Effects of Pesticides on the Quality of Shallow Groundwater in the Suburbs of Hyderabad City

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Abstract: **This study was carried out to assess the effects of pesticides on the quality of groundwater in the suburbs of Hyderabad city. The water quality was assessed in terms of physicochemical, and microbiological parameters. To determine the water quality parameters, fifteen samples were collected from the different locations/villages in the suburbs of Hyderabad city. To know the present status of groundwater quality, the physicochemical parameters such as pH, Turbidity, Total Dissolved Solids (TDS), Total Hardness, Calcium, Magnesium, Sulfate, and Chlorides were analyzed. The obtained results were compared with WHO guidelines for drinking purposes. It has been observed that the groundwater of most of the samples were found contaminated, this means quality parameters were exceeding WHO guideline for drinking purpose. A significant concentration of Chlorpyrifos (pesticide residues) has also been observed in groundwater samples of some villages.**

Keywords: **groundwater, suburbs, physicochemical, WHO, chlorpyrifos, pesticides**

I. INTRODUCTION

Groundwater is most available source of fresh water. It may be difficult and expensive to clean up the contaminated groundwater. Groundwater is drastically affected by anthropogenic activities likewise agricultural applications, wastewater discharges, solid waste dumping and its leachate. Plenty amount of agricultural inputs and uncontrolled waste disposal by human activities contaminate water along its passing routes [1]. Synthetic fertilizers and Chemical pesticides are degrading water quality parameters and the surrounding environment [2]. It is extremely important to evaluate groundwater quality because groundwater is used directly for drinking purposes in many areas [3]. Pesticides are spraying over the agricultural land for achieving maximum yield, transmit diseases both to humans and animals. Pesticides substances either kills the unwanted organism or interfere with their reproduction process so the killing of an unwanted organism of the crop is in our favor but the reproduction process pollutes the water by percolation [4].

II. MATERIALS AND METHODOLOGY

A. Study area

Following seven different villages were selected for the study area. These sites are positioned at the northwest of the Hyderabad as well as southeast of Hyderabad.

Table 1: Location of selected villages

Village name	Location
Jan M. Shoro	1.5 km away from right side of Indus River
Detha Goth	5 km away from left side of Indus River
Gulu Machi	About 3 km away from left side of Indus River
Goth Hatri	7.4 km away from right side of Phuleli Canal
Matiari Side	17.7 km away from right side of Phuleli Canal
Shora Goth	1 km away from left side of Indus River
Chang Goth	0.7 km away from right side of Phuleli canal

B. Sample collection

To assess the quality of groundwater in the suburbs of Hyderabad, 15 samples were collected from the study area. The criteria for selection of sampling sites was the area where hand pumps were located and functional in the agriculture fields, and the same water was being consumed for their livelihood of the villagers. Average two to three samples were taken from each village to assess the groundwater quality

The water quality parameters for which the samples were analyzed are mainly divided into the Physicochemical, Microbiological parameters and pesticide tracing. The parameters are:

1. Turbidity
2. pH
3. Calcium (Ca)
4. Magnesium (Mg)
5. Hardness
6. Chloride (Cl)
7. Sulfate
8. Total Dissolved Solids (TDS)
9. Total coliform
10. Chlorpyrifos (organophosphate compound).

III. RESULTS

The average results of the physicochemical and microbiological parameters for water samples are presented in Tables 2 and 3. Following figures show the comparison of all parameters with WHO limits.

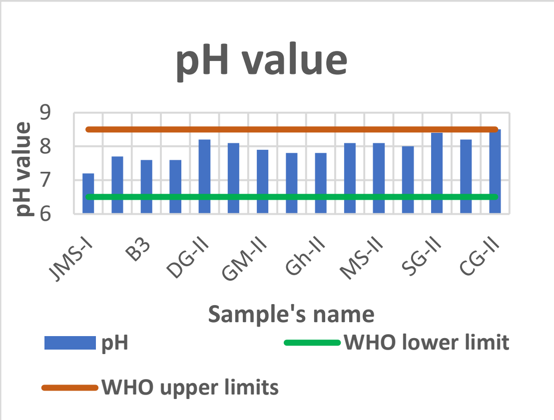
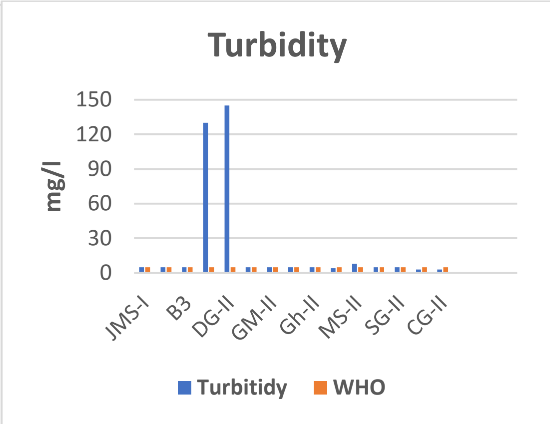


Fig. 1: Comparison of pH with WHO value



Fig, 2: Comparison of Turbidity

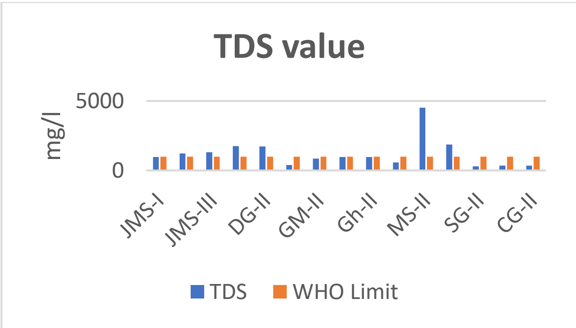


Fig. 3: Comparison of TDS

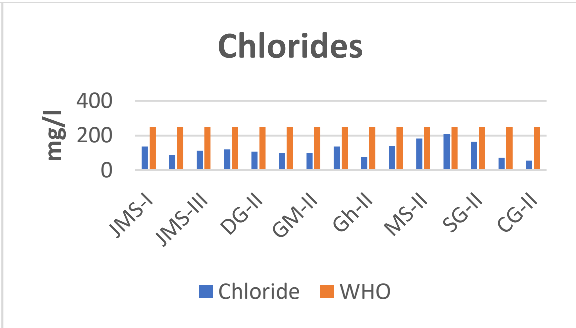


Fig.4: Comparison of Chlorides with WHO limits.

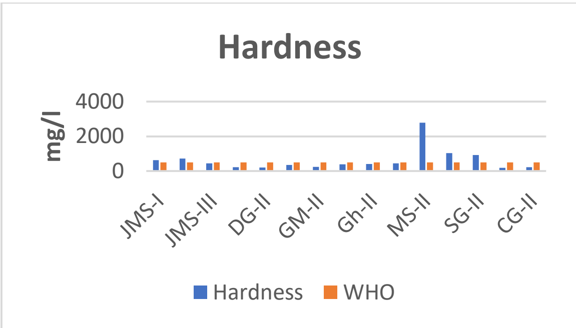


Fig.5: comparison of Hardness value

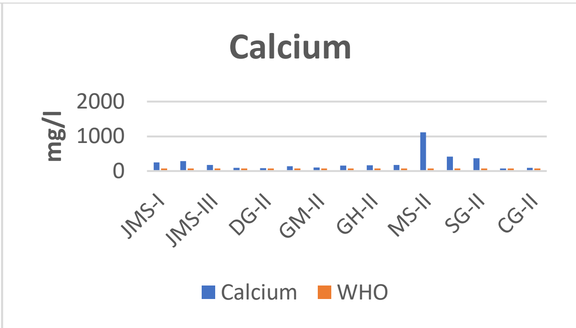


Fig. 6: Comparison of Calcium

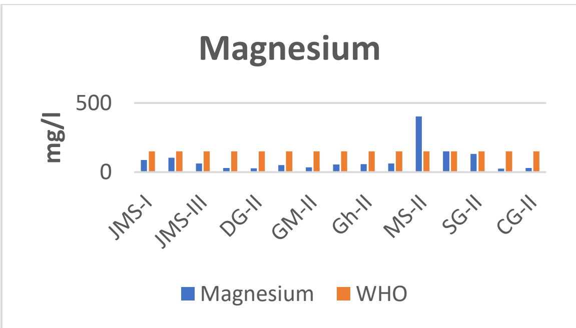


Fig. 7: Comparison of Magnesium value

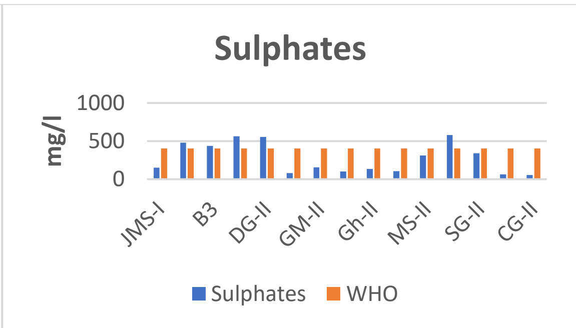


Fig. 8: Comparison of Sulfate value

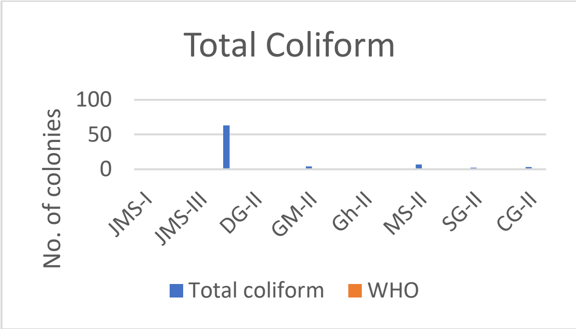


Fig. 9: Comparison of Total Coliform

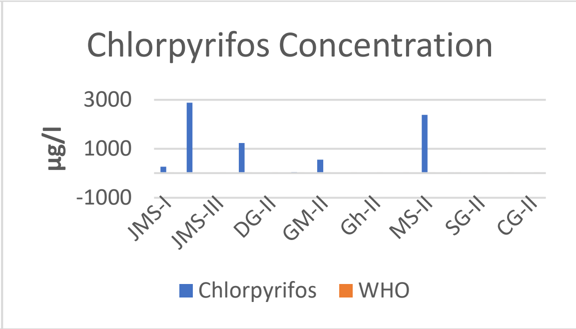


Fig. 10: Comparison of chlorpyrifos concentration with WHO limit

All collected groundwater samples having pH in the range of WHO guideline value as shown in figure 1. The observed pH was found in the range of 7.2 to 8.5. A higher pH value shows the water is alkaline in nature. As shown in the figure 2, the turbidity of all drinking water samples are in the WHO range. Out of fifteen samples, two samples of Detha goth are most turbid. The said hand pump is not in daily use and it was reported by the villagers that the strainer of the hand pump is ruptured and the discharging water carries the silt along with it. The minimum and maximum TDS were observed 295 mg/l and 4530 mg/l respectively as shown in figure 3. The sample Matiari side contains a high concentration of TDS. The variation in the TDS concentration of groundwater may be due to anthropogenic sources and agricultural activity (Tarasha et al 2009).

Figure 4 represents the Chlorides present in groundwater of all selected villages are in the range of the WHO limit. Chlorides depend upon the concentration of minerals present in water, it produces soil salinity and gives bad odor to water (Mahesh et al 2014). Figure 5 depicts that the Hardness of all samples are in the WHO range except Shora Goth and Jan M. Shoro village. A high range of hardness deteriorates the quality of clothes, and it may cause skin irritation. The food prepared in this water may change its taste and quality.

It is shown in figure 6 that, out of fifteen samples, the calcium value of only one sample (CG-I) is under the WHO limit and the calcium value of MS-II exceeding 1000 mg/l. This means the groundwater of all villages having poor lathering capacity. The high value of calcium deteriorates the quality of clothes and it may cause scale formation.

The magnesium present in the groundwater of selected villages is in the range of WHO guideline value as shown in figure 7. Only Matyari side village contains very high value. It showing a large variance in magnesium concentration. The high concentration of hardness, Calcium, and Magnesium in said village may be due to the soil condition of this aquifer and its surrounding.

Figure 8 showing that sulfates in Jan M. Shoro, Detha Goth and Shora Goth are high because these salts are key constituents of TDS. Excessive amounts of sulfates in groundwater give bad taste. The use of fertilizers to crop for maximum yield adds the sulfates in groundwater (Hamen et al 2007). The high sulfate value may cause dehydration and gastrointestinal diseases.

By performing experiments on the Total Coliform test we found relatively better results which mean most of the samples were clear from total coliform bacteria, out of 15 sites, 6 sites showed coliform contamination in the range of 1 CFU's to 63 CFU's. Only DG-I has represented the highest value of 63 CFU's as shown in the figure 9, this may be due to the problem of strainer of the said hand pump. This hand pump is not used regularly and carries impurities while in use.

Most of the samples were free from chlorpyrifos residues, but few samples contain a large concentration of chlorpyrifos. The groundwater samples of JMS-II, MS-I, and DG-I contain high residues of chlorpyrifos, and values are **2878.4, 1231.4** and **2388.6** respectively. It was observed that at these locations along with chlorpyrifos, the other two parameters that are sulfates and TDS were also at high concentration. This shows that one of the causes of this contamination may be due to the leachate or percolation of fertilizers and mixing with the targeted aquifer. The high concentration of Chlorpyrifos is highly toxic to humans, it affects differently in various systems of the human body. It has been reviewed that low-level exposure to chlorpyrifos may affect the central nervous system. Initially, it may cause headaches, dizziness, nausea, vomiting, and diarrhea (St. Louis, 2006 and Dev. Brain Res. 2000).

Table. 2 Physicochemical analysis of all collected samples

Village No	Village Name	Well I.D	pH -	WHO limits	TDS mg/l	WHO limit mg/l	Chloride mg/l	WHO limit mg/l	Turbidity mg/l	WHO limit mg/l	Hardness mg/l	WHO limit mg/l
	Jan M. Shoro	**JMS-I**	7.2		960		136		5		616.66	
1.	**Jan M. Shoro**	**JMS-II**	7.7	6.5 – 8.5	1230	1000	88	250	5	5	720	500
	Jan M. Shoro	**JMS-III**	7.6		1320		112		5		433.333	
2.	**Detha Goth**	**DG-I**	7.6	6.5 – 8.5	1750	1000	120	250	130	5	220	500
	Detha Goth	**DG-II**	8.2		1720		108		145		200	

3.	**Gulu Machi**	**GM-I**	8.1	6.5 – 8.5	390	1000	100	250	5	5	350	500
	Goth Malook	**GM-II**	7.9		850		100		5		240	
4.	**Goth Hatri**	**GH-I**	7.8	6.5 – 8.5	970	1000	136	250	5	5	387	500
	Goth Hatri	**Gh-II**	7.8		970		76		5		406.66	
5.	**Matiari side**	**MS-I**	8.1	6.5 – 8.5	580	1000	140	250	4	5	436.67	500
	Matiari side	**MS-II**	8.1		4530		183		8		2790	
6.	**Shora Goth**	**SG-I**	8.0	6.5 – 8.5	1880	1000	208	250	5	5	1040	500
	Shora Goth	**SG-II**	8.4		295		165		5		926.66	
7.	**Chang Goth**	**CG-I**	8.2	6.5 – 8.5	350	1000	72	250	3	5	183.34	500
	Chang Goth	**CG-II**	8.5		340		55		3		216.67	

Table 3: Physicochemical, Microbiological analysis and Chlorpyrifos analysis of all sample

Village No	**Village Name**	**Well I.D**	**Calcium mg/l**	**WHO limit mg/l**	**Magnesium mg/l**	**WHO limit mg/l**	**Sulfates mg/l**	**WHO limit mg/l**	**Total coliform CFU's**	**WHO limit**	**Chlorpyrifos µg/l**	**WHO limit µg/l**
1.	**Jan M. Shoro**	**JMS-I**	246.66	75	88.8	150	149.04	400	0	0	270.8	30
	Jan M. Shoro	**JMS-II**	288		103.68		475.52		0		2878.4	
	Jan M. Shoro	**JMS-III**	173.33		62.4		435.2		0		0	
2.	**Detha Goth**	**DG-I**	88	75	31.68	150	562.52	400	63	0	1231.5	30
	Detha Goth	**DG-II**	80		28.85		552.36		The hand pump was dismantled		The hand pump was dismantled	
3.	**Gulu Machi**	**GM-I**	140	75	50.4	150	76.82	400	0	0	40.6	30
	Goth Malook	**GM-II**	96		34.56		152.14		4		553.8	
4.	**Goth Hatri**	**GH-I**	154.8	75	55.73	150	97.3	400	0	0	12.3	30
	Goth Hatri	**Gh-II**	162.66		58.56		134.28		1		15.7	
5.	**Matiari side**	**MS-I**	174.68	75	62.87	150	103.8	400	0	0	0	30
	Matiari side	**MS-II**	1116		401.76		308.57		7		2388.6	
6.	**Shora Goth**	**SG-I**	416	75	149.76	150	576.48	400	0	0	29.2	30
	Shora Goth	**SG-II**	370.66		133.44		340.6		2		5.3	
7.	**Chang Goth**	**CG-I**	73.34	75	26.4	150	59.36	400	0	0	0	30
	Chang Goth	**CG-II**	86.67		31.20		52.04		3		0	

IV. CONCLUSIONS

It is concluded that the observed values of pH, Turbidity and Chloride were in the range of WHO limit. According to the results the TDS, Hardness, calcium, and magnesium values of MS-II are 4530 mg/l, 2790 mg/l, 1116 mg/l, and 401.76 mg/l, respectively, which is very high. The groundwater samples of JMS-II, MS-I, and DG-I contain high residues of chlorpyrifos, and values are 2878.4, 1231.4 and 2388.6 µg/l respectively. This high concentration of water quality parameters present in drinking water can cause chronic effects on human health. Out of seven villages, three villages i.e. Shora Goth, Gulu Machi, and Chang Goth showed satisfactory results of water quality from the WHO point of view.

V. RECOMMENDATIONS

- At the time of installation of the hand pump, the minimum safe distance (MSD) should be fixed for avoiding/intrusion of pollutants in the shallow aquifer, where water source for human consumption is being considered.
- To reduce the risk of contamination, the area immediately surrounding the hand pumps should be kept free from the dumping of liquid or solid waste.
- To reduce the risk of water-borne disease, a few most important household treatments should generally be recommended where local water has not been tested. Treatment such as boiling, filtration, chemical disinfection, and cloth filtration.
- The Safe Drinking Water Act should be implemented to reduce exposure to contaminants including pesticides in drinking water.
- Research should be conducted to better understand the long term effects of certain pesticides in drinking water.

VI. ACKNOWLEDGMENT

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