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Assessment of Ground Water Quality in Naka Town, Gwer-West Local Government Area of Benue State, Nigeria.

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A B S T R A C T

Access to safe drinking water is essential for human health, yet many communities in Nigeria, including Naka Town in Gwer-West Local Government Area of Benue State, rely on untreated groundwater sources such as hand-dug wells. This study assesses the quality of groundwater in Naka Town by analyzing its physical, chemical, and biological characteristics and comparing them with recommended drinking water standards. Water samples were collected from selected hand-dug wells over four months (December 2024 to March 2025) and analyzed at the Benue State Ministry of Water Resources, Nasarawa State Ministry of Water Resources, and Benue State Water Board. The results reveal significant contamination, particularly with coliform bacteria, which exceeded permissible limits set by the World Health Organization (WHO). The presence of Escherichia coli indicates fecal contamination, posing potential health risks to the community. Other parameters such as pH, turbidity, colour, and dissolved solids varied across locations, with some falling within acceptable limits while others exceeded standard recommendations. The study highlights the urgent need for water treatment interventions and public health awareness in Naka Town. Recommendations include promoting communal water treatment methods such as boiling and filtration, improving sanitation practices to prevent contamination, and establishing a government-supported water treatment facility. Implementing these measures will enhance groundwater quality and safeguard public health in the region.

1. Main text

Quality drinking water is essential for human life in many countries around the world including Nigeria, water has become a scarce commodity as only small proportion of the world has assess to treated water.

Alternative source of water such as hand-dug wells have become major sources of drinking water for people living in Naka town. Water is a universal solvent and is the most abundant substance in plants and animals' tissues as well as the world around us (Fabio et al; 2009), ground water is both an important direct source of water supply which is tapped by wells and a significant indirect source of supply since a large portion of the flow streams is derived from subsurface. This is found as a result of the portion of precipitation (rainfall and snowfall) which sink into ground (Deju et al; 1990).

The study on quality assessment of ground water is a man part of pollution studies in the environment. In addition, coli-form enters water suppliers from direct disposal of waste into streams or lakes or from run-off wooded areas, pasture feedlots, septic tanks and savage plants into stream or ground water.

(Glenn and William, 1981) Coli-form can also enter an individual's house through back flow of water from a contaminated source carbon filter, leaking wells caps that allow dirt and dead organism to fall into the water. The presence of Eschericha (E) coli in drinking water depicts that the water has been totally contaminated and therefore presents a potential breath risk to households that use them untreated. Research conducted in Ghana indicated that 77% of filtered underground water samples sold as sachet water that were analyzed contained infective stages of pathogenic parasite organisms (Nebel and Wright, 1993). Naka town in Gwer-West Local Government of Benue state has been faced with water scarcity which compels the inhabitants to use untreated water from hand-dug wells. The town has no water treatment plant to supply portable water for public consumption. The people in Naka town predominantly use hand-dug wells as their source of water for domestic purposes such as drinking, bathing, washing and cooking. The quality of the water has not been ascertained by any researcher. It is on this note that the need to examine the quality of the ground water in Naka town is necessary.

Water is a transparent fluid which forms the worlds-lakes, oceans and rain and is the major constituent of the fluids of living things. As a chemical compound, a molecule of water contains one atom of oxygen and two atoms of hydrogen that are connected by covalent bonds. Water is a liquid at a standard ambient temperature and pressure but it often co-exists on earth with its solid state as ice and gaseous state as steam (water vapor).

Water is one of the most indispensable resources and is the elixir of life. It constitutes 7% of the body weight of almost all living organism life is not possible on the planet without water. It acts as a medium for both chemical and biochemical actions and also serves as an internal and external medium for several organisms (Ranjankar et al; 2009).

Ground water provisions are sometimes unsustainable because of poor water productivity well, drying of wells after prolonged drought and sometimes due to poor water quality (Kortatsi et al; 2006) contaminated water resource have important implications on health and environment (Peterson et al; 1971)

the importance of water quality in human health has recently attracted a greater deal of interest. In developing world 8090 of all diseases are indirectly related to poor drinking water and unsanitary condition (Meng, 2011) ground water quality can be affected by varied pollution sources. For example, Hamilton and Helsel (1995) stated that a connection between agriculture and ground water pollution is established. Environmental agency in 2009 defined water quality as a water that contains no pathogenic organisms and free from constituents that may be aesthetically objectionable.

The aim of the study is to investigate the quality of ground water in Naka Town, Gwer –West, Benue State and the set objectives are to:

i. Determine physical, chemical and biological characteristics of the hand dug wells in Naka town

ii. Compare the results with recommended guidelines of water for drinking purpose

2. Materials and Methods

Naka town is located in Gwer-West Local Government Area of Benue State. Naka is located on latitude 710130570N and longitude 8050260E, Naka is bounded to the North by Apa Local Government, the East by Gwer-East Local Government. Naka is the headquarters of Gwer West with a trunk 'A' road linking the Northern and Eastern parts of Nigeria. The town has double maximum rainfall, the major one is around April to July and the minor one is between September to October. Naka town is covered with clay and loamy soil, the area is underlain with sedimentary rocks. Sedimentary rocks consist of lateritic soil. The cultural life of people in Naka town is farming, trading and small-scale business. The choice of Sampling sites and location was due to their strategic location, bulk of human activities as well as population density.

2.1 Methods

This research was based on experiments both Laboratory and field experiment. Water from the selected hand-dug wells were collected in litres which were taken to laboratories, the physical, chemical and biological characteristics of water quality like turbidity, total dissolve solid (TSS), total Undissolved solid, coliform, PH, temperature, odour, colour, suspended solid, temperature, dissolved solids, turbidity, coliform, calcium, magnesium, pH were determined for four consecutive months, from December 2024 to March 2025.

These parameters were taken to Benue State Ministry of Water Resources for laboratory test in the first two months and Nasarawa State Ministry of Water Resource for the remaining two months. The final analysis was conducted at Benue State Water Board.

3. Results

The result obtained from the laboratory test and field work is presented in the two tables below. The first table shows the result obtained in the first two months and the second table depicts the result obtained in the last two months. The laboratory and field analysis lasted for four months.

Table 1 - The average result of the parameters determined in the first two months (December and January, 2024/2025)

Parameter	**Unit**	**N_1**	**N_2**	**N_3**	**N_4**	**N_5**	**N_6**	**N_7**	**N_8**	**N_9**	**N_{10}**	**WHO**	**NSI**	**SON**
Temperature	(°C)	27.1	26.0	25.0	26.6	28.0	24.0	23.0	26.0	24.2	27.1	Ambient	Ambient	Ambient
Dissolved Shorts	mg/l	15.0	14.7	13.0	12.0	12.5	12.1	12.4	12.6	12.5	19.0	1000	500	1000
Suspended Solids	mg/l	0.2	0.3	0.2	0.21	0.4	0.1	0.1	0.2	0.7	0.8	50	NS	50
Colour	TCU	0.28	0.14	0.3	0.1	0.3	0.5	0.4	0.6	0.5	0.7	5	15.0	0-10
Turbidity	NTU	2.1	1.3	1.6	1.8	1.5	1.3	1.2	1.7	1.00	1.3	0-5	0-5	0-5
Coliform	Cfu/ml	50	20	60	30	40	40.5	70	15	25	34	0	0	0
Odour	TCU	0.1	0.2	0.02	0.3	0.4	0.41	0.2	0.1	0.1	0.3	0	0	0
Calcium	mg/l	15.5	38.2	25	63	40	45	63	25	60	70	150	150	150
Magnesium	mg/l	3.0	2.5	2.5	0.1	0.2	2.0	1.2	1.5	1.2	1.7	0.5	0.5	0.5
pH	-	7.1	7.2	8.0	8.2	8.1	8.5	9.0	10.0	10.6	12.0	65-85	70-80	65-85

(Source: Field work 2024/2025)

NS = Not Specified; WHO = World Health Organization

NSI = Nigeria Standard Institute, 2007 SON = Standard Organization of Nigeria

Table 2 - The average result of the parameters determined in the last two months is shown in the table below (February and March, 2025)

Parameter	**Unit**	**N_1**	**N_2**	**N_3**	**N_4**	**N_5**	**N_6**	**N_7**	**N_8**	**N_9**	**N_{10}**	**WHO**	**NSI**	**SON**
Temperature	(°C)	23.1	24.0	25.0	26.6	28.0	24.0	23.0	25.0	23.2	27.1	Ambient	Ambient	Ambient
Dissolved Shorts	mg/l	15.0	14.7	11.0	11.0	12.5	12.1	14.4	13.6	12.5	19.3	1000	500	1000
Suspended Solids	mg/l	0.3	0.5	0.7	0.31	0.5	0.2	0.3	0.4	0.9	0.6	50	NS	50
Colour	TCU	0.26	0.13	0.2	0.1	0.4	0.7	0.5	0.7	0.3	0.6	9	16.0	0-10
Turbidity	NTU	3.1	1.3	1.6	1.8	1.5	1.3	1.2	1.7	1.0	1.3	0-5	0-5	0-5
Coliform	Cfu/ml	40	20	60	30	40	40.5	70	15	25	34	0	0	0
Odour	TCU	0.2	0.2	0.02	0.3	0.4	0.41	0.2	0.1	0.1	0.3	0	0	0
Calcium	mg/l	16.5	38.2	25	53	40	35	53	23	50	60	150	150	150
Magnesium	mg/l	2.0	1.5	2.5	0.1	0.2	2.0	1.2	1.5	1.2	1.6	0.5	0.5	0.5
pH	-	8.1	4.2	6.0	8.2	8.1	8.5	9.0	8.0	9.6	11.0	65-85	70-80	65-85

(Source: Field work 2025)

NS = Not Specified; WHO = World Health Organization

NSI = Nigeria Standard Institute, 2007 SON = Standard Organization of Nigeria

4. Discussions

Temperature: The temperature of the samples ranges from 25-40oC, the highest value of the temperature was obtained from Arts 2, which is above the ambient temperature for drinking water (HWO, 2014).

Turbidity: The turbidity of the samples tested is within the safe recommended limit of 0-5 NTU for drinking water as specified (NSI, 2007).

Coliform: The presence of coliform bacteria was recorded, with values ranging from 15 Cfu/ml to 70 Cfu/ml. According to WHO, NSI, and SON standards, coliform bacteria should be absent (0 Cfu/ml). The detected presence of coliform bacteria indicates potential microbial contamination, which could pose health risks and necessitate further treatment before consumption. This is because the wells are unlined, most of the wells are not covered with wells caps. If a well cap is below the level of the surface, rain water may waste animal fecal matter into the well; if a way casing is cracked or if the well is improperly built, contaminated ground water below the surface of the earth will percolate into the well (SON, 2009).

Colour: The result of the analysis shows that colour ranges from (0.1-0.9 TCU) which is with the acceptable standard of TCU (WHO, 2014).

The analysis further shows that some parameters tested were below the acceptable limit as recommended for drinking water like suspended solid, pH, magnesium, some were within the limit prescribed by WHO like total dissolved solid. Below is the plate showing hand dug wells in Naka town.

(a)  (b) 

Fig 1: (a) Closed hand-dug well; (b) Opened Hand-dug well

5. Conclusions

Samples from the hand dug-wells in Naka town, Gwer-West Local Government of Benue State were taken and examined for quality. This study has shown that the level of contamination of the total coliform is higher than any other parameter in the samples.

The biological analysis shows high total coliform in all the locations. The presence of the coliform indicates faucal pollution and signal a potential health hazard in the nearby future. This pollution is basically from animal human sources due to poor sanitary conditions in Naka town. The study has shown that the level of contamination of other parameters such as magnesium, pH, turbidity, colour, odour, varies from place to place and some of the parameters fall within the acceptable limit of drinking water as recommended by WHO.

6. Recommendations

Based on the result of this study, the following recommendations are made:

i. Awareness should be created among inhabitants of Naka town on the communal methods of water treatment such as boiling and filtration before using for domestic purpose.

ii. To improve on the quality of water from those wells, water from all hand dug wells should be treated using the process of sedimentation, disinfection and filtration process before use.

iii. Public awareness importance of basic hygiene and efficient waste disposal methods should be constantly carried out to boost the role of general public in curtailing anthropogenic activities that degrade ground water quality.

iv. Finally, the federal and state government should provide water treatment plant that will supply portal water for inhabitants of Naka town.

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