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Analysis of Soil microbial count and Water physiochemical parameters in villages near Industrial area Bawal, Haryana (India)

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Abstract: Water and soil are the essential resources of all living beings, as human, animals, birds, aquatic animals, plants and soil microorganisms depend on them for their survival. Present study focuses on the soil microbial count and ground water quality analysis of some villages near Bawal industrial area, in order to analyse the impact of industrial growth on soil and water health of nearby areas. Water and soil samples were collected from four villages, Jaliawas, Suthani, Asalwas and Bhagthala. Water samples were analysed for their pH, TDS, Electrical Conductivity, Nitrate and Iron concentrations and soil samples were analysed for pH, EC and microbial count at depth of 5-10 cm. No significant change in bacterial and fungal colony forming units has observed but soil pH become slight alkaline with the distance from industrial area. All collected water samples are complying with the drinking and irrigation water permissible limits of WHO. Nitrates are found in the range of 8.4 to 10.2 mg/L, iron concentration of samples is in range of 0.03 to 0.1 mg/l. All these studied villages are within the range of 5 km of Bawal Industrial area, there is possibility of contamination of ground water and soil due to industrial pollution.

Introduction: Limiting availability of water is a major concern for today's developing world. Out of which drinking water availability is another major issue, and its demand is ever increasing exponentially. Drinking water scarcity is a worldwide problem and increasing population and development is one of its major reasons. According to World Health Organization (WHO) about 1.1 billion people are forced to drink unsafe water and most diarrheal diseases is due to unsafe drinking water and poor sanitation. Scarcity of water with its poor quality are the problems mainly faced in developing countries and which ultimately affect their sustainable development.[1] Lack of adequate knowledge, hygiene, and storage practices are also responsible for water contamination.[2,3] Previous studies in developing countries revealed the contamination of drinking water samples with E. coli and these were mainly due to use of unhealthy water storage practices.[4,5] Proper knowledge of sanitation and hygiene among people, especially in rural area is required to protect human health. In addition to this, it is necessary to assess the water quality of an area time to time. Drinking water quality can establish a relationship among composition of water and effects of climatic changes due to natural processes and human activities.[6] Ground water quality of an area affects the livelihood of the resident of that area. It depends upon the precipitation, surface water, mechanism of recharging the water bodies and anthropogenic activities and climatic conditions.[7] Overuse and wastage of groundwater and increased inputs from human activities are responsible for a threat to the groundwater quality and quantity.[8] Good groundwater quality is a reflection of degree of its protection from surface contaminants, sustainable agricultural practices, industrial management and protected drinking water services. Groundwater quality assessment is essential due to because of the unwanted threats placed upon its quality by natural and anthropogenic activities.

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Groundwater resources must be protected for maintaining good human health, better ecological balance and ecosystems.[9] The physiochemical parameters are playing a major contribution in describing the water quality and to determine its capability for its various uses including the protection the aquatic ecosystem.[10,11] Proper assessment of water parameters are essential for drinking purposes as well as for irrigation, which also exert effects on the soil and crops grown here.[12] Soil microorganisms plays a vital role in proper understanding of soil health. Soil microbial community includes bacteria, fungi, actinomycetes and protozoa. The microbial type and their count depends on the soil type, depth and location.[13] Soil act as a medium for diverse microbial community , that plays an important role in different processes such as, nutrient management and decomposition of organic matter.[14,15] Discrimination of soil fertility and its health assessment can't be completely done without microbial analysis and their adaptation to climatic conditions.[16,17] Fungal community and bacterial community both exert a important role and their population count can be very helpful in determining the soil profile. In this present study, the selected area is near the industrial township Bawal. We have tested the samples for the primary parameters of water deciding its quality and soil microbial count to assess the soil health of the studied area. In addition to this, we have tried to interpret the influence of the industrial development on ground water quality and soil microbial count of nearby villages.

Methods: Water samples were collected from the bore well of four villages (Jaliawas, Bhagthala, Suthani and Asalwas) near the industrial area Bawal. Soil samples were also collected at the depth of 5-10 cm from each studied village. Jaliawas village is at distance of 180 meter, Suthani village is at 2.3 km, Asalwas is at 3.5 Km and Bhagthala is a 5.5 Km from Bawal. Water samples were collected in well cleaned and dried plastic bottles. Proper labeling was done at the time of sample collection. Samples were stored at 4^0C temperature and analysed for pH, EC, Nitrates and iron concentration using standard methods prescribed BIS-10500 methods.[18] Soil samples were collected in glass vials and sieved through 2 mm sieve to exclude stones and plant residue. Proper labeling was done at the collecting site. Soil microbial count (fungal and bacterial), Soil pH, and EC were also determined. Microbial count was done by serial dilution method.[19]

Results:

Table1: Water parameters of different villages

Water Parameters	**Jaliawas**	**Suthani**	**Asalwas**	**Bhagthala**
Colour	Clear	Clear	Clear	Clear
Odour	None	None	None	None
TDS	1600	1530	1640	1380
Iron(mg/L)	0.1	0.09	0.06	0.03
Nitrates(mg/L)	10.2	9.3	8.4	8.5
pH	7.3	7.6	7.1	7.3
EC (µs/cm)	5.26	4.80	5.00	4.67

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Source	Soil Ph	Soil EC (ms/cm)	Fungi (CFU/ml) 10^3(DF)	Fungi (CFU/ml) 10^4(DF)	Bacterial (CFU/ml) 10^6(DF)	Bacterial (CFU/ml) 10^8(DF)
Jaliawas	7.2	1.104	54	40	155	96
Suthani	7.5	0.834	50	38	150	95
Asalwas	7.8	0.496	55	43	158	98
Bgagthala	8.0	0.482	58	45	160	100

Table 2: Soil microbial count and parameters of different villages

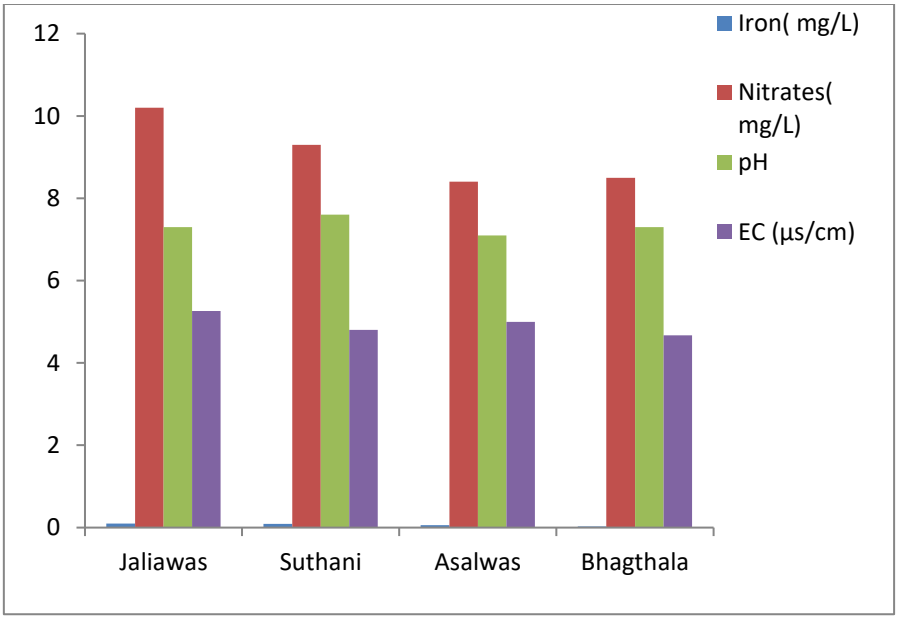

Fig 1: Comparative plot of all measured parameters of different villages

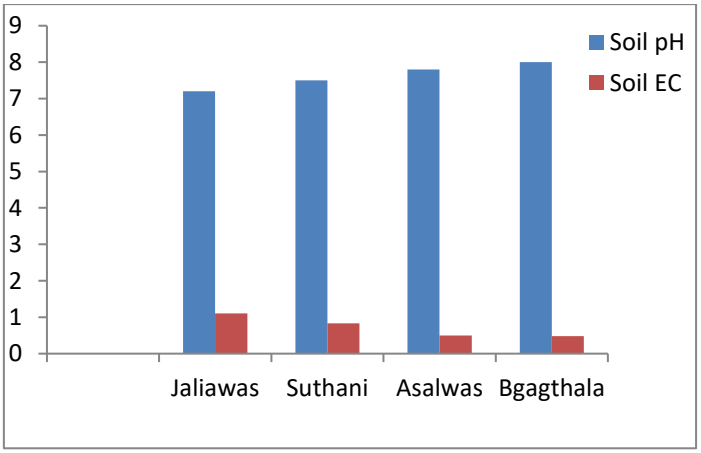

Fig 2: Comparative plots of Soil pH and EC of studied Villages

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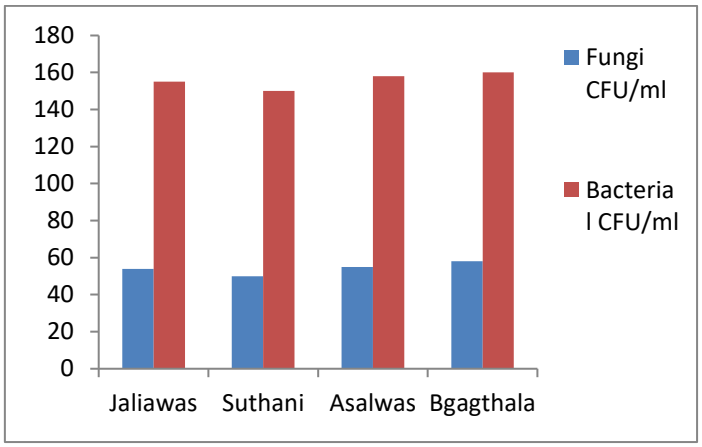

Fig 3: Comparative plot of soil bacterial and fungal counts

Discussion:

Results of all measured parameters have been shown in table 1 and comparative analysis of measured parameters among studied villages has reported in fig 1.

Water pH: All the measured water samples are found odourless and colorless. pH is most important parameter in order to decide the quality of water. The pH is determined by the amount of dissolved carbon dioxide, which after reacting with water forms H_2CO_3 acid[20]. Water pH of all studied villages is reported in range of 7.1 to 7.6. Recommended maximum permissible limit of pH is 6.5 to 8.5, according to WHO and our investigation ranges are in the range of WHO standards.

Nitrates: Nitrate is considered as one of the most important diseases causing water parameter; blue baby syndrome in infants is due to increased nitrate level in water.[20] The increased level of nitrate in water is due to nitrogen cycle, industrial waste, fertilizers, spoiled vegetable water etc.[21] Our analysed samples had showed the nitrate concentration in the range of 8.4 to 10.2 mg/l.(Table 1) Jaliawas village had showed the maximum concentration of nitrate and Asalwas had reported minimum concentration of nitrates among all studied villages.

Iron: Iron has a vital role in human body, required in human diet in sufficient amount. It is present in Fe^{2+} form in ground water and in variable concentrations. It has a prominent role in blood transport mechanism in living beings.[22] Iron concentration of water samples are found to show maximum concentration in Jaliawas (0.1) village, followed by Suthani (0.09), Asalwas (0.06) and least in Bhagthala village (0.03). Iron concentration of all water samples is within permissible limits for drinking water as well as irrigation water as per WHO.

TDS: Total dissolved solids of all the studied are found in the range of 1380 to 1640 mg/L. Samples are collected from borewell and their TDS was found above the permissible range of drinking water (WHO) but adhere with permissible limits for irrigation water and suitable for irrigation.

Electrical Conductivity: Electrical conductivity values in water samples show the amount of cations and anions in water. Increased ionic concentration in water enhances the EC values. Out of all studied villages, Jaliawas had showed the maximum EC values and Bhagthala showed minimum EC values. All the EC values are in range of 4.67 to 5.26 (µs/cm)

Soil Microbial analysis: In this study, we have focused on determination of soil fungal and bacterial colony forming units. These samples are collected at depth 5-10 cm and their pH, EC are reported in table 2. Using serial dilution method, 0.1 ml of solution was poured on petri plates and incubated at 25^0C in order to estimate no of colonies. Different incubation temperatures, incubation days, media can be used for counting the colonies.[23] Bacterial CFU per ml was calculated at dilution factor $10^6$and $10^8$and fungal CFU was at DF (dilution factor) 10^3 and10^4. Results revealed no significant alteration in the microbial count of studied villages. Bacterial and

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fungal colony decreases dilution and become countable. No fungal colony was spotted at dilution of $10^{6.}$ The studied areas are at variable distance from the industrial area and found to show almost similar microbial count. Soil pH is reported in range of 7.2 to 8.0 and increases with the distance from industrial area. Soil EC and pH, both are found within the permissible range of WHO.

Conclusion:

Water samples of all studied villages had shown their measured parameters are within permissible range for drinking water provided by WHO. Water of these villages is found to comply with the limits for irrigation as well as drinking purpose. Jaliawas village is at 180m distance from Bawal, and has shown highest concentration of nitrates and iron as compared to other studied villages. Nitrate concentration in the water of this village is reported very close to the maximum standard limits of drinking water. Jaliawas village is nearest to industrial area, this could be the reason of higher iron and nitrates in water samples of this village Time to time analysis is required, as water of this village could get affected due to industrial development in Bawal area. EC and Fe concentration are present highest in Jaliawas village and lowest in Bhagthala village. This could be correlated to their distance from the Industrial area. However soil microbial (bacterial and fungal) Colony forming units of studied villages at different dilution are found similar, no significant change has been observed. Soil pH becomes alkaline with the distance from industrial area but the change is very slight. Soil and ground water of all villages are found safe but possibility of contamination of same in future can”t be ignored.

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