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Irrigation water quality appraisal of different sources under Amdanga block of West Bengal

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ABSTRACT

Quality assessment of water samples both from surface and sub-surface sources of *Amdanga* block of *West Bengal* was done during April- May 2004. About 80.5% samples were in medium salinity class (C2) and rest was without any salinity hazard. Sodium Adsorption Ratio (SAR) did not pose any threat towards its use, however, HCO_3 being the dominant anion leading to high Residual Sodium Carbonate (RSC) values (>2.5 me L^{-1}) made these unsuitable for irrigation purpose. The average concentration of Fe, Pb, Ni and Co in all the sources of irrigation water was within the safe limit, but the concentrations of Mn, Zn and Cu were beyond the recommended maximum concentration for irrigation purpose.

Key Words : Electrical conductivity, sodium adsorption ratio, residual sodium carbonate, heavy metals

Of the 2.8 per cent of total water in hydrosphere only 22 per cent left as a resource for water supply to plants and animals including human beings for their sustenance, growth and development. Population outburst coupled with urbanization, industrialization and agricultural activity increased the utilization of fresh water both from surface and sub-surface resources. Indiscriminate use of bad quality of water may adversely affect soil physico-chemical properties leading to decline in the production potentiality of the soil.

Concentration of toxic metals, non-metals and anions soluble in water are considered as important parameters for judging the quality of water for irrigation and other purposes. Addition of toxic heavy metals to soil through irrigation water or some other means may pose hazards to animals and human being via web of different crops grown in soils loaded with heavy metals (Lokeshwari and Chandrappa, 2006).A few studies have been carried out o study the changes in quality of irrigation waters over a period of time in different parts of Punjab (Singh and Bishnoi, 2006; Singh and Kumar, 2007) Detailed information about irrigation water is imperative for judicious use of existing water resources of this region. Limited information is available on water quality of *Amdanga* block under *North 24 Parganas* district of *West Bengal*. An attempt has, therefore, been taken to study the quality of water from surface and sub-surface sources of this region for agricultural purposes.

MATERIALS AND METHODS

Amdanga block under *North 24 Parganas* district of West Bengal is laying at 22° 83′ N latitude and 88° 53′ E longitude. Water samples for the present study were collected from different surface (pond, canal, etc) and sub-surface (hand tube well, shallow tube well, mini deep tube well and deep tube well) sources. Details location of sampling was shown in figure 1. The depth of different groundwater sources was as follows- hand tube well (HTW)-15.6 to 20.2m, shallow tube well (STW)-14.6 to 24.5m, mini deep tube well (MDTW)- 60 to 70m and deep tube well (DTW)-120 to 210.7m.

Samples were collected before monsoon i.e. during April-May, the period of maximum use of these resources for irrigating crops. Water samples were collected following the method of Taylor (1958) and preserved after adding 3 ml of nitric acid (1:1 v/v) per liter for metal analysis to avoid precipitation. For determination of other physico-chemical properties, samples were kept in refrigerator with few drops of toluene but without addition of nitric acid to check microbial growth.

Water samples were analyzed for pH, electrical conductivity (EC) and soluble anions like CO_3^{2-}, HCO_3^-, Cl^-, SO_4^{2-}, NO_3^-, PO_4^{3-} and B and cations like, Ca^{2+}, Mg^{2+}, K^+, and Na^+ following standard procedure. Heavy metals like Fe, Mn, Zn, Cu, Pb, Ni and Co were determined on GBC model 902 Atomic Absorption Spectrophotometer (Franson, 1995).

RESULTS AND DISCUSSION

Characteristics and ionic composition of water samples collected from different sources are presented in table 1. The pH of water samples varied between 6.9 and 7.7, that were very much within the normal range (6.5 to 8.4) for irrigation purpose and variability among the sources was not appreciable. The EC of surface, STW, MDTW and DTW water samples indicated that 80.5% of the water samples

Table 1 : Characteristics and ionic composition of water collected from different sources of *Amdanga* block

Parameters	**Surface**		**HTW***		**STW***		**MDTW***		**DTW***	
	Range	**Mean**	**Range**	**Mean**	**Range**	**Mean**	**Range**	**Mean**	**Range**	**Mean**
pH	6.9-7.7	7.2	6.9-7.3	7.0	6.8-7.5	7.1	7.0-7.3	7.1	7.0-7.4	7.2
TSS (mg L^{-1})	64 - 224	168	192 - 288	237	96-352	245	192-384	294	96-256	160
EC (dSm^{-1})	0.10-0.45	0.27	0.30-0.45	0.37	0.15-0.55	0.40	0.30-0.50	0.42	0.15-0.45	0.34
Ca^{2+} (me L^{-1})	1.0-4.7	2.58	3.8-4.6	4.2	3.1-6.7	4.73	3.3-6.4	5.12	2.0-6.9	4.65
Mg^{2+} (me L^{-1})	0.2-2.5	1.27	0.9-1.9	1.4	0.1-2.9	1.08	0.5-1.9	0.94	0.2-2.2	1.18
Na^{+} (me L^{-1})	0.2-1.5	1.09	0.7-1.5	1.1	0.1-1.4	0.43	1.1-1.6	1.28	0.2-1.6	0.92
K^{+} (me L^{-1})	0.11-1.08	0.25	0.10-0.15	0.12	0.01-0.17	0.10	0.06-0.10	0.07	0.06-0.11	0.09
HCO_3^{-} (me L^{-1})	5.2-13.2	8.5	6.4-9.0	7.7	8.6-15.2	11.0	10.8-11.6	11.1	9.0-14.4	11.2
Cl^{-} (me L^{-1})	2.0-4.4	2.88	1.6-2.4	2.2	0.8-.4	1.87	1.6-2.8	2.16	1.2-3.2	1.84
B (me L^{-1})	0.2-0.9	0.31	0.2-0.4	0.35	0.10-0.60	0.40	0.1-0.3	0.16	0.1-0.9	0.3
NO_3^{-}(me L^{-1})	0.20-1.10	0.61	0.40-0.55	0.47	0.1-0.6	0.27	0.10-0.45	0.32	0.10-0.75	0.26
SO_4^{2}-(me L^{-1})	18.6	7.37	4.7-15.9	8.3	2.6-19.2	7.07	0.26-6.6	5.0	1.3-15.6	6.22
PO_4^{3-}(me L^{-1})	0.01-0.15	0.02	0.005-0.03	0.015	0.005-2.0	0.03	0.01-0.04	0.02	0.005-0.04	0.02
SAR	0.25-1.54	0.76	0.39-1.00	0.68	0.05-0.88	0.25	0.61-0.87	0.70	0.11-0.90	0.55
SSP (%)	8.0-44.1	20.4	10.1-	31.0	1.10-20.5	7.0	15.2-27.6	17.6	3.1-24.4	16.6
RSC (me L^{-1})	1.8-10.1	4.9	1.4-2.8	2.0	3.5-8.1	5.3	4.4-6.8	5.0	3.1-7.7	5.4

*HTW-hand tube well, STW- shallow tube well, MDTW- mini deep tube well, DTW- deep tube well

Table 2 : Heavy metal concentration (mg L^{-1}) of water samples collected from different sources and their suitability.

Heavy metals	*SURFACE*		*HTW**		**STW***		*MDTW**		**DTW***		**RMC** for irrigation purpose**
	Range	**Mean**	**Range**	**Mean**	**Range**	**Mean**	**Range**	**Mean**	**Range**	**Mean**	
Fe	0.8-4.7	2.01	2.6-2.8	2.7	0.7-4.4	2.25	2.6-4.7	3.82	0.02-2.3	0.90	5.0
Mn	0.7-5.1	3.46	2.0-2.4	2.2	0.1-6.7	2.26	0.6-3.6	2.26	0.09-2.1	0.86	0.2
Zn	0.4-12.7	6.43	6.5-9.7	8.1	0.4-7.7	3.32	7.1-8.0	7.28	0.7-6.4	4.19	2.0
Cu	0.2-8.1	2.17	0.1-0.4	0.2	0.2-8.2	3.57	0.7-2.7	1.64	0.7-6.2	3.32	0.2
Pb	Tr –0.6	0.15	Tr –0.06	0.02	Tr –0.5	0.08	0.05-0.2	0.1	Tr –0.2	0.08	5.0
Ni	Tr –0.2	0.08	Tr	Tr	Tr –0.2	0.04	Tr –0.2	0.06	Tr –0.2	0.09	0.2
Co	Tr –0.1	0.01	Tr	Tr	Tr –0.1	0.008	Tr –0.02	0.004	Tr –0.02	0.004	0.05

*HTW-hand tube well, STW- shallow tube well, MDTW- mini deep tube well, DTW- deep tube well, **RMC- recommended maximum concentration

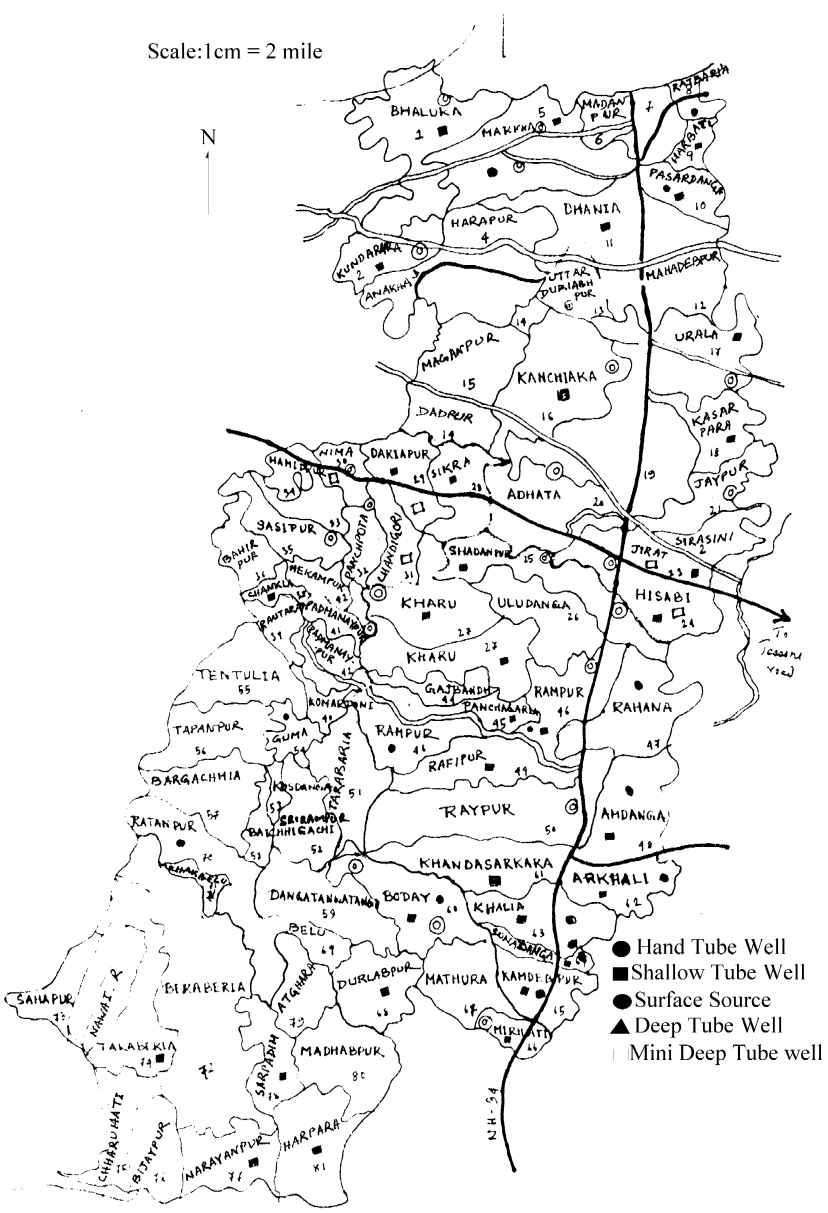

Fig.1. Map of Amdanga Block of West Bengal

were under the class, C2 (0.2 to 0.7 dSm^{-1}) having the possibility of medium salinity hazard and remaining samples would not pose any threat of salinity hazard for their long term use. Das (1998) reported that in April-May month more water samples became unsafe for irrigation than in December-January.

Irrespective of sources, the cationic composition in the water samples followed a general trend: $Ca^{2+} > Mg^{2+} > Na^{+} > K^{+}$ and amongst the anions analyzed HCO_3^- concentration was the maximum followed by SO_4^{2-}, Cl^-, B, NO_3^- and PO_4^{3-}. With respect to sodium hazard expressed in terms of SAR value, all the water samples were safe for irrigation purpose (SAR<3) as suggested by Ayers and Westcot (1985).

Majority of water samples collected from surface water bodies (91.6%) and HTW (60%) and all the samples from STW, MDTW and DTW under this block have RSC values more than 2.5 me L^{-1} and are thus unsafe for their suitability for irrigation purpose (Eaton, 1950). Though, the concentration of Na^+ expressed in terms of SAR was within the safe limit, the RSC values indicated that long-term use of this water for irrigation purpose might induce sodimization and thereby deteriorate the physical condition of soil. Similar result was also reported by Singh and Kumar (2007) for irrigation waters of

Jagraon block of Punjab state. However, none of the samples from any source faced B toxicity (< 0.33 mg L^{-1}) even with the most sensitive crops.

In the context of heavy metal contamination, the average concentration of Fe, Pb, Ni and Co in all the sources of irrigation water was within the safe limit as per guidelines proposed by Pratt (1972) and National Academy of Sciences and National academy of Engineering (1972) (Table 2). The average concentration of Mn, Zn and Cu in different sources of water in this block were beyond the recommended maximum concentration for irrigation purpose.

Thus, periodic monitoring is needed to assess the sodium adsorption and heavy metal accumulation besides the drainage condition of soil. However, use of heavy metal contaminated water resources for irrigation purpose should be avoided as far as practicable.

REFERENCES

Ayers, R. S. and Westcot, D. W. (1985). Water quality for agriculture, *Irrigation and Drainage paper 29, Rev. 1*. Food and Agricultural Organization, Rome, pp. 174.

Das, M. (1998). Appraisal of quality of irrigation water of Canning blocks of West Bengal. *Indian Journal of Agricultural Sciences*, **68**(2) : 92 -95.

Eaton, F. M. (1950). Significance of carbonates in irrigation waters. *Soil Science,* **69 :** 123 - 33.

Franson, M.A. H. (ed.) (1995). Standard methods for examination of water and wastewater. *America Public Health Association*, Washington DC, pp. 3 - 15.

Lokeshwari, H. and Chandrappa, G. K. (2006). Impact of heavy metal contamination of Bellandur Lake on soil and cultivated vegetation. *Current Science*, **91** (5) : 622 - 27.

National Academy of Sciences and National Academy of Engineering (1972). *Water quality criteria*. United States Environmental Protection Agency, Washington DC, Report No. EPA - R373 - 033. 592 p.

Pratt, P. F. (1972). *Quality criteria for trace elements in irrigation waters*. California Agricultural Experimental Station. 46 p.

Singh, B. and Kumar, B. (2007). Variations in the quality of underground irrigation water in Jagraon block of Ludhiana District (Punjab). *Journal of Research Punjab Agricultural University*, **44**(2) : 108 - 09.

Singh, B and Bishnoi, S.R. (2006). Changes in quality of underground irrigation waters in Nihal Singh wala block of Moga District of Punjab. *Journal of Research Punjab Agricultural University*, **43** : 19 - 20.

Taylor, E. W. (1958). *Examination of waters and water supplier*, 7th Ed., F & A Churchill Ltd.