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RESEARCH ARTICLE

WATER QUALITY ASSESSMENT OF DENKADA ANICUT, VIZIANAGARAM DISTRICT, INDIA

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ABSTRACT

Seasonal variation in the physico chemical parameters, water quality assessment using WQI method, irrigation water quality assessment and heavy metal analysis was reported in the present paper by the authors. The work is carried out for the water samples collected from Denkada anicut of Vizianagaram district of Andhra Pradesh, India. The samples were collected and analyzed for eleven different seasons such as August 2010, December 2010, April 2011, August 2011, December 2011, April 2012, August 2012, December 2012, April 2013, August 2013 and December 2013. All the physico- chemical parameters analyzed were compared with IS: 10500 standards and found to be well within the values prescribed. It was found that the quality of the water samples was rated as excellent with respect to the water quality index (WQI) calculations. The parameters such as SAR, RSC, %Na and Mg hazard were also found to well within the prescribed standard values. Inferring that the water is suitable and rated as Good for irrigation and agricultural purpose. From the ICP analysis report it was found that except Si all other metals analyzed were below detection limits.

INTRODUCTION

Ground water is being contaminated due to the inorganic and organic pollutants, storms, cyclones etc. Hence the only source of fresh water is considered to be river water. To make use of the water resources man made impoundments were made and known as Dam or Reservoirs or Anicut. A dam is a barrier that impounds water or underground streams (Day and Sawanth, 2013). Dams generally serve the primary purpose of retaining water, while other structures such as floodgates or levees are used to manage or prevent water flow into specific land regions. A dam or mole made in the course of a stream for the purpose of regulating the flow of a system of irrigation. These dams or reservoirs are either naturally formed or manmade. These founds their wide spread use in the power generation, river regulation and flood control, agricultural irrigation, drinking and municipal water supply and for recreation (Tiwari 2000). Due to urbanization, over usage of fertilizers, and sewage disposal have directly or indirectly influenced the quality of the water (Singh and Mathur 2005), (Ghose and Basu 1968). Globally, in literature (Patil and Girivappanwair, 2013), (Alher, 2013), (GVSR Pavan Kumar, 2013), (GVSR Pavan Kumar, 2014), (Patil Alka, 2014), (Fernado B Lopes, 2014), (Akbulut, 2010), (Brinda and Elango, 2013) it was found that researchers have studied the water quality and factors affecting the same and reported. And hence it is important to assess and determine the quality of the water for its utilization. Physico chemical characterization and WQI methods are the best ways to assess the quality of the water. Other parameters such as salinity, SAR, RSC, %Na and Mg-hazard are considered for the determination of water quality for irrigation and agricultural purpose. Hence the author's present study is aimed at the assessment of the quality of Denkada anicut constructed on river Champavthi in Vizianagarm district of Andhra Pradesh.

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Study area

The Denkada Aniuct (Fig.21) was constructed across Champavathi River The Project is located near Saripalli village, Nellimarla Mandal, Vizianagaram District to irrigate a total ayacut of 5,153 acres in the District. The project was constructed during 1965-68. The Project utilizes 0.640 TMC of the available water. The Denakda anicut was situated in the coordinates of 18°7'51"N 83°28'36"E.

Sampling

Integrated sampling procedures were adopted for the collection of samples of water. Ten different sampling points were chosen and from them water samples were collected and mixed to get a representative sample. And such sample is transferred into cleaned high quality polythene bottles and mixed with adequate volume of dilute nitric acid for heavy metal analysis. Electrical Conductance, pH, temperature were determined on spot. Such samples were brought to the laboratory for further analysis. The samples of water were collected from the anicut for ten different seasons from August 2010, December 2010, April

2011, August 2011, December 2011, April 2012, August 2012, December 2012, April 2013, August 2013 and December 2013.

Experimentation and Methodology

All the solutions required for the analyses were prepared by using A R grade chemicals and double distilled water. All the analytical procedures were performed as per the standard APHA (Lenore, APHA, 1995) methods. The following table gives the data about the parameter analyzed and the corresponding methods followed for it.

parameter analyzed	Method followed for the analysis	Instrument used for the purpose
pH	pH metry	ELICO- LI 120 PH METER
Electrical conductance	conducto mteric method	ELICO- CM 180 conductometer
TDS	gravimetric	
Total hardness of water	complexometric titration using EDTA	-----
Calcium	complexometric titration using EDTA	-----
Magnesium	complexometric titration using EDTA	-----
Sodium	flame photometric method	ELICO- SL 361 flame photometer
Potassium	flame photometric method	ELICO- SL 361 flame photometer
Iron	spectrophotometric method	ELICO SL 177 spectrophotometer
Chloride	Mohr's method	
Phosphate	spectrophotometric method	ELICO SL 177 spectrophotometer
Nitrite	spectrophotometric method	ELICO SL 177 spectrophotometer
Total alkalinity	acid base titartion	-----
Carbonate	acid base titartion	-----
Bicarbonate	acid base titartion	-----
Heavy metals	ICP-OES	ICP-OES

The water quality index calculations are as follows:

$W_i = k/S_i$

Where W_i is the unit weight of and S_i is the standard for i^{th} parameter

K is the proportionality constant

$Q = 100V_i / S_i$

Where Qi is the sub index of the i^{th} parameter, Vi is the monitored value of i^{th} parameter and WQI is calculated as follows

$WQI = \sum Q_i W_i / \sum W_i$

Irrigation water quality can be determined by SAR, RSC, %Na and Mg-hazard values. These can be calculated using the following formula:

$SAR = Na^+ / \sqrt{(Ca^{2+} Mg^{2+})}$

Magnesium hazard = $100 \times Mg^{2+} / (Ca^{2+} Mg^{2+})$

$Na\ \% = 100 \times Na^+ / (Na^+ + Ca^{2+} + Mg^{2+} + K^+)$

$RSC = (CO_3^{2-} + HCO_3^-) - (Ca^{2+} Mg^{2+})$

RESULTS AND DISCUSSION

Physico- chemical characterization

The complete analysis report for the physico chemical parameters for the water samples analyzed was presented in Table 1.

Table 1. Physico chemical characteristics of the water samples analyzed from Denkada anicut

	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11
pH	7.1	8.5	8	8.2	8.4	8.5	8.4	8.5	8.5	8.3	8.4
EC	525	380	460	455	460	465	460	455	448	445	440
TDS	575	100	250	255	250	255	240	235	225	210.5	225
THW	192.1	201.4	210.5	205.8	205.8	210	205.8	205.8	200	205.8	210
Ca	80.5	40.3	55	60	65.8	68.5	65	60	65	60	65
Mg	42.5	24.2	32.5	33	33.8	35	35	33	39	33	30
Na	58.5	42.5	30	35	39	39	35	35	38	38	45
K	12.5	5.5	6.5	6	7.5	6.5	6	6.5	6.5	6.5	6
Fe	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Cl	135	51.2	51.8	55	58	52.5	52	52.5	52	52	55
PO4	0.1	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.5
No2	0.3	0.2	0.2	0.2	0.1	0.2	0.2	0.2	0.2	0.2	0.1
F	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.3
TA	205.8	200	198.5	195	198.5	200.5	200	198	200	205.8	200

From the data it was found that the vales of pH during all the seasons under study were well within the prescribed standard limit such as 6.5-8.5. It is inferred that, in most of the seasons the pH was found to be slightly alkaline. This is due to the bicarbonate alkalinity present in the reservoir water samples.

Electrical conductivity and TDS were found to be well within the prescribed standard values, indicating lower pollutant levels in the waters of the reservoir. This is due to the lower concentrations of cations and anions in the water samples analyzed.

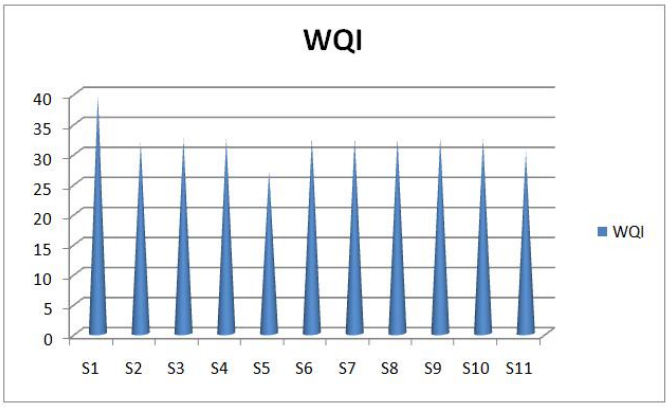

Fig.1. Seasonal variation in WQI of the water samples analyzed

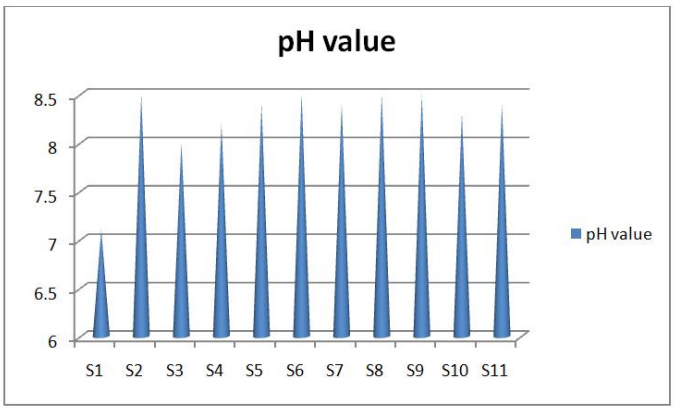

Fig.2. Seasonal variation in pH of the water samples analyzed

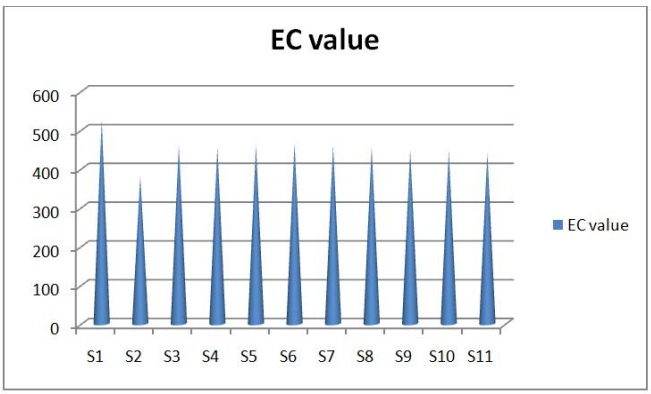

Fig.3. Seasonal variation in EC of the water samples analyzed

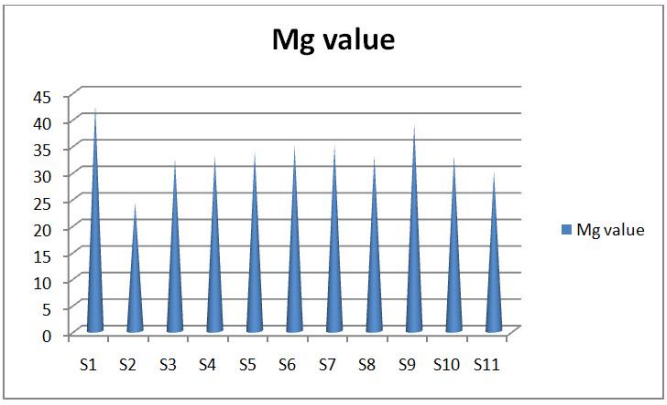

Fig.7. Seasonal variation in Mg of the water samples analyzed

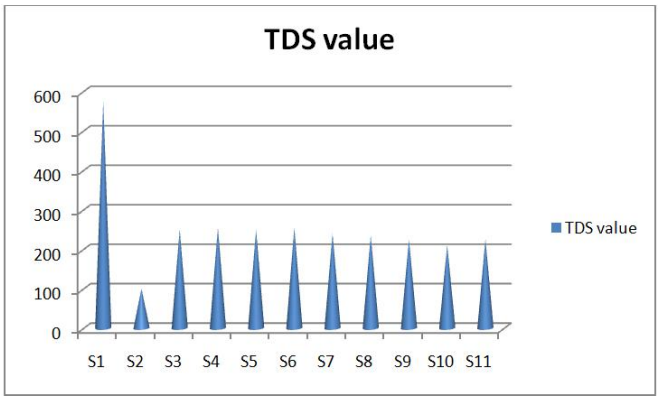

Fig.4. Seasonal variation in TDS of the water samples analyzed

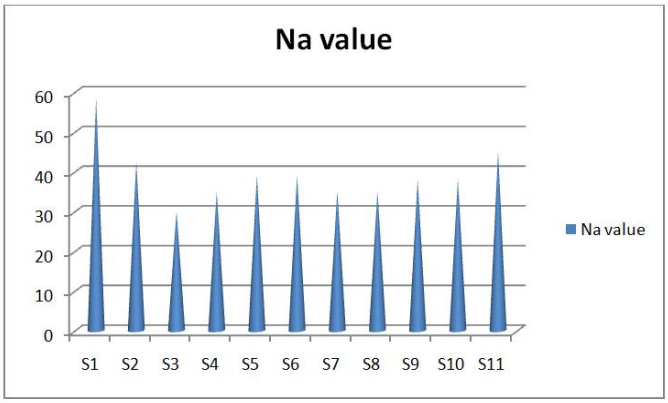

Fig.8. Seasonal variation in Na of the water samples analyzed

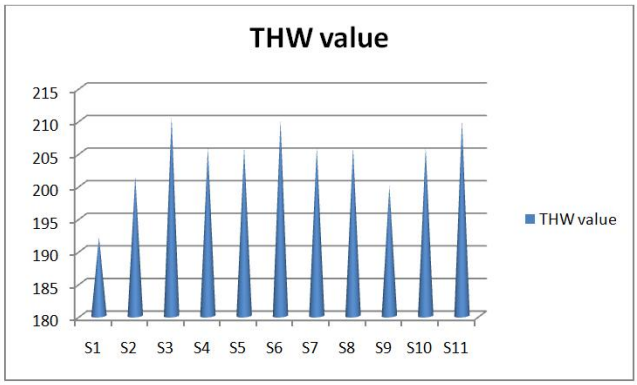

Fig.5. Seasonal variation in THW of the water samples analyzed

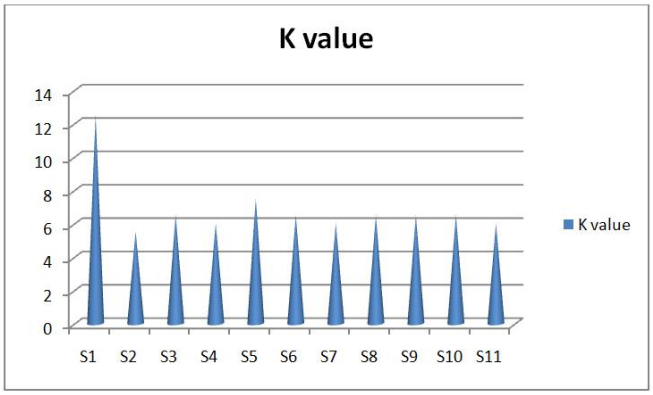

Fig.9. Seasonal variation in Kof the water samples analyzed

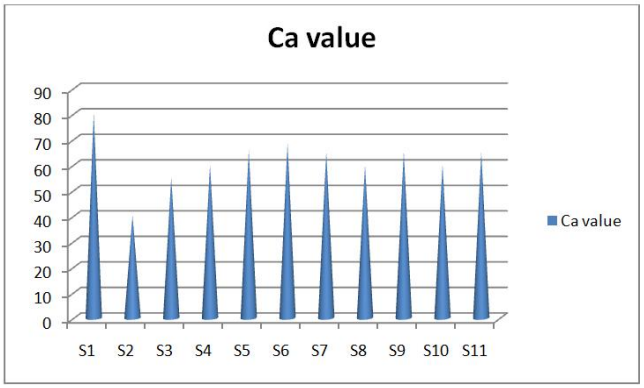

Fig.6. Seasonal variation in Ca of the water samples analyzed

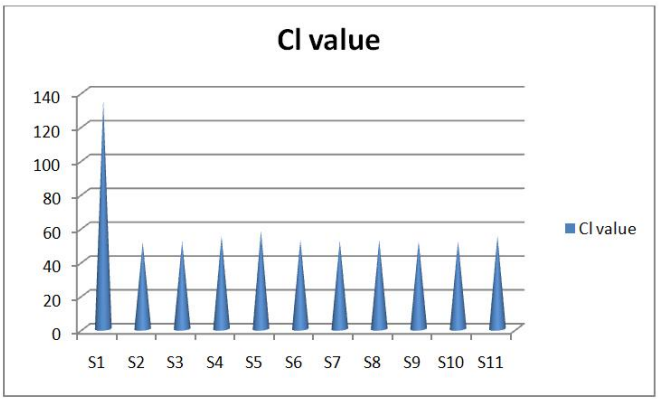

Fig.10. Seasonal variation in Cl of the water samples analyzed

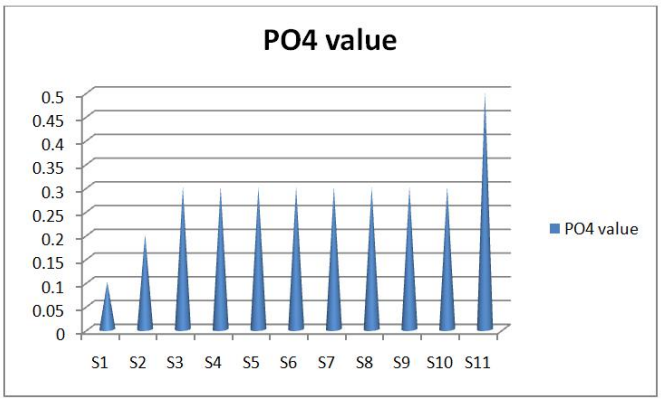

Fig.11. Seasonal variation inPO4 of the water samples analyzed

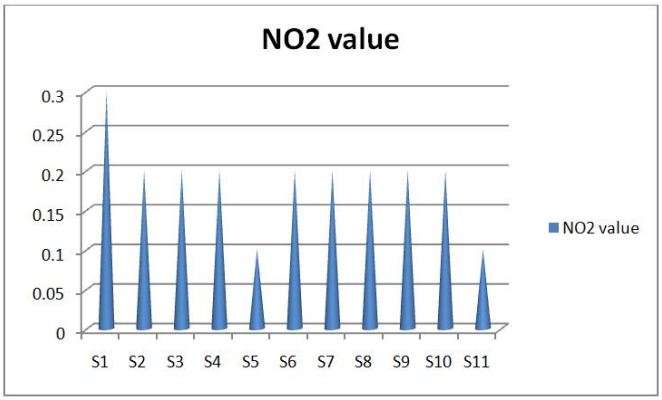

Fig.12. Seasonal variation in NO2of the water samples analyzed

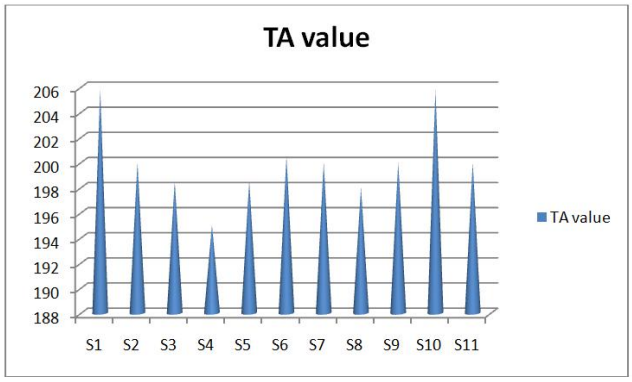

Fig.13 Seasonal variation in Total alkalinity of the water samples analyzed

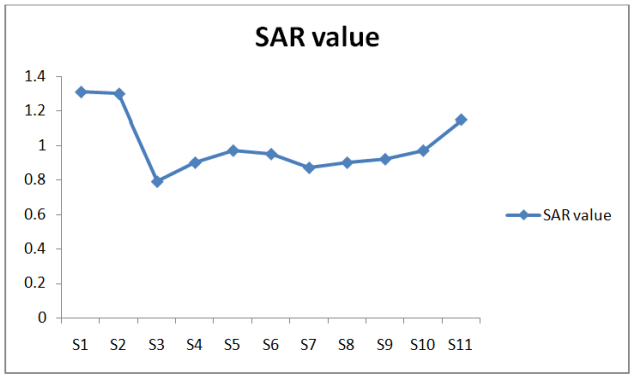

Fig.14. Seasonal variation in SAR of the water samples analyzed

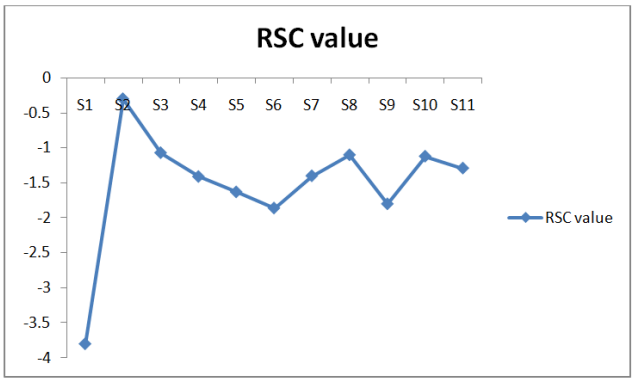

Fig.15. Seasonal variation in RSC of the water samples analyzed

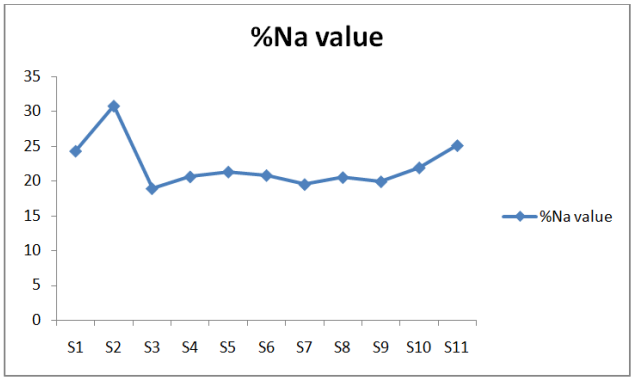

Fig.16. Seasonal variation in %Na of the water samples analyzed

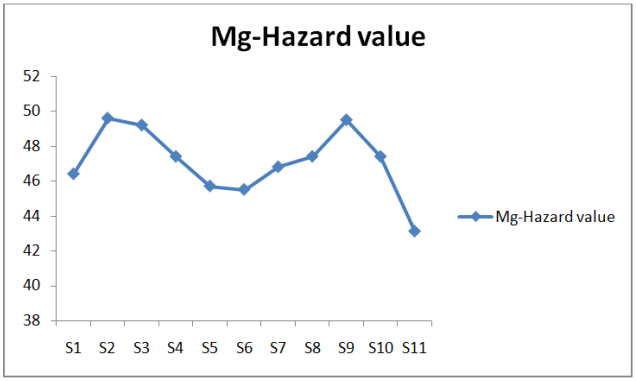

Fig.17. Seasonal variation in Mg-hazard of the water samples analyzed

Fig.18. Denkada anicut under study

Total hardness of water for the samples analyzed in all the seasons was found to be varying from 192-210mg/L, which is well within the prescribed standard value. The concentration of calcium was found to be the highest and beyond the prescribed permissible limit during August 2010. In rest of all the season the concentration of calcium ion was found to be well within the prescribed limit value. The concentration of magnesium was found to be slightly higher than the prescribed standard value varying as 24- 40.5mg/L. The concentration of sodium and potassium was found to be within the standard values prescribed. Indicating the lower concentration of dissolved salts of sodium and potassium in the waters of the anicut. It was observed that the concentration iron in the water samples collected from the anicut during all the seasons was found to be as 0.1mg/L. It is inferred that the water is free from contamination with iron and bacterial growth that is prominently observed in the presence of iron alone (Argirisi Symeonidis, 2012). The concentrations of the ions such as chloride, phosphate, and nitrite were found to be well in accordance with the standard values prescribed by IS: 10500. It can be inferred that the water samples of the anicut are free from contamination by industrial effluents, agricultural wastes and sewage wastes. The total alkalinity of the water samples analyzed was found to be below the standard values. Though total alkalinity is found to be the least, bicarbonate is found to be the only ion responsible for alkalinity of the water. The values of pH of the water samples analyzed stands evidence for the same.

The complete pictorial representation of seasonal variation in the different chemical characteristics analyzed was depicted from Fig.2 to Fig.14.

Water quality Index data

Globally the only approved tool for the assessment of quality of water is Water Quality Index (WQI). Based on the value of WQI the water analyzed was graded as “Excellent” (WQI 0-25), “Good” (WQI 26-50), “Poor” (WQI 51-75), “Very Poor” (WQI 76-100), “Unsuitable” (WQI >100). Water Quality Index for the water samples analyzed collected from the Denkada anicut is presented in Table 3. From the data it was found that the quality of the water samples analyzed in all the seasons was found to be in the range of 26.9-39.6, which is rated as “Good” in its quality for drinking and municipal water supply. Seasonal variation in the values of water quality index is presented in Fig. 1. The water quality analysis reports were presented from Table 2 to Table 11.

Table 2. Seasonal variation in irrigation water quality parameters

season	SAR	%Na	RSC	Mg-hazard
S1	1.31	24.3	-3.8	46.4
S2	1.3	30.8	-0.3	49.6
S3	0.79	18.9	-1.07	49.2
S4	0.9	20.6	-1.41	47.4
S5	0.97	21.3	-1.63	45.7
S6	0.95	20.8	-1.86	45.5
S7	0.87	19.5	-1.4	46.8
S8	0.9	20.5	-1.1	47.4
S9	0.92	19.9	-1.8	49.5
S10	0.97	21.9	-1.12	47.4
S11	1.15	25.1	-1.29	43.1

Table 3. Seasonal variation in WQI

Season	WQI
S1	39.6
S2	31.8
S3	32.4
S4	32.4
S5	26.9
S6	32.5
S7	32.4
S8	32.4
S9	32.5
S10	32.4
S11	30.2

Irrigation water quality data

Suitability of water for irrigation and agriculture is determined by various parameters such SAR (Sodium absorption ratio), RSC (residual sodium carbonate), %Na and Magnesium hazard. Based on the values obtained for SAR, RSC, %Na and Mg-hazard the water is rated as “Excellent”, “Good”, Poor” And “Unsuitable” for irrigation purpose. The irrigation water quality data for the Denkada anicut was presented in Table 2. From this data it was found that all the parameters mentioned above were well within the prescribed standard values, inferring that the water released from the anicut was rated as “Good” for irrigation and agricultural purpose. RSC is expressed in meq/l units. RSC should not be higher than 1 and preferably less than +0.5 for considering the water use for irrigation. From the data it was found the the value of RSC for the water samples analyzed during all the seasons was found to be negative in their values, indicating that the water is safe for irrigation and industrial usage. Seasonal variation in the values of the aforesaid parameters was presented in Fig.14 to Fig.17.

Heavy metal analysis

Due to industrialization, excessive use of fertilizers, release of effluents without treatment into water bodies has adverse effects on the quality of the water, due to the increase in the concentration levels of heavy metals. Most of the metals exhibit toxic effects on the aquatic environment. Hence in the present study, the water samples collected from the anicut were analyzed for heavy metals by using Inductively couples plasma Optical emission spectrometer (ICP-OES) for Zn, Cd, Co, Ni, As, Hg, Cr, Al, Ti, Mn, Ba and Si. Form the data it was found that except Si all the other elements were not detected. Hence it is concluded that the water of the anicut is free from contamination from industrial, agricultural and household wastes.

Conclusion

The water quality index data shows that the water of the anicut was rated as “Good” in its quality. From the RSC data it is concluded that the negative values of RSC firmly conforms the best quality of the water for irrigation. From all the data presented, it is concluded by the authors that the water samples analyzed from Denkada anicut during all the seasons under

study was found to be good in its quality for industrial, agricultural and for drinking purpose also.

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REFERENCES

Alher K.R. and S.M. Deshpande, 2011. Assessment of water quality of the Maniyad reservoir of Parla village, district Auarangabad: suitability for multipurpose usage, *IJRTSAT*, 1, 3, 91-95.

APHA (American Public Health Association) 1995. Standard methods for the examination of water and waste water. 19th edition. *American Public Health Association Inc., New York,* 1193 pp.

Argiris Symeonidis and Markos Marasms, 2012. Iorn and Microbial growth, Insight and Control of infectious diseases in global scenario, 16, 290-330

Brindha K. and L Elango, 2013. Environmental assessment of water in Nagarjuna Sagar reservoir, India, *Earth Resources,* 1, 1, 33-36.

Dey A. and M.B Sawant, 2013, Sesmic response of a concrete gravity dam considering hydrodynamic effects, *APCOM & ISCM*, Singapore.

Fernado.B lopes *et al.* 2014. Assessment of water quality in large reservoirsin semiarid region, Brazil, Revista Brasileria De Engenharia Agricola e Ambiental, 8, 4, 437-445.

Giriyappanwar B. S and R. R Patil, 2013. Water quality assessment of Gullavua reservoir, Belgum district using NSF-WQI, IJSR, 2, 4.

Mehmet Akbulut *et al.* 2010. Assessment of surface water quality in the Atikhisar reservoir and Saricy creek (Turkey), Ekoloji, 19, 74, 139-142.

Patil ALka. A, 2014. An assessment of water quality of Borgaon reservoir in Sangil district of Maharashtra, India, *IRJES*, 3, 5, 48-53.

Pavan Kumar G V S R., Ammireddi Chirla and K Rama Krishna, 2014. Water quality status of Andra reservoir in Vizianagaram district of India, *Journal of Applicable Chemistry*, 3, 5, 2095-2101.

Pavan Kumar G V S R., V S Sanand, N Santhosh Kumar and B Sreerama Murty, 2013. Assessment of water quality of thatipudi reservoir in vizianagaram district of Andhra Pradesh, *Innovare Journal of Sciences*, 1, 2, 20-24.

Poonam Bhadja and Ashok Kumar vaghela, 2013. Assessment of physico-chemical parameters and water quality index of reservoir water, *IJPAAES*, 3, 3, 89-95.

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