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Evaluation of portability of different water sources at District Jabalpur, Madhya Pradesh

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Abstract: Availability of safe and hygienic drinking water for all is one of the most important challenges facing municipal authorities around the world. Human settlements are rapidly urbanizing and the availability of water for people with desired water quality is becoming increasingly scarce, making the situation direr in developing countries and increasing population and increasing water availability in cities. The demand is increasing. India is a country of vast resources and its population is also increasing. Water supply in Indian cities is always becoming a problem with increasing demand and dwindling availability. Water quality is deteriorating due to reduction in demand and supply of water. Therefore, it is necessary to keep a close watch on the quality of the water being supplied and ascertain the potability of the water. The district of Jabalpur in Madhya Pradesh is dependent on hand pumps and tank water sources to meet its potable water needs. Apart from surface water sources, a significant part of the population is also dependent on groundwater for potable water. In the present paper, an attempt has been made to assess the quality of water from various sources in district Jabalpur, Madhya Pradesh.

Keyword: Water, Safe, hygienic, Groundwater, Tank water and Sources etc.

1. Introduction

Jabalpur district is located approximately in the central part of Madhya Pradesh and has a tribal population of 15% of the total population of the district. The most famous are the story deposits around Bharghat, near the marble rocks on the Narmada River, about 13 miles west of Jabalpur. District North Latitude 22^{o} is located between 49' and 23^{o} 07' north of the longitude and the meridians 79^{o} 21' and 80^{o} 35' east. The district is bounded on the southeast and east by Mandla and Dindori districts, on the south by Seoni and Narsingpur districts on the southwest and by Damoh district on the west. The district comes in the survey of India's top sheet numbers 55m, 64A- and 55N on 1:250,000 scale and occupies more than 5655 sq.km. Climate of Jabalpur district is Madhya Pradesh is characterized by hot summers and general dryness except in the southwest monsoon. The year can be divided into four seasons. Cold weather The hot season from December to February lasts from March to almost mid-June. The period from June to September is the southwest monsoon season. October and November constitute the post monsoon or transition period. The average annual rainfall of Jabalpur district is 1279.50 mm. Jabalpur received the highest rainfall during the southwest

monsoon period i.e. June to September. About 90% of the annual rainfall is received during the monsoon season. Only 10%

of the annual rainfall occurs between the periods October to May. Thus the surplus water for groundwater recharge is available only during the southwest monsoon period. Groundwater is defined as fresh water (from rain, snow and ice melt) that seeps into soil and accumulates between pores, fractures and joints found in rocks and other geological formations. It is found in aquifers, deep in soil voids and in crevices of rocks below ground. A layer of rock or any type of geological structure that is porous enough to store water and is permeable enough to transmit water in an economically exploitable quantity is called an aquifer (Chilton, 1996). Aquifers have been classified into 4 types, namely, limited (artesian), semi-deformed (leaky), unconsolidated and semi-deformed (Salaco and Adepalem, 2018). An aquifer that is surrounded by two layers ofrock or soil or is impermeable (does not transmit appreciable amounts of water) is called a confined aquifer. The water pressure in this layer is greater than the atmospheric pressure. The semi-confined aquifer is surrounded by a semi-neutral and an impermeable layer below. When the upper surface (water table) of an aquifer is open to the atmosphere through permeable material, it is called an aquifer. Wells are drilled in aquifers and water can be drawn out. Water in aquifers is replenished by drainage through the soil. Groundwater in an unconfined or semi- confined aquifer is more vulnerable to contamination by surface pollutants than in a confined aquifer (Mahmood et al., 2019). Ground water resources are being used for drinking, irrigation and industrial purposes. In addition, groundwater contains a variety of dissolved inorganic chemical constituents in different concentrations as a result of chemical and biochemical interactions between water and geological material (Central Groundwater Board, 2010). WHO. (2011) and B.I.S. (2012) presents standards for drinking water based on physico-chemical characteristics and microbiological contaminants. Groundwater is more suitable because itsnatural and ubiquitous occurrence is well protected from surface pollutants and pollutants (Anim Giampo et al., 2018).

2. Objective

- To assess the water quality of ground water sources spread around the city.
- To identify the sources of pollution/contamination of water resources.

3. Research Methodology

The objective of the present investigation is to assess the quality of water being used for potable purposes by the residents of Jabalpur city. Sources of potable water in Jabalpur include piped water supply from surface water sources and individual water sources i.e. ground water. At the beginning of the study a careful survey has been conducted across the city to identify the different areas of the city and to assess the water supply scenario in it. The sampling stations have been chosen to cover the maximum possible areas of the Jabalpur city. For the present study, samples were collected during two consecutive years of summer, monsoon and winter seasons. The results of a two-year long study have been compiled to assess the actual quality of potable water being supplied to the Jabalpur city.

4. Result Analysis

Quality Resources of Ground Water of Jabalpur District:

Quality of ground water for drinking:

The EC value is from 505-1603, the NO_3 value is from 8-81, the fluoride value is from 0.02-2.35. The total hardness of ground water in the district is within safe limits as per BIS standards.

Water quality for irrigation:

High SAR is not good for irrigation as it leads to sodium exposure. Water samples in the district generally fall into the C_1S_1 and C_3S_1 classes of the US salinity diagram. Though ground water in general district is safe for irrigation but proper drainage system is required where EC is more than 1500 US cm^1.

Ground water development status:

Ground water is the main source of drinking and irrigation in Jabalpur district. About 37.44 percent of the irrigation in the district comes from groundwater sources. The level of irrigation with the total sown area in the district is 40%. There are 8832 tube wells and 8010 dug wells for irrigation in the district. The depth of the wells dug in the district ranges from 5 to 20 meters. The borewell yield varies from 19.3 to 76.4 m3/hr depending on the hydrological conditions in the area. High yielding tube wells have been found which were drilled in alluvial, Lameta and Gondwana sandstone and their highest discharge was observed at Udna (Alluvial) 528 LPM at Bijna 33.30 LPM. Apart from private sources, hand pumps are the main source of rural water supply in the district.

Issues and problems related to ground water

These are no honorable areas in the districts. There are no waterlogged and polluted areas as per the available data. Long-term water level trend analysis shows mixed results. Some groundwater monitoring wells have observed a decline in groundwater levels during both pre and postmonsoon seasons. The Kundam block of the district may face drilling problem due to basaltic formation, having lamata beds of sedimentary origin which may be loose and friable in nature and by deploying available drillin grig (DTH-rotary combination) in the area. Potential aquifers can be created. Drilling in the lametta bed, which takes place under basalt, has varied by more than 100 m.bgl, as the rotary system of these rigs is not operating below 100 m depth. To drill itslameta formation found beneath hard and compact basalts at deeper levels.

5 Ground Water Resources

Jabalpur district is subject to basaltic lava flows of alluvium, Archean granite, Deccan trap Bijawar and Vindhya sandstone. For the base year-2018/19, dynamic ground water resources of the district have been assessed on block wise basis. Out of 5,26,693 hectares of geographical area, 4,43,866 hectares (84%) are groundwater rechargeable areas and 82,827 hectares (16%) are mountainous areas. There are seven assessment units (blocks) in the district which come under non-command (86% - Kundam and Majoli) and command (14%) subunits. All the blocks except Patan have been kept in safe category. The non command area of Patan block of the district is classified as semi critical (reserved in 2017/18). The highest level of groundwater development has been estimated at 64 percent in Shahpur block. The net groundwater availability in the district is 55,679 ham and the groundwater draft for all uses is 28,184 ham, making the groundwater development level for the district as a whole 51% (42% in 2003-04). After allocating for future domestic and industrial supplies for the next 25 years, the remaining available groundwater for future irrigation will be 25,645 ham.

Calculated Parameters

Temperature: Water temperature is a physical property that expresses how hot or cold the water is. Temperature is an important factor when assessing water quality. In addition to its own effects, temperature affects many other parameters and can alter the physical and chemical properties of water. The temperature of all the lakes is within 18-25 °C.

Hardness: Calcium and magnesium dissolved in water are the two most common minerals that make water "hard". Water hardness is referred to by three types of measurements: grains per gallon, milligrams per liter (mg/l), or parts per million (ppm). The hardness values of the present study in different waterbodies were found to be 200 mg/l in Supatal, 180 mg/l in Ganga Sagar, 156 mg/l in Bal Sagar, 100 mg/l in Devtal and 92 mg/l in Sangram-Sagar. . The hardness was highest in Supatal and Ganga Sagar.

Alkalinity: Alkalinity is a measure of the ability of water to neutralize acids. The major chemical system present in natural water is where carbonates, bicarbonates and hydroxides are present. The bicarbonate ion is commonly prevalent. In the present test, the total alkalinity of water samples has been found to be maximum in Bal Sagar (933.6 mg/l), Sangram Sagar (802 mg/l), Devtal (725 mg/l), Supatal (440 mg/l). Ganga Segar (220 mg/L).

PH: pH is a measure of how acidic/basic the water is. The range goes from 0 - 14, with 7 being neutral. A pH value less than 7 indicates acidity, while a pH greater than 7 indicates a base. pH is actually a measure of the relative amount of free hydrogen and hydroxyl ions in water. The pH value of the present investigation ranged from 7.5 - 9.0, all the lakes in Jabalpur had high pH values.

Conductivity: conductivity is used to measure the concentration of dissolved solids that have been ionized in a polar solution such as water. The commonly used unit of measurement is siemens per centimeter (micro-siemens per centimeter or μS). / cm). The values obtained are in the range of 725 to 1032 mhos.

Total Dissolved Solids: Total Dissolved Solids (TDS) consist of inorganic salts (mainly calcium,magnesium, potassium, sodium, bicarbonates, chlorides and sulfates) and some small amounts of organic matter that dissolve in water. The present study shows that the TDS of Supatal, Ganga- Sagar, Balsagar was maximum.

Turbidity: Turbidity is the cloudiness of a fluid caused by suspended solids that are usually invisible to the naked eye. This is the overall optical property of water and does not identify individual substances; It just says there is something there. This is the overall optical property of water and does not identify individual substances; It just says there is something there. The turbidity in Ganga Sagar was 5.0 NTU, which is maximum. Turbidity in Supatal is 3.4 NTU, Devtal 2.9 NTU and Balsagar 1.8 NTU.

Fluoride: Fluoride is the simple anion of fluorine. Its salts and minerals are important chemical reagents. In terms of charge and size, the fluoride ion resembles the hydroxide ion. Fluoride ions are found on Earth in many minerals, especially fluorite, but are present in only small amounts in water. Fluoride contributes a distinctive bitter taste. It does not give any color to fluoride salts. In studies this varies in the range of 0.356 to 1.5 mg/l. Supatal has the highest amount of fluoride.

Chloride: Chloride is present in all natural waters, but most of the concentrations are low. In most surface streams, chloride concentrations are lower than those of sulfate or bicarbonate. Chloride ions can be kept in solution through most processes that dissociate other ions. The chloride value obtained in the study has been found to be between 33-120mg/lt. Chloride concentration is maximum in Suptal (120 mg/l), Bal Sagar and Ganga-Sagar.

Iron: In the present study it is found to be in the range of 0.04 to 0.2 mg/l.

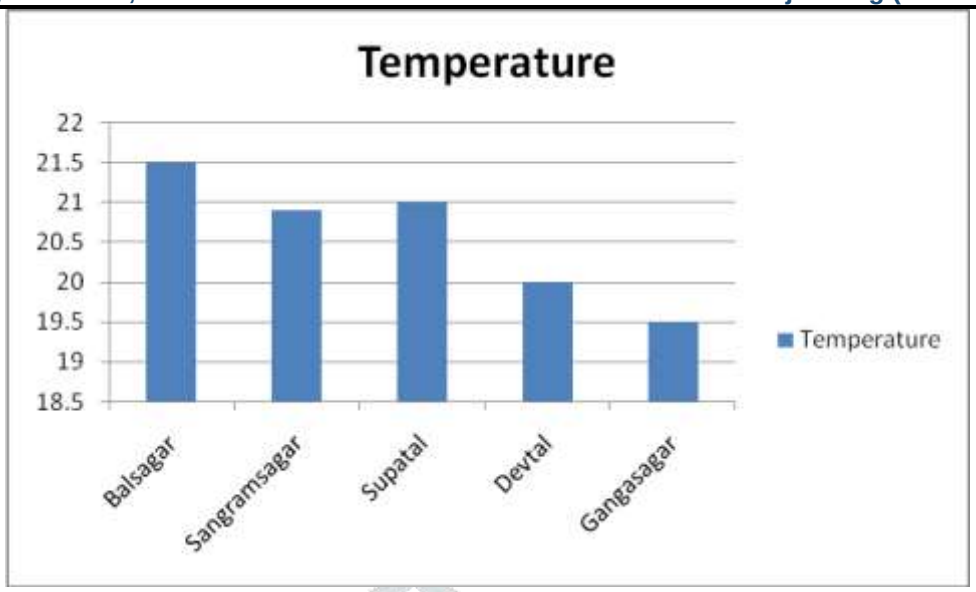
Water from all three sources is subjected to conventional treatment which includes removal of flocculation, physical filtration and disinfection, but during the present investigation, it was observed that the water reaching the consumers was not meeting the required standards. Sometimes the pipeline breaks due to wear and tear due to prolonged use, but in some places it seems to be intentional to break the pipeline. These points of pipeline breakage and leakage attract residents of nearby slums who bring potable water from these leaks. Apart from this, washing of clothes, washing of vehicles, dumping of solid waste etc. is commonly seen at

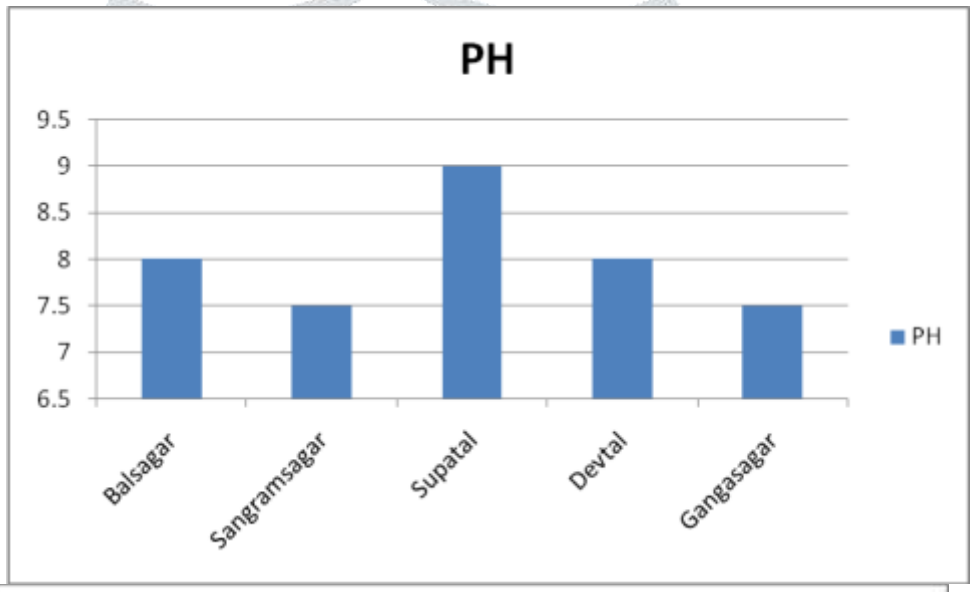
these points. The open spaces near the leak also have unhygienic conditions with open defecation, cattle boundary wall, solid waste disposal etc. All these factors contaminate the piped water supply resulting in pollution of drinking water. Thus, the study identifies several factors responsible for the pollution of municipal water supplies. With the rapid expansion of the city limits the dependence on groundwater sources is increasing. With the pace of urbanization not being able to lay pipelines, newly developing areas of the city depend on groundwater sources for potable water. Many areas of Jabalpur and many other colonies located on the outskirts of thecity are dependent on groundwater. Groundwater is contained in the ground floor and is thereforerelatively far from direct human intervention. It is believed that even pathogens cannot penetrate the depths of the aquifer and hence the groundwater is used for drinking without any treatment.

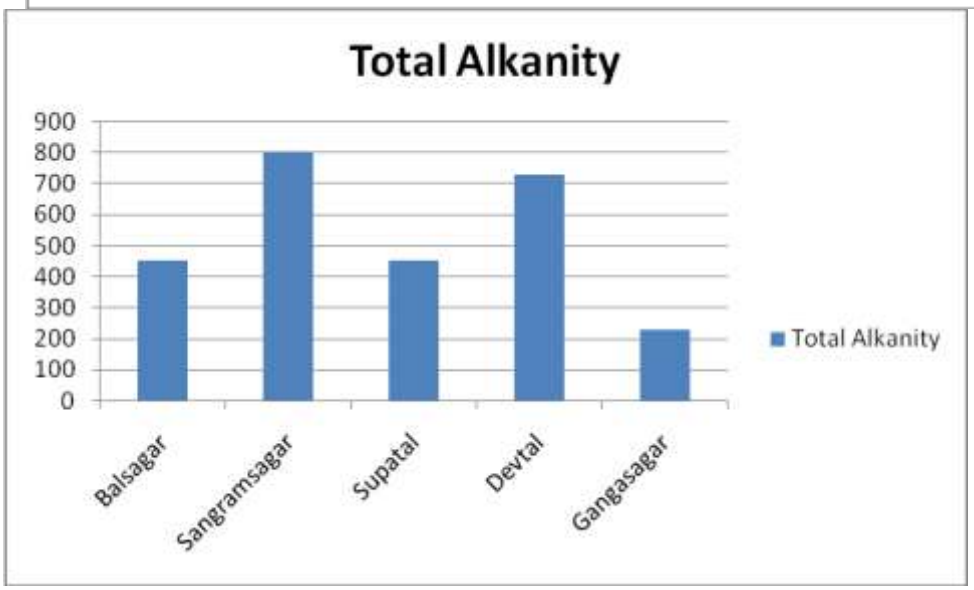
In a situation where the availability of water is less, the concentration of heavy metals is likely toincrease due to the concentration effect. Contamination of surface runoff occurs as a result of open sewage drains, open defecation, open defecation on land, solid waste disposal etc. When this runoff mixes with groundwater, it contaminates it. Some groundwater samples have been recorded positive for aggregate as well as fecal coliform. Consumption of such water can have immediate effect on health. The present study somewhat dispels the myth that groundwater is absolutely safe to drink and can be used without treatment. Most of the parameters during the investigation were recorded in the high range which shows that proper treatment of ground wateris essential before it can be used for drinking purposes. Thus, it is clear from the study that the groundwater of Jabalpur city is contaminated due to several factors and should not be used for drinking purposes without proper treatment.

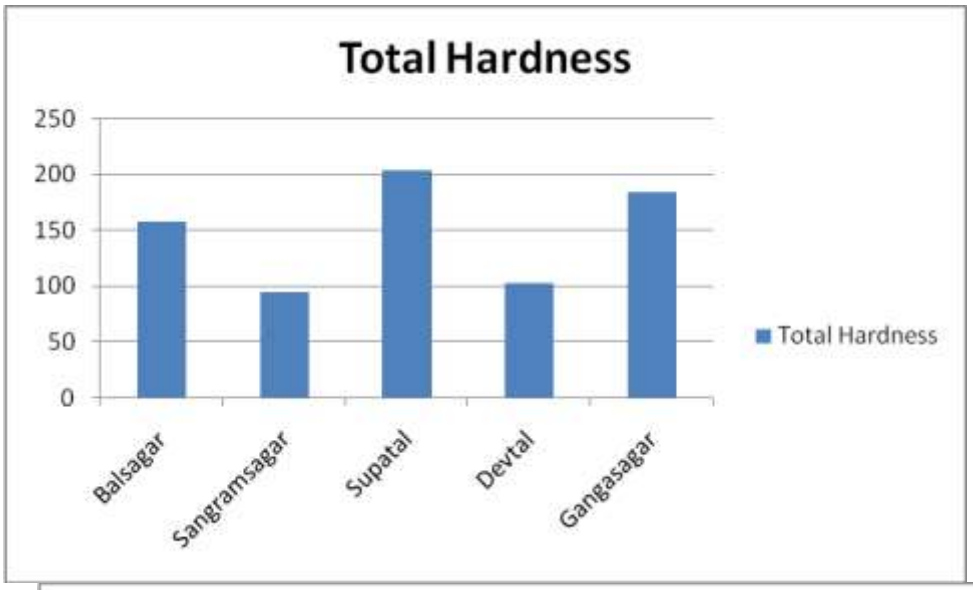
Table 1.1: Water Quality Parameters Of water bodies In Jabalpur

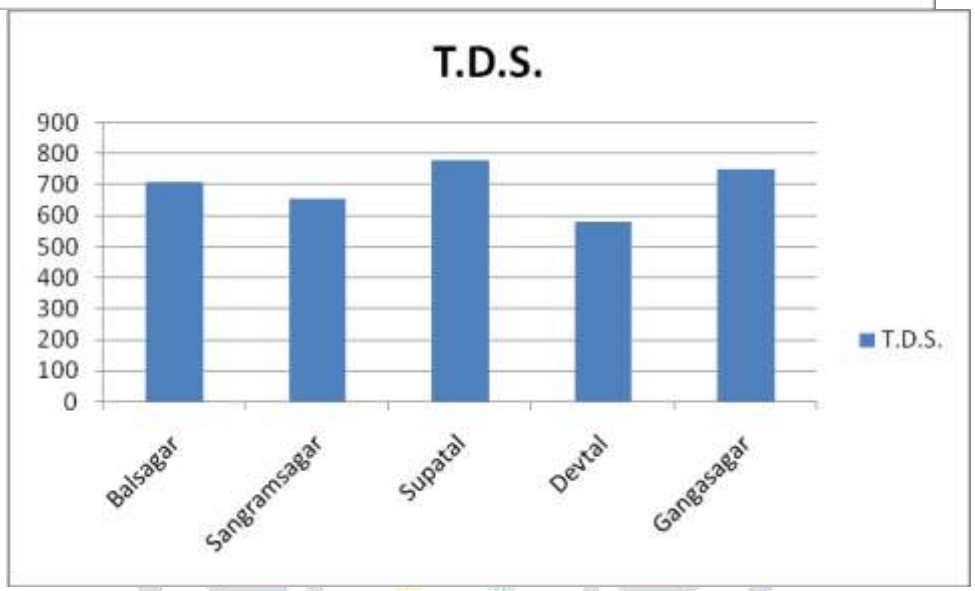
s. no	Parameter	Balsagar	Sangramsagar	Supatal	Devtal	Gangasagar
1	Temperature	21.5	20.9	21	20	19.5
2	PH	8	7.5	9	8	7.5
3	Total Alkanity	450	804	450	730	230
4	Total Hardness	158	94	204	102	184
5	T.D.S.	707.8	654.8	780.8	582.2	752.5
6	EC	944.6	902	1043	836	998.2
7	Turbidity	1.9	1.7	3.5	2.8	6
8	Cl	94	32	125	60	95
9	Fl	0.558	0.758	1.6	0.367	1.4
10	Iron	0.3	0.09	0.07	0.17	0.05
11	Nitrate	9.5	10.8	7.8	6.6	9.8
12	Supphate	9.1	25.4	17.2	10.5	5.3

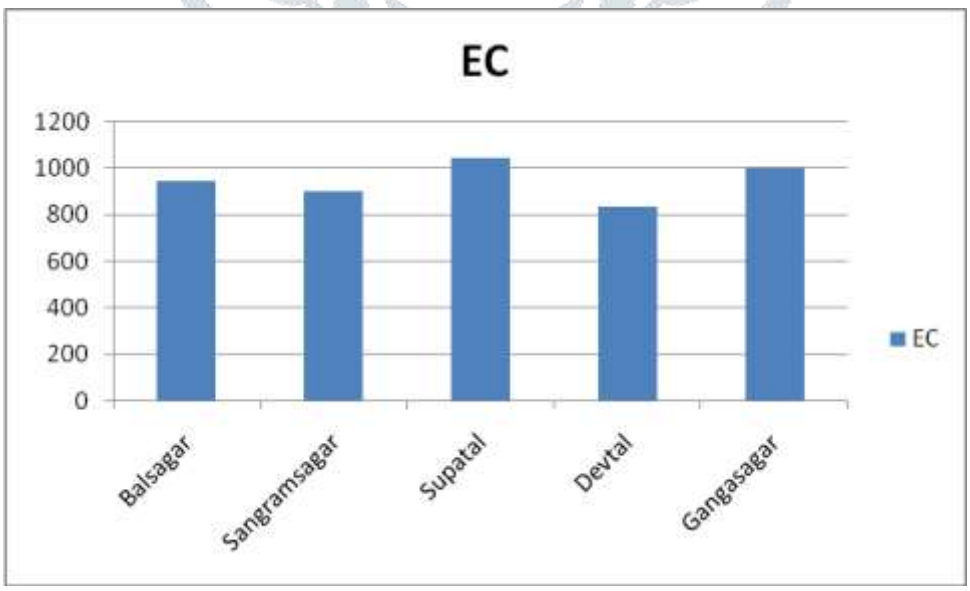

Temperature
22
21.5
21
20.5
20
19.5
19
18.5
Balsagar
Sangramsagar
Supatal
Devtal
Gangasagar
Temperature


PH
9.5
9
8.5
8
7.5
7
6.5
Balsagar
Sangramsagar
Supatal
Devtal
Gangasagar
PH


Total Alkanity
900
800
700
600
500
400
300
200
100
0
Balsagar
Sangramsagar
Supatal
Devtal
Gangasagar
Total Alkanity


Total Hardness
250
200
150
100
50
0
Balsagar
Sangramsagar
Supatal
Devtal
Gangasagar
Total Hardness


T.D.S.
900
800
700
600
500
400
300
200
100
0
Balsagar
Sangramsagar
Supatal
Devtal
Gangasagar
T.D.S.


EC
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1000
800
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200
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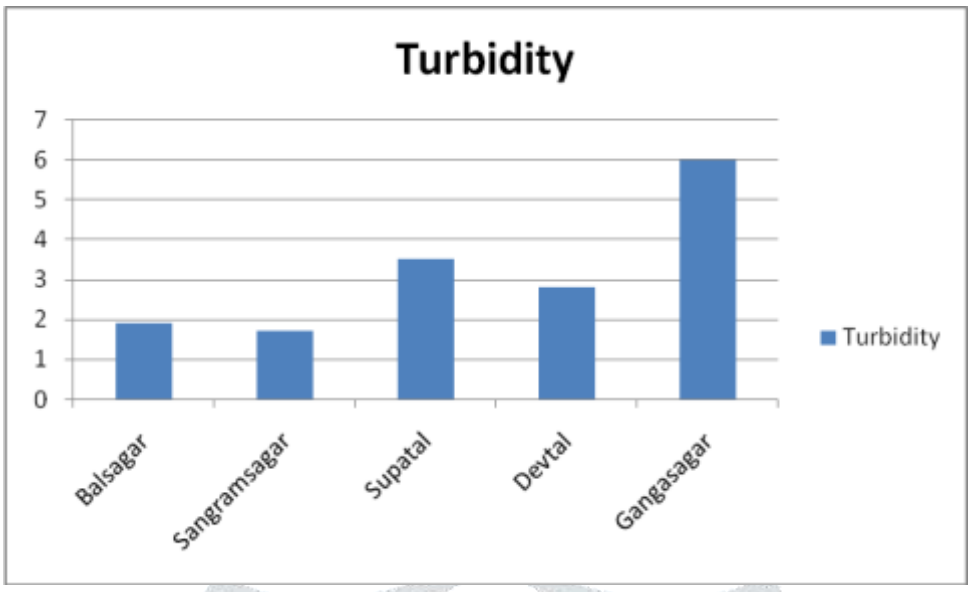
Balsagar
Sangramsagar
Supatal
Devtal
Gangasagar
EC


Turbidity
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5
4
3
2
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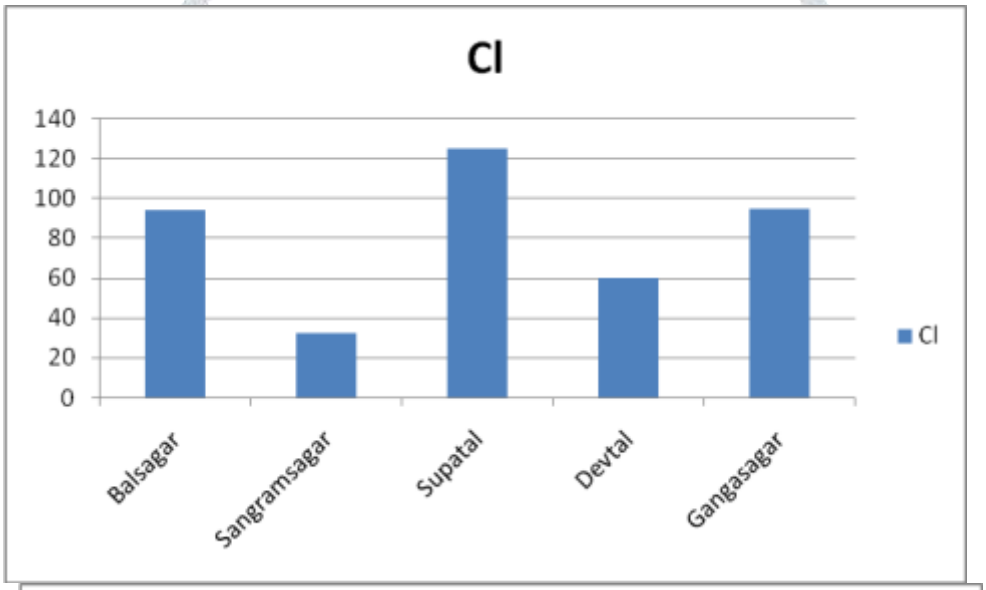
Balsagar
Sangramsagar
Supatal
Devtal
Gangasagar
Turbidity


Cl
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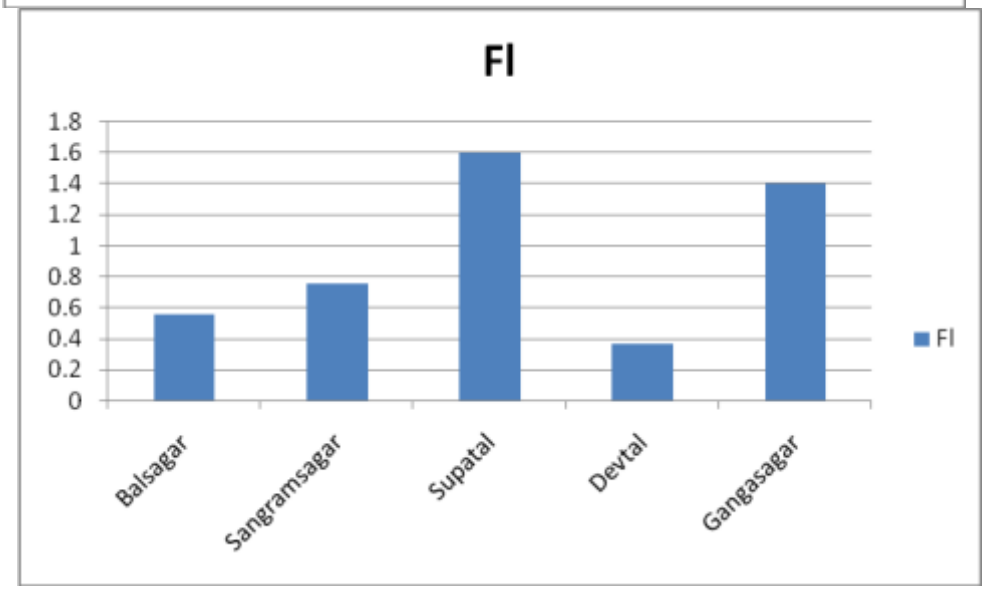
120
100
80
60
40
20
0
Balsagar
Sangramsagar
Supatal
Devtal
Gangasagar
Cl


Fl
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
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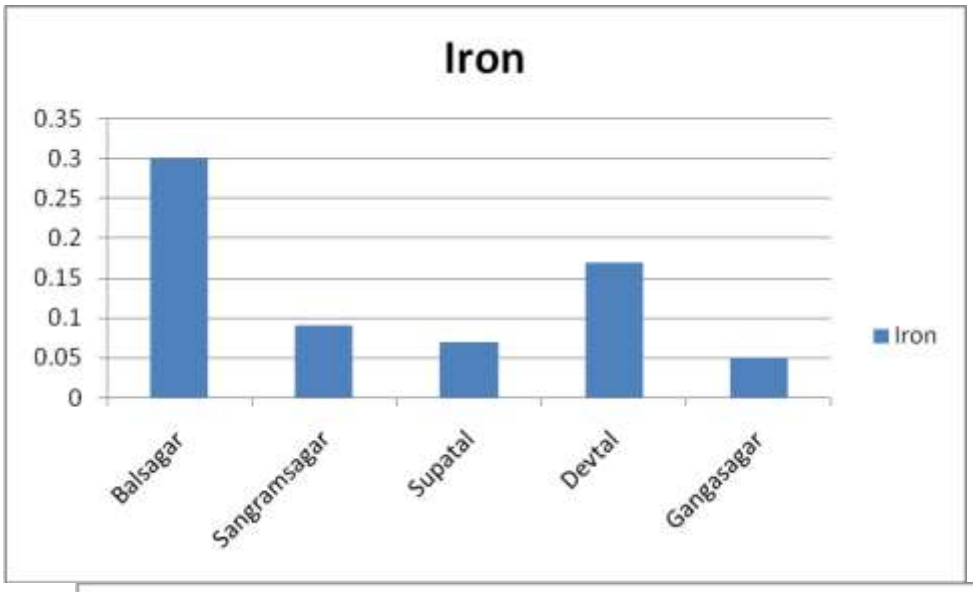
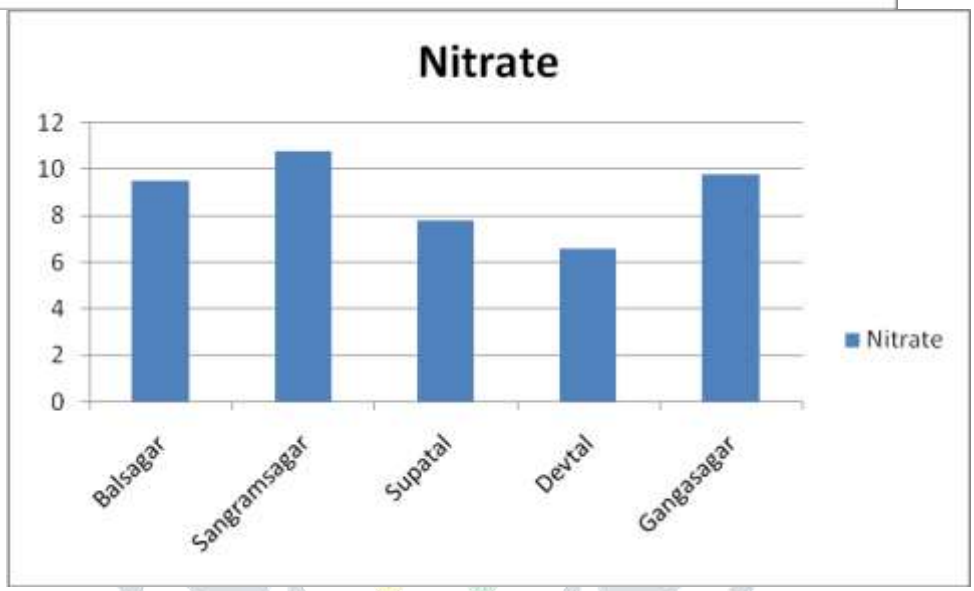
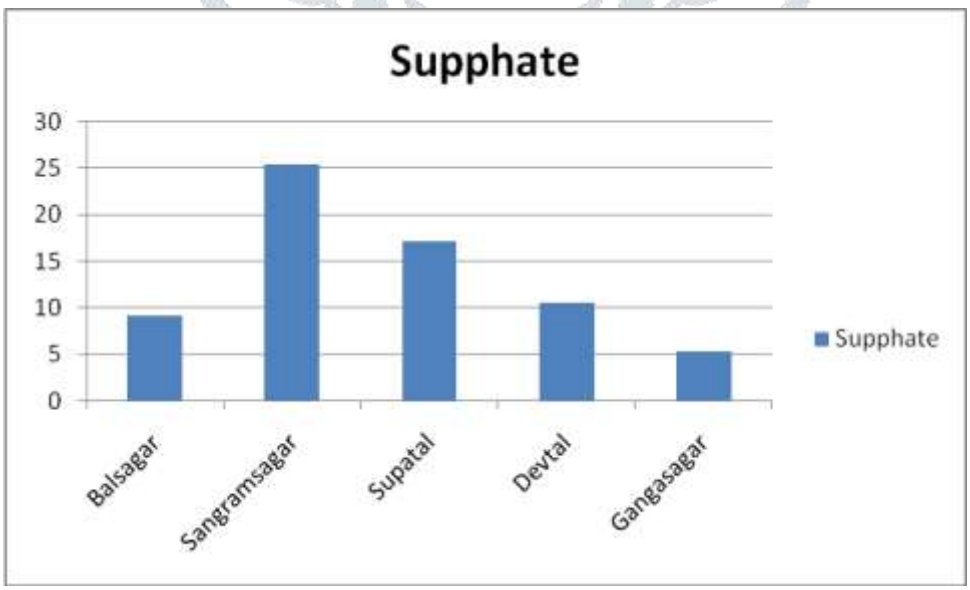
0
Balsagar
Sangramsagar
Supatal
Devtal
Gangasagar
Fl







Conclusion

The results of the present study show that water quality at many locations does not meet the required standards as per BIS requirements (IS 10050, 1995). The study identifies a number of factors leading to

degradation of water quality of water resources including rupture of pipelinesat multiple locations, washing of clothes near pipelines/groundwater sources, washing of vehicles near broken pipelines/groundwater sources, open defecation, Pipelines/ground water sources, cattle near pipelines/ground water sources, disposal of solid waste near pipelines/ground water sources, sewage effluents in open drains, drinking water pipelines/sewerage pipelines closeto groundwater sources and seepage of inorganic minerals from the soil/ rocks. Jabalpur district like other cities is facing the challenge of supplying safe and healthy water to its residents. With ever-increasing city limits, the challenge of water supply is increasing. However, a few small measures can go a long way in maintaining a safe and healthy water supply for city residents. The studies in the present investigation have shown that one of the most important causes of water pollution is unplanned urban development, without adequate attention to the appropriate management of sewage and waste materials. The river Conservation Authority of Madhya Pradesh has conducted a survey to measure the water quality of some of the water bodies of Jabalpurand it has been observed that almost all the water bodies of Jabalpur are affected by pollution. The present study shows that the water quality index (W.Q.I.) of Jabalpur water bodies is more than 100, thiswater is not suitable for drinking and other purposes and the water of these lakes is suffering from pollution.

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