



## RESEARCH PAPER

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## Incidence of heavy metals in River Siran at Parehna site Khyber Pakhtunkhwa, Pakistan

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### Abstract

The main aim of the current study was to explore the concentration of heavy metals in River Siran at Parehna sampling station Khyber Pakhtunkhwa, Pakistan. For the study heavy metals were collected from three sampling stations such as Upstream, Midpoint and Downstream. Heavy metals selected in the current study were Cd, Cr, Cu, Mn, Pb, and Zn respectively. The recorded heavy metals in the current investigation were Zn 1.17-1.75 ppm; Cu 1.05-1.26 ppm; Cd 0.08-1.36 ppm; Pb 0.05-1.28 ppm; Cr 0.04-0.19 ppm and Mn 0.08-0.12 ppm respectively. From the present study, it can be revealed that Cd, Cu, Pb and Cr were found above the permissible ranges while Zn and Mn were within the permissible ranges.

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## Introduction

It is the estuary of the Seine, an ecological association and a representative of the water police that bring their testimony to this worrying situation (Chabrierie *et al.*, 2011). Zinc is a major inorganic pollutant, which has inhibitory and stimulating effects on the growth along with accumulation in plants (Kumar, 1989). However, there has been a growing awareness of the need for sound management of water resources and in particular to control the dumping of waste in the environment (Pahl-Wostl, 2007). Rivers systems are being greatly polluted with heavy metals released from domestic wastes, industrial effluents and agricultural runoff (Mendil *et al.*, 2005). It has been suggested that increased intracellular zinc may result in mitochondrial impairment and generation of reactive oxygen species (Dineley *et al.*, 2003). These microorganisms actively contribute to the amelioration of the effluent quality, since the majority of them feed upon dispersed bacteria (Madoni, 2000). With industrialization and urban activities happening at a faster pace, the study of heavy metal contamination becomes more relevant in this regard. Heavy metals such as mercury, plutonium and lead are toxic and their accumulation, over a period of time in the bodies of animals can cause serious illness (Ayres, 1992). Heavy metal uptake processes by biological cells are known under the general term of biosorption. These phenomena include both passive adsorption of heavy metals to the cell walls and metabolically mediated uptake by the cells (Gadd, 1990). Water is essential for life and is the most important single product in human civilization. Water is an amazing substance constantly moving from sea to land and back again. It shapes the earth's surface and moderates our climate. It is the medium in which all living process occurs. Water dissolves nutrients and distributes them to cells, regulates body temperature, supports structures and removes waste products from the body (Cunningham and Cunningham, 2003; Mani *et al.*, 2013). Atlas *et al.* (2017) find out the amount of heavy metals such as Zn, Cu, Cd, Pb, Cr and Mn in River Kabul at Sardaryab Khyber Pakhtunkhwa, 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 work was conducted by Usman *et al.* (2018h) 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 aim of this research was to analyze heavy metals (Zn, Cu, Cd, Pb, Cr and Mn in the River Dor at Dobandi sampling site. The concentration of hazard heavy metals recorded were Zn 1.151.89 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. Assessment of heavy metals were carried out by Usman *et al.* (2017a) 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. Evaluation of heavy metals were carried out by Afridi *et al.* (2017) in the common carp (*Cyprinius carpio*) collected from two different water bodies the Tarbela dam, District Haripur, and River Soan District Rawalpindi Pakistan. Concentration of Mn, Ni, Cd, Cu, Pb, Se, Zn were determined in five tissues the gills, skin, kidney, liver and muscle. 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 µg/g wet wt. Quantity of health hazard metals was detected by Usman *et al.* (2017d) in natural waters of river Kabul, KP 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. An Investigation was carried out by Usman *et al.* (2018i) to explore the quantity of health hazard toxic metals in River Dor at Jama site Khyber Pakhtunkhwa, Pakistan. In this investigation a detail research work was carried out for the detection of

heavy metals in the three selected site of the River Dor at Jama sampling station. The toxic heavy metals (Zn, Cu, Cd, Pb, Cr and Mn) were under study in the present survey. 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. Measurement of heavy metals was conducted by Fawad *et al.* (2017) 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 behavioral change occurs in the fish is that all the fingerlings of goldfish come to the corner of the aquarium and their appetite also decrease due to chemical effect. Zinc inhibits transporter-mediated glutamate uptake (Vandenberg *et al.*, 1998) and depending on concentration, can inhibit or potentiate glycine receptors (Khan and Wu, 1999). It is also known that zinc is toxic to neurons. Studies in animal models suggest that endogenous zinc mediates neuro degeneration resulting from ischemia (Koh *et al.*, 1996; Suh *et al.*, 1996). A research work was conducted by Usman *et al.* (2017b) 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. Amount of heavy metals were analyzed by Usman *et al.* (2017c) in different sites of River Kabul on Rohu, *Labeo rohita* (Hamilton). The highest concentrations of Zn (6.00 ppm) was found at Jehangera Upper site, Cu (3.05 ppm) at Dalda Oil Mill Nowshera site, Cr (1.05 ppm) at Jehangera Lower, Mn (2.00 ppm) at Jehangera Lower, Pb (0.02 ppm) at Dalda Oil Mill Nowshera site and Cd (3.0 ppm) at the Jehangera Upper site. The objective of current research work was the Incidence of heavy metals in River Siran at Parehna site Khyber Pakhtunkhwa, Pakistan.

## Materials and methods

### Study area

Parehna is a well-known spot of River Siran located in Hazara Division Kyber Pakhtunkhwa Pakistan. Variety of flora and fauna existing in this area. Width of the river is approximately 13 meter and velocity of the water is high. Colony inhabited on the bank of the river which uses water of this area for various purposes like irrigation, washing and cattle's. Vertebrates (Hedgehog, Scaly ant eater, Snakes) and invertebrates (Dragonflies, Ladybird beetles, Butterflies) fauna is very popular.



**Fig. 1.** Map of River Siran at Parehna site Khyber Pakhtunkhwa, Pakistan. Blue Circle show sampling point of the selected site.

*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**

The recorded heavy metals in the current investigation were Zn 1.17-1.75 ppm; Cu 1.05-1.26 ppm; Cd 0.08-1.36 ppm; Pb 0.05-1.28 ppm; Cr 0.04-0.19 ppm and Mn 0.08-0.12 ppm respectively. From the present study, it can be reviled that Cd, Cu, Pb and Cr were found above the permissible ranges while Zn and Mn were within the permissible ranges. A survey was conducted by Usman *et al.* (2018j) to evaluate concentration of heavy metals in River Dor at Mankarai Khyber Pakhtunkhwa, Pakistan. In this assessment, the concentration of heavy metals obtained was 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. Concentration of heavy metals was analyzed by Usman *et al.* (2017e) in the River Kabul Shah Alam tributary, Peshawar Khyber Pakhtunkhwa, Pakistan.

**Table 1.** Concentration of heavy metals (ppm) in River Siran at Parehnasite KP.

S.No	Metals	U.S	M.P	D.S	Permissible limits
1	Zn	1.17	1.75	1.32	5.0 mg/l
2	Cu	1.05	1.26	1.05	0.05 mg/l
3	Cd	0.08	1.36	0.12	0.05 mg/l
4	Pb	0.05	1.28	0.06	0.05 mg/l
5	Cr	0.04	0.19	0.09	0.05 mg/l
6	Mn	0.08	0.12	0.09	50-70 mg/l

Pakistan.

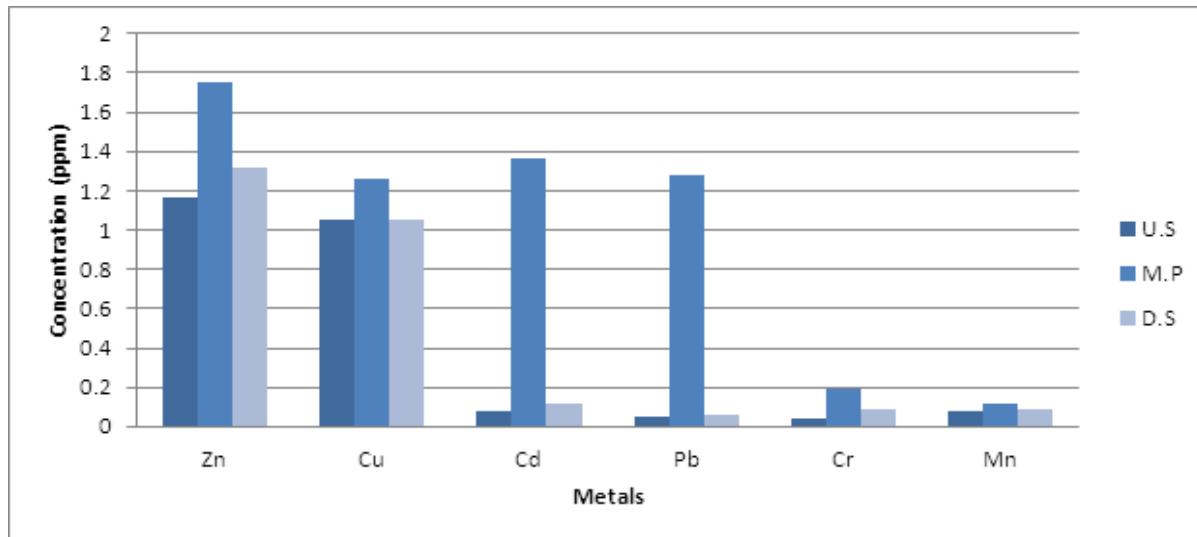
The concentration of the heavy metals were Zn 1.2-2.0 ppm; Cu 0.17-1.48 ppm; Cd 0.2-0.69 ppm; Pb 1.01-1.23 ppm; Cr 0.04-2.01 ppm and Mn 0.01-0.82 ppm respectively. A research study was conducted by Farhan *et al.* (2016) to determine the concentration of some heavy metals (Fe, Ni, Cu, Cr, Cd, Pb and Zn) in water and soil samples of four different dams located in the area of Karak, KP, Pakistan.

The results obtained showed that the average value of Fe and Zn in both water and soil samples were found to be higher than other metals. A study was conducted by Usman *et al.* (2017g) to analyze the concentration of toxic pollutant i.e. heavy metals (Zn, Cu, Cd, Pb, Cr and Mn) in River Kabul at Warsak

Peshawar KP, Pakistan. 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. 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.*, 2018k).

Heavy metals were recorded by Usman *et al.* (2017f) 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 amount of heavy metals such as cadmium, chromium, copper, manganese, lead, and zinc were determined using atomic absorption spectrophotometer.



**Fig. 2.** Concentration of heavy metals (ppm) in River Siran at Parehnasite KP, Pakistan. U.S (Up stream); M.P (Mid point); D.S (Down stream).

The majority of the samples were found to exceed from the permissible limit recommended by WHO. 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 0.41-1.11 ppm respectively. In a study carried out to assess concentration of heavy metals in River Indus at Pattan site Khyber Pakhtunkhwa, Pakistan. Water sampling was 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 in this study 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.*, 2018l). 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±0.2mg/L (Gomalzam dam soil sample) and 46.12±0.1mg/L (Gomalzam dam water sample), Pb 5.53±0.32mg/L (Gomalzam dam water sample) and 5.097±0.17mg/L (Gomalzam dam soil sample), Cu 6.05±0.11mg/L (Gomalzam dam water sample) and 3.50±0.01mg/L (Barganatu dam soil sample), Zn

3.38±0.03mg/L (Damai stream soil sample) and 2.27±0.01mg/L (Baran dam soil sample), Ni 0.77±0.01mg/L (Baran dam water sample) and 0.54±0.01mg/L (Baran dam soil sample), Cd 0.67±0.01mg/L (Damai stream soil sample) and 0.23±0.02mg/L (Damai stream water sample), Cr 0.12±0.01mg/L (Barganatu dam soil sample) and 0.08±0.03mg/L (Baran dam water sample). 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 high concentration of heavy metals found in the sediment is due to the anthropogenic inputs and fishing activity. A study was design to find out concentration of heavy metals 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.*, 2018m). A study was conducted by Khan *et al.* (2017) to find out contamination of toxicological effect on environment as well as on public health and is an emerging problem in District

Quetta. On average, the Antimony (Sb) ( $0.028 \pm 0.022$  mg/L) was above the WHO standard limits while Arsenic (As) ( $0.006 \pm 0.0094$  mg/L) was below the WHO standard limits. Heavy metals were detected by Akhwan *et al.* (2016) to explore the concentration of heavy metals in soil and water of Kohat dams with respect to fish production, KP, Pakistan. The average value of Pb in water (0.24mg/L) was found to be higher than the allowed value i.e. 0.01 mg/L. The average values of Zn, Cd, Cr and Cu in water are in the range of 0.52mg/L, 0.32mg/L, 0.082mg/L and 0.01mg/L which are below than the permissible value. Ni was found absent in all water samples. The average value of the heavy metals were also found in soil and found in the range of 1.43mg/L (Pb), 0.092mg/L (Ni), 0.92mg/L (Zn), 0.039mg/L (Cr), 0.134mg/L (Cu) and 0.20 mg/L (Cd), in which the value of Ni and Pb were found to be higher than the permissible value and other were found below the allowed level according to WHO.

### Conclusion

From the present study, it can be reviled that Cd, Cu, Pb and Cr were found above the permissible limits while Zn and Mn lies within the permissible limits. This high concentration of toxic metals can affect on water quality as a result aquatic flora and fauna are adversely affected.

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