

## Bapoli block

Bapoli, a block of Panipat district in Haryana, is located between 29.3391° N latitude and 77.0849° E longitude. It covers an area of 244 km<sup>2</sup> comprising 49 villages and 22648 households. Bapoli city is surrounded by Panipat Tehsil in west, Samalkha Tehsil in south, Kairana Tehsil in east and Chhaprauli Tehsil towards south. It belongs to Rohtak Division and nearly 181 km away from State capital Chandigarh.

Groundwater is the main source of irrigation water in the Bapoli block. To understand the irrigation water suitability, a total of 193 groundwater samples were collected (1 km x 1 km) from all over the Bapoli block and analysed for different water quality parameters. Laboratory analysis revealed that the salinity i.e. groundwater EC of the tested water samples ranged from 0.46 dS/m (village Nanhera, 29.3622° N latitude 77.1077° E longitude) to 2.47 dS/m (Passina Khurd, 29.3290° N latitude 77.0446° E longitude) with a mean value of 1.05 dS/m (Table 24). Salinity was not a problem in groundwater of the Bapoli block as 98.4% of the collected water samples were characterized with EC <2 dS/m (average EC~1.05 dS/m), the permissible limit for using groundwater for irrigation (Table 25). Only 1.6% of the samples (Bhallor, Bapoli and Passina Khurd) had higher EC range between 2–4 dS/m (average EC~2.24 dS/m), warrant special attention for sustainable use of groundwater for irrigation.

Residual alkalinity in groundwater (RSC) ranged from 0 to 7.3 me/l with an average value of 2.0 me/l (Table 24). The highest RSC~7.3 me/l was recorded in Raslapur village (29.3550° N latitude, 77.0523° E longitude). Out of total 193 samples, about 62% samples were characterized with RSC <2.5 me/l (average RSC~0.6 me/l), the permissible limit of using

**Table 24. Range and values of water quality parameters in Bapoli block**

Sl. No.	Parameters	Range	Mean
1.	EC (dS/m)	0.46–2.47	1.05
2.	pH	6.45–8.61	7.61
3.	CO <sub>3</sub> <sup>2-</sup> + HCO <sub>3</sub> <sup>-</sup> (me/l)	3.0–17.0	8.1
4.	Ca <sup>2+</sup> + Mg <sup>2+</sup> (me/l)	1.6–16.4	6.7
5.	RSC (me/l)	Nil–7.3	2.0
6.	Na <sup>+</sup> (me/l)	0.9–14.8	5.2
7.	SAR (m mol/l) <sup>½</sup>	0.6–7.4	3.0
8.	Cl <sup>-</sup> (me/l)	0.3–8.3	2.0
9.	SO <sub>4</sub> <sup>2-</sup> (me/l)	BDL–17.2	8.3
10.	PO <sub>4</sub> <sup>2-</sup> (me/l)	BDL–0.5	0.1
11.	F <sup>-</sup> (ppm)	0.04–1.4	0.7
12.	NO <sub>3</sub> <sup>-</sup> (ppm)	BDL–23.2	2.9

BDL: Below Detectable Limit

**Table 25. Chemical composition of groundwater samples of Bapoli block against different EC class**

EC class (dS/m)	No. of samples	EC dS/m	CO <sub>3</sub> <sup>2-</sup> + HCO <sub>3</sub> <sup>-</sup> me/l	Cl <sup>-</sup> me/l	SO <sub>4</sub> <sup>2-</sup> me/l	Ca <sup>2+</sup> + Mg <sup>2+</sup> me/l	Na <sup>+</sup> me/l	RSC me/l	F <sup>-</sup> ppm	NO <sub>3</sub> <sup>-</sup> ppm	SAR (mmol/l) <sup>½</sup>
<2	190	1.03	8.0	19.8	83.2	6.6	5.1	2.0	0.7	2.8	2.9
2-4	3	2.25	10.4	x	x	11.1	12.6	2.9	0.5	4.3	5.8
4-8	-	-	-	-	-	-	-	-	-	-	-
Total*	193	1.05	8.1	19.8	83.2	6.7	5.2	2.0	0.7	2.9	3.0

\*represents weighted mean for each parameter

**Table 26. Chemical composition of groundwater samples of Bapoli block against different RSC class**

RSC class (me/l)	No. of samples	RSC me/l	EC dS/m	CO <sub>3</sub> <sup>2-</sup> + Cl <sup>-</sup> HCO <sub>3</sub> <sup>-</sup> me/l	SO <sub>4</sub> <sup>2-</sup> me/l	Ca <sup>2+</sup> + Mg <sup>2+</sup> me/l	Na <sup>+</sup> me/l	F <sup>-</sup> ppm	NO <sub>3</sub> <sup>-</sup> ppm	SAR (mmol/l) <sup>½</sup>	
<1.25	92	0.25	1.15	7.4	2.3	9.4	8.4	5.0	0.6	3.9	2.4
1.25-2.5	28	1.80	1.05	8.2	2.4	10.0	6.4	5.1	0.5	4.4	3.0
2.5-5.0	59	3.59	0.90	8.4	1.6	6.0	4.8	5.2	0.8	1.8	3.4
5.0-10.0	14	6.13	1.06	10.9	2.2	8.1	4.6	6.8	0.7	0.8	4.4
>10	-	-	-	-	-	-	-	-	-	-	-
Total*	193	1.98	1.05	8.1	2.0	8.3	6.7	5.2	0.7	2.9	3.0

\*represents weighted mean for each parameter

alkali groundwater for irrigation purpose (Table 26). Nearly 31% samples have RSC range between 2.5-5 me/l (average RSC~3.6 me/l) and rest 7% with RSC between 5-10 me/l (average RSC~6.1 me/l).

The sodium adsorption ratio (SAR) ranged from 0.6 to 7.4 with a mean value of 3.0 (Table 24). The lowest SAR was recorded in village Khozkipur (29.2611° N latitude, 77.1178° E longitude) and the highest in village Bhallor (29.2873° N latitude, 77.1039° E longitude). As such, the SAR of groundwater remained <10 in whole of the Bapoli block (Table 27), is within permissible limit for irrigation.

**Table 27. Chemical composition of groundwater samples of Bapoli block against different SAR class**

SAR class (mmol/l) <sup>½</sup>	No. of samples	SAR (mmol/l) <sup>½</sup>	RSC me/l	EC dS/m	CO <sub>3</sub> <sup>2-</sup> + HCO <sub>3</sub> <sup>-</sup> me/l	Cl <sup>-</sup> me/l	SO <sub>4</sub> <sup>2-</sup> me/l	Ca <sup>2+</sup> + Mg <sup>2+</sup> me/l	Na <sup>+</sup> me/l	F <sup>-</sup> ppm	NO <sub>3</sub> <sup>-</sup> ppm
<10	193	3.0	1.98	1.05	8.1	2.0	8.3	6.7	5.2	0.7	2.9
10-20	-	-	-	-	-	-	-	-	-	-	-
>20	-	-	-	-	-	-	-	-	-	-	-
Total*	193	3.0	1.98	1.05	8.1	2.0	8.3	6.7	5.2	0.7	2.9

\*represents weighted mean for each parameter

With the increase in salinity (Table 25) and alkalinity (Table 26) of water, the concentration of  $\text{Na}^+$  increased considerably, consequently imparted higher SAR problem. The data presented in Table 26 further revealed that contents of  $\text{CO}_3^{2-} + \text{HCO}_3^-$  increased but that of  $\text{Ca}^{2+} + \text{Mg}^{2+}$  decreased with increasing level of RSC. No definite relationship was observed between EC and RSC.

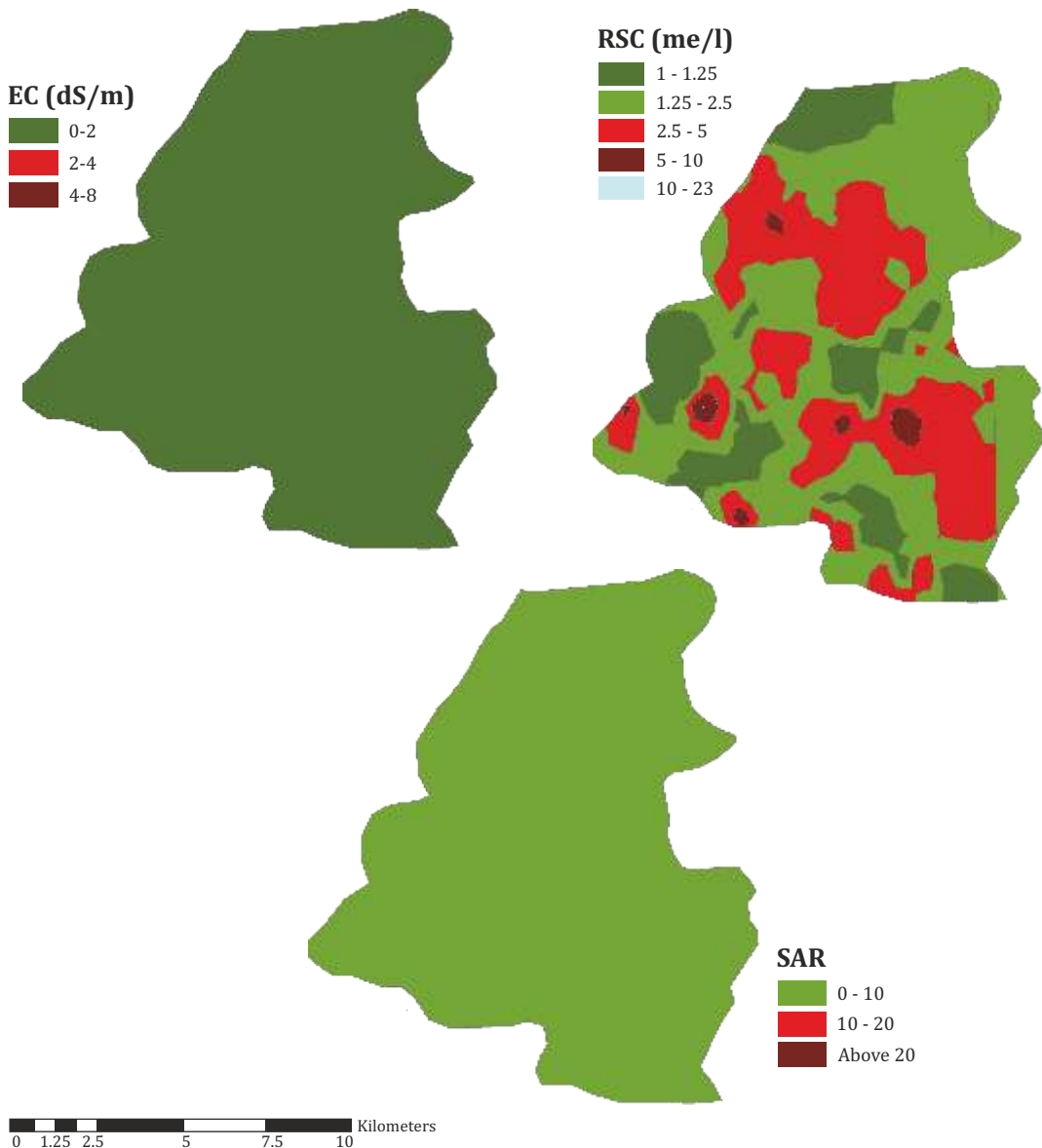


Fig. 12. Distribution of (a) electrical conductivity (EC); (b) residual alkalinity (RSC) and (c) sodium adsorption ratio (SAR) in groundwater of Bapoli block

### Water Quality

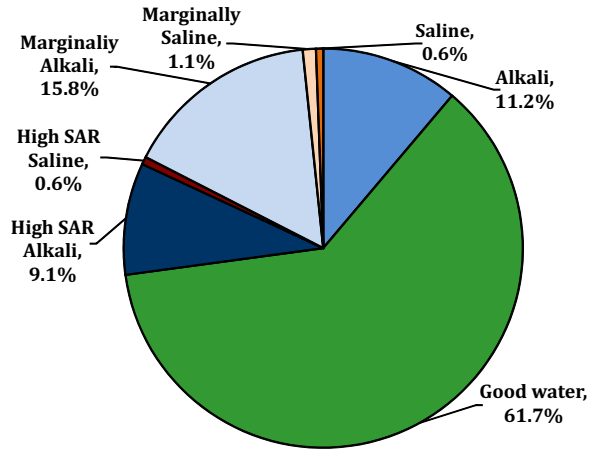
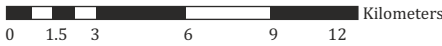
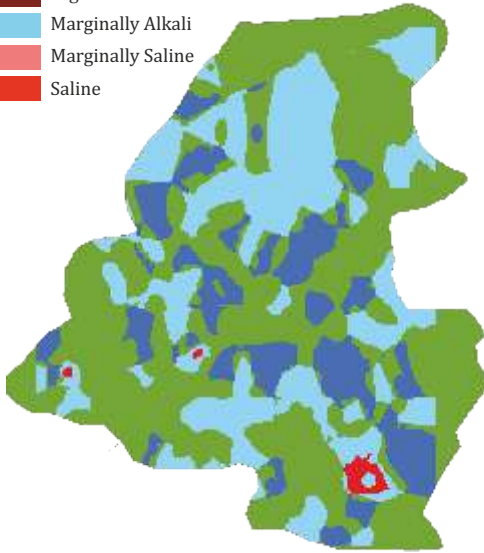
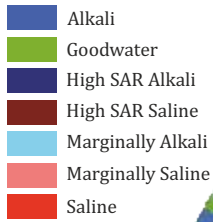


Fig. 13. Distribution and characterization of groundwater quality of Bapoli block

Spatial variability for EC (Fig. 12a) and SAR (Fig. 12c) indicated that there was very low problem of salinity ( $EC < 2$  dS/m) and sodium adsorption ratio ( $SAR < 10$ ) in underground water of Bapoli block in Panipat district. Similarly, nearly 63% of the area had very low problem of residual alkalinity in underground water ( $RSC < 2.5$  me/l). About 35% area was dominated by RSC range between 2.5–5 me/l and only 2% area represents higher RSC between 5–10 me/l (Fig. 12b).

In Bapoli block, groundwater in nearly 62% of the total area was of good quality (Fig. 13). Residual alkalinity was quite critical in about 36% area while only 2% area was affected by salinity of variable nature. About 16 and 11% groundwater of the block was marginal and alkali in nature, respectively. While 9% had the problem of higher SAR alkalinity. In addition, about 1% area represents each of marginally salinity and high SAR saline water.