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Impacts of Industrial Pollution on Human Health: Empirical Evidences from Sriganganagar, Rajasthan, India

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ABSTRACT

Shri Ganganagar is a northern most city of Rajasthan state of Western India. Industries in Sri Ganganagar district of based on agriculture. There are more than 2500 industrial units in the City of different types that pollute the water bodies and wetlands especially around the urban areas. Wastewater effluent from Industries is untreated or inadequately treated before its discharge into agricultural fields. This paper is aimed to study the impact of untreated waste water on crops from industrial influent irrigated agriculture fields. 2 study sites were studied and data were collected for heavy metal content and microbiological profile. The results indicate the presence of Cu, Zn, Fe, Ni and Cd in agricultural produces which may pose serious danger to human health.

Introduction

Effluent water can contain a variety of pollutants that are harmful to the environment as a result of the growing rate of industrialization in residential areas. When effluent that has not been treated is sprayed to agricultural soils in order to grow vegetables, this becomes a significant cause for worry. According to Yadav et al. (2002)'s findings, such applications are growing in popularity due to the fact that effluent water provides an inexpensive supply of essential organic matter as well as plant nutrients. As a result of this, the practise of using wastewater and other types of industrial effluents for the purpose of irrigating agricultural lands is becoming increasingly common, especially in peri-urban areas of developing nations (Arienzo et al, 2009). In a developing country like Nigeria, there had been less of an emphasis placed on the installation of sewage treatment plants. This is in contrast to developed countries, such as the United States, where industrial effluents are subjected to primary and secondary treatments in order to lower the concentration of a variety of toxic elements to safe limits in water and soil. An investigation indicated that the majority of subsistence and commercial farming, particularly in urban areas, receives industrial effluent for the purpose of irrigating agricultural produce surrounding the same areas where the end product of these farm produces is consumed by humans (WHO, 2006).

The quantity of metals transfer from sludge-treated soil into the edible sections of crops was examined by (Carlton-Smith, 1987). Soil contamination caused by sewage and industrial effluents had adverse effects on both soil health and crop productivity (Cheraghi et al., 2009). However, sewage and industrial effluents are thought to have both a good and a harmful impact on the environment (Rajinder, 2012). This is due to the fact that the majority of these effluents include vital nutrients that plants require. According to Narwal et al. (1993), untreated industrial effluents and sewage can include high concentrations of heavy metals such as cadmium, nickel, lead, and chrome. According to the findings of two separate bodies of study (Narwal et al., 1993 and Kharche et al., 2011), the buildup of toxic metals in soil has the potential to pose significant risks to both human and animal health. According to Ward et al. (1995), heavy metals have the ability to accumulate in human essential organs over time. This is due to the fact that heavy metals are not easily biodegradable, which can induce varied degrees of sickness upon acute and chronic exposure.

The purpose of this study is to determine the effect that effluent discharge from industrial processes has on agricultural lands that are irrigated with effluent.

Method and Material

Study area

Ganganagar district lies in Rajasthan's far northwestern corner. The district is flanked by the Rajasthan districts of Bikaner and Hanumangarh and covers an area of approximately 11154.66 square kilometres. The majority of the district has an arid climate. It is distinguished by scorching summers and frigid winters. The Ganganagar district experiences a southwest monsoon season from June to mid-September, followed by a post-monsoon period till the end of November. Wheat, mustard, cotton, and other crops such as guar, bajra, sugar cane, and grams are also grown on a considerable scale. The study was conducted at 3-y, 6-z villages.

Soil types

The northern half of the district is distinguished by sierozems, or arid soils that range in colour from light yellowish brown to pale. The presence of kankar layer (calcareous concretions) has been discovered at depths ranging from 75 to 100 cm. The soils are deep and well-drained. Permeability is moderate to slow, and natural fertility and water holding capacity are often low. Within this soil group, the most common forms of soil encountered are loamy sand and sandy loam. Heavy metal pollution was studied in four key crops (*Cyamopsis tetragonoloba, Vigna radiate, Pennisetum glaucum, and Gossypium arboretum).* These crops were chosen for the study based on their cultivation area.

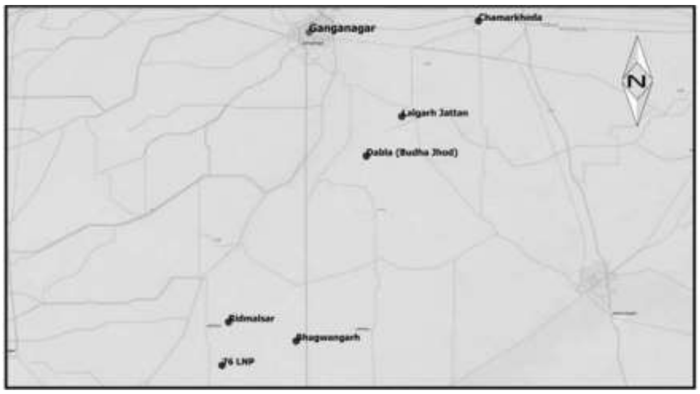

Fig 1. Sampling location in Sri Ganganagar District

Sample Analysis

For the purpose of researching the presence of heavy metals in water, soil, and crops, Ganganagar was chosen. Water samples were taken in polypropylene sample vials that had previously been thoroughly cleaned with nitric acid and rinsed several times with distilled water. After the rainy season, crop leaves and soil samples from the top 5 to 20 cm of the superficial mineral layer (5-20 cm) were gathered from a region with a lot of agricultural cover. The soil samples were ground in a mortar to pass a 2 mm filter after being air dried at 20° C. Before being dried at 70° and ground, the leaves of the chosen crops were thoroughly cleaned in deionized water to remove particles. Crop and soil samples weighing 0.5 g were put into a tough Borosil glass tube. Concentrated nitric acid and perchloric acid were applied to each sample in a ratio of 4:1. For 5 to 6 hours, or until they were completely digested and translucent, the samples were kept in a water bath. Three to four drops of H2O2 (30%) were then used to neutralise and dissolve the fat. Each sample was allowed to cool completely before being diluted with deionized water to a level of 10 mL, transferred to a sterile Borosil glass vial, and kept at room temperature until analysis.

Results and discussion

Heavy Metal Assessment in Soil and water:

The presence of nine primary heavy metals in the soil and water of the Sri Ganganagar district was investigated in a total of 80 samples. The locations were picked based on the size of their agricultural enterprises, the frequency of their pesticide applications, and the distribution of their populations. Table 1 below lists the average concentrations of several heavy metals in water sample and soil sample. Fe was the most heavily contaminated element in water samples, followed by Zn, Cr, Pb, Mn, Ni, Cu, Co, and Cd.

The sequence of the heavy metal contamination in soil samples was Fe>Mn>Cr>Zn>Pb>Ni>Cu>Co>Cd. It's important to note that the average amount of heavy metals in soil was lower than in water. It can be as a result of their filtration through groundwater. Ground water contamination may be caused by heavy metals produced by various agrochemicals applied to crops and naturally existing in the form of water soluble salts.

Table: 1 Concentration of different heavy metal in Soil and Water

S. No	Heavy Metal	Soil (ppb)		Water (ppb)	
		Min	**Max**	**Min**	**Max**
1	**Zn**	0.12	0.21	0.12	0.23
2	**Cu**	0.01	0.05	0.02	0.04
3	**Pb**	0.14	0.20	0.1	0.22
4	**Cd**	0.002	0.003	0.003	0.005
5	**Ni**	0.03	0.09	0.04	0.06
6	**Fe**	10.11	16.2	0.2	0.3
7	**Mn**	0.31	0.38	0.2	0.32
8	**Cr**	0.12	0.21	0.2	0.4
9	**Co**	0.02	0.03	0.02	0.04

The results of the present study may be related to those of a prior investigation that explored the mobility of different metals in soil and water in the abandoned Kettara Mine in Morocco. Heavy Metals in Particular Crops

Heavy metal accumulation in crops

Four important crops—Cyamopsis tetragonoloba (Gawar), Vigna radiata (Moong), Pennisetum glaucum (Bajara), and Gossypium arboretum (Narma)—were chosen for this study in order to examine the effects of heavy metals on crops growing in locations that are heavily polluted with heavy metals. We looked at the levels of Zn, Pb, Cu, Cd, Fe, Ni, Cr, Mn, and Co in diverse crops. Seven different places were used to gather the samples. To determine the levels of heavy metals in the various parts of the crops (roots, leaves, and leaves), all of the samples were tested. The results (Table 2) show that the average Zn concentration was found in several crops in the following order:

Table 2: Concentration of different heavy metal in selected crops.

S. No	Crops	Average concentration of Heavy Metals (ppb)								
		Zn	**Cu**	**Pb**	**Cd**	**Ni**	**Fe**	**Mn**	**Cr**	**Co**
1	*Pennisetum glaucum*	0.3	0.043	0.21	0.005	0.06	3.45	0.21	0.12	0.013
2	*Cyamopsis tetragonoloba*	0.4	0.06	0.16	0.007	0.07	7.1	0.29	0.13	0.018
3	*Gossypium arboretum*	0.21	0.04	0.17	0.002	0.06	4.3	0.26	0.11	0.16
4	*Vigna radiata*	0.31	0.06	0.15	0.002	0.05	4.6	0.22	0.12	0.02

Gawar had the greatest Pb content, whilst Moong had the lowest average value. At larger levels, Pb prevents cell division and elongation, which inhibits the formation of roots in plants. Excess Pb in animal feed can cause acute or chronic poisoning in animals, impairing their ability to synthesise haemoglobin and causing other problems such peripheral neuropathy, reproductive issues, and neurological abnormalities in developing children. Gawar had the greatest average Cr concentration, while Bajara had the lowest average Cr concentration. Crop Cr levels were far higher than the permitted maximum values for fodder (CERSPC 2009). Cr concentrations that are higher than permitted limits can harm plant physiological systems including photosynthesis and respiration. Numerous research conducted across India have shown that animals exposed to contaminated fodder are toxic to heavy metals (Pb, Cd, Cr, Cu, Mn, etc.). Gawar and Bajara had the highest and lowest average concentrations of cd, respectively. Similar research on vegetables grown near trash dumps in Kumasi, Ghana, found 0.68 to 1.78 mg/kg16 of cadmium contamination. Due to its association with kidney and bone damage as well as its potential carcinogenicity, cadmium toxicity is becoming a growing health concern in crops that are watered with wastewater. The most prevalent metals in crops are Cu and Zn, which are also essential micronutrients for plants18,19. Gawar was found to have the highest concentration of Zn, whilst Narma had the lowest average value. Similar to this, the higher level of Cu was revealed by the average Cu content in Gawar and Moong. In Bajara and Gawar, respectively, the average Ni content was found to be 0.059 ppb and 0.058 ppb. The plant metrics used to examine the effects of heavy metals on their growth included plant height, shoot and root biomass, leaf soluble sugars and starch, and the Ni contents of the shoots and roots. Nickel reduced leaf soluble sugars in general, indicating an effect on plant carbohydrate metabolism as well as plant development, morphology, photosynthesis, mineral nutrition, and enzyme activity. The greatest average Fe concentration is found in Bajara. Fe is a vital element for all plants because it performs numerous biologically significant processes such as photosynthesis and biosynthesis. Gawar was determined to have the highest average Mn concentration, whereas Bajara had the lowest. The current study's findings are consistent with previous research, which found that excessive manganese (Mn) deposition in leaves reduces photosynthetic rate. It was discovered that cobalt concentrations were highest in Narma and lowest in Bajara. It has been observed that plants can absorb trace amounts of cobalt from the soil. Cobalt absorption and distribution in plants are species dependent and controlled by numerous factors (Kitao et al., 1997).

Conclusion

The investigation assessed heavy metal concentrations in soil, water, and crops in Sri Ganganagar district. Water samples showed Fe, Mn, Cr, Zn, Pb, Ni, Cu, Co, and Cd, while soil samples showed Fe, Mn, Cr, Zn, Pb, Ni, Cu, Co, and Cd. Co and Cd concentrations were lowest in the study area. Heavy metal contamination may result from untreated waste water, pesticide use, and atmospheric deposition of suspended particulate matter. Regular monitoring is crucial for combating these issues.

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