OPEN ACCESS

International
Journal
Of Modern Engineering Research (IJMER)

# Study of Irrigation Water Quality With Reference To Coastal Andhra Pradesh, India

Sudhakar Gummadi[1], Swarnalatha G.[2], P. Brahmaji Rao[3],
V. Venkataratnamma[4], G. Vijaya Kumar[5]

*[1,2& 5] Research Scholar, Dept of Environmental sciences, Acharya Nagarjuna University,*
*[3]Assistant Professor, Dept of Environmental sciences, Acharya Nagarjuna University*
*[4]Assistant Professor, Dept of Zoology, Acharya Nagarjuna University, Guntur*

*ABSTRACT : Water quality for irrigation purposes is very important, in present study the water samples are collected from canals, bore wells and open wells in Bapatla mandal, Coastal Andhra Pradesh, in monthly wise during 2009-2010 (October to May) and chemically analyzed to check its suitability for irrigation .The analysis reveals that most of the samples were within the lower limit (pH 7.54 to 8.52), The electrical conductivity of the samples ranged from 453.24 to 658.4. Potassium, Sodium, Chloride, and The other parameters like sodium adsorption ratio, SAR (0.72–0.99), residual sodium carbonate, RSC (−2.46 to −1.3), were analyzed in laboratory in a systematic procedure.*

**Key words:** *water quality, Irrigation, Physico-chemical Parameters, Sodium absorption ratio*

## I. Introduction

Water quality for agricultural purposes is determined on the basis of the effect of water on the quality and yield of the crops, as well as the effect on characteristic changes in the soil (Food and Agriculture Organization (FAO 1985). The adequate amount of water is very essential for proper growth of plants but the quality of water used for irrigation purpose should also be well within the permissible limit otherwise it could adversely affect the plant growth. Quality of water is assuming great importance with the rising pressure on industries and agriculture and rise in standard of living. Quality of irrigation water depends on the amount of suspended sediment and chemical constituents in the water.

The water quality in watershed is directly affected by vegetative cover and agricultural and other land management practices (Bhattaria et al. 2008). Definition of the water quality for irrigation and for domestic use is not simple for several reasons: (a) multiple quality parameters are relevant; and (b) it is possible that an unrecognized group of people will make use of irrigation water for non-agricultural purposes (Jensen et al., 2001). The effect of sediment is influenced by the nature of the disposed material and soil condition of irrigated area. The agricultural sector is alleged to be the largest contributor to non-point source pollution through runoff of nutrients, sediments pesticides, and other contaminants (USEPA 1998). The concentration and composition of dissolved constituents in water de-termines its quality for irrigation use. The quality of potable water has also been a major issue in the water industry for the last few decades (Tamminen et al. 2008). Efe ( 2008) also found that most of the hand-dug well water qualities are unsafe for human consumption. The usual criteria include salinity, sodicity, and element toxicity. At present, the canal system is recharged by a combination of sewage, wastewater treated at one large and two small treatment plants, and by precipitation during the rainy season (May–October), receiving a continuous load of microorganisms and other contaminants (Mazari-Hiriart et al, 2002, Mireles 2004, Ramos et al, 2003)

The Irrigation water quality criteria developed by US salinity laboratory has received acceptance in many countries. Total salt concentration and probable sodium hazard of irrigation water are two major constituents of the criteria (Richards 1954), and the quality of groundwater is the resultant of all the processes and reactions that act on the water that is condensed in the atmosphere until the time it is discharged by a well or spring (Kesavan and Parameswari2005).

The estimate of residual sodium carbonate (RSC) is another way to examine the irrigation water quality as was suggested by Eaton (Eaton1950). And also the estimate of residual sodium carbonate (RSC) is another way to examine the irrigation water quality as was suggested by Eaton (Eaton1950).

Due to the importance of water quality issues, better management of water systems is required for regional supply of water for irrigation, industrial and domestic uses. In semi-arid regions, the diversity of water quality at sources and different quality requirements of consumers complicates the management problem (Percia et al.,1997), Low-quality water can be used for irrigation of a broad variety of crops, with each crop being tolerant to a specific maximum salinity level (Oron, 1987). Based on US Salinity Laboratory Staff (1954), the most commonly encountered soil problems used for evaluating water quality are salinity, water infiltration, toxicity and miscellaneous problems

## II. Materials and Methods

### 2.1 Study Area

I was selected 20 villages for collect the ground and surface water samples that are located in Bapatla mandal to study of irrigation water quality. The study area, Bapatla mandal is one of the major regions in Guntur district, Andhra Pradesh situated in the south east and coastal of Andhra Pradesh, lies within the latitude - $15^0$.48' North and the longitude-$80^0$.17' East. The locations of sample collection in agricultural regions in monthly October to May during 2009-2010. The samples have analyzed in the laboratory find the parameter concentrations and compare with the guidelines suggested by WHO (1998). Water samples were collected in clean polyethylene bottles from different sources viz. canal, bore well and open wells. The results of statistical analysis for important physico-chemical characteristics viz., Minimum, Maximum, Mean and Standard deviation of the samples indicated in table 2.

### 2.2 Methodology

A systematic sampling was carried out in eight months, liability the respective physicochemical study of the water in the period (October to May, 2009- 2010); water samples were taken from the selected sampling sites and analyzed to determine the physicochemical parameters for irrigation. Water pH, salts (EC), manganese, and iron are the most important chemical tests for irrigation water quality

Water samples were analyzed for pH (pH is measured with an electrode pH meter). The pH was determined using pre-calibrated portable pH meter conductivity was measured at 25°C, while total dissolved solids (TDS) were separated by filtering the water through a 0.45 µm filter paper and determined according to standard procedures (APHA 1992). Chloride was determined by the argentometric (Mohr's) method, while nitrate ($NO_3^-$) and phosphate ($PO_4^-$) were determined by using a Cecil spectro-photometer to measure the intensities of colour developed following the phenoldisulphonic acid and the phosphomolybdate methods, and residual sodium carbonate, and sodium adsorption ratio. The methods recommended by U.S.D.A (1954) were used for these analyses respectively

Irrigation water salinity is not the only parameter to be considered; concentrations of other ions (magnesium and sulphur, for example) are also important. These are called here independent (primary) parameters. In addition, some water quality parameters are expressed as functional relationships between constituent concentrations, which are called here dependent parameters. For example, the sodium adsorption ratio (SAR), where

$$SAR = \frac{[Na]}{\sqrt{[Mg] + [Ca]}}$$

[Na], [Mg], [Ca] are the concentrations of sodium, magnesium and calcium, respectively.

The response of crop yield to water quality is a complicated issue which, in itself, requires a plant physiological model.

Another predictor of sodium hazard is the residual sodium carbonate (RSC) of water. RSC is the sum of carbonates (bicarbonate + carbonate) minus the sum of the divalent cations (calcium and magnesium).

## III. Results

The values of the various parameters of the water samples monitored during October 2009–May 2010 (table 1). The pH is favorable to the crop production in some water samples that range between 7.54 to 8.52, above 8 is sever to the crops ((Ayers and Westcot 1985),) in 2010 January, April and May the pH is greater than 8 (Table 2), High-pH water can reduce the effectiveness of some N fertilizers function through irrigation.(Bryan et al., 2007), EC mean value of 577.742 µmohs cm−1 is much below the threshold salinity for even many sensitive crops (Hoffman et al. 1981), Salts in a water sample are calculated with total dissolved solids (TDS) or electrical conductivity (EC). The higher the TDS or EC, the higher the salt hazard (Bryan et al., 2007), Wilcox norm is another quality factor that related Electrical conductivity versus % Na to evaluate irrigation waters given five qualification zones. In this study case the water is classified as favor to irrigation but not excellent (César Almeida 2008). Chlorides in all water samples during 2009 to 2010 observed in this study range from 35.34 to 43.64 ppm the mean value is 40.77 mg/l. The chloride levels in unpolluted waters are often below 10 mg/l (Tebbut 1992) in this study the water samples beyond the range. the calcium hardness range from 105.69 to 142.81, Megnesium hardness concentration is from 79.38 to 98.64 and the total hardness ranges are from 138 to 186, The Soft water (water high in sodium) makes hard ground and hard water (water high in calcium and magnesium) makes soft ground (Bryan et al., 2007).

High concentrations of phosphates and nitrates increase the growth of vegetation in water systems and elevate oxygen demand (McEldowney et al. 1993). However, as well as its contribution to eutrophication and algal blooms, phosphate does not have notable adverse health effects (WHO 2008), in all water samples have normal range, it may not effect to the irrigation.

In general, sodium hazard increases as SAR increases and EC decreases (Bryan et al., 2007)), Residual sodium carbonates (RSC) -When RSC is positive, calcium is lost from the soil solution via the following chemical reaction: carbonates in water + soil calcium ⇒calcium carbonate (lime deposit in soil) this loss of calcium from the soil solution increases SAR in the soil solution, thereby increasing the sodium hazard (Bryan et al., 2007). A negative RSC is the best situation since the total concentration of $CO_3^{2-}$ and $HCO_3^-$ is lower than the combined $Ca^{2+}$ and $Mg^{2+}$ concentrations. This means that there is no residual carbonate to react with $Na^+$ to increase the sodium hazard in the soil. (César Almeida 2008)

## IV. Conclusion

The concept of quality is not unique but multiple and they can be so different that they could be incompatible among they, so it makes no sense to talk about an unique quality factor From the analysis of the different parameters calculated and quality norms, we can conclude that the quality profile for water from the Bapatla mandal, Coastal Andhra Pradesh water is moderate and fulfills all the requirements for the intended use. But the water samples having slightly high concentrations of salts that should decrease with proper usage of gypsum. In my study region over usage of water may decrease the quality and much of the ground water used for irrigation change the quality of water it has been described as being of less quality.

## REFERENCE


[1] Food and Agriculture Organization (FAO). 1985. Soil Survey Investigation for Irrigation. Soil Bulletin 42. Food and Agriculture Organization of the United Nations, Rome, Italy

[2] Bhattaria, G. R., Srivastva, P., Margen, L., Hite, D., & Hatch, U. (2008). Assessment of economic and water quality impacts of land use change using a simple bio-economic model. *Environmental Management, 42*, 122–130.

[3] Jensen PK, Matsuno Y, van der Hoek W, Cairncross S. 2001. Limitations of irrigation water quality guidelines from a multiple use perspective. Irrigation and Drainage Systems15: 117–128.

[4] US Environmental Protection Agency (USEPA) Office of Water (1998). National water quality inventory; 1996 report to congress. Washington, DC.

[5] Tamminen, S., Ramos, H., & Covas, D. (2008). Water supply system performance for different pipe mate-rials Part 1: Water quality analysis. *Water Resources Management, 22*, 1579–1607. doi:10.1007/11269-008-9244-X.

[6] Efe, S. I. (2008). Quality of water from hand dug wells in Onitsha Metropolitan Areas of Nigeria. *The Environ-mentalist*, *25*, 5–12. doi:10.1007/s10669-005-3091-6

[7] M. Mazari-Hiriart, Y. Lo ´pez-Vidal, S. Ponce de Leo´n, J.J. CalvaMercado, F. Rojo-Callejas, in: Proceedings of the International Conference: Water and Wastewater, Perspectives of Developing Countries. Indian Institute of Technology Delhi–International Water Association, New Delhi, India, 11–13 December 2002, p. 407.

[8] A. Mireles, C. Solı ´s, E. Andrade, M. Lagunas Solar, C. Pin ˜a, R.G. Flocchini, Nuc. Instr. and Meth B. 219–220 (2004) 187.

[9] R. Ramos, N. Garcı ´a, E. Andrade, C. Solı´s, G. Murillo, Int. J. PIXE 12 (3–4) (2003) 237.

[10] Richards, L. A. (1954). Diagnosis and improvement of saline and alkali soils. U.S. Salinity Laboratory Staff. USDA Handbook, 60, 160.

[11] Kesavan, K. G., & Parameswari, R. (2005). Evaluation of ground water quality in Kancheeppuram. IJEP, 25(3), 235–239

[12] Eaton, F. M. (1950). Significance of carbonate in irrigation water. Soil Science, 69, 123–133

[13] Oron G. 1987. Marginal water application in arid zones. Geographical Journal 15(3): 259–266

[14] Percia C, Oron G, Mehrez A. 1997. Optimal operation of regional system with diverse water quality sources. Journal of Water Resources Planning and Management ASCE123 (2): 105–115.

[15] World Health Organization. (2008). Guidelines to drinking water quality (3rd ed., Vol. 1, pp. 1–666). Geneva: World Health Organization

[16] Ayers, R.S. and D.W. Westcot. 1985. Water Quality for Agriculture. FAO Irrigation and Drainage Paper 29. http://www.fao.org

[17] Bryan G. Hopkins, Donald A. Horneck, Robert G. Stevens, Jason W. Ellsworth, Dan M. Sullivan. (2007), Managing Irrigation Water Quality, for crop production in the Pacific Northwest, A Pacific Northwest Extension publication PNW 597-E.

[18] Hoffman, G. J., Ayers, R. S., Doering, E. J., & McNeal, B. L. (1981). Salinity in irrigated agriculture. In M. E. Jensen (Eds.), Design and operation of farm irrigation systems. ASAE Monograph 3.

[19] César Almeida, Silvya Quintar, Patricia González and Miguel Mallea (2008) Assessment of irrigation water quality. A proposal of a quality profile, Environ Monit Assess, 142:149–152, DOI 10.1007/s10661-007-9916-7

[20] Tebbut, T. H. Y. (1992). Principles of water quality (pp. 1– 251). Oxford, England: Pergamon Press.

[21] McEldowney, S., Hardman, D. J., & Waite, S. (1993). Pollution: ecology and bio treatment (pp. 135–157). Essex England: Longman Group Ltd.

[22] APHA (1992). Standard methods for the examination of water and wastewater (18 th ed.). Washington, DC, USA:

American Public Health Association.

Table 1: Physicochemical parameters obtained for the canal and bole well water.

| | 2009 | | | | 2010 | | | |
|---|---|---|---|---|---|---|---|---|
| | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May |
| pH | 7.98 | 7.65 | 7.69 | 8.12 | 7.96 | 7.54 | 8.14 | 8.52 |
| Conductivity | 637.82 | 622.46 | 582.57 | 537.15 | 485.93 | 453.24 | 644.37 | 658.4 |
| TH | 165 | 148 | 153 | 158 | 142 | 138 | 175 | 186 |
| Ca Hardness | 128.34 | 124.28 | 105.69 | 115.38 | 120.62 | 122.15 | 135.64 | 142.81 |
| Mg Hardness | 98.64 | 85.27 | 83.61 | 88.35 | 82.4 | 79.38 | 88.64 | 95.31 |
| Sulphates | 67.18 | 65.27 | 64.83 | 60.71 | 71.24 | 54.24 | 71.54 | 75.4 |
| Nitrates | 0.58 | 0.47 | 0.34 | 0.42 | 0.39 | 0.35 | 0.48 | 0.52 |
| Alkalinity | 150.64 | 146.25 | 144.31 | 142.69 | 155.28 | 132.5 | 155.72 | 154.24 |
| Cholorides | 43.64 | 42.31 | 42.86 | 40.21 | 39.27 | 35.34 | 40.18 | 42.37 |
| Sodium | 5.6 | 4.5 | 3.8 | 4.8 | 3.2 | 3.5 | 5.8 | 5.7 |
| Potassium | 6.89 | 6.42 | 5.34 | 5.21 | 5.7 | 5.51 | 6.46 | 6.82 |
| TDS | 440 | 421 | 420 | 415 | 339 | 418 | 410 | 437 |
| DO | 7.68 | 7.55 | 7.52 | 7.48 | 7.4 | 7.25 | 7.24 | 7.36 |
| Phosphate | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| SAR | 0.99 | 0.85 | 0.84 | 0.89 | 0.72 | 0.75 | 0.86 | 0.94 |
| RSC | -2.42 | -1.35 | -1.86 | -1.51 | -1.3 | -1.76 | -2.35 | -2.46 |

Table 2: Statistical Analysis of water Quality

| | Min | Max | Mean | Stan Dev |
|---|---|---|---|---|
| pH | 7.54 | 8.52 | 7.95 | 0.3199 |
| Conductivity | 453.24 | 658.4 | 577.742 | 77.6027 |
| Total Hardness | 138 | 186 | 158.125 | 16.4875 |
| Calcium Hardness | 105.69 | 142.81 | 124.363 | 11.536 |
| Magnesium Hardness | 79.38 | 98.64 | 87.7 | 6.5339 |
| $SO_4$ | 54.24 | 75.4 | 66.3012 | 6.712 |
| $NO_3$ | 0.34 | 0.58 | 0.4437 | 0.08399 |
| Alkalnity | 132.5 | 155.72 | 147.704 | 7.9545 |
| Cl | 35.34 | 43.64 | 40.7725 | 2.6708 |
| Na | 3.2 | 5.8 | 4.6125 | 1.0357 |
| K | 5.21 | 6.89 | 6.0437 | 0.6789 |
| TDS | 339 | 440 | 412.5 | 31.4642 |
| DO | 7.24 | 7.68 | 7.435 | 0.1519 |
| $PO_4$ | 0.01 | 0.01 | 0.01 | 0 |
| SAR | 0.72 | 0.99 | 0.855 | 0.0896 |
| RSC | -2.46 | -1.3 | -1.8762 | 0.4807 |

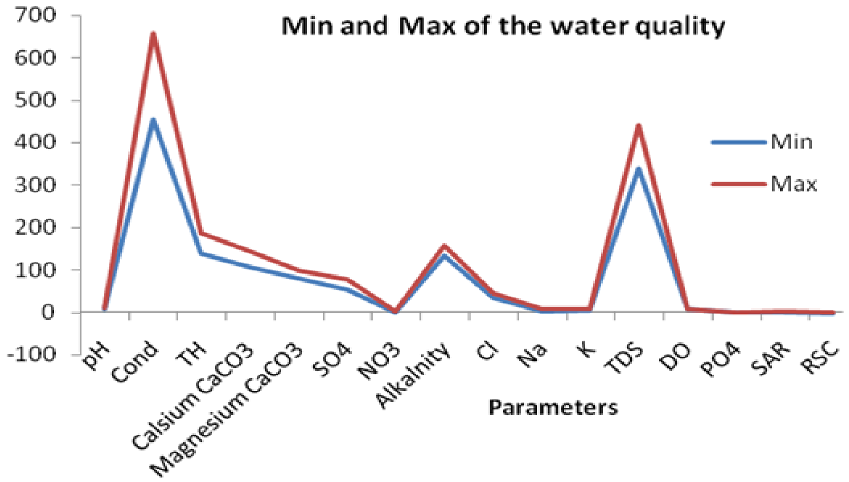


Fig 1: Minimum and maximum of the water samples

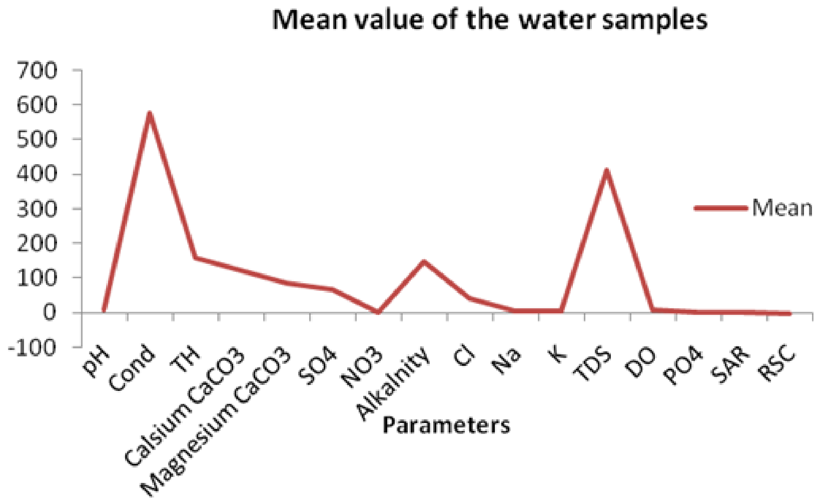


Fig2: Mean value of water samples

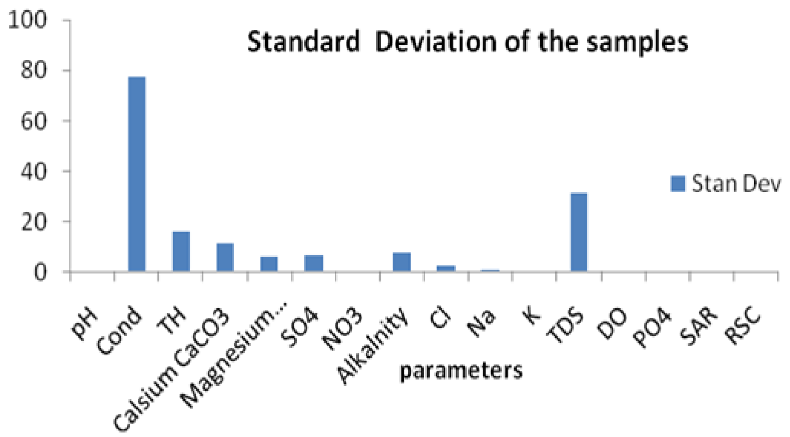


Fig 3: Standard deviation of the water samples

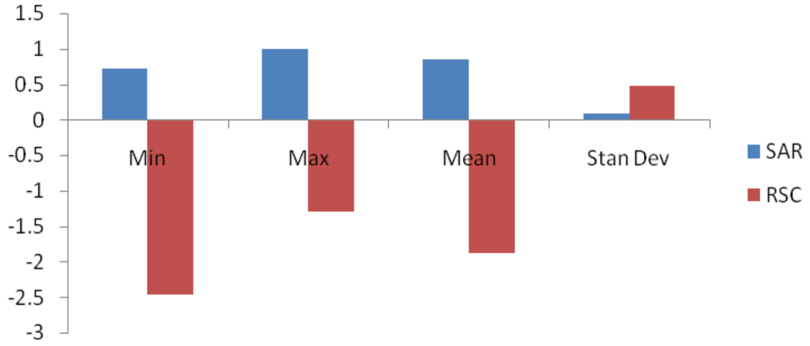


Fig 4: Sodium Absorption ratio and Residual Sodium Carbonate