

Heavy Metals (Cd, Ni and Pb) Contamination of Soils, Plants and Waters in Madina Town of Faisalabad Metropolitan and Preparation of Gis Based Maps

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Abstract

Heavy metal pollution is a great threat to the environment. These metals are enters to the soil-plant environment through anthropogenic sources. A survey study was conducted to assess the heavy metals contamination of soils, plants and waters of Madina town of Faisalabad, Metropolitan area in 2010. Soil, plant and water samples were collected in the vicinity of Faisalabad following 4 × 4 Km grids. Soil samples were taken from 0-15 cm and 15-30 cm depths and prepared for the determination of metals (Cd, Pb and Ni). Plant samples were also taken from the same location and dried and digested in HClO₄:HNO₃ in the ratio of 1:3. AB-DTPA extract of soil, plants extract and water samples was analyzed on Atomic Absorption Spectrophotometer (Model Thermo S series). The results of the study showed the concentration of metals in Soils ranged from Cd (0.00-0.111 ppm), Pb (0.87-8.97 ppm) and Ni (0.017-1.72 ppm) at 0-15 cm while Cd (0.00-0.88 ppm), Pb (0.43-6.77 ppm) and Ni (0.055-0.852 ppm) at 15-30 cm respectively. Cd, Pb and Ni concentration in the plants ranged from 0.00-2.25 ppm 1.11-5.29 ppm and 1.51-4.96 respectively. Concentration of metal in the ground water ranged from Cd (0.00-0.06 ppm), Pb (0.10-11.10 ppm) and Ni (0.03-0.05). The concentration Pb and Ni was below the permissible limits while concentration of Cd in waters and plants above the permissible limits. Finally it was concluded that soil, plant and water of Madina town were in the safe limits with respect to metals. The use of city effluent is increasing the level of metals into the soils that ultimately contaminate the soils, plants and waters. So, it is suggested that city effluent must be treated for the detoxification of metals before use in irrigation purposes for crops.

Keywords: Heavy metals; Contamination; Soil; Plants and water

Introduction

Pollution of heavy metals directly and indirectly affects the human health. These substances adversely affect the productivity of soils, plants, animals and the entire environment if exceed certain limits [1]. Since quantity of good quality of water for agriculture is decreasing so, peoples are using raw city effluent for the production of different crops especially for vegetables. This raw city effluent contains lot of carcinogenic constituents like heavy metals, organic pollutants, salts and pathogens. Even in low concentration in soil-water system heavy metals persist for longer time in soil from where these enter into food chain through plant uptake. Sources of heavy metals pollution in environment are mainly derived from anthropogenic in nature. Which include vehicle exhaust, tire wearing, weathering street surfaces, power plants, coal combustion, metallurgical industry, auto repair shop, chemicals plant, domestic emission, weathering of building and pavement surface and atmospheric deposits. However, the anthropogenic sources of heavy metals in agricultural soils include mining, smelting, waste disposal, urban effluent, vehicle exhausts, sewage sludge, pesticides and fertilizers application. Among all the heavy metals cadmium (Cd) is a highly toxic for both the plants and animals as well as for human beings. Cadmium enters into soil-plant environment mainly through anthropogenic activities. Compounds of Cd are more soluble than other heavy metals rendering it more available for plant absorption where these could accumulate in edible plant parts.

In Pakistan Cd concentration in soil samples from the Islamabad expressway varied from 5.8 to 6.1 mgkg⁻¹ with an average value of 5.95 mgkg⁻¹[2]. The value of Cd in the paddy and straw was ranged from 0.116 to 0.370 mgkg⁻¹ and 0.315 to 0.370 mgkg⁻¹ in the areas of Faisalabad

[3]. Nickel (Ni) another heavy metal which is toxic, carcinogenic and dangerous for humans, plants and animals. The Ni released into the soil from copper-nickle smelters, burning of diesel oil containing Ni, city effluent, bio-solid, impurities in fertilizers, mining and smelting [4]. It enters into the soil-environment through anthropogenic activities although small quantities are released during *in-situ* weathering of parent material. In soil samples from Islamabad expressway, average concentration of Ni was 32 mg kg⁻¹ [2]. Chemical analysis of paddy and straw from Sheikhpura contained Ni 0.073-0.093 mg kg⁻¹ [5].

Lead (Pb) is a widespread heavy present in soils, plants and waters. It is mostly present in top layer of soil due to the deposition from air containing smoke from vehicles. The Pb is released to the from mining, industrial and agricultural chemicals. In uncontaminated soils, Pb concentrations are generally below 50 mg kg⁻¹ [6]. The Pb concentration in vegetation growing on such soils is often less than 10 mg kg⁻¹ dry mass. Soil lead ranging from 10 to 293 mgkg⁻¹ in agricultural areas and in the areas of pesticide manufacturing companies 57.05 mg kg⁻¹ were noted in Rajasthan, area of India [7].

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For mapping pollution hit areas different tools are used like geostatistics, multivariate statistical methods and GIS. Geographic information systems (GIS) provide powerful tools for spatial analysis Sweeney [8], Rodda et al [9]. applied GIS based decision support system to predict nitrate leaching to groundwater. Ahn and Chon [10] investigated groundwater contamination and derived spatial relationship between groundwater constituents and pollution sources using GIS. This database will help to locate the pollution of heavy metal in Faisalabad. It may also help the government to develop policies for the contaminated areas in Pakistan.

Faisalabad is one of the third largest city having many textile industries due to which it is called as Manchester of Pakistan. There are 512 large industrial units, out of which 328 are textile, 92 engineering complexes and 92 chemical and food processing units. All these industrial units are releasing huge quantity of untreated city waste water into unlined surface drains. From these drains farmers are using this contaminated water for the production of crops, especially vegetables. Farmers consider this raw city effluent is a good source of water and nutrients, substitute of good quality water and reliable source of irrigation round the clock. Keeping in view the above facts, the studies were designed to investigate the heavy metal contamination in soils, plants and water in the Madina town of Faisalabad, Pakistan followed by preparation of GIS base maps of polluted areas. This efforts will help development agencies to plan out types of sensitive land uses.

Materials and Methods

Study area

This study includes sampling of soil, plant and water. For the collection of soil, plant and water samples Madina Town of Faisalabad, Meteropolitan was selected. The samples was taken in the month of March 2010. Samples were collected from every grid 4-Km apart for soil, plant and water. Samples from each grid was collected and prepared according to the prescribed method and then analysed on Atomic Absorption Spectrophotometer (Model Thermoelectron S-Series) for the heavy metals determination. Global Positioning System (GPS) reading of coordinates was taken and then base maps was developed with the help of Geoghrapic Information System (GIS) software Arc GIS v.9.1. Detailed methods for collection, preparation and analysis of soil, plant and water samples are given below.

Collection and preparation of soil samples

Soil samples were collected from different urban and periurban area of Madina Town, Faisalabad after every 4-Km from 0-15 cm and 15-30 cm. soil samples were taken from 3 points at each grid and mixed thoroughly in a plastic bucket. Samples are taken to laboratory air dried, ground with wooden roller and sieved through 2 mm stainless steel sieve. For the determination of heavy metals soil samples were extracted with AB-DTPA (Soltanpur, 1985) and analysed on Atomic Absorption spectrophotometer (Model Thermoelectron S-Series). Physiochemical characteristics were also determined EC_e, pH_s and SAR [11].

Collection and preparation of plant samples

Plant samples were also collected from the above mentioned places as the soil samples taken. Two Plant samples of vegetables, crops, trees and ornamental plants depending upon the availability of vegetation were taken. Samples were taken to laboratory washed with tap water, diluted HCl water and distilled water to remove the external contamination. Samples were air dried and then placed in Oven at

65°C for drying of samples. After oven drying samples were ground and stored in plastic zipper. A 1 g samples was taken in digestion flask and 12 ml diacid mixture (i.e. Pechloric acid HClO₄ and Nitric acid HNO₃ with a ratio of 1:3) were added and kept for overnight stay. Next day samples are digested on hot plate till the plant material digested and color was clear. After digestion sample was cooled and made 25 ml volume with distilled water and stored in air tied bottles for the determination of heavy metals. Samples were analyzed on Atomic Absorption spectrophotometer (Model Thermoelectron S-Series). Instrument was calibrated with standard solution of respective metal.

Collection and preparation of water samples

Water samples were collected from the above mentioned sites. For water samples groundwater (tube well, hand pump and motor pumps), surface water (canal) and waste water (sewerage, industries effluent) were taken depending upon the availability in the area but ground water was taken from each site. Water sample was taken to laboratory and filtered with Whatman No.40. The water samples were analyzed for EC, SAR and RSC [11]. After the basic analysis of water samples concentrated HCl was added to the waste water samples and Sodium Haxametaphosphat was added to ground water samples to check the metal precipitation. For the determination of heavy metal Atomic Absorption spectrophotometer (Model Thermoelectron S-Series) was used.

Construction of GIS maps

For the construction of GIS (Geographic Information System) maps latitude (X coordinate) and longitude (Y coordinate) reading were taken with the help of Global Positioning System (GPS) model Etrex Germin. From the latitude and longitude reading obtained from the GPS was feed in the GIS software Arc GIS v.9.1 and base maps was drawn.

Results

Metal ions in the soil, plants and water collected from Madina town of Faisalabad

Cadmium (Cd) concentration in Soils

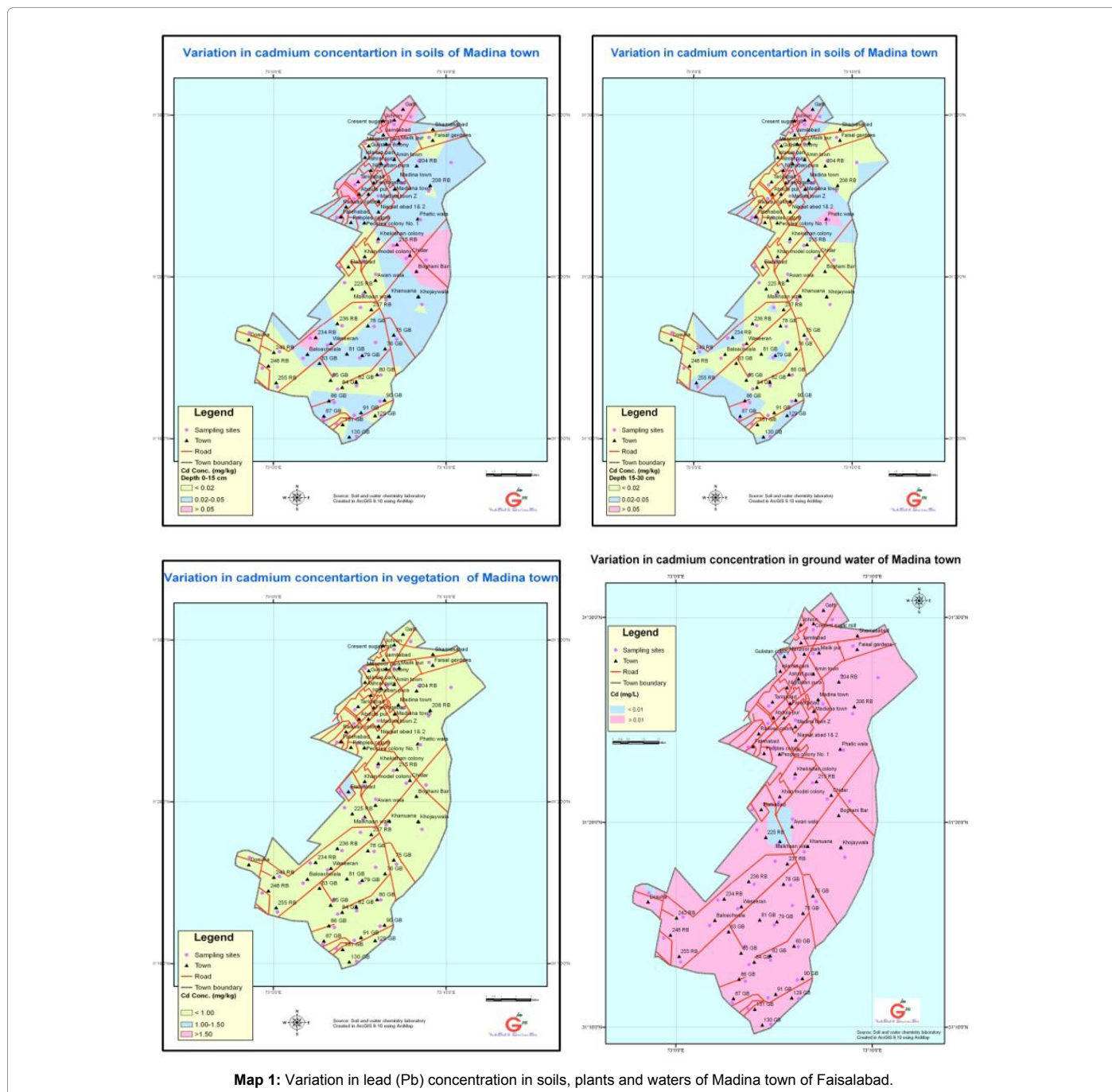
In the soil collected from Madina town of Faisalabad the AB-DTPA Extractable Cd ranged from 0.000 to 0.111 ppm and 0.000 to 0.088 ppm in 0-15 cm and 15-30 cm respectively with mean value of 0.03 and 0.02. The maximum concentration of AB-DTPA Extractable Cd (0.111 ppm) was observed at Crescent sugar mill while minimum concentration of Cd (0.001 ppm) was observed at Chak No. 255 RB, Bogran in 0-15 cm soil depth. The AB-DTPA extractable Cd was high in the upper layer of soil as compare to the lower depth which might be due to the anthropogenic activities. In the meanwhile the maximum concentration of AB-DTPA extractable Cd (0.088 ppm) was also observed at Crescent sugar mill and minimum concentration of Cd (0.000 ppm) was at Kahkashan colony in 15-30 cm soil depth. The high concentration of AB-DTPA extractable Cd may be due to the application of industry water in the lawns of Crescent sugar mill because the soil samples was taken from the industry lawn. Although the AB-DTPA extractable concentration of Cd in all the soil samples collected from the Madina town were below the permissible limits (<0.31 ppm) proposed by Alloway [4]. The results are similar to the findings of Zhou et al. Recent advances in industry and agriculture have led to an increased level of Cd in the agricultural soil environment. Cadmium enters the soil through various anthropogenic sources including application of phosphate fertilizers, waste water, Cd contaminated

sewage sludge and manures, and anthropogenic emissions from power stations, metal industries, urban traffic and cement industries. The main sources of Cd pollution are enhanced agricultural activities by using phosphatic fertilizers.

Cadmium (Cd) concentration in Plants

Plant samples collected from the Madina town of Faisalabad contained the Cd concentration in the range of 0.000-2.25 with mean concentration of 0.44 ppm in plants. The concentration of Cd was maximum (2.25 ppm) at Nawab town No. 2 in Barseem samples. The high concentration of Cd in the plants might be due to the application of sewage water. Although at Nawab town No. 2 sewage water samples

has the Cd concentration below the permissible limits, but by the continuous application of sewage water build up the concentration of metals into the soil. From the soil metals transfer to the plants and accumulate in the tissues of plants. Cd is more soluble as compare to other metals so, it can accumulate more into the plant tissues. The permissible limits of Cd were (0.10 ppm) in the plant tissue proposed by Macnicol and Beckett. The efficiency of plants to absorb metals can be evaluated by their ability of metal uptake or soil to plant transfer factors. Although soil concentrations may be the source of metals for plants uptake through roots by the process of translocation [12]. Find the Cd concentration in the plant samples above the permissible limits (Map 1).



Cadmium (Cd) concentration in waters

In the ground water samples collected from Madina town ranged from 0.00-0.06 ppm with mean concentration of 0.03 ppm. The maximum concentration of Cd 0.06 ppm in ground water was observed at Chak No. 227 JB, Kararwala while Cd concentration was not detected at Gulistan colony and Chak No. 226 RB. The concentration in the drinking water should be less than 0.01 ppm. The concentration of Cd at most of site was found above the critical limits (0.01 ppm). The high concentration of Cd in ground water may be due to the *in situ* weathering of parent material. The results are similar to the findings of Saif, they found Cd concentration in various water samples.

The concentration of Cd in canal water collected from Madina town of Faisalabad ranged from 0.00-0.05 with mean value of 0.02 ppm. The maximum concentration of Cd (0.05 ppm) in canal water was observed at Chak No. 226 RB Malkhanwala while at Chak No. 244 RB and Blochwala the Cd concentration was not detected. The concentration of Cd above the permissible limits might be due to the mixing of city effluent into the canal.

Waste water samples also showed Cd concentration above the permissible limits (0.01 ppm) proposed by Ayers and Westcot. The concentration of Cd in the waste water collected from the Madina town of Faisalabad ranged from 0.02-0.06 with mean value of 0.03 ppm. The maximum concentration of Cd (0.060 ppm) in the waste water was observed at Chak No. 87 GB while minimum concentration of Cd (0.020 ppm) was observed at Chak No. 236 RB Kajlay which is also above the permissible limits. The high concentration in the waste water at Chak No.87 GB might be due to the use of cadmium containing chemical in the industry.

Lead (Pb) concentration in soils

The AB-DTPA extractable Pb in soil samples collected from the Madina town of Faisalabad ranged from 0.87-8.97 ppm and 0.43-6.77 ppm at 0-15 cm and 15-30 cm with mean value 2.64 and 2.07 respectively. The available Pb concentration in the soil samples is much higher in the 0-15 cm depth as compare to the 15-30 cm depth it might be due to the aerial deposition from the vehicle exhaust. The maximum concentration of Pb was observed at Faisal garden (8.97 ppm) while minimum concentration (0.87) was at Chak No. 76 GB at 0-15 cm depth. In all the soils of Madina town the Pb concentration was between the normal range (5-15 ppm) proposed by Alloway [4] reported the high concentration of AB-DTPA extractable Pb at 0-10 and 10-20 cm soil depth around Faisalabad city irrigated with raw city effluent. The high concentration of Pb in the surface layer might be due to the continuous use of city effluent containing metals and also due to the less mobility of Pb within the soils particularly in alkaline soil conditions. The Pb is reported to mobilize more in acidic range of pH because Pb binds strongly with organic matter and oxides of Fe and Mn it is a low mobility metal in the soil. The results of the study are similar to the finding of Hussain and Saif.

Lead (Pb) concentration in plants

Plant samples collected from the Madina town of Faisalabad contained Pb in the range of ppm and 1.11-5.29 ppm with mean value of 2.72 ppm. The maximum concentration of Pb (5.29 ppm) was found at National Textile University in Gardenia shrub while minimum concentration of Pb (1.11 ppm) was minimum at Govt. Islamia high school Ghatti. The normal range (5-10 ppm) for the plant tissue was proposed by Kabata-Pendias and Pendias. The overall concentrations

of Pb in the plants of Madina town have Pb concentration between the normal ranges. The Pb concentrations in the samples taken from the urban area of Madina town have high concentration of Pb as compare to the village this might be due to the aerial deposition of Pb from the vehicles exhaust. These results are accordance with Chary et al [12] who reported the concentration of Pb in plants 1.3-3.6 ppm. Sekhar also reported the Pb concentration in the plants ranged from 0.1-5 ppm which are also below the permissible limits.

Lead (Pb) concentration in waters

The concentration of Pb in ground water samples collected from the Madina town of Faisalabad ranged from 0.10-11.10 ppm. The maximum concentration of Pb was high at Chak No. 226 RB Malkhanwala while minimum concentration of Pb (0.10 ppm) was observed at Ahmadabad, Chak No. 130 GB and Chak No. 204 RB. The Pb concentration in the water at Chak No. 86 GB, Maan pur garala and Chak No. 226 RB Malkhanwala was high from the permissible limits (5 ppm) proposed by Ayers and Westcot.

The canal water samples collected from the area of Madina town contained Pd in the range of 0.30-10.70 ppm. The maximum concentration of Pb (10.70 ppm) in canal water was observed at Chak No. 90 GB, Abdullah farm this might be due to the air-borne Pb contamination into the canal water. Minimum concentration of Pb (0.30 ppm) was observed at Chak No. 208 RB. Most of the canal water samples of Madina town have Pb concentration below the permissible limits (5 ppm) proposed by Ayers and Westcot.

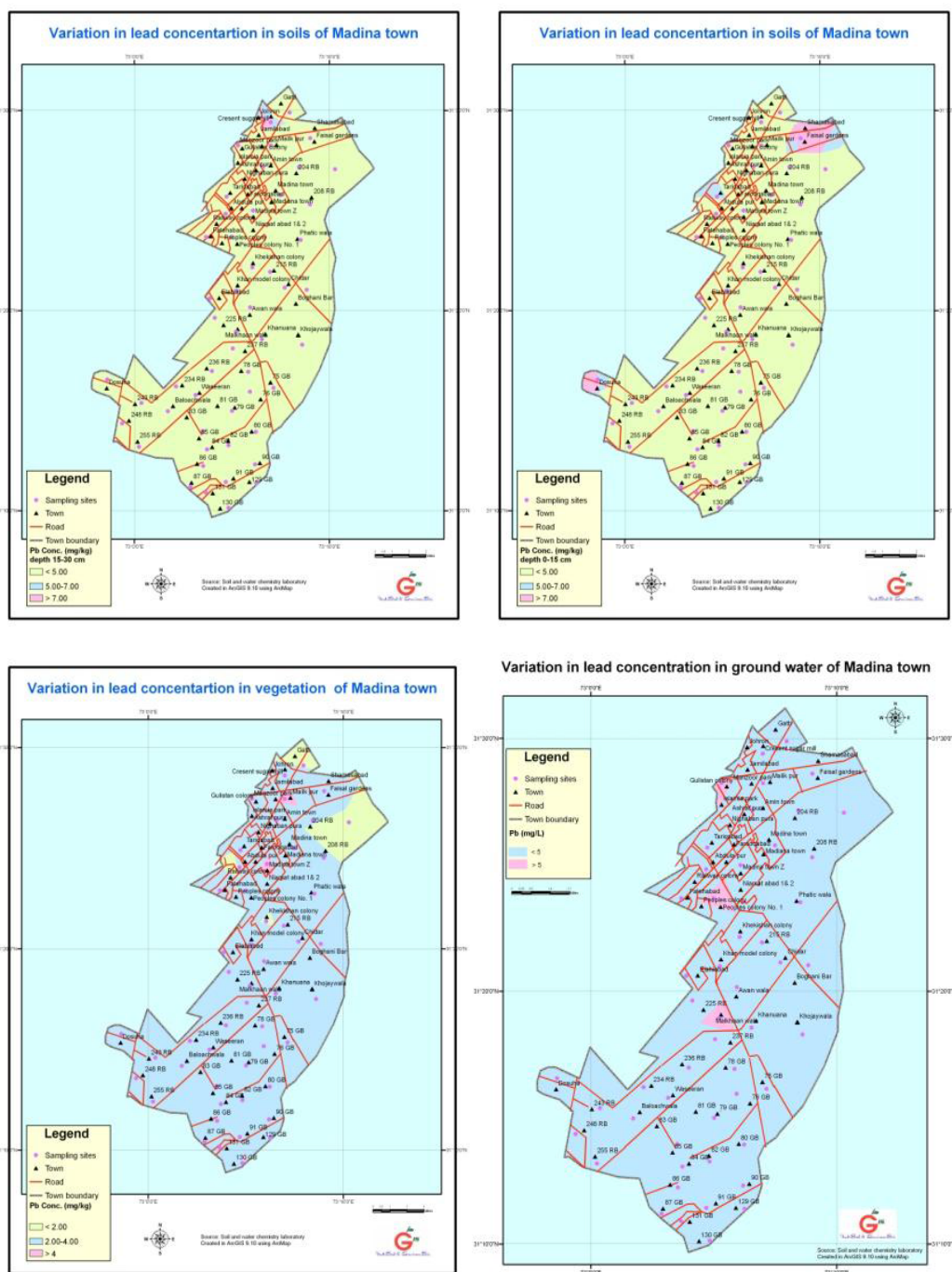
The waste water samples collected from the Madina town of Faisalabad have the Pb concentration below the permissible limits (5 ppm) proposed by Ayers and Westcot. The Pb concentration in the waste water of Madina town ranged from 0.10-0.90 ppm. The maximum concentration of Pb (0.90 ppm) was observed at Chak No. 215 RB, Naitheri while the minimum Pb concentration (0.10 ppm) was at Chak No. 86 GB and Chak No. 204 RB. Although in all the samples of waste water have the Pb concentration below the permissible limits. The concentration of Pb in the waste water was between the permissible limits because the most of the samples were from the village waste water (Map 2).

Nickle (Ni) concentration in soils

The AB-DTPA extractable Ni concentration in soil ranged from 0.017-1.072 with mean concentration of 0.33 ppm at 0-15 cm and 0.055-0.852 with mean concentration of Ni 0.27 ppm at 15-30 cm. The AB-DTPA extractable Ni concentration was less at 15-30 cm soil depth as compare to 0-15 cm soil depth. Maximum concentration of Ni was observed in sample collected at Govt. Municipal Degree College Abdullah Pur, Madina town. Nickle concentration at most of the sites was found in the normal range of 0.02-5.2 ppm in the soil [4]. The result showed that soils of Madina town were uncontaminated with nickle. Ni is also essential nutrient for plant growth. Saleem et al. [13] reported the Ni concentration in soil samples 0.92-1.57 ppm the results of study are also similar to the above findings. a study was conducted by Jie-liang et al. and results are in accordance with the present study. Li et al. also reported the Ni contamination in soils of Hong Kong by using GIS-Base approach.

Nickle (Ni) concentration in plants

The result showed that the Ni concentration in the plant samples collected from the Madina town ranged from 1.51-4.96 ppm in plants. The maximum concentration of Ni (4.96) was found at Chak No. 228



Map 2: Variation in lead (Pb) concentration in soils, plants and waters of Medina town of Faisalabad.

JB while minimum concentration of Ni was observed at Amin town. The plant Ni concentration in the Medina town also remained within the permissible limits (10 ppm) proposed by Macnicol and Beckett. City area has more concentration of Ni in plant as compare to the villages. The concentration of Ni in urban areas might be due to the anthropogenic activities. Hussain et al. reported the concentration of Ni ranged 4.4-20.0 ppm in the vicinity of Faisalabad. The results are similar to the study of Saleem et al [13] who also reported the

concentration of Ni in Korangi area of Karachi. The results are also in line with Sekhar et al.

Nickle (Ni) concentration in waters

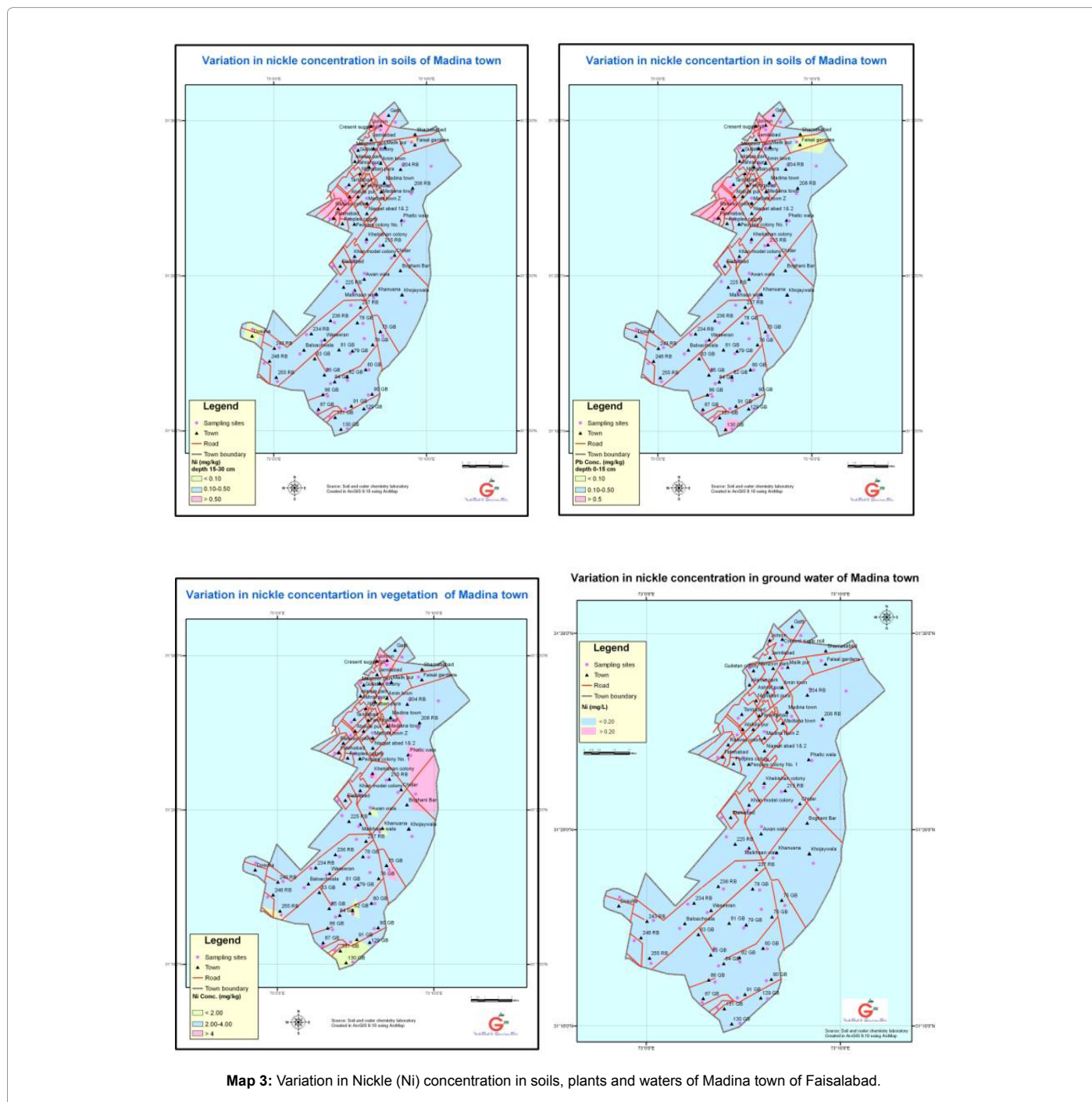
The Ni concentration in the ground water samples collected from the Medina town ranged from 0.03-0.05 ppm with mean concentration 0.04. Maximum concentration of Ni (0.05 ppm) was observed at Chak No. 225 RB, Malkhanwala while minimum concentration of Ni (0.030

ppm) was at Chak No. 229 JB. The Ni concentration in the ground water samples was below the permissible limits (0.2 ppm) proposed by Ayers and Westcot.

The canal water sample collected from the Madina town showed the Ni concentration ranged from 0.04-0.06 with an average concentration 0.05 ppm. Three canals are passing through the Madina town area viz. Gogera Branch, Jhang Branch and Rakh Branch. The Ni concentration in the canal water was also below the permissible limits (0.2 ppm). The maximum concentration of Ni was observed in canal water also at Chak No. 225 RB, Malkhanwala while the minimum concentration of Ni was

0.04 ppm at Chak No. 225 RB, Dasoha. Sekhar et al. have reported the Ni concentration in the surface water. Saif et al. also reported the Ni concentration in the waters of Korangi area of Karachi 0.02-5.35 ppm.

The results of waste water collected from the Madina town showed that range for the Ni concentration was 0.046-0.060 with mean concentration of 0.05 ppm. The maximum concentration of Ni (0.060 ppm) in waste water was observed at Chak No. 225 RB, Kajlay while the minimum concentration 0.046 was at Chak No. 204 RB. The results of waste water shows that the concentration of Ni below the proposed limits (0.2 ppm) by Ayers and Westcot (Map 3).



Conclusion

Finally it was concluded that in the vicinity of Faisalabad the use of raw city effluent is increasing for the irrigation of crops (due to the shortage of good quality water) which contains many heavy metals. By the continuous application of raw city effluent to the soils the metals are accumulating into the soils and plants as well as surface and ground water is also having these heavy metals concentrations. The production of safe food while using raw city effluent for irrigation requires some management strategies.

References

1. Mapanda F, Mangwayana EN, Nyamangara J, Giller KE (2005) The effect of long term irrigation using waste water on heavy metal content of soil under vegetables in Harare, Zimbabwe. *Agric Ecosyst Environ* 107: 151-165.
2. Faiz Y, Tufail M, Javed MT, Chauhadry M, Siddique N (2009) Road dust pollution of Cd, Cu, Ni, Pb, and Zn along Islamabad expressway, Pakistan. *Micro-chem J* 92: 186-192.
3. Nawaz A, Khurshid K, Arif MS, Ranjha AM (2006) Accumulation of heavy metals in soil and rice plants (*Oryza sativa* L) irrigated with industrial effluents. *Int J Agri and Biol* 391-393.
4. Alloway BJ (1990) Heavy metals in soils. Blackie and Academic Professionals, London, UK.
5. Mehdi SM, Abbas G, Sarfraz M, Abbas ST, Hassan G (2003) Effect of industrial effluents on mineral nutrition of rice and soil health. *Pak J applied sci* 3: 462-473.
6. Reimann C, De Caritat P (1998) Chemical elements in the environment-Factsheets for the Geochemist and Environmental Scientist. Springer-Verlag Berlin, Germany.
7. Karishna AK, Govil PK (2005) Heavy metal distribution and contamination in soils of Thane-Belapur industrial development area, Mumbai, Western India. *Environ Geol* 47: 1054-1061.
8. Sweeney MW (1999) Geographic Information Systems. *Water Environ Res* 71: 551-556.
9. Rodda HJE, Demuth S, Shankar U (1999) the application of a GIS-based decision support system to predict nitrate leaching to groundwater in southern Germany. *Hydrol Sci* 44: 221-35.
10. Ahn HI, Chon HT (1999) Assessment of ground water contamination using geographic information system. *Environ Geochem Health* 21: 273-289.
11. Allison JE, Bernstein L, Bower CA, Brown JW, Fireman M, et al. (1954) US Salinity Lab Staff, Diagonosis and improvement of saline and alkali soils. USDA Washington DC USA.
12. Chary NS, Kamala CT, Raj DSS (2008) Assessing risk of heavy metals from consuming food grown on sewage irrigated soils and food chain transfer. *Ecotoxicol and Environ Safety* 69: 513-524.
13. Saleem MS, Haq MU, Memon KS (2005) Heavy metals contamination through industrial effluent to irrigation water and soil in Korangi area of Karachi (Pakistan). *Int J Agri & Biol* 7: 646-648.

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