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RESEARCH ARTICLE

ACCUMULATION OF MANGANESE AND SELENIUM IN WATER: A CASE STUDY OF MANJARA DAM, MAHARASHTRA

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ABSTRACT

Natural water is never pure water but a complex and ever-changing mixture of dissolved inorganic and organic molecules and suspended particles. Trace elements were found in rarer form in surface water. The present study was undertaken to determine the trace elements from Manjara Dam. The total concentrations of manganese and selenium were determined using UV spectroscopic method. The concentration of selected trace elements was evaluated from three sampling sites named S1, S2 and S3. The study was carried out for two years of 2009 – 2010 and 2010 - 2011. The highest amount of manganese was recorded as 0.1866 mg/L and lowest amount as 0.057 mg/L and the highest amount of selenium was recorded as 0.022 mg/L and lowest amount as 0.0092 mg/L. The observed values showed the seasonal variations during the entire study period.

INTRODUCTION

Water is the most important single commodity in human civilization but it is also responsible for most diseases due to contamination. Clean, fresh water is essential for nearly every human endeavor perhaps more than any other environment factor; the availability of water determines the location and activities of humans on the earth. Renewable water supplies are resources that are replenished regularly-mainly surface water and shallow groundwater. Renewable water is most plentiful in the tropics, where rainfall is heavy, followed by mid latitudes, where rainfall is regular. A healthy environment is one in which the water quality supports a rich and varied community of organisms and protects public health (Ramachandra *et al.*, 2002). Dams and canals are a fundamental basis of civilization; they can also be a source of environmental disaster and injustice. Some of the great civilizations (Sumeria, Egypt, China, and he Incan culture of South America) were organized around the large-scale redistribution of water from rivers to irrigated farm fields. More than half the world's 227 largest rivers have been blocked by dams or diversion structures with adverse effects on freshwater ecosystems. Of the 50,000 large dams in the world, 90 percent were built in the twentieth century, and half of those are in China, Economically speaking, at least one-third of those dams should never have been built.

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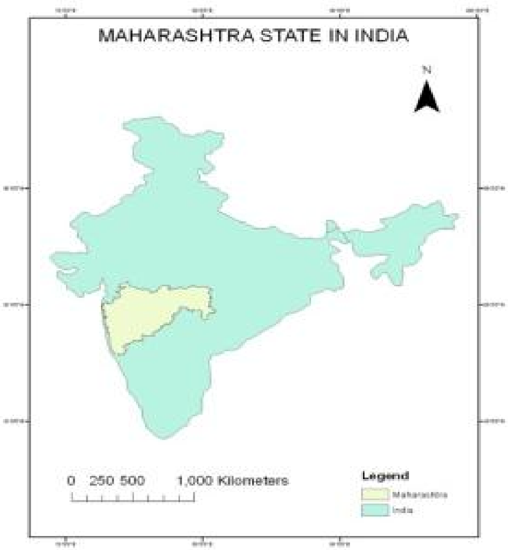
Pollution control standards and regulations usually distinguish between point and non-point solution sources. Factories, power plants, sewage treatment plants, underground coal mines, and wells are classified as Point sources because they discharge pollution from specific locations, such as drain pipes, ditches, of sewer outfalls. These sources are discrete and identifiable, so they are relatively easy to monitor and regulate. It is generally possible to divert effluent from the waste streams of these sources and treat it before it enters the environment (Ramesh and Anbu, 1996).

Some toxic inorganic chemicals are naturally released into water from rocks by weathering processes. Humans accelerate the transfer rates in these cycles thousands of times above natural background levels through the mining, processing, using and discarding of minerals (Jackson, 1993). Many metals, such as mercury, lead, cadmium, and nickel, are highly toxic in minute concentrations. Because metals are highly persistent, they accumulate in food chains and have a cumulative effect in humans. In natural environment though the average abundance of heavy metals is generally low, heavy metal exert their harmful effects in many ways (Mohapatra, 2006). The hydrosphere accounts for a greater area of the earth's surface than the lithosphere and is divided into lakes, rivers, estuaries and oceans. Metals exist in hydrosphere as dissolved material and suspended particulates and are in deposited sediments. Sediments in rivers, lakes, estuaries and oceans account for the main sinks of heavy metals in the hydrosphere. In estuaries, heavy metals from the atmosphere and rivers accumulate, thus permitting chemical and physical reactions to occur before being washed out in the ocean (Cockerham and Shane, 1994). Manganese is a very brittle grayish-white, metallic chemical element resembling iron but harder. Oxides, silicates and carbonates are the most common manganese minerals. It is a very important contributor to alloys and widely used in chemical industries. In water the mean expected value of manganese is about 0.06 mg/L. In raw water the manganese concentrations were registered between 0.001 – 0.60 mg/L. Manganese is an essential trace nutrient for plants and animals. Nutritional deficiency in man has not been evaluated as a health hazard. Manganese poisoning following work-related exposure is rare. High concentration of manganese dust or fumes and prolonged inhaling are necessary to cause chronic manganese poisoning.

Selenium is a gray (in crystalline hexagonal), deep red (in monoclinic selenium), non – metallic chemical element of the sulfur group, existing in many allotropic forms. Selenium is used in its elemental form or in several salts for electronic and photocopy applications, glass manufacture, pigments, chemicals, pharmaceuticals, fungicides and rubber industry. Selenium appears in soil as ferric selenite, calcium selenite and elemental selenium. Selenium is expected to be found in raw water from soil contamination in areas rich in selenium. Otherwise, it appears in trace quantities only in public sewers due to industrial pollution. Selenium is considered nutritionally essential at low levels. In animals it has caused acute and chronic toxicity at high levels, resulting in congenital muscle disease. Little knowledge is available for human poisoning doses, but it has been considered to be similar to arsenic in physiological reaction (Dara, 2002).

Study Area

The present study carried out on the Manjara dam which is situated at Dhanegaon, village of Kaij Taluka, Beed District, Maharashtra, India as shown in Fig. 1 and 2. The dam was constructed on Manjara River. The study area is bounded by Latitude $18^0\,25'$ to $18^0\,55'$ N and $75^0\,75'$ to $76^0\,15'$ E Longitude. The construction of the dam was completed on 1981. It's catchment area is about 2371.59km^2 while it's irrigational potential is 18222 hectare.



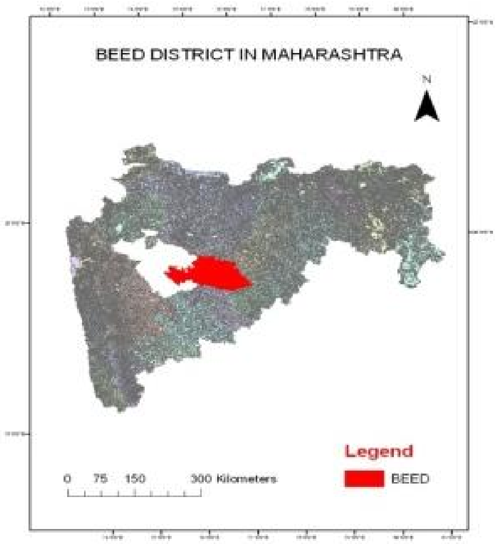
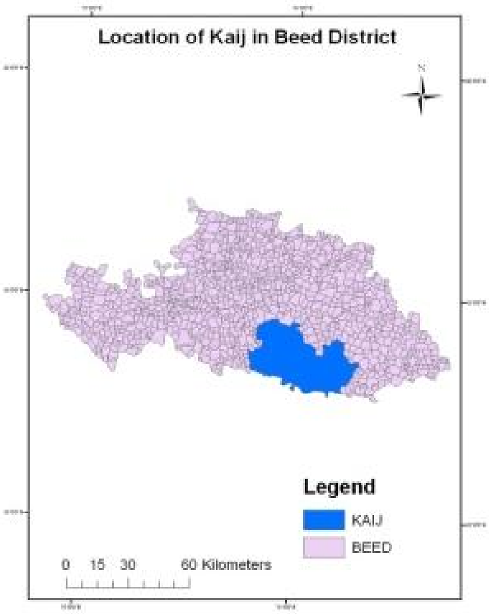


Fig. 1. Location of Beed district in Maharashtra state of India



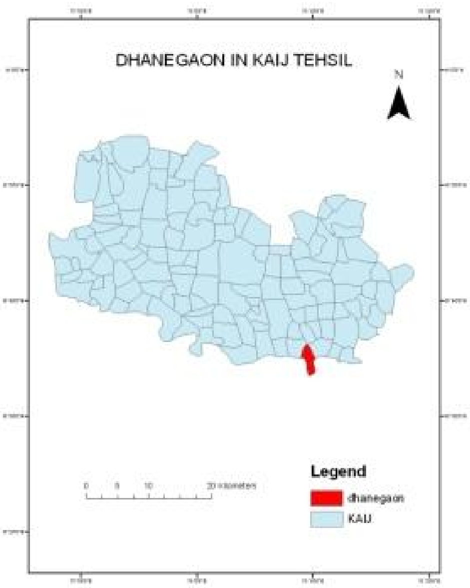


Fig. 2. Location of Dhanegaon in Kaij Tehsil of Beed district

MATERIALS AND METHODS

For the present investigation water samples were collected for two years during 2009 – 2010 and 2010 – 2011. The samples of water were collected in clean plastic bottles of 1 liter volume from each station at the depth of one to one and half feet below the surface of water from sampling station-1 (S1), sampling station-2 (S2) and sampling station-3 (S3) of the Manjara dam as shown in Figure 3. Three samples were collected from each sampling site. The water sample was then filtered through a membrane filter when necessary. The pH of all the water samples were noted immediately and water was acidified further. This acidified water was then brought into laboratory and stored at 4^0C until analysis. The manganese concentration from the water sample was determined by Persulphate method and selenium was determined by Diaminobenzidine method.

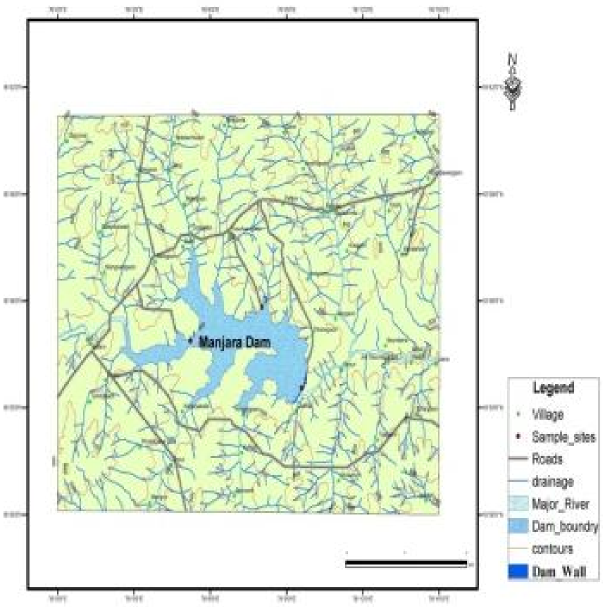


Fig. 3. Location of sampling stations at Manjara dam

RESULTS AND DISCUSSION

P^H is a prime parameter for deciding acidic or alkaline water. Keeping this in view, we have analyzed the p^H values. The p^H of Manjara dam water was recorded for two years i.e. February 2009 to January 2011. The minimum p^H was recorded as 8.11, 8.13 and 8.12 at site I, site II and site III respectively in the month of September 2009. While in 2010 the maximum p^H was recorded as 8.38, 8.40 and 8.39 at site I, site II and site III respectively in the month of September as shown in Figure 4 and 5. Pawar and Pulle (2005), studied the water quality of Pethwadaj dam, Nanded district of Maharashtra during January-December 2004. The high pH range 7.02-7.85 was recorded in summer and low ranged in winter. Davina and D'souza (1999), studied the impact of the tourism industry on ground water in Calangute, Goa. They found pH season wise in 1997 which was ranged as 5.45 to 6.03 and it is undesirable. Thomas and Azis (2000), studied the water quality of tropical reservoir in Kerala during February 1991 to January 1992. They recorded the pH of water ranged from 6.10 to 7.53 and 5.10 to 7.49 in surface and bottom water respectively.

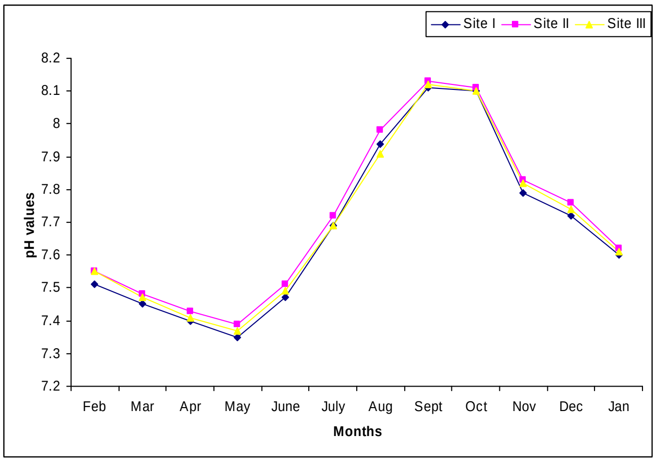


Fig. 4. Levels of p^H observed from Manjara dam water during Feb. 2009 to Jan. 2010

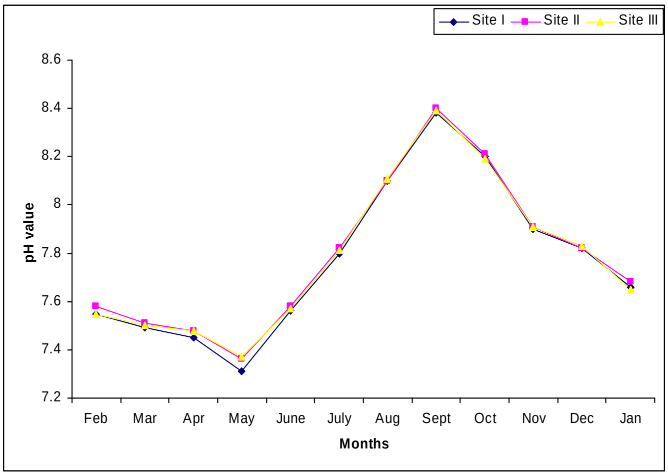


Fig. 5. Levels of p^H observed from Manjara dam water during Feb. 2010 to Jan. 2011

During the entire study period (February 2009 – January 2011), the highest amount of manganese was recorded as 0.1866 mg/L and lowest amount as 0.057 mg/L. The highest value of manganese was noted in the month of May 2010 at site II and the lowest value of manganese was noted in the month of September 2009 at site I as shown in figure 6 and 7.

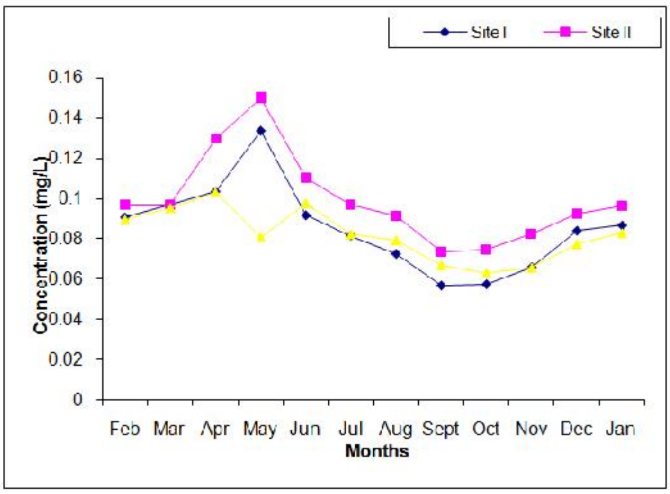


Fig. 6. Monthly mean values of manganese of Manjara dam water during Feb. 2009 to Jan. 2010

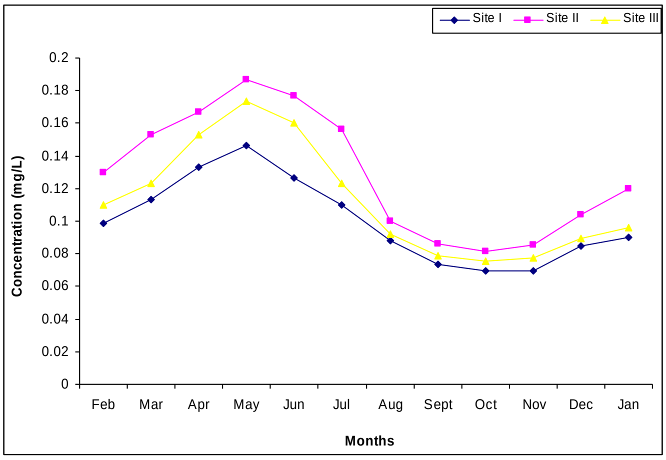


Fig. 7. Monthly mean values of manganese of Manjara dam water during Feb. 2010 to Jan. 2011

Hejabi *et al.*, (2001), carried out research work on metal pollution in the water of Kabini river of Karnataka during April 2009 to January 2010, seasonally from 17 locations. The highest concentration of manganese 35.7 mg/L in water was measured at site 1, while the lowest mean concentration of manganese as 1.66 mg/L was recorded at site 5. Dixit and Tiwary (2008), carried out the impact assessment of metal pollution in the water of Shahpura lake, Bhopal during May 2004 – October 2004 and recorded manganese concentration from four sampling stations. The maximum concentration of manganese 0.19 mg/L was recorded station 4 in the month of June and lowest value 0.01 mg/L was recorded at station 3 in the month of July. Kar *et al.*, (2008), analysed the heavy metal pollution in surface water from river Ganga in West Bengal during 2004 – 2005. During this investigation, they noted the manganese concentration 0.181 mg/L in winter, 0.369 mg/L in summer and 0.712 mg/L in monsoon season.

Gupta *et al.* (2011), undertaken the study on the water characteristics of ponds at Varanasi which are affected by religious activities. They collected the water samples for twelve months from January 2010 to December 2010 and analysed. They found the average manganese concentration of 0.011 mg/L at Sarnath pond, 0.019 mg/L at Haraua pond, 0.082 mg/L at Shivpur pond, 0.095 mg/L at Pisachmochan pond and 0.146 mg/L at Baulia pond. Majagi *et al.*, (2008), analysed the concentration of heavy metals in Karanja reservoir of Bidar during October 2001 to September 2003. In this assessment they found the average manganese values of 0.2252 mg/L, while minimum manganese concentration was recorded as 0.0072 mg/L during monsoon of 2002 and maximum manganese concentration recorded was 0.912 mg/L during summer 2003. During the entire study period (February 2009 – January 2011), the highest amount of selenium was recorded as 0.022 mg/L and lowest amount as 0.0092 mg/L. The highest value of selenium was noted in the month of September 2010 at site II and the lowest value of selenium was noted in the month of May 2010 at site I as shown in Figure 8 and 9. Lee (2003), assessed the contamination load on water affected by the Kongjujeil mine drainage, Republic of Korea. For the analysis of selenium content in water, the samples were collected in August and December 1998. The selenium concentration of the water sample ranges from 0.001 mg/L to 0.008 mg/L.

Li *et al.*, (2008), studied the dissolved trace elements and heavy metals from the Danjiangkou reservoir of China during November 2004 to July 2006. During this study period, the mean selenium concentration as 15.36 µg/L was recorded within the range of 0.00 µg/L to 50.2 µg/L. Lee *et al.*, (2005), worked on selenium analysis from the water of Elk river, Canada, during 2002. During this investigation, they found an average concentration of selenium, 0.6 µg/L at upper Elk river water samples. Zhang and Moore (1997), investigated the distribution of selenium in Benton lake surface water, during 1992 – 1995. The results of this study shows that, in 1994, the selenium concentration in water of Benton lake was 3.79 mg/L and in 1995 it was 6.48 mg/L. they also mentioned that the highest concentration occurred during spring runoff when water flowed from Benton lake basin. During the summer, when there was no normal inflow or water was pumped from muddy creek to the lake, selenium concentration were much lower.

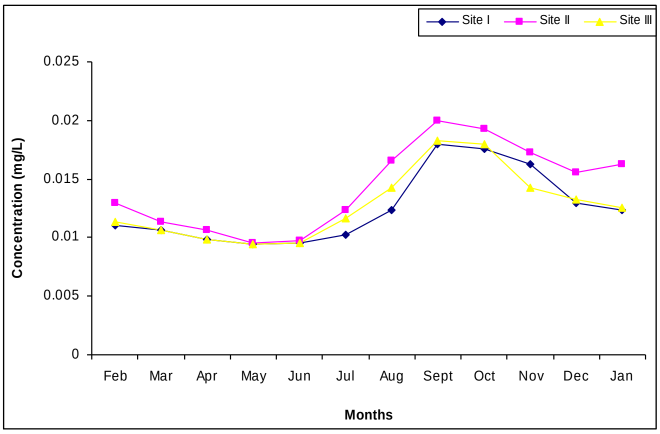


Fig. 8. Monthly mean values of selenium of Manjara dam water during Feb. 2009 to Jan. 2010

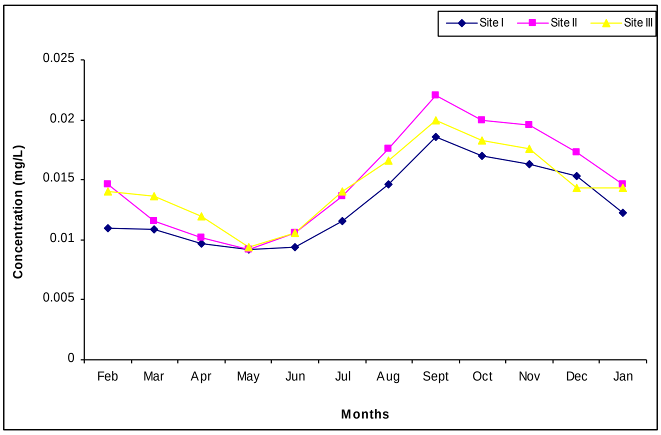


Fig. 9. Monthly mean values of selenium of Manjara dam water during Feb. 2010 to Jan. 2011

Wayland and Crosley (2006), determined the levels of selenium from water the streams in the Rocky Mountain foothills of west central Alberta from 2001-2003. In the results they mentioned the selenium concentrations in water of reference site, near Hinton during 2001, 2002 and 2003 was 0.5, 0.3, 0.51 µg/L respectively. While the selenium concentration during 2001, 2002 and 2003 from coal mine impacted area was 4.23, 4.45 and 5.46 µg/l respectively. Hamilton and Buhl (2004), carried out the research work on the assessment of selenium in water from nine stream sites in the Blackfoot river watershed in southern Idaho in September 2000. The lowest concentration of selenium recorded was less than 5 µg/L while highest value for selenium was recorded as 24 µg/L at lower Blackfoot river and Upper and Lower East Mill Creek respectively.

Conclusion

P^H is very important parameter which is responsible for solubilizing the metals in the water system. Basically metals are soluble in acidic conditions. In the present work the sampling station (S_1) showed the less concentration of both the metals considered during the study. However everyday run-off contains less metal concentration when compared to that of sampling station (S_2). Because the running water has low concentration of trace metals as compared to the stored water in the dam. At the sampling station (S_2), the trace metals get deposited due to which slightly increase in all metals concentration was observed. Heavy metals present in the running water interact with organic matter and settle down resulting in high concentration.

REFERENCES

Cockerham L. G and Shane B. S. 1994. Basic environmental toxicology, *CRC Press*, USA, 109 – 132.

Dara S. S. 2002. A text book of Environmental Chemistry and Pollution Control, (5th Ed.) S. Chand and Company Ltd. New Delhi. Pp. 177.

Davina V. Gonsalves and Joe D'Souza. 1999. Impact of the Tourism Industry on Ground Water in Calangute, Goa, *Ecology Environment and Conservation*, 5 (1), 19 - 24.

Dixit S. and Tiwary S. 2008. Impact assessment of heavy metal pollution of Shahpura lake, Bhopal, India, *Int. J. Environ. Res.*, 2 (1), 37 – 42.

Gupta A. K., Mishra K., Kumar P., Singh C and Srivastava S. 2011. Impact of religious activities of the water characteristics of prominent ponds at Varanasi (U.P.), India, *Plant Archives*, 11 (1), 297 – 300.

Hamilton Steven J and Buhl K. J. 2004. selenium in water, sediment, plants, invertebrates, and fish in the Blackfoot river drainage, *Water, Air, Soil Pollution*, 159, 3 - 34.

Hejebi Azadeh Taghinia, Basawrajappa, Karbassi A. R and Monavari S. M. 2011. Heavy metal pollution in water and sediments in the Kabini river, Karnataka, India, Environ Monit Assess, 182, 1 – 13.

Jackson R. 1993. A laboratory manual for water and spentwater chemistry, Van Nostrand Reinhold, New York.

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

Lee Chan Hee. 2003. Assessment of contamination load on water, soil and sediment affected by the Kongjujeil mine drainage, Republic of Korea, *Environmental Geology*, 44, 501 – 515.

Lee E. Harding, Mark Graham and Dale Paton. 2005. Accumulation of selenium and lack of severe effects on productivity of American Dippers (Cinclus mexicanus) and Spotted Sandpipers (Actitis macularia), *Arch. Environ. Contam. Toxicol.*, 48, 414 – 423.

Li Siyue, Xu Zhifang, Cheng Xiaoli and Zhang Quafa. 2008. Dissolved trace elements and heavy metals in the Danjiangkou reservoir, China, *Environ Geol*, 55, 977 - 983.

Magaji S. H., Vijaykumar K and Vasanthkaumar B. 2008. Concentration of heavy metals in Karanja reservoir, Bidar district, Karnataka, India, *Environ. Monit. Assess.*, 138, 273 – 279.

Mohapatra Pradipta Kumar. 2006. Text book of Environmental Biotechnology I. K. International Publ., New Delhi, pp. 358 – 359.

Pawar S. K and J. S. Pulle. 2005. Studies on Physico-chemical Parameters in Pethwadaj Dam Nanded in Maharashtra, *Journal of Aquatic Biology*, 20 (2), 123 - 128.

Ramachandra T.V., Kiran R and Ahalya N. 2002. Status, Conservation and Management of Wetlands— Allied Publishers (P) Ltd, India.

Ramesh R and Anbu M. 1996. Chemical methods for environmental analysis: water and sediment, *Macmillan Ind. Ltd.*, Madras.

Thomas Sabu and P. K. Abdul Azis. 2000. Physico-chemical Limnology of a Tropical Reservoir in Kerala, S. India, *Ecology Environment and Conservation*, 6 (2), 159 - 162.

Wayland Mark and Crosley Robert. 2006. Selenium and other trace elements in aquatic insects in coal mine – affected streams in the rocky mountains of Alberta, Canada, *Arch. Environ. Contam. Toxicol*., 50, 511 – 522.

Zhang Yiqiang and Moore Johnnie N. 1997. Controls on selenium distribution in wetland sediment, Benton lake, Montana, *Water, Air and Soil Pollution*, 97, 323 – 340.

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