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Drinking Water Quality Assessment and Monitoring in Morena District, Madhya Pradesh, India

Bidyalakshmi Phurailatpam [a*], Ramkumar Lodhi [b] and Kush Kushwah [c]

[a] Department of Environmental Science, ITM University, Gwalior-474011, Madhya Pradesh, India.
[b] School of Studies in Zoology, Jiwaji University, Gwalior, Madhya Pradesh, India.
[c] Government Shrimant Maharaja Madhav Rao Scindia College Kolaras, Shivpuri, Madhya Pradesh, India.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Over extraction of ground water through borehole caused to reduction of water quality in city areas. An assessment of drinking water quality was undertaken at selected sites in the district of Morena, Madhya Pradesh, India. Some of the selected water parameters were observed at the time of sampling while other selected parameters were observed in laboratory. Water sample were collected in polyethylene coated wide mouth bottle in early hours of the day and sent to laboratory as soon as possible for further analysis. The areas selected have access to drinking water from borehole only located in their respective areas. Standard methods were followed for the analysis of

**Corresponding author: Email: bidyalakshmi.sos@itmuniversity.ac.in, bidya_khoi2003@yahoo.co.in;*

selected water parameters. Basic water quality measures such as pH, EC, TDS, Cl, Total Hardness, Calcium, magnesium, etc. were varied, with high levels in certain regions of the study area. The majority of the samples are drinkable water; however some had high TDS, Ca and Mg, indicating the possibility of contamination. Presented study revealed that some of the water parameters are beyond permissible limit of world health organization (WHO). Study clearly indicated that proper monitoring should be applied at a regular interval in study area.

Keywords: Ground water; physico-chemical; contamination; borehole.

1. INTRODUCTION

Water is a necessary component for the existence of life on earth since it includes minerals that are beneficial to both people and aquatic life. Water is one of the most significant natural resources in our country. Water is a natural wonder. "There is no life without water," as the adage goes, because water is a naturally occurring vital necessity of all life-sustaining processes [1]. It is a dynamic system that contains living and nonliving, organic and inorganic, soluble and insoluble components. As a result, its quality is likely to fluctuate from day to day and from source to source. Any change in natural quality may disrupt the equilibrium system and would become unfit for designated uses. The availability of water through surface and groundwater resources has become critical day to day and from source to source. Only 1% part is available on land for drinking, agriculture, domestic power generation, industrial consummation, transportation and waste disposal [2].

Groundwater provision is sometimes unsustainable because of poor water productivity of wells, drying of wells after prolonged drought and sometimes due to poor water quality. These problems are usually caused by the lack of understanding of the hydrological regime [3].

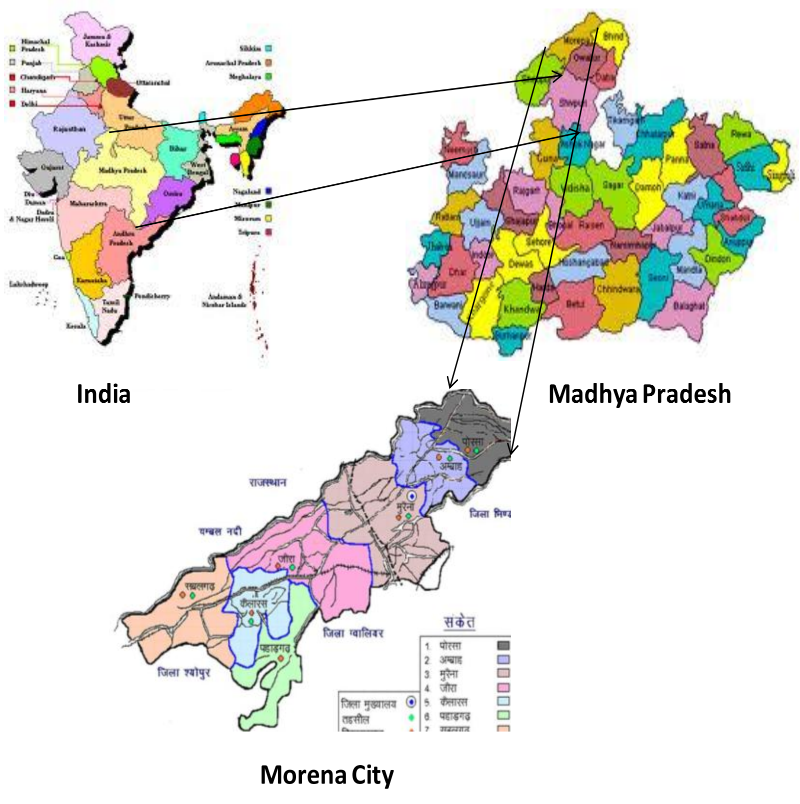

Fig. 1. Location map of Morena District, Madhya Pradesh, India

The fast rise of the population has increased the need for portable water, necessitating the investigation of raw water sources, as well as the development of treatment and distribution systems. However, as a result of massive population increase, urbanization, and industrialization, the majority of our water bodies are contaminated. The supply of clean water has grown scarce. Water pollution (surface and groundwater) can be defined as a naturally occurring change in water quality or as circumstances caused directly by man's countless activities that leave it unfit for food, human health, industry, agriculture, or recreation [4].

Toxic chemicals in water constitute the biggest danger to the safety of (drinking) water, with tremendous consequences for human health, agriculture, and aquatic organisms. Pollution of ground and surface waterways by agrochemicals (fertilisers and pesticides) and industry is a serious environmental health risk, with potentially huge economic consequences for the country. Polluted water intake is to blame for numerous infectious ailments such as typhoid, jaundice, dysentery, viral disorders, etc. According to the World Bank, the entire cost of environmental degradation in India amounts to $9.7 billion per year, or 4.5% of GDP. It was calculated that 59% of this is due to the health effects of water contamination [5]. The study assess know the present status of water quality and availability in Morena, Madhya Pradesh, India.

1.1 Study Area

The current study on drinking water quality was undertaken in the different zones of district Morena, Madhya Pradesh, India. The district headquarters are generally located in the mid-southwestern section of Madhya Pradesh state, between 13' 27" and 14'39" latitude and 12' 12" and 13'13" longitude. The district is abundant in tiny bodies of water, and most agricultural fields rely on them for water. It is also known as Muraina, and it serves as the administrative centre for Morena District and Chambal Division. It is about 39 kilometres from the northern side of Gwalior, Madhya Pradesh (Fig. 1).

2. MATERIALS AND METHODS

The current research focused on a single community in the Morena area. The research location was chosen based on the existing state of drinking water quality and the presence of sources. Intensive study site were chosen randomly viz; Ridora kala village, Warbadi village, Tiktoli gurjar village, and Higona kala village depicted as Site R, Site W, Site T, and Site H in Morena District, Madhya Pradesh S1, S2, and S3 sample stations were randomly built in each research location for extensive analyses of ground water physicochemical characteristics. Groundwater supplies are available in the form of borehole only in these selected study sites. No other sources of water were observed. Water samples were collected from the designated places in May 2021 and placed in poly ethylene coated wide mouth plastic bottles. The samples were immediately placed in dark boxes after collection and processed in the laboratory within 4 hours after collection for examination. Physical parameter of water were analyzed at the sampling point during the collection of water while chemical parameters of water were analyzed in laboratory after collection by followed standard method of water analysis APHA [6] and Trivedy & Goel [7].

3. RESULTS AND DISCUSSION

The collected samples were analyzed for different Physico-chemical parameters such as Colour, Taste, Odour, Water Temperature, Turbidity, pH, Electrical Conductivity, TDS, Total Alkalinity, Chloride, Total Hardness, Calcium Hardness, Magnesium Hardness, Calcium and Magnesium. Table 1 shows the monthly values of physicochemical properties at various sites. Table 2 shows the range of fluctuation in several physicochemical properties, as well as their annual mean and standard deviation.

The presence of suspended matter, siltation, and minerals causes colour in natural water, which is mainly dependent on the formation and degradation processes of minerals [8]. The presence of colored organic materials (mainly humic and fulvic acids) associated with the humus portion of soil or the presence of iron and other metals, either as natural impurities or as corrosion products, causes colour in drinking water [9]. During the research, no water colour was discovered at any sample point. Taste and odour were likewise judged to be unobjectionable at each sample point.

The quality of physical, chemical, and biological factors is an excellent indicator for presenting a full and trustworthy picture of ground water conditions [10]. Temperature is an important factor in organism development [11,12]. Surve et al. [13] discovered that when the temperature of the atmosphere rises, so does the temperature of the water. In May 2021, the water temperature ranged from 30.2°C to 39.3°C, with an average mean of 35.414.01°C. As a result, the water temperature was low at Site H at S2 and higher in Site W at S1 & S2.

The turbidity had a range from 0.6 NTU low at Site R at S_1 to 2.3 NTU high at Site W at S_3 (May, 2021) with an average mean of 1.30±0.47 NTU which were normal according to drinking water standard guidelines of India.

The strength of acidity or alkalinity, or the concentration of hydrogen ions in water, is measured by pH. The pH ranged from 6.7 in Tiktoli Gurjar hamlet at Site S3 to 7.7 in Site R at S1, with an annual mean of 7.130.24 in May 2021. The low pH levels may induce corrosion in containers and pipes, whereas high pH values may create silt, deposit, and difficulty in chlorination for water disinfection [14]. Despite the fact pH has no direct influence on consumers; it is one of the most essential operational water quality criteria.

Electrical conductivity is used to indicate the total ionized constituent of water. It is proportional to the sum of the cations and anions [15]. Electrical conductivity (EC) is a measure of the quantity of water soluble ions in water that indicates the level of mineralization in an environment [16]. The electrical conductivity ranged 451µmho/cm lower in Site T at S3 to 1496 µmho/cm higher in Site R at S2 with an average mean of 966.75333.39 µmho/cm, which was both low and high in some locations.

According to Welch [17], dissolved solids change qualitatively and quantitatively in various fluids depending on season, location, and other factors. Dissolved solids in freshwater ecosystems come from natural sources and are affected by location, geological basin of water body, drainage, rainfall, bottom deposit, and inflowing water. Ramana et al. [18] measured high dissolved solids in the range of 235.0 to 301.0 mg/l. TDS in drinking-water originate from natural sources, sewage, urban runoff and industrial wastewater.

TDS concentrations in water vary greatly across geological locations due to mineral solubility variances. Water with a TDS level of less than 600 mg/l is typically considered to be pleasant; drinking water becomes considerably and increasingly disagreeable at TDS levels more than roughly 1000 mg/l. High levels of TDS may also be unpleasant to customers due to excessive scaling in water pipes, heaters, boilers, and home appliances. TDS has no health-based recommendation value. Water with exceptionally low TDS concentrations may also be unpleasant due to its flat, insipid flavour [19]. In the present study, TDS levels varied from 298 at S2 in Site T to 976 at S2 in Site R, with a mean value of 630.92226.63 mg/l.

Total alkalinity is the sum of bicarbonate and carbonate alkalinities. During May 2021, the total alkalinity varied between research sites, ranging from 120 mg/l lower at Site W at S1 to 346 mg/l higher in Site H at S3, with an average of 201.5070.47 mg/l.

Although chloride in drinking water is largely innocuous, excessive chloride levels in water bodies are damaging to metallic pipes and agricultural crops [20]. The chloride concentration ranged from 24 at Site H's S3 to 112 at Site W's S2, with a mean value of 67.1734.79 mg/l. High chloride concentrations cause hypertension, alter human metabolism, and enhance the electrical conductivity of water (Gummadi, and Latha, Swarna, 2013)).

Hardness is due to magnesium, calcium carbonates, bicarbonates and sulphates it is further classified into temporary and permanent hardness. Temporary hardness can be removed by just boiling the water whereas the permanent hardness can be removed by suitable physical and chemical methods. Water hardness is caused by Ca2+ and Mg2+ salts in the form of bicarbonates, sulphate, and chloride. The recommended overall hardness value is 500 mg/l [21]. During the research period, total hardness varied between 296 mg/l lower in Site W at S3 to 440 mg/l greater in Site R at S1, with an average mean of 358.1749.33 mg/l.

During the research period, the calcium hardness ranged between 100 mg/l at Site W at S3 and 232 mg/l at Site R at S1, with an average mean of 143.8341.83 mg/l.. Magnesium is directly related to hardness. The magnesium Hardness was fluctuated between 128 mg/l lower in Site W at S_1 to 258 mg/l in Site H at S_3 with average value of 209.00±33.83 mg/l during the study period 2021.

Calcium is a principal cation and it is widely distributed in earth’s crust and is important

Table 1. Physico-Chemical characteristics of water different selected Sites of Morena District during the study period May 2021 at three sampling station

S. No.	Parameters	Unit	Site R			Site W			Site T			Site H		
			S_1	S_2	S_3	S_1	S_2	S_3	S_1	S_2	S_3	S_1	S_2	S_3
1	Colour	Pt. Cobalt Scale	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL	CL
2	Taste and Odour		UO	UO	UO	UO	UO	UO	UO	UO	UO	UO	UO	UO
3	Water Temperature	°C	33	33.1	33.2	39.3	39.3	39.1	39	38.9	39.1	30.3	30.2	30.4
4	Turbidity	NTU	0.6	1.2	1.9	1.9	1.2	2.3	1	1	1	1.4	1	1.1
5	pH		7.7	7.1	7	7	7.2	7.1	7.1	7	6.7	7.1	7.4	7.2
6	Conductivity	µmho/cm	550	1496	1297	1374	1233	839	1120	451	608	1102	780	751
7	TDS	mg/l	360	976	849	894	805	547	729	298	396	719	508	490
8	Total alkalinity	mg/l	286	198	202	120	216	130	126	210	152	142	290	346
9	Chloride	mg/l	106	30	28	62	112	38	96	98	68	106	38	24
10	Total Hardness	mg/l	440	392	316	314	300	296	330	372	406	318	388	426
11	Calcium Hardness	mg/l	232	198	140	116	104	100	110	130	178	110	140	168
12	Mg Hardness	mg/l	214	194	176	128	196	196	220	242	228	208	248	258
13	Ca	mg/l	92.8	79.2	56	46.4	41.6	40	44	52	75.2	44	56	67.2
14	Mg	mg/l	51.36	46.56	42.24	45.12	47.04	47.04	52.8	58.08	54.72	49.92	59.52	61.92

Table 2. Range of variation, mean and standard deviation of Physico-chemical parameters of selected sites

S. No.	Parameter	Unit	Range of variation	Mean ± S.D.
1	Colour	Pt. Cobalt Scale	-	-
2	Taste and Odour		-	-
3	Water Temperature	°C	30.2-39.3	35.41±4.01
4	Turbidity	NTU	0.6-2.3	1.30±0.47
5	pH		6.7-7.4	7.13±0.24
6	Conductivity	µmho/cm	451-1496	966.75±333.39
7	TDS	mg/l	298-976	630.92±226.63
8	Total alkalinity	mg/l	120-346	201.50±70.47
9	Chloride	mg/l	24-112	67.17±34.79
10	Total hardness	mg/l	296-440	358.17±49.33
11	Calcium hardness	mg/l	100-232	143.83±41.83
12	Magnesium hardness	mg/l	128-258	209.00±33.83
13	Ca	mg/l	40-92.	57.87±17.07
14	Mg	mg/l	42.24-61.92	51.36±5.92

elements in all waters. It is mainly derived from weathering of Silicate mineral groups of Plagioclase, Pyroxene, and Amphiboles which are present in rocks [22]. The calcium fluctuated between 40 mg/l low in Site W at S_3 and 92.8 mg/l higher in Site R at S_1 (May 2021) with an average mean of 57.87±17.07 mg/l during the study. The magnesium fluctuated between 42.24 mg/l low in Site R at S_3 to 61.92 mg/l higher in Site H at S_3 with average value of 51.36±5.92 mg/l during the study period May, 2021.

4. CONCLUSIONS

The current study on the drinking water characteristics of a selected hamlet in Morena, Madhya Pradesh, India highlights the need of preserving water quality, particularly for drinking. The water quality of ground water sources is determined by their geographical location and the ground water recharge source that surrounds them. Since there is insufficient water supply in a selected hamlet of the City, each selected Borehole requires regular maintenance based on scientific procedures. The majority of settlements in Morena district are experiencing shortage of water in their area and some villages are facing the low water level in their district. Moreover, there is a great necessity for Hand pump in some villages as they have no other sources of water for drinking. As a result, the current assessment of the ground water supply in Morena area recognizes some of the significant issues. Some of the recommendations include: periodic monitoring of microbiological contamination, Waste disposal inspection, Leveling using cement or bricks to prevent waste water input and leaky percolation. Ponds should be built in each hamlet to increase the sources of ground water recharge.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Simpi B, Hiremanth SM, Murthy KNS. Analysis of water quality using physicchemical parameters, Hosahalli tank in shimoga District, Karnataka, India. Glob. J Sci From. Res. 2011;11:3.
2. Bombatkar SN, Murhekar GH, Raut AR. Microdetermination of Trace metal ions contamination of water samples by using AAT. Int J Adv Res Chem Sci. 2015;2(2):47-53.
3. Bello AK, Ademola AK, Adejumobi CA, Unuode AU. The effects of leachate on groundwater in OTA industrial area Southwest, Nigeria. J Meteorol Clim Sci. 2013;11(1):1-9.
4. Hakeem KR, Bhat RH, Qadri H. Concerns and threats of contamination on aquatic ecosystem. Biorem Biotechnol. 2020;27:1-26.
5. Sharma S, Bhattacharya A. Drinking water contamination and treatment techniques. Appl Water Sci. 2017;7(3):1043-67. DOI: 10.1007/s13201-016-0455-7
6. APHA. Standard Methods for the examination of water and waste water. AWWA. 21st ed. New York: WPCE; 2005.
7. Trivedy RK, Goel PK. Chemical and biological methods for water and pollution

studies. Karad, India: Environmental Publications; 1986.

8. Bhalla R, Lomte VS, Mule MB. Physico-chemical assessment of water in relation to primary production of plankton of Godavari River at Nashik. Bull Environ Sci. 2006;24(2):165-9.
9. World Health Organization. Washington, DC: Drinking Water Standards and Health Advisories Office of Water United States Environmental Protection Agency; 2011.
10. Mishra A, Gulati JML, Patra AK, Samal KC, Panigrahi B, Jena SN. Variability and correlation studies on weather components. Pollut Res. 1999;18(2): 183-6.
11. Ram KH, Ramachandra Mohan M, Vishalakshi Y. Karnataka: Limnological Studies on Kolaramma Lake Kolar. Environment and Ecology. 2007;25(2):364-7.
12. Manimegalai M, Kumari SB, Shanthi K, Saradhamani N. Limnological studies on Walayar Reservoir, Palghat, Kerala. Nat Environ Pollut Technol. 2010;9(1):189-92.
13. Surve PR, Ambore NE, Pulle JS. Hydrobiological studies of Kandhar Dam Water, Distric Nanded (M.S.), India. J Ecophysiol Occup Hlth. 2005;5:61-3.
14. Kumaraswamy N. Physico-chemical analysis of ground water in pravara area, Dist. Ahmednagar, Maharashtra. Pollut Res. 1991;10:13.
15. Tripathi BD, Dwivedi RK, Tripathi A. Water Air Soil Pollut. 1989;49:107.
16. Das AK. Limno-chemistry of some Andhra Pradesh reservoirs. J Inland Fish Soc India. 2000;32(2):37-44.
17. Welch PS. Limnology. New York: McGraw-Hill Book. Co.; 1952.
18. Ramana P, Patil SK, Sankri G. Evaluation of Water quality of Magadi Wetland in Gadag District Karnataka. Dharwad: Univerisity of Agricultural Sciences, department of forest Utilization. Sirsi: College of Forestry. Karnataka, India. 2008;581401.
19. Anon. Drinking water and sanitation status in India, water aid India; 2011.
20. Durrani A. Physico-chemical parameters of Ground-Water. Afr J Basic Appl Sci. 2012;4(2):28-9.
21. Dhok RP, Patil AS, Ghole GS. Hardness of groundwater resources and its suitability for drinking purpose. Int J Pharm Chem Sci. 2017;2(1):169-72.
22. Subramani T, Elango L, Damodarasamy SR. Groundwater quality and its suitability for drinking and agricultural use in Chithar River Basin, Tamil Nadu, India. Environ Geol. 2005;47(8):1099-110.
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