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Research Article

Seasonal Investigations of chromium metal level from water and sediment of Isapur Reservoir, Maharashtra, India

Bhosle Arjun Bapurao and *Lolage Yogesh Popatrao

School of Earth Sciences,
Swami Ramanand Teerth Marathwada University, Nanded – 431 606, Maharashtra, India
*lolage.yogesh@gmail.com

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Abstract

Excessive chromium is carcinogenic and leads to allergic and asthmatic reactions and can damage liver and kidney etc. The current research work was carried out to study and estimate the seasonal concentrations of chromium metal in an aquatic system of the Isapur reservoir, located near Pusad on Penganga river of Maharashtra state using UV-VIS double beam spectrophotometer. The water and sediment sample were collected and analysed in the laboratory. Using diphenyl-carbazide method, the level of chromium was estimated every month during the study period i.e. June 2012 to May 2013. The maximum average concentration was recorded in summer. The chromium levels in both water and sediment has shown similar trend. The concentration has shown a wide range, the minimum value recorded was 0.0100 mg/L in monsoon, in the month of September 2012 and the maximum chromium concentration was recorded in the month of May 2013 i.e. in summer. Whereas, In sediment analysis, maximum chromium levels were 44 mg/kg in may 2013 and minimum 18 mg/kg in October 2012. The polynomial trend notifies the maximum average chromium concentration is observed in monsoon and summer and showed reducing pattern in winter season.

INTRODUCTION

Aquatic water pollution due to industrial and agricultural activities renders freshwater undrinkable and incompatible for consumption (Kumar and Padhy, 2015). Accumulation of non-natural pollutants including chemicals and chemical fertilizers like herbicides, pesticides, into a waterway are adding to the pollution and hinder the quality of water (Agrawal *et al.,* 2010). The alterations caused by nutrient additions are apparent and create hazard to the society (Renata *et al.*, 2012). As a result hazardous chemicals and metal ions can enter into the food chain from the soil or water, disturb the bio-chemical processes and finally lead to serious effects on living organisms (Sharma *et al.*, 2011). The circulation dynamics study of these contaminants is useful in assessing the risk for environment and human health (Ritter *et al.*, 2002).

These contaminants including heavy metals as they are greatly persistent and have toxic potential, enter into aquatic water-bodies and can be awfully toxic and therefore studies for understanding the threat of toxic metal pollution in natural waters has become essential (Storelli *et al.*, 2005). These toxic metals can damage and lethal for the existence of aquatic life forms and can have irreversible and direct effects on individual activity like growth, metabolism, and reproduction (David and Pamela, 2002).

Chromium is first element in group VI. It is 21st most plentiful mineral in the earth crust. Chromium compounds are listed in water hazard class 3 and are known as highly toxic even at smaller concentrations for plants and animals. Chromium enters into environmental systems like air, soil and water through natural and anthropogenic sources in trivalent and hexavalent forms (Velma *et al.,* 2009). Chromium has wide industrial applications (Selvam *et al.,* 2013), used extensively in stainless steel, leather tanning, electroplating, dyes, and wood industries (Das and Mishra, 2008). Trivalent chromium is highly essential to regular carbohydrate, lipid and protein metabolism process (Pechova and Pavlata, 2007). Hexavalent chromium is a wicked environmental pollutant because of its high toxicity and its high doses having potential to cause birth defects and cancer. Chromium maintains proper carbohydrate and lipid metabolism and is crucial for mammals however, its molecular level function shows problematic role (Vincent, 2000).

River sediments acts as a pollutant sink and explains various sources and history of the river pollution (Jain 2004). Singh *et al.,* (2005) analysed heavy metals from water and sediments of river Gomti, a tributary of the river Ganga to study the impact of domestic sewage and industrial effluents. They found that the chromium concentration in water samples found in the range of 0.0015 to 0.0688 mg/L and 6.105 to 20.595 µg/g in sediment during their study in 2002-03. Shaikh and Bhosle (2012), studied the chromium contents from Siddheshwar dam water of Maharashtra state. The study was carried out during July 2009 to June 2010, they recorded the highest chromium concentration i.e. 0.274 mg/L in the month of October 2009.

Kar *et al.,* (2008) analyzed 96 surface water samples from river Ganga in west Bengal during 2004-05. They noted that the seasonal chromium variation was significant and maximum mean concentration of chromium was 0.020 mg/L during winter. Dahab and Madfa (1997), investigated the chromium concentrations of the eastern side of the Qatari Peninsula. They observed average chromium content of water ranged from 0.08, 0.66 and 0.54 µg l^{-1}, respectively and sediments concentration ranged from 11.6 to 46.5 µg g^{-1} dry wt. with an average of 25.4 ± 8.7 µg g^{-1} dry wt. Gautam *et al.,* (2011) observed total chromium content from Krishna river in Bagalkot district of Karnataka and noted that the chromium has ranged from 0.008 to 2.332 and 0.007 to 0.104 mg/L in post and pre- monsoon respectively.

Mane *et al.,* (2013) assessed the chromium contents from Sudha dam of Maharashtra (India). They observed chromium concentration 0.002 mg/L from water and 0.006 mg/gm for sediment respectively. Hamda *et al.,* (2016) assessed the chromium contamination in water and sediment from river Chenab, Pakistan during January to May 2015. The maximum concentrations in water and bed sediment recorded were 23.54± 3.43 mg/L and 81.72±2.54 (µg/g) respectively.

Brian *et al.,* (2014), studied the heavy metal concentration in bed sediment of Iloilo Batiano river, Philippines. The average concentration of available chromium recorded was 9.68, 12.93 and 16.34 mg/kg of dry weight for 3 selected sampling stations. Similar study was done by Diya *et al.,* (2014) on the Sediment of the Vaipar coast, Gulf of Mannar during January to December 2008. They noted the chromium values ranged between 15 – 40 µg/g. Tenai *et al.,* (2016) analysed water and sediment samples from river Nakaru, recorded values showed chromium concentration 18.56 µg/L and 136.4 µg/kg respectively. Banerjee *et al.,* (2017) measured heavy metals concentrations in surface sediments of Chilika Lake from Odisha, India. They observed that the chromium levels in three selected sites from three sampling stations were 58.75, 86.29, and 87.77 mg/kg respectively.

MATERIALS AND METHODS:

Study area

Isapur dam (Latitude 19°43'40"N and Longitude 77°26'12"E) is an earth-fill dam constructed in 1982 to provide water for irrigation. It is situated near Pusad tehsil, Yavatmal district of Maharashtra state on Penganga river (Keshave *et al.,* 2013), a sub tributary of the river Godavari (Sharma *et al.,* 2014).

Chromium is one of the most important micronutrient required by all living beings including humans. Its circulation and function particularly in aquatic ecosystem is very vital. Chromium is estimated by extensively used diphenyl-carbazide method using UV double beam spectrophotometer (SHIMADZU UV 1800). The values obtained are expressed in mg/L and mg/kg for water and sediment samples respectively. Water samples were collected in pre cleaned plastic containers and sediment in polyethylene bags from selected sampling locations. The collected samples were brought in to the laboratory and were analysed as per the standard methods.

Fig. 1: Google image of Isapur dam

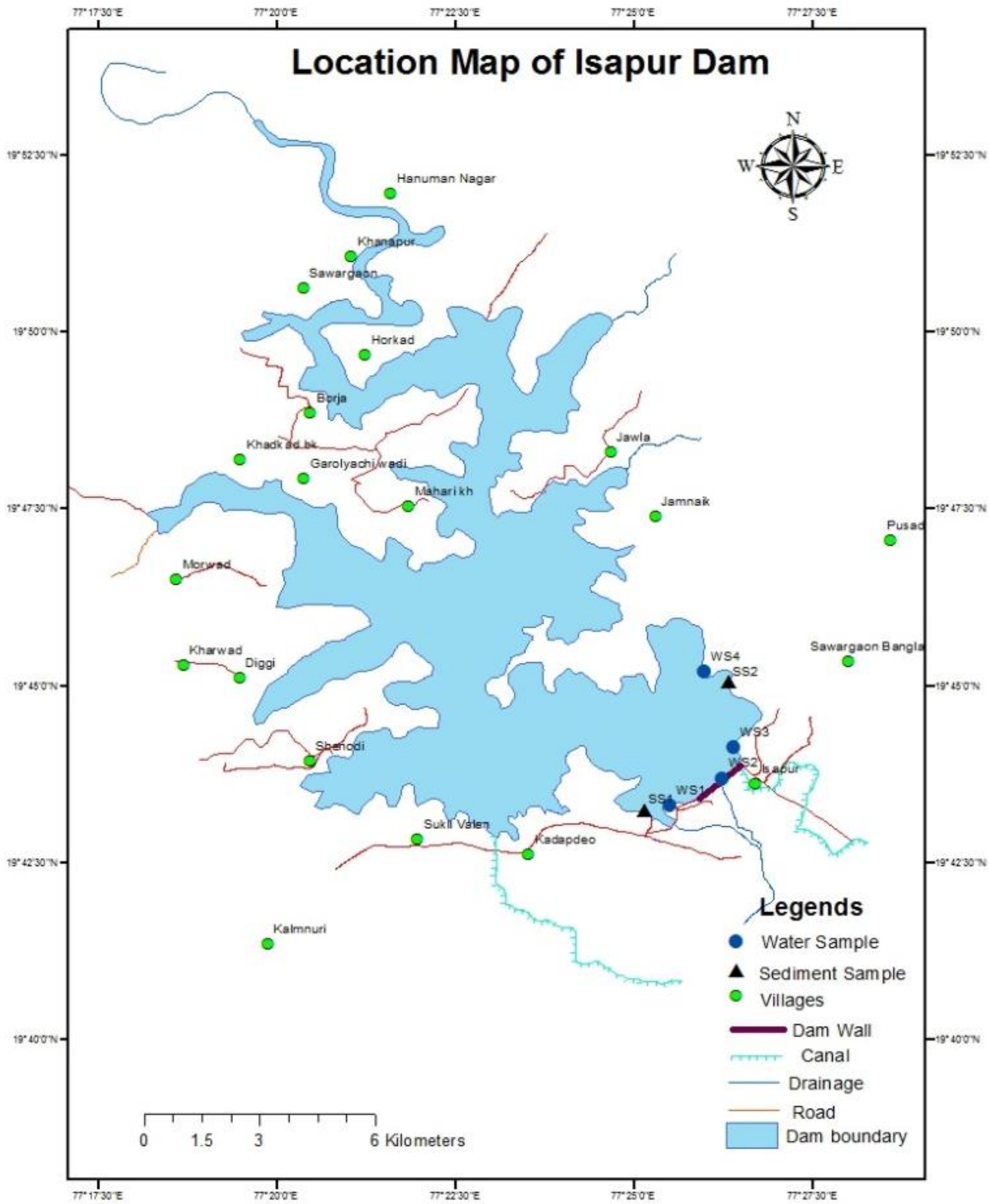

Figure 2: Water and Sediment Sampling Locations from Isapur dam

Table 1: Geographical coordinates of the selected Sampling locations

Sr No	Sample Details	Geographical Coordinates	
		Latitude	Longitude
1	Water Sample (WS) 1	19°43'33.17"N	77°25'50.52"E
2	Water Sample (WS) 2	19°43'45.23"N	77°26'12.68"E
3	Water Sample (WS) 3	19°44'10.04"N	77°26'10.01"E
4	Water Sample (WS) 4	19°44'55.00"N	77°26'14.91"E
5	Sediment Sample (SS) 1	19°44'27.75"N	77°26'30.64"E
6	Sediment Sample (SS) 2	19°43'33.00"N	77°25'36.37"E

RESULTS AND DISCUSSION:

All the values observed and recorded during present research work. The details after the analysis are shown in Table 2.

Table 2: Chromium concentration observed during June, 2012 to May, 2013

Season	Month	Water Samples (mg/L)				Sediment Samples (mg/kg)	
		Site 1	Site 2	Site 3	Site 4	Site 1	Site 2
Monsoon	June	0.023	0.018	**0.022**	0.016	42	40
	July	0.02	0.018	0.02	0.015	36	35
	August	0.014	0.012	0.014	0.012	28	28
	September	0.01	0.01	0.01	0.01	22	23
Winter	October	0.01	0.01	0.011	0.01	20	18
	November	0.012	0.011	0.011	0.011	21	19
	December	0.013	0.012	0.012	0.011	25	24
	January	0.014	0.012	0.014	0.012	27	26
Summer	February	0.016	0.014	0.014	0.012	30	30
	March	0.017	0.016	0.016	0.015	33	32
	April	0.02	**0.018**	0.02	**0.017**	38	37
	May	**0.024**	0.016	0.02	0.015	**44**	**42**
Average		0.0161	0.0139	0.0153	0.0130	30.5000	29.5000
Maximum		0.0240	0.0180	0.0220	0.0170	44.0000	42.0000
Minimum		0.0100	0.0100	0.0100	0.0100	20.0000	18.0000
Standard Deviation		0.0048	0.0031	0.0042	0.0024	8.1408	7.9143

(Note: Concentration of Chromium in Water are expressed in mg/L and sediment concentration in mg/kg)

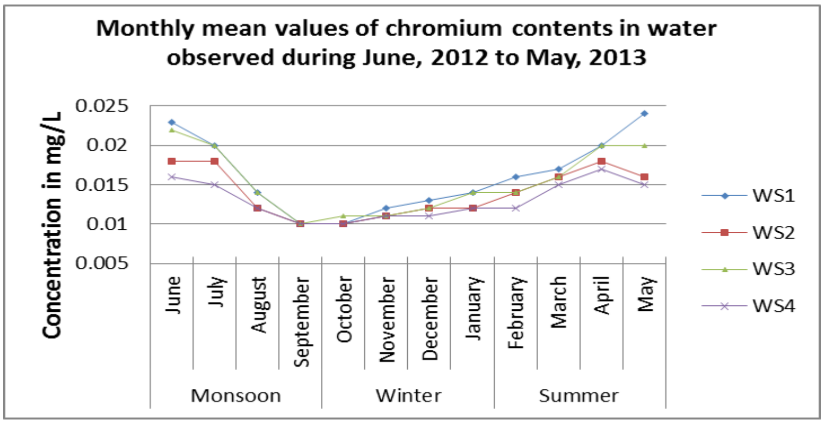

Fig. 3: Monthly mean values of chromium in water (mg/L) from Isapur reservoir during June, 2012 to May, 2013

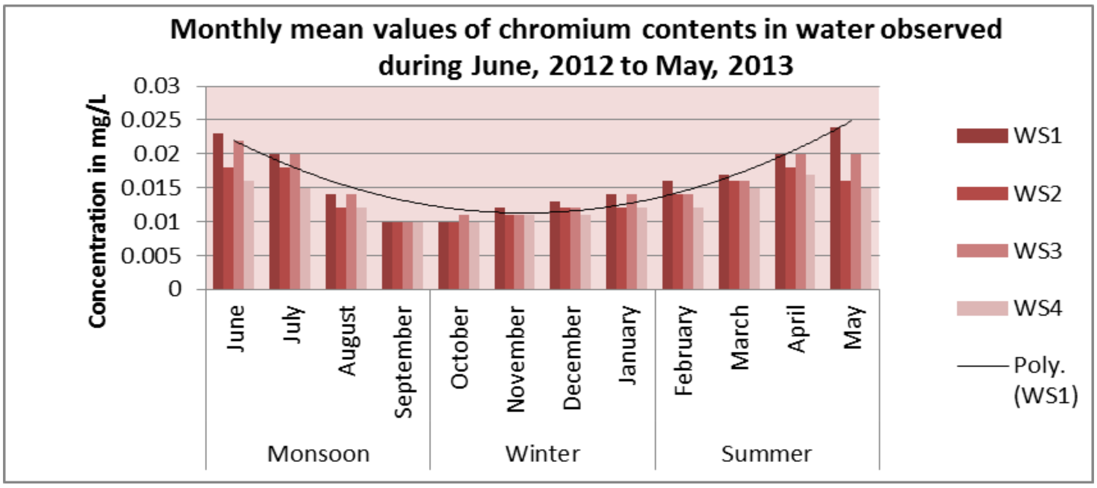

Fig. 4: Polynomial trend line showing seasonal variations of chromium level in water (mg/L) from Isapur reservoir during June, 2012 to May, 2013

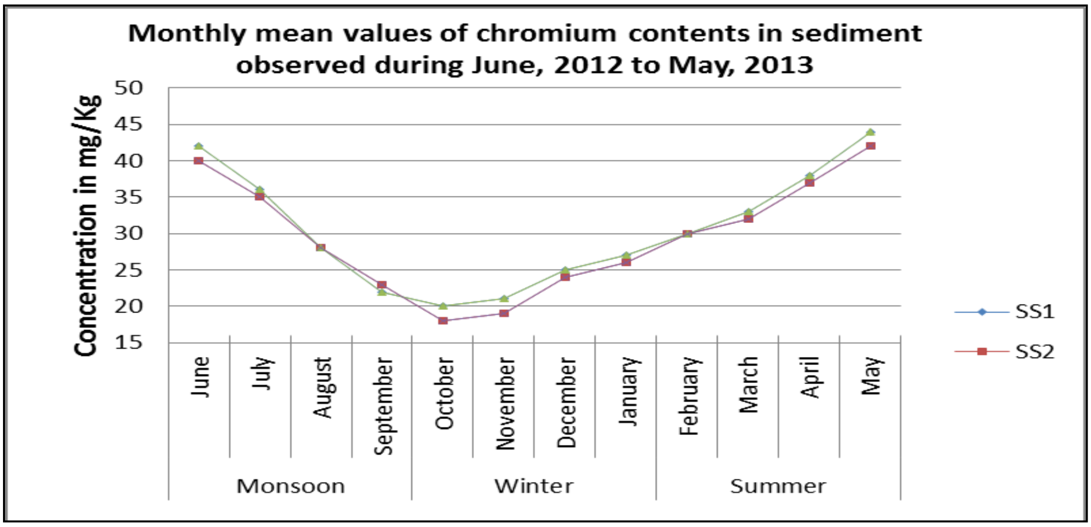

Fig. 5: Monthly mean values of chromium amount in sediment (mg/kg) from Isapur reservoir during June, 2012 to May, 2013

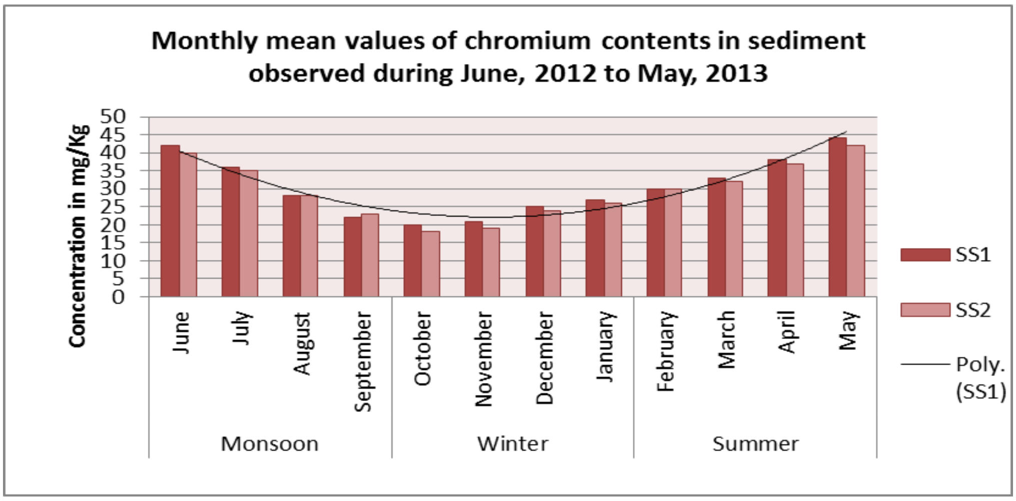

Fig 6: Polynomial trend line showing seasonal variations of chromium in sediment (mg/kg) from Isapur reservoir during June, 2012 to May, 2013

The substantial dissimilarity was observed for chromium concentration in water and sediment analysis, may be due to the weathering of rock and surface runoff containing varied pollutants. The chromium concentration in water has shown a wide range of 0.0100 mg/L in monsoon to 0.0240 mg/L in summer. In case of sediment analysis chromium levels were ranged from 18 mg/kg in winter to 44 mg/kg in summer, because of dilution effect (Figure 3 to 6). The maximum chromium iron levels were recorded in summer (Table 2). All the average values noted are below the permissible level as mentioned by WHO (1993). Polynomial trend line suggests that the chromium concentration is higher in monsoon, summer and showed inclined pattern in winter season.

With overall observations, it is clear that the chromium values are lower than the permissible level. The water and sediment shows similar trend and the values suggest that surface runoff and geological structures both are contributing to the metal pollution in to the water reservoir. The trend suggests that the chromium concentration may increase due to changing natural and anthropogenic sources of metal. This can have serious health issues in future. Therefore further studies are essential to minimize the probable impact on the surrounding population for better water management policies. The data obtained from will be significantly useful for better management of water the surrounding areas.

REFERENCES

Agrawal A, Pandey RS and Sharma B, 2010. Water Pollution with Special Reference to Pesticide Contamination in India. *J. Water Resource and Protection,* **2**:432-448. doi:10.4236/jwarp.2010.25050

Banerjee S, Pramanik A, Sengupta S, Chattopadhyay D and Bhattacharyya M, 2017. Distribution and source identification of heavy metal concentration in Chilika Lake, Odisha India: an assessment over salinity gradient. *Current Science*, **112**(1):87-94.

Brian GS, Lorna DG, Eden BJ, Marlon RT and June Raymund PV, 2014. Assessment of Heavy Metals in Sediments of Iloilo Batiano River, Philippines. *International Journal of Environmental Science and Development*, **5**(6):543-546.

Dahab OA, and Madfa HA, 1997. Chromium distribution in waters and sediments of the eastern side of The Qatari Peninsula. *Science of the Total Environment*, **196**:1-11.

Das AP, and Mishra S, 2008. Hexavalent chromium (VI): Environmental pollutant and health hazard. *Journal of Environmental Research and Development*, **2**(3):386-392.

David AW, and Pamela W, 2002. *Environmental Toxicology*, Cambridge University Press, Cambridge, U.K.

Diya EA, Mohamed AF, Omar AA, Pragatheeswaran V and Yogesh Kumar JS, 2014. Distribution of Heavy Metal Pollution in Vaipar Coastal Sediments, Southeast Coast of India. *International Journal of Advanced Research*, **2**(6):886-891.

Gautam SK, Suresh R, Sunil Kumar, Hooda RK and Mary A, 2011. Assessment of air and water quality of limestone mining area of Karnataka. *Indian Journal of Environmental Protection,* **31**(2):99-115.

Hamda A, Waqas A, Arshad J, Ali H, Syed MH, Zara S and Syed Shafiq HB, 2016. Chromium contamination in water, sediment and its bioaccumulation in Indian major carps in River Chenab, Pakistan. *Punjab Univ. J. Zool.*, **31**(1):83-86.

Jain CK, 2004. Metal fractionation study on bed sediments of river Yamuna, India. *Water Res.*, **38**:569–578

Kar D, Sur P, Mandal SK, Saha T. and Kole RK, 2008. Assessment of heavy metal pollution in surface water. *Int. J. Environ. Sci. Tech*, **5**(1):119-124.

Keshave JV, Ananthan PS and Landge A, 2013. Fish Diversity and Productivity of Isapur Reservoir, Maharashtra State. *International Journal of Biomedical and Advance Research,* **04**(12):865-867.

Kumar M, and Padhy PK, 2015. Discourse and Review of Environmental Quality of River Bodies in India: An Appraisal of Physico-chemical and Biological Parameters as Indicators of Water Quality. *Current World Environment*, **10**(2):537-571.

Mane PC, Kadam DD and Chaudhari RD, 2013. Accumulation of heavy metal ions in water, sediment and aquatic weeds: A case study of Sudha Dam, Bhokar, India. *Advances in Applied Science Research,* **4**(5):394-400.

Pechova A and Pavlata L, 2007. Chromium as an essential nutrient: a review. *Veterinarni Medicina,* **52**(1):1–18.

Renata T, Jolanta G and Michał Ł, 2012. The bottom sediments of the urban lake in the context of the need and possibility of its restoration. *Bioscience Discovery,* **3**(3):279-283.

Ritter L, Solomon K, Sibley P, Hall K, Keen P, Mattu G and Linton B, 2002. Sources, Pathways and Relative risks of contaminants in surface water and groundwater: A perspective prepared for the Walkerton inquiry. *Journal of Toxicology and Environmental Health, Part A,* **65**:1–142.

Selvam K, Arungandhi K, Vishnupriya B, Shanmuga TP, and Yamuna M, 2013. Biosorption of Chromium (VI) from industrial effluent by wild and mutant type strain of Saccharomyces cerevisiae and its immobilized form. *Bioscience Discovery,* **4**(1):72-77

Shaikh PR, Bhosle AB, 2012. Occurrence of chromium metal in Siddheshwar Reservoir at Hingoli, India. *Advances in Applied Science Research* **3**(3):1507-1512.

Sharma KM, Pattewar DV, and Dahe PD., 2014. Identification of Failure Years by Modification of Yield Model in Isapur Reservoir, India. *Journal of Water Resource and Protection,* **6**:1509-1516

Sharma V, Mamta V, Sakhuja N, and Arora D, 2011. Impact of heavy metals (Chromium and Nickel) on the health of residents of Jagadhri city due to intake of contaminated underground water. *Archives of Applied Science Research,* **3**(5):207-212.

Singh KP, Mohan D, Singh VK, Malik A, 2005. Studies on distribution and fractionation of heavy metals in Gomti river sediments - a tributary of the Ganges, India. *Journal of Hydrology,* **312**:14–27.

Storelli, MM, Storelli, A, D'Addabbo, R, Marano C, Bruno R, and Marcotrigiano GO, 2005. Trace elements in loggerhead turtles (Caretta caretta) from the eastern Mediterranean Sea: Overview and evaluation. *Environ. Pollut.,* **135**(1):163–170.

Tenai BC, Mbaria JM, Muchemi GM, Jansen R, Kotze A, Naidoo V, Kariuki EK, Nduhiu JG, Nderitu JG, and Gitau FK, 2016. Assessment of heavy metals concentration in water, soil sediment and biological tissues of the lesser flamingos in four eastern rift valley lakes. *African Journal of Environmental Science and Technology,* **10**(6):162-166.

Venkatramreddy V, Vutukuru SS, Paul BT, 2009. Ecotoxicology of Hexavalent Chromium in Freshwater Fish: A Critical Review. *Rev Environ Health,* **24**(2):129–145.

Vincent JB, 2000. Biological Role for Chromium at a Molecular Level. *Acc. Chem. Res.,***33**:503-510.

WHO, 1993. *Guidelines for drinking water quality,* Vol.**1**, Recommendations, second edition World Health Organization, Geneva.

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