Assessment of groundwater and surface water quality for irrigation suitability in Rupnagar district, Punjab, India

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INTRODUCTION

- Rupnagar district of Punjab, India (the current study site) covers about 54% of its total area with agriculture where groundwater, Sutlej and Sirsa river water are major sources of irrigation.
- In arid to semi-arid area like this, evaluation of irrigation water quality is of paramount importance.
- The suitability of any source of water for irrigation purpose depends upon the salinity, toxicity, soil permeability, concentration and composition of dissolved constituents.
- The quality indices of the irrigation water should be verified before proceeding any agricultural practice as the soil may develop salinity or sodicity when irrigated with poor quality of irrigation water.

OBJECTIVE

1. To evaluate the surface and groundwater quality in order to find its suitability for irrigation purposes.

METHODOLOGY

- Systematic sampling was done during the pre-monsoon (May 2019) and post-monsoon (Dec 2018) seasons.
- Total 54 samples (32 groundwater and 22 surface water: 16 from Sutlej and 6 from Sirsa River) were collected (Fig.1).
- Water quality and its suitability for irrigation was evaluated by measuring the pH, EC, TDS, Ca^{2+}, Mg^{2+}, Na^{+}, K^{+}, CO_3^{2-}, HCO_3^{-}, SO_4^{2-}, NO_3^{-} and Cl^{-} (Table 1).
- Parameters like %Na, SAR, RSC, Chloride content and Wilcox diagram were used for the assessment of irrigation water.

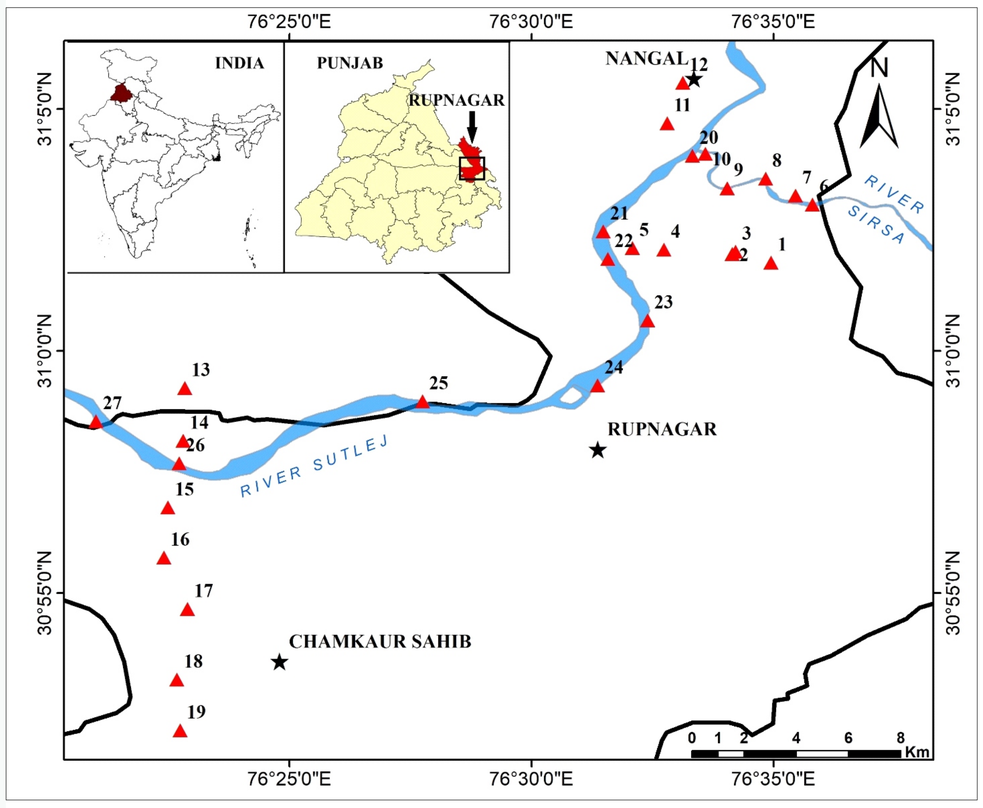

Fig. 1. Map showing Rupnagar district, Punjab and location of study site (inset) and the sampling sites.

PARAMETERS	UNITS	PRE-MONSOON			POST-MONSOON		
		MIN	MAX	MEAN	MIN	MAX	MEAN
pH	-	6.6	7.57	7.02	6.89	8.22	7.51
TDS	mg L^{-1}	94	1250	341.10	119	1250	392.93
EC	µS cm^{-1}	146.9	1953.1	532.97	185.9	1953.1	613.95
Ca^{2+}	mg L^{-1}	8.02	97.8	32.42	27.25	137.07	62.2
Mg^{2+}	mg L^{-1}	1.46	75.04	31.64	1.95	91.12	26.87
Na^{+}	mg L^{-1}	2.15	193	41.47	8.4	123	38.01
K^{+}	mg L^{-1}	2.15	141	9.44	0.7	188	10.87
HCO_3^{-}	mg L^{-1}	90	830	276	90	830	296
SO_4^{2-}	mg L^{-1}	11.72	149	45.04	15.12	138.42	46.27
Cl^{-}	meq L^{-1}	0.61	10.75	2.19	0.61	6.69	1.89
NO3^{-}	mg L^{-1}	8.57	97.14	37.70	2.86	48.57	19.37
%Na	%	5.96	81.01	24.29	5.36	51.08	21.36
SAR	meq L^{-1}	0.11	8.30	1.39	0.23	3.03	0.96
RSC	meq L^{-1}	-4.00	6.23	0.99	-4.78	4.24	-0.51

Table 1. Analysis of chemical parameters in studied surface and ground water samples

RESULTS

- Permissible pH of both surface and groundwater in pre- and post-monsoon.
- Conductivity ranged from 147-1953 µS/cm in pre- and 185.9-1953 µS/cm in post-monsoon.
- All 6 Sirsa river samples and sample no. 3 (GW) showed high chloride content.
- %Na was greater than the permissible limit only in 3 pre-monsoon Sirsa river samples (Fig.3).
- SAR of all the samples were within the permissible limits.
- Around 30 and 8% of samples in pre- and post-monsoon showed higher residual sodium carbonate (RSC) (Fig.4).
- The Wilcox diagram of pre-monsoon samples indicate high, medium and low saline to low sodium hazard except 1 sample (high saline to medium sodium hazard) while in post-monsoon comparatively lower salinity sodium hazard was observed (Fig.2).

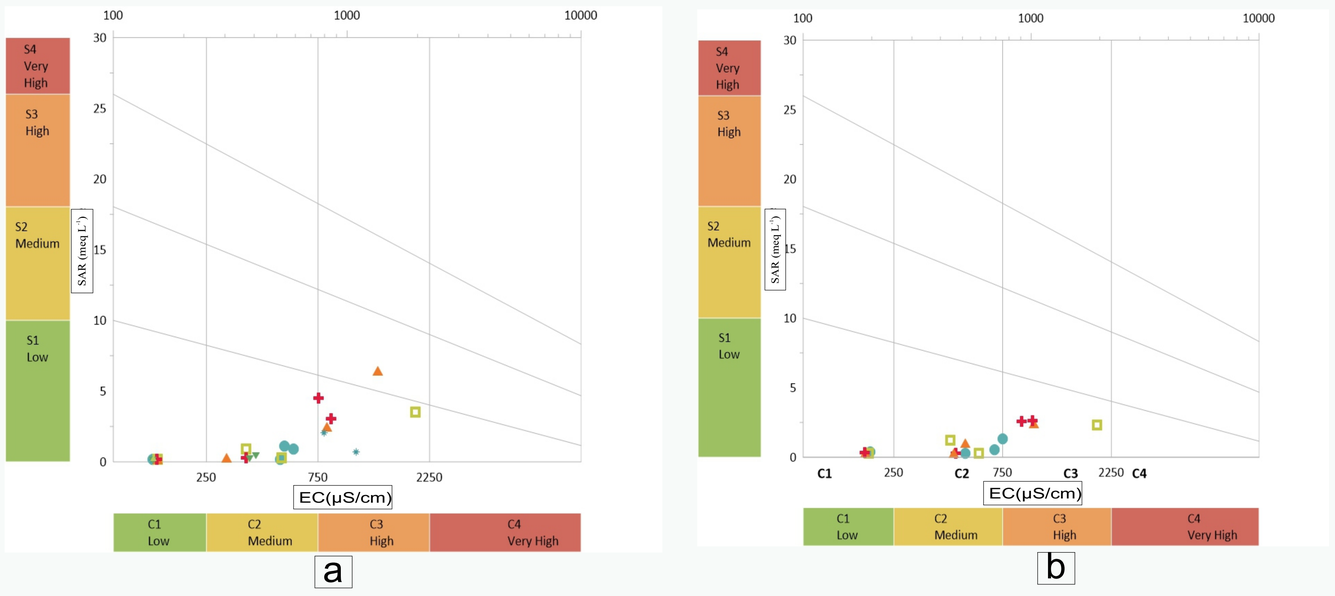

Fig. 2. Wilcox diagram of studied samples in (a) pre- and (b) post-monsoon

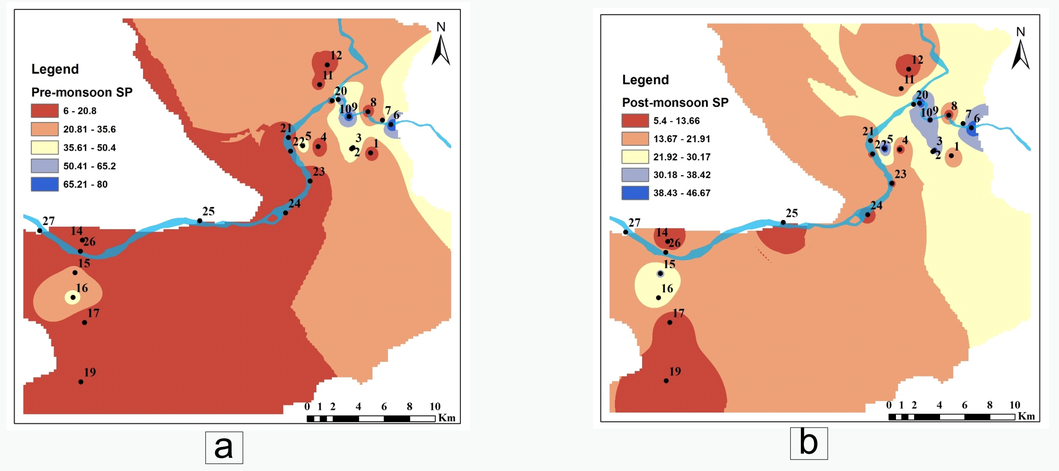

Fig. 3. Spatial distribution of sodium percent in (a) pre- and (b) post-monsoon

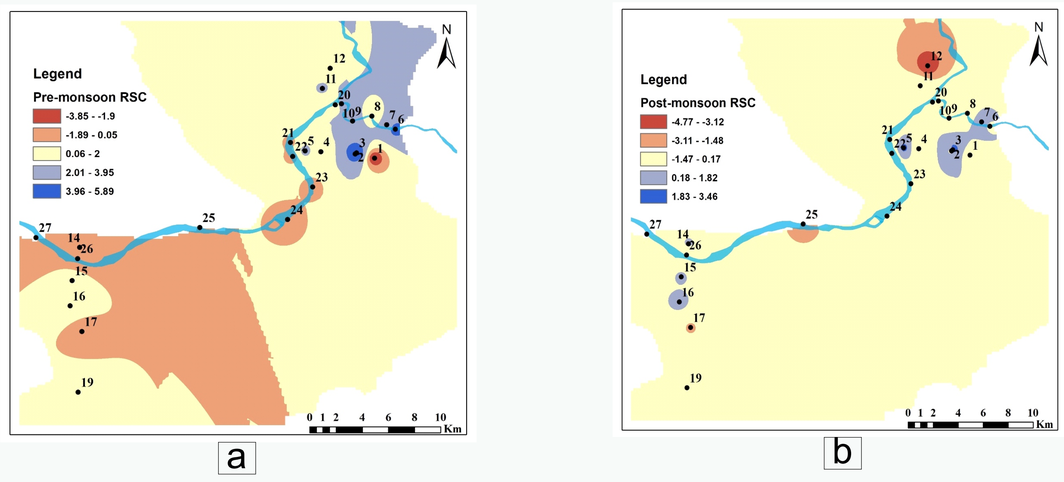

Fig. 4. Spatial distribution of RSC in (a) pre- and (b) post-monsoon

DISCUSSION AND CONCLUSION

- All the parameter like EC, TDS, %Na, SAR, RSC and Chloride content were higher in pre-monsoon than post-monsoon which may be due to dilution during post-monsoon.
- The suitability for irrigation as per SAR is because of low sodium content in all the samples relative to calcium and magnesium.
- All the Sirsa River water samples (S.no.6,9 &10) were found unfit for irrigation wherein the quality was more deteriorating in pre- than post-monsoon season.
- Groundwater sample (S.no. 3) was also found unsuitable for irrigation purpose.
- All the other ground and Sutlej River water samples can be used for irrigation due to their suitability.

NOVELTY

- Assessment of irrigation water quality can help in agricultural practices.
- Role of monsoon on the irrigation water quality.

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