

Israna block

Israna city, a tehsil headquarter in Panipat District is located at 29.2769° N latitude and 76.8519° E longitude and belongs to Rohtak Division. It is 18 km towards south from district headquarter Panipat and 188 km from State capital Chandigarh. Israna Tehsil is surrounded by Madlauda Tehsil towards north and Samalkha Tehsil towards east. Israna block covers an area of 280 km² area comprising 27 villages and 23,542 households. This block represents border areas of the Panipat District touching western part of Sonipat District (Mundlana).

To understand the irrigation water suitability for agricultural use, a total of 241 water samples were collected (1 km x 1 km) from all over the Israna block. Electrical conductivity (EC) of collected water samples ranged from 0.26 dS/m to 7.94 dS/m with a mean value of 2.54 dS/m (Table 12). Salinity problem (EC >2 dS/m) was quite critical in almost half of Israna block. About 31% samples were characterized with EC between 2–4 dS/m and 20% had EC >4 dS/m (Table 13). Highest EC~7.94 dS/m was recorded in village Karad (29.2943° N latitude 76.8246° E longitude) while lowest EC~0.26 dS/m in village Gawarla, (29.2729° N latitude 77.0099° E longitude).

RSC in groundwater ranged from 0 to 13.2 me/l with an average value of 2.3 me/l (Table 8). Highest RSC~13.2 me/l was recorded for a tube well in village Shahpur located at 29.34.4° N latitude, 76.8716° E longitude. Nearly 62% of the collected samples had very low RSC problem (average RSC~0.3 me/l), of which 90% had RSC <1.25 me/l category (average RSC~0.14 me/l). About 38% samples had RSC >2.5 me/l (average RSC~5.5 me/l) (Table

Table 12. Range and values of water quality parameters in Israna block

Sl. No.	Parameters	Range	Mean
1.	EC (dS/m)	0.26–7.94	2.54
2.	pH	6.66–8.60	7.81
3.	CO ₃ ²⁻ + HCO ₃ ⁻ (me/l)	2.5–20.6	9.8
4.	Ca ²⁺ + Mg ²⁺ (me/l)	1.2–45.0	10.2
5.	RSC (me/l)	Nil–13.2	2.3
6.	Na ⁺ (me/l)	0.4–90.9	16.2
7.	SAR (m mol/l) ^½	0.2–54.4	7.6
8.	Cl ⁻ (me/l)	0.7–46.5	8.9
9.	SO ₄ ²⁻ (me/l)	BDL–41.3	14.3
10.	PO ₄ ²⁻ (me/l)	BDL–0.7	0.04
11.	F ⁻ (ppm)	BDL–7.8	1.7
12.	NO ₃ ⁻ (ppm)	0.1–42.4	10.8

BDL: Below Detectable Limit

14); 21% with RSC between 2.5–5 me/l (average RSC~3.5 me/l), 15% with RSC between 5–10 me/l (average RSC~7.4 me/l) and rest 2% with RSC >10 me/l (average RSC~11.3 me/l).

The sodium adsorption ratio (SAR) ranged from 0.2 (village Buana Lakhu, 29.2120' N latitude, 76.8332' E longitude) to 54.4 (village Karad, 29.4026° N latitude, 76.9191° E longitude) with a mean value of 7.6 (Table 8). SAR problem was quite critical in one-fourth of the tested water samples (Table 15), though most of the samples belong to SAR between 10–20 (average SAR~12.7).

With the increase in salinity, there was decrease in residual alkalinity in groundwater (Table 13). The concentration of Na⁺ increased considerably with increasing salinity (Table 13) and alkalinity (Table 14). The concentration of Ca²⁺ and Mg²⁺ also decreased with increasing RSC.

Spatial variability for EC (Fig. 6a) indicated that nearly 62% (173 km²) of the water in Israna block was affected by irrigation water salinity (EC >2 dS/m), the critical limit for safe use of saline groundwater for irrigation. Out of this, 151 km² area (54% of total block area) belongs to EC between 2–4 dS/m and rest 22 km² area (8%) had EC >4 dS/m. Maximum salinity problem was confined to central parts of the Israna block. Only 28% of the block area (78 km²) was affected with residual alkalinity; 24.6% with RSC between 2.5–5 me/l, 3.3% with RSC between 5–10 me/l and 0.1% with RSC >10 me/l (Fig. 6b). RSC problem was

Table 13. Chemical composition of groundwater samples of Israna block against different EC class

EC class (dS/m)	No. of samples	EC dS/m	CO ₃ ²⁻ + HCO ₃ ⁻ me/l	Cl ⁻ me/l	SO ₄ ²⁻ me/l	Ca ²⁺ + Mg ²⁺ me/l	Na ⁺ me/l	RSC me/l	F ⁻ ppm	NO ₃ ⁻ ppm	SAR (mmol/l) ^{1/2}
<2	118	1.27	9.7	3.0	9.0	7.3	8.2	3.0	1.3	9.6	4.7
2–4	75	2.95	10.0	12.4	15.0	10.8	18.9	1.7	1.8	12.7	8.6
4–8	48	5.04	9.8	19.1	28.8	16.6	31.4	1.4	1.8	10.2	13.0
Total*	241	2.54	9.8	8.9	14.3	10.2	16.2	2.3	1.6	10.8	7.6

*represents weighted mean for each parameter

Table 14. Chemical composition of groundwater samples of Israna block against different RSC class

RSC class (me/l)	No. of samples	RSC me/l	EC dS/m	CO ₃ ²⁻ + Cl ⁻ HCO ₃ ⁻ me/l	SO ₄ ²⁻ me/l	Ca ²⁺ + Mg ²⁺ me/l	Na ⁺ me/l	F ⁻ ppm	NO ₃ ⁻ ppm	SAR (mmol/l) ^{1/2}	
<1.25	135	0.14	2.96	8.7	10.0	14.6	13.2	17.0	1.0	11.9	6.6
1.25–2.5	14	1.95	1.70	10.1	9.4	4.3	8.1	16.7	1.1	5.1	7.3
2.5–5	50	3.48	1.95	10.4	4.2	13.4	6.9	17.0	1.8	10.7	8.1
5–10	38	7.44	2.19	12.6	10.6	14.8	5.2	16.7	3.3	9.4	10.6
>10	4	11.33	2.38	15.7	14.5	41.3	4.4	26.1	4.4	2.9	15.7
Total*	241	2.27	2.54	9.8	8.9	14.3	10.2	16.2	1.6	10.7	7.6

*represents weighted mean for each parameter

Table 15. Chemical composition of groundwater samples of Israna block against different SAR class

SAR class (m mol/l) ^½	No. of samples	SAR (mmol/l) ^½	RSC me/l	EC dS/m	CO ₃ ²⁻ + HCO ₃ ⁻ me/l	Cl ⁻ me/l	SO ₄ ²⁻ me/l	Ca ²⁺ + Mg ²⁺ me/l	Na ⁺ me/l	F ⁻ ppm	NO ₃ ⁻ ppm
<10	184	5.26	1.89	2.12	9.6	8.0	12.0	10.4	11.8	1.2	10.4
10–20	50	12.72	2.86	3.78	10.3	12.7	19.5	10.3	27.6	2.4	13.7
>20	7	30.82	8.16	4.94	13.3	12.2	38.3	5.1	49.8	4.7	7.0
Total*	241	7.55	2.27	2.54	9.8	8.9	14.3	10.2	16.2	1.6	10.8

*represents weighted mean for each parameter

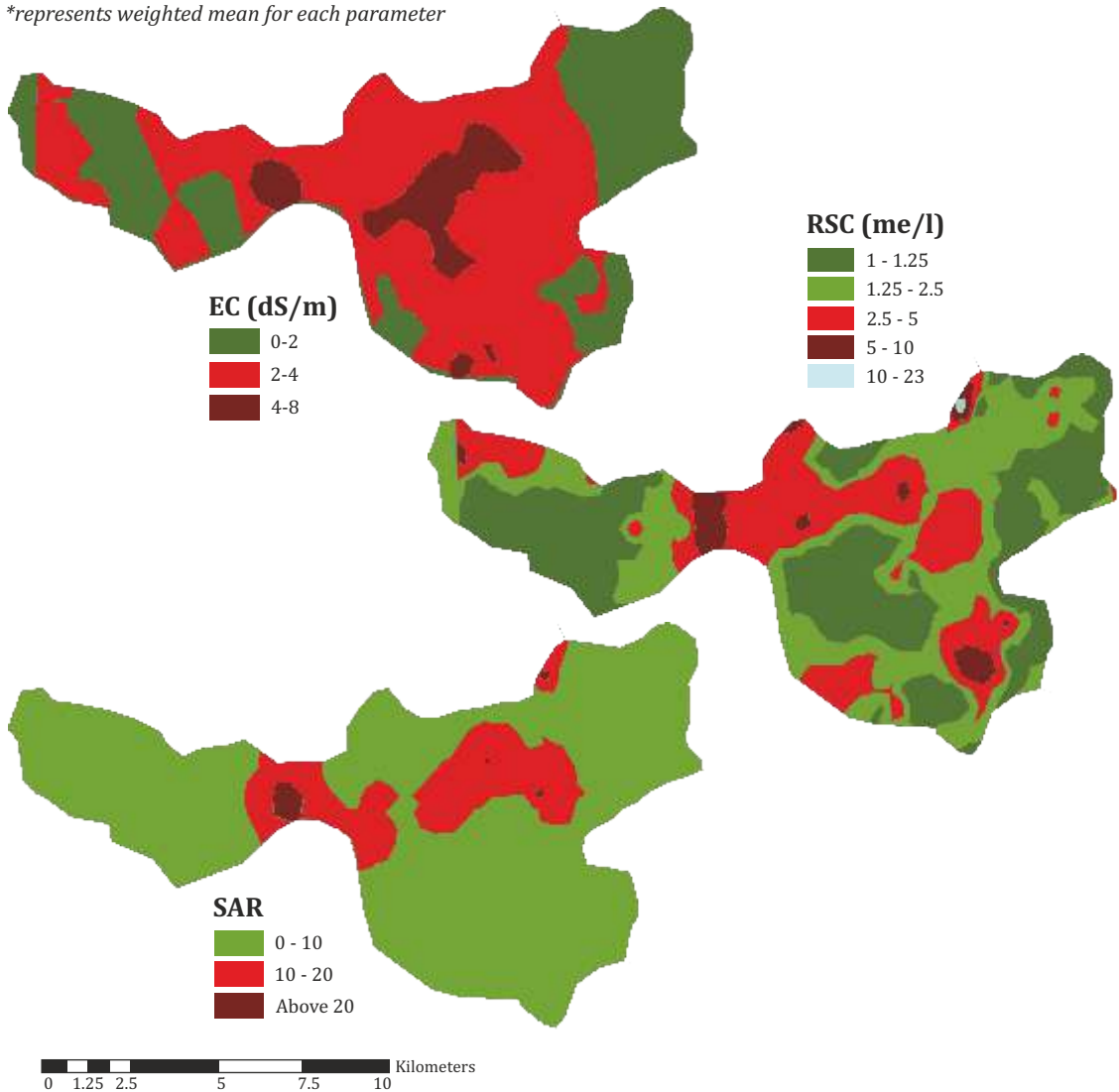


Fig. 6. Distribution of (a) electrical conductivity (EC); (b) residual alkalinity (RSC) and (c) sodium adsorption ratio (SAR) in groundwater of Israna block

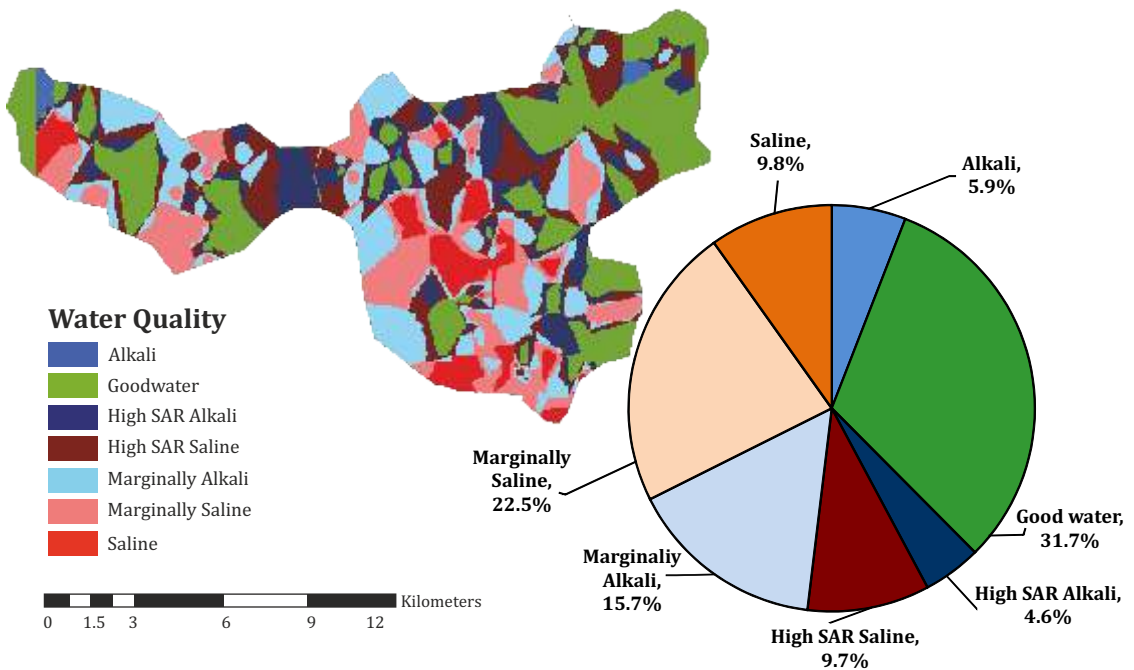


Fig. 7. Distribution and characterization of groundwater quality of Israna block

sporadically distributed all over the Israna block; extreme west touching Madlauda block, central parts and few patches in southern side. Groundwater covering nearly 84% area (235 km²) had very low problem of SAR (SAR<10). Majority (93%) of the SAR prone area belongs to SAR class 10–20 and was confined to central parts of Israna block (Fig. 6c).

In Israna block covering 280 km² total area, only 32% area represents good quality groundwater (EC <2 dS/m, RSC <2.5 me/l, SAR <10) while 68% area had poor quality water (Fig. 7). Salinity was quite critical in 42% of the total area in the order of marginal saline (22.5%) > Saline (9.8) = high SAR saline (9.7%). High SAR problem of variable salinity (9.7%) and residual alkalinity (4.6%) was encountered in 14.3% area. Residual alkalinity of variable nature (marginal alkali~15.7%, alkali~5.9% and high SAR alkali~4.6%) was observed in 26.2% area.