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Suitability of ground water for irrigation in Lakhanpur block of Jharsuguda District, Orissa

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Abstract

Lakhanpur block of Jharsuguda district rests predominantly on crystalline and sedimentary rocks of Precambrian and Permo-carbonifeous age. In most of the part of the study area cultivation sustain on groundwater. The area is characterized by shallow to moderate deep phreatic aquifers system. The present study has been carried out to evaluate the suitability of ground water for irrigation. On the basis of various criteria like salinity, magnesium hazard, RSC etc. The majority of water samples are found suitable for irrigation.

Keywords: *Ground water quality, SAR, Percent sodium, Magnesium hazard*

Introduction

Ground water is a valuable as well as a dependable source to meet both the domestic and agricultural need. In ground water evaluation quality is as important as quantity. The quality of ground water depends on the various chemical constituents and their concentration, which decides its suitability for any particular use. Water used for irrigation can vary greatly in quality depending upon type and quantity of dissolved solid present. The soil problems most commonly encountered and used as the basis of evaluation of water quality are those related to salinity, water infiltration etc. Water used for irrigation should therefore meet the demands of both soil as well as crops for better results.

Lakhanpur block comprises 602.71 sq.km. The livelihood of this area largely depends upon agriculture. The study area rests on crystalline and sedimentary rock of precambrian and permo-carboniferrous age. Geomorphologically it is pedeplain with nos scattered structural and denudation hill. The drainage of the area is controlled by the Mahanadi River. Loamy soil is the most common soil and is of medium depth. The study area enjoys a humid tropical climate with hot summer (maximum 43 °C) and chilled winter (minimum 12 °C). The average rainfall is 1300 mm. The irrigated area with respect to Khariff and Rabi crops are 3376 hectares and 1648 hectares respectively. The total ground water resources available in the block are 3297 ham, out of which utilizable ground water for irrigation purpose is 1929 ham. The purpose of this paper is the evaluation of ground water quality of shallow aquifer and finds its suitability for irrigation purposes. Use of ground water for irrigation if not judged from angle of suitabiiity, may cause serious problems.

Materials and Method

A total of 20 water sample, representing shallow ground water of the study area were collected as per standard procedures laid down by Brown *et al.* (1974). Environmental sensitive parameters such as pH, electrical conductivity (EC) and temperature were measured on the spot at the time of sampling with water analysis kit (CK711 of Century make). For chemical analysis, the ground water samples were collected in precleaned, dried one liter polyethylene bottles after rinsing. The chemical analysis for major cations

(Na^+, K^+, Ca^{+2}, Mg^{+2}) and anions (HCO^{-3}, Cl^-, $SO4^{-2}$, F^-) of water samples were done at the laboratory, according to standard procedure (APHA, 1989; Jain *et al.*, 1987). The sodium adsorption ratio (SAR), residual sodium carbonate (RSC), percent sodium (% Na), magnesium hazard were calculated, which are used to evaluate water quality for irrigation use. The results of chemical analysis are given in Table.1.

Results

Water quality evaluation for irrigation

Ground water quality depends largely on both, type and quantity of dissolved solids. The important characteristic properties of ground water used for determine its suitability for irrigation in present study area are:

Salinity: Salinity of irrigation water is of major importance. The evaluation of salinity within the root zone is the controlling factor for plant growth and crop yield. The total salt concentration is usually measured as EC in irrigation work. Out of 20 ground waters, no water falls under salinity hazard. Most of the water samples fall in good to permissible zone.

Sodium Hazard: Owing to its effect on both soil and plant, sodium is one of the governing specific ion. A number of indices have been proposed to assess sodium effects and the equilibrium between soil chemistry and soil water chemistry. Percent sodium (%Na) is calculated as

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

where,

all values are in epm.

According to the classification depending on % Na as proposed by Wilcox (1967), the ground water of the study area is of good quality.

Sodium adsorption ratio (SAR) is an important parameter for determination of suitability irrigation water and is calculated as

$$SAR = Na^+ / \{(Ca^{+2} + Mg^{+2})/2\}^{1/2}$$

where,

all the values are in epm.

The SAR values in ground water of study area ranges from 0.62 to 2.4 which implies that no alkali hazard is anticipated in the study area. According to classification for irrigation based on SAR the water is of excellent quality (Raghunath, 1987).

Fig. 1. U. S. Salinity Diagram for classification of Irrigational water (After Richards,1954)

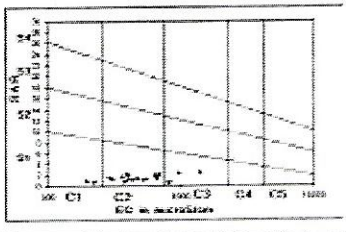

Table.1. Chemical quality of ground water samples of Lakhanpur Block

Sl. No	Location	pH	EC	Na	K	Ca	Mg	HCO3	Cl	SO4	SAR	%NA	RSC	Mg Hazard
1	Charpali	7.6	402	43	12	27	6	150	50	17	1.94	54.06	0.61	27.03
2	Kanaktura	7.9	546	36	22	34	20	137	75	16	1.21	38.74	-1.12	49.50
3	Kandijharan	8.2	401	30	16	24	14	120	60	12	1.20	42.01	-0.40	49.30
4	bikampali	7.1	460	43	8	42	18	200	46	30	1.39	36.56	-0.32	41.67
5	Rengali	7.5	289	29	5	20	7	50	53	27	1.42	46.73	-0.76	36.84
6	Machida	8.3	951	90	65	60	30	315	195	56	2.36	50.36	-0.34	45.45
7	Jamgaon	7.3	640	60	25	52	9	150	110	38	2.02	49.24	-0.89	22.39
8	Kuremal	7.1	1390	118	4	114	41	330	305	15	2.40	36.47	-3.71	37.48
9	Kodapada	8	680	68	5	40	22	260	85	30	2.14	44.59	0.43	47.83
10	Durga	8.4	378	19	14	34	12	150	32	16	0.71	30.50	-0.24	37.04
11	Bagmunda	8.8	812	20	11	26	32	215	113	8	0.62	22.50	-0.44	67.23
12	Pandra	7.3	360	34	6	20	8	120	30	18	1.62	49.48	0.30	40.00
13	Lakhanpur	8.4	300	25	6	21	10	200	25	5	1.12	39.72	1.40	44.25
14	Kudloi	7.9	515	29	3	34	14	165	64	18	1.05	31.82	-0.16	40.70
15	Ubda	8.1	390	43	16	20	8	110	35	30	2.05	57.77	0.14	40.00
16	Kursoloi	8.6	195	16	4	28	1	100	23	4	0.81	34.99	0.16	5.62
17	Kumarbandha	7.5	220	14	6	20	6	90	25	9	0.70	33.70	-0.02	33.33
18	Piplikani	8	425	30	3	38	12	200	30	7	1.08	32.26	0.38	34.48
19	Sarandamal	7.1	656	47	10	50	22	225	45	12	1.39	34.67	-0.64	42.31
20	Karpabahal	7.2	467	36	6	45	8	120	30	30	1.30	37.08	-0.95	22.86

***All concentration are in mg/l, except pH, EC(µS/cm), SAR and RSC (meq/l**

Magnesium Hazard: a ratio of (Mg X 100)/ (Ca + Mg), is used as magnesium hazard of irrigational water. When this ratio is less than 50, no magnesium hazard is found. According to this scheme all of the ground water samples except one are found to be within 50.

Alkalinity Hazard: when the sum of CO_3^{-2} and HCO_3^{-1} is in excess of Ca and Mg there occurs a complete precipitation of the later. It is judged by the RSC value (Eaton, 1950).

$RSC = (HCO_3^{-1} + CO_3^{-2}) - (Ca^{+2} + Mg^{+2})$, all values area in epm.

The water of low RSC values (<1.25) is safe for irrigation where RSC value above 2.5 is unsuitable and may cause hardening of soil which may lead to infertile soil. Except one (1.6), all the water samples are found to be within safe limit.

Integrated effect of Electrical conductance and SAR: The SAR (Sodium Hazard) and EC (Salinity Hazard) values of the ground water of the study area were plotted in the graphical diagram of irrigational water (Richards, 1954) (Fig.1). Most of the samples (16) fall in the category of good quality with low alkali hazard and moderate salinity hazard (C_2S_1). Only 3 sample fall under class C_3S_1, show medium to high salinity hazard.

Toxicity: Certain ions like sodium and chloride in the soil and water are taken up by plant and accumulate to concentration high enough to cause crop damage or reduce yield. The degree of damage depends upon the exposure time, concentration, sensitivity of the crop and volume of water transpired by crop. Sodium and chloride can also cause toxicity by absorbing through wetted leaves by over head sprinklers. No sodium, chloride and bicarbonate toxicity have been encountered in the water samples of the study area.

Conclusion

On the basis of various criteria and guidelines the ground water quality of the phreatic aquifers of Lakhanpur block of Jharsuguda Dsistrict is found suitable for agricultural purpose. There is no harm in using ground water as source of irrigation in present soil condition.

References

APHA, 1985. *Standard Methods for the examination of water and wastewater*. American Public Health Association, 1134 pp.

Brown, E., Skougstod, M.W.and Fishman, F.J., 1974. *Methods for collection and analysis of water samples for dissolved minerals and gases*. U.S. Deptt. of interior. Book No.5.

Eaton, F.M., 1950. Significance of carbonates in irrigation water. ***Soil Science***,69: 123-133.

Jain, C.K. and Bhatia, K.K.S., 1987. *Physico-chemical analysis of water and wastewater*. User's Manual, U.M.-26, National Institute of Hydrology, Roorkee.

Raghunath, H.M., 1987. *Groundwater*. Wiley Eastern Limited, Delhi, India.

Richards, L.A., 1954. *Diagnosis and improvement of saline and alkaline soils*. U.S.deptt. Agri. Hand book, 60 pp.

Wilcox, L.V., 1967. *Classification and use of irrigation water*. USDA Circ. 969, Washington, D.C., 19 pp.