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Evaluation of ground water quality for drinking and irrigation purpose of the left side of the Ganga canal, Muzaffarnagar to Ghaziabad, Uttar Pradesh, India

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Abstract
Water is the most important natural resources which need to be properly and scientifically utilized for improving the productivity and economic condition of the rural area. Water is essential for life. It is used for irrigation, drinking, industrial and another various daily necessities. If the quality of water happens to be below the standard prescribes, for drinking purpose from time to time, with respect to its different chemical constituents, it is likely to affect human health and life span. Water samples were also analyzed for their chemical properties i.e. pH, total salt (electrical conductivity), Cations (Ca^{++}, Mg^{++}, Na^{+}, K^{+}), TDS, water quality indices. Water samples pH varied from 7.22 to 8.78 and electrical conductivity of water varied from 0.11 to 1.20 dSm^{-1}. Sodium, potassium content of water samples varied from 1.7 to 8.1 and 1.9 to 20.5 mg L^{-1} Correlation was also worked out between different parameters. Potassium, sodium and electrical conductivity were not related to water pH at any significance level while TDS and calcium plus magnesium were associated positively and significantly.

Keywords: Water analysis, Ganga river water, irrigation water quality, SAR and Salinity

Introduction
Water is essential for life. It is used for irrigation, drinking, industrial and another various daily necessities. If the quality of water happens to be below the standard prescribes, for drinking purpose from time to time, with respect to its different chemical constituents, it is likely to affect human health and life span. The main factors responsible for deterioration in water quality are excess of soluble salts, disproportion of dissolve ions, industrial effluents. Whatever may be the source of water i.e. river, canal, well and tanks etc. some soluble salts sodium, potassium, calcium, magnesium, and phosphorus etc. are dissolve there in, depending upon the nature of the source, geological surroundings and climatology conditions determines the quality of water.

Excess of soluble salts adversely affect the human health and in case of some constituents even amount in excess of a few ppm causes serious diseases. The well water if saline and used for irrigation purpose, it not only adversely affects the soil properties and crop productivity but also the quality of produce and indirectly health of the consumers with the industrials development in the country, the water quality is further deteriorated by industrials effluents specially near the industrial town.

Water quality of canal generally reflect that of the river from which is originates, until and unless it is contaminated by salts, if passing over a salt infested area. Hence the canal originated from north Indian rivers have good quality water, but indirectly by way of seepage and increase water table they have been responsible for the development of saline soils. This is true to a large extent of area in U.P, Delhi, Punjab, Chambal commended area of Rajasthan and Punjab (Paliwal 1996) [11].

Ground water is an important water supply source worldwide. It is the major source of water in both urban and rural area in India. An adequate water resource for future generation is not only a fresh water wealth and human influence. The concentration of these minor constituents including iron and nitrate is of concern as large amount of ground water is abstract by drilling water – well both in rural and urban areas for drinking and irrigation purpose. The sixteen states in India – Andhra Pradesh, Bihar, Delhi, Gujarat, Haryana, Jammu and Kashmir, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Manipur, Orissa, Punjab, Rajasthan, Tamilnadu, and Uttar Pradesh have already identified endemic to fluorosis. 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.
Intense competition among user's agriculture, industry, and domestic sectors is driving the groundwater table lower. The quality of groundwater is getting severely affected by the widespread pollution of surface water. Besides, discharge of untreated waste water through bores, unscientific disposal of solid wastes also contaminates groundwater, thereby reducing the quality of fresh water resources.
Groundwater is an integral part of the environment and hence cannot be looked upon in isolation. There has been a lack of adequate attention to water conservation, efficiency in water use, water re-use, groundwater recharge, and ecosystem sustainability. An uncontrolled use of the bore well technology has led to the extraction of groundwater at such a high rate that often recharge is not sufficient. The causes of low water availability in many regions are also directly linked to the reducing forest cover and soil degradation.
Naturally, ground water contains mineral ions. These ions slowly dissolve from soil particles, sediments and rocks as the water travels along mineral surfaces in the pores or fractures of the unsaturated zone and aquifer. They are referred to as *dissolved solids*. Some dissolved solids may have originated in the precipitation water or river water that recharges the aquifer. Human activities can alter the natural composition ground water through the disposal or dissemination of chemicals and microbial matter at the land surface and into soils, or through injection of waste directly into groundwater. Groundwater pollution *(or ground water contamination)* is defined as an undesirable change in ground water quality resulting from human activities.

Materials and Methods

Location of study area: The study area falls in three district of Western Uttar Pradesh i.e. Muzaffarnagar, Meerut and Ghaziabad. Ganga canal was considered as base line and on the left side hand (LHS) of Ganga canal from Purkaji to Muradnagar was taken as the study area. Each bridge on the canal between these two end points (Purkaji to Muradnagar) was selected for sampling location. Samples was taken from the distance of 1000, 2000, 3000, 4000, and 5000 meter

Geographical outline of study area

Muzaffarnagar is located at northern part of Uttar Pradesh. It is roughly rectangular in shape, lying between north latitude 29^0 11' 30'' and 29^0 45' 15'' and east longitude 77^0 3' 45'' and 78^0 7'. Meerut district is located from 29^o04' N latitude and $77^0$42' E longitude at an altitude of 237 meter above the mean sea level (MSL). Ghaziabad district is located from 25^0 N latitude and 28^0 40'00' E longitudes at an altitude of 77^0 26' meter above the mean sea level (MSL). Ground water samples were collected from four various location and analyzed for their chemical properties i.e. pH, total salt (electrical conductivity), Cations (Ca^{++}, Mg^{++}, Na^+, K^+), total dissolve salt (TDS) water quality indices (APHA 1998). All the analysis of ground water was carried out in the laboratory of Department of Soil Science, SVPUA&T, Modipuram, Meerut (U.P), India by adopting the standard methods.

Kelley's ratio

Kelley's ratio was computed for all the water samples to describe the water quality for irrigation purpose. Kelley's ratio is the ratio to the sum of Ca^{++} + Mg^{++} ion on epm and gives indication of Na hazards if any for good irrigation water.

US Salinity laboratory (SAR)

The united state of salinity diagram (USLL, 1954) of the water is based on the EC and the sodium adsorption ration (SAR), SAR can be calculate by the formula.
$SAR = Na^+ [(Ca^{2+} + Mg^{2+}) 2]0^{.5}$
According of the US salinity laboratory classification of irrigation water (USLL, 1954), the sallow ground water fall in the field of $C_1S_1 - C_2S_2$ which indicates a low to medium salinity hazards but not an alkalinity hazard due to low sodium adsorption ratio (SAR 0.37 to 1.19).

Suitability of ground water for drinking and irrigation purpose

The suitability of ground water for drinking and irrigation purpose has been evaluated on the basis of pH, EC, Ca + Mg, Na^+, K^+, TDS, SAR. Moreover, Kelly's and Collin's ratio has also been computed for the evaluation of suitability of ground water of drinking purpose. The observed values are compared with different standard set by different organization for the suitability of ground water for the drinking and irrigation purpose.

Results and Discussion

Suitability of Ground water for drinking purpose

The suitability of ground water for drinking purpose has been evaluated on the basis of pH, EC, Ca^{2+}+Mg^{2+}, Na^+, K^+, and TDS. Collin's ratio and Kalley's ratio has also been computed for the evaluation of suitability of ground water for drinking purpose. The observed values are compared with standard set by different organization for the suitability of ground water for the drinking purpose. The water samples collected from eighteen different locations at various depths of Muzaffarnagar, Meerut and Ghaziabad district from the left side of Ganga canal were analyzed for various parameters and were compared with standard value.
pH value of collected water sample varied from 7.22 to 8.78 Table- 1. The maximum value of 8.78 was found in Kamheda (TP) at 16.5 m depth of water table while minimum 7.22 in Bhopa location at 3.4 m depth of water. By comparing observed pH value with standard pH value of WHO, it was found that among eighteen different locations 3.33% samples were found above the permissible limit(8.5), 1.11% samples below the permissible limit (6.5) remaining 95.46% samples were found within the permissible limits (6.5-8.5). pH has no direct effect human health, but lower value below 5.0 produce sour test and higher value above 8.5 produce alkaline test. A similar finding was reported by Patil and Patil (2011) [7].
The EC value of collected water samples in eighteen different locations ranged from 0.11 to 1.20 dSm^{-1} Table- 2. The maximum value of 1.20 dSm^{-1} was recorded for water sample at 7.6m in Niwari locations while minimum 0.11 dSm^{-1} at 6.1m depth in Bhopa location. By comparing EC value with standard as purposed by WHO, it was found that all samples were in permissible limit and found suitable for irrigation purpose. The indicting the presence of high amount of dissolve inorganic substances in ionized form similar finding was reported by Gill (2005) [5].

The potassium (mg L^{-1}) in water at different eighteen locations and various depths varied from 1.9 to 20.5mg/l Table 3. The maximum potassium 20.5 mg L^{-1} was found in Pooth (Rohata) location at 9.6m depth of water table while minimum 1.3 mg L^{-1}in Kamheda location at 11.6 m depth. The high concentration of potassium may be due to the influence of the more application fertilizers through farmer suggested by Uma Devi *et al.*, (2010) [1], Patil & Patil (2011) [7].

The sodium content (mg L^{-1}) in eighteen different locations at various depths ranged from 1.7 to 8.1mg/L Table-4. Maximum sodium content 8.1 mg $L^{-1}$was found in location of Jani location at 4.6 m depth, while minimum 1.7 mg L^{-1} in Belda at 4.6 m depth. By comparing sodium content of water with standard proposed by WHO, It was found that all samples were below the permissible limit (< 20 mg L^{-1}). Similar findings was reported by Acharya *et al.*, (2008) [3], Patil and Patil (2001).

Calcium and Magnesium content in eighteen different locations at various depth varied from5.0 to 22.8 me L^{-1} Table-5. Maximum value 22.8 me L^{-1} was found in Niwari location at 7.6 m water table depth while minimum 5.0 me L^{-1} at 7.6 m water table depth in Balda location. The content of Ca + Mg in most of the water sample was above the permissible limit as set by different organization BIS and WHO (1983). On the other hand Ca^{2++} mg^{2++} was higher in bottom than in the surface layer during the summer. Similar finding is also reported by Umadevi *et al.*, (2010) [1]. The high concentration of calcium may be due to the discharge of industrial wastes and passage through deposit of lime stone, dolomite and gypsum.

Total dissolved solids (TDS) indicate the general quality of ground water. The TDS value in the study area varies from 83 to 1015 me L^{-1} Table 11. The Maximum TDS value 1015 meL^{-1} was found in Kamheda (TP) location at 31.5m depth while minimum 83 me L^{-1} at Bhopa location at 4.6 m water table depth. As per the standard of WHO and BIS the ground water of some location at particular depth is not suitable as the observed value, 500,565,635,560,836 and 1015 me L^{-1} are more than the permissible limit (500mg/l) respectively.

4.2.2 Suitability of ground water for irrigation purpose.

The chemical quality of ground water is an important factor in evaluating its suitability for irrigation purpose. Suitability of ground water for irrigation depends upon its mineral constituents, besides affecting the growth of plants; presence of salt in water also directly affects full soil structure, permeability and aeration, which affect the plant growth. It is an imperative to have knowledge of ground water quality before utilization and recommended for irrigation.

The chemical characteristics of ground water at various depths of eighteen different locations are presented in Table. The water quality of the study area has been evaluated on the basis of EC, SAR, for irrigation purpose.

The SAR was calculated to describe the suitability of ground water for irrigation purpose. On the basis of SAR the ground water in eighteen different locations at various depths of study area is safe for irrigation purpose. The samples are classified on the extent of SAR as shown in Table-16&17. The ground water of study area is found excellent for irrigation purpose.

Kalley's ratio was calculated for all the water samples to describe the suitability for irrigation purpose. Kalley's ratio is the ratio of sodium ions to the sum of calcium and magnesium ions on epm and givens an idea of sodium hazard if any. For good irrigation water the value should less than one. Data presented is given in Table-19.Based on the Kalley's ratio, 97.77.% of the ground water samples are excellent for irrigation purpose without any Hazards while about 2.22 % samples are good for irrigation purpose.

Correlation between water pH and different ions present in water at different locations

The correlation coefficient (r) among few water quality parameters namely EC, sodium (Na), potassium (K), total dissolve salt(TDS) calcium + magnesium (Ca+ Mg) were calculated.

According to Table-21, the pH of the water displayed a weak association with some water quality parameter i.e. EC (r = +0.138) and sodium (r =+ 0.080) respectively, while significantly positive correlation coefficient between TDS (r = +0.508) Ca + Mg (r = +0.348) was observed, Statistically poor correlation coefficient of pH with K (r = -0.176) was recorded. Similar findings were reported by Bhandari and Nayal (2008) [10], Patil and Patil, (2011) [7], Joarder *et al* (2008) [9], Chouhan *et al.*, (2010) [2] and Umadevi *et al.*, (2010) [1].

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	Purkaji	8.18(5.3)	8.06(7.5)	8.00 (10.0)	7.89 (12.0)	7.50 (3.5)
2	Kamheda (TP)	8.15 (11.6)	8.10 (13.8)	8.78 (16.5)	8.40 (20.5)	7.56 (31.5)
3	Baldea	7.96 (4.6)	7.34 (6.0)	8.18 (7.6)	8.23 (12.4)	8.00 (20.0)
4	Bhopa	8.12 (4.6)	7.25 (6.1)	7.22 (3.4)	7.50 (10.0)	7.65 (15.4)
5	Jouli	8.03 (1.2)	8.14 (2.0)	8.70 (4.5)	8.57 (3.7)	8.26 (10.0)
6	Janshath	8.12 (2.5)	7.97 (3.7)	7.85 (6.0)	7.40 (7.6)	7.24 (13.5)
7	Tajpur	8.12 (1.5)	7.24 (2.4)	7.97 (4.5)	7.40 (5.8)	7.85 (7.6)
8	Khatauli	7.23 (1.8)	7.78 (3.0)	7.52 (5.4)	7.30 (7.6)	7.97 (10.7)
9	Kaili (Sakoti)	7.89 (1.2)	7.45 (2.5)	7.51 (4.2)	7.40 (5.4)	7.31 (7.6)
10	Milak(Sardhana)	7.28 (3.0)	7.44 (6.1)	7.60 (6.7)	7.35 (12.2)	7.83 (16.4)
11	Nanu (SP)	7.28 (1.2)	7.44 (2.4)	7.60 (4.0)	7.35 (6.5)	7.83 (9.1)
12	Pooth (Rohata)	7.34 (2.1)	7.70 (3.7)	7.30 (6.5)	7.4 (9.6)	7.34 (12.2)
13	Bhola (Jhal)	7.65 (0.91)	8.09 (3.0)	7.46 (4.6)	7.46 (8.2)	7.51 (14.8)
14	Jani	7.43 (1.2)	7.50 (2.1)	7.51 (6.1)	7.62 (8.8)	7.64 (11.6)
15	Nanglai	7.71 (1.5)	7.63 (4.6)	7.55 (7.3)	7.54 (9.1)	7.42 (12.2)
16	Niwari	7.59 (2.4)	7.43 (5.4)	7.31 (7.6)	7.35 (9.8)	7.67 (13.7)
17	Sonda	8.11 (1.5)	7.80 (3.5)	7.57 (6.1)	7.53 (9.1)	7.38 (10.7)
18	Aboopur	7.36 (2.1)	7.40 (6.1)	7.42 (7.3)	7.86 (8.5)	7.42 (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	Purkaji	0.34 (5.3)	0.42 (7.5)	0.33 (10.0)	0.56 (12.0)	0.48 (3.5)
2	Kamheda (TP)	0.33 (11.6)	0.78 (13.8)	0.56 (16.5)	0.44 (20.5)	0.52 (31.5)
3	Baldea	0.36 (4.6)	0.42 (6.0)	0.48 (7.6)	0.72 (12.4)	0.32 (20.0)
4	Bhopa	1.02 (4.6)	0.11 (6.1)	0.90 (3.4)	0.84 (10.0)	0.37 (15.4)
5	Jouli	0.61 (1.2)	0.59 (2.0)	0.39 (4.5)	0.55 (3.7)	0.66 (10.0)
6	Janshath	0.25 (2.5)	0.89 (3.7)	0.16 (6.0)	0.52 (7.6)	0.46 (13.5)
7	Tajpur	0.69 (1.5)	0.31 (2.4)	0.38 (4.5)	0.13 (5.8)	0.36 (7.6)
8	Khatauli	0.43 (1.8)	0.16 (3.0)	0.23 (5.4)	0.29 (7.6)	0.67 (10.6)
9	Kaili (Sakoti)	0.17 (1.2)	0.29 (2.5)	0.31 (4.2)	1.04 (5.4)	0.37 (13.4)
10	Milak(Sardhana)	0.51 (3.0)	0.47 (6.1)	0.43 (6.7)	0.45 (12.2)	0.53 (16.4)
11	Nanu(SP)	0.29 (1.2)	0.41 (2.4)	0.40 (4.0)	0.44 (6.0)	0.50 (9.1)
12	Pooth (Rohata)	1.00 (2.1)	0.58 (3.7)	0.65 (6.5)	0.46 (9.6)	0.67 (12.2)
13	Bhola (Jhal)	0.24 (0.91)	0.33 (3.0)	0.59 (4.6)	0.73 (8.2)	0.49 (14.8)
14	Jani	0.44 (1.2)	0.41 (2.1)	0.37 (6.1)	0.57 (8.8)	0.48 (11.6)
15	Nanglai	0.22 (1.5)	0.44 (4.6)	0.65 (7.3)	0.46 (9.1)	0.50 (12.2)
16	Niwari	0.39 (2.4)	0.56 (5.4)	1.20 (7.6)	0.73 (9.8)	0.55 (13.7)
17	Sonda	0.67 (1.5)	0.60 (3.5)	0.50 (6.1)	0.61 (9.1)	0.57 (10.7)
18	Aboopur	0.49 (2.1)	0.44 (6.1)	0.43 (7.3)	0.55 (8.5)	0.49 (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	Purkaji	1.9 (5.3)	2.8 (7.5)	3.0 (10.0)	4.1 (12.0)	3.9 (3.5)
2	Kamheda (TP)	4.3 (11.6)	5.2 (13.8)	5.8 (16.5	2.1 (20.5)	4.0 (31.5)
3	Baldea	6.5 (4.6)	7.6 (6.0)	5.3 (7.6)	4.9 (12.4)	4.7 (20.0)
4	Bhopa	3.3 (4.6)	4.5 (6.1)	3.1 (3.4)	2.4 (10.0)	2.0 (15.4)
5	Jouli	4.2 (1.2)	4.0 (2.0)	4.9 (4.5)	6.0 (3.7)	4.3 (10.0)
6	Janshath	5.0 (2.5)	2.9 (3.7)	3.5 (6.0)	2.9 (7.6)	2.0 (13.5)
7	Tajpur	3.2 (1.5)	4.5 (2.4)	5.7 (4.5)	3.9 (5.8)	4.8 (7.6)
8	Khatauli	3.4 (1.8)	3.1 (3.0)	4.2 (5.4)	3.1 (7.6)	4.3 (10.6)
9	Kaili (Sakoti)	4.0 (1.2)	4.9 (2.5)	3.8 (4.2)	4.8 (5.4)	5.1 (13.4)
10	Milak (Sardhana)	4.6 (3.0)	5.9 (6.1)	7.1 (6.7)	4.5 (12.2)	7.4 (16.4)
11	Nanu (SP)	4.5 (1.2)	5.9 (2.4)	4.5 (4.0)	6.9 (6.0)	7.7 (9.1)
12	Pooth (Rohata)	28 (2.1)	6.0 (3.7)	7.8 (6.5)	20.5 (9.6)	6.2 (12.2)
13	Bhola (Jhal)	4.0 (0.91)	5.4 (3.0)	6.2 (4.6)	4.9 (8.2)	5.2 (14.8)
14	Jani	6.1 (1.2)	5.5 (2.1)	5.1 (6.1)	6.5 (8.8)	6.0 (11.6)
15	Nanglai	3.5 (1.5)	6.0 (4.6)	5.7 (7.3)	6.3 (9.1)	4.9 (12.2)
16	Niwari	4.2 (2.4)	4.5 (5.4)	6.9 (7.6)	8.5 (9.8)	10.1 (13.7)
17	Sonda	5.3 (1.5)	4.1 (3.5)	5.6 (6.1)	5.8 (9.1)	4.6 (10.7)
18	Aboopur	4.3 (2.1)	5.3 (6.1)	4.2 (7.3)	4.8 (8.5)	6.1 (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	Purkaji	3.1 (5.3)	3.9 (7.5)	4.0 (10.0)	5.0 (12.0)	6.6 (3.5)
2	Kamheda (TP)	3.6 (11.6)	4.1 (13.8)	4.8 (16.5)	5.2 (20.5)	5.9 (31.5
3	Baldea	1.7 (4.6)	3.4 (6.0)	3.7 (7.6)	4.6 (12.4)	6.9 (20.0)
4	Bhopa	3.2 (4.6)	7.0 (6.1)	5.9 (3.4)	5.1 (10.0)	6.0 (15.4)
5	Jouli	7.7 (1.2)	6.5 (2.0)	3.9 (4.5)	4.3 (3.7)	3.5 (10.0)
6	Janshath	5.2 (2.5)	7.2 (3.7)	2.6 (6.0)	8.0 (7.6)	7.6 (13.5)
7	Tajpur	5.9 (1.5)	6.4 (2.4)	7.1 (4.5)	2.1 (5.8)	6.9 (7.6)
8	Khatauli	5.5 (1.8)	2.6 (3.0)	6.5 (5.4)	4.6 (7.6)	5. (10.6)
9	Kaili (Sakoti)	2.7 (1.2)	4.2 (2.5)	4.0 (4.2)	6.8 (5.4)	7.2 (13.4)
10	Milak(Sardhana)	7.9 (3.0)	6.6 (6.1)	7.7 (6.7)	7.5 (12.2)	7.7 (16.4)
11	Nanu(SP)	4.4 (1.2)	6.9 (2.4)	7.5 (4.0)	7.8 (6.0)	8.0 (9.1)
12	Pooth (Rohata)	4.0 (2.1)	7.9 (3.7)	8.0 (6.5)	6.3 (9.6)	7.5 (12.2)
13	Bhola (Jhal)	2.4 (0.91)	6.6 (3.0)	8.0 (4.6)	6.9 (8.2)	7.9 (14.8)
14	Jani	8.1 (1.2)	7.4 (2.1)	6.3 (6.1)	8.0 (8.8)	7.2 (11.6)
15	Nanglai	3.5 (1.5)	7.9 (4.6)	1.5 (7.3)	7.8 (9.1)	7.3 (12.2)
16	Niwari	7.8 (2.4)	6.3 (5.4)	4.6 (7.6)	3.0 (9.8)	6.3 (13.7)
17	Sonda	4.6 (1.5)	6.2 (3.5)	6.8 (6.1)	4.6 (9.1)	5.9 (10.7)
18	Aboopur	7.1 (2.1)	6.5 (6.1)	4.0 (7.3)	5.0 (8.5)	6.7(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	Purkaji	10.0 (5.3)	9.0 (7.5)	5.8 (10.0)	6.8 (12.0)	8.9 (3.5)
2	Kamheda (TP)	10.7(11.6)	11.5(13.8)	10.4(16.5)	11.8(20.5)	13.6 (31.5)
3	Baldea	8.6 (4.6)	6.1 (6.0)	5.0 (7.6)	9.4 (12.4)	8.2 (20.0)
4	Bhopa	6.4 (4.6)	16.1 (6.8)	22.2 (3.4)	18.7(10.0)	17.2 (15.4)
5	Jouli	9.4 (1.2)	10.7 (2.0)	6.4 (4.5)	9.8 (3.7)	5.8 (10.0)
6	Janshath	6.8 (2.5)	12.9 (3.7)	8.9 (6.0)	15.1 (7.6)	14.0 (13.5)
7	Tajpur	10.0 (1.5)	12.2 (2.4)	13.3 (4.5)	6.6 (5.8)	11.8 (7.6)
8	Khatauli	13.6 (1.8)	9.4 (3.0)	13.3 (5.4)	7.9 (7.6)	12.5 (10.6)
9	Kaili (Sakoti)	5.8 (1.2)	9.7 (2.5)	9.0 (4.2)	10.7 (5.4)	10.4 (13.4)
10	Milak (Sardhana)	14.3 (3.0)	13.5 (6.1)	11.8 (6.7)	12.6(12.2)	11.5 (16.4)
11	Nanu (SP)	7.2 (1.2)	12.4 (2.4)	10.4 (4.0)	7.6 (6.0)	12.0 (9.1)
12	Pooth (Rohata)	12.9 (2.1)	11.8 (3.7)	14.3 (6.5)	17.2 (9.6)	28.6 (12.2)
13	Bhola (Jhal)	7.2 (0.91)	6.1 (3.0)	13.4 (4.6)	9.4 (8.2)	10.0 (14.8)
14	Jani	10.7(1.2)	12.3 (2.1)	8.6 (6.1)	18.3 (8.8)	19.3 (11.6)
15	Nanglai	22.6 (1.5)	10.4 (4.6)	15.4 (7.3)	8.9 (9.1)	10.7 (12.2)
16	Niwari	8.2 (2.4)	9.8 (5.4)	22.8 (7.6)	9.4 (9.8)	13.6 (13.7)
17	Sonda	9.2 (1.5)	14.3 (3.5)	12.2 (6.1)	8.2 (9.1)	10.4 (10.7)
18	Aboopur	10.8 (2.1)	6.8 (6.1)	10.4 (7.3)	7.2 (8.5)	10.0 (11.6)

Values in parenthesis denotes the sampling depth (m)

Table 6: 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	Purkaji	181 (5.3)	165 (7.5)	130 (7.5)	128 (12.0)	154 (3.5)
2	Kamheda (TP)	188 (11.6)	210 (13.8)	235 (16.5)	105 (20.5)	315 (31.5)
3	Baldea	155 (4.6)	121 (6.0)	138 (7.6)	504 (12.4)	565 (20.0)
4	Bhopa	83 (4.6)	304 (6.8)	635 (3.4)	509 (10.0)	278 (15.4)
5	Jouli	268 (1.2)	178 (2.0)	118 (4.5)	134 (3.7)	108 (10.0)
6	Janshath	206 (2.5)	560 (3.7)	480 (6.0)	434 (7.6)	392 (13.5)
7	Tajpur	243 (1.5)	275 (2.4)	266 (4.5)	90 (5.8)	230 (7.6)
8	Khatauli	311 (1.8)	116 (3.0)	207 (5.4)	148 (7.6)	447 (10.6)
9	Kaili (Sakoti)	123 (1.2)	221 (2.5)	201 (4.2)	160 (5.4)	234 (13.4)
10	Milak(Sardhana)	308 (3.0)	297 (6.1)	234 (6.7)	211 (12.2)	349 (16.4)
11	Nanu(SP)	115 (1.2)	154 (2.4)	272 (4.0)	183 (6.0)	311 (9.1)
12	Pooth (Rohata)	498 (2.1)	362 (3.7)	402 (6.5)	276 (9.6)	495 (12.2)
13	Bhola (Jhal)	172 (0.91)	155 (3.0)	408 (4.6)	401 (8.2)	299 (14.8)
14	Jani	180 (1.2)	167 (2.1)	244 (6.1)	405 (8.8)	318 (11.6)
15	Nanglai	153 (1.5)	204 (4.6)	400 (7.3)	218 (9.1)	253 (12.2)
16	Niwari	253 (2.4)	291 (5.4)	836 (7.6)	490 (9.8)	393 (13.7)
17	Sonda	242 (1.5)	334 (3.5)	351 (6.1)	379 (9.1)	384 (10.7)
18	Aboopur	291 (2.1)	310 (6.1)	305 (7.3)	390 (8.5)	339 (11.6)

Values in parenthesis denotes the sampling depth (m)

Table 7: Classification of ground water on the basis of TDS for drinking purpose.

S. No	Class	TDS (me L^{-1})	No. of sample	Percentage
1	Non – saline	< 1000	89	99
2	Slightly saline	1000 – 3000	1	1
3	Moderately saline	3000 – 10, 000	-	-
4	Very saline	> 10, 000	-	-

Table 8: Classification of ground water on the basis of Collin's ratio for drinking purpose

S.N0	Collin; ratio	Class	No. of samples	Percentage
1	< 1	Safe	82	91.77
2	1-3	Slightly contaminated	08	8.88
3	3-6	moderately	-	-
4	6-10	Injuriously	-	-

Table 9: 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	8	8.88	Safe with no likelihood of any salinity problem developing
0.25-0.75	C2 - medium salinity	74	82.22	Need moderately leaching
0.75-2.25	C3 - high salinity	8	8.88	Cannel be used on soils with inadequate drainage, since saline condition are likely to develop
2.25-5.0	C4 - Very high salinity	-	-	Cannel be used on soils with inadequate drainage, since saline conditions are likely to develop

Table 10: Sodium absorption ratio (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	Purkaji	1.40 (5.3)	1.80 (7.5)	2.30 (10.0)	2.71 (12.0)	3.14 (3.5)
2	Kamheda (TP)	1.60 (11.6)	1.77 (13.8)	2.01 (16.5)	2.20 (20.5)	2.30 (31.5)
3	Baldea	1.78 (4.6)	4.00 (6.0)	1.10 (7.6)	2.12 (12.4)	1.70 (20.0)
4	Bhopa	1.79 (4.6)	2.50 (6.8)	1.77 (3.4)	1.70 (10.0)	2.50 (15.4)
5	Jouli	3.60 (1.2)	2.81 (2.0)	2.10 (4.5)	1.94 (3.7)	2.10 (10.0)
6	Janshath	2.82 (2.5)	2.85 (3.7)	1.24 (6.0)	2.92 (7.6)	2.88 (13.5)
7	Tajpur	2.65 (1.5)	2.60 (2.4)	2.80 (4.5)	1.16 (5.8)	2.85 (7.6)
8	Khatauli	2.12 (1.8)	1.20 (3.0)	2.53 (5.4)	2.32 (7.6)	2.24 (10.6)
9	Kaili (Sakoti)	1.60 (1.2)	1.91 (2.5)	1.88 (4.2)	2.94 (5.4)	3.20 (13.4)
10	Milak(Sardhana)	2.96 (3.0)	2.55 (6.1)	3.20 (6.7)	3.00 (12.2)	3.22 (16.4)
11	Nanu(SP)	2.33 (1.2)	2.78 (2.4)	3.90 (4.0)	4.03 (6.0)	3.30 (9.1)
12	Pooth (Rohata)	1.60 (2.1)	3.26 (3.7)	2.99 (6.5)	2.15 (9.6)	1.98 (12.2)
13	Bhola (Jhal)	1.27 (0.91)	3.79 (3.0)	3.10 (4.6)	3.20 (8.2)	3.54 (14.8)
14	Jani	3.50 (1.2)	3.00 (2.1)	3.04 (6.1)	2.65 (8.8)	2.33 (11.6)
15	Nanglai	1.04 (1.5)	3.50 (4.6)	0.54 (7.3)	3.71 (9.1)	3.16 (12.2)
16	Niwari	3.86 (2.4)	2.85 (5.4)	1.36 (7.6)	2.12 (9.8)	2.42 (13.7)
17	Sonda	2.15 (1.5)	2.32 (3.5)	2.76 (6.1)	2.28 (9.1)	2.60 (10.7)
18	Aboopur	3.10 (2.1)	3.53 (6.1)	2.81 (7.3)	2.65 (8.5)	3.00 (11.6)

Values in parenthesis denotes the sampling depth (m)

Table 11: Classification of ground water on the basis of SAR for irrigation purpose.

Alkali hazards	Class of water	No. of samples	Percentage
<10	Excellent	90	100
10-18	Good	-	-
18-26	Fair	-	-
>26	Poor	-	-

Table 12: The ground water study area is classified and given in the following

Kalley's ratio	Class of water	`No. of samples	Percentage
>1	Excellent	88	97.77
1-3	Good	02	2.22
3-6	Permissible	-	-
<6	Not suitable	-	-

Table 13: Correlation studies between pH to EC, Na, K, TDS, Ca+ Mg, different locations (all values of different locations)

Locations	pH to EC, Na, K, TDS, Ca+ Mg,				
	EC	Na	K	TDS	Ca+ Mg
pH	0.138	0.080	-0.176	0.508	0.348

Conclusion

Assessment of the drinking and irrigation water quality of the left side of the Ganga Canal flowing through Muzaffarnagar, Meerut and Ghaziabad district**.** The ground water study concluded that the water at different depth of eighteen different locations is safe for Agriculture (irrigation) use, however for the drinking purpose some parameters were above the permissible limit according to different organization. By analyzing the water of various depth and eighteen different locations following conclusion can be drawn

1. All the ground water analyzed and concluded that the ground water is safe for domestic and irrigation purpose.
2. Few ground water parameters found above the permissible limit.
3. According to Collin's & Kalley's ratio and salinity the underground water is safe for irrigation purpose.

Reference

1. Umadevi AG, George M, dharmalingam, Jose P, Abraham, Rajagopalan M *et al*. An investigation of the quality of under ground water at Elor in Ernakulam district of Kerala, India. E – Journal of chemistry. 2010; 7(3):908-914
2. Avnish Chauhan, Mayank Pawar, Showkat Ahmad Lone. Water quality status of Golden Key Lake in Clement Town, Dehradun, Uttarakhand. Journal of American Science. 2010; 6(11):459- 464
3. Acharya GD, Hathi MV. Chemical properties of ground water in Bhiloda Tuluka Region, North Gujarat, India. E – Journal of chemistry. 2008; 5(4):792-796.
4. BIS (Bureau of Standard 10500 Indian standard drinking water – specification (Second Revision) Manak Bhawan, 9 Bahadur Zafar Marg, New Delhi 110002, 2009.
5. Gill MS. Ground water quality in MiDs. IRFC Farmer' News leter. 2005; 170:10-14.
6. Indian Standard drinking water – specification (First Revision) IS – 10500*:* 1991. BIS New Delhi, India.
7. Patil VT, Patil PR. Groundwater Quality of Open Wells and Tube Wells around Amalner Town of Jalgaon District, Maharashtra, Indian E-Journal of Chemistry. 2011; 8(1):53-58.
8. WHO' s (World Health Organization) (1993)WHO's Guideline for Drinking Quality, set up in Geneva, *the* international reference point for standard setting and drinking water safety.
9. Joarder MAM, Raihan F, Alam JB, Hasan uzzaman S. Regression Analysis of Ground Water Quality Data of Sunamganj District, Bangladesh. Int. J Environ. Res., 2008; 2(3):291-296.
10. Narendra Singh Bhandari, Kapil Nayal. Correlation Study on Physico-Chemical Parameters and Quality Assessment of Kosi River Water, Uttarakhand. E-Journal of Chemistry. 2008; 5(2):342-346,
11. Paliwal ML. Studies on major and micronutrient status of soils of Panchayat Samiti Bhinder, Udaipur. M. sc. (Ag) thesis, Rajasthan Agricultural University, Bikaner, 1996.