Available online www.jocpr.com

Journal of Chemical and Pharmaceutical Research, 2018, 10(1):83-87

Research Article

ISSN : 0975-7384
CODEN(USA) : JCPRC5

Spatial Identification of Agricultural Water Quality in Dhanbad District, Jharkhand State

Saranaathan SE[1*] and Loveson VJ[2]

[1]School of Civil Engineering, SASTRA University, Thanjavur, Tamil Nadu, India
[2]CSIR-National Institute of Oceanography, Dona Paula, Goa, India

---

ABSTRACT

This paper mainly deals with the integrated chemical parameters and Geographical Information System (GIS) to delineate agricultural water quality prospective zones in Dhanbad district. The various thematic maps to identified agricultural water quality were generated in GIS domain on the basis of TDS, SAR, EC, and RC. Multi-criterion technique is used to explore a number of decision possibilities and identified suitability according to the assigned weight and scores of each unit. The final derived map of the area shows various zones of agricultural water quality prospectics viz. Good (38.7%), Medium (53%) and Bad (8.3%).

Keywords: Agricultural water quality; GIS; TDS; SAR; EC; RC; Multi-criterion

---

INTRODUCTION

Groundwater is the most important resource for drinking purpose and agricultural uses. The contamination of groundwater is inclined by natural and anthropogenic factors and any descent in water quality could affect agricultural output and human health. The physico-chemical properties of the groundwater depend upon the different rock types of the area and also the activities that continuously occur on the surface. Leaching from the industrial waste and piles, effluent discharge, settling ponds, surface runoff in the industrial areas significantly affect the quality of ground water due to the infiltration that takes place through the porous media. The impact of urban sewage on the groundwater quality is considerable. The integration of soil, water quality and nutrient status is GIS domain help in the development of a decision support system [1,2]. Many investigations have been conducted that show the spatial distribution of water quality [3-7]. In this paper, the evaluation of ground water quality for agriculture has been discussed in detail.

Study Area

Dhanbad district is taken into this study. It is situated in Jharkhand state. The area lies between 23^{o} 38’ 58” N to 24^{o} 03’ 30” N latitudes and 86^{o} 06’ 11” E to 86^{o} 50’ 26” E longitude and covers an area of about 2057 km^2 (Figure 1). The study area is a combination of both mining and agricultural environment. This reason makes the area interesting to perform a spatial groundwater quality assessment.

MATERIALS AND METHODS

The spatial database consists of 73I/1, 2, 5, 6, 9, 10, 13, 14 and 72L/8. Survey of India toposheets on 1:50,000 scale were used. The base map was prepared from above said toposheets and delineate district boundary, natural and cultural features and for geo-referencing. The total salt concentration, TDS, SAR, EC and RC are suitable parameter for assessing the agricultural water quality for irrigation uses [8].

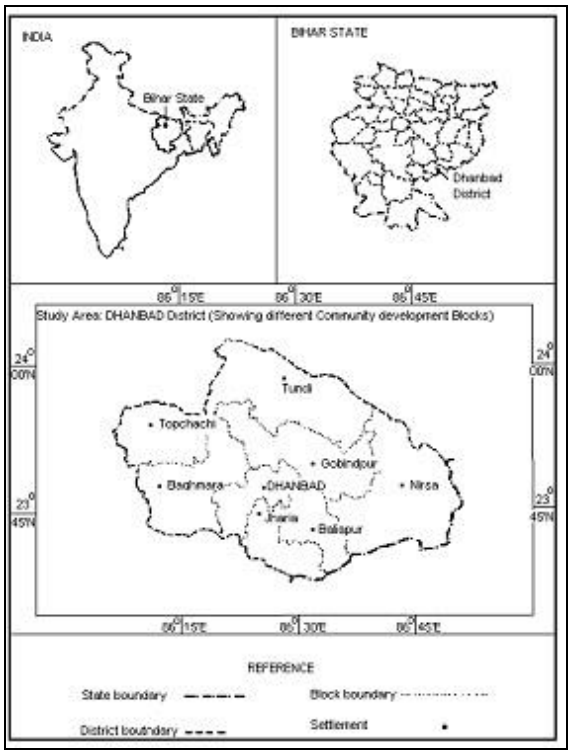

Figure 1: Location map

Quality of water in the Dhanbad district has been assessed for agricultural purpose using the standards constituted by the Regional Salinity Laboratory of United States. The water samples considered for the assessment of agricultural use are as same as the samples assessed for drinking water purpose, collected from 16 wells, which comes under the ground water monitoring network system of Central Ground Water Board (CGWB), Calcutta. In all, 14 samples were analyzed in Center of Mining Environment, Indian School of Mines, Dhanbad [9,10]. Only three significant parameters like electrical conductivity, sodium absorption ratio and total dissolved solids were considered while preparing basic quadtrees as modules showing different classes of agricultural water quality over the district with respect to each parameter. The concentration values are again interpolated for other areas to prepare the derived quadtrees.

Multi-criterion overlay analysis was a simple mathematical model for a combined analysis of malty parameters. Each water quality parameters was assigned a weight (Table 1) depends on it's manipulate on contamination of groundwater [4,5,11]. The scores of the each thematic map were assigned as decision making based hierarchy using spatial analysis tool of Arc-GIS v.10.2 software.

Table 1: Assigned weight and score for different classes of various thematic layers

S No	Thematic layer	Class	Weight	Score
1	SAR	Excellent	40	9
		Good		8
		Medium		6
		Bad		4
2	EC	Good	35	8
		Medium		6
3	TDS	Below permissible limit	25	6
		Within permissible limit		9

The final derived map is identified good, moderate, and bad groundwater quality zones.

Normally the following parameters are taken in to account in agricultural or irrigation water quality studies.

- Total Dissolved Solids
- Relative proportion of Sodium to other cat ion (SAR)
- Concentration of certain specific elements

The U.S. Regional Salinity Laboratory has developed a module [12] on the basis of the studies and researches conducted over a long period of time on agricultural practices. This technique has been widely used in India. Based

on USRS module, integrated agricultural water quality map has been derived using multi-criteria decision making analysis over the quadtrees prepared for each significant parameter, *viz*., TDS, SAR and EC. The Table 2 shows the classification of irrigation water quality.

Table 2: Irrigation water quality classification (USRS standard)

S No	Class	EC in u mhos/cm	TDS mg/l	SAR	RC mg/l
1	Excellent	<250	<0.25	Up to 10	
2	Good	251–750	0.26–7.50	Nov-18	<1.25
3	Medium	751-2250	7.51 – 22.50	19 - 26	1.26–2.50
4	Bad	2251-4000	22.51 – 40.00	>26	>2.50 poor
5	Very bad	>4000	>40		

Source: Raghunath[7]

RESULTS AND DISCUSSION

Total Dissolved Solid (TDS)

According to the standards for the agricultural use of water, the desirable limit of TDS is 500 mg/l whereas the permissible limit is 2000m g/l. The TDS concentration in Dhanbad district except Jharia, and Baliapur areas is found less than 400 mg/l which is below desirable limit and the remaining area has the concentration more than 500 mg/l but within the permissible limit. The Figure 2 shows the distribution of water quality with respect to the parameter TDS in the district. About 14% of the total area of the district around Jharia and Baliapur has of water with TDS quality below the desirable limit and the remaining area (about 85%) has the concentration above the desirable limit.

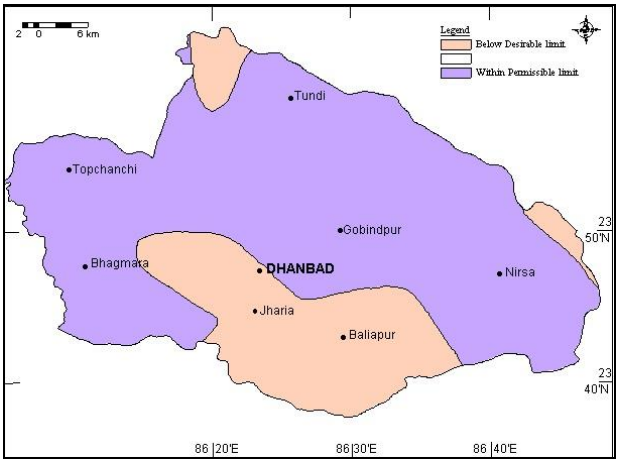

Figure 2: Total dissolve solid map

Sodium Absorption Ratio (SAR)

Based on the U.S. Regional Salinity laboratory standard, the whole district has been divided with respect to SAR into 4 classes subject to the quality of water for agricultural use like excellent, good, medium and bad. The Figure 3 shows that about 50% of the total district in the eastern part has been found under the category, of good class and 23% area of central part of Gobindpur and southwestern part of the district comes under the category of bad water quality. About 11% and 14%of the study area has been found under excellent and medium categories respectively.

Electrical Conductivity (EC)

According to USRS laboratory standards, EC has been categorized in 4 classes like excellent, good, medium and bad. Only two classes i.e. good and medium exist in this district. The value of EC lies in the range of 250 mhos/cm to 750 mhos/cm is good quality of water and 750 mhos/cm to 2250 mhos/cm for medium class. Very small area of Dhanbad district falls under good class of water. The distribution of area in to different classes subject to the quality of water for agricultural purpose has been shown in Figure 4.

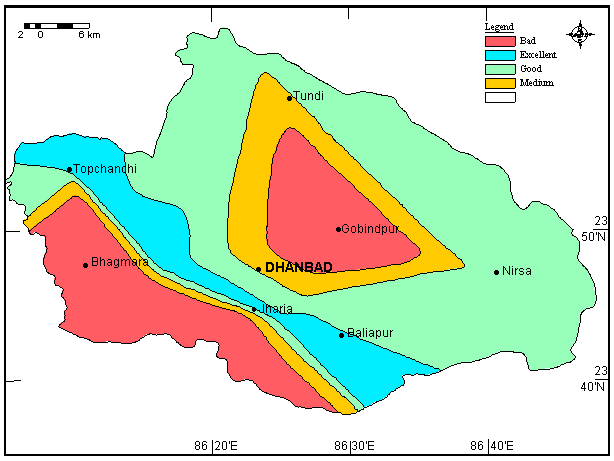

Figure 3: Sodium absorption ratio map

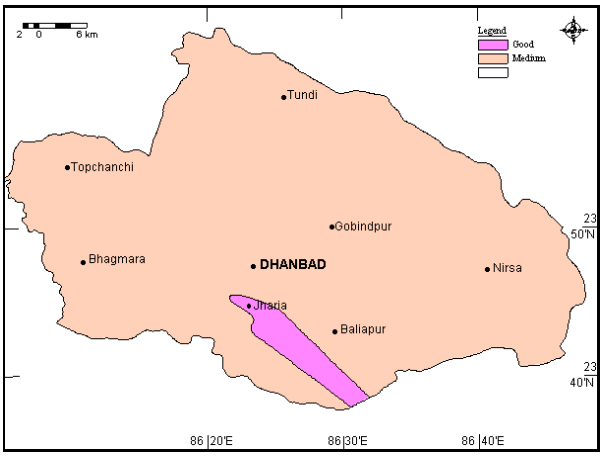

Figure 4: Electrical conductivity map

Agricultural Water Quality

Only three classes of water quality have been found over the district after deriving the agricultural water quality map (Figure 5). Water of good quality with respect to irrigation is found in 39% of the district in northern and northwestern part, and also around Jharia and Baliapur areas. Medium quality of water exists over the district in about 53% of the study area. The remaining 8% area around Baghmara and southeast part of Gobindpur falls under the bad water quality. The details of aerial extent of agricultural water quality classes have been shown in Table 3.

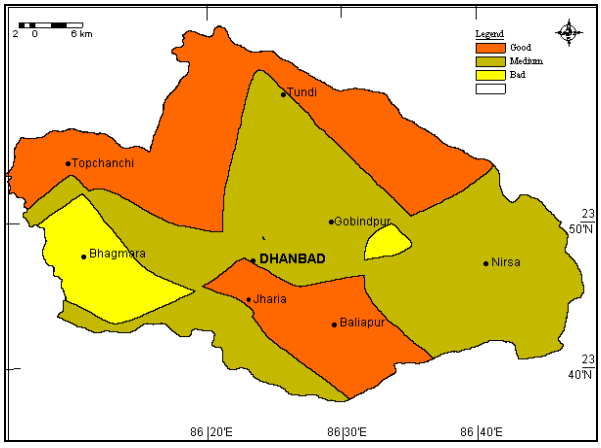

Figure 5: Agriculture water quality map

Table 3: Distribution of various classes of integrated agricultural water quality over the Dhanbad district

S No	Category	Area (sq.km.)	Area (%)
1	Good	795.22	38.65
2	Medium	1089.39	52.96
3	Bad	172.65	8.39
Total of 3 classes		2057.26	100

CONCLUSION

The spatial data thus generated would be helpful for site specific water quality management. The evaluation of groundwater resources has understood important in recent years because of increased demand for water. Using GIS is important tool for management of groundwater resource. Quality assessment for irrigation suitability shows that the groundwater of the area belongs to moderate to good category and can be used for irrigation. The resultant map of the study area discovered that about 38.65% of the district showing good quality, 52.96% of the area comes under moderate and the remaining area falls in bad categories.

REFERENCES

[1] A Sarangi; NH Rao; PBS Sarma; SM Brownee; AK Singh. *GIS Development*. **2001**, 5, 35-36.
[2] VK Verma; RK Setia; PK Sharma; H Singh. *Agropedology*. **2007**.
[3] RB Binoy Kumar; MP Divya. *J Geol Soc India.* **2012**, 80, 48-56.
[4] M Mahalakshmi; SE Saranaathan. *Int J Earth Sci Engine.* **2016,** 10, 1.
[5] SE Saranathan; VJ Loveson. *Int J Chem Tech Res.* **2014**, 6, 5441-5449.
[6] AK Tiwari; AK Singh. *J Geol Soc India*. **2014**, 83, 329-343.
[7] VK Verma; RK Setia; PK Sharma; H Singh. *J Indian Soc Rem Sens.* **2008,** 36, 273-281.
[8] RS Ayers; DW Westcot. Water quality for irrigation. FAO Irrigation and Drainage, Food and Agriculture Organisation, Rome, **1985**, 29(1), 1-109.
[9] G Binay Kumar. A Pollution Profile of Damodar River along Dugda-Sindri Industrial Stretch of Jharia Coalfield, Unpublished M.Tech Thesis, Indian School of Mines, Dhanbad, India, **1992**, 86.
[10] RK Trivedy, PK Geol. Chemical and Biological methods for water pollution studies. Environmental Publication, Karad, **1986**, 248.
[11] HM Raghunath. Ground Water, Pub. New Age International (P) Ltd., New Delhi, **1996**, 563.
[12] US Salinity Lab, Saline and Alkali Soils-Diagnosis and improvement of US Salinity Laboratory. Agriculture Hand book, 60, **1954**.