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Physical profiling of water samples in fruits and vegetable growing specific sites in Singrauli region associated with heavy metals

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ABSTRACT
With the buildup of heavy metals in the industrialised region of Singrauli, Madhya Pradesh, India, water pollution is defined as the amount of undesired substances that are introduced into a natural water supply by human activity, affecting its physical, chemical, or biological qualities. This investigation examined the heavy metals and physical profiles of several water samples taken from Singrauli commercial fruit and vegetable production areas between 2020 and 2022..

The state of irrigation water and heavy metal contamination were investigated at each of the eight sites in question. Eight heavy metals (Cr, As, Fe, Pb, Cd, Cu, Ni, and Zn) and pH, EC, OC%, and OM% as physical parameters were studied. The quantity of these heavy metals in diverse water samples was expressed as alteration due to various long-standing pollution concern concerns. This study makes a compelling case for ongoing monitoring of the soil, irrigation water, and plants to prevent unwarranted buildup in the food chain.

I. INTRODUCTION

On earth, water is a natural resource that cannot be without. Water is a necessity for all life, including human life. Water serves a variety of purposes for living things because of its special qualities [1]. Research locations Due to the interruption and release of industrial pollution, Singrauli are extremely contaminated. In aquatic ecosystems, heavy metals are a significant source of dangerous contaminants [2,3].

They have a significant negative impact on intertidal creatures, aquatic organisms, and people [4,-6]. Heavy metals in the water can build up over time as a result of long-term deposition and interactions, which can harm the ecosystem and pose a serious hazard to life [7,8].

The accumulation of heavy metals and their chemical cycle have an effect on the ecosystem and associated biome, Heavy metals are the most frequent type of contamination and a factor in environmental monitoring [9]. They are produced by the chemical dissolution of bed rock, the discharge of urban, industrial, and rural waste wastes, and water drainage [10]. Urbanisation and industrialization are driving up the concentration of trace metals, especially heavy metals, in our rivers [11-17]. The biological phenomena depend on the chemistry of water reveals much about the metabolism of the ecosystem and explain the general hydro biological relationship completely [18,19]. The physico-chemical parameters of water and the dependence of all life process of these factors make it desirable to take as an environment [20]. In Present Study involves the analysis of water Quality in terms of basic physico-chemical parameters and heavy metal content.

II. MATERIAL AND METHODS

Study Area The present study was carried out in Singrauli region, all the experimental sample collected sites were cover the established industries and their discharge affect to the water and soil field also where the fruits and vegetables grow through the local farmers. Total 8 sites were taken in the study as GF1-GF8 having variable range of contamination and heavy metal contents.

In order to determine the physico-chemical analysis and heavy metals in collected water samples for water analysis has been tested. Analysis of various physico-chemical attributes

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were done following the standard procedures as detailed in APHA [20-22]. The atomic absorption spectrophotometer was employed for heavy metal determination. Samples of water are taken in bottle of 1000 ml, bottle was from polyethylene well cleaned, and transport and storage of samples are done with refrigerator for saving temperature between 4-7° C. Samples of water are brought immediately in laboratory to analyze. The physical parameter that has been analyzed are: Value of pH, Electrical conductivity these parameters has been rated in the place where samples has been taken through mobile device, heavy metals such as Fe, Pb , Cd ,Zn, Cu, evaluated with standard procedure [23]. Heavy metals in water were analyzed using the AAS. 100ml of water samples were measured, 10ml of aqua regia and 1 ml of perchloric acid added in a culture test tube, then incubated at 80°C in a water bath, after total digestion and subsequent cooling, the solution was diluted to 50ml and analyzed for heavy metals. The heavy metals analyzed were Zn, Pb, Cd, Hg and Cr [23].

III. RESULTS AND DISCUSSION

The results of the physical profiling of collected water from commercially growing (fruits and vegetable) sites of Singrauli during 2020-22 were studies with respective selected eight sites. The investigation highlights the throughout year 2020-21 examination of water samples listed the pH assessment ranged from 7.62 (most) -9.20 (least). Least pH obtained in GFS 5 water sample however maximum pH was in GFS 8 sample. The increasing order of pH were GFS 5 (7.62) < GFS 2 (7.65) < GFS 4 (7.82) < GFS 1 (7.88) < GFS 6 (8.24) < GFS 3 (8.60) < GFS 7 (8.84) < GFS 8 (9.20) respectively. The factors like air temperature bring about changes the pH of water. Most of bio-chemical and chemical reactions are influenced by the pH. The reduced rate of photosynthetic activities reduces the assimilation of carbon dioxide and bicarbonates which are ultimately responsible for increase in pH, the low oxygen values coincided with high temperature during the summer month [24].

EC ranges from 0.280-0.757 mS/cm. The raising sequence in EC (mS/cm) was GFS 4 (0.280) < GFS 5 (0.336) < GFS 1 (0.396) < GFS 6 (0.587) < GFS 8 (0.610) < GFS 7 (0.699) < GFS 2 (0.707) < GFS 3 (0.757). The conductivity informs on the degree of global mineralization of the surface waters. High temperatures affect the conductivity [25, 26]. According the analysis of the results of the evolution of the electrical conductivity in all study the stations, there is spatial and temporal variations of this factor similar to those of salinity [25].

Level of OC % was resolute and it distinguishes its lowest standard of 0.04% in GFS 2, 3, 4. On the contrary 0.07 % OC content recognized in GFS 5 and GFS 8 which was peak value. Other sampling stations have GFS 1 (0.06) = GFS 6 (0.06) > GFS 7 (0.05) OC%. For the level of OM% GFS 2 obtained least of 2.22 % while GFS 5 find its maximum value 4.60 % than other sites. Other Site stumbles on its altitude in random series GFS 1 (3.24), GFS 7 (3.61), GFS 4 (3.69), GFS 3 (4.37), GFS 6 (4.54), and GFS 8 (4.80) % correspondingly (Table 1 and Fig. 1).

The analysis of water mainly focused in determination of 8 heavy metals (Cr, Pb, Cd, As, Cu, Fe, and Zn). The level of Cr ranged from 0.02 ± 0.2 to 0.05 ± 0.3. The Cr order in samples collected from different sites was GFS 1 (0.05±0.3) > GFS 4 (0.04±0.1) = GFS 5 (0.04±0.2) = GFS 6 (0.04±0.3) = GFS 7 (0.04±0.1) > GFS 3 (0.03±0.4) = GFS 8 (0.03±0.4) > GFS 4 (0.02±0.2). The Pb range varied from (0.032±0.3) to (0.051±0.3). The Pb values meant for diverse sites were GFS 1 (0.051±0.3), GFS 2 (0.044±0.2), GFS 3 (0.032±0.3), GFS 4 (0.035±0.4), GFS 5 (0.036±0.2), GFS 6 (0.051±0.3), GFS 7 (0.044±0.2), and GFS 8 (0.039±0.3) accordingly. The result thus showed minimum Pb in GFS 3 (0.032±0.3) and most (0.051±0.3) in both GFS1 and GFS 6. For the Cd standard the values fluctuated from 0.074±0.4 to 0.087±0.2. The least Cd level observed in GFS 8 (0.074±0.4) however maximum Cd level establish in two GFS 3 and GFS 4 having values (0.087±0.2) and (0.087±0.3). As was establish as GFS 3 (1.31±0.5) < GFS 5 (1.33±0.4) < GFS 8 (1.34±0.4) < GFS 1 (1.43±0.3) = GFS 6 (1.43±0.3) < GFS 2 (1.50±0.4) = GFS 4 (1.50±0.6) = GFS 7 (1.50±0.3). Similarly, the Cu level order was found to be GFS 4 (0.012±0.3) < GFS 1 (0.015±0.4) = GFS 3 (0.015±0.3) = GFS 5 (0.015±0.2) < GFS 2 (0.016±0.3) < GFS 6 (0.018±0.4) < GFS 7 (0.019±0.3) < GFS 8 (0.019±0.4). Least amount GFS 3 (0.042±0.2) and most GFS 8 (0.082±0.2) Fe were determined in collected samples. However, the level of Zn varied from GFS 7 (0.01±0.1) to GFS 3 (0.05±0.4) (Table 1 and Fig. 1). All the studies heavy metals were shown their bioabsorption and binding principle with water particle [27]. The Speciation dynamics and bioavailability of metals help in exploration of the case of two uptake routes [28].

Table 1 Physical properties of water samples collected from commercially growing different sites 2020-21

	Physical parameters (Mean) (n=3)				Heavy Metals (Mean) (mg/l) (n=3)						
Water collecting site	**pH**	**EC (mS/cm)**	**Organic Carbon%**	**Organic Matter %**	**Cr**	**Pb**	**Cd**	**As**	**Cu**	**Fe**	**Zn**
GFS 1	7.88	0.396	0.06	3.24	0.05±0.3	0.051±0.3	0.080±0.2	1.43±0.3	0.015±0.4	0.068±0.4	0.01±0.3
GFS 2	7.65	0.707	0.04	2.22	0.04±0.1	0.044±0.2	0.081±0.1	1.50±0.4	0.016±0.3	0.066±0.1	0.02±0.1
GFS 3	8.6	0.757	0.04	4.37	0.03±0.4	0.032±0.3	0.087±0.2	1.31±0.5	0.015±0.3	0.042±0.2	0.05±0.4
GFS 4	7.82	0.280	0.04	3.69	0.02±0.2	0.035±0.4	0.087±0.3	1.50±0.6	0.012±0.3	0.054±0.4	0.04±0.2
GFS 5	7.62	0.336	0.07	4.6	0.04±0.2	0.036±0.2	0.081±0.4	1.33±0.4	0.015±0.2	0.048±0.5	0.03±0.2
GFS 6	8.24	0.587	0.06	4.54	0.04±0.3	0.051±0.3	0.080±0.2	1.43±0.3	0.018±0.4	0.068±0.3	0.00±0.0
GFS 7	8.84	0.699	0.05	3.61	0.04±0.1	0.044±0.2	0.078±0.1	1.50±0.3	0.019±0.3	0.076±0.1	0.01±0.1
GFS 8	9.2	0.610	0.07	4.55	0.03±0.4	0.039±0.3	0.074±0.4	1.34±0.4	0.019±0.4	0.082±0.2	0.01±0.4

Table 2 Physical parameters and heavy metal content in water samples collected from commercially growing different sites during 2021-22

	Physical parameters (Mean) (n=3)				Heavy Metals (Mean) (mg/l) (n=3)						
Water collecting site	**pH**	**EC (mS/cm)**	**Organic Carbon %**	**Organic Matter %**	**Cr**	**Pb**	**Cd**	**As**	**Cu**	**Fe**	**Zn**
GFS 1	7.81	0.443	0.06	3.63	0.06±0.2	0.065±0.3	0.084±0.3	1.48±0.3	0.025±0.1	0.072±0.2	0.02±0.3
GFS 2	7.61	0.784	0.05	2.58	0.05±0.1	0.056±0.2	0.085±0.1	1.58±0.4	0.019±0.3	0.073±0.1	0.02±0.1
GFS 3	8.54	0.815	0.046	4.56	0.04±0.3	0.040±0.4	0.088±0.2	1.35±0.5	0.018±0.3	0.052±0.2	0.06±0.3
GFS 4	7.72	0.35	0.05	3.85	0.03±0.2	0.039±0.4	0.088±0.3	1.55±0.6	0.020±0.2	0.058±0.2	0.05±0.2
GFS 5	7.57	0.376	0.08	5.08	0.04±0.2	0.042±0.3	0.082±0.3	1.37±0.4	0.018±0.2	0.051±0.3	0.03±0.2
GFS 6	8.15	0.62	0.06	4.94	0.04±0.3	0.059±0.4	0.084±0.3	1.49±0.3	0.028±0.4	0.069±0.3	0.01±0.0
GFS 7	8.77	0.702	0.06	3.65	0.05±0.1	0.048±0.2	0.081±0.1	1.58±0.3	0.023±0.3	0.076±0.1	0.01±0.2
GFS 8	9.04	0.625	0.07	4.80	0.04±0.3	0.043±0.3	0.075±0.3	1.36±0.4	0.024±0.4	0.084±0.2	0.02±0.3

The level of Cr ranged from 0.03±0.2 to 0.06±0.2. The order of Cr heavy metal in samples collected from different sites was GFS 1 (0.06±0.2) > GFS 2 (0.05±0.1) = GFS 7 (0.05±0.1) > GFS 3 (0.04±0.3) = GFS 5 (0.04±0.2) = GFS 6 (0.04±0.3) = GFS 8 (0.04±0.3) > GFS 4 (0.03±0.2). The range of Pb varied from (0.039±0.4) to (0.065±0.3). The values of Pb content for different sites were GFS 1 (0.065±0.3), GFS 2 (0.056±0.2), GFS 3 (0.040±0.4), GFS 4 (0.039±0.4), GFS 5 (0.042±0.3), GFS 6 (0.059±0.4), GFS 7

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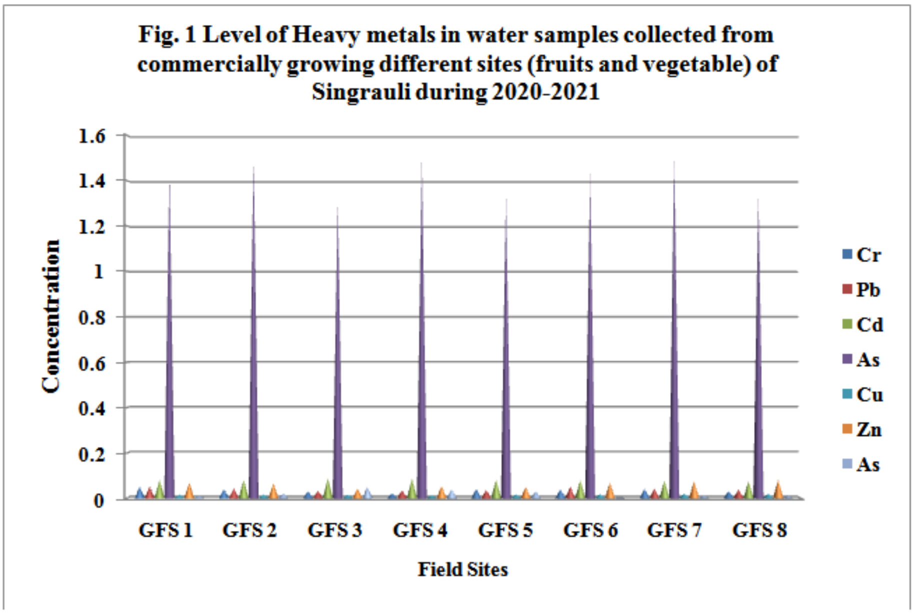
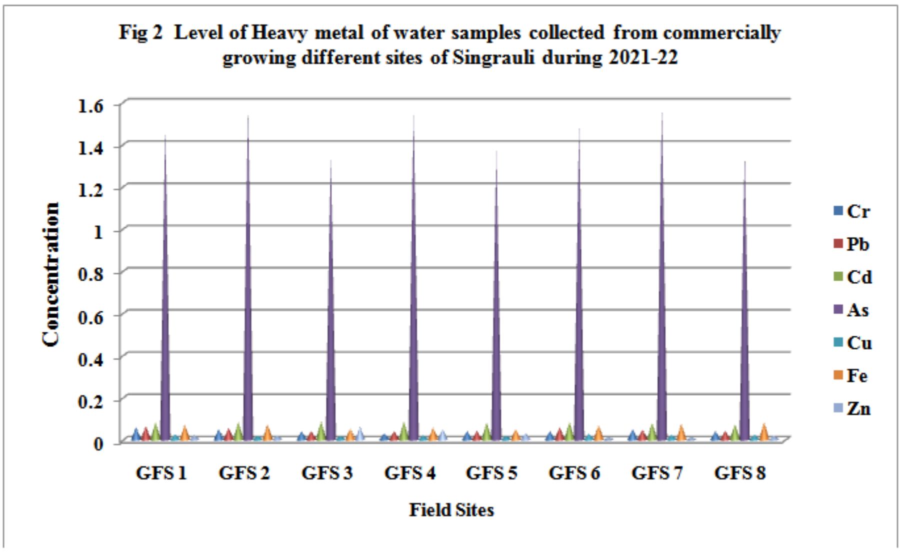
(0.048±0.2), and GFS 8 (0.043±0.3) accordingly. The result thus showed minimum Pb level in GFS 4 (0.040±0.4) and maximum (0.065±0.3) in both GFS1. For the Cd standard, the values fluctuated from 0.075±0.3 to 0.088±0.3. The minimum Cd level was observed in GFS 8 (0.075±0.3) however maximum Cd level was found in two GFS 3 and GFS 4 express (0.088±0.2) and (0.088±0.3) respectively. As intensity was establish as GFS 3 (1.35±0.5) < GFS 8 (1.36±0.4) < GFS 8 (1.37±0.4) < GFS 1 (1.48±0.3) < GFS 6 (1.49±0.3) < GFS 4 (1.55±0.6) < GFS 7 (1.58±0.3) = GFS 2 (1.58±0.4). Similarly, the order of Cu level was found to be GFS 5 (0.018±0.2) = GFS 3 (0.018±0.3) < GFS 2 (0.019±0.3) < GFS 4 (0.020±0.2) < GFS 7 (0.023±0.3) < GFS 8 (0.024±0.4) < GFS 1 (0.025±0.1) < GFS 6 (0.028±0.4). Minimum GFS 5 (0.051±0.3) and maximum GFS 8 (0.084±0.2) Fe content was determined in collected samples. However, the level of Zn varied from GFS 6 (0.01±0.0) to GFS 3 (0.06±0.3) (Table 2 and Fig. 2). Cadmium and zinc interaction and their transfer in water soil crop system under actual field conditions [29].





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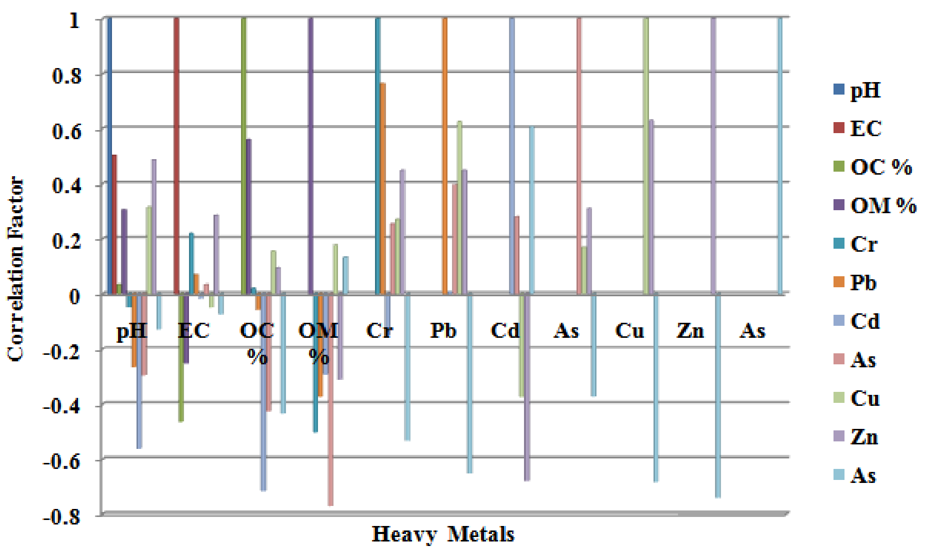
Correlation of physicochemical parameters and heavy metal content in water samples of 2021-22

The varied correlation matrix was established among various heavy metals during 2020-21 and 2021-22. The results illustrated that maximum positive and negative correlation was found between Cr-Pb (0.763928) and As-OM% (-0.77055) accordingly. However the least positive and negative correlation established between Cd-Pb (0.006932) and Cd-EC (-0.01734). The common unit correlation was found to each heavy metal with itself as shown in correlation matrix (Table 3 and Fig. 3).

Fig. 3 Correlation of physicochemical parameters and heavy metal content in water samples of 2021-22



IV. CONCLUSION

This research reveals to identify a spatial and temporal functional dynamism of the study. Maximum positive and negative correlation was found between Cr-Pb and the least positive and negative correlation established between Cd-Pb. The physical properties four basic parameters (pH, EC, OC and OM%) of water samples collected from commercially growing different sites of Singrauli region were alter randomly through geographical changes and involvement of heavy metals accumulation in soil and water. All studies sites were show maximum fluctuation of heavy metals content during 2021 and 2022 analysis. Study sites Singrauli is highly contaminated due to the disruption and release of industrial discharge. Long-term deposition and interactions can accumulate heavy metals in the water and negatively affect the ecosystem, thus posing severe threats to living beings specially growing and irrigated fruits and vegetables.

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