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UNDER GROUND WATER QUALITY OF GANGA CANAL IN MEERUT DISTRICT UTTAR PRADESH, INDIA

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ABSTRACT: *The present study is conducted to assess the underground water nearby the Ganga canal, Meerut, Uttar Pradesh for drinking and irrigation purpose. Water samples were analyzed for their chemical properties i.e. pH, total salt (electrical conductivity), Anions (Cl^-, $CO3^-$, HCO_3^-, $SO4^-$ and $NO3^-$) and Cations(Ca^{++} and Mg^{++}, Na^+,K^+), TDS, water quality indices, toxic element and heavy content of water samples pH varied 7.28 to 8.09 and electrical conductivity 0.17 and 1.04 dSm^{-1}, potassium, sodium 9.5 and 2.4 mgL^{-1}, Ca^{++} and Mg^{++} content ranged from 5.8 to 28.6 $meqL^{-1}$, Cl^- content varied from 0.16 to 0.53 g L^{-1}, nitrate ranged 0.10 to 4.47 mgL^{-1} , sulphate varied from 0.12 to 2.77 mgL^{-1}. The carbonate and bicarbonate sample varied from 1.0 to 6.0 and 6.00 to 22.0 $meqL^{-1}$. As sample varied 1.08 to 21.29 ppb. The TDS value 115.0 mgL^{-1}. The Meerut district is safe for irrigation and drinking purpose on the basis of most parameters.*

KEYWORDS*:* Water quality assessment, TDS, SAR, RSC and Ganga canal

INTRODUCTION

Water is one of the most abundant components found in nature covering approximately three – forth of surface of the earth **(Beebi et al., 2004)**. Water is the elixir of life, a precious gift of nature for mankind and millions of other species living on the earth. It is fast becoming a scare commodity in most part of the world **(Ushrani et. al., 2010)**. Water is essential requirement of human and industrial development and also it is one of the most delicate parts of the environment **(Das and Acharya, 2003)**.

Ground water is the main source of drinking, irrigation and industrial purpose. During last two decades the indiscriminate disposal of industrial wastes on mother earth slowly makes the ground water susceptible pollution **(Tank and Chandel, 2010)**. Ground water is an important water supply source worldwide. It is the major source of water in both urban and rural area in India. Arsenic, fluoride, and heavy metals occur as major constituents of ground water in all categories of hydro- geological setting in India. The concentration of these minor constituents including iron and nitrate is of concern as large amount of ground water is extraction by drilling water – well both in rural and urban areas for drinking and irrigation purpose. The sixteen state in India – Andhra Pradesh, Bihar, Delhi, Gujarat, Haryana, Jammu and Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharastra, Manipur, Orrisa, Punjab, Rajasthan, Tamilnadu, and Uttar Pradesh have already identified endemic to flourosis. Marippan *et al. (*2006).

Groundwater crisis is not the result of natural factors it has been caused by human actions. During the past two decades, the water level in several parts of the country has been falling rapidly due to an increase in extraction. The number of wells drilled for irrigation of both food and cash crops have rapidly and indiscriminately increased. India's rapidly rising population and changing lifestyles has also increased the domestic need for water. The water requirement for the industry also shows an overall increase.

Various workers in our country have carried out an extensive work on water quality for various purposes. **Subramani et al., (2005)** have studied ground water quality and its suitability for drinking and agriculture use in Chithar River Basin. Charu et al., (2008) have studied the drinking water quality status in Bhopal and concluded that the water quality is good and are within the range of standard value prescribed by various agencies. **Raju (2007)** has evaluated the ground water quality in the upper Gunanaeru River basin, Cuddapah District, Andhra Pradesh, South India.

MATERIALS AND METHODS

The study area falls in Meerut district of Western Uttar Pradesh. Ganga canal was considered as base line and on the left hand side (LHS) of Ganga canal from Kaili to Jani was taken as the study area. Each bridge on the canal between these two points (Kaili to Jani) was selected for sampling location. Samples were taken from the distance of 1000, 2000, 3000, 4000, and 5000 meter away from canal.

Water samples were collected from six locations of Meerut district under different cropping pattern. The water samples were analyzed by standard methods for pH, electrical conductivity, Potassium, Sodium and Carbonate and Bicarbonate (Jackson, 1973), Calcium and Magnesium, Nitrate, Sulphate (Tandon, 1993), Total dissolve salts (TDS), Sodium adsorption ratio (SAR) and Residual Sodium carbonate (RSC) (Chopra and Kanwar, 1976). The concentration of Arsenic was determined by atomic absorption spectrophotometer (GBC Avanta PM). All the analysis of soil samples was carried out in the laboratory of Department of Soil Science, SVPUA& Tech, Modipurm, Meerut (U.P), India.

RESULTS AND DISCUSSION

Suitability of ground water for domestic (Drinking) purpose

To study the chemical parameters or water quality the samples were collected from six selected locations of left side of Ganga canal during Nov 2009 to Feb 2010. The chemical parameters for the selected locations are presented in Table 1 to 18.

pH

The pH value of ground water ranged from 7.28 to 8.09 (Table-1). This shows that the ground water of the study area is mainly alkaline in nature and on the basis of observed value all the samples were within the permissible limit as prescribed by WHO.

Electrical conductivity
Electrical conductivity is useful tool to evaluate the purity of water. The minimum and maximum electrical conductivity of water 0.17 and 1.04 dSm^{-1} and 1.2 to 5.4 m depth of water table were recorded in Kaili Sakoti respectively (Table-2). The primary effect of high EC water on crop productivity in the inability of the plant to compete with ion in solution for water on crop productivity. The higher the EC, the less water is available to plants, even though the soil may be appearing wet. Because plants can only transpire "pure water" usable plant water in the soil solution decreases dramatically as EC increase suggested by **Joshi et al., 2009.**

Potassium
In the present study most of the water samples were found safe for drinking purpose as the observed value of potassium lower than the permissible limit of 9.5 mgL^{-1} as prescribed by BIS. Only two water sample collected from Pooth Rohata were unsuitable since their K content was 28 and 20.5 mgL^{-1}

Sodium
Sodium content of the water samples ranged from 2.4 mgL^{-1} (Bhola Jhal) to 8.1 mgL^{-1} for (Jani) location. All the water samples showed lower than the Na permissible limit (50ppm) in drinking water prescribed by BIS (1983).

Calcium and Magnesium hardness
Ca^{++} and Mg^{++} are responsible for hardness occurring in natural waters. Hardness of the water is objectionable from the view point of water use. The Ca^{++} and Mg^{++} value of the water samples ranged from 5.8 to 28.6 $meqL^{-1}$at different depths of water samples. The lowest value of 5.8 $meqL^{-1}$ was recorded in Kaili Sakoti where as the highest value of 28.6 $meqL^{-1}$ from Pooth Rohata.

Chloride
Chloride content of water samples in the present study ranged from 0.16 to 0.53 g L^{-1} Table-. The maximum chloride 0.53 g L^{-1} was found in Kaili Sakoti location at 7.3 m depth while minimum 0.16 g L^{-1} in same location at 2000 m depth. 1.0% samples exceeded the desirable limit (500mg L^{-1}) as per WHO norms.

Nitrate
The nitrate concentration of ground water samples ranged from 0.10 to 4.47 mgL^{-1} (Table-7). The lowest value of 0.10 mgL^{-1} was observed in the water sample collected from (Bhola Jhal) and Nanu (SP) where as highest value of 4.47 mgL^{-1} was observed in Milak Sardhana. All the samples were found within desirable limit of 45 mgL^{-1} as per WHO norms. The highest concentration of nitrate in drinking water is toxic and causes methaemoglobinamia (Blue baby disease) in Children and Gestic carcinomas (Comly 1945).

Sulphate
Sulphate extract of collected water samples varied from 0.12 to 2.77 mgL^{-1} (Table-8). All the samples were in desirable limit of 500 mgL^{-1} as per WHO standard.

Carbonate

Carbonate content of ground water samples in the study ranged from 1.0 to 6.0 $meqL^{-1}$ (Table-9). The maximum value of 6.0 $meqL^{-1}$ was observed in the water sample collected from (Pooth Rohata), while lowest value 1.0 $meqL^{-1}$ in Kaili Sakoti and Milak Sardhana

Bicarbonate

The value of HCO_3^- in the water samples varied from 6.00 to 22.0 $meqL^{-1}$ (Table-10). The lowest value of 6.0 $meqL^{-1}$ was observed in the water sample collected from (Kaili Sakoti) where as the highest value of 22.0 $meqL^{-1}$ in Pooth Rohata. All the samples are below the permissible limit of 120 $meqL^{-1}$ as prescribed by WHO.

Arsenic

The Arsenic in the ground water samples ranged from 1.08 to 21.29 ppb (Table.11). Beyond the acceptable limit 0.01 mg L^{-1} water becomes toxic. All the water samples were and therefore all below the acceptable limit as set by different organization BIS, WHO and ISS and samples are safe for drinking purpose.

Irrigation water quality

Total dissolve salts (TDS)

Water used for irrigation can very greatly depending upon type and quality of dissolved salts. Salts are present in irrigation water in relatively small but significance amounts, they originate from dissolution or weathering of the rocks and soil, including dissolution of lime, gypsum and other slowly minerals. These salts are carried with the water to wherever it is used. The salts are applied with the water and remain behind in the soils as water evaporate or is used by the crop. A salinity problem exist, salt accumulate in the root zone to the concentration that causes a loss in yield as the crop is no longer able to extract sufficient water from the salty soil solution, resulting in water stress for a significant period of time. If water uptake is appreciably reduced, the plant shows its rate of growth. Water with TDS less 450 mgL^{-1} is considered good and that with greater than 2000 mgL^{-1} is unsuitable for irrigation purpose (Joshi et al., 2009). In the present study the minimum value of total dissolved salts were found 115.0 mgL^{-1} in Nanu (SP) whereas maximum value 498 mgL^{-1} in Pooth Rohata. According to WHO desirable limit of TDS is 500 and all samples were lowest the standard permissible limit.

Sodium adsorption ratio

The suitability of ground water samples for investigation is also judged by the determining the SAR value and they categorized under different irrigation classes on the basis of alkalinity. The SAR value varied from 1.27 to 4.03. The samples are classified on the extent of SAR as shown in Table-14, 15 and the ground water of study area is found excellent for irrigation purpose.

Residual Sodium carbonate

Residual sodium carbonate is computed by difference of (CO_3^{-2} and HCO_3^-) and cations (Ca^{+2}+ Mg^{+2}) where the ionic content is in meq L^{-1}. The RSC value varied from -0.2 to 11.0. The maximum RSC was found 11.0 in Pooth Rohata location while minimum value -0.2 was observed in Nanu (SP). in (Table-16 & 17). Based on the alkalinity hazards only 13.66 % of the ground water samples are useful for irrigation purpose without any hazards, about 16.66 %

samples can be used for irrigation with little danger of development of alkalinity hazards and 26.66 samples required good drainage while 16.66 samples are not suitable for irrigation purpose.

Salinity hazards

Based on the salinity hazards only 6.66 % of the ground water samples are useful for irrigation purpose without any hazards, about 86.66 % samples can be used for moderate leaching while 6.66 samples required good drainage.

CONCLUSION

From the study it can be concluded that the water of different depth of six different locations of left side of Ganga canal flowing through Meerut district is safe for irrigation and drinking purpose on the basis of most parameters, however its suitability is questionable on the basis of few parameters for drinking as well as irrigation purpose

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Table: 1. pH of water sample & collected at different distance from Ganga canal.

S. No	Locations	Water sampling distance from Ganga canal (m)				
		1000	2000	3000	4000	5000
1	Kaili (Sakoti)	7.89 (1.2)	7.45 (2.5)	7.51 (4.2)	7.40 (5.4)	7.31 (7.6)
2	Milak (Sardhana)	7.28 (3.0)	7.44 (6.1)	7.60 (6.7)	7.35 (12.2)	7.83 (16.4)
3	Nanu (SP)	7.28 (1.2)	7.44 (2.4)	7.60 (4.0)	7.35 (6.5)	7.83 (9.1)
4	Pooth (Rohata)	7.34 (2.1)	7.70 (3.7)	7.30 (6.5)	7.4 (9.6)	7.34 (12.2)
5	Bhola (Jhal)	7.65 (0.91)	8.09 (3.0)	7.46 (4.6)	7.46 (8.2)	7.51 (14.8)
6	Jani	7.43 (1.2)	7.50 (2.1)	7.51 (6.1)	7.62 (8.8)	64 11. 6)

*Values in parenthesis denotes the sampling depth (m)

Table: 2. Electrical conductivity (dSm^{-1}) of water sample collected at different distance from Ganga canal.

S. No	Locations	Water sampling distance from Ganga canal (m)				
		1000	2000	3000	4000	5000
1	Kaili (Sakoti)	0.17 (1.2)	0.29 (2.5)	0.31 (4.2)	1.04 (5.4)	0.37 (13.4)
2	Milak (Sardhana)	0.51 (3.0)	0.47 (6.1)	0.43 (6.7)	0.45 (12.2)	0.53 (16.4)
3	Nanu (SP)	0.29 (1.2)	0.41 (2.4)	0.40 (4.0)	0.44 (6.0)	0.50 (9.1)
4	Pooth (Rohata)	1.00 (2.1)	0.58 (3.7)	0.65 (6.5)	0.46 (9.6)	0.67 (12.2)
5	Bhola (Jhal)	0.24 (0.91)	0.33 (3.0)	0.59 (4.6)	0.73 (8.2)	0.49 (14.8)
6	Jani	0.44 (1.2)	0.41 (2.1)	0.37 (6.1)	0.57 (8.8)	0.48 (11.6)

* Values in parenthesis denotes the sampling depth (m)

Table: 3. Potassium (mg/L) of water sample collected at different distance from Ganga canal.

S. No	Locations	Water sampling distance from Ganga canal (m)				
		1000	2000	3000	4000	5000
1	Kaili (Sakoti)	4.0 (1.2)	4.9 (2.5)	3.8 (4.2)	4.8 (5.4)	5.1 (13.4)
2	Milak (Sardhana)	4.6 (3.0)	5.9 (6.1)	7.1 (6.7)	4.5 (12.2)	7.4 (16.4)
3	Nanu (SP)	4.5 (1.2)	5.9 (2.4)	4.5 (4.0)	6.9 (6.0)	7.7 (9.1)
4	Pooth (Rohata)	28 (2.1)	6.0 (3.7)	7.8 (6.5)	20.5 (9.6)	6.2 (12.2)
5	Bhola (Jhal)	4.0 (0.91)	5.4 (3.0)	6.2 (4.6)	4.9 (8.2)	5.2 (14.8)
6	Jani	6.1 (1.2)	5.5 (2.1)	5.1 (6.1)	6.5 (8.8)	6.0 (11.6)

* Values in parenthesis denotes the sampling depth (m)

Table: 4. Sodium (mg/L) of water sample collected at different distance from Ganga canal.

S. No	Locations	Water sampling distance from Ganga canal (m)				
		1000	2000	3000	4000	5000
1	Kaili (Sakoti)	2.7 (1.2)	4.2 (2.5)	4.0 (4.2)	6.8 (5.4)	7.2 (13.4)
2	Milak (Sardhana)	7.9 (3.0)	6.6 (6.1)	7.7 (6.7)	7.5 (12.2)	7.7 (16.4)
3	Nanu (SP)	4.4 (1.2)	6.9 (2.4)	7.5 (4.0)	7.8 (6.0)	8.0 (9.1)
4	Pooth (Rohata)	4.0 (2.1)	7.9 (3.7)	8.0 (6.5)	6.3 (9.6)	7.5 (12.2)
5	Bhola (Jhal)	2.4 (0.91)	6.6 (3.0)	8.0 (4.6)	6.9 (8.2)	7.9 (14.8)
6	Jani	8.1 (1.2)	7.4 (2.1)	6.3 (6.1)	8.0 (8.8)	7.2 (11.6)

Values in parenthesis denotes the sampling depth (m)

Table: 5. Ca^{++} + Mg^{++} (me/L) of water sample collected at different distance from Ganga canal.

S. No	Locations	Water sampling distance from Ganga canal (m)				
		1000	2000	3000	4000	5000
1	Kaili (Sakoti)	5.8 (1.2)	9.7 (2.5)	9.0 (4.2)	10.7 (5.4)	10.4 (13.4)
2	Milak (Sardhana)	14.3 (3.0)	13.5 (6.1)	11.8 (6.7)	12.6(12.2)	11.5 (16.4)
3	Nanu (SP)	7.2 (1.2)	12.4 (2.4)	10.4 (4.0)	7.6 (6.0)	12.0 (9.1)
4	Pooth (Rohata)	12.9 (2.1)	11.8 (3.7)	14.3 (6.5)	17.2 (9.6)	28.6 (12.2)
5	Bhola (Jhal)	7.2 (0.91)	6.1 (3.0)	13.4 (4.6)	9.4 (8.2)	10.0 (14.8)
6	Jani	10.7(1.2)	12.3 (2.1)	8.6 (6.1)	18.3 (8.8)	19.3 (11.6)

Table: 6. Chloride (g/L) of water sample collected at different distance from Ganga canal.

S. No	Locations	Water sampling distance from Ganga canal (m)				
		1000	2000	3000	4000	5000
1	Kaili (Sakoti)	0.53 (1.2)	0.16 (2.5)	0.25 (4.2)	0.18 (5.4)	0.23 (13.4)
2	Milak (Sardhana)	0.18 (3.0)	0.21 (6.1)	0.28 (6.7)	0.18 (12.2)	0.21 (16.4)
3	Nanu (SP)	0.32 (1.2)	0.25 (2.4)	0.43 (4.0)	0.32 (6.0)	0.23 (9.1)
4	Pooth (Rohata)	0.25 (2.1)	0.21 (3.7)	0.43 (6.5)	0.50 (9.6)	0.46 (12.2)
5	Bhola (Jhal)	0.28 (0.91)	0.38 (3.0)	0.40 (4.6)	0.36 (8.2)	0.50 (14.8)
6	Jani	0.18 (1.2)	0.25 (2.1)	0.28 (6.1)	0.34 (8.8)	0.39 (11.6)

* Values in parenthesis denotes the sampling depth (m)

Table:7. Nitrate (mg/L) of water sample collected at different distance from Ganga canal.

S. No	Locations	Water sampling distance from Ganga canal (m)				
		1000	2000	3000	4000	5000
1	Kaili (Sakoti)	1.30 (1.2)	1.71 (2.5)	0.23 (4.2)	0.20 (5.4)	0.43 (13.4)
2	Milak (Sardhana)	0.11 (3.0)	1.20 (6.1)	1.60 (6.7)	2.03 (12.2)	4.47 (16.4)
3	Nanu (SP)	0.19 (1.2)	0.10 (2.4)	2.30 (4.0)	2.23 (6.0)	0.68 (9.1)
4	Pooth (Rohata)	3.22 (2.1)	0.90 (3.7)	0.30 (6.5)	1.40 (9.6)	0.40 (12.2)
5	Bhola (Jhal)	0.10 (0.91)	0.23 (2.1)	0.31 (4.6)	0.69 (8.2)	1.25 (14.8)
6	Jani	1.42 (1.2)	1.40 (2.1)	0.88 (6.1)	0.74 (8.8)	0.23 (11.6)

S. No	Locations	Water sampling distance from Ganga canal (m)				
		1000	2000	3000	4000	5000
1	Kaili (Sakoti)	1.12 (1.2)	0.20 (2.5)	2.81 (4.2)	0.40 (5.4)	0.23 (13.4)
2	Milak (Sardhana)	2.77 (3.0)	0.73 (6.1)	0.24 (6.7)	0.20 (12.2)	0.15 (16.4)
3	Nanu (SP)	0.30 (1.2)	0.50 (2.4)	0.90 (4.0)	0.26 (6.0)	0.18 (9.1)
4	Pooth (Rohata)	2.41 (2.1)	0.60 (3.7)	0.34 (6.5)	0.27 (9.6)	0.24 (12.2)
5	Bhola (Jhal)	1.61 (0.91)	1.40 (3.0)	1.33 (4.6)	0.65 (8.2)	0.46 (14.8)
6	Jani	0.12 (1.2)	0.27 (2.1)	0.73 (6.1)	0.67 (8.8)	0.35 (11.6)

Table:8. Sulphate (mg/L) of water sample collected at different distance from Ganga canal.

- Values in parenthesis denotes the sampling depth (m)

Table: 9. Carbonate (me/L) of water sample collected at different distance from Ganga canal.

S. No	Locations	Water sampling distance from Ganga canal (m)				
		1000	2000	3000	4000	5000
1	Kaili (Sakoti)		1.8 (2.5)		1.0 (5.4)	2.0 (13.4)
2	Milak (Sardhana)	2.0(3.0)	4.0 (6.1)	4.2 (6.7)	1.0 (12.2)	2.8 (16.4)
3	Nanu (SP)		1.0 (2.4)	2.0 (4.0)		3.0 (9.1)
4	Pooth (Rohata)	2.6(2.1)	3.0 (3.7)	2.0 (6.5)	6.0 (9.6)	2.0 (12.2)
5	Bhola (Jhal)			3.5 (4.6)	1.3 (8.2)	2.0 (14.8)
6	Jani				1.8 (8.8)	

- Values in parenthesis denotes the sampling depth (m)

Table: 10. Bicarbonate (me/L) of water sample collected at different distance from Ganga canal.

S. No	Locations	Water sampling distance from Ganga canal (m)				
		1000	2000	3000	4000	5000
1	Kaili (Sakoti)	6 (1.2)	15 (2.5)	13 (4.2)	10 (5.4)	13 (13.4)
2	Milak (Sardhana)	9 (3.0)	12 (6.1)	14 (6.7)	16 (12.2)	19 (16.4)
3	Nanu (SP)	7 (1.2)	11.5 (2.4)	12 (4.0)	16 (6.0)	18 (9.1)
4	Pooth (Rohata)	17 (2.1)	20 (3.7)	15 (6.5)	22 (9.6)	5 (12.2)
5	Bhola (Jhal)	9 (0.91)	13 (3.0)	16 (4.6)	19 (8.2)	20 (14.8)
6	Jani	14 (1.2)	10 (2.1)	15 (6.1)	18 (8.8)	7 (11.6)

- Values in parenthesis denotes the sampling depth (m)

Table.11. Arsenic (ppb) of water sample collected at different distance from Ganga canal.

S. No	Locations	Water sampling distance from Ganga canal (m)				
		1000	2000	3000	4000	5000
1	Kaili (Sakoti)	1.04 (1.2)	1.68 (2.5)	16.48 (4.2)	11.78 (5.4)	12.02(13.4)
2	Milak (Sardhana)	4.38 (3.0)	21.29 (6.1)	13.45 (6.7)	2.87 (12.2)	2.09 (16.4)
3	Nanu (SP)	1.08 (1.2)	1.46 (2.4)	2.77 (4.0)	21.06 (6.0)	2.64 (9.1)
4	Pooth (Rohata)	3.21 (2.1)	3.34 (3.7)	3.48 (6.5)	3.69 (9.6)	4.25 (12.2)
5	Bhola (Jhal)	4.54 (0.91)	5.07 (3.0)	3.47 (4.6)	1.61 (8.2)	3.95 (14.8)
6	Jani	1.86 (1.2)	4.66 (2.1)	3.83 (6.1)	2.92 (8.8)	4.97 (11.6)

Table: 12. Total dissolve salts (mg/L) of water sample collected at different distance from Ganga canal.

S. No	Locations	Water sampling distance from Ganga canal (m)				
		1000	2000	3000	4000	5000
1	Kaili (Sakoti)	123 (1.2)	221 (2.5)	201 (4.2)	160 (5.4)	234 (13.4)
2	Milak (Sardhana)	308 (3.0)	297 (6.1)	234 (6.7)	211 (12.2)	349 (16.4)
3	Nanu (SP)	115 (1.2)	154 (2.4)	272 (4.0)	183 (6.0)	311 (9.1)
4	Pooth (Rohata)	498 (2.1)	362 (3.7)	402 (6.5)	276 (9.6)	495 (12.2)
5	Bhola (Jhal)	172 (0.91)	155 (3.0)	408 (4.6)	401 (8.2)	299 (14.8)
6	Jani	180 (1.2)	167 (2.1)	244 (6.1)	405 (8.8)	318 (11.6)

- Values in parenthesis denotes the sampling depth (m)

Table: - 13. Classification of collected water samples on the basis of TDS for drinking purpose.

S. No	Class	TDS (me L^{-1})	No. of sample	Percentage
1	Non – saline	< 1000	-	-
2	Slightly saline	1000 – 3000	1	1
3	Moderately saline	3000 – 10, 000	-	-
4	Very saline	> 10, 000	-	-

Table: 14 Sodium absorption ratios (SAR) of water sample collected at different distance from Ganga canal.

S. No	Locations	Water sampling distance from Ganga canal (m)				
		1000	2000	3000	4000	5000
1	Kaili (Sakoti)	1.60 (1.2)	1.91 (2.5)	1.88 (4.2)	2.94 (5.4)	3.20 (13.4)
2	Milak (Sardhana)	2.96 (3.0)	2.55 (6.1)	3.20 (6.7)	3.00 (12.2)	3.22 (16.4)
3	Nanu (SP)	2.33 (1.2)	2.78 (2.4)	3.90 (4.0)	4.03 (6.0)	3.30 (9.1)
4	Pooth (Rohata)	1.60 (2.1)	3.26 (3.7)	2.99 (6.5)	2.15 (9.6)	1.98 (12.2)
5	Bhola (Jhal)	1.27 (0.91)	3.79 (3.0)	3.10 (4.6)	3.20 (8.2)	3.54 (14.8)

6	Jani	3.50 (1.2)	3.00 (2.1)	3.04 (6.1)	2.65 (8.8)	2.33 (11.6)

- Values in parenthesis denotes the sampling depth (m)

Table: 15. Classification of collected water on the basis of SAR for irrigation purpose.

Alkali hazards	Class of water	No. of samples	Percentage
<10	Excellent	30	100
10-18	Good	-	-
18-26	Fair	-	-
>26	Poor	-	-

Table.16: Residual sodium carbonate and bicarbonate (RSC/RSBC) of water sample collected at different distance from Ganga canal.

S. No	Locations	Water sampling distance from Ganga canal (m)				
		1000	2000	3000	4000	5000
1	Kaili (Sakoti)	2.2 (1.2)	7.1 (2.5)	4.0 (4.2)	0.3 (5.4)	4.6 (13.4)
2	Milak (Sardhana)	-0.3 (3.0)	2.5 (6.1)	6.4 (6.7)	4.4 (12.2)	9.3 (16.4)
3	Nanu (SP)	-0.2 (1.2)	4.6 (2.4)	3.6 (4.0)	8.4 (6.0)	9.0 (9.1)
4	Pooth (Rohata)	4.1 (2.1)	11.2 (3.7)	2.7 (6.5)	10.8 (9.6)	-21.6(12.2)
5	Bhola (Jhal)	1.8 (0.91)	9.9 (3.0)	10.1 (4.6)	10.9 (8.2)	5.0 (14.8)
6	Jani	7.3 (1.2)	8.1 (2.1)	1.4 (6.1)	2.4 (8.8)	-12.3(11.6)

Table:17. Evaluation of irrigation water on the basis of alkalinity hazards RSC/ RSBC

Alkali hazards	Class of water	`No. of samples	(%)	Remarks
A0- (- ve)	Non alkaline	4	13.33	Used for irrigation on almost all soils & crops
A1- (0 meL^{-1})	Normal water	0	0.0	Used for irrigation on almost all soils & crops
A2- (< 2.5 meL^{-1})	Low alkalinity	5	16.66	Used for irrigation on almost all soils & crops
A3- (2.5-5.0 meL^{-1})	Medium alkalinity	8	26.66	Use for irrigation and little danger of development of harmful limit of alkalinity.
A4- (5-10 meL^{-1})	High alkalinity	8	26.66	Use for irrigation with good drainage
A5- (> 10 meL^{-1})	Very high alkalinity	5	16.66	Not suitable for irrigation with consumption with low alkalinity water

Table:-18. Assessment of ground water quality based on salinity measurement for irrigation purpose

EC(dS/m) at 25^{0c}	Water class	No. of samples	%	Remarks
<0.25	C1-low salinity	6	6.66	Safe with no likelihood of any salinity problem developing
0.25-0.75	C2 - medium salinity	26	86.66	Need moderately leaching
0.75-2.25	C3 - high salinity	2	6.66	Cannel be used on soils with inadequate drainage, since saline condition are likely to develop
2.25-5.0	C4 - Very high salinity	0	0	Cannel be used on soils with inadequate drainage, since saline conditions are likely to develop