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Effects of Small Scale Industries Proliferation on the Quality of Water for Domestic use in Bauchi State, Nigeria

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Abstract:- The importance of water, sanitation and hygiene for health and development has been discussed in various fora. Rapid industrialization and indiscriminate use of chemical fertilizers and pesticides have caused various degrees of pollution in aquatic environment which lead to the deterioration of water quality. The study was conducted to assess the effects of small scale industries proliferation on the quality of water used for domestic purposes in Bauchi state, Nigeria. Simple random, cluster and purposive sampling techniques were used to select the headquarters of three LGAs of Bauchi state. Nine in one (9 in 1) water test strips were used to determine the quality of water on the spot. The parameters determined on the spot included: KH, pH, Carbonate (CO_3), General Hardness (GH), H_{25}, Nitrate (NO_3), Nitrite (NO_2), Chloride and Total Contamination Level (TCL). The results of the study revealed high level of concentration of hardness (KH = 240mg/L and GH = 450mg/L), Total Contamination Level (10mg/L) and Nitrate (10mg/L). The contamination and hardness of the water found in Bauchi state, Nigeria could be as a result of the proliferation of small scale industries whose wastes generated are washed and leaked into water systems. Relevant authorities and agencies such as Environmental Protection Agencies should be proactive in running and monitoring basic water tests to assess the quality of water and detect possible associated problems.

Keywords:- *Effects, Small scale industries, Proliferation, Water quality, Bauchi state.*

I. INTRODUCTION

Small scale industries are industries in which the process of manufacturing, production and servicing are done on a small scale. A small scale enterprise is a business that is not large, in terms of its size, scope of operation, financial involvement and the workforce involved. Most small scale enterprises are owned by one entrepreneur. The federal ministry of industries (2001) defined a small scale enterprise as an enterprise whose total cost including working capital but excluding cost of land, does not fall below one million naira and does not exceed forty million naira and having number of employees between 11 to 35 workers (Obi, 2015). Isaac and Oluwaniyi (2021) defined small scale enterprise as those enterprises whose total assets (excluding land and building) are above five million naira but not exceeding fifty million naira with a total workforce of above ten, but not exceeding forty nine employees.

Small scale industries in Nigeria include: private tutoring, hair styling, fashion businesses, personal catering, photography, content creation, sachet water factory, poultry rearing, make up services, bakery industries. Others are paper, toothpick, pen, candles local chocolates etc. Small scale industries play significant role in the economic development of any country. The importance small scale industries include among others: ensuring food security, manufacturing of daily need commodities, employment creation, youth engagement and development, improving Nigeria's technical capacity as well as marketing of goods and services.

Nigeria has witnessed the proliferation of small scale businesses which are aimed at increasing industrial output and subsequent economic growth and development through the efficiency of small scale enterprise (Uduak, 2016). This explains why small scale enterprises are everywhere in every sector and are seen in every community.

Wastes generated by small scale industries are: metals, plastics, chemicals, papers, wood, fabrics, stones, food, ceramics, glass, candles and cooking oils among others. The hazards associated with wastes include environmental pollution, CO_2 emissions, human diseases, health disaster and marine life destruction (Derbab&Elkhwesky, 2023).

Martinez and Poveda (2022) reported that SMEs represent 90% businesses in the globe, maintain 50% of employment and generate 40% of the natural gross domestic product in emerging countries. SMEs generate pollution and waste. Fahad*et al.* (2022) stated that More than 70% of waste emissions are generated in form of solid, gas and liquid which are often overlooked in Nigeria. The uncollected solid and liquid wastes could cause infectious diseases and pollution of air, soil and water.

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Liquid waste is produced both domestically and industrially, water in large quantities is needed in almost all industrial processes which may be contaminated by harmful substances such as radioactive materials, dirty water, detergent, organic liquids and waste detergent. This type of waste can cause harm to humans, animals and the environment, and if not properly managed, may contaminate waterways such as rivers and lakes. This type of waste is generally a by-product of other materials generated by industries, hospitals and manufacturing facilities (De Vroom, 2019).

Solid waste such as paper, plastic, wood, cardboard, scrap metal etc, if not properly handled serves as breeding zones for insects and rodents which consequently result in infection (Fahrion, 2019). Solid waste according to environmental protection agency is chemical waste. Most industrial activities produce certain chemical waste which includes all types of inflammable, corrosive, toxic and explosives (Fahrion, 2019).

II. SMALL SCALE INDUSTRIES IN BAUCHI STATE

Field survey by the research team revealed that Bauchi state like many other states in Nigeria is full of small scale industries some of which were identified at the time of the visit include: grinding mills, barbing saloon, hair dressing saloon, dry cleaning factories, sachet water factories, bread factories, food restaurants, blacksmith factories, ready to eat foods/meat joints, poultry houses, fish farming ponds, motor mechanic workshops, GSM repair containers, electronic repair shops and etc. The wastes generated by these small scale industries could be in liquid, solid or gaseous state and may be washed off or dump into water bodies leading to its contamination. This research was conducted to assess the effects of small scale industries proliferation on the quality of water used for domestic purposes in Bauchi State, Nigeria.

III. THE IMPORTANCE OF QUALITY WATER

Access to safe drinking-water is essential to health, a basic human right and a component of effective policy for health protection. Most recently, the UN general assembly declared safe and clean drinking water and sanitation a human right essential to the full enjoyment of life and all other human rights. Access to safe drinking water is important as a health and development issue at national, regional and local levels. In some regions, it has been shown that investments in water supply and sanitation can yield a net economic benefit (WHO, 2011).

Quality water should be colorless, tasteless and odorless. It should be free of microorganisms such as bacteria, virus, fungi, algae and others. It should be free from all kinds of chemicals such as pesticides, chemical fertilizers and others. It should be free from any trace of acid (Al-taai, 2021).

IV. WATER POLLUTION AND ITS SOURCES

Abiodun *et al.*(2016) opined that water contamination happens when undesirable materials with possibilities to undermine human and other common frameworks find their ways into waterways, lakes, wells, streams, boreholes or even held new water in homes and industries. Water contamination have kept on creating upsetting ramifications for wellbeing and economic development in Nigeria and the third world by and large, the outcomes of which includes 4.6 million death from diarrhea disease a sizeable number of casualties from ascariasis. In Nigeria today research indicates that, majority of the common fresh water sources are polluted, resulting to serious outbreak of diseases (Abiodun *et al.*, 2016). A study by Umeh *et al.* (2004) demonstrated that 48% of the general populations in Katsina Ala Local Government territory of Benue state are affected by urinary schistosomiasis because of expansion in contamination record.

Chemical contaminants from Agricultural lands such as heavy metals and other residues from fertilizers, insecticides and pesticides are washed into water bodies. Wastes from garages, residential areas (sewages) and so on are washed off continually into aquatic environments and constitutes water pollution. The acid rain from the atmosphere that drop in water bodies also constitute to the pollution of the water. According to Abiodun (2016), water contamination has a wide range of causes and this is one reason why it is such a troublesome issue to explain.

The most important sources of water pollution are industrial sources, especially tanning factories, lead, mercury, copper and nickel, paints,cement, glass, detergents, dairy sterilization plants, slaughterhouses, sugar refineries, hydrocarbon pollution resulting oil pollution. The wastes go to water because most factories do not adhere to industrial drainage controls by using pesticides and fertilizers. Also, waste leaks from homes have a significant impact on water pollution (Al-taai, 2021). Factory water and their wastes contain 60% of the total pollutants of seas, lakes and rivers. In developing countries, and even in developed one, most factories do not abide by industrial drainage controls, and throw their wastes into the water (Al-taai, 2021).

V. DOMESTIC WATER

This is water used for a residential and/or commercial application. Domestic water is used for indoor and outdoor household purposes. It is used for drinking, food preparation, bathing, washing clothes and dishes, watering garden and even brushing teeth. In all the Local Government areas selected in Bauchi state their sources of domestic waters were groundwater which included tap, well, borehole and rain water reservoirs.

VI. MATERIALS AND METHODS

The water samples were collected using sterilized universal containers and subjected to a test kits and laboratory procedures to determine the level of pollutants concentration in the water environment.

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VII. STERILIZATION TECHNIQUES

Sterilized universal containers were used for the collection of the sample, while glasswares were treated in the hot-air oven at 160°C for 2 hours. Growth media and diluents (distilled water) were autoclaved at 121°C for 15 min.

VIII. SAMPLING

The water samples used for this work were collected from two (2) different sources at three different sites in each selected Local Government Area (LGA) of Bauchi State. The samples were labeled according to the site of collection as Bauchi site 1 MudaLawalOgbonna Axis (B1 Well water, B2 Borehole water), Bauchi site 2 Central Market (B2 well water, B2 Borehole water) and Bauchi site 3 Yankari Pack Area (B3 well water, B3 borehole water). Ningi site 1 Tiffi (N1 well water, N1 borehole water), Ningi site 2 Emir's drive (N2 well water, N2 borehole water) and Ningi site 3 Lowcost (N3 well water, N3 borehole water). Katagum site 1, UngwanDankawu/ TashanGadau (K1 well water, K1 borehole water), Katagum site 2, Federal Lowcost/Garage (K2 well water, K2 borehole water) and Katagum site 3, Matsango (K3 well water, K3 borehole water).

Test strips (9 in 1) were used to determine the quality of water on the spot. The parameters determined on the spot included: KH, pH, Carbonate (CO_3), General Hardness (GH), Nitrate (NO_3), Nitrite (NO_2), Total Contamination Level (TCL), Chloride and K_{25}. The samples for Laboratory investigations were aseptically transported in ice pack to the dedicated NRF laboratory, Aminu Saleh College of Education, Azare Bauchi State. When samples could not be processed immediately, they were stored in refrigerator at 4°C.

IX. RESULTS

The results in figures 1 – 9 showed the parameters of ground water (well and borehole water) in Bauchi state Nigeria. Figure 1 revealed that Bauchi LGA recorded the highest pH (8.4) of well water and borehole water in all the three sites while site 3 in Ningi LGA had the least pH value of 5.0. The pH of well water ranges from 6.0 – 8.4 while that 0f borehole water ranged from 5.0 – 8.4. The nitrite level of both well and borehole water was zero (0) in all the sites of the three LGAs covered in the state (figure 2). Figure 3 showed that site 2 in Ningi LGA had the Nitrate concentration of 20mg/L while all the other sites had zero concentration. The results in figure 4 indicates well water in Bauchi LGA site 3 as having the highest carbonate (CO3) concentration of 80mg/L while borehole water had 20mg/L as the highest level of carbonate concentration. Majority of the sites had zero KH level in the three LGAs as shown in figure 5. Well water as well as borehole recorded the highest KH content of 250mg/L while both had zero as the least KH level.The general hardness of well water ranges from 25 – 450mg/L (figure 6) while borehole water had the range of 125 – 425mg/L. In figure 7, the hardness of both well and borehole was zero. The chloride level of well water shown in figure 8 was found to be in the range of 0.5 – 5 and that of borehole was in the range of 0.5 – 10mg/L. Figure 9 shows that the total contamination level of both well and borehole water had 10mg/L as the highest level of contamination and 0,5mg/L as the least level of contamination.

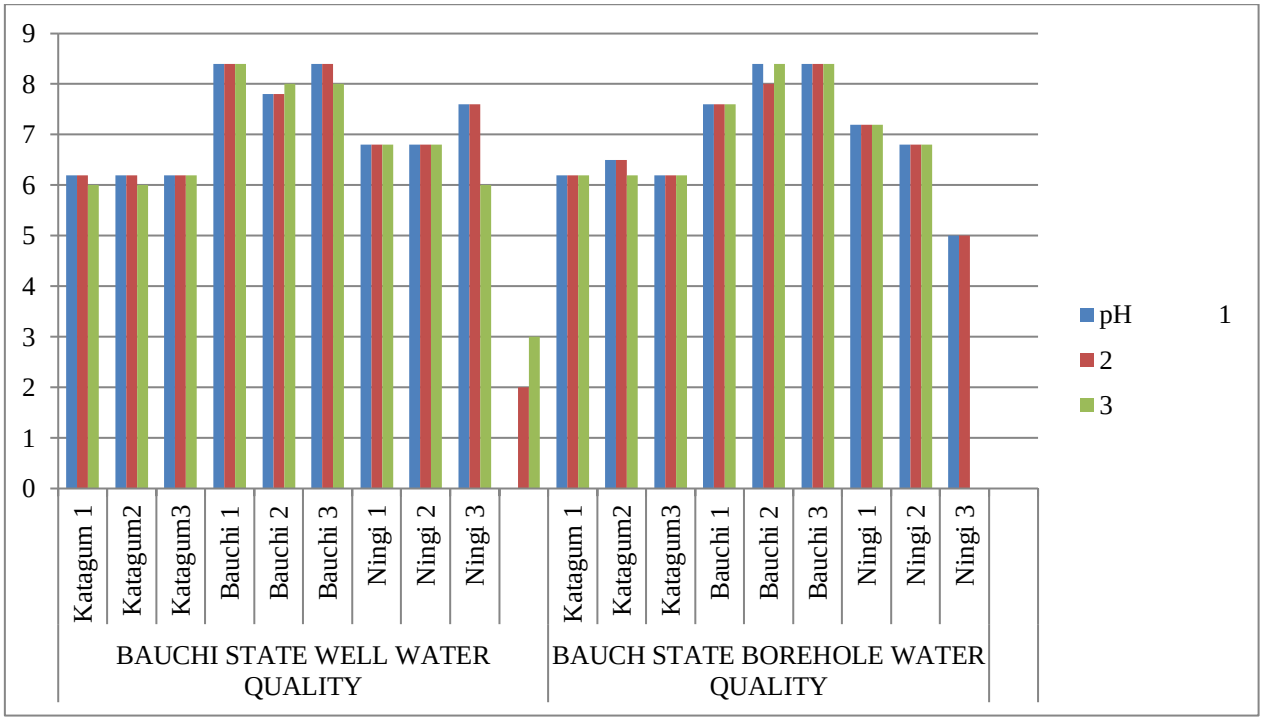

Fig. 1: pH of well and borehole water in Bauchi State

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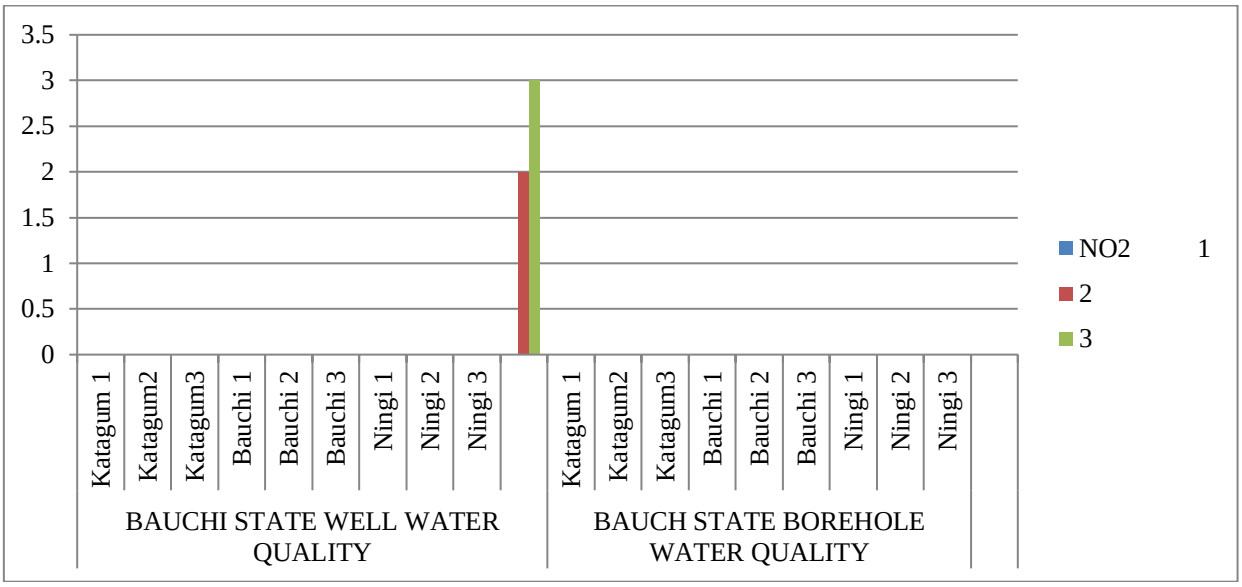

Fig. 2: Nitrite (NO2) of well and borehole water in Bauchi State

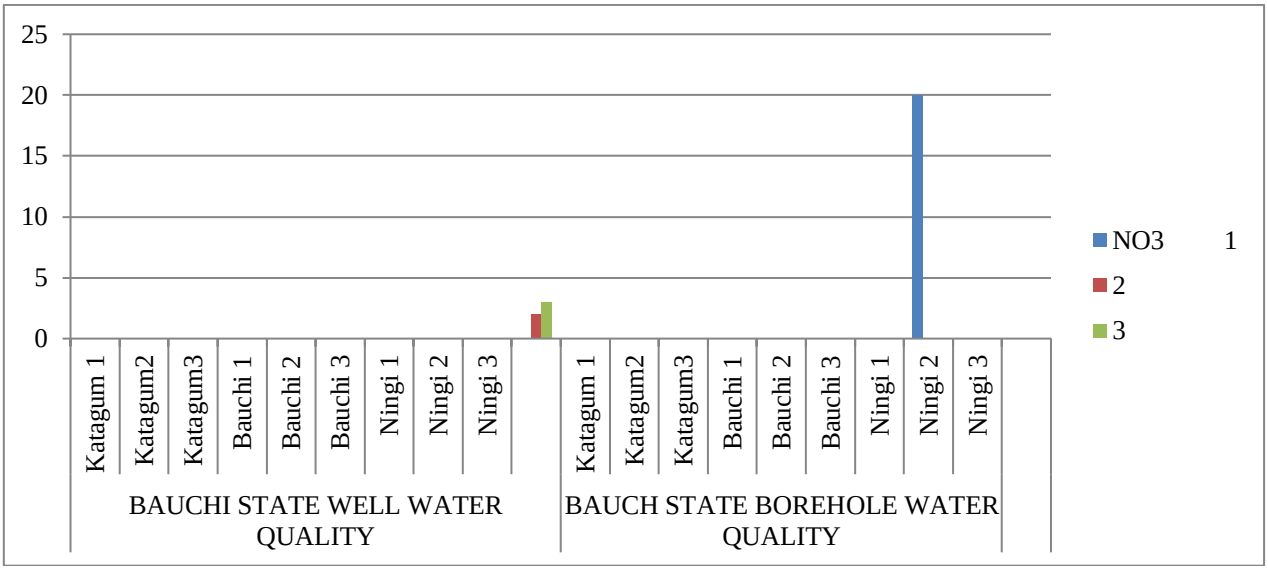

Fig. 3: Nitrate (NO3) of well and borehole water in Bauchi State

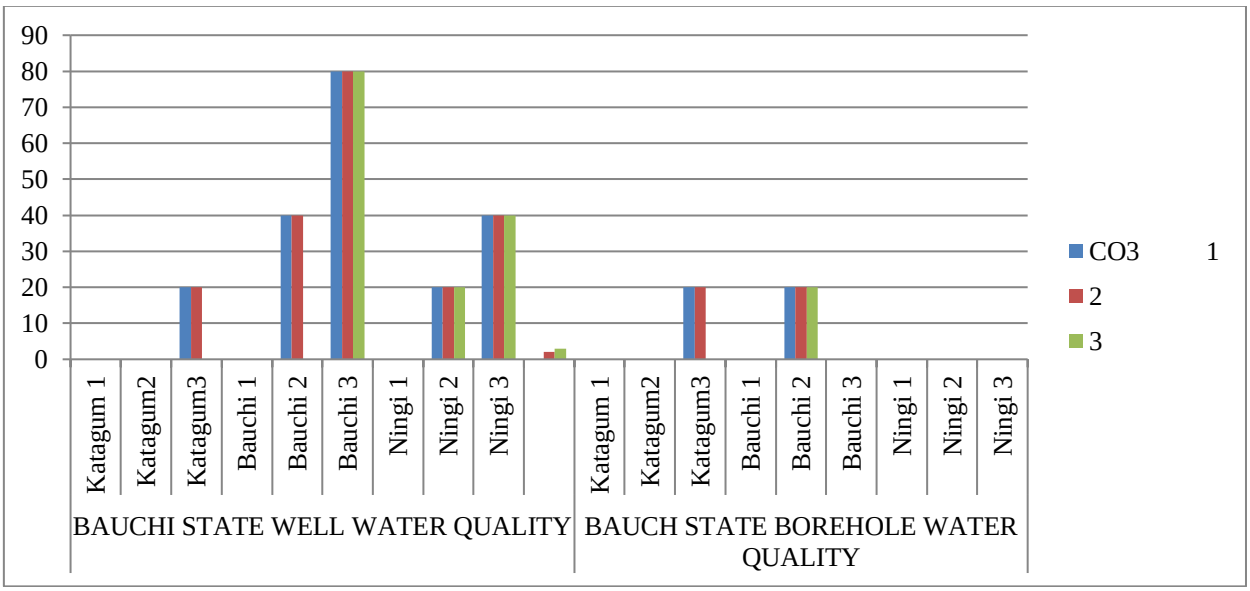

Fig. 4: Carbonate (CO_3) of well and borehole water in Bauchi State

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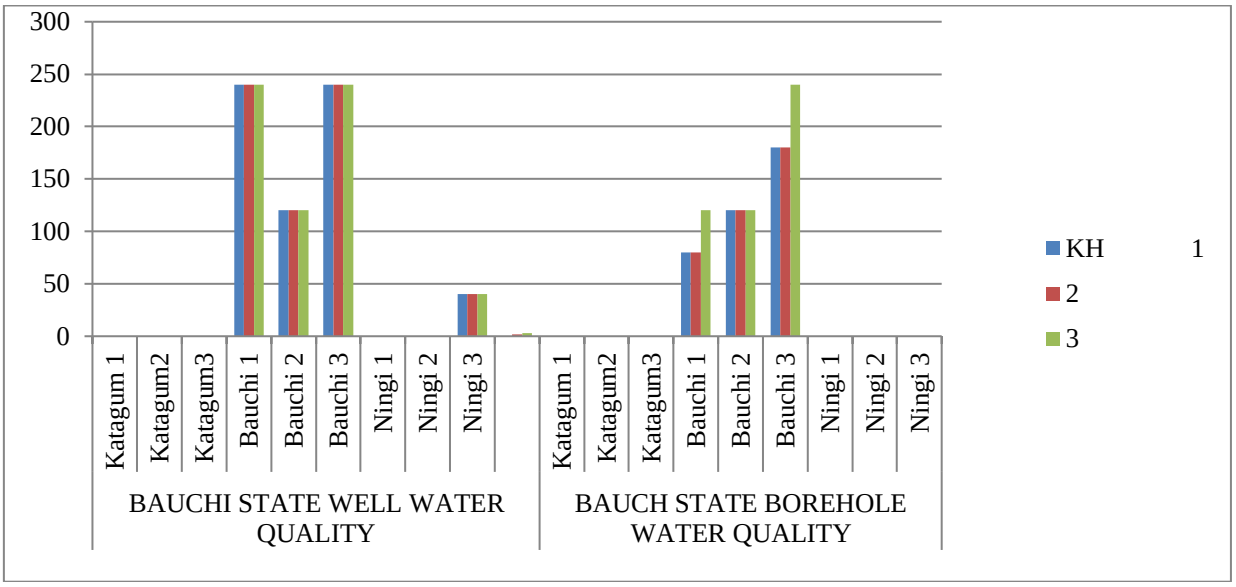

Fig. 5: KH of well and borehole water in Bauchi State

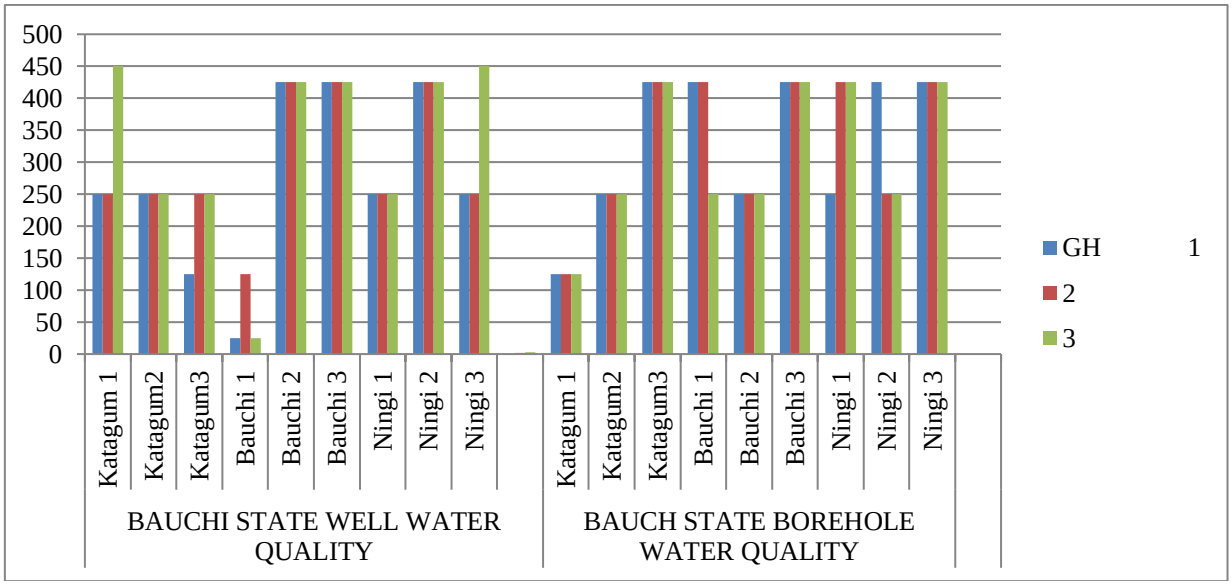

Fig. 6: General Hardness (GH) of well and borehole water in Bauchi State

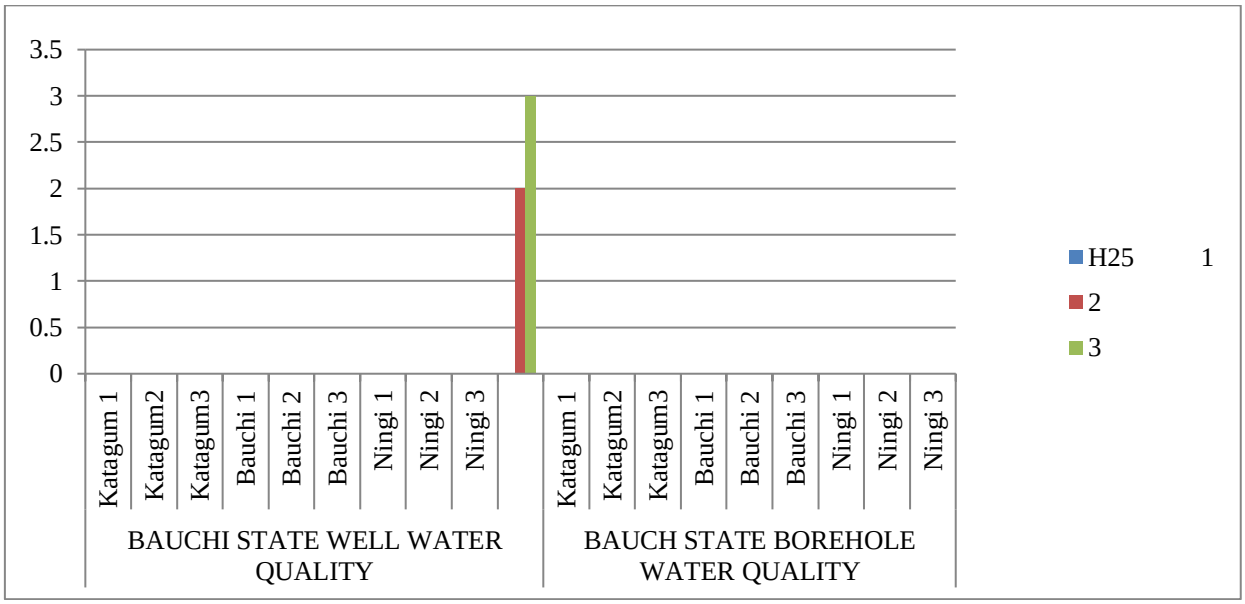

Fig. 7: H25 of well and borehole water in Bauchi State

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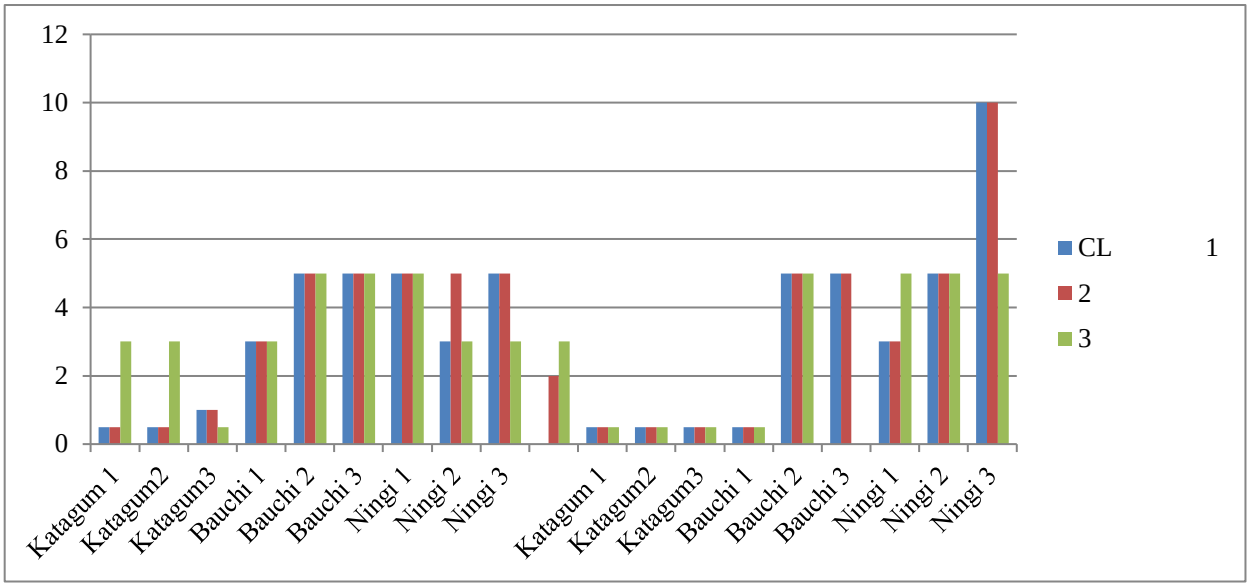

Fig. 8: Chlorides of well and borehole water in Bauchi State

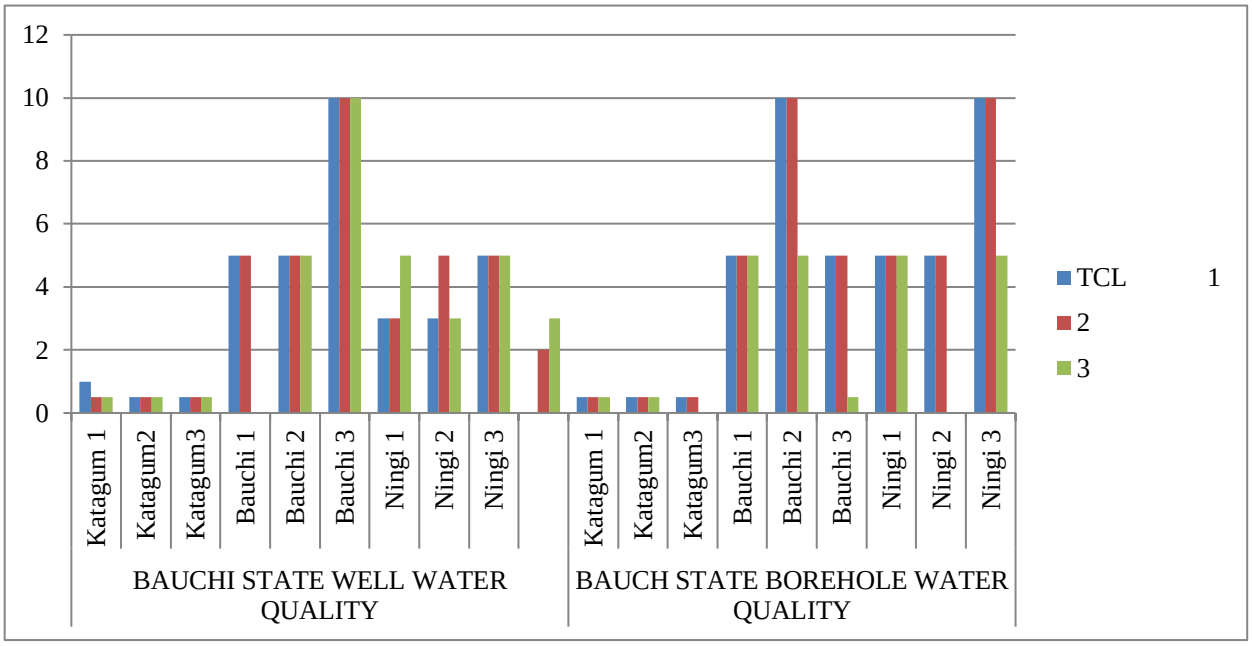

Fig. 9: Total Contamination Level (TCL) of well and borehole water in Bauchi State

X. DISCUSSION OF FINDINGS

The lower limit in pH range (5.0 – 9.0) of water in Bauchi state water was found to be outside the acceptable pH range of 6.5 – 9.0 set by SrC Environmental Analytical Laboratories (2023)and Nigerian Industrial Standard (NIS, 2015) who set the acceptable standard of drinking water quality at pH range 6.5 – 8.5. The low pH of 5.0 discovered in some of sample sites revealed that the wastes generated by small scale enterprises have added to the acid level of the water in the environment. This water acidity has a health implication for human consumers as well as aquatic life. Majority of the sites had pH above 6 possibly because of the presence of biocarbonates and carbonates (80mg/L) and this will cause scaling problem of plumbing facilities made with metals as reported by NIS (2015).

The highest concentration of nitrate found in this study was 20mg/L which is less than the maximum acceptable concentration of nitrate in drinking water (450mg/L) reported by Environmental Analytical Laboratories (2023). Chris and Andrews (2023) on the other hand, opined that water containing 10mg/L nitrate is unsafe. The presence of nitrate in waters of the study areas is a future threat to infants under six months. This is because of the report (Environmental Analytical Laboratories, 2023) that water containing more than 10ppm nitrate – nitrogen can contribute to methemoglobinemia disease in infants. NIS (2015) had earlier submitted that Nitrate (NO3) concentration of 50mg/L causes Cyanosis and Asphyxia (blue – baby syndrome) in infants under 3 months and Nitrites as low as 0.2mg/L can cause the same disease in infants.

The findings on water hardness (KH = 240mg/L and GH = 450mg/L) in this study exceeded the maximum acceptable concentration of 150mg/L reported by NIS (2015) and 200mg reported by Chris and Andrews (2023) respectively. The high level of water hardness in the study environment may be due to the excessive deposit of Calcium and Magnesium salts which have been known to contribute to hardness of water. The effects of hardness of water include undesirable tastes of drinking water, scale formation and excessive soap consumption.

Ten (10mg/L) was the total contamination level of both well and borehole water in Bauchi state. This is higher than the level recommended by Lishtot (2022) who reported zero as the maximum contaminant level goal below which there is no known or expected risk to health. The TCL value obtained in this study suggest the presence of disease causing microorganisms like viruses, parasites and some bacteria. Long term exposure to contaminants such as *Giardia lamblia*, *Cryptosporidium*, Enteric viruses, *Legionella*, Faecal coliform and *Escherichia coli* pose public health risk to the water drinkers. Some of these contaminants come from man made sources such as factories, chemical manufacturers and sewage leaking into drinking water system.

XI. CONCLUSION

The high total contamination level, hardness and the presence of nitrates revealed that the water used for domestic purposes are contaminated and hard. The contamination and hardness of the water found Bauchi state, Nigeria could beas a result of the proliferation of small scale industries whose wastes generated are washed and leaked into water systems. Relevant authorities and agencies such as Environmental Protection Agencies should be proactive in running and monitoring basic water tests to assess the quality of water and detect possible associated problems.

REFERENCES

[1]. Abiodun, A. S., Temilade, E. O., Oladimeji, F. N. &Tawakalit, F. T. (2016). Assessment of Water Contamination in Nigeria: Review. *Journal of Basic and Applied Research International*. 19 (1): 62 – 76
[2]. Al-taai, S. H. H. (2021). Water pollution, its causes and effects. IOP Conf. Series: *Earth and Environmental Science 790*: 1 – 9. doi:10.1088/1755-1315/790/1/012026
[3]. Chris, M. &Andrews, E. (2023).Interpreting Drinking Water Test. University of Wisconsin G3558-4 Home Water Safety. 1 – 12 pages.
[4]. Derhab, N. and Elkhwesky, Z. (2023). A systematic and Critical review of waste management in micro, small and medium sized enterprise: future directions for theory and practice. *Environmental Science and Pollution* 30, 13920 – 13944.
[5]. Devroom (2019). www.blog.idrenvironmental.com
[6]. Eze, V. C., Onwuakor, C. E. &Ukeka, E. (2014) "Proximate Composition, Biochemical and Microbiological Changes Associated with Fermenting African Oil Bean (*Pentaclethramacrophylla Benth*) Seeds." *American Journal of Microbiological Research*, 2 (5): 138-142.
[7]. Fahad, S., Chavan, S., Chichaghare, A, R. &Uthappa, A. R. (2022).Agroforestry system for Soil Health Imprfovement and Maitenance.*Sustainability* 14 (22) DOI: 10.3390/su142214877
[8]. Fahrion, D. (2019). What are the different types of industrial waste www.wasteconlinc.com
[9]. Isaac, A. B. &Oluwaniyi, A. M. (2021).Impact of entrepreneurship development on the proliferation of small-scale and medium scale enterprises in Abeokuta, Ogun State.*Trinitarian International Journal of Arts and Humanities*, 1 (1), 2021
[10]. Lishtot (2022).TCL – Total Contamination Level.mhtml. The most relevant water purity index
[11]. Martinez, P. C. and Poveda, C. A. (2022). Strategies to improve sustainability: an analysis of 120 microenterprises in emerging economy. *Global Sustainability*. 5 (3): 1 – 14.
[12]. Nigerian Industrial Standard (NIS-554-2015).Nigerian-Standard-for-Drinking-Water-Quality-ICS 13,060.20 Copyright SON 2013. 1 – 28 pages.
[13]. Obi, N. J. (2015).The role of small-scale enterprise in achievement of Economic growth in Nigeria.*International Journal of Social Sciences and Humanities*, 3 (1): ISSN: 2141 –1162
[14]. Ogunmwonyi, I. N., Igbinosa, O. E., Aiyegoro, O. A. &Odjadjare, E. E. (2008). Microbial analysis of different top soil samples of selected site in ObafemiAwolowo University, Nigeria. *Scientific Research and Essay*. 3 (3): 120 –124.
[15]. SrC Environmental Analytical Laboratiories (2023).Water Quality Package.www.src.sk.ca/analytical accessed date: 18th May, 2023.
[16]. Uduak, E. E. (2016). Assessing the Effects of entrepreneurship on Nigeria's economic growth.
[17]. Umeh, J. C., Amali, O. &Umeh, E. U. (2004).The socioeconomic effects of tropical diseases in Nigeria.*Economics and Human Biology*.2004; 2: 245 – 263.
[18]. World Health Organization (2011).*Guidelines for drinking water quality*, 4th Edition.