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Original Research Article

The quality of surface water of river kali and its effect on groundwater in Muzaffarnagar District

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ABSTRACT

Background: With rapidly increasing urbanization and scarcity of adequate river water, there is a constant rise in the extraction of groundwater and its use for various purposes such as drinking, bathing etc. But due to steep expansion of industrialization there is increase in amount of discharge of untreated sewage water in these water bodies which imposes a high risk of percolation to nearby groundwater sources creating an alarming situation to public health. One such case is of the River Kali in Muzaffarnagar District where untreated water from numerous industries flows in which makes its water unfit for use.
Aim & Objectives: The study was carried out to access the effect of river water to groundwater within 500m radius and study its impact on public health.
Materials and Methods: This was an observational study conducted in Muzaffarnagar district where, river water from 4 locations and groundwater from 4 locations (near 500m radius) was taken and tests performed for pH, taste, odor, BOD, Coliform count, heavy metals, hardness, suspended solids using references from Indian standards of drinking water.
Results: The water quality of river Kali is not fit for any purpose and also the Groundwater in its proximity is not fit for drinking.

1. Introduction

1.1. Groundwater[1]

Groundwater is present beneath Earth's surface in rock and soil pore spaces and in the fractures of rock formations. It is recharged from the surface usually by rainwater and may discharge on surface as oasis or springs. Groundwater is often withdrawn for agricultural, municipal, and industrial use by constructing and operating extraction wells. It is commonly being used for public water supplies. Use of groundwater has its own disadvantages, for example, polluted groundwater is less visible and more difficult to clean up than pollution in rivers and lakes. Groundwater pollution most often results from improper disposal of wastes on land. Major sources include industrial and household chemicals and garbage landfills, excessive fertilizers and pesticides used in agriculture, industrial waste lagoons, tailings and process wastewater from mines, industrial fracking, oil field brine pits, leaking underground oil storage tanks and pipelines, sewage sludge and septic system. Preventing groundwater pollution near potential sources such as landfills requires lining the bottom of a landfill with watertight materials, collecting any leachate with drains, and keeping rainwater off any potential

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contaminants, along with regular monitoring of nearby groundwater to verify that contaminants have not leaked into the groundwater.

1.2. River Kali[2]

River Kali being one of the major arterial river in mid-90's and its water being extracted for various household purposes has lost its existence due to increased sewerage discharge from industries in the outskirts of Muzaffarnagar district.

It originates from the Upper Sivaliks and passes through district Saharanpur, Muzaffarnagar, Baghpat and Meerut before merging with Hindon River, which further flows into the Yamuna River. The total length of the river from its emergence to confluence is around 150km. This river is targeted for cleanup under the National Ganga River Basin Authority (NGRBA).

Various private and government organizations have also organized events in the past to bring awareness and also to revive River Kali by imposing fines and restrictions towards untreated sewage/industrial discharge being collected in the river.

2. Aim and Objectives

To study the quality of river water and groundwater in its proximity by analyzing the water samples drawn from four different locations for:

1. Physiochemical properties.
2. Biological properties.
3. Analyze the presence of heavy metals.

3. Material and Methods

Study design: Observational field study
Duration of study: Two months (August 2021-September 2021)
Area of Study: Muzaffarnagar District
Procedure (for collecting samples):
Performed as prescribed in IS 3025 (Part 1)

1. The sample should be taken in midstream of the river and the water to be collected in polyethylene bottles.
2. The bottles were filled until full and closed under water to minimize aeration.
3. The bottle was closed properly and flex tape was applied on the lid.
4. The bottles were carefully labelled (sample no., date and time of collection, place of sampling, upstream/downstream) and numbered before transport.
5. The bottles were placed in thermo col freezer containing ice packs to maintain temperature 4°C and transported to the lab immediately.

3.1. Study procedures[3]

1. River and Groundwater will be collected from 4 different points.
2. The samples collected will be sent to laboratory for testing on selected parameters mentioned below in the table.
3. The results thus obtained will be used as a comparison between river and groundwater and its impact on public health to be studied.

4. Sample Collection Points

The water samples were collected from the following locations in compliance with all the necessary precautions;

1. Surface water of river kali from 4 locations
2. Groundwater from either side of the river (corresponding to each sampling location of river) within 500 meters radius.

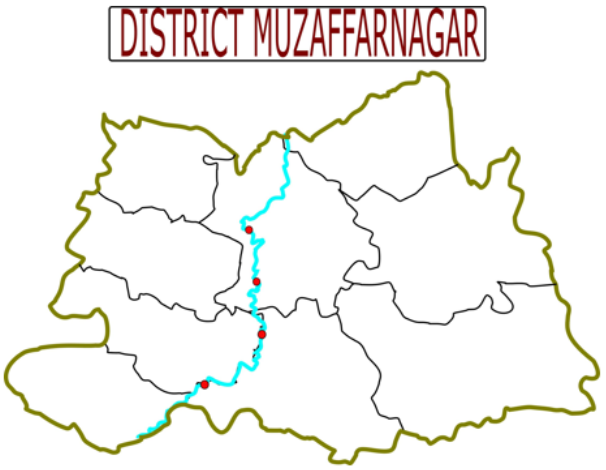

Fig. 1: Map of selected locations in muzaffarnagar district

5. Result

On testing the samples according to Indian Standard for Drinking Water 2012 the results of the following parameters were found to be:

5.1. pH

The pH of the river water ranged from 7.23 to 7.72, while that of groundwater ranged from 7.34 to 7.71 at all four selected locations. According to Indian Standards for Drinking Water 2012 these values are under the permissible limit and no irregularities were noted.

S. NO	Location on River Kali	Location Of Grounwater Within 5kms (On Eithersides Of River Correspondingto The Sampling Location On River Kali)
1.	29.535454, 77.701206	Maleera Bannagar
2.	29.432716, 77.675671	Vehalna Sujroo
3.	29.35308 77.684158	Purbaliyan HusenpurBopara
4.	29.289905, 77.633841	Samauli Dabal

(all the locations mentioned are accurate up to 50m)

Table 1:

Parameters	Test method	Required desirable limit (according to bureau of indian standards for drinking water 2012)
pH	IS:3025(Part-11)	6.5 to 8.5
Taste	IS:3025(Part-8)	Agreeable
Odor	IS:3025(Part-5)	Unobjectionable
Biochemical Oxygen Demand	IS:3025(Part-44)	<5.0mg/l
Dissolve Oxygen	IS:3025(Part-36)	6mg/l or more
Total Hardness (as CaCO3)	IS:3025(Part-21)	200mg/l
Total suspended solids	IS:3025(Part-17)	500mg/l
Detergent (as MBAS)	Annex K of IS-13428	0.2mg/l
Lead (as Pb)	IS-3025(P-47)	0.01mg/l
Mercury (as Hg)	IS-3025(P-48)	0.001mg/l
Total Coliform	IS:1622	Absent
E-Coli	IS:1622	Absent
Total Plate Count	IS:1622	Absent

5.2. Total suspended solids

The total suspended solids in the river water ranged from 28 to 92 mg/l at all four locations. The values noted were under the permissible limit.

5.3. Total hardness (as CaCO3)

The total hardness of river water ranged from 200 to 388 mg/l, while that of groundwater was noted to be from 152-392 mg/l at all four selected locations. The values of all samples collected was above the permissible limit except groundwater from site S2 (Shamli Road) and S4 (Budhana-Khatauli road)

5.4. Biochemical oxygen demand (at 27°C for 3days)

The BOD of river water ranged from 10 to 42 mg/l. It is noted well above the permissible limit of <5.0mg/l.

5.5. Total coliform

The total coliform of river water ranged from 560 to 1260 MPN/100ml, whereas it was absent in groundwater. The total coliform of river water was above the permissible limit.

5.6. MBAS, lead (as Pb), mercury (as Hg)

All three parameters were found to be well under the permissible limit in both river as well as groundwater.

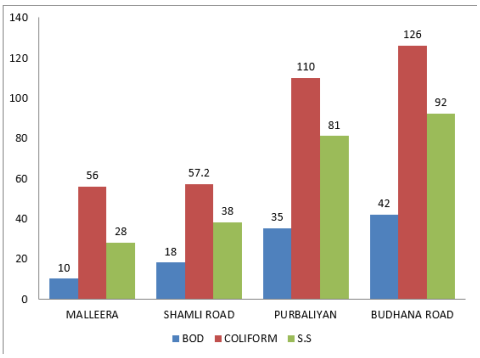

Fig. 2: Riverwater BOD, coliform count, suspended solids of river water at 4 different locations (in mg/l)

6. Discussion

Water pollution is a leading threat to public health in developing countries like India. The major culprit behind

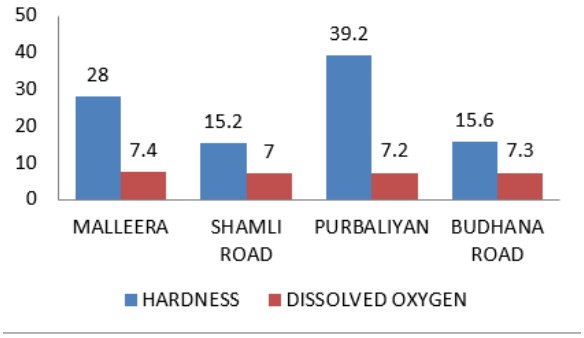

Fig. 3: Groundwater Hardness, dissolved oxygen of groundwater at 4 different locations (in mg/l)

this rise is untreated discharge of sewerage, household water, industrial effluents. These factors together make the river water unfit for drinking as well as using it for other purposes such as bathing, cooking etc. Comparisons were drawn with various studies conducted in the past to establish a conclusion on deteriorating condition of river kali.[4]

The study done by U.P. pollution control board in 2019 the range of the B.O.D was 38-69.5, Total coliform count was 1.2 x 10^5– 6 x 10.[1]

The BOD of the study conducted by National Institute of Hydrology, Roorkee was found out to be 5.95mg/l at Maleera Bridge which was found out to be lesser than the values obtained.[5]

As stated in the study conducted by Meerut Institute of Engineering, Meerut, the Total Hardness was found out to be ranging from 210mg/l to 425mg/l, and BOD ranged from 20mg/l to 82mg/l respectively.[6]

The River Kali flowing majorly in Muzaffarnagar district is heavily polluted which is confirmed by the results mentioned above. It can be easily deduced from (Table 1) that the total coliform count showed an increasing trend on collecting of samples from east and moving towards west. This, heavy increase in total coliform count is due to untreated discharge from major industries i.e., paper and sugar situated on banks of river Kali. Samples collected from four different locations to test the water quality of River Kali were swiftly transported to the laboratory under desirable temperature. The samples were tested for parameters like pH, odor, taste, Biochemical Oxygen Demand, Total Hardness, Dissolve Oxygen, Total suspended solids, MBAS, Lead, Mercury and Total Coliform.

As noted from the results there was an incessant increase in the total hardness of ground river and it was found to be above the permissible limit according to IS for Drinking Water 2012. Drinking unpurified hard water impose a serious health effect on the villages nearby the marked locations and its regular intake may cause kidney dysfunction. Also, hard water may cause eczema, skin irritation, dry-scaly skin and hair loss.

A two to three folds increase in Biochemical Oxygen Demand was also noted in the river water, the test to measure BOD was performed at 27°C for 3 consecutive days. Higher levels of BOD impose a serious threat to the ecosystem especially the aquatic life. Thus, it is of utmost importance to treat the industrial effluents before discharge into the river water.

The river water was found to be contaminated with enormous levels of coliform count; consumption of such water may lead to gastrointestinal diseases such as severe diarrhea, nausea and vomiting.

Thus, from above study it is deduced that the river water is unfit for use for any kind of household purposes such as drinking, bathing, cooking etc. and needs serious attention for its clean-up.

The groundwater in its proximity should also be avoided for drinking as long term intake of such quality of water may lead to renal dysfunction.

7. Conclusion

In conclusion, the water of the River kali is not fit for drinking or any other purpose and also the groundwater around the river has increased hardness thus may cause ill effect on public health.

8. Limitation of The Study

There was heavy rainfall prior to the day the sample was taken, this could have affected the outcome as there would have been serial dilution of the river water which affects the total suspended solids and BOD.

9. Relevance of Study

Various programs are launched by the state as well as central government in order to clean the water of River Kali, in spite of which the water is contaminated. This study may help in spreading awareness among the masses.

10. Source of Funding

None.

11. Conflict of Interest

None.

12. Acknowledgement

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