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ARTICLE

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SCIENTIFIC ASSESSMENT OF GROUNDWATER QUALITY FOR RURAL DEVELOPMENT IN FALDI VILLAGE, INDIA

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The quality of groundwater is crucial for public health in rural areas, yet contamination behaviour is often not well understood, particularly in underdeveloped regions of India. This study evaluates groundwater from Faldi Village in North 24 Parganas and finds that iron concentrations varied significantly, with some samples exceeding the permissible limit of 5.78 mg/L as per BIS 10500:2012. Report signifies the presence of Iron in ground water and fecal coliform in the collected water for few cite locations. Studies on spatial interpolation and water quality assessments, indicated the various pollution hotspots. The water quality index of 25 samples were determined to justify the drinking water suitability and the mutual relationships among microbial and physicochemical groundwater parameters

Introduction

Groundwater quality plays a vital role in rural public health in India. Faldi Village depends heavily on shallow wells, which are susceptible to iron enrichment and microbial contamination[1]. Recent studies on water security in West Bengal recommend effective groundwater management strategies[2,3]. This study provides a clear hydrochemical and microbiological assessment to identify contamination mechanisms and inform potential interventions.

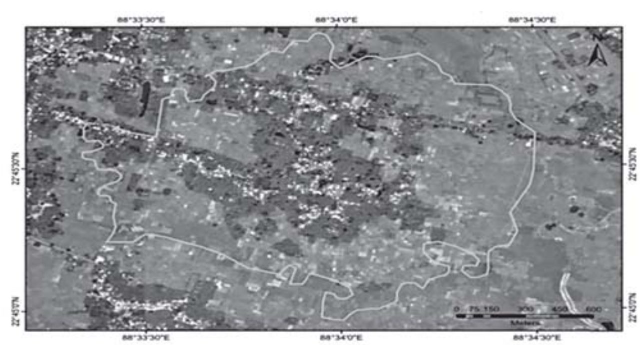
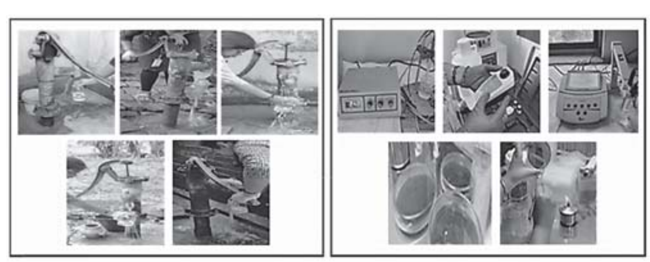


Fig. 1: Survey the selected locations to identify the water quality.



(a) (b)

Fig. 2: (a) Collection of water samples as per guidelines and (b) Instruments used for physicochemical and microbiological analysis.

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Materials and Methods

Twenty-five groundwater samples were collected following BIS 10500:2012[4] standards. Physicochemical parameters and microbial indicators were analyzed using standard methods. The Water Quality Index (WQI) was calculated based on BIS weighting, and spatial variation was assessed using Inverse Distance Weighting (IDW) interpolation.

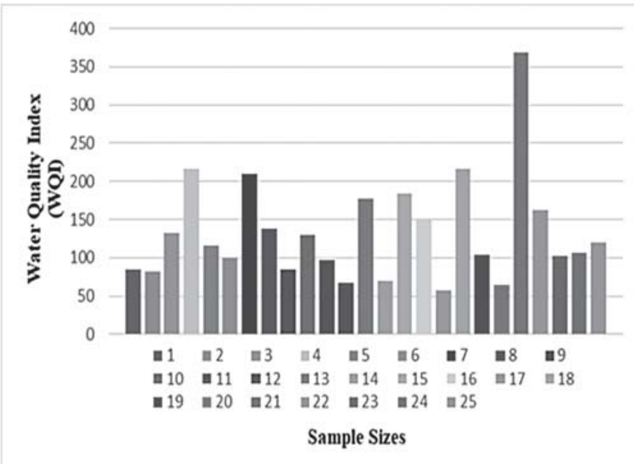

Fig. 3: Comparative bar chart showing variation in Water Quality Index (WQI) across 25 Groundwater samples and calculated WQI for 25 groundwater samples.

Results

Iron contamination levels varied, with some samples above 0.3 mg/L and two over 2 mg/L. Spatial maps showed high-iron areas in the northeast, indicating geogenic reductive dissolution in organic-rich sediments.

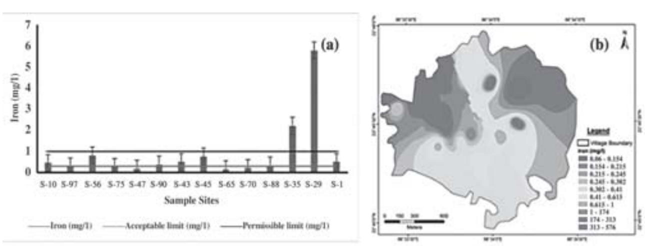

Fig. 4: (a) Variations of Iron Concentration and (b) GIS Map of variation of Iron Content

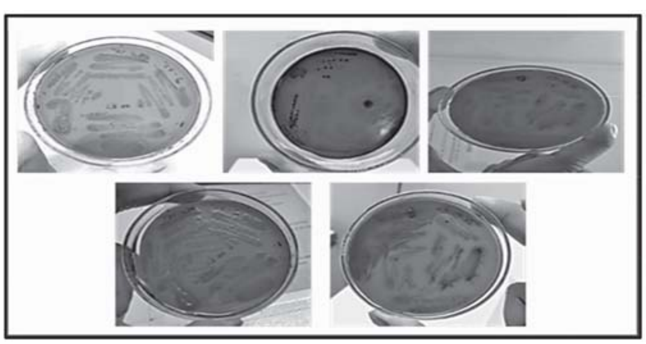

Fig. 5: Faecal Coliform at 5 Samples

Total coliforms were present in 58–72% of samples, while faecal coliforms were found in 28–40%. The presence of faecal coliforms suggests faecal contamination linked to poor sanitation, unsealed wellheads, and monsoonal runoff.

Correlation analysis showed that iron had negative correlations with pH and positive correlations with turbidity and electrical conductivity, indicating reducing conditions. Microbial indicators strongly correlated with turbidity and shallow well depths.

WQI Interval	Quality Category	Drinking Water Suitability
0–50	Excellent	Safe for direct consumption
50–100	Good	Generally Acceptable
100–200	Poor	Requires appropriate treatment
200–300	Very Poor	Not fit for drinking purposes
>300	Unsuitable	Indicates severe contamination

Parameter	pH	Iron	Turbidity	EC	Total
pH	100	-0.56	0.48	0.18	0.44
Iron	-0.56	0.48	0.52	0.52	0.18
Turbidity	0.48	0.52	0.52	0.45	0.31
EC	0.52	0.45	0.45	0.52	0.69
Total Coliform	0.63	0.33	0.34	0.29	0.71
WQI	0.77	0.65	0.31	0.29	0.74

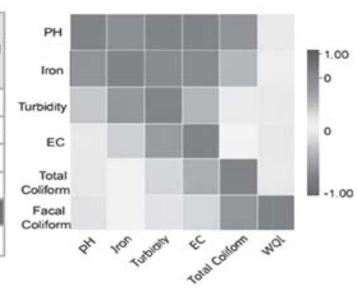

Fig. 6: Integrated Pearson correlation matrix and heatmap showing mutual relationships among physicochemical and microbial groundwater parameters

Discussion

Groundwater contamination in Faldi stems from geogenic iron mobilization and human-induced microbial intrusion, affecting drinking water quality. WQI assessments indicate several areas are unsuitable for potable use. Essential measures include chlorination, microbial monitoring, sealing wellheads, and improved sanitation.

Conclusion

Faldi Village faces significant iron and microbial contamination, which reduces groundwater potability. Science-based, low-cost interventions are essential to protect rural drinking water security and promote sustainable development.

Acknowledgement

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