# Water Quality Surveillance of Panchana Dam Irrigation Project (PIP), Karauli, Rajasthan

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**ABSTRACT:** Water is a unique liquid, without it life is not possible. Water chemistry provide precious parameters to evaluate the environmental impact assessment of the project. Water pollution refers to degradation of water quality. In defining pollution we generally look at the intended use of the water how far it departs from the norms or standards it effects on public health or its environmental impacts. The Panchana Dam is situated 12 km. north to Karauli in the estern 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 10,606 ha. The climate of Panchana Dam area is almost semi-arid and comparatively milder with distinct winter, summer and rainy season. The summer season is from the middle of March to June, being extreme in the month of June. The present study revealed that the pH (7.6–8.3), Electrical conductivity (260–300 µmhos), Total dissolve solids (169–195 ppm), Phosphate (0.121–1.939 ppm), Total alkalinity (480–650 ppm), Carbonate alkalinity (60–100 ppm), Bicarbonate alkalinity (390–610 ppm), Total hardness (92–128 ppm) Calcium hardness (22.05–37.67 ppm), Magnesium hardness (54.33–99.14 ppm), Chloride (24.14–28.4 ppm) and Acidity (2.0–4.0 ppm). In many present investigation, water in Panchana Dam irrigation project (PIP) are influenced by hydrology and related factors which causes variations in nutrients amounts present in a particular time. PIP as wetland plays an important role to develop the favourable microclimatic conditions for biodiversity as whole. The physico-chemical analysis of water samples from these area showed that, the water is within the safe limits that may be assessed by important parameters of drinking water quality seasonal variations in water quality is 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 & 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 at the catchment area.

Panchana Dam is one of the important waterbody of Karauli, as it is used for irrigation and is also the important source of drinking water supply for the district itself. It is a earthen dam, with the maximum height upto is 25.9 M (85 ft). Panchana Dam site falls under the eastern gravelly/rocky plateau with outliers of Aravallies and the total catchment area is about 621.60 sq. km. and the command area is about 10,606

ha. The climate of the Panchana Dam area is almost semi-arid and comparatively milder with distinct winter, summer and rainy season (Panchana Dam irrigation project, index plan-1, 2005). The physico-chemical characteristics of water samples is taken at different sites of waterbody has been identified for the factors operating act on 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 asses the trophic status of waterbody (Meena and Sharma, 2004).

## MATERIAL AND METHOD

Seasonally samples were collected from Dam and Rivers. Physico-chemical analysis of water was done by following standard method (A.P.H.A., 1992, Maiti, 2001, and Trivedi and Goel, 1987). All water samples were taken during the period of December, 2005 to November, 2006 for physico-chemical analysis.

During the course of study in order to assess hydrology of 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 & Bhansawat, RS-1V = Junction of RS-1,RS-11& RS-111,which is main inlet of zone of the Dam, RS-V = Junction of two river Barkhera & Bhadrawati), two along Dam side (DS-1 = Near Anjani Tample, DS-11 = Canal regulator point) and one of each at Main Canal side CS = Canal site.

## DISCUSSIONS

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 was recorded at RS-II and DS-I, representing alkaline nature of water. Electrical conductivity of water is the ability of water to conduct electric current through it and is an indicator of salinity. The highest annual mean value of conductance 297 µmhos was recorded at CS while the lowest 270 µmhos at RS-I. The electrical conductivity varies in different samples ranging from 288–395 µmhos. Langengger (1990), has described the importance of

electrical conductance which measure the salinity and also effect the test of water. The highest value of total dissolved solid 192.83 ppm was measured at CS and while the lowest value of total dissolved solid 119.83 ppm was reported from RS-II.

Phosphate is most important from agriculture point of view. Phosphate content was found to be 1.878 ppm at CS, which was highest. The lowest value of phosphate was reported from RS-I, and its value was 0.122 ppm. The maximum annual mean value of total alkalinity was reported as 633.33 ppm and minimum annual mean value of total alkalinity was found to be 346.66 ppm, from CS and RS-I respectively. The maximum mean value for carbonate was 86.66 ppm and minimum mean value was 73.33 ppm recorded at CS and RS-I, II, and DS-II, while Bicarbonates, maximum mean value was 596.66 ppm and minimum mean value was 413.33 ppm has been observed at CS and RS-III. The high value of alkalinity indicates that river water pollution is caused by sewage (Upadhyay and Rana, 1991), while higher value of total alkalinity in canal water may be attributes to higher concentration of bicarbonates salts which makes the water unpotable as compare to other sites (Latif and Jha 1998).

**Table 1:** Range and Annual Mean Values of Physico-Chemical Charactertistics of Water of Different Study Sites of Panchana Dam at Karauli

| Parameters | RS - I | RS - II | RS - III | RS - IV | RS – V | DS - I | DS - II | CS |
|---|---|---|---|---|---|---|---|---|
| pH | 7.9–8.1 (8.0) | 7.6–7.9 (7.7) | 7.7–8.0 (7.8) | 7.8–8.1 (7.9) | 7.9–8.1 (8.0) | 7.6–7.9 (7.7) | 7.7–8.1 (7.9) | 8.0–8.3 (8.1) |
| EC(µmhos) | 260–280 (270) | 260–290 (277) | 260–290 (273.33) | 260–290 (277) | 270–290 (280) | 280–290 (281) | 270–280 (273.33) | 290–300 (297) |
| TDS (ppm) | 169–182 (175.50) | 169–188.50 (119.83) | 169–188.50 (177.66) | 169–188.50 (179.83) | 175.50–188.80 (184) | 182–188.50 (186.33) | 175.50–182 (177.66) | 188.50–195 (192.83) |
| Phosphate (ppm) | 0.121–0.124 (0.122) | 0.136–0.163 (0.151) | 0.210–0.244 (0.222) | 0.210–0.296 (0.250) | 1.434–1.589 (1.523) | 0.255–0.311 (0.287) | 0.637–0.761 (0.701) | 1.839–1.939 (1.878) |
| Total alkalnity (ppm) | 500–530 (346.66) | 550–570 (560) | 480–510 (493.33) | 500–530 (353.33) | 480–510 (496.66) | 480–530 (500) | 500–530 (513.33) | 610–650 (633.33) |
| Carbonate Alkalnity (ppm) | 60–80 (73.33) | 70–80 (73.33) | 70–90 (80) | 70–100 (83.33) | 60–90 (76.66) | 80–90 (83.33) | 60–80 (73.33) | 80–90 (86.66) |
| Bicarbonate Alkalnity (ppm) | 430–450 (440) | 480–490 (486.66) | 390–440 (413.33) | 430–450 (436.66) | 390–440 (420) | 390–450 (416.66) | 430–450 (446) | 590–610 (596.66) |
| Total hardness (ppm) | 98–106 (102.66) | 92–98 (96) | 92–106 (98.66) | 104–112 (109.33) | 92–106 (98.66) | 104–128 (116) | 98–112 (105.33) | 116–128 (120) |
| Calcium Hardness (ppm) | 22.05–24.85 (23.78) | 22.44–37.67 (27.51) | 22.44–37.67 (28.05) | 24.85–27.25 (26.45) | 22.44–37.67 (28.05) | 24.85–31.26 (28.32) | 24.05–27.25 (25.38) | 28.66–31.26 (29.46) |
| Magnesium Hardness (ppm) | 75.56–81.95 (78.89) | 54.33–75.56 (68.48) | 54.33–81.95 (70.61) | 79.15–84.75 (82.88) | 54.33–81.95 (70–61) | 79.15–99.14 (89.01) | 73.15–84.75 (79.95) | 88.74–99.14 (92.20) |
| Chloride (ppm) | 24.14–25.56 (24.61) | 25.56–26.98 (26.50) | 24.16–26.98 (25.56) | 24.14–27.31 (26.33) | 24.14–26.98 (25.56) | 24.14–27.31 (25.20) | 24.14–26.96 (25.56) | 26.98–28.4 (27.60) |
| Acidity (ppm) | 2–2 (2) | 2–2 (2) | 2–2 (2) | 2–2 (2) | 2–2 (2) | 2–2 (2) | 2–2 (2) | 4–4 (4) |

The hardness generally occurs in small amounts in surface water. The maximum mean value of total hardness was analysed as 120 ppm, and minimum mean value was 96 ppm, recorded at CS and RS-II, respectively while the maximum mean value for calcium was 30.46 ppm and minimum mean value was 23.78 ppm found at CS and RS-I, respectively. The maximum mean value for magnesium was 92.20 ppm was reported at CS, while the minimum value of magnesium 68.48 ppm was observed at RS-II. The highest mean value of chloride was 27.60 ppm and acidity was 4 ppm, recorded at CS, However the minimum mean value of chloride was 24.61 ppm was observed at RS-I and Acidity was 2 ppm observed 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 is performed and correlation matrix so emerged is given in Table 2. Significant and positive correlation was observed among EC–$PO_4^{-3}$, $HCO_3^-$, TH, $Ca^{+2}$, $Cl^-$ and Acidity, pH–$PO_4^{-3}$, $PO_4^{-3}$–Acidity, $CO_3^{-2}$–$Mg^{+2}$, $HCO_3^-$–$Cl^-$ and Acidity, TH–$Mg^{+2}$ and $Cl^-$– Acidity. All these correlation showed that $PO_4^{-3}$, $HCO_3^-$, TH, $Ca^{+2}$, $Cl^-$, $Mg^{+2}$ and Acidity greatly influence the EC–$PO_4^{-3}$, pH, $CO_3^{-2}$, $HCO_3^{-1}$, 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 (Meenakshi, *et al.*, 2002).

## CONCLUSIONS

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 Dam is surrounded by the agricultural field and therefore the dam water is getting influence by the chemicals and fertilizers which is being use by the farmers of this area. The water chemistry is also influence by the mining activities in the catchment area of rivers.

The physico-chemical analysis of water samples from this sites shows that the water is still within the safe limits that may be assessed by important parameters of water quality i.e. pH (Paliwal and Dinesh, 1970). Since the Panchana Dam receives water from tributaries passing through varied geological surfaces, the nutrients spectrum of water is complete and thus it is for irrigation of all kinds of crops. Both diurnal and seasonal variations in water chemical characteristics are due to intrinsic and extrinsic factors of the aquatic system.

**Table 2**

| | pH | EC | TDS | $PO_4^{-3}$ | TA | $CO_3^{-2}$ | $HCO_3^-$ | TH | $Ca^{+2}$ | $Mg^{+2}$ | $Cl^-$ | Acidity |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| pH | 1 | | | | | | | | | | | |
| EC | 0.393158 | 1 | | | | | | | | | | |
| TDS | 0.397698 | 0.038327 | 1 | | | | | | | | | |
| $PO_4^{-3}$ | 0.706023* | 0.768286* | 0.250726 | 1 | | | | | | | | |
| TA | 0.373701 | −0.050796 | −0.132293 | 0.01236 | 1 | | | | | | | |
| $CO_3^{-2}$ | −0.010149 | 0.658445 | 0.428709 | 0.240326 | −0.346226 | 1 | | | | | | |
| $HCO_3^-$ | 0.465876 | 0.80159* | −0.325751 | 0.580354 | 0.290007 | 0.242275 | 1 | | | | | |
| TH | 0.276808 | 0.701541* | 0.428801 | 0.365227 | −0.028488 | 0.814072* | 0.497403 | 1 | | | | |
| $Ca^{+2}$ | 0.008545 | 0.838205* | −0.044395 | 0.589288 | −0.330341 | 0.665333 | 0.512373 | 0.411854 | 1 | | | |
| $Mg^{+2}$ | 0.305083 | 0.599368 | 0.447939 | 0.288116 | 0.066536 | 0.729774* | 0.456488 | 0.985143* | 0.253562 | 1 | | |
| $Cl^-$ | 0.24231 | 0.789541* | −0.355938 | 0.528579 | −0.254553 | 0.37137 | 0.833334* | 0.388809 | 0.696057 | 0.288289 | 1 | |
| Acidity | 0.589015 | 0.897838* | 0.021232 | 0.715326* | 0.236243 | 0.477495 | 0.923978* | 0.660366 | 0.635654 | 0.602623 | 0.761929* | 1 |

Correlation Co-efficient among different water quality parameters * Represents significant correlation.
*Represents significant correlation.

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