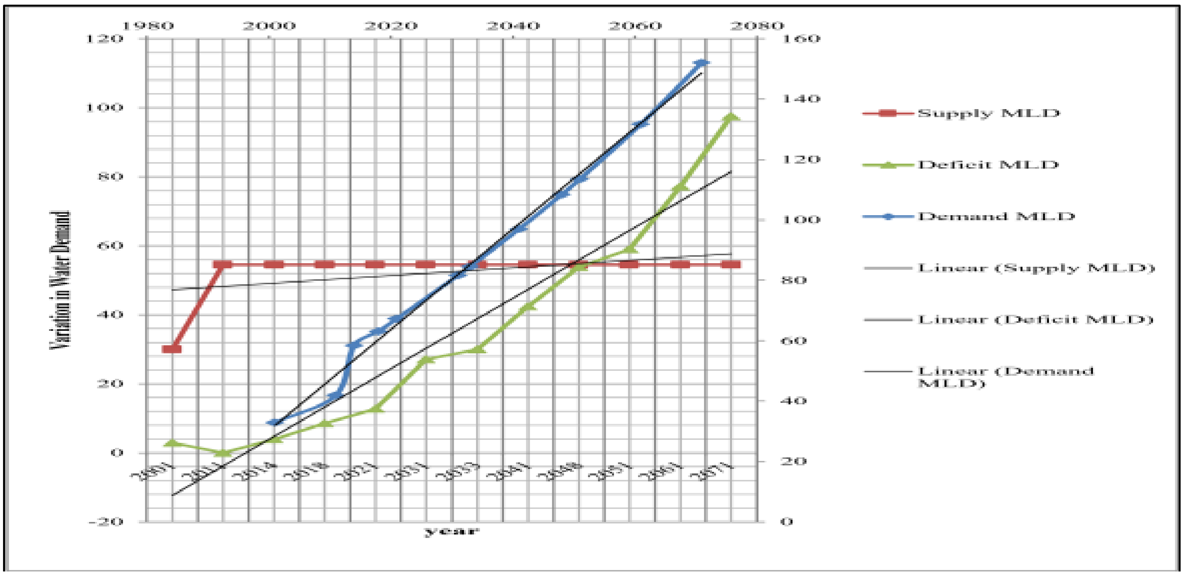

Figure 2. Gap between demand & supply of Shimla

3. MATERIAL AND METHODOLOGY:

Test was performed testing on various water samples at Water Testing laboratory Jal Shakti Vibhag C&M Division Tutikandi Shimla-4. We collected water Samples from various sources & various locations with in Shimla city namely: Satluj river locations in Rampur, Pabber river location Aandra dam, Badira, main market

Rohru near new bus stop, Hatkati near hydro project. We take these samples at 15 km distance for Pabber river & 10 Km distance between sample locations of Satluj river.We take these samples to investigate pollutants present in these rivers as these are main rivers in Shimla city. Spring sources from Dhar Jabbal, Main market

Rampur, & New Shimla spring as comparative sample. Natural Lake Gadhakufer, Artificial lake ITBP Taradevi lakes, Tap water form instutional area Rampur, Commercial & transportation area, Borewell Sample from main market Chirgaon, Rohru, Totu Shimla. We take these samples to investigate pollutants present in water in various locations in Shimla city.

In order to assess the water quality of various sources in district shimla different test were performed on various water samples at Water Testing laboratory Jal Shakti Vibhag C&M Division Tutikandi Shimla-4.

3.1Sample containers:

Containers typically are made of plastic or glass, but one material may be preferred over the others. For example, silica, sodium, and boron may be leached from soft glass but not plastic, and trace levels of some pesticides and metals may absorb onto the walls of glass containers. Thus hard glass container is preferred. For samples, containing organic compounds, do not use plastic containers expect those made of fluorinated polymers such as polytetrafluoroethylene (PTFE). Sample volumes: Collect a 1 liter sample for most physical and chemical analyses. Do not use sample from the same container for multiple testing requirements (e.g., organic, inorganic, radiological, bacteriological, and microscopic examinations) because methods of collecting and handling are different for each type of test. Always collect enough sample volume in the appropriate container in order to compile with the sample handling, storage and preservation requirements.

3.2 Time interval between collection and analysis:

In general, the shorter the time that elapses between collection of a sample and its analysis, the more reliable will be analytical results. For certain constituents and physical values, immediate analysis in the field is required. For compositedsample it is common practice to use the time at the end of composite collection as the sample collection time.

3.3 Preservation Techniques:

To minimize the potential for volatilization or biodegradation between sampling and analysis, keep samples as cool as possible without freezing. Preferably pack samples in crushed or cubed ice or commercial ice substituent before shipment. Avoid using dry to break. Dry ice also may effect a pH change in samples. Keep composite samples cool with ice or a refrigeration system set at 4˚C during compositing. Analyze samples as quickly as possible on arrival at the laboratory. If immediate analysis is not possible, preferably store at 4˚C. We use Sodium thiophosphate as preservative in side glass bottle used for sampling we also ensure safety measures to collect samples (Wear mask & gloves). Then preserve sample in refrigerator at 4°C so as to minimize outside bacteria, micro organisms. We also use Ice Container to Transfer samples to laboratory. (IS 3025 1987).

Table 1. Sample Collecting Area

Sr.No.	Sample Type	Location	Longitude	Latitude
1.	Satluj River	Jagatkhana	77.631059	31.451334
2.	Satluj River	Chattikhad	77.589407	31.398929
3.	Pabber River	Gushali	77.884565	31.298801
4.	Pabber River	Badiara, Bus Stop	77.8176081	31.2166259
5.	Pabber River	Rohru main market	77.7489633	31.200174
6.	Pabber River	Hatkoti	77.738949	31.1484657
7.	Bore Water	Chirgaon main market	77.876767	31.2363869

8.	Bore Water	Samoli (Rohru)	77.7699677	31.2033105
9.	Bore Water	Totu Shimla	77.1240633	31.0974981
10.	Spring Water	Dhar Jabal (Rohru)	77.651016	31.453899
11.	Spring Water	New Shimla	77.904517	31.311957
12.	Lake Water	Gadakufri Lake	77.342607	31.208416
13.	Lake Water	ITBP Lake (Taradevi)	77.125324	31.071715
14.	Tap Water	Govt. collage Rampur	77.639384	31.455187

3.4 TESTING WATER QUALITY [15-05-2023 to 20-06-2023]

For water quality testing, different parameters are identified by different means in IPH Water testing laboratory Shimla Tutikandi-171004 H.P. probably physical parameters are checked by using instruments. Chemical, through titration Biological using incubator. Different methods that we used are represented below: Na+, K+, cl-, Co3-, Hco3-,Do, CoD, BoD, Nitrate, Color, Odour, Residual Chlorine, Phenophatline , MPN Index.

Table 2. Instrument/ method

Water Quality Parameters	Description	Instrument/ method
Temperature	Temperature exerts a major influence on the biological activities and growth.	Thermometer
pH	The major of acidity (hydronium ion,H+) in the water.	pH meter
Turbidity(NTU)	Turbidity in water is the reduction of transparency.	Turbidity meter
TDS	The measure of the amount of particulate solids that are in the water	TDS meter
Dissolved oxygen	The amount of oxygen available in the water.	Titrimetric method (iodometric)
BOD	Biological oxygen demand	Incubalator
Alkalinity	Alkalinity of water is its quantitative capacity to react with a strong acid to a designated pH.	Titrimetric method
Chloride	Measurment of Chloride amount in water	Titrimetric method
Calcium	Measurment of Calcium amount in water	Titrimetric method
Magnesium	Measurment of Magnesium amount in water	Titrimetric method
Total hardness	Measurment of calcium and magnesium in water.	Titrimetric method (complexometric)
COD	Chemical oxygen demand	Reflux method
Nitrate		Using Phenol solution
Chloride	uingSilver nitrate 0.014 N Solution as titrant	Titeration
MPN index	Most probable number of bacteria	Bacteriological Incubalator
K+	Flame photometer with Standard Solution	Flame phatometer
Na+	Flame phatometer Standard Solution	Flame phatometer

4. RESULTS AND DISCUSSION

We successfully performed testing on various water samples at Water Testing laboratory Jal Shakti Vibhag C&M Division Tutikandi Shimla-4. We performed about 20 test parameters in laboratory for about 15

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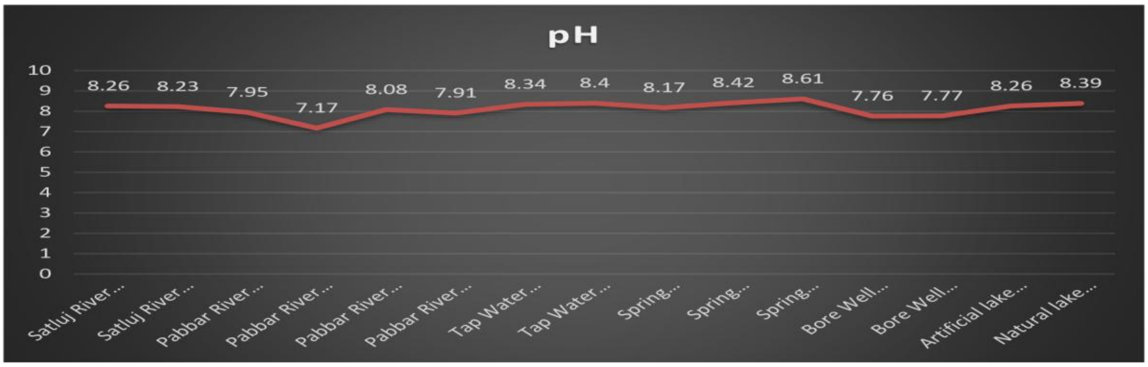
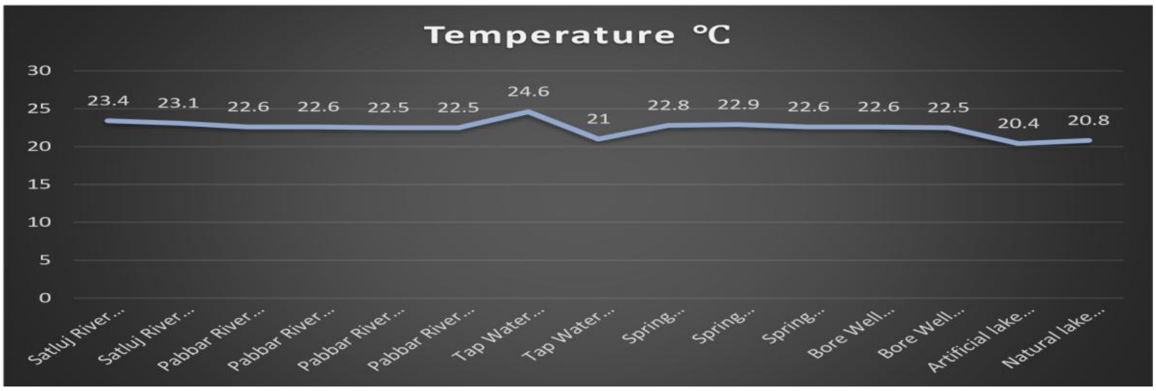
samples of various source from various locations. We successfully analyse samples based on water quality index. For this we use IS **10500: 2012** standards /acceptable limit of water quality parameters.

Table 3. Testing Parameter (IS 10500:2012)

Sr. No.	IS 10500 : 2012 Acceptable limits	Parameters
1	pH	6.5-8.5
2	Conductivity µmho/cm	300
3	Turbidity. NTU	1-5
4	Temperature, °c	-
5	Total Hardness, mg CaCo3/L	200-600
6	Ca Hardness	75
7	Mg Hardness	30
8	Do, mg/l	3
9	CoD, mg/l	250
10	BoD, mg/l	5
11	Nitrate, mg/l	45
12	Total MPN/100 ml (NIL)	Nil
13	TDS, mg/l	Max 500
14	Alkanity, mg/l CaCo3	Max 200
15	Ca++, mg/l	75
16	Mg++, mg/l	30
17	Na+, mg/l	-
18	K+, mg/l	-
19	Cl-, mg/l	Max 250

4.1. GRAPHICAL REPRESENTATION OF VARIOUS SAMPLE PARAMETERS





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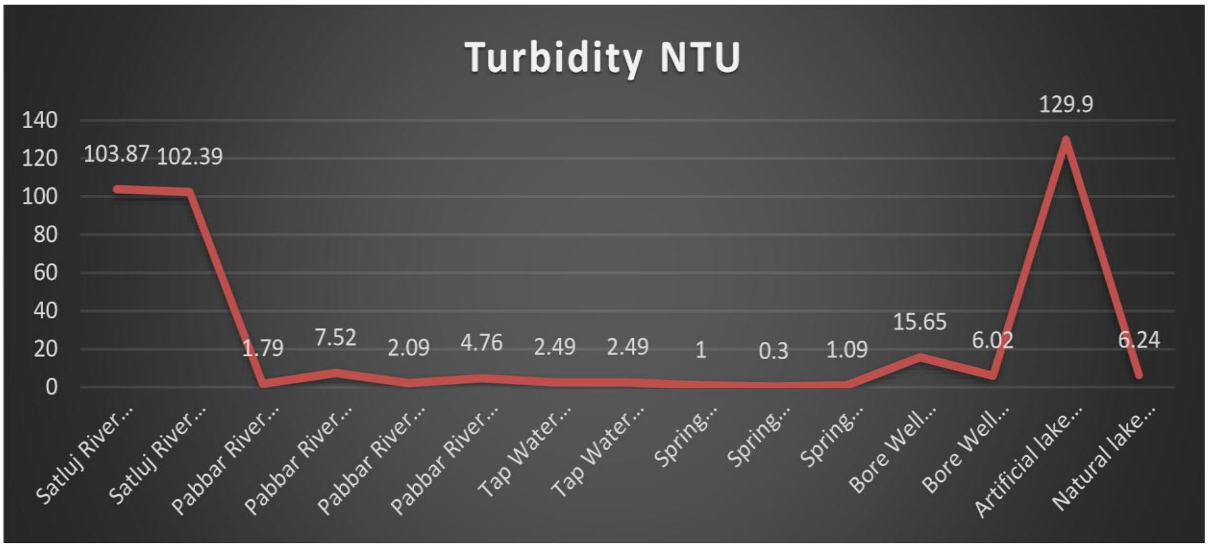
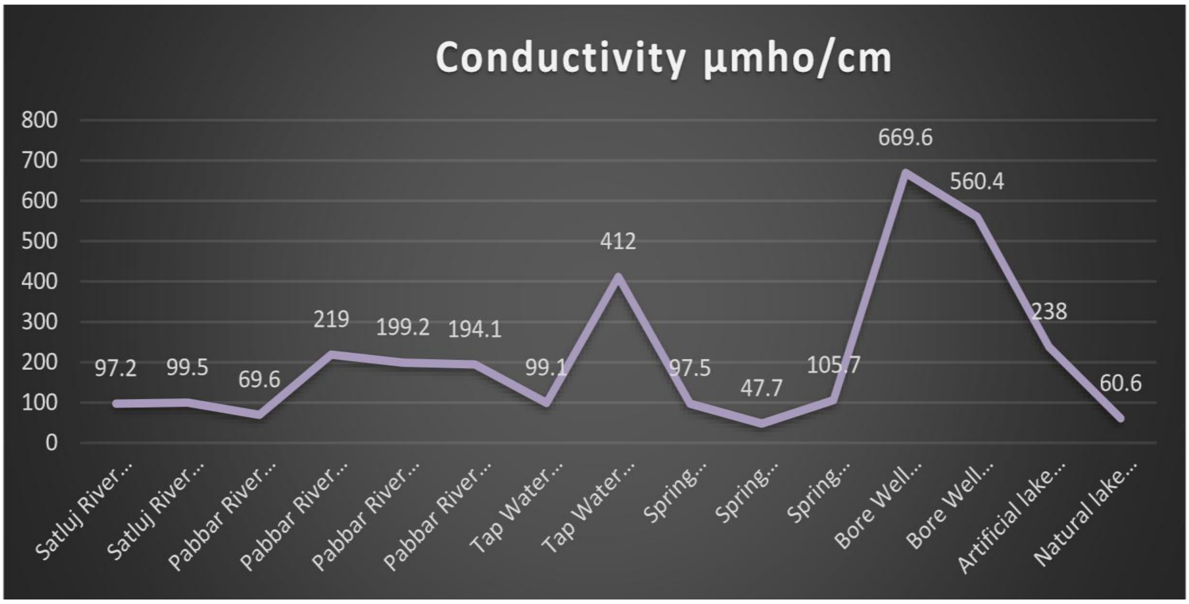
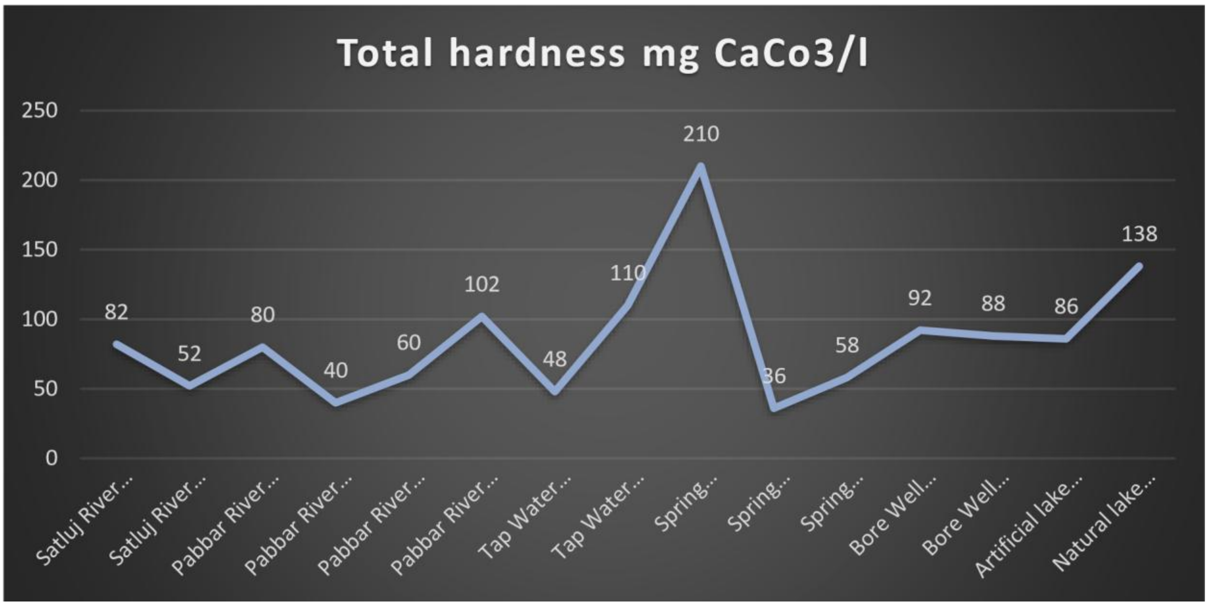
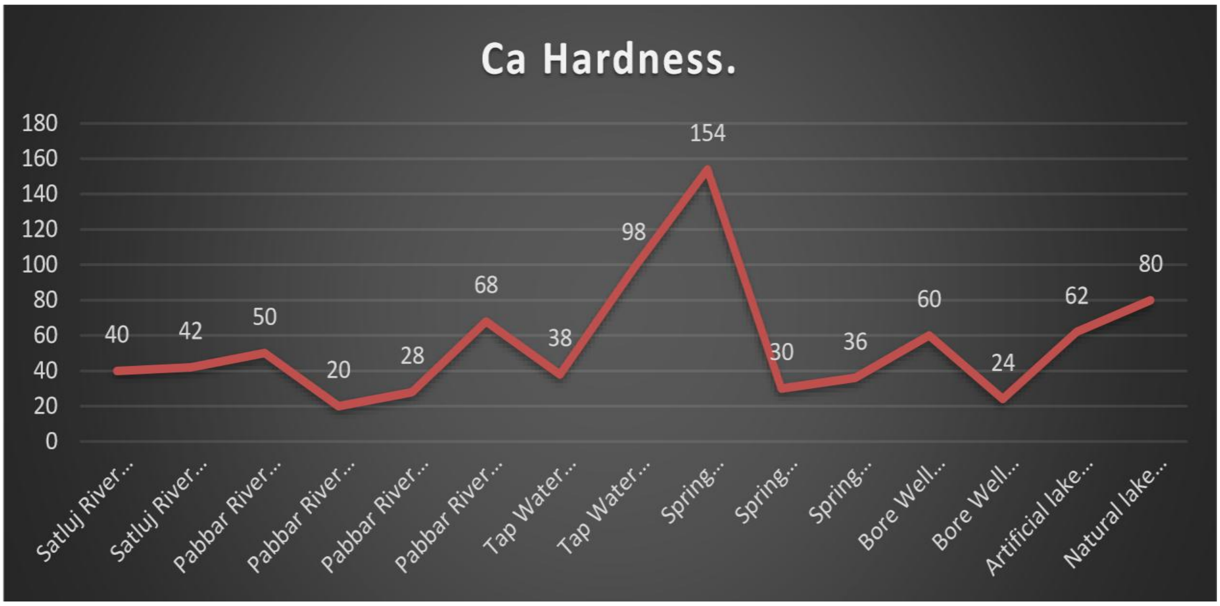
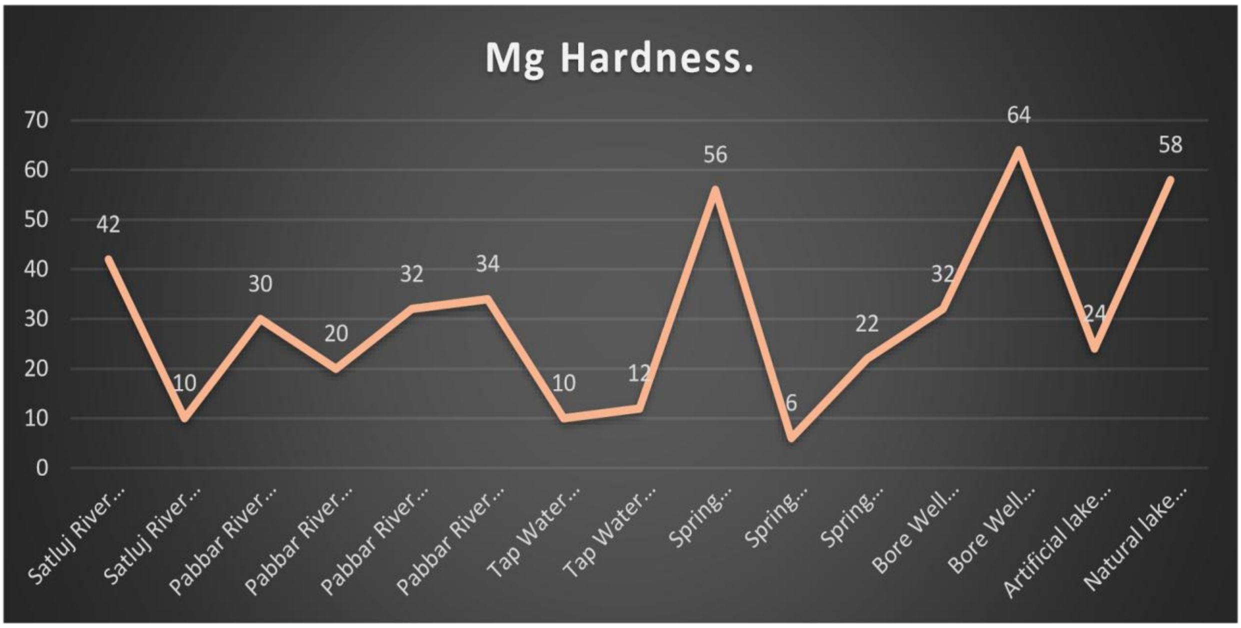
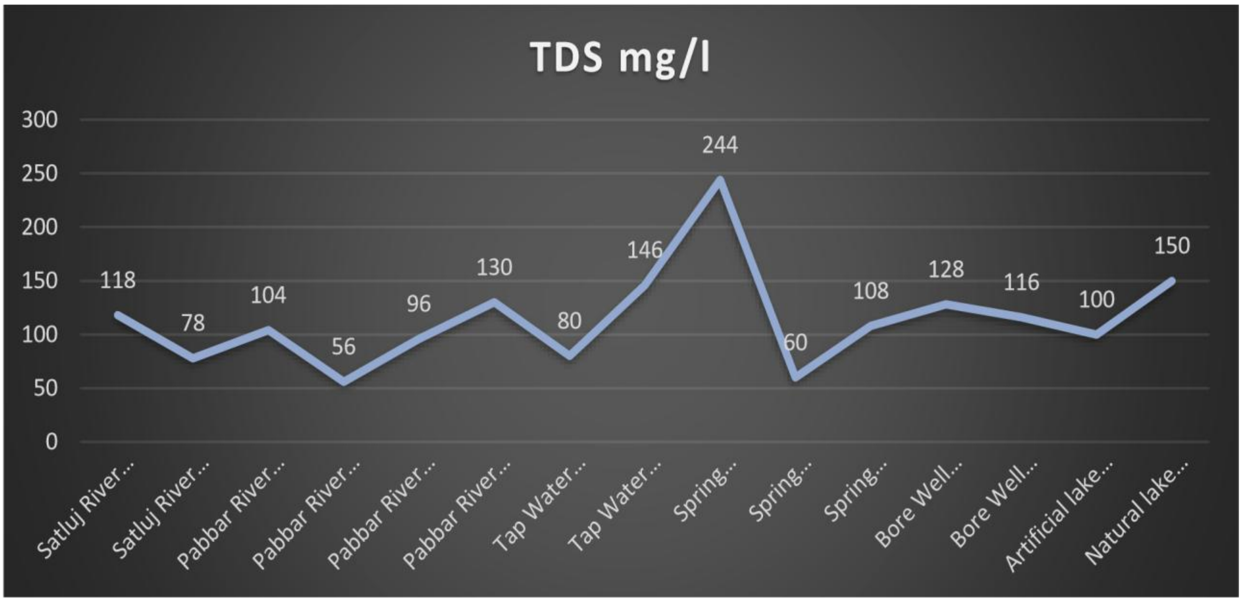


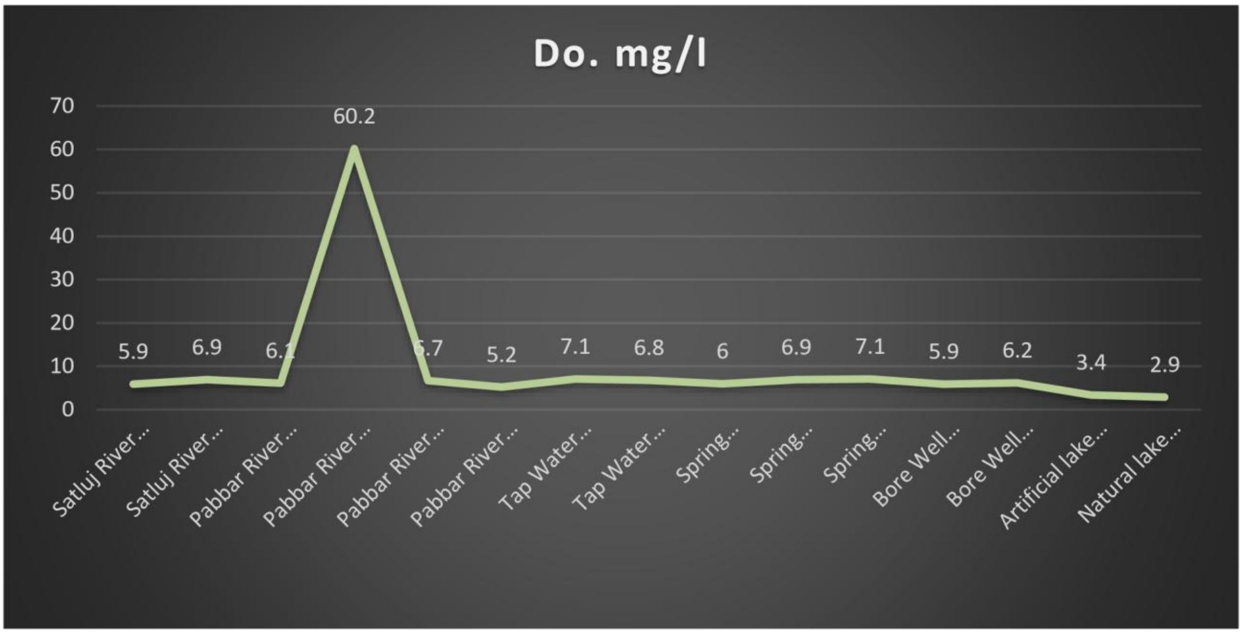


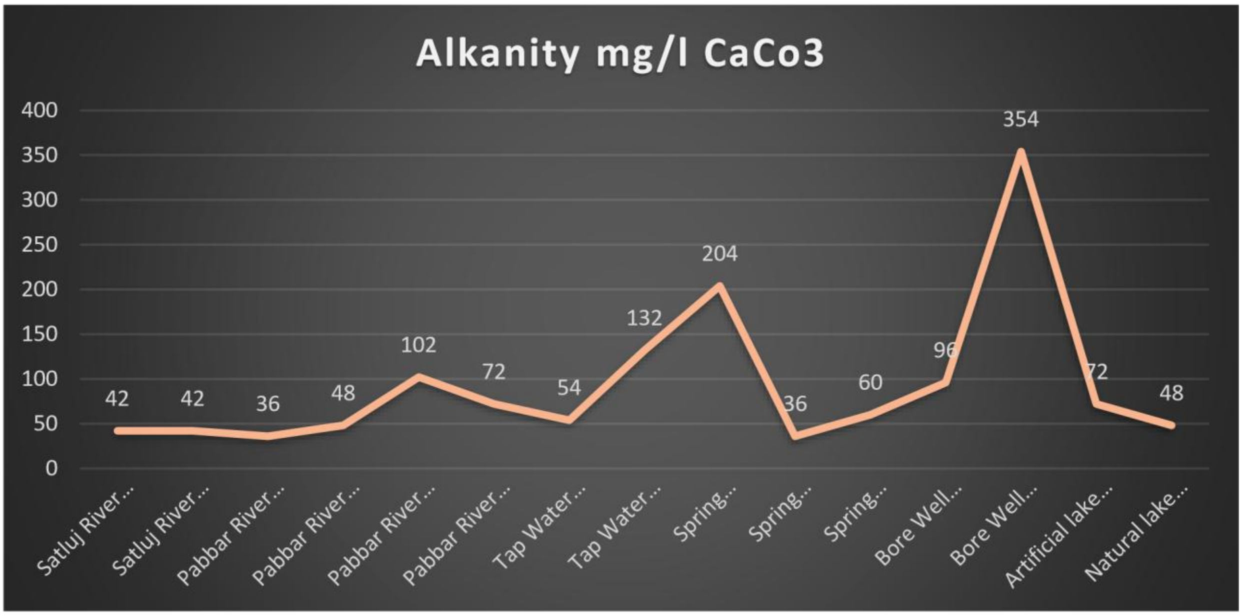


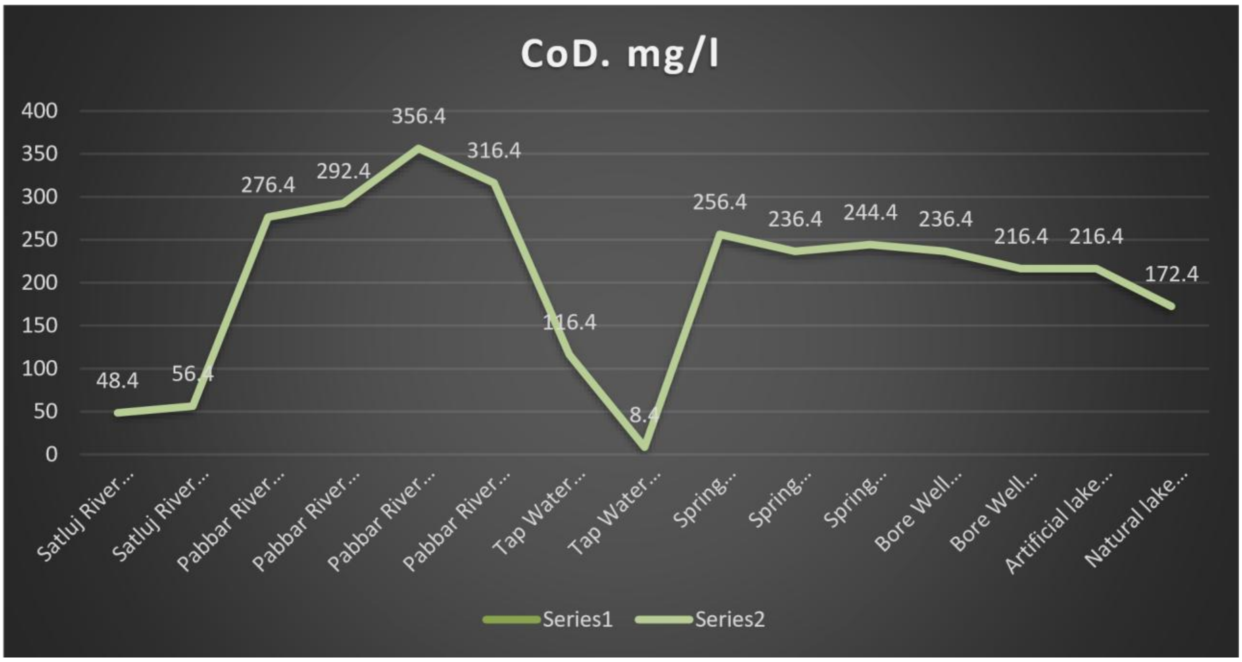

Ca Hardness.
180
160
140
120
100
80
60
40
20
0
40
42
50
20
28
68
38
98
154
30
36
60
24
62
80
Satluj River...
Satluj River...
Pabbar River...
Pabbar River...
Pabbar River...
Pabbar River...
Tap Water...
Tap Water...
Spring...
Spring...
Spring...
Bore Well...
Bore Well...
Artificial lake...
Natural lake...

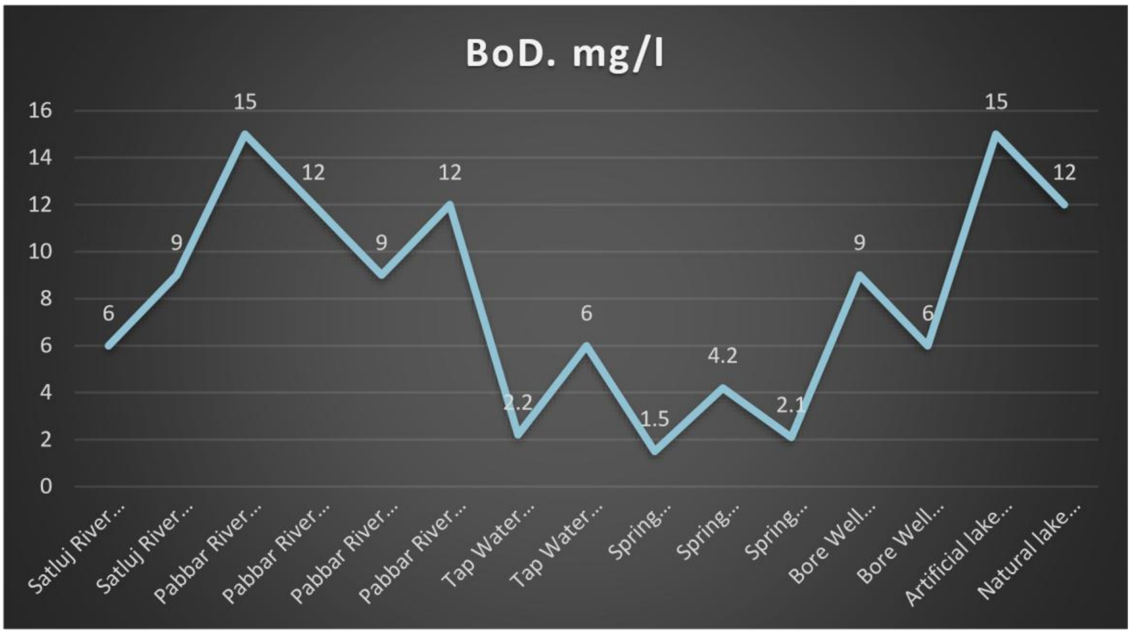

Mg Hardness.
70
60
50
40
30
20
10
0
42
10
30
20
32
34
10
12
56
6
22
32
64
24
58
Satluj River...
Satluj River...
Pabbar River...
Pabbar River...
Pabbar River...
Pabbar River...
Tap Water...
Tap Water...
Spring...
Spring...
Spring...
Bore Well...
Bore Well...
Artificial lake...
Natural lake...

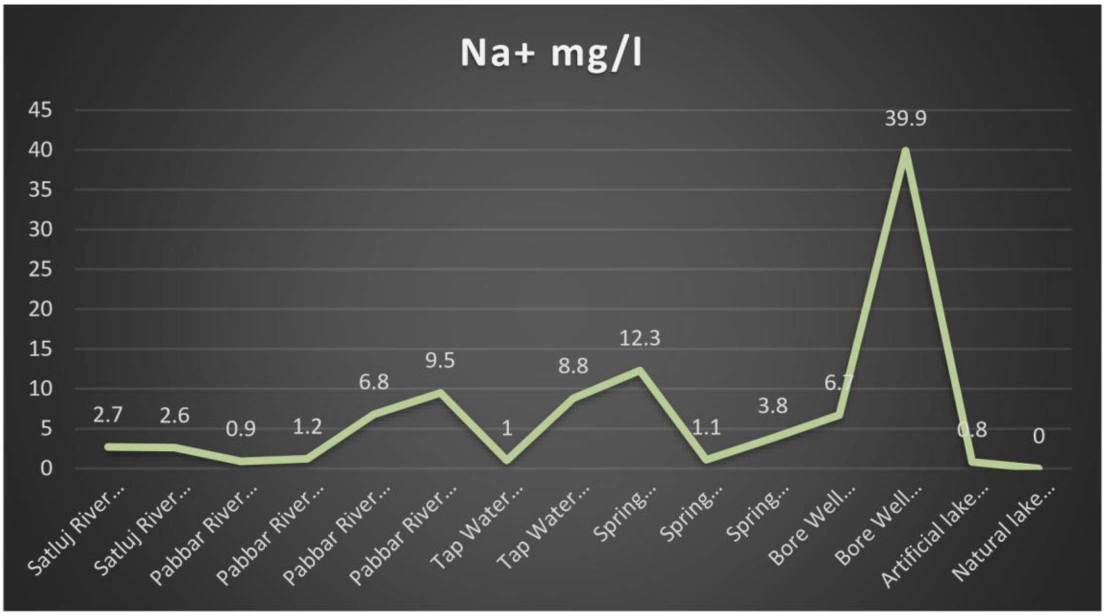

TDS mg/l
300
250
200
150
100
50
0
118
78
104
56
96
130
80
146
244
60
108
128
116
100
150
Satluj River...
Satluj River...
Pabbar River...
Pabbar River...
Pabbar River...
Pabbar River...
Tap Water...
Tap Water...
Spring...
Spring...
Spring...
Bore Well...
Bore Well...
Artificial lake...
Natural lake...

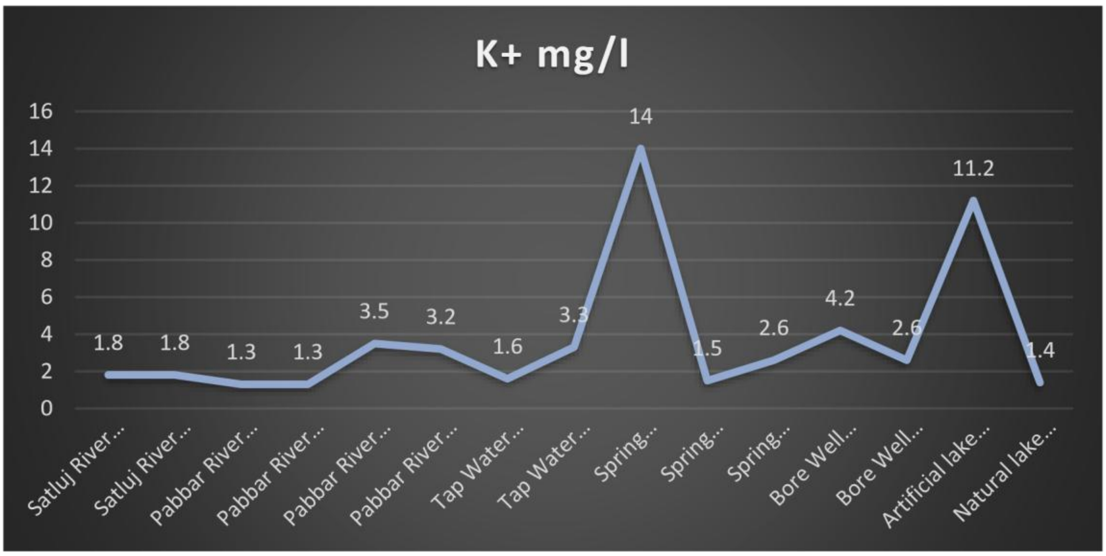

Do. mg/l
70
60
50
40
30
20
10
0
5.9
6.9
6.1
60.2
6.7
5.2
7.1
6.8
6
6.9
7.1
5.9
6.2
3.4
2.9
Satluj River...
Satluj River...
Pabbar River...
Pabbar River...
Pabbar River...
Pabbar River...
Tap Water...
Tap Water...
Spring...
Spring...
Spring...
Bore Well...
Bore Well...
Artificial lake...
Natural lake...

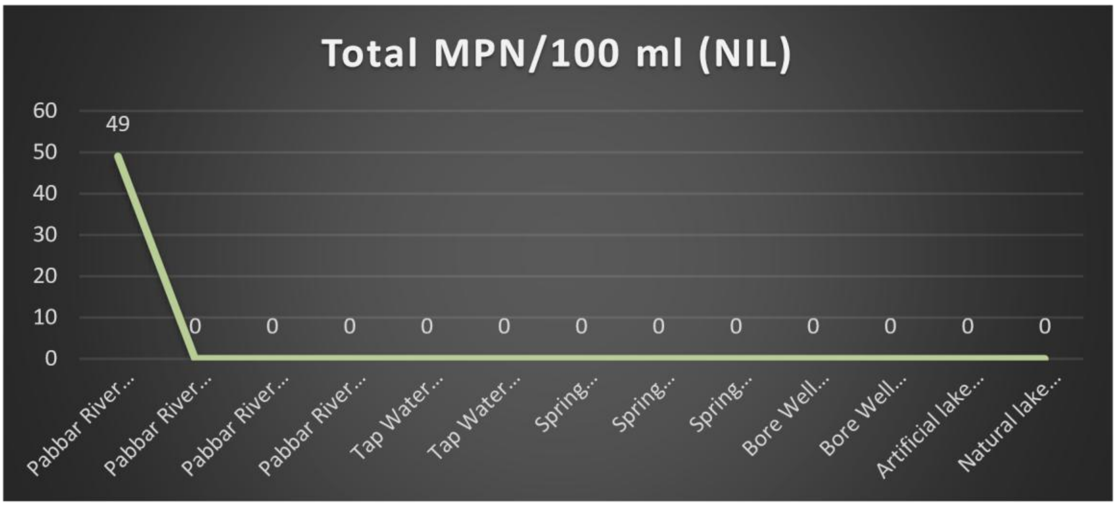

Alkanity mg/l CaCo3
400
350
300
250
200
150
100
50
0
42
42
36
48
102
72
54
132
204
36
60
96
354
72
48
Satluj River...
Satluj River...
Pabbar River...
Pabbar River...
Pabbar River...
Pabbar River...
Tap Water...
Tap Water...
Spring...
Spring...
Spring...
Bore Well...
Bore Well...
Artificial lake...
Natural lake...

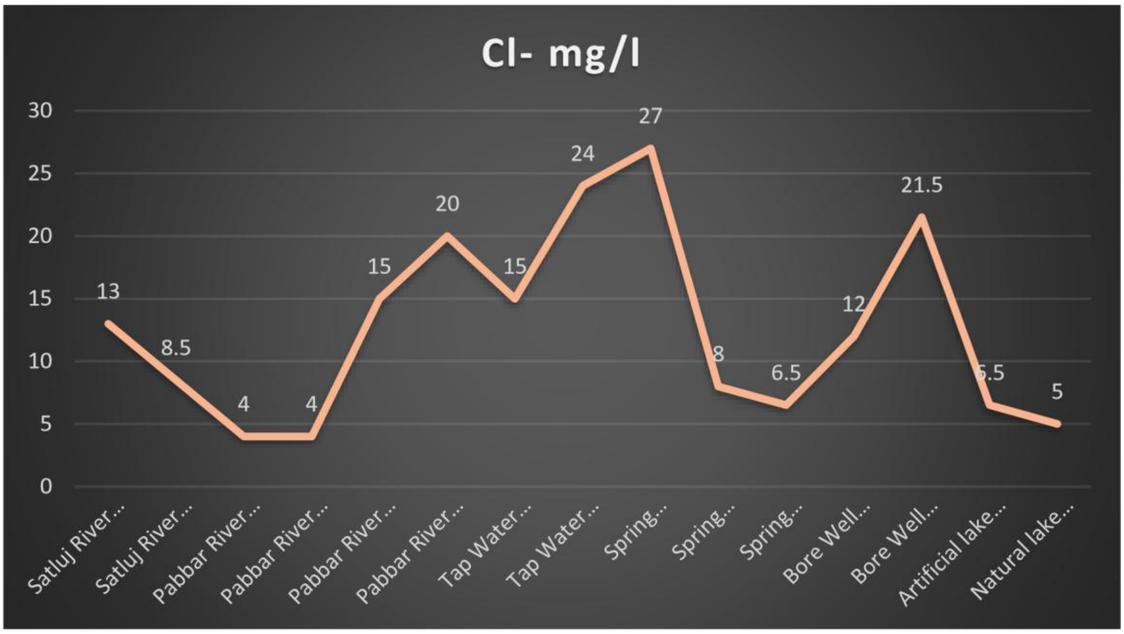

CoD. mg/l
400
350
300
250
200
150
100
50
0
48.4
56.4
276.4
292.4
356.4
316.4
116.4
8.4
256.4
236.4
244.4
236.4
216.4
216.4
172.4
Satluj River...
Satluj River...
Pabbar River...
Pabbar River...
Pabbar River...
Pabbar River...
Tap Water...
Tap Water...
Spring...
Spring...
Spring...
Bore Well...
Bore Well...
Artificial lake...
Natural lake...
Series1
Series2

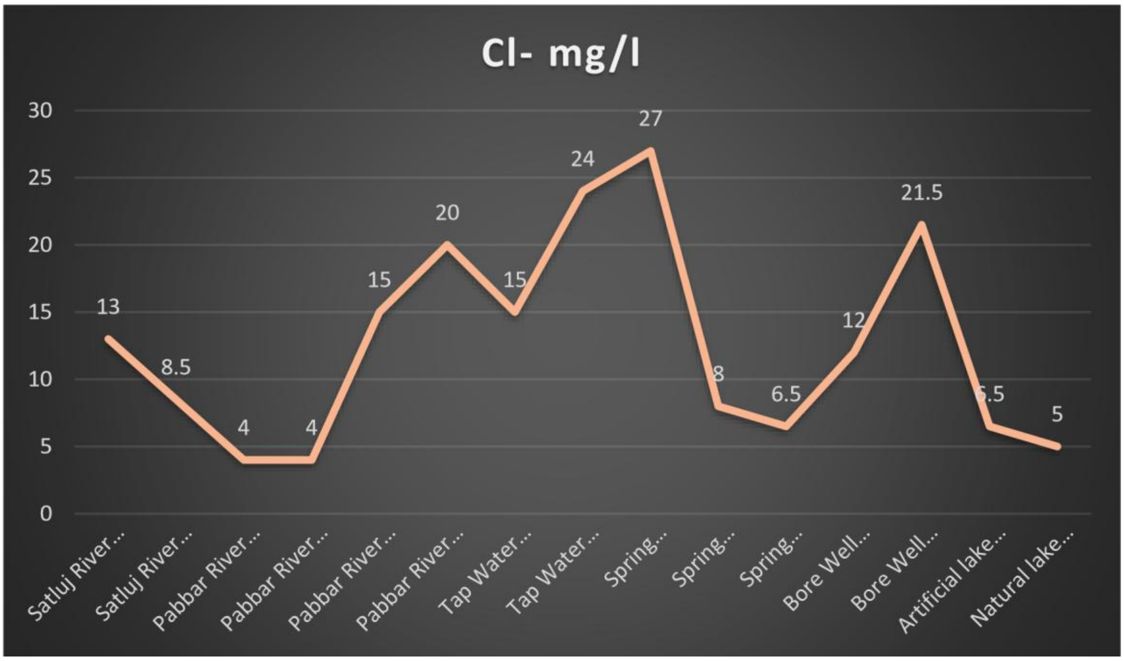

BoD. mg/l
16
14
12
10
8
6
4
2
0
6
9
15
12
9
12
2.2
6
1.5
4.2
2.1
9
6
15
12
Satluj River...
Satluj River...
Pabbar River...
Pabbar River...
Pabbar River...
Pabbar River...
Tap Water...
Tap Water...
Spring...
Spring...
Spring...
Bore Well...
Bore Well...
Artificial lake...
Natural lake...


Na+ mg/l
45
40
35
30
25
20
15
10
5
0
2.7
2.6
0.9
1.2
6.8
9.5
1
8.8
12.3
1.1
3.8
6.7
39.9
0.8
0
Satluj River...
Satluj River...
Pabbar River...
Pabbar River...
Pabbar River...
Pabbar River...
Tap Water...
Tap Water...
Spring...
Spring...
Spring...
Bore Well...
Bore Well...
Artificial lake...
Natural lake...


K+ mg/l
16
14
12
10
8
6
4
2
0
1.8
1.8
1.3
1.3
3.5
3.2
1.6
3.3
14
1.5
2.6
4.2
2.6
11.2
1.4
Satluj River...
Satluj River...
Pabbar River...
Pabbar River...
Pabbar River...
Pabbar River...
Tap Water...
Tap Water...
Spring...
Spring...
Spring...
Bore Well...
Bore Well...
Artificial lake...
Natural lake...


Total MPN/100 ml (NIL)
60
50
40
30
20
10
0
49
0
Pabbar River...
Tap Water...
Spring...
Bore Well...
Artificial lake...
Natural lake...


Cl- mg/l
30
25
20
15
10
5
0
13
8.5
4
4
15
20
15
24
27
8
6.5
12
21.5
6.5
5
Satluj River...
Pabbar River...
Tap Water...
Spring...
Bore Well...
Artificial lake...
Natural lake...


Cl- mg/l
30
25
20
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15
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27
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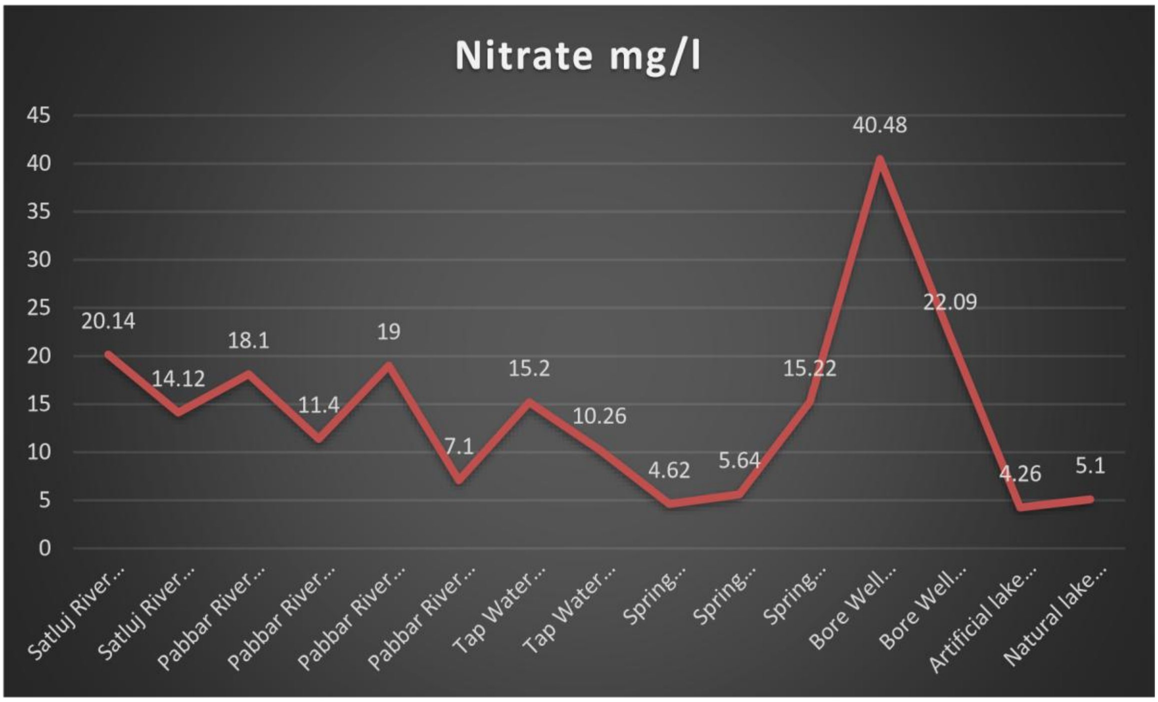
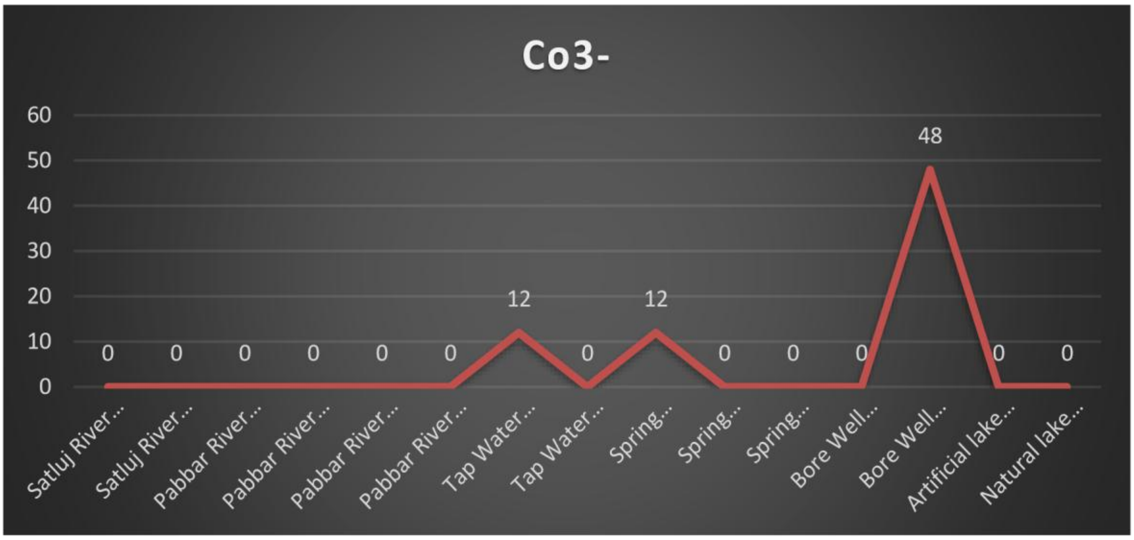
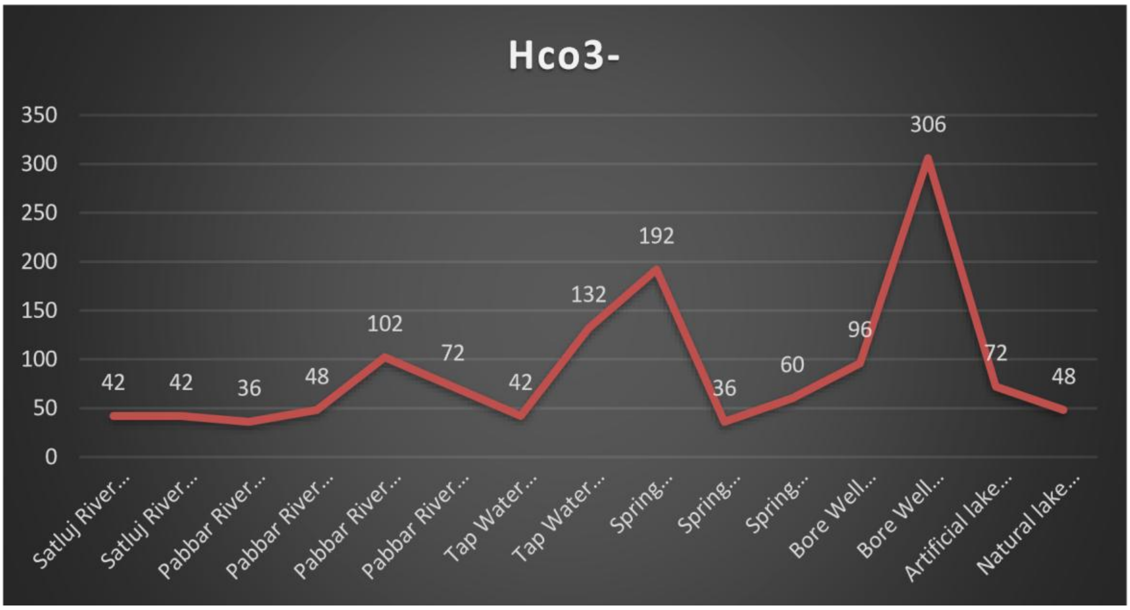
5
Satluj River...
Pabbar River...
Tap Water...
Spring...
Bore Well...
Artificial lake...
Natural lake...


Nitrate mg/l
45
40
35
30
25
20
15
10
5
0
20.14
14.12
18.1
11.4
19
7.1
15.2
10.26
4.62
5.64
15.22
40.48
22.09
4.26
5.1
Satluj River...
Satluj River...
Pabbar River...
Pabbar River...
Pabbar River...
Pabbar River...
Tap Water...
Tap Water...
Spring...
Spring...
Spring...
Bore Well...
Bore Well...
Artificial lake...
Natural lake...


Co3-
60
50
40
30
20
10
0
0
0
0
0
0
0
12
0
12
0
0
0
48
0
0
Satluj River...
Satluj River...
Pabbar River...
Pabbar River...
Pabbar River...
Pabbar River...
Tap Water...
Tap Water...
Spring...
Spring...
Spring...
Bore Well...
Bore Well...
Artificial lake...
Natural lake...


Hco3-
350
300
250
200
150
100
50
0
42
42
36
48
102
72
42
132
192
36
60
96
306
72
48
Satluj River...
Satluj River...
Pabbar River...
Pabbar River...
Pabbar River...
Pabbar River...
Tap Water...
Tap Water...
Spring...
Spring...
Spring...
Bore Well...
Bore Well...
Artificial lake...
Natural lake...

4.2 WATER QUALITY INDEX Different Quality parameters are taken into account to investigate WQI of various samples Table 4 Consideration for WQI

Parameters	**BIS Standards (Sn)**	**1/Sn**	**k=1/(∑1/Sn)**	**Wn=k/Sn**	**Ideal Value (v_o)**
pH	8.5	0.1176	0.148077891	0.017421	7
Conductivity	300	0.0033	0.148077891	0.000494	0
Turbidity	1	1	0.148077891	0.148078	0
TDS	500	0.002	0.148077891	0.000296	0
Alkanity	200	0.005	0.148077891	0.00074	0
Total Hardness	200	0.005	0.148077891	0.00074	0
Ca	75	0.0133	0.148077891	0.001974	0
Mg	30	0.0333	0.148077891	0.004936	0
cl-	250	0.004	0.148077891	0.000592	0
Co3-	200	0.005	0.148077891	0.00074	0
Hco3-	200	0.005	0.148077891	0.00074	0
Do	3	0.3333	0.148077891	0.049359	14
CoD	250	0.004	0.148077891	0.000592	0
BoD	5	0.2	0.148077891	0.029616	0
Nitrate	45	0.0222	0.148077891	0.003291	0
Total = Sum		1.7532		1	

For Water Quality Index Consider following:
BIS standards for water quality according to IS 10500:2012 = Sn Value
K value = 1/ (∑1/Sn) = 0.148077891
Wn=k/Sn
Ideal Value (v_o) for pH =7, for Do (v_o) =14
(Vn)=Mean Conc Value
Qn=Vn/Sn*100
WQI =∑WnQn

Table 5.WQI of R1 Sample

R1 Sample of Satluj River located Chattibushar Rampur, longitude 77.589407 latitude 31.398929			
Parametrs	**Mean ConcValue(Vn)**	**Qn= Vn/Sn*100**	**WnQn**
pH	8.26	60	1.045
Conductivity	97.2	32.4	0.016
Turbidity	32.87	3287	486.7
TDS	118	23.6	0.007
Alkanity	42	21	0.016
Total Hardness	82	41	0.03
Ca	40	53.3333	0.105

Mg	42	140	0.691
cl-	13	5.2	0.003
Do	5.9	196.667	9.707
CoD	48.4	19.36	0.011
BoD	6	120	3.554
Nitrate	20.14	44.7556	0.147
Total= WnQn = 502.1			

Table 6. WQI of R1 Sample Satluj, R7 Sample Pabber River

R7 Pabber River Hatkoti latitude31.1484657 longitude 77.738949			
Parameter	**Mean Conc Value (Vn)**	**Qn=Vn/Sn*100**	**WnQn**
pH	7.19	60	1.045
Conductivity	194.1	64.7	0.032
Turbidity	4.76	476	70.49
TDS	130	26	0.008
Alkanity	72	36	0.027
Total Hardness	102	51	0.038
Ca	68	90.6667	0.179
Mg	34	113.333	0.559
cl-	20	8	0.005
Do	5.26	175.333	8.654
CoD	316.4	126.56	0.075
BoD	12	240	7.108
Nitrate	7.1	15.7778	0.052
Total=∑WnQn=88.29			

Table 7.WQI H2 Rohrulongitude77.7699677 latitude31.2033105

H2 Rohrulongitude77.7699677 latitude31.2033105			
Parameter	**Mean ConcValue(Vn)**	**Vn/Sn*100=Qn**	**WnQn**
pH	7.77	60	1.04526
Conductivity	604	201.333	0.09938
Turbidity	0.01	1	0.14808
TDS	310	62	0.01836
Alkanity	354	177	0.13105
Total Hardness	88	44	0.03258
Ca	24	32	0.06318
Mg	64	213.333	1.053
cl-	4.5	1.8	0.00107
Do	6.2	206.667	10.2009

CoD	16.4	6.56	0.00389
BoD	6	120	3.55387
Nitrate	0.09	0.2	0.00066
Total= ∑WnQn=16.4823			

Table 8. WQI of H2 Sample Borewell Rohru L2 Sample Gadakufer Lake

L2 GadakuferLake longitude77.342607 latitude 31.208416			
Parameter	**Mean Conc Value(Vn)**	**QnVn/Sn*100**	**WnQn**
pH	8.39	60	1.04526
Conductivity	60.6	20.2	0.00997
Turbidity	6.24	624	92.4006
TDS	100	20	0.00592
Alkanity	75	37.5	0.02776
Total Hardness	138	69	0.05109
Ca	80	106.667	0.2106
Mg	58	193.333	0.95428
cl-	5	2	0.00118
Do	2.9	96.6667	4.7714
CoD	216.4	86.56	0.05127
BoD	15	300	8.88467
Nitrate	5.1	11.3333	0.03729
Total= ∑WnQn= 108.451			

CONCLUSION

After testing different water parameters of various Samples collected from various locations in Shimla district in water testing laboratory Tutikandi Shimla. We analyse Water Quality of different parameters and investigate about Water Quality Index for various samples that we have tested in laboratory.Sample of Gadakufer lake, Satluj River, ITBP lake Taradevi ,one sample of Pabber River, Bore well sample chirgaon are found very poor (Unfit for consumption). This was due to pollutants present in Satluj River rises as river moves along. At first location Bayal Rampur WQI found 234.7477. At second location Chattibushar, Rampur WQI found 502.0833. At final lacotionJagatkhana, Rampur WQI found 917.0271427. Similar for Pabber river pollutants rises along river flow through various locations: At first location Pabber near Aandra river dam WQI found 47.35683. At third location PabbarRohru WQI found 49.27351. At final location PabbarHatkoti WQI estimated 88.16777. Pabber river less polluted then Satluj river as WQI estimation. Hence, Pabberriverrequire less treatment than Satluj river. As local citizens need more water as per demand rise with increasing population. Also river effilents released by towns at various locations need to be within limit so as aquatic life present in river does not suffer due to river pollutants.Gadakufer lake situated middle of shimla district got polluted/effluents released by the citizens living near that location. Gadakufer Lake is 108.4513 which is in Danger zone for Aquatic life in this lake.For Borewell in chirgaon WQI estimated to be 100.9741which is of very poor quality. This can be due to infiltration of market effluents toi ground Borte well water.all other spring samples are of good quality except spring located New Shimla WQI estimated 60.38021 which is poor water.

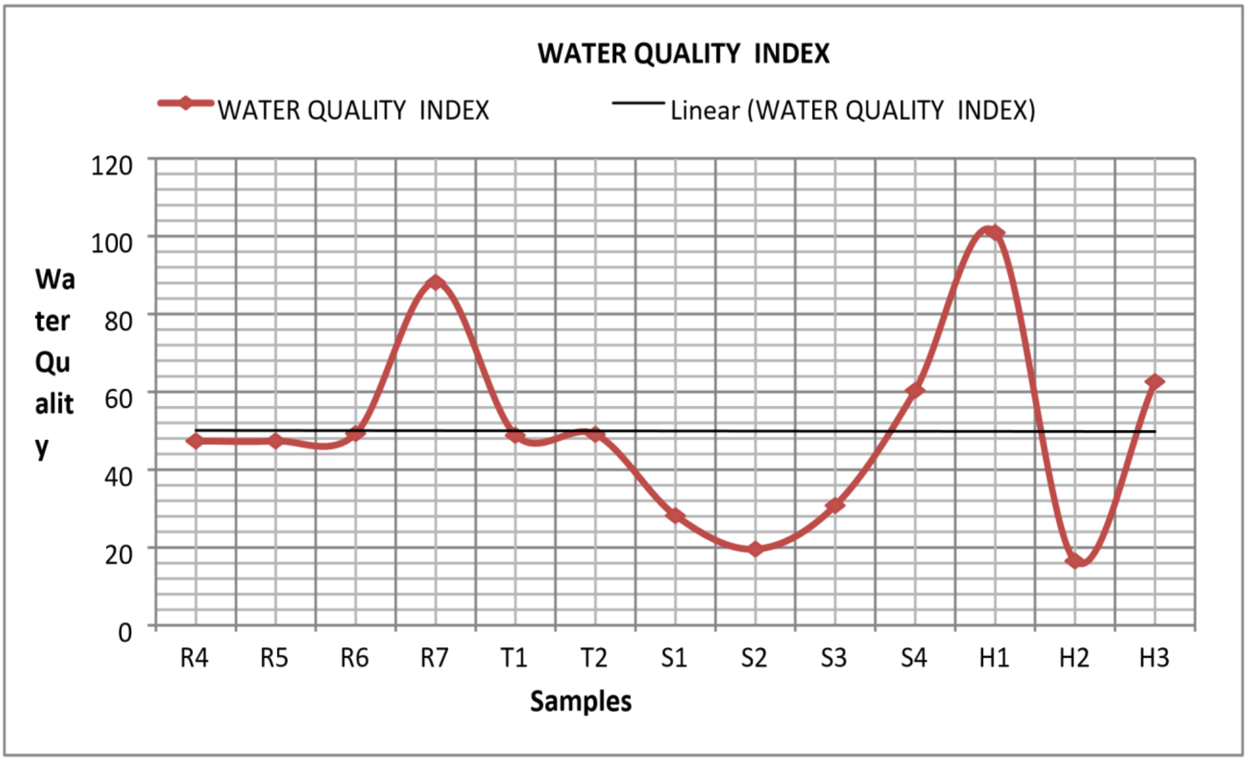
Table 9. WQI Status

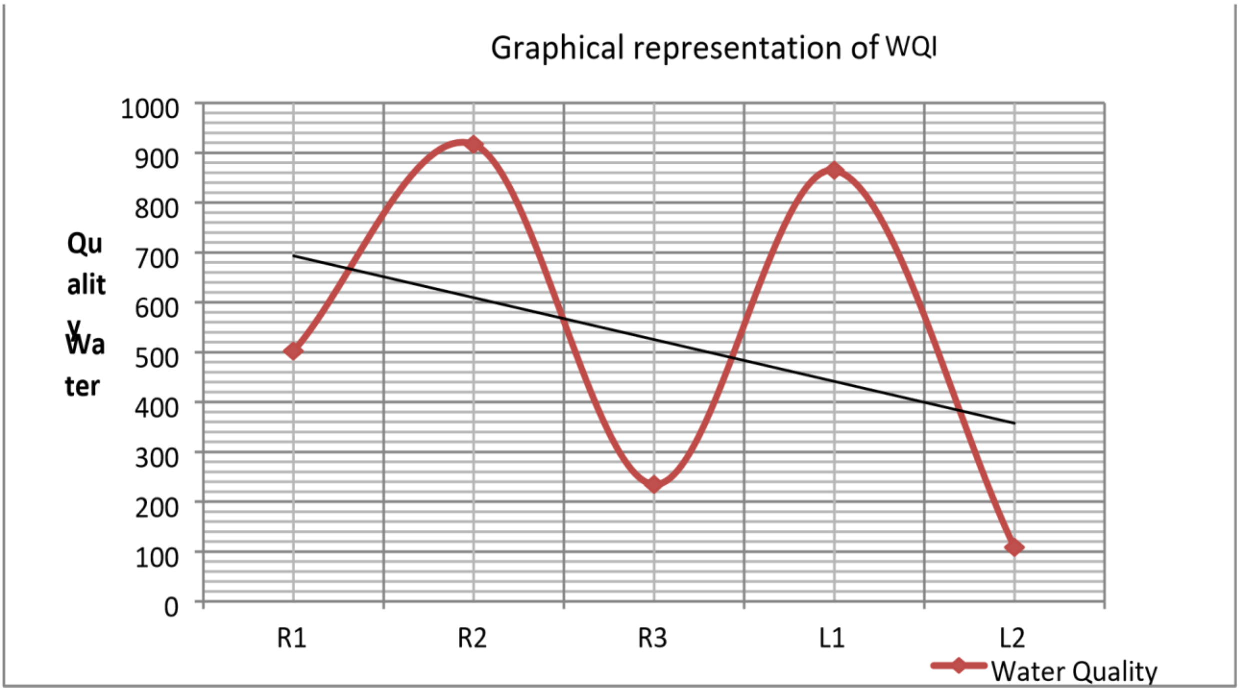
Sr.No.	**Sample**	**Water Quality**

1.	Chattibushar,Rampur	502.0833
2.	Jagatkhana, Rampur	917.0271427
3.	Bayal Rampur	234.7477
4.	PabbarGushali	47.35683
5.	PabbarBadira	47.36912
6.	PabbarRohru	49.27351
7.	PabbarHatkoti	88.16777
8.	T1 Rampur	48.85552
9.	T2 New ISBT	49.11113
10.	S1 Main market Rampur	28.22483
11.	S2 DharJabal	19.58361
12.	S3 Village Jabbal	30.82731
13.	S4 New Shimla	60.38021
14.	H1 Chirgaon	100.9741
15.	H2 Rohru	16.54489
16.	H3 Totu	62.62365
17.	L1 ITBP lake	864.78
18.	L2 Gadakufer	108.4513

Table 10. WQI Status, Drinking Water Specification (IS 10500)

WQI	**Water Quality Status**
0-25	Excellent
26-50	Good
51-75	Poor
76-100	Very Poor
>100 Unfit for consumption	





6.4: SUMMARY

We investigate the water pollutants released by the town. We estimated the pollutants present in the various sources, Establish a relationship between actual river water pollution and pollution induced due to industrial effluents.Water quality standards in place of fixed effluent discharge standards. Study the Causes of water contaminant sources. To investigate techniques for minimizing the water impurities. To perform the various possible water tests and observes water quality. Effect of various impurities on human health.

Water sources need to be properly monitored by government agencies so as to reduce pollutants present in water at various sources. Reduce river effluents release by town. Proper management for water at various sources like lakes, rivers, Borewell, spring, ponds. So as to conserve water sources for aquatic life, future generation. So as to fulfill demand of growing population.

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