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EVALUATION OF GROUNDWATER QUALITY CHARACTERISTICS IN THE VINICITY OF ASBESTOS FACTORY IN BAUCHI STATE, NIGERIA

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Abstract
Groundwater quality around Industrial areas is subject to test particularly on its portability. Bigi and Gudum villages are the study area and the Asbestos factory is situated around them. Many research have shown that where Asbestos industry is cited the health of the inhabitant and the company workers are threaten. Eighteen (18) water samples were collected from six (6) functional hand dug wells, samples collection repeated 3 times at different period range between 2010 to 2014 and analyses it physicochemical characteristics of Sixteen (16) parameters while the chemical parameters are Fe, Mn, Mg, Pb, Cr, Cd, SiO2, Na and Ca. which are part of the chemical composition of Asbestos fibers such as Chrysotile Mg4 Si2 O5 (OH) 4, Crocidolite Na2 +Fe2+Fe3 Si8O22 (OH)2 etc. while the physical parameters are PH, Temperature, Conductivity, Alkalinity, Total Hardness, Hardness, TSS and TDS. The obtained values from laboratory analysis are compared with Nigerian and WHO standard guidelines for drinking water. The analytical result represented statically in table 1 revealed that most of the chemical parameters of the water analysed from the wells in the study area exceeded WHO and National standard guidelines for drinking water. Meanwhile some of physical parameters are also above WHO and National standard. In conclusion, it can be said that the Asbestos factory (Supercor Nigeria Limited) has impact on Bauchi environs especially those that are located in the immediate surroundings. It is recommended that the houses located very close to factory and the well which is the major source of water in the village, should be located 1km away from the factory and any possible source of contamination.

Keywords: Evaluation; Groundwater; Quality; Asbestos and Factory.

Background to the Study
Portability of groundwater in many communities depends solely on numerous attributing factors from both individual, community efforts, government and other organizations. Despite the advantages of ground water, however ground water is susceptible to pollution as a result of recent or past activities. The sources of pollution may be municipal sewage, industrial discharges and agricultural activities. (Umar, 2009)

Many researchers have shown that where Asbestos industry is sited the health of the inhabitants and company workers are threatning (EPA, 1990). Asbestos fibers are releases into environment through erosion (leaching) and carried by wind. Asbestos is released to the environment from both natural and

anthropogenic sources and has been detected in indoor and outdoor air, soil, drinking water, food, and medicines (ATSDR 2001).

Asbestos are generally made up of fibers bundles such as Chrysotile Mg4 Si2 O5 (OH) 4, Crocidolite Na2 + Fe2 + Fe3 Si8O22 (OH) 2, Amosite Fe7 Si8O22 (OH) 2 etc. All asbestos fibers are hazardous to human health. High concentration of these chemicals Fe, Mg, Si, Al, Mn, Ca. in ground water is known to be carcinogenic material (i.e. it causes cancer and tumor relate disease) (ATSDR, 2001). All metal are soluble to some extent in water while excessive amount of any metals may present health hazard. Continues exposure to elevated level on the other hand, can be deadly (Tebbult, 1983).

High levels of asbestos fibers in drinking water, and a small but statistically significantly increased incidence of benign intestinal tumors in one National Toxicology Program (NTP) study of male rats exposed to Chrysotile in their food for life (ATSDR, 2001). However, the increased gastrointestinal mortalities noted in workers and in populations exposed through drinking water were usually quite small, Some investigators have proposed that Chrysotile fibers may not be the primary cause of mesothelioma in humans exposed predominantly to Chrysotile, whereas others have proposed that amphibole fibers are more potent than Chrysotile in this regard (see Berman et al. 1995; Case 1991; Churg 1988; Churg and Wright 1994; Frank et al. 1998; Langer. This is a factsheet about a chemical that may be found in some public or private drinking water supplies. It may cause health problems if found in amounts greater than the health standard set by the WHO.

Evaluation of the performance of ground water quality aims primarily by ensuring safe drinking water quality for the presence and the future. The rapid growth of urban areas and industries further affected the groundwater quality due to over-exploitation of resources and improper waste disposal practices. Quality is determined based on physical and chemical parameters, the factors are being correlated to the established national and international standards of safety for each parameter. Ground water source on other hand being widely distributed source and not immediately influence by vagaries of weather, constitute an assured measured of supply. It is relatively free of pollutants and is especially useful for domestic use in Nigerian villages, town and cities.

Asbestos contaminated material has occurred throughout the first 16 years of operation at Bigi site of Bauchi metropolis. This can be attributed to absence of any treatment plant in the factory and uncontrolled disposal of waste material and wastes from laboratories which enter into the ground, Discharge of the asbestos dust from the exhaust into the atmosphere and open dumping of Asbestos waste on ground in the factory premises (Ojobe, 1997). The success of this research like any other assessment of the concentration of chemical in ground water will help in ensuring safe ground water supply as a way of curtailing many direct threats to human health and environmental degradation

Study Area

The Asbestos factory is situated along latitude 10016'07.6”N and 10016'22.6"N and longitude 009050'41.4"E and 009050'56.3"E. Bigi and Gudum villages are the study area and the Asbestos factory is situated around them in Bauchi State the North Eastern State of Nigeria has a total land area of

66,510,045 sq km and has borders with Kano, Kaduna, Plateau, Taraba, Yobe, Jigawa and Gombe States. The population of Bauchi town from 1991 to 2007 is 513439 people. The present population of Bauchi town comprises mainly of Hausa, followed by Fulani other prominent tribes include Galawa, Jarawa, Sayawa and host of other the Igbo, Yaroba, Kanuri, Efik, Ngas etc.

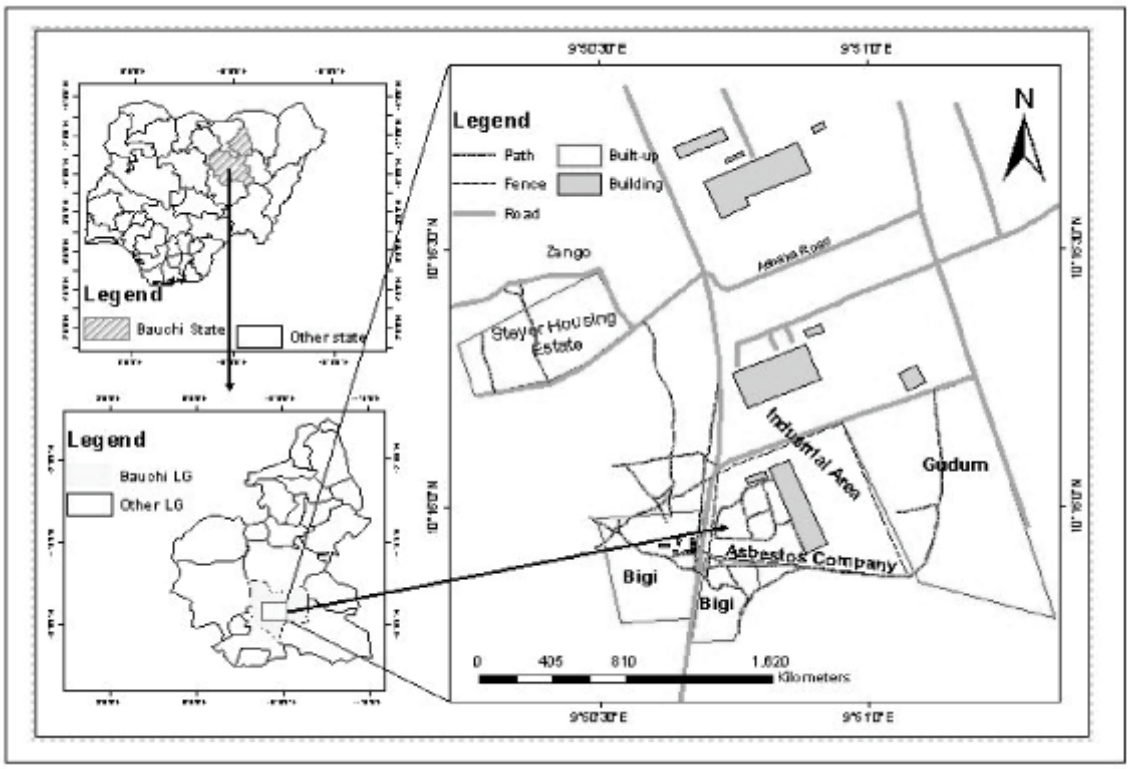

Figure 1: Nigeria showing Bauchi State, and Bauchi State showing Bauchi Local Government Area and showing study area

Materials and Methods

Sampling Techniques

Water samples was collected through systematic and randomly from various hand dug wells within Bigi and Gudum villages situated in the vicinity of Asbestos factory

Sample Collection

Eighteen (18) water samples were collected from six (6) functional hand dug wells, samples collection repeated 3 times at different period range between 2010 to 2014, patching pail were used to collected water sample and do not allow the pail to touch the wall of the well and pail was to sink completely in the ground water and collecting several times at list three times and measure 2litres. Before filling the samples bottle it was rinse three times with the water been collected.

Records of all sample collected was made and identify every bottle by attaching an appropriately inscribe tag or label. Sufficient information was record in a booklet to provide positive sample identification at a later date, as well as the name of the sample collector, the date, time and exact location,

Sample Handling and Transportation

Certain Citaions are subject to loss by absorption on, or exchange with, the walls of containers. These include all major and trace metals such as calcium, potassium, aluminium, iron, manganese, lead etc. which collected in a separate clean bottle. Once samples collected was immediately taken laboratory in a dark cool environment using cold packs

Parameters	Bigi Village		Gudum Village		WHO Thresholds Limit (2008)	Nigeria Thresholds Limit (2007)
	Mean ± SD	Range	Mean ± SD	Range		
pH	7.12 ± 0.288	6.68 – 7.40	7.01 ± 0.219	6.82 – 7.41	6.5 – 8.5	6.5 – 8.5
Temperature (^{0}C)	32.32 ± 0.185	32.40 – 32.60	32.27 ± 0.103	32.10 – 32.40	-	-
Conductivity (? S/cm)	4.82 ± 181.5	214 – 503	5.502 ± 159.02	317 – 648	-	1000
Alkalinity (mg/L)	8.95 ± 14.83	0 – 33.55	14.68 ± 15.02	0-29.20	200	-
Total Hardness (mg/L)	1.68 ± 62.6	80 – 260	1.71 ± 48.83	137 – 254	500	150
Total Suspended Solids (mg/L)	8.00 ± 8.268	2 – 29	4.00 ± 1.414	4 – 5	-	-
Total Dissolved Solids (mg/L)	2.162 ± 72.18	106 – 363	2.51 ± 82.53	158 – 323	30	500
Cadmium (mg/L)	0.011 ± 0.005	0.0014 – 0.014	0.013 ± 0.01	0.004 – 0.024	0. 002	0.003
Calcium (mg/L)	3.44 ± 2.88	32 – 104	1.85 ± 2.122	54.80 – 101.6	-	-
Chromium (mg/L)	0.101± 0.073	0.013 – 0.204	0.503 ± 0.019	0.033 – 0.4	0.05	0.05
Magnesium (mg/L)	0.59 ± 0.22	0. 24 – 0.781	0.616 ± 0.434	0.236 – 0.07	30	0.2
Manganese (mg/L)	0.78 ± 0.743	0.2 – 2.289	0.209 ± 0.133	0.049 – 0.4	0.2	0.2
Iron (mg/L)	3.86 ± 4.124	1.125 – 13.79	4.145 ± 4.98	0.175 – 13.58	0.1	0.3
Lead (mg/L)	0.39 ± 0.236	0.1482 – 0.822	0. 573 ± 0.083	0.4986 – 0.606	0.01	0.01
Sodium (mg/L)	7.88 ± 4.302	2.11 – 18.26	7.57 ± 2.97	20.07 – 37.21	200	200
Silica (mg/L)	85.34 ± 288.4	0.853 – 1.97	3.15 ± 0.11	3.07 – 3.26	-	-

Sampling Area

The area of sampling is Bauchi metropolis the water sample were collected from various point within the study area as shows below:

Well 1.	Bigi, Primary School	50m to factory fence
Well 2.	Bigi,Idris Solomi	47m to factory fence
Well 3.	Bigi, Rijir Wali	53m to factory fence
Well 4.	Gumun Hausawa, Adjacent To Poultry	250m to factory fence
Well 5.	Gumun Hausawa, Husbandry	80m to factory fence
Well 6.	Bigi, Daniel Maina	34m to factory fence

Laboratory and Procedure

The whole sample reagents, apparatus and machines for this research were obtained from National Research Institute for Chemical Tecnology (NARICT), Environmental Pollution laboratory under Ahmadu Bello University Zaria and Bauchi State Water Board Treatment Plan Laboratory.

Procedure for Analysing Iron, Mn, Cr, Cd, and Pb

A 25ml of distilled water (Blank Sample) was measured and poured into sample cell (a bottle) so also 25ml of water sample in another sample cell. The sample contained the distilled water was placed on spectromometer and allowed to warm for 15 seconds it was then removed. A reagent iron phenolthroline was poured into the water sample shook until dissolved then placed on spectrophotometer. The programme number of iron (257) was input and a given wavelength (510) was asked by the machine to adjust, after adjusting a shift key was pressed followed by the enter key and waited for 3 minute. The reading was taken when the maximum steady value was reached.

Procedure for Analysing PH

pH	7.12 ± 0.288	6.68 – 7.40	7.01 ± 0.219	6.82 – 7.41	6.5 – 8.5	6.5 – 8.5
Temperature (^{0}C)	32.32 ± 0.185	32.40 – 32.60	32.27 ± 0.103	32.10 – 32.40	-	-
Conductivity (? S/cm)	4.82 ± 181.5	214 – 503	5.502 ± 159.02	317 – 648	-	1000
Alkalinity (mg/L)	8.95 ± 14.83	0 – 33.55	14.68 ± 15.02	0-29.20	200	-
Total Hardness (mg/L)	1.68 ± 62.6	80 – 260	1.71 ± 48.83	137 – 254	500	150
Total Suspended Solids (mg/L)	8.00 ± 8.268	2 – 29	4.00 ± 1.414	4 – 5	-	-
Total Dissolved Solids (mg/L)	2.162 ± 72.18	106 – 363	2.51 ± 82.53	158 – 323	30	500
Cadmium (mg/L)	0.011 ± 0.005	0.0014 – 0.014	0.013 ± 0.01	0.004 – 0.024	0. 002	0.003
Calcium (mg/L)	3.44 ± 2.88	32 – 104	1.85 ± 2.122	54.80 – 101.6	-	-
Chromium (mg/L)	0.101± 0.073	0.013 – 0.204	0.503 ± 0.019	0.033 – 0.4	0.05	0.05
Magnesium (mg/L)	0.59 ± 0.22	0. 24 – 0.781	0.616 ± 0.434	0.236 – 0.07	30	0.2
Manganese (mg/L)	0.78 ± 0.743	0.2 – 2.289	0.209 ± 0.133	0.049 – 0.4	0.2	0.2
Iron (mg/L)	3.86 ± 4.124	1.125 – 13.79	4.145 ± 4.98	0.175 – 13.58	0.1	0.3
Lead (mg/L)	0.39 ± 0.236	0.1482 – 0.822	0. 573 ± 0.083	0.4986 – 0.606	0.01	0.01
Sodium (mg/L)	7.88 ± 4.302	2.11 – 18.26	7.57 ± 2.97	20.07 – 37.21	200	200
Silica (mg/L)	85.34 ± 288.4	0.853 – 1.97	3.15 ± 0.11	3.07 – 3.26	-	-

The instrument PH meter was put in a sample to standardize it. Then water sample and agitate, a reading taken after disappearing of small clock on the screen.

Procedure for Titration of Alkalinity (CaCo3) Mg/L

A 25ml of water sample and 100ml of distilled water was measured and poured in a single conical flask. Regent of 4 drops of phenotheline and 1 sachet of Bromcresol Green and drop of mythel re indicator was added and the colour of the solution changed to blue, if there is no change in colour, carbonate alkalinity would be present. 1.6ml of H2 SO4 was injected into Digital Tatritor. The lower tube of Digital Tatritor was placed into a conical flask contained the above solution, the scroller in the Digital Tatritor was scrolled until there were change to blue – grey on the Digital Titrator at that point gave the value.

Statistical analysis of analytical data

Simple descriptive Statistics, One way parametric analysis of variance (ANOVA) and Duncan multiple range test of variable with harmonic mean sample size of 3.6 at $P < 0.05$ were used to ascertain statistical significance difference in the observed concentrations in the groundwater between two villages around the factory.

Result and Discussion

Table 1: The Levels of Physicochemical Parameters in Water Samples
Source: Laboratory Analysis 2010 to 2014, significant difference ($p < 0.05$)

PH

The mean PH value obtained at Bigi village is 7.12mg/l while, the mean value obtained at Gudum village ranges from 7.01mg/l, this is shown in Table 1. The highestvalue of PH (7.40mg/l) was recorded atBigi well 1, while the lowest (6.82mg/l) wasat Gudum. However the result shows that the statistical comparison of PH value at Bigi (7.12 ± 0.288) and Gudum (7.01 ± 0.219), revealed high mean value at Bigi than Gudum, while, The PH result for the entire water samples was found to be neutral; (i.e. no acidity and no alkalinity) this shows that in terms of water PH for the sources analysed is neutral.

Temperature

The mean value of Temperature obtained at Bigi ranges from 32.40 – 32.60. While, at Gudum ranges from 32.10 – 32.40 of water samples analysed and these are presented in Table 1. The highest mean value of Temperature (32.32 oC) was recorded in water sample obtained at Bigi (i.e. well 6), while the least (32.27 oC) was recorded in samples collected at Gudum village. The statistical comparison of Temperature at Bigi (32.32 ± 0.185oC) and at Gudum (32.10 – 32.40oC) water samples revealed no much mean values difference between Bigi and Gudum. Hence the Temperature of water of the study area is virtually the same and does not matter most since there is no specified limit of WHO and National standard provided for temperature. However, generally potable water has low temperature which is necessary for its palatability and wholesomeness.

Conductivity

The average conductivity value ranges from (214 – 503 µS/cm) was obtained at Bigi, while, that of Gudum ranges from (317 – 648 µS/cm). The highest mean value of conductivity (727 µS/cm) was recorded in water sample obtained at Gudum (i.e. well 3), while the least conductivity value (214 µS/cm) was recorded from samples collected at Bigi village, the analytical result revealed for conductivity of the whole water sample analysed satisfied National guidelines for drinking water. In the other hand Total Dissolve Solid is the half of conductivity.

Total Hardness

The mean value of Total Hardness obtained at Bigi village ranges from 1.68 mg/l. While, that obtained at Gudum village ranges from 1.71 mg/l, this is shown in Table 1. The highestvalue of Total Hardness (260mg/l) was recorded atBigi (well 1), while the lowest (80mg/l) was alsoat Bigi (well 2). However the result shows that the statistical comparison of Total Hardness value at Bigi (1.68 ± 62.6) and Gudum (1.71 ± 48.83) revealed high mean value at Bigi than Gudum, while, with this regard asbestos factory is another contributor to contamination of the water because hardness is produced mainly due to Calcium and Magnesium ions, these metals (Calcium and Magnesium) are constituents of the product produced by the company and released as pollutants which contaminate the drinking water of the areas around the factory. The result shows that almost water sources analysed is hard.

Total Dissolve Solid

The mean value of Total Dissolve Solid obtained at Bigi village ranges from (2.162 ± 72.18mg/l). While, that obtained at Gudum village ranges from (2.51 ± 82.53mg/l), this is shown in Table 1. The highestvalue of TDS (363mg/l) was recorded atBigi (well 1), while the lowest (106mg/l) wasalsoat Bigi. From the result in Table 1 it shows that the highest level of the TDS from the entire wells is 363mg/l which satisfies WHO and Nigerian standard that has maximum allowable limit of <500mg/l for drinking water quality. However the presence of high levels of TDS in drinking-water may be objectionable to consumers.

Total Suspended Solid

The mean of TSS value obtained at Bigi village ranges from (8.00 ± 8.268mg/l). While, that obtained at Gudum village ranges from (4.00 ± 1.414mg/l), this is shown in Table 1. The highestvalue of TSS

(29mg/l) was recorded atBigi (well 6), while the lowest wasat Gudum (2mg/l). However no limit is specified by WHO and Nigerian standard for suspended solid levels. However, the current EC guidelines specify that suspended solid should be completely absent in drinking water. The result of suspended solid levels shows that the water samples have high concentration of TSS, which makes the water turbid.

Iron

The mean value of Iron obtained at Bigi village ranges from (1.125 – 13.79mg/l). While, that obtained at Gudum village ranges from (0.175 – 13.58mg/l), as shown in Table 1. The highestvalue of Iron (13.79mg/l) was recorded atBigi (well 6), while the lowest (0.125mg/l) was alsoat Bigi. WHO and Nigerian guidelines give a limit value of (0.3mg/l) for drinking water and almost all wells have value above these standards. Dissolved Iron, though not harmful to human health, does have adverse impact on some aesthetic quality of potable water e.g. taste, color and sometime odour. Most underground water sources in Nigeria have dissolved Iron.

Magnesium

The average level of magnesium ion at Bigi's water was (0.59 ± 0.22mg/l) and that obtained at Gudum's wells water was (0.616 ± 0.434mg/l). The mean value of magnesium obtained at Gudum village was higher than that of Bigi village. While, the mean value obtained between two villages have slight difference, as shown in Table 1. The highestvalue of magnesium (0.78mg/l) was recorded atBigi (well 6), while the lowest (0.24mg/l) was alsoat Bigi and the analytical result of wells water shows that the magnesium ion in the entire wells water exceeded National standard and is one of the factors that cause hardness of wells water in the regions.

Sodium

The mean value of Sodium obtained at Bigi village ranges from 2.11 – 18.26mg/l While, that obtained at Gudum village ranges from 20.07 – 37.21mg/l, as shown in Table 1. The highestvalue of Sodium (18.26mg/l) was recorded atGudum (well 3), while the lowest (2.11mg/l) wasat Bigi. WHO and Nigerian guidelines give a limit of permissible concentration as 200mg/l. From Table 1 the value are all below that limit which has a range value of (2.11 – 37.21mg/l) and hence satisfied the aforementioned standards. The mean value difference of sodium at Bigi (7.88 ± 4.30mg/l), and at Gudum (7.57 ± 2.97mg/l), this revealed slight difference between Bigi and Gudum. Excess of sodium in drinking-water can cause hypertension; in addition concentrations in excess of 200 mg/l may give rise to unacceptable taste

Calcium

The mean value of Calcium obtained at Bigi village ranges from 32 – 104mg/l. While, that obtained at Gudum village ranges from 54.80 – 101.6 mg/l as shown in Table 1. The highestvalue of Calcium (104mg/l) was recorded atBigi (well 6), while the lowest (32mg/l) wasalso at Bigi. Water samples analysed revealed high mean value difference at Gudum than Bigi. Therefore WHO specified limit for Calcium is (75mg/l). The result from Table 1 shows that (well 3), (well 5) and (well 6) are significantly above permissible limit while, other sources satisfy WHO standard. Meanwhile, no specified limit of

Calcium level was provided by National standard. Higher concentration of calcium causes hardness that causes furies in kettle and boiler and do not forms lather with soap and hence causes soap wastage.

Total Alkanity

The mean value of Total Alkalinity obtained at Bigi village ranges from (8.95 ± 14.83mg/l) While, that obtained at Gudum village ranges from (14.68 ± 15.02mg/l), as shown in Table 1. The highestvalue of Total Alkalinity (33.55mg/l) was recorded atGudum (well 6), while the lowest (0mg/l) wasat Bigi and Gudum. High Alkane water are undesirable because of corrosive hazard and possible difficult in treatment. WHO and National guidelines give a limit of permissible concentration as 200mg/l. at Table 1, the obtained values have entirely satisfied the guidelines, which range from (0 – 33.55mg/l). The result shows that there is no concentration of salt in the ground water sources.

Silicate

The average Silicate value ranges from 0.853 – 1.97mg/l was obtained at Bigi, while, that obtained at Gudum was 3.07 – 3.26mg/l. The highest mean value of Silicate (3.26mg/l) was recorded in water sample obtained at Gudum (i.e. well 4), while the least Silicate value was at Bigi (1.97mg/l). Hence the mean values comparison of Silicate at Bigi was (85.34 ± 288.4mg/l) and that of Gudum was (3.15 ± 0.11mg/l) water samples revealed much significant difference between Gudum than Bigi. No specified limit of WHO standard and National standard was provided for Silicate.

Heavy Metals (Mn,Cr, Cd, Pb)

The analytical result represented statically in table 1 revealed that most of the chemical parameters of the water analysed from the wells in the study area exceeded WHO and National standard guidelines for drinking water. The Mn, Cr, Cd, and Pb are carcinogenic when it exceeded acceptable limit. The result from the table 1 ranges from 0.2 – 2.289mg/l, this shows that the manganese level of entire ground water sources exceed maximum permissible limit of WHO and Nigerian standard which provide a limit value of (0.2 and 0.3mg/l). High level of manganese in drinking water has the possibility of causing Neurological disorder. Statistical comparison of the levels of these metals in groundwater in the study area is above the threshold limit

Discussion of Result

The evaluation of Physico and chemical characteristic of ground water quality In this study, the analytical results revealed that, the mean values of Bigi village wells water shows highest mean value difference in terms of PH, Iron, Manganese and others aforementioned result citated, almost high at Bigi water sample analysed than Gudum. While, there was much mean value difference in statistical comparison in terms Alkanity, Silica, Sodium, and TDS of Gudum water higher than in Bigi waters. This shows that the whole villages' wells waters are pollute. The analytical results revealed that the physicochemical characteristics of the wells water, were by well 6 are significantly very high in terms of manganese, Iron, Mn, Cr, Cd, Pb, Calcium, magnesium, Total alkalinity, Total suspended solid, among the water sources, this shows that well 6 is more polluted than other sources and is situated in Bigi site and is very close to factory (Supercor Nigeria Limited) fence. This shows that Bigi is more polluted compared with Gudum. And lastly drinking water around study area is not potable.

Conclusion

The ground water in the study area is polluted because most of the chemical parameters analyzed exceed standard and high concentration of chemical in ground water and is said to be health hazard and increase incidence of tumor related diseases. The water resources in the study are not properly managed. In this study well 6 are more polluted than other sources and are situated at Bigi village and is very close to factory (Superco Nigeria Limited) fence. This also shows that Bigi is more polluted compared with Gudum. While the Manganese concentration of the water in the area was 0.2mg/l – 1.1mg/l, has the potential of causing neurological disorder and this shows there is high failure of pollution abatement measures in the area.

In conclusion, it can be said that the factory (Superco Nigeria Limited) has impact on Bauchi environs especially those that are located in the immediate surroundings.

Recommendations

Based on the outcome of this research work the following recommendations were made.

(1) The houses located very close to the factory and the well which is the major source of water in the village s, should be located 1km away from the factory and any possible source of contamination.

(2) Wells water should be boiled and filtered before use to reduce hardness; this will go a long way in reducing the cases.

(3) The government should supply safe water for drinking and domestic uses through pipe lines networking throughout the villages as a substitute to ground water.

(4) Water development should go hand in hand with water quality consideration.

(5) The factory should treat their liquid properly by installing modern treatment plants.

(6) The factory should construct sanitary land fill to dispose their solid waste properly instead of dumping openly in their premises. These lands should be line with leak proof material such as bitumen to prevent leaching problem.

(7) Periodical analysis of water quality of the environment should be made and be compared with previous value to check the cumulative impact the factory has on the environment.

(8) This project only checked the impact the factory has on environment with reference to ground water. It is also recommended that further work to be carried out in the future to check the impact on the basis of particular matter emitted into the atmosphere.

(9) It is important to initiate campaign, to inform the people on the level of well water contamination and the sanitation steps to be followed for ensuring safe drinking water.

(10) To avoid polluting environment and contaminating ground water, the FEPA and BASEPA should be monitoring and reviewing the factories EIA and ensure implementation of pollution abatement act in the factories.

(11) Monitoring should be carried on regular basis on the activity of the industries around, not only restricted to the asbestos factory.

(12) The public at large should be educated on the possible impact associated with living around or nearby industrial site and its consequence.

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