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STATUS OF TOXIC HEAVY METALS (CD, NI, PB & CR) IN THE SOILS OF SAURASHTRA REGION OF GUJARAT, INDIA

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ABSTRACT

An attempt has been made in the present investigation to study the status of toxic heavy metals (Cd, Ni, Pb and Cr) in the soils Saurashtra region of Gujarat. Surface (0-20 cm) soil samples were collected for analysis from different ten districts of Saurashtra region by using GPS based free survey sampling method. Total 760 soil samples were collected from 76 Tehsils among 10 districts of Saurashtra region of Gujarat state. Samples were analysed by standard scientific method. The overall range of Cadmium in the study area were recorded as trace to 0.136 mg/kg with mean value of 0.033 mg/kg. In case of nickel, overall range indicated between trace to 9.37 mg/kg with mean value of 0.923 mg/kg. Lead recorded as trace to 6.73 mg/kg with mean value of 0.65 mg/kg. While in case of chromium in studied area soil examined between trace to 4.58 mg/kg with mean value of 0.0504 mg/kg.

Key words : Cadmium, Chromium, Lead, Nickel, Toxic heavy metals, Soil status.

Introduction

Heavy metal contamination of soils has markedly increased in the past few decades. In natural environment, distribution of heavy metals has no adverse impact on plant and human life but due to pedogenic and biogeochemical processes and anthropogenic inputs, concentration of heavy metals rises to such a level that these often become phytotoxic. Soils may become contaminated by the accumulation of heavy metals through emissions from the rapidly expanding industrial areas, mine tailings, disposal of high metal wastes, leaded gasoline, paints, land application of fertilizers, animal manures, sewage sludge, pesticides, waste water irrigation, coal combustion residues, spillage of petrochemicals and atmospheric deposition (Raymond and Felix, 2011). Land disposal of solid wastes like sewages, land mining and deposition from the atmosphere are also the major sources for heavy metal accumulation in the soil (Palaniappanan *et al.*, 2002). Industrial inputs and an application of agro-chemicals like fungicides, insecticide, fertilizers, pesticides, herbicides and metal-contaminated sewage contribute the metal accumulation in the soil (Herland *et al.*, 2000).

At present scenario, the main source of nutrients is chemical fertilizer in agriculture but those fertilizer containing heavy metals that accumulated in cultivated soil though continue fertilization specifically phosphatic fertilizers like single super phosphate derived from the rock phosphate are the chief source of heavy metals like cadmium and lead. The soil pollution by heavy metals resulting from phosphate fertilizer application has been a cause for concern in some countries (Alloway, 1990). On an average, rock phosphate contains 11, 25, 188, 32, 10 and 239 mg/kg of As, Cd, Cr, Cu, Pb and Zn, respectively (Mortvedt and Beaton, 1995). The nitrogenous fertilizer may increase Cd concentrations in plants, even if the fertilizers do not contain significant levels of Cd (Waongstrand *et al.*, 2007). In addition, (Alloway, 1995) concluded that phosphate fertilizer application in agricultural lands can cause increased levels of Cd, As, Cr, and Pb in soil and dramatically decreased soil pH that cause desorption of heavy metals from the soil matrix.

Use of large quantities of different agro-chemical like fertilizers, pesticides, bio-solids and waste water as inputs by the farmers for management of nutrients, pest, diseases and weeds, but agro-chemicals having trace quantity of pollutants including toxic heavy metals (Cd, Cr, Ni and Pb *etc*.). Continuous application of such agro-chemicals may accumulated toxic heavy metals at unacceptable level in soils due to less degradable nature, which may reduce the microbes activities and bio-chemical reaction. Now days, some quantity of heavy metal like Pb also accumulated in soil through petroleum product under farm mechanization.

Materials and Methods

Study area

The study area comprising of Saurashtra, a peninsular region of Gujarat state located on the Arabian Sea coast. With a total area of 66,000 sq. km. It is located on the West Coast of India in Gujarat and lies between 20^{o} $30^{'}$ to 23^{o} N latitude and 69^{o} to 72^{o} E longitude.

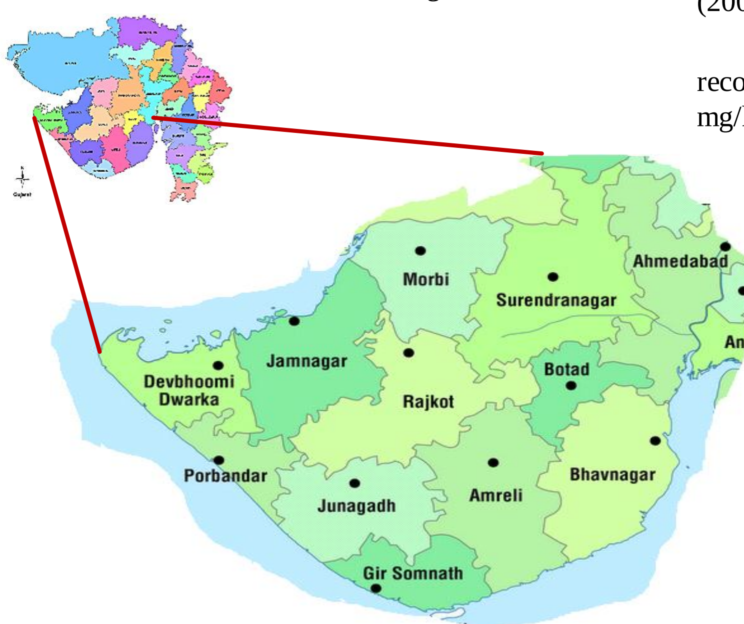

Fig. 1 : Sampling area (Saurashtra region).

Collection of soil samples

Soil samples were collected with use of free survey method through use of GPS technique, from surface soil level 0-20 cm. Ten soil samples were collected from each tehsils/talukas of 10 district of Saurashtra region during the summer season of year 2021. Soil sample was collected in plastic bag and transfer to cotton bag from the surface soils of study area and it was label properly.

Soil sample analysis

The prepared soil samples were analysed for determining toxic heavy metals (Cd, Ni, Pb & Cr) by adopting standard methods. Exactly 20 gram processed air-dried soil were weighed accurately into conical flask of 150 ml capacity and to be kept ready as per procedure described by Lindsay and Norvell (1978). After the soil extrection, heavy metals were estimeted on atomic absorption spectrophotometer.

Results and Discussion

The district wise mean value of toxic heavy metals (Cd, Ni, Pb & Cr in mg/kg) is being specified table 1. The overall range of Cadmium in Saurashtra region of Gujarat recorded as 0.00-0.136 mg/kg with mean value of 0.033 mg/kg. The data revealed that lowest mean value of Cadmium (0.013 mg/kg) was recorded from the soil samples of Probandar district which was followed by Surendranagar, where in case highest mean value of Cadmium (0.040 mg/kg) was recorded in soil samples of Amreli district. This finding is in conformity with the findings of earlier work done by Chen *et al.* (2007), Khan and Kathi (2014), Ahirwar *et al.* (2018), Zaniewicz *et al.* (2007) and Wani (2019).

The overall range of nickel in soils of Saurashtra was recorded as 0.00-9.37 mg/kg with mean value of 0.923 mg/kg. The data revealed that highest mean value of nickel (1.21 mg/kg) was recorded from the soil samples of Morbi district, where in case lowest mean value of nickel (0.796 mg/kg) was recorded in soil samples of Jamnagar district. Similar findings were also recorded by Krishna and Govil (2005) for Belapur industrial area of Mumbai, Sakram *et al*. (2015) conducted a study in soils around Zaheerabad town, Medak district, Andhra Pradesh, Wani (2019) for Kashmir division and Kumari (2021) investigated status of toxic metal contaminants in industrial areas of Himachal Pradesh.

The overall range of lead in Saurashtra was found as 0.00-6.73 mg/kg with mean value of 0.650 mg/kg. The data revealed that highest mean value of lead (1.16 mg/kg) was recorded from the soil samples of Morbi district, where in case lowest mean value of lead (0.210 mg/kg) was recorded in soil samples of Porbandar district. Similarly, Khan and Kathi (2014) for Pondicherry. Kumar *et al*. (2018) for industrial-affected area of Mandeep, Madhya Pradesh, the results indicated the concentration of lead in the range of 0.018-1.710 ppm. Wani (2019) conducted soil survey at five locations (hot spots) of Kashmir division like, Lassipora, Pampore, Khrew, Srinagar and Budgam. Rahman *et al*. (2022) studied the toxic metals in contaminated soil near a

Table 1 : Range and mean value of toxic heavy metals (Cd, Ni, Pb & Cr in mg/kg) in the soils of Saurashtra region of Gujarat.

Name of district	Cd	Ni	Pb	Cr
Rajkot	0.00-0.060 (0.026)	0.492-3.39 (1.19)	0.00-6.73 (0.732)	0.00-0.040 (0.010)
Amreli	0.011-0.104(0.040)	0.560-2.52(1.04)	0.00-1.72 (0.675)	0.001-0.076 (0.016)
Surendranagar	0.00-0.066 (0.024)	0.00-9.37 (0.995)	0.00-3.72 (0.914)	0.00-0.039 (0.008)
Jamnagar	0.009-0.048 (0.034)	0.267-1.49 (0.796)	0.165-0.90 (0.458)	0.008-4.58 (0.134)
Devbhumi-Dwarka	0.013-0.058 (0.032)	0.675-1.03 (0.923)	0.285-1.04 (0.662)	0.013-0.043 (0.026)
Morbi	0.00-0.136 (0.028)	0.544-3.05 (1.21)	0.168-1.97 (1.16)	0.008-0.044(0.020)
Bhavnagar	0.012-0.055 (0.034)	0.611-1.17 (0.985)	0.118-0.950 (0.549)	0.009-0.243(0.036)
Junagadh	0.020-0.093 (0.034)	0.28-1.76 (0.830)	0.00-0.980(0.60)	0.002-0.322 (0.054)
Porbandar	0.009-0.016 (0.013)	0.27-0.39 (0.32)	0.16-0.27 (0.21)	0.004-0.013(0.008)
Gir-Somnath	0.026-0.049 (0.039)	0.80-1.16 (0.95)	0.45-0.80 (0.58)	0.013-0.047 (0.027)
Overall	**0.00-0.136 (0.033)**	**0.00-9.37 (0.923)**	**0.00-6.73 (0.65)**	**0.00-4.58 (0.0504)**

tannery industrial estate in Bangladesh.

The overall range of chromium in Saurashtra was recorded as 0.00-4.58 mg/kg with mean value of 0.0504 mg/kg. The data revealed that highest mean value of chromium (0.134 mg/kg) was recorded from the soil samples of Jamnagar district, where in case lowest mean value of chromium (0.008 mg/kg) was recorded in soil samples of Surendranagar and Porbandar districts. Similar result also found by Khan and Kathi (2014), Paul *et al*. (2015), Sakram *et al.* (2015), Ahirwar *et al.* (2018) and Rahman *et al.* (2022).

Conclusion

In the present study, the stause of heavy metals presented based on overall range and mean value in soils for different ten districts of Saurashtra region. In case of cadmium was found between trace to 0.136 mg/kg with mean value of 0.031 mg/kg, nickel was recorded between tace to 9.37 mg/kg with mean value of 0.993 mg/kg, while in case of lead was recorded as trace to 6.73 mg/kg with mean value of 0.707 mg/kg and chromium was recorded as trace to 4.58 mg/kg with mean value of 0.035 mg/kg.

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