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Original Research Paper

Water Quality Surveillance of Panchana Dam Irrigation Project, Karauli, Rajasthan

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ABSTRACT

Water chemistry provides precious parameters to evaluate the environmental impact assessment of irrigation projects. The Panchana Dam is situated 12 km north to Karauli in the eastern part of Rajasthan. Panchana Dam site falls under the eastern gravelly/ rocky plateau with outliers of Aravallis, and the total catchment area is about 621.60 sq. km and the command area is about 10606 ha. The climate of Panchana Dam area is almost semi-arid and comparatively milder with distinct winter, summer and rainy seasons. The summer season is from the middle of March to June, being extreme in the month of June. The present study revealed that the water has pH (7.6-8.3), electrical conductivity (260-300 µmhos), total dissolve solids (169-195 mg/L), phosphate (0.121-1.939 mg/L), total alkalinity (410-650 mg/L), carbonate alkalinity (20-100 mg/L), bicarbonate alkalinity (390-610 mg/L), total hardness (92-128 mg/L), calcium hardness (22.44-33.67 mg/L), magnesium hardness (69.56-90.33 mg/L), chloride (24.14 -28.4 mg/L), and acidity (2.0-4.0 mg/L). Water in Panchana Dam irrigation project (PIP) is influenced by hydrology and related factors, which cause variations in nutrients present in a particular time. PIP as wetland plays an important role to develop the favourable microclimatic conditions for biodiversity as a whole. The physico-chemical analysis of water samples from this area showed that the water is within the safe limits of drinking water quality. Seasonal variations in water quality are due to intrinsic and extrinsic factors of the aquatic system.

INTRODUCTION

In Rajasthan, the Panchana Dam is situated at Panchana river, near Karauli district (a tributary of Yamuna). The dam is situated at 12 km north to Karauli in the eastern part of Rajasthan. It lies between 27°67' to 27°12.2' N Latitude and 77°22.5' to 77°33.9' E Longitude on Panchana river. It is an important man-made wetland system, formed by the confluence of five rivers, named Barkhera, Bhadrawati, Attaki, Bhansawat and Manchi. These all are coming from different directions and carrying water which flows through various sediment pockets of different topography, influenced by climatic hydrology of corridor areas and anthropogenic activities like agriculture and mining operations in the catchment area.

Panchana dam is one of the important waterbodies of Karauli, as it is used for irrigation and is also the important source of drinking water supply for the district itself. It is an earthen dam, with the maximum height up to 25.9m (85ft). Panchana dam site falls under the eastern gravelly/rocky plateau with outliers of Aravallis with the total catchment area of about 621.60 sq. km, and the command area about 10,606 ha. The climate of the Panchana dam area is almost semi-arid and comparatively milder with distinct winter, summer and rainy seasons. The physico-chemical characteristics of water samples, taken at different sites of waterbody, have been identified for the factors operating in aquatic systems, which indicate not only the conditions of the water but also express the nature of

the biological factors. The dissolved solids and specific conductance are related to the biological productivity. These characteristics are also used to assess the trophic status of waterbody (Meena & Sharma 2004).

MATERIALS AND METHODS

Seasonally, samples were collected from the dam and the river. Physico-chemical analysis of water was done by following standard methods (APHA 1992, Maiti 2001 and Trivedy & Goel 1987). All the water samples were collected during the period of December, 2005 to November, 2006. During course of the study, in order to assess hydrology of the dam and its corridor system, five sites were selected in the river side (RS-1 = River Barkhera, RS-11 = River Bhadrawati, RS-111 = Junction of three rivers Manchi, Attaki and Bhansawat, RS-1V = Junction of RS-1, RS-11and RS-111, which is main inlet of zone of the Dam, RS-V = Junction of two rivers, Barkhera and Bhadrawati), two along Dam side (DS-1 = Near Anjani temple, DS-11 = Canal regulator point) and one of each at main canal side CS = Canal site (Fig. 1).

RESULTS AND DISCUSSION

The range and annual mean values of physico-chemical parameters concerning with dam and river sites are shown in Table 1. The maximum annual mean value of pH = 8.1 was recorded at Canal site (CS), while minimum annual mean value of pH = 7.7 at RS-II and DS-I, representing alkaline nature of the water. The physico-chemical analysis of water samples from these sites shows that the water is still within the safe limits that may be assessed by important parameters of water quality like pH (Paliwal & Dinesh 1970). The maximum annual mean value of electrical conductivity = 297 µmhos is recorded at CS, and minimum value (270 µmhos) at RS-I. The electrical conductivity varies in different samples ranging from 288-395 µmhos/cm. Langengger (1990) has described the importance of electrical conductance, which measure the salinity and also affect the taste of water.

The maximum annual mean value of total dissolved solid = 192.83 mg/L was recorded at CS, and minimum annual mean value (175.50 mg/L) at RS-I. Phosphate is most important from agriculture point of view. The maximum mean value of phosphate = 1.878 mg/L, and minimum mean value (0.122 mg/L) was recorded at CS and RS-I. The maximum mean value of total alkalinity was 633.33 mg/L at CS, and minimum mean value of 346.66 mg/L at RS-I. The carbonate maximum mean value was 86.66 mg/L, and minimum mean value 73.33 mg/L recorded at CS and RS-I, II. Bicarbonate maximum mean value (596.66 mg/L), and minimum mean value (413.33 mg/L) has been observed at CS and RS -III. The high value of alkalinity indicates that the river water pollution is caused by sewage (Upadhyay & Rana 1991), while higher value of total alkalinity in canal water may be attributed to higher concentration of bicarbonates salts which make the water nonpotable as compared to other sites (Latif & Jha 1998).

The hardness is generally low in surface waters. The maximum mean value of total hardness (120 mg/L), and minimum mean value (96 mg/L) were recorded at CS and RS-II. The concentration of calcium was maximum (30.46 mg/L) with minimum (28.78 mg/L) at CS and RS-I. Magnesium was maximum (68.48) at CS and RS-II. The maximum mean value of chloride was 27.60 mg/L, and acidity 44 mg/L recorded at CS. However, the minimum mean value of chloride (24.61) was observed at RS-I, and acidity (2 mg/L) at RS- I, II, III, IV, V and DS-I, II.

To explore the relationship between different water quality parameters, Karl-Pearson's correlation analysis was performed and correlation matrix so emerged is given in Table 2. Very significant

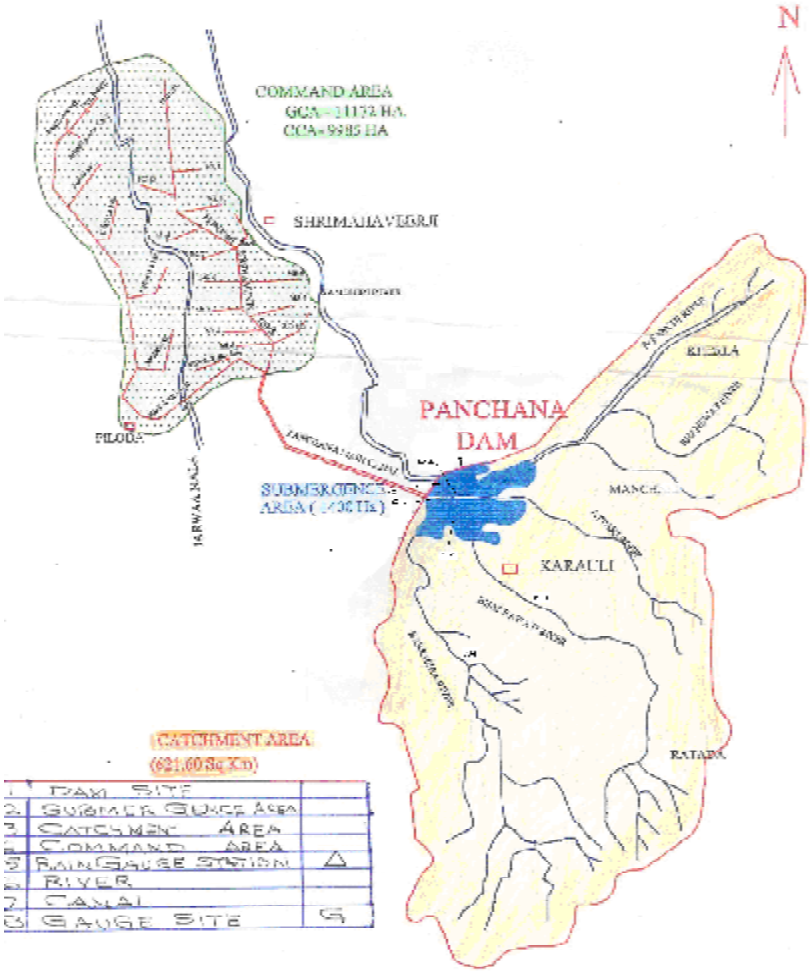

Fig.1: Map showing eight study sites of Panchana dam (sites I-VIII).

and positive correlation was observed between EC-HCO_3^-, TH, Ca^{2+}, Cl^- and acidity, pH-PO_4^{3-}, PO_4^{3-}-acidity, HCO_3^--Cl^- and acidity, TH-Mg^{+2} and CO_3^{-2}-TH. All these correlations showed that PO_4^{-3}, HCO_3^-, TH, Ca^{2+}, Cl^-, Mg^{+2} and acidity greatly influence the EC, PO_4^{-3}, pH, CO_3^{-2}, HCO_3^-, TH and Cl^- of water. Total hardness is positively and significantly correlated with Ca^{+2} and Mg^{+2} showing dependence of TH on these ions. The overall result is that the corridor system, which is influencing the water chemistry, is due to the following reasons:

The topographic characteristics of corridor area provide an inclination towards the river and the dam. Therefore, the high rate of sedimentation takes place particularly in the rainy season. The corridor features of individual rivers are quite different which consequently differentiate rivers of the Panchana dam with respect to physico-chemical parameters. The agricultural fields surround the dam and, therefore, the chemicals and fertilizers are influencing the dam water, which is being used by farmers of this area.

Table 1: Physico-chemical characteristics of water at different sites.

Parameters	RS I	RS II	RS III	RS IV	RS V	DS I	DS II	CS
pH	8.0	7.7	7.8	7.9	8.0	7.7	7.9	8.1
EC(µmhos)	270	277	273.33	277	280	281	273.33	297
TDS (mg/L)	175.5	119.83	177.66	179.83	184	186.33	177.66	172.83
Phosphate (mg/L)	0.122	0.151	0.222	0.25	1.523	0.287	0.701	1.818
Total alk (mg/L)	846.66	560	493.33	353.33	496.66	500	513.33	633.33
Carbonate (mg/L)	73.33	73.33	80	83.33	76.66	88.33	73.33	86.66
HCO_3 (mg/L)	440	486.66	413.33	436.66	420	416.66	446	596.66
T. hardness (mg/L)	102.66	96	98.66	109.33	98.66	116	105.33	120
Calcium (mg/L)	23.78	27.57	28.05	26.45	28.05	28.32	25.38	30.46
Magnesium (mg/L)	78.89	68.48	70.61	82.88	70.61	89.01	79.95	92.2
Chloride (mg/L)	24.61	26.5	25.56	26.33	25.56	25.2	25.56	27.6
Acidity (mg/L)	2	2	2	2	2	2	2	4

Table 2: Correlation coefficients among various parameters.

	Correlation Co-efficient											
~	pH	EC	TDS	Phos phate	Total alk	Carbo-nate	Bicar-bonate	Total hardness	Ca	Mg	Chlo-ride	Aci-dity
pH	1	~	~	~	~	~	~	~	~	~	~	~
EC	0.393	1	~	~	~	~	~	~	~	~	~	~
TDS	0.398	0.038	1	~	~	~	~	~	~	~	~	~
Phosphate	0.706	0.768	0.251	1	~	~	~	~	~	~	~	~
Total alk	0.374	-0.051	-0.132	0.012	1	~	~	~	~	~	~	~
Carbonate	-0.010	0.658	0.429	0.240	-0.346	1	~	~	~	~	~	~
Bicarbonate	0.466	0.802	-0.326	0.580	0.290	0.242	1	~	~	~	~	~
T. hardnes	0.277	0.702	0.429	0.365	-0.028	0.814	0.497	1	~	~	~	~
Ca	0.009	0.838	-0.044	0.589	-0.330	0.665	0.512	0.412	1	~	~	~
Mg	0.305	0.599	0.448	0.288	0.067	0.730	0.456	0.985	0.254	1	~	~
Chloride	0.242	0.790	-0.356	0.529	-0.255	0.371	0.833	0.389	0.696	0.288	1	~
Acidity	0.589	0.898	0.021	0.715	0.236	0.477	0.924	0.660	0.636	0.603	0.762	1

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