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Assessment of heavy metals in Soil of auto-workshop and nearby ground water of Rawalpindi, Islamabad, Pakistan

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Abstract

The present study is aimed to assessing the heavy metals concentrations in soil samples of auto-workshops and nearby ground water of Rawalpindi and Islamabad, Pakistan. Thirty Composite soilsamples were collected from auto-workshops and thirty samples of ground water were collectedof the study area to analyzed for selected heavy metals (Cd, Cr, Co, Fe, Mn, Ni, Pb&Zn) by using Atomic Absorption Spectrophotometer (AAS) (Perkin-Elmer model 700, USA). From study it is concluded that heavy metals concentrations in most of the soil samples were found within permissible limits except Zn values, which were found above the permissible limits. In water samples, some of the parameters including pH, Co, Ni, Zn and Mn values were found with in permissible limits while Pb, Cr and Fe at various locations points were noted above the permissible limit of WHO. So it is concluded that workshop area should be cemented and their effluent and waste should be treated properly before disposing off into the surrounding environment in order to eliminate the hazardous impacts on environment, agricultural soil and ground water resources.

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Introduction

Several activities in the auto mobile workshop includes metal scraps, used batteries, packaging materials, spent lubricants and worn-out parts mostly generate waste which contain contaminants such as heavy metals (Pam *et al.,* 2013b). These waste are indiscriminately dumped on soils, toxic metals in food stuffs, and ultimately leach into ground water and can endanger human health (Ogundele *et al*., 2015). Any of the Pakistan cities has no proper system of waste management and waste disposal. Due to poor management system for waste collection, a large amount of waste gets stuck in natural drains, ponds, rivers, canals etc. This provides a source place for disease causing insects such as mosquitoes which are mainly responsible for serious diseases like malaria, typhoid etc. On the other hand provision of less proper waste disposal sites, large amount of waste find its way to the natural rivers, ponds, streams, agricultural land, and open dumps. Due to these environmental conditions, Pakistan is getting worse year by year (Aziz, 2005). Presently heavy metals like Cr, Cd, Fe, Hg and Pb accumulation in soil is one of the most serious environmental concerns. Because this toxic heavy metals have capability to effects on human, animals and plants life. These metals are non-biodegradable which have carcinogenic effects (More *et al*., 2003).

Uncontrolled heavy metal i.e. Cr, Cd, Pb, Fe and Mn input to soils is undesirable, Some time when it accumulated, it is extremely difficult to remove and leads to i) toxicity to plants grown on contaminated soils, ii) absorption by crops resulting in heavy metals in plant tissues which may be harmful to the health of humans or animals, and iii) transport from soils to groundwater or surface water (Murtaza *et al*., 2010). Rawalpindi and Islamabad are cities where there are many authorized as well as unauthorized auto mechanic workshops. Activities conducted in these shops are typical of auto-mechanic repair shops and invariably involve working with and spilling of oils, greases, petrol, diesel, battery electrolyte, paints and other materials which contain heavy metals and contaminate bare soil as well as through runoff contaminate surface water and through percolation ground water resources.

In Pakistan, land resources are degrading at an alarming rate, causing environmental problems (Sarwar *et al*., 2008). Ground water is real wellspring of drinking water in Pakistan which usually approach by people groups from country zones and in addition significant urban communities including Karachi, Islamabad, Lahore, Hyderabad and so forth. There are some different origins of savoring water in Pakistan too. Since the development occurred and explosion of technology came, with which the residents numbers started striking high, after that exterior water became extremely a smaller amount to full the water requirements, along with the massive urban development and synthetic actions the exterior water now then became incompatible for intake capability, Likewise also became scarce for actions of industries and for their mechanism. One of the major and stable contaminants in water is heavy metals. Heavy metals are greatly more solid to split down, and jointly cause accountable effects on humans and their physical condition, alongside with these vital things also damage the ecosystem (Song, 2011). Poor environmental management and industrialization in the world especially in developing countries like Pakistan have increased the environmental problems. Industrial wastes and chemicals clearly pose a significant risk to the quality of soils, plants, natural waters and human health. The main objective of the study was to assess the levels of soil contamination present around the workshop area of Rawalpindi Islamabad area, and their effects on ground water.

Materials and methods

Study area

The modern capital and the ancient city of Rawalpindi stand side by side and are commonly referred to as the Twin Cities, where no exact boundary exists between the two cities, Shown in Fig., 1. The climate of both cities is almost same that was the reason why most suitable for research. The Soan and Kurang rivers are the main streams draining the area. The Kurang and Soan rivers are dammed at Rawal and Sambli lakes, respectively, to supply water for the urban area. Extensive forest reserves in the headwaters of the Kurang and Soan rivers benefit the quality and quantity of supply. A supplemental network of municipal and private wells as deep as 200 meters produces ground water primarily from Quaternary alluvial gravels. The altitude of the water table decreases from about 600 m at the foot of the Margala hills to less than 450 m near the Soanriver, so that the saturated zone generally lies 2-20m below the natural ground surface. Lei Nala carries the terrain in the metropolitan area of Islamabad Rawalpindi consists of plains and mountains whose total relief exceeds 1,175m (Qadir *et al.*, 2015).

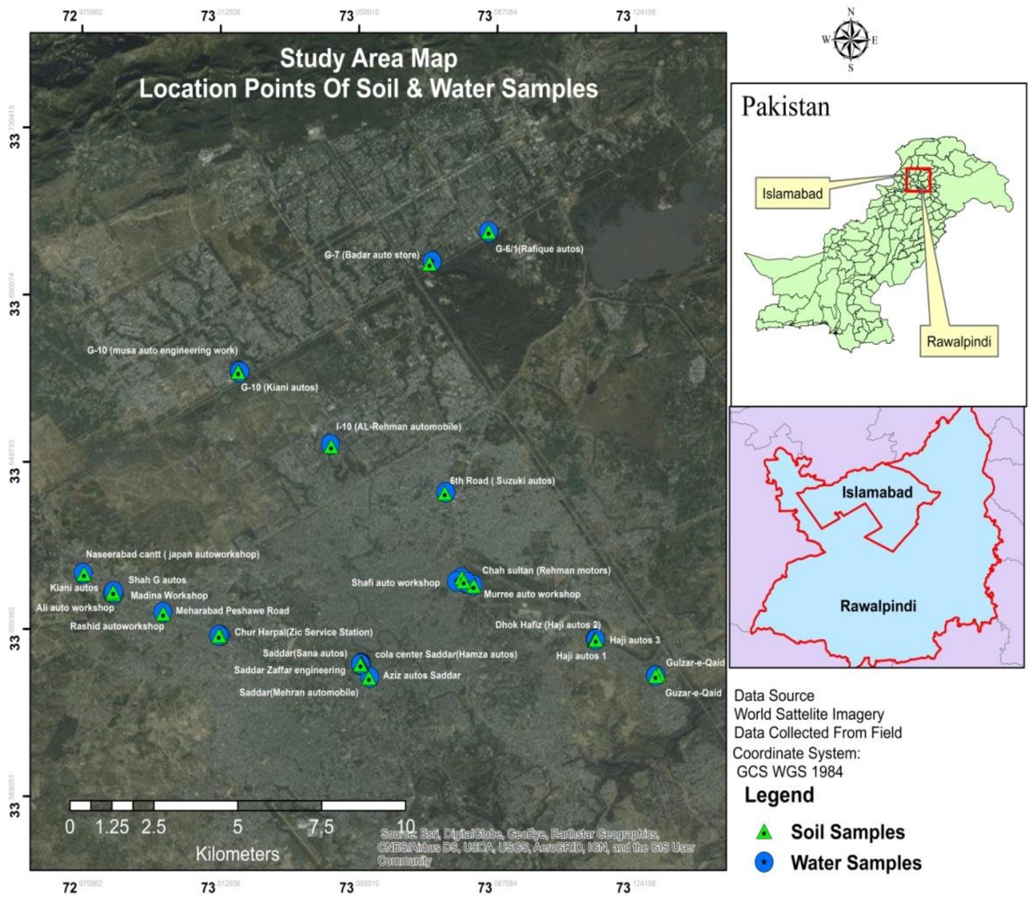

Fig. 2.1. Study areas Map of samples location point.

Methods

Thirty composite soil samples were collected from the selected auto workshop areas and thirty samples of drinking water of the study area. All soil samples were collected by digging the soil from 0cm upto 50 cm, using special soil collection augar kit, provided by the Bahria University, Islamabad. By using morter and pestle all soil samples were homogenized and gently crushed repeatedlyand passed through a 0.125mm sieve prior to analysis. In one gram of well homogenized sample 12mL of freshly prepared aqua regia (HNO_3: HCl, 1:3) was added. The beaker was covered and the contents heated for 2 hrs on the medium heat of a hot plate. The mixture was allowed to cool and then filtered through a Whatman No. 42 filter paper into a 50mL standard volumetric flask. The filtrate was diluted to 50mL with de-ionized distilled water. Blank solutions were also prepared using aqua regia and de-ionized water.

The digested sample solution were analysed using the atomic absorption spectrometer (AAS). Standard solutions of the various heavy metals were analysed. All soil samples were analysed in triplicate to minimize error. (Joseph., *et al.* 2017). On the other hand 30 water samples were collected in leak tight/ lined cap plastic bottles. Standard field sample preservation methods were used for later physical and chemical analysis in laboratory.

Analytical grade chemicals with 99.9% spectroscopic purity (Merck Darmstadt, Germany) were used for sample preparation and analysis. Double distilled water was used throughout the analysis. Standard solutions of all nine elements were prepared by diluting 1000 mg/L certified standard solutions (FlukaKamica, Buchs, Switzerland) of corresponding metal ions. The concentrations of selected heavy metals (Cd, Cr, Co, Fe, Mn, Ni, Pb and Zn) in water samples were analysedusing atomic absorption spectrophotometer (AAS) (Perkin-Elmer model 700, USA), under standard operating conditions. The integration and delay time of AAS was 5 sec (Khan *et al.*, 2013).

Results and discussions

Concentration of heavy metals in soils and water were analyzed by using Atomic Absorption Spectrophotometry by using standard methods, the soil results are shown in table 1. The soil samples which were collected from various workshop areas, they were analyzed for various heavy metals concentrations. From the result it was observed that Ni were ranged 0.011-0.023mg/kg, Co 0.002-0.33mg/kg, Zn 113-389, Pb 6.1-64.5mg/kg, Cr 0.007-0.016mg/kg, Cd 0.879-1.877mg/kg ,Fe 26.96-64.3mg/kg and Mn 0.014-0.06 mg/kg.

These values were compared with FAO/WHO. All the values were found within permissible limits except Zn values in some of samples at various location points of the study area. The result obtained from this work shows that the concentration of heavy metals were found which may in a small doses either through inhalation or absorption through skinor bio-accumulation (Garba *et al.*, 2013). The study which was conducted in Benin City also showed that the soil which were collected from the auto-mechanic site is highly contaminated with PAHs and elevated levels of heavy metals due to indiscriminate disposal of spent crankcase engine oils (Anegbe *et al.*, 2016).

Table 1. Concentration (mg/kg) of metals in soil of Auto workshops.

	Concentration (mg/kg)							
Sample No	Ni	Co	Zn	Pb	Cr	Cd	Fe	Mn
S-1	0.011	0.007	229	49.85	0.016	1.649	44.8	0.06
S-2	0.013	0.004	144	50.79	0.01	1.213	43.85	0.018
S-3	0.018	0.33	326.9	64.45	0.01	1.877	26.96	0.02
S-4	0.015	0.002	278	23.45	0.013	1.756	64.3	0.018
S-5	0.014	0.004	238	45.18	0.012	1.804	38.1	0.019
S-6	0.015	0.003	291	50.98	0.016	1.812	62.11	0.014
S-7	0.02	0.005	349	52.24	0.01	1.179	56	0.014
S-8	0.023	0.007	320.5	37.84	0.01	1.877	38.1	0.021
S-9	0.021	0.004	201.1	59.79	0.013	1.756	62	0.016
S-10	0.019	0.007	321	55.75	0.012	1.804	60.22	0.015
S-11	0.016	0.005	290.5	57.39	0.011	1.812	64.3	0.016
S-12	0.018	0.01	138	57.63	0.013	1.179	60	0.017
S-13	0.02	0.008	265	36.72	0.011	1.812	38.1	0.016
S-14	0.018	0.01	312	57.81	0.013	1.179	62	0.019
S-15	0.019	0.01	234.5	52.36	0.011	1.818	60.22	0.02
S-16	0.014	0.007	276	6.006	0.007	1.653	44.8	0.021
S-17	0.014	0.01	302	47.91	0.01	1.518	43.85	0.022
S-18	0.021	0.009	359	36.45	0.009	1.767	26.96	0.02
S-19	0.016	0.016	152	42.54	0.016	1.356	64.3	0.019
S-20	0.015	0.015	249	22.03	0.015	1.33	40	0.017
S-21	0.016	0.016	282	26.81	0.016	0.879	44.19	0.016
S-22	0.017	0.01	289	58.75	0.01	1.877	64.3	0.017
S-23	0.016	0.01	207	50.18	0.01	1.756	60	0.016
S-24	0.019	0.013	332	43.11	0.013	1.804	38.1	0.019
S-25	0.02	0.012	309	52.51	0.012	1.812	62	0.02
S-26	0.021	0.011	319	62.696	0.011	1.179	60.22	0.021
S-27	0.022	0.013	323	58.207	0.013	1.812	44.8	0.022
S-28	0.02	0.011	389	60.726	0.011	1.179	43.85	0.02

S-29	0.019	0.013	296	59.363	0.013	1.818	26.96	0.017
S-30	0.017	0.011	113	21.376	0.011	1.653	64.3	0.016

The water samples which were collected from various sources of the workshop areas, they were analyzed for various heavy metals concentrations and compare with WHO. From the result it is concluded that pH were ranged 7.1- 8.3, Ni were ranged 0.0.002-0.33mg/l, Co 0.009-0.023mg/l, Zn 0.03-4.13mg/l, Pb 0.03-0.135mg/l, Cr 0.017-0.073mg/l, Cd 0.034-0.135mg/l, Fe 0.845-2.179mg/l and Mn 0.031-0.135 mg/l. Some of the parameters including pH, Co, Ni, Zn and Mn values were found with in permissible limits in all samples. While Pb, Cr and Fe in maximum samples at various locations points were noted above the permissible limit of WHO, as shown in table 2.

Table 2. Concentration (mg/L) of metals in drinking water of the study area.

		Concentration (mg/l)							
Sample. No	pH	Ni	Co	Zn	Pb	Cr	Cd	Fe	Mn
SW-1	7.5	0.007	0.011	0.06	0.035	0.035	0.038	1.658	0.031
SW-2	7.2	0.004	0.013	0.051	0.038	0.038	0.036	1.966	0.041
SW-3	7.3	0.33	0.018	4.13	0.055	0.055	0.109	1.83	0.051
SW-4	7.7	0.002	0.015	0.05	0.03	0.03	0.034	2.179	0.055
SW-5	7.4	0.004	0.014	0.049	0.073	0.073	0.081	1.865	0.05
SW-6	7.3	0.003	0.015	0.054	0.041	0.041	0.045	1.714	0.035
SW-7	7.2	0.005	0.02	0.044	0.051	0.051	0.135	1.818	0.033
SW-8	7.8	0.007	0.023	0.051	0.033	0.033	0.05	1.653	0.035
SW-9	7.3	0.004	0.021	0.04	0.05	0.05	0.05	0.845	0.04
SW-10	7.5	0.007	0.019	0.038	0.035	0.035	0.051	1.518	0.035
SW-11	7.3	0.005	0.016	0.036	0.033	0.033	0.04	1.049	0.037
SW-12	7.5	0.01	0.018	0.109	0.035	0.035	0.038	1.339	0.06
SW-13	7.9	0.008	0.02	0.034	0.04	0.04	0.036	1.229	0.051
SW-14	7.5	0.01	0.018	0.081	0.035	0.035	0.109	1.865	0.135
SW-15	8.3	0.01	0.019	0.045	0.037	0.037	0.034	1.714	0.05
SW-16	8.1	0.007	0.014	0.035	0.06	0.05	0.081	1.818	0.049
SW-17	7.4	0.01	0.014	0.038	0.051	0.035	0.045	0.987	0.054
SW-18	7.4	0.009	0.021	0.055	0.135	0.033	0.135	1.011	0.044
SW-19	7.5	0.009	0.009	0.03	0.05	0.035	0.05	1.445	0.051
SW-20	7.1	0.009	0.009	0.073	0.049	0.04	0.049	1.335	0.04
SW-21	7.7	0.012	0.012	0.041	0.054	0.035	0.054	1.225	0.038
SW-22	8	0.01	0.017	0.051	0.044	0.037	0.044	1.445	0.036
SW-23	7.5	0.01	0.016	0.033	0.051	0.06	0.051	1.445	0.109
SW-24	7.5	0.013	0.019	0.05	0.04	0.019	0.04	1.335	0.034
SW-25	4	0.012	0.02	0.035	0.038	0.035	0.038	1.876	0.081
SW-26	7.3	0.011	0.021	0.033	0.036	0.038	0.036	1.555	0.033
SW-27	7.7	0.013	0.022	0.035	0.109	0.055	0.109	1.223	0.035
SW-28	7.4	0.011	0.02	0.04	0.034	0.03	0.034	1.021	0.04
SW-29	7.3	0.013	0.019	0.035	0.081	0.073	0.081	0.987	0.035
SW-30	7.2	0.011	0.017	0.037	0.045	0.017	0.045	1.101	0.037
WHO	6.5-8.5	0.02	0.05	3	0.01	0.05	0.03	0.3	0.5
PAK-EPA	6.5-8.5	≤0.02	N/A	5	≤0.05	≤0.05	0.01	1.01	≤0.5

The same type of study was conducted in Sub-Saharan Africa this study examined soil and water samples to quantify the load of heavy metals within these enterprises.Water samples around the workshops were also 82, 89 and 93% higher in Hg, Pb and Cd, respectively.Nemerow Pollution Index (NPI) shows that all the water samples from the workshop site are heavily polluted while 88% of the soil is between *slightly polluted* and *heavily polluted*. 55% of the background samples (water) are heavily polluted, while 30% of soil samples fall within the safety domain class of NPI. This shows that AWs pose a significant risk to human health, and there is an indication that increased concentration of heavy metals in soil could be linked to the content in the groundwater (Lawal *et al*, 2015). Another study was conducted automechanic villages, of Ibadan metropolis, to analyze physicochemical and heavy metals concentration in soil and ground water. From their study they concluded that there is various pollutants including the heavymetals and oil and grease build up to very highconcentrations in the soil, and thereby seep or percolate into the groundwater (Adewoyin *et al.*, 2013).

Conclusions

From the current study it is concluded from the results of soil and drinking water samples that they are consists of several heavy metals due to dumping of their waste in nearby. This study showed that may be due to seepage and leaching process from several decades, it contaminated the ground water resources, which may have impacts on ground water resources, because ground water samples showed heavy metals concentrations. Therefore workshop area should be cemented and their effluent and waste should be treated properly before disposing off into the surrounding environment in order to eliminate the hazardous impacts on environment, agricultural soil and ground water resources.

References

Adebayo AJ, TitilopeJJ,Oguntimehin II, Lajide L. 2017. Delineation of heavy metals in soils from auto-mechanic workshops within Okitipupa, Ondo State, Nigeria. International Research Journal of Public and Environmental Health **4(7),** 136-147

Adewoyin OA, Hassan AT, Aladesida AA. 2013. The impacts of auto-mechanic workshops on soil and groundwater in Ibadan metropolis. African Journal of Environmental Science and Technology **7(9),** 891-898.

Anegbe B, Okuo JM, and Okieimen FE. 2016. The impact of inorganic and organic pollutants in soil from the vicinity of mechanic workshops in Benin City., International Journal of Chemical Studies **4(3),** 106-112.

Aziz JA. 2005. Review, Management of source and drinking-water quality in Pakistan.Eastern Mediterranean Health Journal **11,** 1087-1098.

Garba NN, Yamusa YA, Isma'ila A, Habiba, SA, Garba ZN, Mus Y, Kasim SA. 2013. Heavy metal concentration in soil of some mechanic workshops of Zaria-Nigeria. International Journal of Physical Sciences **8(44),** 2029-2034.

Khan K, Lu Y, Khan H, Zakir, Khan S, Khan AA, Wang T. 2013. Health risks associated with heavy metals in the drinking water of Swat, northern Pakistan. Journal of environmental sciences **25(10),** 2003-2013.

More TG, Rajput RA, Bandela NN. 2003. Impact of heavy metals on DNA content inthe whole body of freshwater bivalve. Environmental Sciences and Pollution Resources **22,** 605-616.

Murtaza G, Ghafoor A, Qadir M, Owens G, Aziz MA, Zia Saifullah MH. 2010. Disposal and use of sewage on agricultural lands in Pakistan: a review. Pedosphere **20(1),** 23-34.

Ogundele DT, Adio AA, Oludele OE. 2015. Heavy Metal Concentrations in Plants and Soil along Heavy Traffic Roads in North Central Nigeria. Journal of Environmental & Analytical Toxicology **5(6),** 1.

Olanrewaju LO, Arokoyu SB, Udeh II. 2015. Assessment of Automobile Workshops and Heavy Metal Pollutionin a Typical Urban Environment in Sub-Saharan Africa. Environmental Research, Engineering and Management **71(1),** 27-35.

Pam AA, Sha' Ato R, Offem OJ. 2013. Evaluation of heavy metals in soils around automechanic workshop clusters in Gboko and Makurdi, Central Nigeria. Journal of Environmental Chemistry and Ecotoxicology **5(11),** 298-306.

Qadir A, Khan T, Zafar M, Murata M, Ali S, Gilani SM, Khan M. 2015. Effects of solid waste dumping on the water resources around Sector-H-12, Islamabad, Pakistan.

Sarwar G, Schmeisky H, Hussain N, Muhammad S, Ibrahim M, Safdar E. 2008. Improvement of soil physical and chemical properties with compost application in rice-wheat cropping system. Pakistan Journal of Botany **40(1),** 275-282.

Son E, Jaishanka GB, Saleh H, Jithpratuck W, Sahni R, Krishnaswamy G. 2011. Chronic granulomatous disease: a review of the infectious and inflammatory complications. Clinical and Molecular Allergy **9(1),** 10.