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Water quality monitoring of ken river of Banda district, Uttar Pradesh, India

Jitendra Kumar and Amit Pal*

Institute of Environment & Development Studies, Bundelkhand University, Jhansi – 284128, India.

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ABSTRACT

Banda is the easternmost district of Bundelkhand region. It lies between latitude 24º 53' and 24º 55' North and longitude 80º 27' and 81º 34' East with an area of 7,624 sq.km. The western boundary of Banda touches Chhatarpur and Hamirpur districts separated by river Ken for certain distance. In present investigation the physicochemical characteristic of Ken River were studied. Water samples were collected quarterly from ten different sites of Ken River during the year January 2009 to December 2010. Preservation and analysis of water samples were based on standard method proposed by American Public Health Association (APHA, 2005). In cationic abundance sodium is followed by calcium, magnesium and potassium (Na>Ca>Mg>K) in the river through out the year. The tolerance limit for TDS, SAR and % Na of water use for irrigation has been found to be excellent for TDS and % Na, fair for SAR. Nitrate, Sulphate and Phosphate were found to below the permissible limit of WHO (1993).

Introduction

The surface water quality is a matter of serious concern today. Rivers due to their role in carrying off the municipal and industrial wastewater and run off from agricultural land in their vast drainage basins are among the most vulnerable water bodies to pollution (Yerel, 2010).Water pollution has now reached a crisis point specifically in developing world. Almost every water body is polluted to an alarming level. Thus, estimation of quality of water is extremely important for proper assessment of the associated hazards (Warhate *et al*, 2006). Aquatic ecosystem are not only source of water and resources, such as fish and crop for household and agro industrial uses, but are vital parts of natural environment on which economic systems are parasites and depend for their survival (Rai and Pal, 2001).

Aquatic ecosystems are getting polluted day by day due to growth of the industrial corridor, nutrient loading and rapid anthropogenic activities especially in developing countries. Due to addition of domestic waste (sewage), phosphate, nitrate etc. from wastes or their decomposition products in water bodies, they become rich in nutrients, especially phosphates and nitrate ions. Thus with the passage of these nutrients through such organic wastes, the water bodies become highly productive or eutrophic and the phenomenon as eutrophication in lake which is increasing day by day. The oxygen content of lake is also low due to oxygen depletion waste generated by anthropogenic activities (Kumar *et al*., 2010).

In natural aquatic ecosystems, metallic compounds use to occur in low concentration, normally at nanogram to microgram per liter level. Heavy metals may come from natural sources, leached from rocks and soils according to their geochemical mobility or come from anthropogenic sources, as the result of human land occupation and industrial pollution (Espinoza-Quinones *et al*, 2005)]

Industries discharge variety of pollutants in the waste water including heavy metals, organic toxins, oil nutrients and solids. Many of the substances are toxic or even carcinogenic. Pathogens can obviously produce water born diseases in either human or animal hosts. These wastes also increase the concentration of suspended solids (turbidity), bacteria and virus growth leading to potential health impacts. Increase in nutrient load may lead to eutophication; organic wastes increases the oxygen demand in water leading to oxygen reduction in water with potentially severe impacts on whole ecosystems (Yadav and Rajesh, 2011). Therefore now a days fresh water has become a scare commodity due to over exploitation and pollution (Gupta *et al.*, 2009).With this background present proposed study has been undertaken for examine the water quality of river ken in Banda district.

Materials and Methods

This is the easternmost district of Bundelkhand. Banda lies between latitude 24º 53' and 24º 55' North and longitude 80º 27' and 81º 34' East with an area of 7,624 sq.km. The southern and south eastern boundary of the district is made up of plateau and the mountain of Vindhyas bordering on the district Rewa, Satna and Panna. The northern boundary is entirely made up by Yamuna River which flows for nearly 215 km, separating it from Fatehpur and Allahabad districts. The western boundary of Banda touches Chhatarpur and Hamirpur districts separated by river Ken for certain distance.

Water samples were collected quarterly from ten different sites from Ken River (Figure-1) during the year 2009 & 2010. Samples were collected in good quality screw-capped high density pre-sterilized polypropylene bottles of one liter capacity, labeled properly and analyzed in the laboratory. Preservation and analysis of water samples were based on standard method proposed by American Public Health Association (APHA, 2005). pH, EC, TDS, Temperature and DO were analyzed on the spot by water quality analyzer kit (Elico, PE 138). NO_3, PO_4 and SO_4 were analyzed by UV Visible Spectrophotometer (Elico, SL 159). Na and K were analyzed by Flame Photometer (Systronic 130). The water quality was tested for its use for irrigation and interpreted in terms of Sodium Absorption Ratio (SAR) and % Na.

Tele:
E-mail addresses: apu13@rediffmail.com

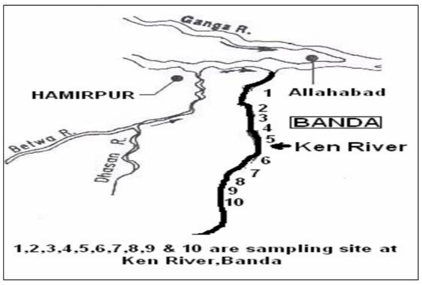

Figure -1: Map showing sampling site at Ken River

The tolerance limits for some parameters recommended by Wilcox (1965) are given below: -

The Na % describing the Sodium hazard giving by (Warhate *et al*, 2006)-

$$\% Na = 100 X Na^{+} / (Na^{+} + Ca^{+} + Mg^{+} + K^{+})$$

The Sodium or Alkali hazard in the use of water for irrigation is determined by absolute and relative concentration of cation and is expressed in terms of Sodium Absorption Ratio (SAR) and it can be estimated by formula (Singh, 2002):

$$SAR = Na^{+} / [(Ca^{+} + Mg^{+})/2]^{1/2}$$

Where, concentrations are expressed in milli equivalent per litre (meq/l).

Results and Discussion

The physico-chemical analysis carried out in quarterly from ten different sites of Ken River water during the year 2009 and 2010 are given in Tables - 2 and 3. The temperature plays a crucial role in physical-chemical and biological behavior of aquatic system (Dwivedi and Pathak, 2007).A study revealed that temperature varied from 19ºC (in winter season) and 30ºC (in summer seasons). Average temperature in both the year found to be 24ºC. Higher values of pH fasten the scale formation in water heating apparatus and reduce germicidal potential of chlorine (Vijaya *et al*., 2002).It was observed that water is slightly alkaline in nature. The average pH value was found to be 7.5. The total hardness is mainly due to Ca; Mg and eutrophication. The water containing excess hardness is not desirable for potable water. It consumes more soap during washing of clothes. In the present study average value of hardness was found to be 230 mg/l. Electrical conductivity is considered to be a rapid and good measure of dissolved solids. Conductivity is an important criterion in determining the suitability of water for irrigation (Gupta *et al*., 2009). The conductivity mainly depends on ionic concentration or dissolved inorganic substances (Zaidi *et al.,* 2011).The average value of electrical conductivity in both the year was found to be 730µS/cm. Alkalinity is due to the presence of bicarbonates, carbonates or hydroxides (Trivedi and Goel, 1992). The weathering of rocks is the potential source of alkalinity. The average value of alkalinity was found to be 190 mg/l in both the year. TDS indicates the general nature of salinity of water. Water with high TDS produces scales on cooking vessels and boilers. Water containing more than 500mg/l of TDS is not considered suitable for drinking water supplies (Gupta *et al*., 2009). According to Wilcox (1965) classification (Table -1) the TDS value of Ken River was found to be excellent for irrigation use i.e, less than 200 ppm. The main sources of dissolved oxygen in water are diffusion of oxygen from air and photosynthetic activity taking place in water. The diffusion of oxygen from air mainly dependent on temperature, salinity, total dissolved salt and water movements etc. (Zaidi *et al.,* 2011).The maximum value of DO in the month of January to March (14.5 mg/l) and minimum 10.2mg/l in the month of April to June. Biochemical oxygen demand is usually defined as the amount of oxygen required by bacteria in stabilizing the decomposable organic matter. BOD gives an idea about the extent of pollution (Yadav and Rajesh, 2011; Jain *et al.*, 1996).

The BOD value was maximum (14.2 mg/l) in January to March and minimum (8.6 mg/l) in the month of April to June. The average value of BOD was found to be 10 mg/l. The chemical oxygen demand (COD) is a measure of oxygen equivalent to the requirement of oxidizing organic matter contents by a strong chemical agent. The COD test is helpful in indicating toxic conditions and the presence of biologically resistant organic substances. The maximum value (78mg/l) of COD was found in July to September and minimum value (43mg/l) in the month of January to March. The average value of COD was found to be 62 mg/l. The main sources of nitrate in water are human and animal waste, industrial effluent, use of fertilizers and chemicals, silage through drainage system (Jain *et al*.1991). The nitrate (Maximum- 44mg/l; Minimum- 29 mg/l), phosphate (Maximum- 4.8mg/l; Minimum- 1.7mg/l) and Sulphate (Maximum- 98mg/l; Minimum- 82mg/l) were found under the permissible limit of WHO (1993) and BIS (1991).

The major cations include Ca, Mg, Na and K. The cationic chemistry is dominated by sodium and calcium. In cationic abundance sodium is followed by calcium, magnesium and potassium (Na> Ca > Mg > K) in the Ken River water through out the year (Tables - 2 and 3). The tolerance limit for TDS, SAR and % Na of water use for irrigation recommended by Wilcox (1965) the data has been found to be excellent for TDS and % Na and fair for SAR (Tables - 1, 2 and 3).

Conclusion

The natural water bodies are continuously getting contaminated by the discharge of sewage, industrial and other wastes originated from anthropogenic activities in and around the both of the lakes. The water quality and pollution of surface water disrupts algal communities which can affect the entire aquatic food web that will result is a serious threat to life (Rai and Pal, 2001).

It is concluded that water quality of Ken River such as pH, alkalinity, hardness, Na, K, Ca, Mg, Nitrate, phosphate and sulphate were found to be within WHO and BIS permissible limits. Therefore water of these dams can be used for irrigation purpose. The Cationic chemistry is dominated by Sodium (Na) and Calcium (Ca). According to Wilcox (1965) TDS & % Na is Excellent and fair for SAR that means it is suitable for agricultural purposes.

References

APHA (2005). Standard methods for examination of water and wastewater 21st ed. American Public Health Association, Washington.

B.I.S. Bureau of Indian Standards Drinking water specification (1991), Ist revision, ISS 10500.

Espinoza-Quinones, F.R., Zacarkim, C.E., Palacio, S.M., Obregon, C.L., Zenatti, D.C., Galante, R.M., Rossi, N., Rossi, F.L.,Pereira, A., Welter, R.A. and Rizzutto M.A. (2005). Removal of Heavy Metal from Polluted River Water using Aquatic Macrophytes Salvinia sp., *Brazillian Journal of Physics*, 35 (3B), 744.

Dwivedi, S.L. and Pathak, V. (2007). Studies of water quality of Mandakini River in chitrakoot for irrigation purposes, *IJEP*, 27(8): 751-754.

Gupta Preeti, Choudhary Ranjeeta and Vishwakarma Monika (2009). Assessment of water quality of Kerwa and Kaliasote

rivers at Bhopal district for irrigation purpose. *International Journal of Theoretical & Applied Sciences*, 1(2): 27-30.
Jain, S.M., M. Sharma and R. Thakur (1996). Seasonal variations in physicochemical parameters of Halali reservoir of Vidisha district, India. *J. Ecobiol*., (8); 181-188.
Kumar Jitendra, Gond Dadhibal Prasad and Pal Amit (2010). Contamination of Water in Century old Freshwater Lakes of Historical City-Jhansi, Uttar Pradesh, India. *International Journal of Recent Scientific Research.* (2), 044-052.
Rai, U.N. and Pal Amit (2001). Algae as indicator and mitigator of toxic metals in aquatic environment, Applied Botany Abstracts, 21 (1); 60-71.
Singh, A. K. (2002) Quality Assessment of Surface and Subsurface Water of Damodar River Basin, *Indian J. Environ Hlth*, 44, 42-46.
Trivedi, R.K. and P.K. Goel (1992). Chemical and Biological Methods for Water Pollution Studies. *Environ. Publ*., Karad.
Vijaya Kumara, Narayana, J., Puttaiah, E.T. and Harish Babu (2005), K., Assessment of surface and subsurface water of Bhadra river basin near Bhadravati town Karnataka, J. Ecotoxicol. Environ. Monit.,15 (3): 253-261.
Yadav S.S. and Kumar Rajesh (2011). Monitoring Water quality of Kosi River in Rampur District, Uttar Pradesh, India. *Advances in Applied Science Research*, 2 (2): 197-201.
Yerel Suheyla (2010). Water Quality Assessment of Porsuk River, Turkey, *E-Journal of Chemistry*, 7(2), 593-599.
Warhate S.R., Yenkie M.K.N., Chaudhari M.D. and Pokale W.K. (2006), Impacts of Mining Activities on Water and Soil, *Journal of Environ. Science & Engg*. 48 (2), 81& 88.
WHO (World Health Organization) (1993), Guidelines for drinking-water quality, vol. 1, Recommendations, Geneva, WHO, 130.
Wilcox, L.V. (1965). Effects of Industrial Wastes on Water for Irrigation Use, ASTM Tech Pub. No.273, 58.
Zaidi, Jamshed, Shree Ganesh and Pal, Amit (2011). Assessment of water quality in river Betwa and Pahuj around Jhansi city, Uttar Pradesh, India, *International Journal of Current Research*, 5(3),027-031.

Table- 1: Classification of water for irrigation use based on TDS, SAR and % Na

Classification	TDS (ppm)	SAR	Na %
Excellent	< 200	< 10	<20
Good	200-500	10-18	20-40
Fair	500-1500	18-26	40-60
Unsuitable	>1500	>26	>60

Table- 2: Physico chemical properties of Ken River during the Year 2009

Sample No.	pH	EC	Temp.	Total Hardness	Alkalinity	TDS	DO	BOD	COD	NO_3	PO_4	SO_4	Na	K	Ca	Mg	% Na	SAR
1.	7.71 ± 0.05	734 ± 4.53	24.75 ± 1.14	230 ± 3.57	191 ± 2.23	187 ± 2.66	12.5 ± 0.44	9.6 ± 0.72	60.0 ± 3.90	39.0 ± 1.45	4.12 ± 0.33	87 ± 1.73	157 ± 2.24	4.05 ± 0.15	63.5 ± 1.79	23 ± 1.10	6.57 ± 0.10	23.9 ± 0.26
2.	7.71 ± 0.05	730 ± 5.01	24.13 ± 1.13	231 ± 3.44	190 ± 2.17	189 ± 2.60	12.8 ± 0.43	10.4 ± 0.71	64.7 ± 3.78	36.7 ± 1.39	3.67 ± 0.34	85 ± 1.74	160 ± 2.08	3.85 ± 0.15	63.0 ± 1.77	25 ± 1.05	6.61 ± 0.10	24.1 ± 0.26
3.	7.78 ± 0.05	734 ± 5.17	24.25 ± 1.11	236 ± 3.43	189 ± 2.20	189 ± 2.63	13.5 ± 0.43	10.5 ± 0.67	59.2 ± 3.70	37.2 ± 1.40	3.37 ± 0.33	90 ± 1.68	158 ± 2.12	3.85 ± 0.15	62.7 ± 1.67	23 ± 1.05	6.56 ± 0.09	24.0 ± 0.25
4.	7.65 ± 0.05	718 ± 6.11	25.00 ± 1.09	237 ± 3.34	191 ± 2.12	185 ± 2.81	12.7 ± 0.41	10.0 ± 0.62	61.7 ± 3.51	42.7 ± 1.23	3.65 ± 0.31	93 ± 1.68	158 ± 2.04	3.75 ± 0.14	62.5 ± 1.63	24 ± 1.03	6.54 ± 0.09	24.1 ± 0.26
5.	7.71 ± 0.05	733 ± 6.46	25.00 ± 1.06	234 ± 3.37	190 ± 2.11	191 ± 2.67	12.6 ± 0.40	10.0 ± 0.59	63.5 ± 3.36	41.2 ± 1.21	3.32 ± 0.28	92 ± 1.64	158 ± 1.93	3.80 ± 0.14	62.7 ± 1.50	25 ± 0.97	6.62 ± 0.08	23.8 ± 0.25
6.	7.76 ± 0.05	728 ± 6.62	25.13 ± 1.03	233 ± 3.34	188 ± 2.03	189 ± 2.69	12.7 ± 0.39	10.3 ± 0.55	62.5 ± 3.22	40.7 ± 1.21	3.67 ± 0.26	87 ± 1.68	159 ± 1.87	3.70 ± 0.14	63.5 ± 1.40	24 ± 0.93	6.62 ± 0.08	23.9 ± 0.25
7.	7.61 ± 0.05	713 ± 7.41	25.00 ± 1.00	243 ± 3.22	187 ± 2.00	200 ± 2.71	12.2 ± 0.36	9.6 ± 0.47	62.5 ± 2.96	39.0 ± 1.20	3.97 ± 0.24	93 ± 1.69	159 ± 1.75	3.95 ± 0.14	62.0 ± 1.37	25 ± 0.86	6.57 ± 0.07	24.2 ± 0.26
8.	7.68 ± 0.05	730 ± 7.68	24.38 ± 0.98	239 ± 3.02	183 ± 2.01	189 ± 2.75	12.2 ± 0.36	9.9 ± 0.44	60.5 ± 2.71	42.7 ± 1.24	3.82 ± 0.22	90 ± 1.59	161 ± 1.60	4.17 ± 0.14	60.5 ± 1.19	23 ± 0.79	6.45 ± 0.06	24.9 ± 0.26
9.	7.68 ± 0.04	734 ± 8.14	25.00 ± 0.95	238 ± 2.57	189 ± 1.76	191 ± 2.70	12.5 ± 0.33	10.0 ± 0.41	63.7 ± 2.32	41.5 ± 1.23	3.92 ± 0.21	86 ± 1.57	160 ± 1.64	3.90 ± 0.13	60.7 ± 1.08	25 ± 0.78	6.52 ± 0.06	24.6 ± 0.27
10.	7.66 ± 0.04	726 ± 8.32	25.00 ± 0.91	231 ± 2.82	182 ± 1.77	195 ± 2.65	12.9 ± 0.32	10.4 ± 0.34	64.2 ± 1.85	41.0 ± 1.23	3.75 ± 0.20	85 ± 1.52	163 ± 1.44	3.95 ± 0.12	63.0 ± 1.00	22 ± 0.79	6.52 ± 0.05	25.0 ± 0.27

Values are mean ± SE (n=6); Units: - Concentration in mg/l, except pH; Temperature (ºC); EC (µS/cm); SAR (meq/l)

Table- 3: Physico chemical properties of Ken River during the Year 2010

Sample No.	pH	EC	Temp.	Total Hardness	Alkalinity	TDS	DO	BOD	COD	NO_3	PO_4	SO_4	Na	K	Ca	Mg	% Na	SAR
1.	7.71 ± 0.05	729 ± 8.14	24.25 ± 1.92	231 ± 3.48	192 ± 1.78	190 ± 2.58	12.5 ± 0.36	10.2 ± 0.69	63.7 ± 4.22	40.2 ± 1.31	4.1 ± 0.30	87 ± 1.48	158 ± 2.38	3.9 ± 0.12	66.0 ± 1.92	24 ± 1.15	6.68 ± 0.10	23.6 ± 0.28
2.	7.68 ± 0.05	731 ± 9.05	24.12 ± 1.91	230 ± 3.26	190 ± 1.78	191 ± 2.36	12.6 ± 0.36	10.3 ± 0.67	67.2 ± 4.09	39.7 ± 1.26	3.7 ± 0.31	87 ± 1.44	163 ± 2.23	4.1 ± 0.11	64.2 ± 1.88	26 ± 1.01	6.71 ± 0.10	24.2 ± 0.29
3.	7.73 ± 0.05	728 ± 10.0	24.00 ± 1.89	238 ± 3.20	188 ± 1.92	194 ± 2.30	12.9 ± 0.36	10.3 ± 0.64	63.2 ± 3.96	39.0 ± 1.29	3.9 ± 0.30	90 ± 1.34	163 ± 2.06	4.2 ± 0.11	64.0 ± 1.81	26 ± 1.02	6.71 ± 0.09	24.2 ± 0.29
4.	7.67 ± 0.05	725 ± 10.7	24.50 ± 1.86	240 ± 3.12	190 ± 1.96	192 ± 2.25	12.7 ± 0.35	10.1 ± 0.61	64.0 ± 3.71	43.5 ± 1.09	3.9 ± 0.29	94 ± 1.31	163 ± 1.98	4.0 ± 0.11	64.5 ± 1.77	23 ± 1.03	6.59 ± 0.09	24.7 ± 0.29
5.	7.67 ± 0.05	726 ± 11.4	24.87 ± 1.81	240 ± 3.12	190 ± 1.92	192 ± 2.09	12.6 ± 0.35	10.5 ± 0.59	64.7 ± 3.55	43.2 ± 1.05	3.8 ± 0.27	92 ± 1.32	162 ± 1.94	4.2 ± 0.10	66.7 ± 1.70	24 ± 1.03	6.72 ± 0.09	24.1 ± 0.27
6.	7.73 ± 0.05	733 ± 11.8	24.87 ± 1.78	237 ± 3.10	187 ± 1.82	192 ± 1.93	12.6 ± 0.33	10.2 ± 0.52	65.0 ± 3.38	42.7 ± 1.03	3.9 ± 0.26	90 ± 1.31	164 ± 1.87	4.2 ± 0.09	64.5 ± 1.61	24 ± 1.05	6.64 ± 0.08	24.7 ± 0.28
7.	7.69 ± 0.05	722 ± 12.6	24.87 ± 1.73	242 ± 3.03	189 ± 1.85	195 ± 1.88	12.5 ± 0.32	9.9 ± 0.47	64.5 ± 3.16	42.7 ± 0.90	4.0 ± 0.24	95 ± 1.29	164 ± 1.81	4.2 ± 0.09	65.2 ± 1.37	24 ± 1.00	6.67 ± 0.07	24.5 ± 0.27
8.	7.69 ± 0.05	727 ± 13.0	24.00 ± 1.71	244 ± 2.80	186 ± 1.92	193 ± 1.85	12.1 ± 0.31	10.2 ± 0.43	63.5 ± 2.82	42.2 ± 1.01	4.1 ± 0.21	90 ± 1.33	168 ± 1.60	4.3 ± 0.09	65.2 ± 1.24	24 ± 0.97	6.67 ± 0.06	25.1 ± 0.28
9.	7.70 ± 0.05	739 ± 13.1	24.75 ± 1.65	239 ± 2.30	189 ± 1.88	192 ± 1.73	12.6 ± 0.29	10.0 ± 0.38	65.0 ± 2.44	43.0 ± 1.02	4.1 ± 0.18	91 ± 1.33	163 ± 1.58	4.0 ± 0.09	62.2 ± 1.13	23 ± 0.98	6.52 ± 0.06	24.9 ± 0.28
10.	7.66 ± 0.05	726 ± 13.7	24.75 ± 1.59	233 ± 2.45	188 ± 1.96	193 ± 1.53	12.6 ± 0.28	10.5 ± 0.30	66.0 ± 1.96	41.2 ± 1.01	4.0 ± 0.15	91 ± 1.31	166 ± 1.38	4.0 ± 0.09	64.7 ± 1.03	22 ± 1.00	6.59 ± 0.05	25.1 ± 0.29

Values are mean ± SE (n=6); Units: - Concentration in mg/l, except pH; Temperature (ºC); EC (µS/cm); SAR (meq/l)