ASSESSMENT OF HEAVY-METALS OF WELL WATER SAMPLES ALONG NATIONAL HIGHWAY ROADSIDES

D. B. Dhangar[1], R. G. Mahale[2,*], S. S. Rajput[3], R. S. Dhivare[3]

[1,3]Department of Chemistry, BSSPM's, Arts, Commerce and Science College, Songir, Dhule, (M.S.) India

[2*]Department of Chemistry, SSVPS's Late Karmaveer Dr. P.R. Ghogrey Science College, Dhule, (M.S.) India

[3]Department of Chemistry, SVS's Dadasaheb Rawal College, Dondaicha, Dhule, (M.S.) India

ABSTRACT:

Groundwater is the primary source of water on the earth's high waste disposal in various forms into water bodies exacerbated by its densely populated feature, thereby contaminating other water sources. However, untreated effluent from chemical treatment plants and solid waste from residential areas finds its way by leaching through groundwater. The present research work has been analyzed for the characterization of heavy metals, such as As, Hg, Cd, Zn, Cr, Fe, Cu, Mn, Ni, and Pb from roadside well water. In the Shirpur toll plaza chromium found in WS4, the highest quantity of arsenic in WS2 recorded from Songir toll plaza. Ferrous and copper were reported in all samples from all sites within the minimum acceptable WHO criteria, but lead concentration from all sites was found to be higher than the maximum permissible ICMR and WHO requirements and therefore not suitable for consumption.

Keywords: *Well Water, Heavy Metals, National Highway-3*

1. Introduction:

The need for the Earth's biosphere is essential for water. Water is one of the ecosystem's most essential nutrient compounds. This is also important for human being's socio-economic growth. Water and air are the two essential elements of the world's survival and health mechanism. In India, the actual water usage capacity of approximately surface water 690km^3/year; land water 432km^3/year has been projected to be slightly lower than expected water needs, in the region of 1450 km^3/year for population prediction in future 2050. Our atmosphere has witnessed continuous and rapid degradation in all of its abiotic and biotic components which causes contamination [1]. Water in voids and rock fissures is called groundwater [2]. It is governed by quantity and rate of rainfall, the timing of weather, the quantity of evaporation, land slope, dryness of the air, temperature, plant cover, voids, and non-permeability of rocks and soil soaking water capacity. A surface flow goes underwater by percolation, a region of 0.58% of the overall groundwater wealth. It means that the planet has a very low percentage of groundwater [3].

Dhule district is a central Indian district of Maharashtra state. Dhule district is the Maharashtra Northern edge. The district of Dhule is well linked by road transport. The city of Dhule is situated roughly 340 km north. Dhule is situated at the intersection of National Highway No.3 and National Highway No. 6, the district headquarters. The National Highway No.3 to Mumbai and Agra while the National Highway No. 6 to Surat and Nagpur. This ensures the district headquarters are well connected to four main directions with National Highways. The effectiveness of vertical drainage relies on the availability of favorable aquifer and water level to sustainably raise the groundwater and on the desired water quality that could be re-used for irrigation purposes. Many researchers have carried out most work on the heavy metal study of groundwater bodies. The main objective of this assessment study is the evaluation of heavy metal analysis of groundwater samples from the selected locations in the Dhule region on the way to National Highway No. 3, to identify accurately and suitable information regarding groundwater contamination due to heavy traffic on highway roadsides.

2. Water Sample Collection:

The area is Dhule to Palasner North of Maharashtra, Mumbai-Agra is the largest National Highway that connects various states in the region with the segment of the National Highway-3 resides. It was constructed during the British period. The Surat-Bhusawal railway line and Tapi Dam, Maharashtra's largest dam is cross-lined by the highway.

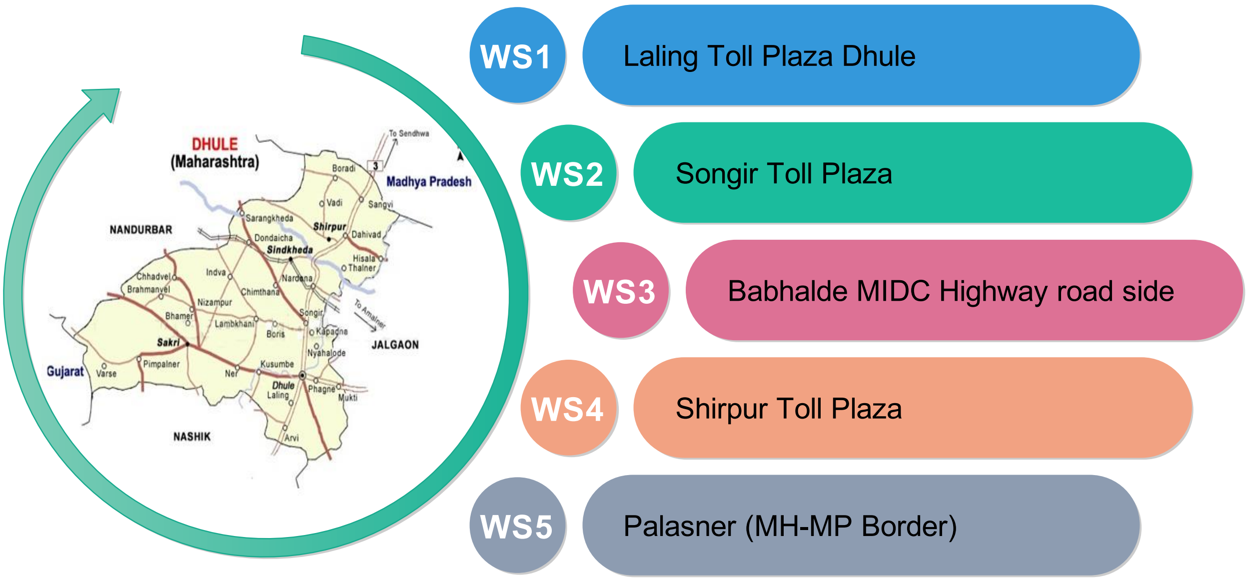


Fig. 1: Well water sampling sites nearby NH-3

The North Maharashtra National Highway, connected to the Madhya Pradesh (M.P.) neighborhood, and approximately 91.8 km distance from Dhule to Palasner has several kinds of vehicles, cars, trucks, etc. To both sides are clustered a range of villages and small towns. Due to high traffic density and many small, heavy vehicles move by every day, the National Highway (NH-3) has been built to four lanes. There is also a risk for significant emission impacts in and around these areas. Dhule toll plaza and Songir toll are the major towns along with roadsides of the study area. Nardana and Shirpur are the key cities were chosen for sampling for dignified region of the water analysis.

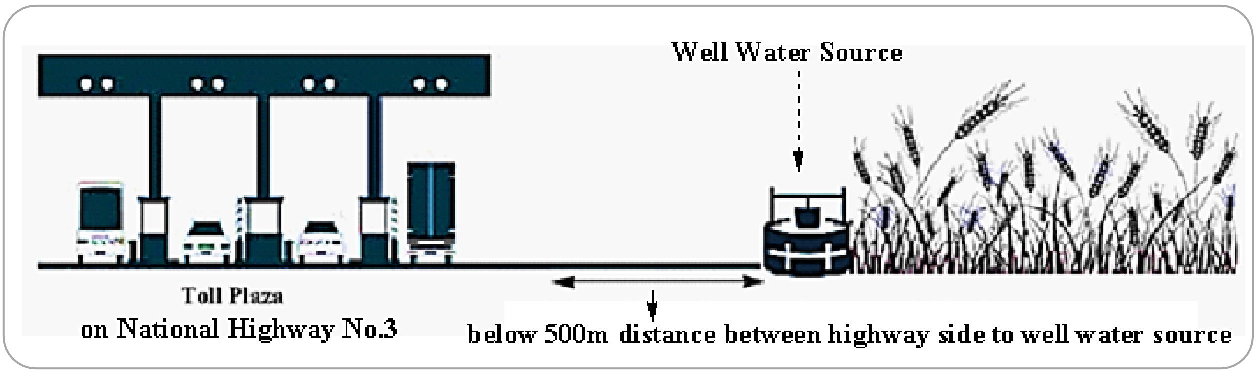


Fig. 2: Water sampling distance map

On the National Highway (NH-3) five main site areas were chosen for well water sampling from Laling toll plaza to Palasner. In each sampling site only one sampling point was chosen below 500 m perpendicular distance from the highway for the collection of well water samples.

3. Material and Methods:

All the water samples were collected from the chosen locations of the well water nearby the National Highway NH-3 road sides by using sterile plastic water bottles, the Physico-chemical properties of the collected water samples were accessed from heavy metal testing analysis ICP/AES detection from water samples were got from IIT Powai, Mumbai.

4. Heavy Metal Analysis by ICP/AES methods (WS1-5):

Heavy metal is a part of a loosely defined class of metallic products displaying components. This contains primarily intermediate metals, a few metalloids, lanthanides, and actinides. Any concepts based on mass, some based on atomic number or atomic weight and some based on chemical properties or toxicity have been suggested. As mentioned below, heavy metal can contain elements lighter than carbon depending on the context and may lack some of the heavier metals. These heavy metals are not biodegradable; hence such remediation technique needs to be created, which should be effective, economical, and easy to deploy in a broad range of physical settings. Hence the present research work has been analyzed for the characterization of heavy metals, such as As, Hg, Cd, Zn, Cr, Fe, Cu, Mn, Ni, and Pb from roadside well water.

4.1 Arsenic (As):

Arsenic is a metal-like substance found in small amounts in nature. Elevated amounts of arsenic can be present naturally in the soil in certain parts of Illinois. Arsenic is absorbed into the water through dissolving stone, salts, and ores, through chemical effluents and mining waste, and by atmospheric precipitation [4-6] Arsenic (V) is typically the most abundant arsenic element present in well-oxygenated surface waters [7-8] under reduced circumstances, such as those commonly encountered in deep lake sediments or groundwater, arsenic (III) is the predominant type [9-10]. An increase in pH can raise dissolved arsenic concentrations in water [11]. Arsenic (As) was found (table-1 and graph-1) only in the year 2018-19 from only WS2-0.5114 ppm i.e. higher amount as per the limits of WHO guidelines. The well water sample (WS2) was collected nearby the Songir toll plaza on the National Highway (NH-3).

4.2 Chromium (Cr):

Chromium is not easily found in nature. The primary element containing chromium is the chromite. As already stated, chromium compounds can only be present in small quantities in waters. Via numerous factories, the product and its compounds may be discharged into surface water. In a variety of species Chromium is a food necessity. It refers only to trivalent chromium though. Hexavalent chromium is highly poisonous to the fauna and flora. Chromium water contamination is not known to be one of the biggest and most significant environmental issues, but discharging unregulated chromium-polluted wastewater in waterways has triggered environmental hazards in the past. Chromium (VI) compounds are Class-III categorized underwater hazard, and are known to be extremely radioactive. The solubility of chromium in the surface water is smaller than with other highly harmful metal. The chromium concentration in groundwater is low (<1 μg/L). In India, less than 2 μg/L chromium was contained in 50% of 1473 water samples from dug wells [12]. In our analysis report chromium (Cr) was found only in the year 2018-19 of only Shirpur toll plaza sample WS4-0.0013 ppm means quite amount as per the limits of WHO standards.

4.3 Iron (Fe):

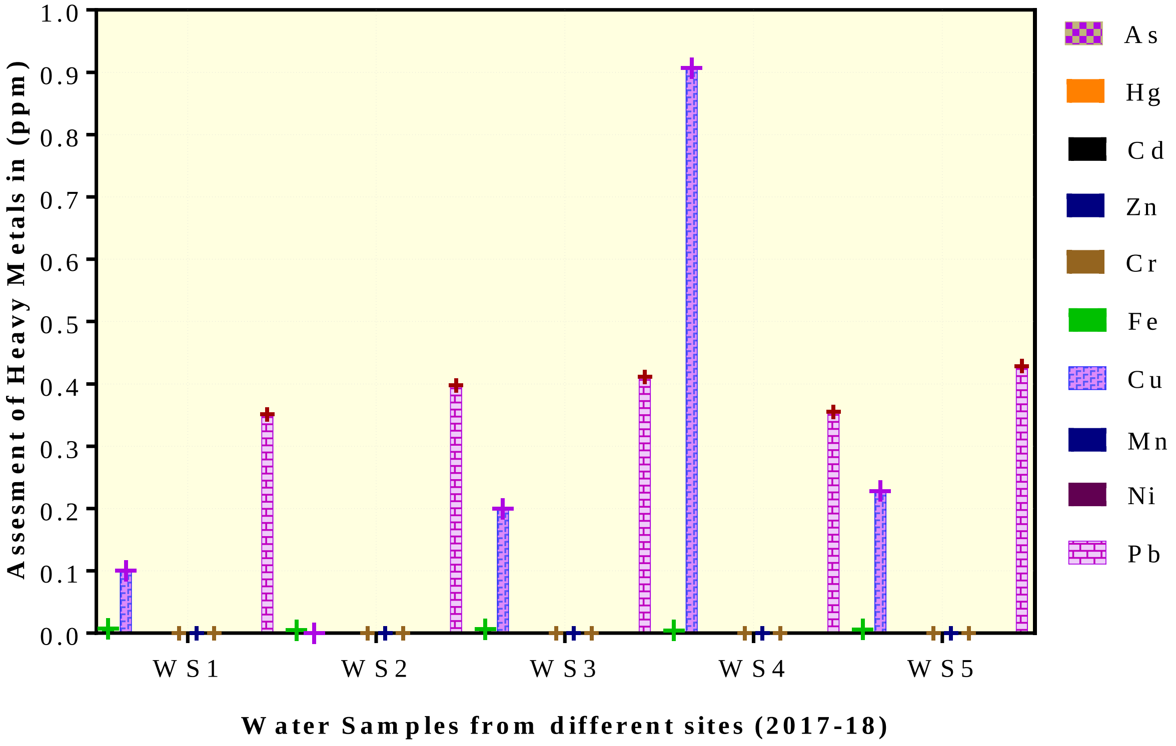
Iron is a common issue in rural groundwater supplies: its content varies from 0 to 50 mg/L, while the WHO suggested standard is < 0.3 mg/L. The iron exists naturally in the aquifer but with the dissolution of the ferrous borehole and hand-pump elements, the groundwater amounts may be raised. Iron-bearing groundwater is sometimes distinctly orange in color, triggering laundry discoloration, and has an acidic taste which is noticeable in consuming and cooking food The existence of iron bacteria can be shown by rusty slime within headwork, decreased water flow into the bore and nasty odor from bore-pumped water, slimy deposits covering main and lateral lines, extreme pavement staining, wall foiling [13]. The ferrous (Fe) was recorded in the year 2017-18 in the water sample WS1-0.0075, WS2-0.0049, WS3-0.0065, WS4-0.0044, and WS5-0.0057 ppm as shown in the table-4.8 and table-4.9. Correspondingly in the academic year 2018-19, the readings of WS1-0.0155, WS2-0.0159, WS3-0.0155, WS4-0.0156, and WS5-0.0156 ppm were found as shown in the graph-1 and graph-2. All the samples from all the sites were found under the minimum acceptable limits of WHO guidelines. The recorded values are given in table-1.

Table-1: Heavy Metals data found in well-water samples (WS1-5)

Sr. No.	Heavy Metals (ppm)	Water Samples in 2017-18					Water Samples in 2018-19				
		WS1	WS2	WS3	WS4	WS5	WS1	WS2	WS3	WS4	WS5
1.	**As**	0.00	0.00	0.00	0.00	0.00	0.00	**0.5114**	0.00	0.00	0.00
2.	**Hg**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.	**Cd**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4.	**Zn**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5.	**Cr**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.0013**	0.00
6.	**Fe**	**0.0075**	**0.0049**	**0.0065**	**0.0044**	**0.0057**	**0.0155**	**0.0159**	**0.0155**	**0.0156**	**0.0156**
7.	**Cu**	**0.1001**	0.00	**0.1995**	**0.907**	**0.2284**	**0.2829**	**0.0857**	**0.2629**	**0.1124**	**0.2593**
8.	**Mn**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9.	**Ni**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10.	**Pb**	**0.3514**	**0.3975**	**0.4110**	**0.3551**	**0.4288**	**0.5111**	**0.5114**	**0.5114**	**0.5112**	**0.5113**

4.4 Copper (Cu):

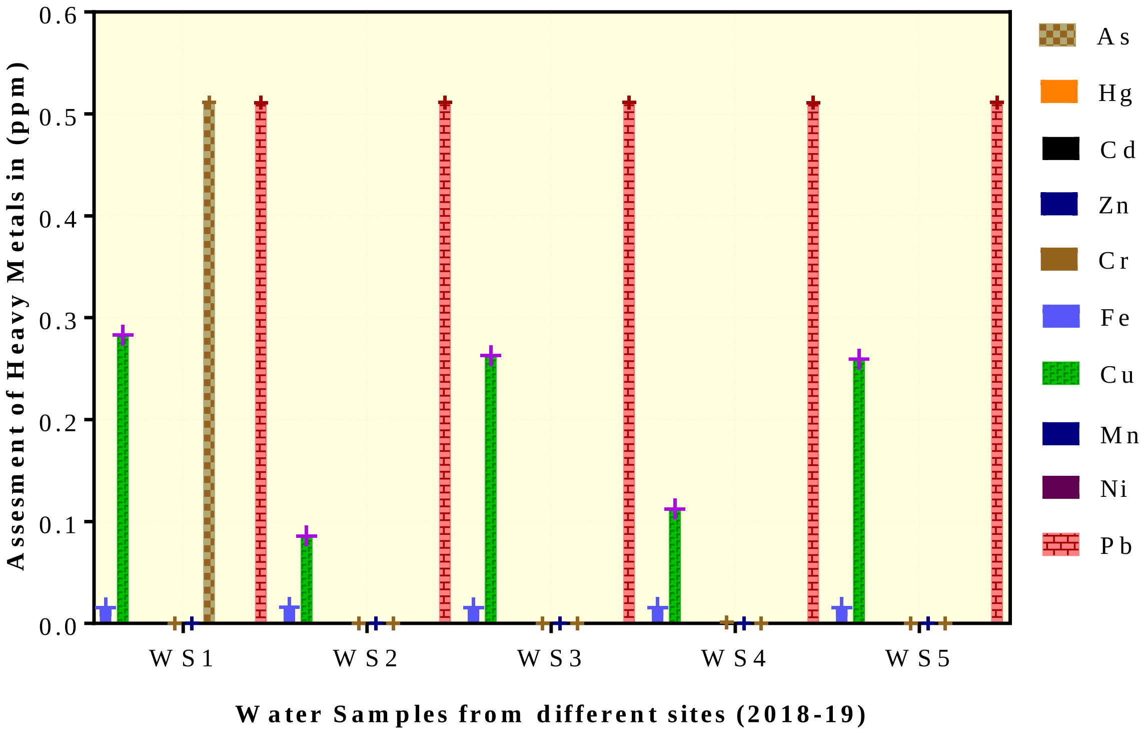
Copper levels are generally very small in soil and groundwater. Large amounts of copper may get into the atmosphere through waterways and streams from mining, forestry, processing activities, and urban or industrial wastewater releases. When the water is acidic, copper may contact drinking water either directly by contaminating the well water or by corrosion of the copper tubing. The baseline standard at an upper catchment monitoring site was 0.001 mg/L. Four times the copper concentration rises were evident underwater of a sewage treatment system. Copper concentrations ranged from 0.0008 mg/L to 0.010 mg/L in an unpolluted region of the River Periyar in India. Because of its main role in many enzymatic reactions; copper is an important metal for all living species. However, it is basically pollutant at large concentrations [14-15]. In the present research work; the concentration of copper (Cu) was noted in the year 2017-18 in the water sample WS1-0.1001, WS3-0.1995, WS4-0.907, and WS5-0.2284 ppm except WS2 as shown in the table-4.8 and table-4.9. Correspondingly in the academic year 2018-19, the readings of WS1-0.2829, WS2-0.0857, WS3-0.2629, WS4-0.1124, and WS5-0.2593 ppm were found as shown in the graph-1 and graph-2. All the samples from all the sites were found lower than the minimum acceptable limits of ICMR, WHO, CPCB guidelines and therefore can be suitable for drinking.



Graph-1: Variance of the Heavy Metals in WS1-5 (2017-18)

4.5 Lead (Pb):

Lead is a naturally occurring bluish-gray metal found in small concentrations on the outer layer of the globe. Lead can be present in any corner of our world. All of this arises from human actions like fossil fuel combustion, refining, and processing. Lead occurs often naturally in soil but can be detected in wells on the bedrock. Many examples include water services network components such as lead solder used to connect copper tubing, brass in faucets, refrigerators, and valves. In the current explorations; the concentration of lead (Pb) was distinguished in the year 2017-18 in the water sample WS1-0.3514, WS2-0.3975, WS3-0.4110, WS4-0.3551, and WS5-0.4288 ppm as shown in the table-4.8 and table-4.9. Gradually more in the academic year 2018-19, the readings of WS1-0.5111, WS2-0.5114, WS3-0.5114, WS4-0.5112, and WS5-0.5113 ppm were found as shown in the graph-1 and graph-2. All the samples from all the locations were found higher than the maximum permissible limits of ICMR and WHO standards and therefore cannot suitable for consumption.



Graph-2: Variance of the Heavy Metals in WS1-5 (2018-19)

In the heavy metal analysis of the National Highway (NH-3) roadsides water samples by ICP/AES method, only copper, iron, and lead metals were recorded, in all samples including both years, arsenic found in WS2 (2018-19) and chromium found in WS4(2018-19). Except for these, the reaming heavy metals showed nil record in both years.

5. Results and Discussion (WS1-5):

Groundwater is the primary source of water on the earth's high waste disposal in various forms into water bodies exacerbated by its densely populated feature, thereby contaminating other water sources. However, untreated effluent from chemical treatment plants, and solid waste from residential areas finds its way by leaching through groundwater. In this analysis, groundwater samples were collected nearby the National Highway (NH-3) well water samples of the selected and collected from the locations tested. Arsenic (As) was found (table-1, graph-1, and graph-2) only in the year 2018-19 and chromium (Cr) was found only in the year 2018-19, of only Shirpur toll plaza sample WS4-0.0013 ppm means quite amount as per the limits of WHO standards. The ferrous (Fe) was recorded in the year 2017-18 in the water sample WS1-0.0075, WS2-0.0049, WS3-0.0065, WS4-0.0044, and WS5-0.0057 ppm and similarly in the academic year 2018-19 the readings of WS1-0.0155, WS2-0.0159, WS3-0.0155, WS4-0.0156, and WS5-0.0156 ppm. the concentration of copper (Cu) was noted in the year 2017-18 in the water sample WS1-0.1001, WS3-0.1995, WS4-

0.907, and WS5-0.2284 ppm except WS2, in the academic year 2018-19 the readings of WS1-0.2829, WS2-0.0857, WS3-0.2629, WS4-0.1124, and WS5-0.2593 ppm respectively. To end of the concentration of lead (Pb) was distinguished in the year 2017-18 in the water sample WS1-0.3514, WS2-0.3975, WS3-0.4110, WS4-0.3551, and WS5-0.4288 ppm and gradually more in the academic year 2018-19 the readings of WS1-0.5111, WS2-0.5114, WS3-0.5114, WS4-0.5112, and WS5-0.5113 ppm from all the locations were found higher than the maximum permissible limits of ICMR and WHO standards.

6. Conclusion:

The higher amount of Arsenic (WS2) recorded from the Songir toll plaza and chromium (WS4) in Shirpur toll plaza on the National Highway (NH-3). The ferrous and copper was recorded in all the samples from all the sites were found under the minimum acceptable limits of WHO guidelines but lead concentration was found from all the locations were found higher than the maximum permissible limits of ICMR and WHO standards and therefore cannot suitable for the consumption.

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