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Heavy metal investigation in River Siranat Khaki site Khyber Pakhtunkhwa Pakistan

Khalid Usman^{*1}, RizwanUllah Khan², Hameed Ur Rehman², Wajid Ullah²,
 Muhammad Naseem³, Muhammad Ayub Babar⁴, Muhammad Asif⁵, Ehsan Ullah⁶,
 Muhammad Arif⁷, Muhammad Ayub⁸, Muhammad Tariq⁹, Khalid Pervaiz¹⁰,
 InayatUllah Malik¹¹

¹Department of Zoology, Hazara University Mansehra, Khyber Pakhtunkhwa, Pakistan

²Department of Chemistry, Kohat University of Science & Technology, Kohat, KP, Pakistan

³Directorate of Agriculture Research, Potato Seed Production Pishin, Quetta, Pakistan

⁴Directorate of Vegetable Seed Production, Agriculture Research Institute, Quetta, Pakistan

⁵Directorate of Cereal Crops, Agriculture Research Institute Sariab Road, Quetta Pakistan

⁶Rural Development Academy Quetta, Balochistan, Pakistan

⁷Directorate of Pulses, Agriculture Research Institute, Quetta, Pakistan

⁸Directorate of Oilseed Crops, Agriculture Research Institute, Quetta, Pakistan

⁹Directorate of Special Crops, Agriculture Research Institute, Quetta, Pakistan

¹⁰Fisheries Research & Training Institute, Government of the Punjab, Lahore, Pakistan

¹¹Department of Biological Sciences, Sub Campus Mianwali, University of Sargoda, Pakistan

Article published January 26, 2019

Key words: Siran, Khaki, Pollution, Metals, Sampling, Range.

Abstract

The present investigation was conducted to evaluate the amount of heavy metals from River Siran at Khaki site Khyber Pakhtunkhwa, Pakistan. The chosen heavy metals were Zn, Cu, Cd, Pb, Cr and Mn correspondingly. In the current survey, the concentration of heavy metals examined were Zn 1.14-1.85 ppm; Cu 1.04-1.25 ppm; Cd 0.02-1.35 ppm; Pb 0.05-1.27 ppm; Cr 0.04-0.16 ppm and Mn 0.06-0.08 ppm respectively. In the present research Cu, Cd, Pb and Cr were found above the permissible ranges while Zn 1.13-1.88 and Mn 0.01-0.04 were lies within the permissible limits.

*Corresponding Author: Khalid Usman ✉ khalidusmankhattak1985@gmail.com

Introduction

Among environmental pollutants, metals are of particular concern, due to their potential toxic effect and ability to bioaccumulate in aquatic ecosystems (Censi *et al.*, 2006). Heavy metals including both essential and non-essential elements have a particular significance in ecotoxicology, since they are highly persistent and all have the potential to be toxic to living organisms (Storelli *et al.*, 2005). The most common heavy metal pollutants are cadmium (Cd), chromium (Cr), copper (Cu), nickel (Ni), lead (Pb), manganese (Mn) and zinc (Zn). Their source of entry into the aquatic system could either be single, identifiable or dispersed (often difficult to identify). The fact that heavy metals cannot be decomposed through biological degradation and have the ability to accumulate in the environment (Asaolu and Olaofe, 2005; Olowuet *et al.*, 2010). After decades of rapid urbanization, population growth and industrialization, developing countries are now home to many of the world's most critical air, water and solid waste problems. Early studies have identified the rise in the pollution of particular heavy metals in freshwater systems around the world, particularly in rivers. The pollution has mainly been caused by industrial processes and industrial waste, typically from rubber and oil palm mills (Tariq *et al.*, 1996). Heavy metal concentrations in aquatic ecosystems are usually monitored by measuring their concentrations in water, sediments and biota (Camusso *et al.*, 1995), which generally exist in low levels in water and attain considerable concentration in sediments and biota (Namminga and Wilhm, 1976). Trace elements are chemical elements that are required in a very minute amount for the proper growth, development and human physiology. They are called heavy metals because their densities greater than 5g/cm³. However these essential trace elements become poisonous when their concentration becomes extreme (Dao *et al.*, 2008). Contamination of surface water by heavy metals is a serious ecological problem as some of them like Hg and Pb are toxic even at low concentrations, are non-degradable and can bioaccumulate through food chain.

Though some metals like Fe, Cu and Zn are essential micronutrients, they can be detrimental to the physiology of the living organisms at higher concentrations (Kar *et al.*, 2008; Nair *et al.*, 2010). Heavy metals are produced from a variety of natural and anthropogenic sources, they are indeed an intrinsic natural constituents of our environment. In fluvial environments, however, metal pollution can result in from direct atmospheric deposition, geologic weathering or through the discharge of agricultural, municipal or industrial waste products (Dawson and Macklin, 1998). Heavy metals were recorded by Usman *et al.* (2017d) to study the water quality of the River Kabul at Dalda Oil Mill Nowshera Khyber Pakhtunkhwa, Pakistan. Water samples were collected from three different sites along the course of the River Kabul at Dalda Oil Mill Nowshera. The ranges of the heavy metals obtained during the present research were Zn 2.11-2.8 ppm; Cu 0.3-2.23 ppm; Cd 0.12-0.88 ppm; Pb 0.02-2.06 ppm; Cr 0.02-0.16 ppm and Mn 0.41.11 ppm respectively. A study was conducted by Usman *et al.* (2017e) to analyze the concentration of toxic pollutant. In this study the amount of heavy metals recorded were Zn 1.19-1.7 ppm; Cu 0.13-0.75 ppm; Cd 0.02-0.32 ppm; pb 1.01-0.03 ppm; Cr 0.00-0.00 ppm and Mn 0.01-0.03 ppm respectively. Measurement of heavy metals was conducted by Fawad *et al.* to know the rate of bioaccumulation of Chromium (Cr (III)) in the gills, intestine, and skin and its acute toxicity to goldfish (*Carassius auratus*) fingerlings. The result shows that the rate of accumulation of chromium in Gills > Intestine > Skin of gold fish (Fawad *et al.*, 2007). Concentration of heavy metals was analyzed by Usman *et al.* (2017c) in the River Kabul Shah Alam tributary, Peshawar Khyber Pakhtunkhwa, Pakistan. The concentration of the heavy metals were Zn 1.2-2.0 ppm; Cu 0.17-1.48 ppm; Cd 0.2-0.69 ppm; Pb 1.01-1.23 ppm; Cr 0.04-2.01 ppm and Mn 0.01-0.82 ppm respectively. Evaluation of heavy metals were carried out by Afridi *et al.* in the common carp (*Cyprinus carpio*) collected from two different water bodies the Tarbela dam, District Haripur, and River Soan District Rawalpindi Pakistan.

The concentration of detected metals found in different tissues of same species varied for Mn: 0.43-4.96, Ni: 0.49 – 1.60, Cd: 0.06 – 0.08, Cu: 0.36 – 0.81, Pb: 0.50 – 0.74, Se: 6.17 – 17.05, Zn: 0.59 – 3.74 $\mu\text{g/g}$ wet wt (Afridi, 2017). Amount of heavy metals were analyzed by Usman *et al.* (2017a) in different sites of River Kabul on Rohu, *Labeorohita* (Hamilton). As a result of accumulation of heavy metals in fish bodies, various diseases occurred which ultimately declined their population.

It is suggested that if the proper, timely remedial measures are not adopted, the situation will be aggravated and may cause the loss of precious fish diversity in the country. Hence, to overcome this serious problem industries discharge should be cleaned before entering to the River and properly time to time Fish fauna should be checked out. Quantity of health hazard metals was detected by Usman *et al.* (2017b) in natural waters of river Kabul,

Khyber Pakhtunkhwa Province, Pakistan. The concentrations of the metals recorded were in the range as: Pb 0.06-4.41 ppm; Zn 4.11-7.11 ppm; Cd 0.42-1.46 ppm; Cu 1.07-3.86 ppm; Mn 0.06-2.11 ppm and Cr 0.05-2.11 ppm. The aim of the current research work was to find out the heavy metal in River Siranat Khaki site Khyber Pakhtunkhwa Pakistan

Materials and methods

Study area

Khaki is one of the most beautiful place of Mansehra Khyber Pakhtunkhwa, Pakistan. Geographical Khaki is situated in Mansehra. Its coordinates is $34^{\circ} 24' 0''$ North, $73^{\circ} 8' 0''$ East. Climate of this area is warm and temperate. The rainfall in Khaki is significant, with precipitation even during the driest month.

The average annual temperature remains 18.5°C . In a year, the average rainfall is 1445 mm.



Fig. 1. Map of Khaki site at River Siran Khyber Pakhtunkhwa, Pakistan.

Sampling of water

Water samples were stored in clean and dry plastic bottles with screw caps and labeled. The freshly collected samples were analyzed for Heavy metals analysis at GC University Faisalabad lab by using atomic absorption.

Method for preparation of stock solution

The stock solution was prepared as 1000 ppm = 1000 mg/l. Then 100 ppm solution was prepared from stock solution using serial dilution equation of $C_1V_1 = C_2V_2$.

Determination of heavy metals in water

The water samples were first filtered with the help of filter paper and then taken in 250 ml of glass bottles and subjected to the atomic absorption spectrophotometer (Zn, Cu, Cd, Mn, Cr, Pb) at GC University Faisalabad lab.

Results and discussion

In the present study, the amount of heavy metals analyzed were Zn 1.14-1.85 ppm; Cu 1.04-1.25 ppm; Cd 0.02-1.35 ppm; Pb 0.05-1.27 ppm; Cr 0.04-0.16 ppm and Mn 0.06-0.08 ppm respectively. According WHO the Cu, Cd, Pb and Cr were found above the

standard level while Zn 1.13-1.88 and Mn 0.01-0.04 were lies within the permissible ranges. Usman *et al.*, 2018 conducted study to find out concentration of heavymetals in River Indus at Thakot Khyber Pakhtunkhwa, Pakistan. Heavy metals concentration obtained was Zn 1.15-1.86 ppm; Cu 1.06-1.25 ppm; Cd 0.05-1.39 ppm; Pb 0.03-1.22 ppm; Cr 0.04-0.13 pm and Mn 0.02-0.06 ppm respectively.

In this examination Cu, Cd, Pb and Cr were above the permissible limits. Usman *et al.* (2017e) work on River Kabul at Cantt area Nowshera to evaluate heavy metals.

Table 1. Concentration of heavy metals (ppm) in River Siran at Khaki site KP, Pakistan.

S.No	Metals	U.S	M.P	D.S	Permissible limits WHO
1	Zn	1.14	1.85	1.34	5.0 mg/l
2	Cu	1.04	1.25	1.07	0.05 mg/l
3	Cd	0.02	1.35	0.16	0.05 mg/l
4	Pb	0.05	1.27	0.15	0.05 mg/l
5	Cr	0.04	0.16	0.03	0.05 mg/l
6	Mn	0.06	0.03	0.08	50-70 mg/l

The metals which were recorded in the present study were Zn 1.13-1.85 ppm; Cu 1.02-1.21 ppm; Cd 0.03-1.32 ppm; pb 0.04-1.23 ppm; Cr 0.010.16 ppm and Mn 0.00-0.00 ppm respectively. In a research study demonstrated by Usman *et al.* (2018f) to estimate the amount of heavy metals in the water of River Kabul at Jehangira Lower Khyber Pakhtunkhwa, Pakistan. The highest concentration of the heavy metals was found Cu 0.2-1.66, Cd 0.06-0.96, Pd 0.02-1.1, Cr 0.01-0.06 while the lowest concentration was found Mn 0.11-0.23 and zinc 1.13-2.37 respectively. In a study carried out to assess concentration of heavy metals in River Indus at Pattan site Khyber Pakhtunkhwa, Pakistan.

Water samplings were carried out from the three selected sites of the River at Pattan site like The Upstream, Mid-Point and Downstream. The amount of heavy metals obtained was Zn 1.16-1.89 ppm; Cu 1.04-1.25 ppm; Cd 0.56-1.32 ppm; Pb 0.07-1.27 ppm; Cr 0.02-0.18 ppm and Mn 0.04-0.09 ppm

respectively (Usman *et al.*, 2018o). A survey was carried out by Usman *et al* (2017g) to find out the concentration of heavy metals in Jhanjira Upper site of the River Kabul Khyber Pakhtunkhwa, Pakistan. The results obtained from the current study were in the range of Zn 1.11-1.97 ppm; Cu 1.05-1.63 ppm; Cd 0.11-0.89 ppm; Pb 0.07-1.07 ppm; Cr 0.01-0.11 ppm and Mn 0.02-0.28 ppm respectively. A study was conducted to evaluate the concentration of heavy metals in River Indus at Biliyani site Khyber Pakhtunkhwa, Pakistan. For this purpose water samples were collected from three sites of the River i.e. upstream, midpoint and downstream respectively. The concentration of heavy metals such as cadmium, chromium, copper, manganese, lead, and zinc was recorded Zn 1.18-1.71 ppm; Cu 1.05-1.26 ppm; Cd 0.06-1.38 ppm; Pb 0.05-1.24 ppm; Cr 0.04-0.19 ppm and Mn 0.03-0.08 ppm respectively (Usman *et al.*, 2018n). Analysis of heavy metals was determined by Usman *et al.* (2017h) to explore the amount of heavy metals in River Kabul at Khairabad water KP,

Pakistan. Concentration of water samples was Zn 1.5-1.59 ppm; Cu 1.15-1.94 ppm; Cd 0.02-0.05 ppm; Pb 0.15-0.73 ppm; Cr 0.01-0.02 ppm and Mn 0.07-0.21 ppm respectively. A survey was conducted by Usman *et al.* (2018m) to evaluate concentration of heavy metals in River Dor at Mankarai Khyber Pakhtunkhwa, Pakistan. Heavy metals obtained were Zn 1.13-1.86 ppm; Cu 1.03-1.25 ppm; Cd 0.04-1.35 ppm; Pb 0.05-1.28 ppm; Cr 0.05-0.17 ppm and Mn 0.03-0.07 ppm respectively. Assessment of heavy metals were carried out by Usman *et al.* (2017i) to

examine the concentration of health hazard toxic metals in in River Kabul at Khazana Suger Mill Peshawar KP, Pakistan. Heavy metals concentration obtained from the present study was Zn 1.13-201 ppm; Cu 0.55-0.9 ppm; Cd 0.02-1.22 ppm; Pb 1.231.84 ppm; Cr 0.21-1.2 ppm and Mn 0.02-0.05 ppm respectively. An Investigation was carried out by Usman *et al.* (2018l) to explore the quantity of health hazard toxic metals in River Dor at Jama site Khyber Pakhtunkhwa, Pakistan.

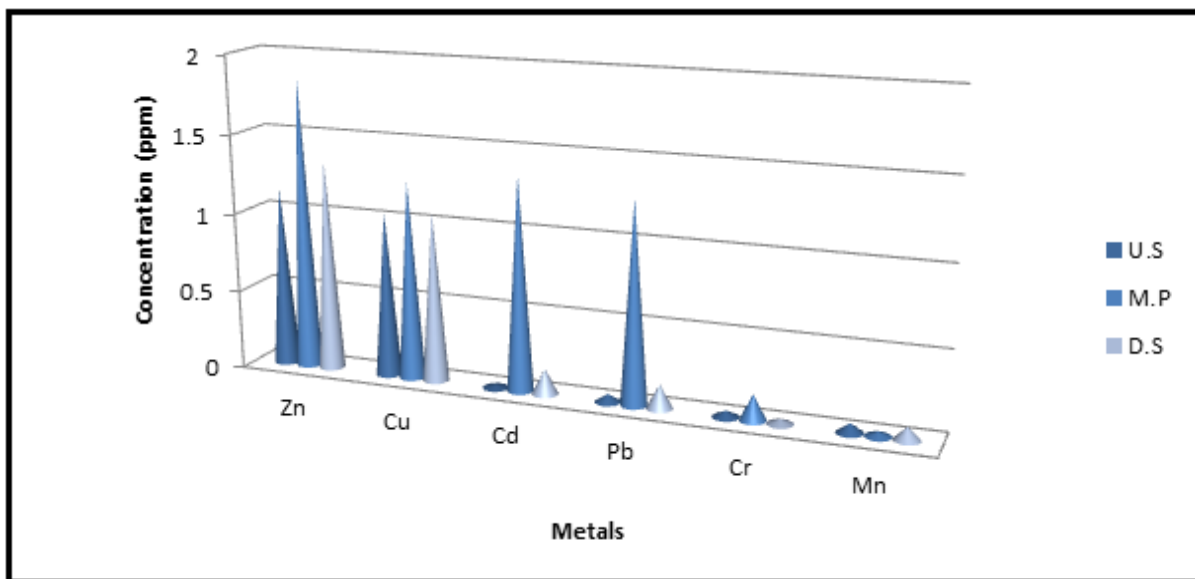


Fig. 2. Concentration of heavy metals (ppm) in River Siran at Khaki site site KP, Pakistan. U.S (Upstream); M.P (Mid-point); D.S (Downstream).

The concentration of the toxic heavy metals obtained was Zn 1.12-1.86 ppm; Cu 1.03-1.24 ppm; Cd 0.04-1.35 ppm; Pb 0.05-1.28 ppm; Cr 0.02-0.17 ppm and Mn 0.01-0.03 ppm respectively. A research work was conducted by Usman *et al.* (2017j) to estimate the amount of heavy metals in River Kabul at Kond Marble factory KP, Pakistan. The concentration of heavy metals obtained was Zn 1.2-231 ppm; Cu 0.3-1.89 ppm; Cd 0.13-0.75 ppm; Pb 1.13-0.96 ppm; Cr 0.01-0.02 ppm and Mn 0.11-0.44 ppm respectively. Atlas *et al.* (2017) find out the amount of heavy metals in River Kabul at Sardaryab KP, Pakistan. The heavy metals analyzed in the present research were in the range of Zn 1.14-1.86 ppm; Cu 1.03-1.22 ppm; Cd 0.12-0.89 ppm; Pb 0.08-1.08 ppm; Cr 0.02-0.12 ppm and Mn 0.03-0.29 ppm respectively.

A research study was conducted by Farhan *et al.* (2016) to determine the concentration of some heavy metals in water and soil samples of four different dams located in the area of Karak, KPK, Pakistan. Heavy metals analyzed in water and soil samples of all the four dam's indicated that among the seven heavy metals tested, Fe was maximum in concentration, followed by Zn, Cu, Pb, Ni, Cr and Cd. The sequence of heavy metals decreased in Zebi dam as Fe>Cu>Zn>Pb>Ni>Cr>Cd, in the sarki dam as Fe>Cu>Zn>Pb>Cd>Cr>Ni, in the sharki dam as Fe>Zn>Cu>Pb>Ni>Cd>Cr, and in the Changos dam as Fe>Zn>Pb>Cu>Cd>Cr> Ni respectively. A survey was carried out by Rehman *et al.* (2015) on Bannu Dam's and Damai Stream during Breeding Season of Fishes.

The order of heavy metals concentration in water and soil of damai stream and dam's was: Fe $53.17 \pm 0.2 \text{ mg/L}$ (Gomalzam dam soil sample) and $46.12 \pm 0.1 \text{ mg/L}$ (Gomalzam dam water sample), Pb $5.53 \pm 0.32 \text{ mg/L}$ (Gomalzam dam water sample) and $5.097 \pm 0.17 \text{ mg/L}$ (Gomalzam dam soil sample), Cu $6.05 \pm 0.11 \text{ mg/L}$ (Gomalzam dam water sample) and $3.50 \pm 0.01 \text{ mg/L}$ (Barganatu dam soil sample), Zn $3.38 \pm 0.03 \text{ mg/L}$ (Damai stream soil sample) and $2.27 \pm 0.01 \text{ mg/L}$ (Baran dam soil sample), Ni $0.77 \pm 0.01 \text{ mg/L}$ (Baran dam water sample) and $0.54 \pm 0.01 \text{ mg/L}$ (Baran dam soil sample), Cd $0.67 \pm 0.01 \text{ mg/L}$ (Damai stream soil sample) and $0.23 \pm 0.02 \text{ mg/L}$ (Damai stream water sample), Cr $0.12 \pm 0.01 \text{ mg/L}$ (Barganatu dam soil sample) and $0.08 \pm 0.03 \text{ mg/L}$ (Baran dam water sample). A research work was conducted by Usman *et al.* (2018k) to find out the concentration of heavy metals in River Dor at Dobandi site Khyber Pakhtunkhwa, Pakistan. In this study three sampling stations (Upstream, Mid-Point and Downstream) were selected in River Dor at Dobandi site which were away from one another 100 meter distance. The concentration of hazard heavy metals recorded were Zn 1.15-1.89 ppm; Cu 1.05-1.27 ppm; Cd 0.07-1.39 ppm; pb 0.06-1.27 ppm; Cr 0.03-0.19 ppm and Mn 0.03-0.05 ppm respectively. Another research was conducted by Rehman *et al.* (2016) to evaluate heavy metal of Molluska Shell, Water and Soil Collected from Darmalak Dam, Tehsil Lachi District Kohat. The homogeneity, samples Cr not present. But tissue samples having the diverge the concentration as well as order. The high concentration of heavy metals found in the sediment is due to the anthropogenic inputs and fishing activity.

Conclusion

The current survey was conducted in River Siran at Khaki site Khyber Pakhtunkhwa Pakistan to assess the concentration of heavy metals. From the current results it can be concluded that due to heavy metals toxicity water quality of this sampling station was not suitable.

Acknowledgement

Immense Thankful to Dr. Khalid Pervaiz and Dr. InayatUllah Malik. I am greatly thankful to Hameed Ur Rehman (Department of Chemistry). I am also thankful to my brother Dr. Wahid Raza (Department of Management Sciences ICUP) who helps me throughout in my research work.

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