

THE INTERNATIONAL JOURNAL OF HUMANITIES & SOCIAL STUDIES

The Effects of Urban and Peri Urban Livestock Production on Groundwater Quality in Potiskum, Yobe State, Nigeria

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Abstract:

This study looked at the effects of solid waste dumpsites on groundwater quality of Potiskum yobe State, Nigeria. Water samples were collected from twenty-five (25) different hand dug wells and boreholes in strategic areas that have major dumpsites in Potiskum town. Soil sample as well were also collected from dumpsite close to each water points during rainy season. Coordinates of both water points and dumpsites were taken using handheld GPS to determine their respective location and the distances between each were measured in meters. Physico-chemical properties of water samples were tested in laboratory, while heavy metal properties were also tested for soils in the dumpsite and water as well. The pollutants assessed include, Biological Oxygen Demand, (BOD) Total Dissolved Solid, (TDS), Chemical Oxygen Demand, (COD) Chloride, Total Hardness, Colour, pH, Magnesium, Zinc, Iron, Chromium and Lead. Descriptive research design method was used for the study. Data were analyzed using descriptive statistical tools such as percentage computation, frequency distribution table. From the findings of the research it was discovered that many wells and boreholes in the study area that are located close to the dumpsites (<50 meters) have levels of high concentration of pollutants of both physico- chemical and heavy metals. This mean that all water points close to dumpsites are highly polluted compared to wells and boreholes far from dumpsites > 50m. From the laboratory analysis conducted it was discovered that TDS has the highest physico-chemical concentration of 230.00 less than the world standard concentration, while COD and BOD were not detected in the water sample. Nitrite had the highest heavy metal concentration of 33.00, magnesium with 0.980, Iron with 4.900, Cadmium with 0.84, Lead 2.20 are all above the water drinking standard of WHO.

Keywords: *Coordinates, dumpsites, groundwater, oxygen, demand*

1. Introduction

Livestock provide essential commodities and services to the majority of the World's population. With increasing number of people, meat production is projected to increase from 200 million to 310 million tons per year by the year 2020 (De Haan et al., 1996). Although demand for livestock products is stagnated in developed countries, it is rapidly increasing elsewhere due to urbanization and associated shift in eating habits towards livestock products. The demand and consumption of livestock products are growing even faster than the increase in world population. Such demand has called for development of the livestock industry. The development also leads to pollution problem caused by the increasing amount of animal waste. Pollution is on the increase and has reached its peak in developed countries like Japan since 1973 (Harada, 1994). Rising affluent, particularly in the developing countries where average real incomes have doubled since the early 60's, means that more people can afford the high valued protein that livestock can offer. What effect is the demand for meat, milk and eggs going to have on the environment? Obviously, in spite of their growing global importance, livestock are increasingly being held responsible for many adverse effects on the environments. Loss of vegetation cover, reduced biodiversity, soil erosion and compaction and excessive run-off often from overgrazing. High concentrations of livestock contribute to contamination of ground water and soil pollution. Livestock can produce significant quantities of "greenhouse" gases thereby possibly contributing to global warming (Anon, 1982).

Urban and pre- urban livestock rearing in Nigeria has taken a different dimension compared to how it is been practiced in the developed world. This is due to the fact that Nigerian adapts the localized strategy in their livestock production. Animals are either restricted in a small portion inside residential building or are allowed to roam about within the available spaces. Because of this old system being used in our locality, it has therefore led to the growth and expansion of heaps of dumpsites, destruction of plants and valuable properties thereby degrading our environment. Livestock and man are inseparable as they constitute a component of the ecosystem and therefore need to be raise as it is the major sources of food (milk, egg, meat, skin and hides) for human and economic development. It is therefore an economic activity where a significant proportion of our population largely depends on it. But its poor management practice, inadequate planning and lack of support from individuals and authorities has made it irrelevant resulting to contamination of land, and water as well as a basis for quick transmission of various zoonotic diseases to man. It is also a major way of generating solid waste disposed all over the streets in water ways, packed in bags inside our houses which attracts many other solid wastes in our environment today.

The term urban is a complex concept because it is a function of sheer population size, land area, the ratio of population to space density and economic and social organization as cited in (Rashed and Jurgens, (2010). The peri-urban zone on the other hand can broadly be defined as an interface where there has been a blurring of the rural and urban, and is characterized by mixed land use by a wide range of stakeholders (Tanko 2002). The term 'peri-urban' is usually used to convey the overlapping of rural and urban areas. In other word urban agriculture is the growing and harvesting of plants and trees, and the rearing of livestock in and on the fringes of urban areas and is practiced in a variety of places. Urban agriculture usually consists predominantly of perishable and high value products that can be grown or reared in confined spaces (De Zeeuw, 2011). A United Nations Report (August 2004) noted with regret that while developing countries are improving access to clean drinking water, they are falling behind on sanitation goals. At one of its summit in 2000 (Uwaegbelun (2004) revealed that The World Health Organization- (WHO 2004) and United Nations International Children Education Fund- (UNICEF 2004) joint report in August 2004 that: "about 2.4 billion people will likely face the risk of needless disease and death by the target of 2015 because of bad sanitation". The report also noted that bad sanitation – decaying or non-existent sewage system and toilets- fuels the spread of diseases like cholera and basic illness like diarrhea, which kills a child every 21 seconds. Surveys conducted in Benin City, Nigeria showed that although economic performance is competitive, most producers are operating outside the boundaries of sustainability because of inadequate waste management and excessive waste produced in small geographical areas, beyond the assimilation capacity of the local environment.

Despite its economic contribution of a nation's growth, livestock can cause severe degradation and damage if the livestock and the area are not monitored correctly as asserted by (Hoffman Todd, (2000). Similarly, Fabricie et al reported in (Hoffman Todd, (2000). a conflicting urban land uses just as the pray and predator relationship that residential and urban green areas were not designed for the holding and grazing of livestock, and the green areas are often not big enough for the number of livestock grazing on them. This is because overgrazing leads to disruption and destruction of natural ecosystem as well as degeneration of natural vegetation (Chandre et al, (2008). It is therefore clear that if livestock production is allowed to be carried without adopting the principles of checks and balances within the sphere through research, it will subsequently lead to the contamination of both water and land and thereby affecting urban livelihood.

2. Statement of Research Problem

The faeces of livestock has been observed to consist of undigested food, mostly cellulose fiber, undigested protein, excess nitrogen from digested protein, residue from digested fluids, waste mineral matter, worn-out cells from intestinal linings, mucus, bacteria, and foreign matter such as dirt consumed, calcium, magnesium, iron, phosphorus, sodium, etc. Improper disposal of animal feces can therefore cause oxygen-depletion in the receiving environment It can also cause nutrient-over enrichment of the receiving system. And the possibility of disease causation is also present The study area has already been identified as post insurgent area and one of the centers of a number of significant outbreaks in Yobe state, due to its contamination of both surface and underground water that has long effects on human health. Quick spread of diseases has been witnessed over the years and no serious effort has ever been made to understand zoonotic outbreak emanating from livestock farming as an attribute. It is usually impossible to determine the degree of exposure of a given individual to a specific problem. Pollutants are numerous and varied and many of them are difficult to detect. Techniques for monitoring pollutants are inadequate and long-term records are almost unavailable. Methane, emitted by the digestion of food by animals, for example cattle as cited in Tawari C.C. (2012). It is therefore pertinent for this research whose primary focus is to harmonize human health and economic benefits derived from urban livestock. As a secondary data, no documents from research bodies, veterinary Doctors, ministry of environment, has been traced in the study area in other to address the problems. It is these reasons that prompted the research to be carried out in the study area with a view to ameliorate the situation.

2.1. Aim and objectives

The aim of the study is to examine the problems and prospects of the effect of urban livestock rearing on the residents of Potiskum and identify areas where future research could make a contribution to in order to promote this activity to be carried out in a more safety way. The objectives are.

To identify the locations of dumpsites generated from urban livestock rearing in the area.

To measure the distance between dumpsites and the nearest water points (wells and boreholes) in the study area

To assess the level of heavy metal concentration from the soils at the dumpsites, and to determine the physico-chemical characteristics of wells and boreholes in the study area

To analyze the implication of urban livestock production on public health as it relates to pollution.

3. Research Questions

- What are the locations of dumpsites generated from urban livestock rearing in the area
- What are the various distances between dumpsites and the nearest water points in the study area?
- What is the level of heavy metal concentraysico-chemical characteristics of water in wells and boreholes in the study area
- What is the implication of urban livestock production on public health as it relates to pollution.

4. Significance of the Study

The quality of environment can be expressed in terms of the air we breathe, the food we eat, the water we drink, and the house we live as well as the non-contamination of our beautiful environment through sustainable living. No doubt, the antithesis of this is the unwholesome dumping of unsorted and untreated waste material into landfills and wide spaces in the ground. Landfills are supposed to be sited away from residence because of the inherent environmental nuisance and poor aesthetic value associated with its operation. But in Potiskum, dumpsites are virtually sharing fences with residential houses. Because of many toxic materials or pollutants released by leachates into the groundwater which are not readily removable by the conventional water treatment process. It is essential to carry out an intensive study so as to monitor the nature and extent of such pollution on ground water quality. Such study will among other things, help to produce data that will be useful in the following:

- Sitting and construction of sanitary landfills particularly in rapidly growing urban areas such that the disposal of waste does not constitute health hazard.
- Monitoring the quality and nature of the groundwater reservoirs in the vicinity of the site.
- Determination of the ideal treatment that can be applied where ground water resources are contaminated.
- Legislation to control types of solid waste disposal and thus guarantee quality controls of groundwater reservoirs as well as surface water.

5. Literature Review

In Nigeria for instance, environmental issues did not gain official prominence until the 1988 Koko toxic waste dumping saga which also brought the need to establish the Nigeria Federal Environmental Protection Agency (FEPA), Federal Ministry of Environment and other relevant agencies, ostensibly to tackle environmentally related issues, in the country. These include issues such as environmental pollution, sanitation, depletion of ozone layer, desertification, flooding, erosion, poverty, bush burning, deforestation, soil conservation etc. Environmentally minded scholars: Ocheri (2003:174), Gbehe (2004), and Aja (2005:114) have associated environmental pollution with human activities and albeit persistent human interaction with the environment. Research has also shown that as the population of a country grows/increases with attendant pressure on the environment especially in the wake of improved technologies, environmental abuse and pollution is nevertheless heightened with corresponding effects on lives of people and other living organisms, (Ocheri, 2003. It has been observed further that man through industrial, agricultural and the ever-increasing urbanization process, security and terrorist activities tend to directly and/or indirectly pollute the environment. Jande (2005) and Aja (2005) in their separate observations, also in tandem with the foregoing agree that unrestricted use of pesticides, insecticides, herbicides and indiscriminate dumping of refuse, excreta and animal dung as well as spillages from refineries, large scale bush burning etc are perceived as some of the leading factors of environmental pollution in Nigeria.

The term pollution is a derivation of the word pollute; which means, to make something dirty or no longer pure, especially by adding harmful or unpleasant substances to it.

In another development; the committee on pollution of the United States National Research Council (1965) defined pollution as;

“an undesirable change in physical, chemical or biological characteristics of our air, land and water that may or will harmfully affect human life or that of other desirable species, our industrial processes, living conditions cultural assets that may or will waste or deteriorate our raw material resources”.

Pollution according to the above definition is a disorder within an environment and is a by-product of energy conversion and the use of resources. Ekuri and Eze (1999) accordingly, defined pollution as “a contamination, a defilement, mischief, perturbation and reduction in the value of an object or thing”. Relatedly, Jande (2005) describes the term – Pollution” to mean “to make something dirty or no longer pure, especially by adding harmful or unpleasant substances to it.

The concept of water resources is multidimensional. It is not limited only to its physical measure (hydrological and hydrogeological), the ‘flows and stocks’, but encompasses other more qualitative, environmental and socio-economic dimensions. However, this work focuses on the sources and quality of water.

Water is one of the essentials that supports all forms of plant and animal life (Vanloon and Duffy,(2005) and it is generally obtained from two principal natural sources; Surface water such as fresh water lakes, rivers, streams, etc. and Ground water such as borehole water and well water (McMurry and Fay, (2004). Mendie, (2005). Also consider Water is an essential component of an ecosystem. It contains life on the earth. A community depends on water for its domestic, agricultural and industrial needs. Water has unique chemical properties due to its polarity and hydrogen bonds which means it is able to dissolve, absorb, adsorb or suspend many different compounds (WHO, 2007), thus, in nature, water is not pure as it acquires contaminants from its surrounding and those arising from humans and animals as well as other biological activities. One of the most important environmental issues today is ground water contamination and between the wide diversity of contaminants affecting water resources, heavy metals receive particular concern considering their strong toxicity even at low concentrations as cited in (Marcovecchio et al., (2007). Galadima et al (2011) reported that in Nigeria today research indicates that, majority of the common fresh water sources are polluted, resulting to serious outbreak of these and other diseases. A study by Umeh et al (2004) in Galadima showed that 48% of the people in Katsina-Ala Local Government area of Benue state are affected by urinary schistosomiasis, due to increased in water pollution index. Some previous investigations indicate that 19% of the whole Nigerian population is affected, with some communities having up to 50% incidence. This has raised serious concerns to World Health Organization, in an attempt to improve cultural and socio-economic standards of people in the tropical region Umeh, (1989); Umeh et al., (2004).

Recently, Olaoye and Onilude (2009) all in Galadima have documented varying levels of microbial contaminations in drinking water from western parts of the country. According to this research total bacteria and coliform counts were found to be between 2.86 -4.45 and \leq 1.62 log cfu/ml respectively. In addition to microbial infections, heavy metals poisoning through drinking water have also been documented. Nriagu et al. (1997) reported blood lead levels greater than 30 $\mu\text{g}/\text{dl}$ in children from Kaduna states. The elevated levels were linearly correlated with water and air contaminations by lead emissions. Garba et al. (2010) reported a mean arsenic concentration of 0.34 mg/l in drinking water from hand dug wells, boreholes and taps of Karaye Local Government area, Kano state. The arsenic levels are of serious concerns to regulatory agencies because they by far exceed the upper band (0.01 mg/l) recommended by WHO. Heavy metal can cause serious health effects with varied symptoms depending on the nature and quantity of the metal ingested (Adepoju-Bello and Alabi, (2005). They produce their toxicity by forming complexes with proteins, in which carboxylic acid ($-\text{COOH}$), amine ($-\text{NH}_2$), and thiol ($-\text{SH}$) groups are involved. These modified biological molecules lose their ability to function properly and result in the malfunction or death of the cells. When metals bind to these groups, they inactivate important enzyme systems or affect protein structure, which is linked to the catalytic properties of enzymes.

6. Effects of Physico-Chemical and Heavy Metal Properties on Human Health

Excess amount of physico-chemical properties in drinking water have different effects on human health. A high value of pH causes bitter taste of water, affects mucous membrane, cause corrosion and also affects aquatic life Okpanachi (2012). High amount of hardness in drinking water leads to heart diseases, and kidney stone formation. Excess hardness causes poor lathering with soap, deterioration of the quality of clothes, scale formation and skin irritation as confirmed by Okpanachi 2012 in (Lalitha and Barani, (2004).

Excessive chloride concentration increases rate of corrosion of metals in distribution systems especially for deep wells. This can lead to increased concentration of metals in the supply, and this can cause laxative effects and gastro-intestinal irritation in humans (WHO, 2002). High amount of Dissolve Oxygen (DO) imparts good taste of water. With regards to solids, high values of Total Dissolve Solid (TDS) in ground water are generally not harmful to human beings, Consumption of water with high Total Solid Substance (TSS) content can cause gastro-intestinal irritation. It also causes undesirable taste and corrosion or incrustation (Shihab, (1993). In terms of heavy metals concentration, high concentrations of heavy metals can cause various health effects in humans. For example, high intake of chromium can cause, skin rashes, upset stomachs and ulcers, respiratory problems, weakened immune systems, kidney and liver damage, alteration of genetic material, lung cancer and even death (Singh, (2009). Lead is a naturally occurring element that can be harmful to humans when ingested or inhaled, particularly to children under the age of six. Although the effects of lead exposure are a potential concern for all humans, young children (less than seven years old) are mostly at risk (Reagon and Silberged, (1989). In adults, lead poisoning can cause; poor muscle coordination, damage to the sense organs and nerves controlling the body, increased blood pressure, hearing and vision impairment, reproductive problems (e.g. decreased sperm count). In children, lead can cause damage of the brain and nervous system, behavioral problems, anemia, liver and kidney damage, hearing loss, developmental delays and in extreme cases, death. Iron and Zinc are essential micronutrients for human health. By micro it means it is needed only in small quantity (Black, 2003). But when intake is high and regular, it can cause some health defects which include liver and kidney diseases, high blood pressures, heart failure and in some extreme cases death (Cardar, 1983). The risks posed by these properties make this study imperative.

This type of toxin may also cause the formation of radicals which are dangerous chemicals that cause the oxidation of biological molecules. The most common heavy metals that humans are exposed to are Aluminium, Arsenic, Cadmium, Lead and Mercury. Aluminium has been associated with Alzheimer's and Parkinson's disease, senility and presenile dementia. Arsenic exposure can cause among other illness or symptoms cancer, abdominal pain and skin lesions. Cadmium exposure produces kidney damage and hypertension. Musa H.A at el (1999) reported that access to adequate supplies of good quality drinking water continues to be limited among many rural and peri urban communities in Africa, despite several decades of water improvement programmes.

It is generally conceived that water pollution processes occur in three interlocking ways. These are physical pollution, chemical pollution and biological pollution. The physical pollution occurs in the deterioration of physical properties of water such as colour, turbidity and suspended particles as cited in Ahmed (2002). While the chemical pollution at times accentuated by physical deterioration, involves pronounce changes in the natural chemical composition of water through contaminants or pollutants. These include temperature, dissolve oxygen, PH, hardness, alkalinity, nutrients, heavy metal and an array of toxic substances which may have simple chemical properties or their dynamics may be complex and changing depending upon other constituents in the geological strata, soils and land use in the region. High concentration of pathogens of diseases represents biological pollution.

From the assertions highlighted so far, it could be understood that solid waste generated from urban livestock and are dispose within urban open spaces may pollute all the three sphere components particularly when rainfall is at its peak thereby affecting both surface and underground water. Lack of understanding to this observation in Ahmed (2002) set a serious limitation to his work and therefore need to be fulfilled. In another development, Mohammed (2009) wrote on physiochemical analysis of water sample of cement wells in Potiskum Mohammed (2009) wrote on physiochemical analysis of water sample of cement wells in Potiskum. He selected only three cement wells as samples which is too limited to cover the entire town and did not consider livestock as an attribute in his work. These set a serious limitation to his work and therefore contain a wide gab for generalization of results.

In David M. (2016) reported in his work and estimated that nearly 10% of the global burden of disease is associated with lack of access to adequate sanitation, safe drinking water, proper hygiene and effective water management. However, he did not specify clearly factors responsible for the contamination of water bodies (rivers, streams, wells, seas, oceans) and so on. As well he only dwelled on types of diseases associated with water but did not attributed to urbanization and increase human activities that affect water quantity and quality. In the same vein, the high burden of sanitation related diseases is particularly common in developing countries including Nigeria as cited in Bamaïyi (2016) and that water related diseases such as cholera, typhoid, diarrhea, hepatitis A and E can easily be transmitted to human. This observation could have been more relevant, but could not address the issue of public health threat completely since small land holdings possessed by many poor urban livestock keepers was not recognized as one of the major causes of zoonotic outbreak that can be transmitted to human. Napoleon S. (2011) wrote on mitigating of the impact of solid waste in urban centers in Nigeria from a general term with no specification to livestock waste. Tanko A. (2002) also worked on urban and peri urban food production with more emphasis on crop cultivation in Kano metropolis and assessed the rate of contamination of water mainly from industrial effluents disposed to the major streams and rivers. Perhaps his methodology as well as his findings paves ways greatly to carry out this research. He did not however consider urban livestock production as one of the major environmental problems that has corresponding effects on land, water and public health

7. Methodology

7.1. Types and Sources of Data Required

The types of data that was used for the research work are the physico-chemical and heavy metal properties which are the; Biological Oxygen Demand (BOD), Total Dissolved Solid (TDS), Dissolved Oxygen (DO), Chemical Oxygen Demand (COD), Magnesium (Mg), Cadmium (Cd), hardness, color, pH, and heavy metals which are; zinc, iron, chromium and lead. The sources of data employed in this research work are basically of two types which are; the primary and secondary data sources. The primary data sources were generated from the field in the form of soil and water samples

7.2. Sampling Technique

Razaq and Ajayi (2000) define sampling as a systematic process used to select a required portion of a target population or area. In order to achieve a desired output and conduct a thorough study, the researcher used 25 major dumpsites which correspond with 25 water points in potiskum. All containers used were deionized with distilled water, rinsed with sample before taking the samples to the laboratory for analysis. The water samples were analyzed within three hours of collection in order to avoid unpredictable change in the samples.

The sampling technique employed for this research is the purposive sampling technique, because sampling site for well and borehole water sample collection was purposively chosen. Sample collection was in mid August during the wet season when rainfall was at its peak. This is so, in order to observe the level of contamination in the well and borehole water quality of the study area. The water samples were taken from distance that range from less than 10 meters (<10m) to distance of greater than 150 meters (>150m) away from the dumpsites. A total of twenty-five (25) water samples were collected for the purpose of this research, because twenty-five samples has properly covered the study area and also because of the high cost of water analysis in the laboratory. Water samples were collected from 18 shallow wells of depths of between 10-20 meters and the other six (6) samples from deep boreholes of depths greater than twenty-five (25) meters and above.

A comprehensive physico-chemical and microbial test was conducted at the department of chemistry in Yobe State University laboratories to determine the level of water pollution indicator parameters. In order to avoid staleness of samples, some of the pollution indicator parameters analyzed was conducted within five hours of its collection. The researcher also used the Global Positioning System (GPS) during a transact walk with some farmers (team work) to obtain the coordinates of heaps of refuse generated through the process of livestock production and the water points as well.

The data analysis for this research work was carried out in the soil and water analysis laboratory in the department of chemistry Yobe State University Damaturu where physico-chemical properties and heavy metals were tested. The chemical parameters analyzed are the Dissolved Oxygen (DO), Total Dissolved Solid (TDS), magnesium, Nitrate, Nitrite, sulphate, Phosphate, Calcium, electrical conductivity and pH. The total hardness and colour are physical parameters considered while iron, chromium, Cadmium, copper and lead were tested for heavy metals.

8. Methods and Materials

The study used Google Earth imageries sourced from Google Earth (digital globes) as well as map of Potiskum Township which was also acquired from the local Government areas headquarter. The study also used data in text file format (.txt file) containing the Geographical coordinates, names and addresses of the identified water points (wells, water pumps, dug boreholes) and animal dung dumpsites. The data regarding the geographical coordinates of the water points and the dumpsites were collected from the study area using handheld Global Positioning System device (GPS).

9. Procedure for Data Analysis

The tiles of Google Earth images covering the entire study area were first downloaded from the official website of the digital globe. The Google earth images were then stitched and geo-referenced using the coordinates of the control points obtained from the original images using GIS software (ArcGIS version 10.4). The Universal Traverse Mercator

(UTM) zone 32N Minna Datum was used as a spatial reference system in referencing the data. The final geo-referenced image depicting the study area was then used to create the land use map of the study area. This was done painstakingly by digitizing all the existing land use features such as built-up area (residential areas) primary and secondary roads as well as streams found in the study area. The study area map was also used as a reference while carrying out the digitizing exercises to ensure reasonable degree of accuracy that reflects reality.

10. Database Creation (Data Layers)

The following data were collected and used in the development of the GIS data layers.

- The polygon map of the study area.
- Data table containing the geographic coordinates, names and address of the water points as Shown in Table 2
- The data table containing the coordinates, names and address of the dumpsites as shown in Table 1.0
- The study area Land use map shown in Figure 1.0

The data tables were then exported and converted to ESRI Shape file formats using GIS software (ArcMap Version 10.4.2) as it is originally compatible with the software. All of the data layers were incorporated into GIS using ArcGIS Version 10.4 software. All the data were represented using the traditional GIS features classes (Point, Line and Polygon) as shown in Figure 4. All the data were converted and projected to the same coordinate system of UTM Zone 32N Minna Datum as depicted in Figure 2.0, except the polygon map of Nigeria as well as polygon map of Yobe State that are in ESRI Shape file indicating the study area. These were referenced in Geographical Coordinates System of World Geodetic Systems of 1984 (WGS 1984).

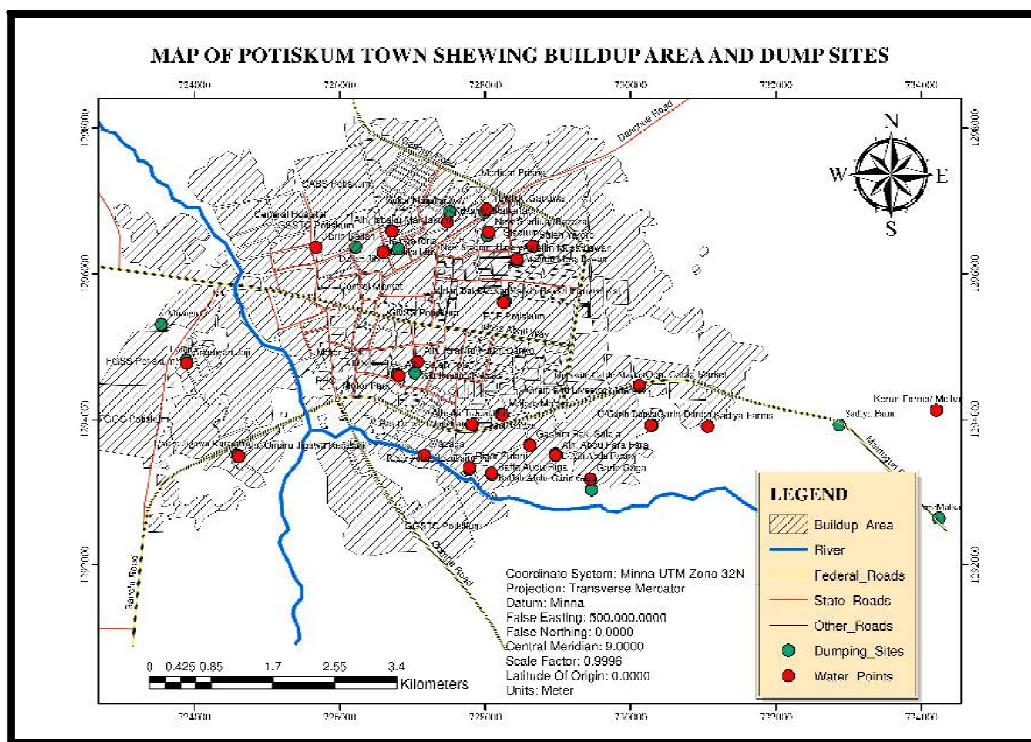


Figure 1
Source: Field work 2018

S/N	Address	Northings	Eastings	Size (sqk)
1	Iamba Idris	11.27167N	11.76972E	102
2	Jibrin Dallari	11.13028N	011.78028E	357
3	Ishaku Mai Jakuna	11.29056N	011.81278E	314
4	Suleh Yaroro	11.32528N	011.77972E	92
5	Kukar Makabarta	11.14667N	011.83083E	336
6	Yindiski Ganuwa	11.22889N	011.85667E	62
7	New Stadium/Bazaza	11.23278N	011.80944E	102
8	Asibitin Musa Lawan	11.29167N	011.75306E	286
9	Sarkin Baka	11.26306N	011.92472E	314
10	Furan Danko	11.34250N	011.80361E	314
11	Alh. Saleh Total	11.30306N	011.77472E	305
12	Anguwan Jaji	11.11778N	011.80361E	161
13	Mazaga	11.09417N	011.87056E	92
14	Umaru Kurasati	11.22611N	011.87083E	268

S/N	Address	Northings	Eastings	Size (sqk)
15	Malam Ma'azu	11.25917N	011.95306E	100
16	Alh. Ali T-Junction	11.19472N	011.93417E	599
17	Rigar Fulani	11.18833N	011.84500E	280
18	Baffa Audu/Riga	11.23528N	011.83306E	210
19	Gashim Baki Salala	11.31667N	011.88944E	198
20	Alh. Abdu Fara	11.10889N	011.86861E	280
21	Garin Gaga	11.18167N	011.81889E	408
22	Garin Danga	11.30972N	011.92917E	240
23	Keran Farms/ Malka	11.38778N	011.95611E	982
24	Sadiya Farms	11.16806N	011.92583E	974
25	Opp. Cattle Market	11.28639N	011.75056E	168

Table 1: Names of Geographical Location of Dumpsites in the Study

Source: Field Work 2018

OID	Address	Northings	Eastings
1	lamba Idris	11.7697222	11.2716667
2	Jibrin Dallari	11.7802778	11.1302778
3	Alh. Ishaku Mai Jakuns	11.8127778	11.2905556
4	Suleh Yaroro	11.7797222	11.3252778
5	Kukar Makabarta	11.8308333	11.1466667
6	Yindiski Ganuwa	11.8566667	11.2288889
7	New Stadium/Bazaza	11.8094444	11.2327778
8	Asibitin Musa Lawan	11.7530556	11.2916667
9	Sarkin Baka/Unguwar Kaji	11.9247222	11.2630556
10	Alh. Ibrahim Furan Danko	11.8036111	11.3425
11	Alh. Saleh Total	11.7747222	11.3030556
12	Anguwan Jaji	11.8036111	11.1177778
13	Mazaga	11.8705556	11.0941667
14	Alh. Umaru Jigawa Kurasati	11.8708333	11.2261111
15	Malam Ma'azu	11.9530556	11.2591667
16	Alh. Ali T-Junction	11.9341667	11.1947222
17	Rigar Fulani	11.845	11.1883333
18	Baffa Audu/Riga	11.8330556	11.2352778
19	Gashim Baki Salala	11.8894444	11.3166667
20	Alh. Abdu Fara Fara	11.8686111	11.1088889
21	Garin Gaga	11.8188889	11.1816667
22	Garin Danga	11.9291667	11.3097222
23	Keran Farms/ Malka	11.9561111	11.3877778
24	Sadiya Farms	11.9258333	11.1680556
25	Opp. Cattle Market	11.7505556	11.2863889

Table 2: Names and Coordinates of Water Points of the Study Area

Source: Field Work 2018

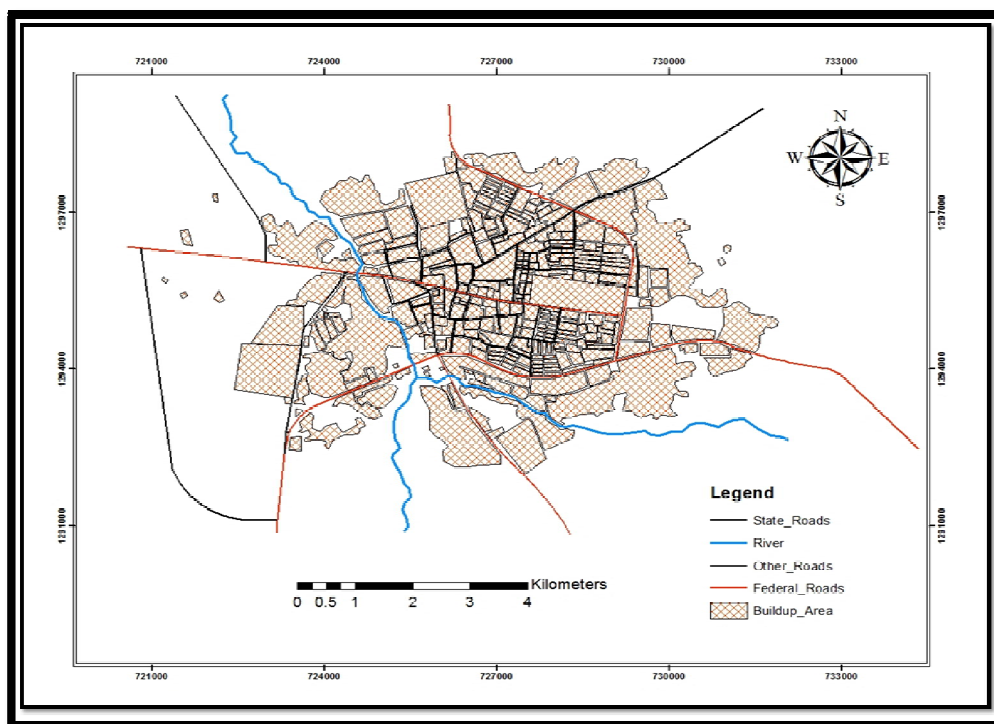


Figure 2: Showing Land Use Map of the Study Area

11. Procedure Used for the Chemical Analysis

pH determination pH is a measure of the H⁺ concentration. It is expressed mathematically as $\text{pH} = \log(\text{H}^+)$. pH value ranges from acidic (1-6.8) through neutral (6.8-7.8) to basic (7.9-14). The pH was determined electrometrically using digital pH meter (Jenway, Model 3505) with glass electrode and standard buffer solutions of pH 4, 7 and 9 respectively.

11.1. Procedure

- The pH meter was warmed for 15 minutes. The electrode was then removed from the distilled water and wiped dry.
- The pH meter was calibrated using the buffer solutions at room temperature. This was done by inserting the pH probe (electrode) into the buffer solution (of pH 7) and allowed to stabilize until the pH reading was stable, and then necessary adjustment was made. The pH probe was removed, rinsed with distilled-deionised water and wiped with blotting paper before inserting into the next buffer (pH 4) and adjusted again.
- The electrode (pH probe) was thoroughly rinsed again and inserted into the sample, and then the reading of the scale was taken.
- The electrode was finally rinsed and stored, immersed in distilled water.

11.2. Electrical Conductivity

Procedure:

- The conductivity of the samples was measured using conductivity meter.
- This was done by immersing the conductivity electrode (which was washed with distilled water and dried before used) in the beakers containing (0.01M) KCl standard mixture. The conductivity was recorded. This was done to calibrate the equipment.
- The conductivity electrode was then washed again and immersed into another beaker containing the samples. The conductivity was recorded.

$$\text{EC} = \frac{\text{CS} \times \text{K}}{\text{CKCl}}$$

Where EC is the actual electrical conductivity of the sample, CS is the conductivity of the sample recorded, K is the standard conductivity of KCl (1413 $\mu\text{S}/\text{cm}$) and CKCl is the conductivity of the KCl recorded.

12. Dissolved Oxygen (DO) Determination

The dissolved oxygen (DO), serves as a means of water control. All atmospheric gas even oxygen is soluble in water. The level of DO in water determines the microbiological plant and animal content and also its ability for sustaining the life of fishes and other aquatic organisms. DO have an important effect on water quality and the solubility of atmospheric oxygen in fresh water ranges from 14.6 mg/L at 0°C to about 7 mg/l at 35°C under atmospheric condition.

12.1 Procedure

- The dissolved oxygen (DO) of the sample was tested immediately the samples were collected and brought to the laboratory using digital colorimeter (HACH DR 900) with standard DO reagent system.
- The samples were initially used to rinse the sample bottle (10mL glass cuvette) and were filled up by ensuring no air bubble remained in the bottle.
- The sample bottle was inserted into the sample compartment of the colorimeter and then scanned as blank.
- The bottle was then removed and the standard DO reagent system (alkali-iodide-acid reagent) was added into the sample. The bottle was capped and shaken, the sample then formed brownish to whitish precipitate and then returned to the colorimeter and scanned again.
- The DO was measured directly from the display in mg/Liter against a blank (distilled-deionized water).

12.2. Determination of Nitrate (NO_3)

- The nitrate content was determined using digital colorimeter ((HACH DR 900) with standard Nitrate reagent system.
- The samples were initially used to rinse the sample bottle (10mL glass cuvette) and were filled up by ensuring no air bubble remained in the bottle.
- The sample bottle was inserted into the sample compartment of the colorimeter and then scanned as blank.
- The bottle was then removed and the HACH standard Nitrate reagent system (tablet) was added into the sample and dissolved. The bottle was capped and shaken; the sample then formed reddish color.
- The sample bottle was returned to the colorimeter and scanned again.
- The nitrate content was measured directly from the display in mg/Liter against a blank (distilled-dionised water).

13. Determination of Nitrite (NO_2)

- The nitrite content was determined using digital colorimeter ((HACH DR 900) with standard Nitrite reagent system.
- The samples were initially used to rinse the sample bottle (10mL glass cuvette) and were filled up by ensuring no air bubble remained in the bottle.
- The sample bottle was inserted into the sample compartment of the colorimeter and then scanned as blank.
- The bottle was then removed and the HACH standard Nitrate reagent system was added into the sample and dissolved. The bottle was capped and shaken; the sample then formed reddish color.
- The sample bottle was returned to the colorimeter and scanned again.
- The nitrite content was measured directly from the display in mg/Liter against a blank (distilled-dionised water).

14. Determination of Sulphate (SO_4^{2+})

- The sulphate content was determined using digital colorimeter ((HACH DR 900) with standard sulphate reagent system.
- The samples were initially used to rinse the sample bottle (10mL glass cuvette) and were filled up by ensuring no air bubble remained in the bottle.
- The sample bottle was inserted into the sample compartment of the colorimeter and then scanned as blank.
- The bottle was then removed and the HACH standard sulphate reagent system was added into the sample and dissolved. The bottle was capped and shaken; the sample then formed reddish color.
- The sample bottle was returned to the colorimeter and scanned again.
- The sulphate content was measured directly from the display in mg/Liter against a blank (distilled-dionised water).

15. Determination of Phosphate (PO_4^{2+})

- The phosphate content was determined using digital colorimeter ((HACH DR 900) with standard phosphate reagent system.
- The samples were initially used to rinse the sample bottle (10mL glass cuvette) and were filled up by ensuring no air bubble remained in the bottle.
- The sample bottle was inserted into the sample compartment of the colorimeter and then scanned as blank.
- The bottle was then removed and the HACH standard phosphate reagent system was added into the sample and dissolved. The bottle was capped and shaken; the sample then formed reddish color.
- The sample bottle was returned to the colorimeter and scanned again.
- The phosphate content was measured directly from the display in mg/Liter against a blank (distilled-dionised water).

16. Total Dissolved Solid (TDS) Determination

The apparatus used include filter membrane, weighing balance (Ohaus PA 214), oven (Mermert), beaker, volumetric flask and desiccators.

16.1. Procedure

25mls of water sample was filtered and then evaporated to dryness in a conical flask using the oven. After the evaporation the residue in the beaker was then measured to get the Total Dissolved Solid (TDS) in ml/L. This was done by subtracting the difference in the weight of the flask before and after oven drying.

17. Methodology Used for Physical Analysis

For the physical analysis of the water samples; total hardness, calcium and magnesium were examined.

17.1. Total Hardness (Calcium and Magnesium Determination)

Hardness is always expressed in terms of calcium carbonate (CaCO_3) and the description may be given as follows: 0-50mg/l Soft 50-100mg/l moderately soft 100-150mg/l slightly hard 150-200mg/l moderately hard Over 200mg/l Hard Over 300mg/l very hard. The Method used here is the EDTA Titrimetric method.

17.2. Procedure

- 25cm³ of the sample was transferred into a 250 cm³ conical flask and acidified with hydrochloric acid.
- The mixture was boiled and allowed to cool down and the few drops of ammonia solution were added until it becomes alkaline.
- The solution was filtered and 1cm³ of pH 10 ammonia buffer was added followed by 3 drops of eriochrome Black indicator.
- The mixture was titrated with 0.01M EDTA solution until the color changes from violet to blue.
- The titre value was recorded and the entire process was repeated three (3) more times.

17.3. Calculations

Sample calculation (CaCO_3) = $\frac{1.0\text{g CaCO}_3 \times 1.0 \text{ mol CaCO}_3/100.09\text{g 1litre}}{\text{(X mol of Ca)} \times (25\text{cm}^3 \text{ of solution})} = 0.01\text{M EDTA} \times \text{Titre value}$
Where X is the mg of Ca

18. SOIL Digestion (for Elemental Analysis; Lead, Copper, Cadmium, Magnesium etc)

The soil sample (0.5g) weighed into a microwave tube and 6ml of concentrated nitric acid (64.3% HNO_3) was added followed by 3ml of hydrofluoric acid. The sample was then digested under microwave for 50minutes and a temperature range between 130°C to 180°C.

After digestion with microwave oven, the sample was transferred to a 25mL volumetric flask and diluted with distilled water, and then kept for further analysis.

The sample standards (Buck Sci AAS 1000ppm heavy metal standards) were prepared (0ppm, 2.5ppm, 5.0pp, 10ppm, 15ppm, 25ppm, 50.0pp and 75ppm) and their respective absorbances were determined spectrophotometrically. A standard calibration curve for absorbance and standard concentrations was plotted.

The absorbances of the samples were also recorded (at respective wavelengths) and analysed against a blank using and the result was calculated in Microsoft Excel by extrapolating from the standard calibration curve (of each analyte).

18.1. The Study Area

Potiskum town is located roughly between latitudes 11° 03' and 11° 30' North of the Equator and between longitudes 10° 50' and 11° 15' East of the Meridian. Its distance by road from Damaturu (the State capital) is about 98 kilometers west. It is bounded on the north and west by Nangere local government, on the south by Fika local government and on the east by Fune local government. It covers an area of roughly 120,000 ha or about 12 square kilometers.

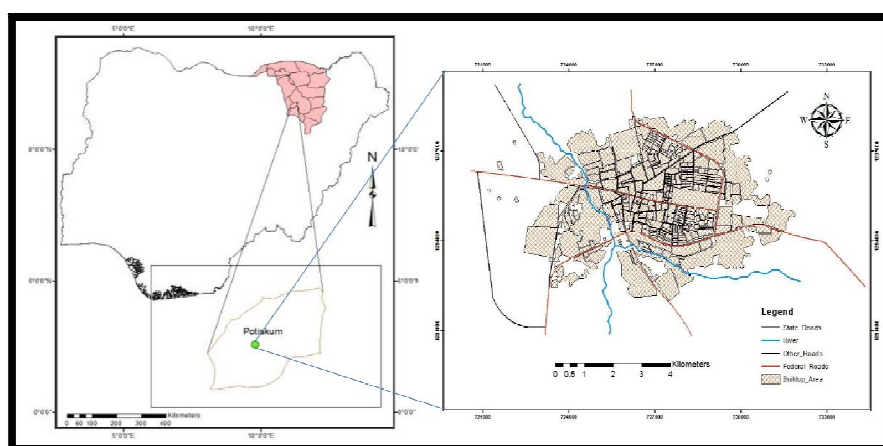


Figure 3: Map of the Study Area

Potiskum town is situated on a geomorphologic unit known as the Potiskum plain and hills according to Mark Lock Group, (1976). The geology of Yobe principally comprises crystalline and sedimentary rocks, underlain by basement complex rocks. The crystalline rocks are represented by older granites found in pockets of places in the southern part of the state. Another crystalline rock formation of younger age is located in the northwestern tip of the state on the machina area. The older granite is pre-Cambrian in origin consisting of metamorphic structures of gneiss and amphibolites. The younger granitic rocks are of Jurassic period, deposited between 195 and 135 million years before the present. The sedimentary rocks that are found in most part of the state was uncomfortably deposited on the basement crystalline rocks.

19. Climate

It is generally assumed that a decrease in rainfall implies a decrease in surface runoff and also a decrease in groundwater recharge. In fact, changes in water resources are linked with climatic fluctuations, but also with environmental changes and human activities.

The climate of Yobe state is hot and dry for most periods of the year. The mean temperature of the most stations in the state is about 37C. The highest temperature about 42C is normally experienced in April, while minimum temperatures about 30C are usually recorded in December. (Iloeje, 1977). The state exhibits a remarkably high annual range of mean monthly temperatures.

There is marked dry season of between eight to nine months and a wet season of only three to four months. Rainfall in the state is highly irregular in space and time, which makes farming difficult since small differences in the amount and timing of rain received at a point, may determine the success or failure of critical stages in vegetation development and hence crop production. The development of agriculture would, therefore, effectively depend on irrigation farming especially in the drier part of the state.

The present landscape is inherited from former wetter and drier conditions during the Quaternary (valley cutting, Aeolian ergs, respectively). The research area is therefore situated within the tropical savanna (dry and wet) type classified by Koppen as Aw with rainfall ranging from 750mm -900mm per year.

Runoff from agricultural land and other human activities had been found to increase water pollution indices in Potiskum. Whenever there's a rainfall, varieties of contaminants from the atmosphere and land surfaces are deposited into surface and ground waters resulting in pollution (Strahler and Strahler, 1973).

20. Soil

Soil play an important role in the development of Yobe state. The soil in most part of the state derived its origin from drift materials which vary in textural characteristics, but are mainly silt clay. This profile of soil is poorly developed with a low water retention capacity. Three types of soils can be identified on the basis of their geological formation. These are the dominant leached ferruginous tropical soil, shallow skeleton soils developed over granites basalt sand storm and iron stone mostly found at outcrops. Also found is weakly leached ferruginous tropical soils which consist of sandy, loamy soil with some profile development on sands. It shows slightly alkaline reactions and is acidic with low organic content, (Mark Lock Group, (1976). The productivity of soil is greatly impaired due to lack of adequate vegetation cover to supply organic matter. Wind erosion poses a serious threat to the quality of soil in the active areas of the north. It has been that the windblown fine soil particles have nutrients essential for plant growth. Alluvial soils are also found in the major river valleys, such as the Yobe system, and are suitable for the cultivation of crops like rice and wheat, around the water bodies.

21. Market

Another issue of concern that led to the rapid growth and the demand for more urban land is market. Potiskum town is a centre of trading of both livestock and farm produces. The best cattle market of West Africa is located in Potiskum. Hundreds of cattle, sheep and goats are transported to the southern parts of Nigeria on daily basis. In terms of grains and edible fruits, the villages and the neighboring towns patronizes Potiskum town to sell their farm produce and in turn buy other finished goods for their livelihoods. This led to the emergence of chain of trailer transport owners which serve as a source of employment and investment in houses, education and business as highlighted by Mortimore (2009). In addition to the many retail businesses peculiar to the town, there are now emerged large number of wholesale traders who supply both the retail traders within the town and those within the surrounding regions.

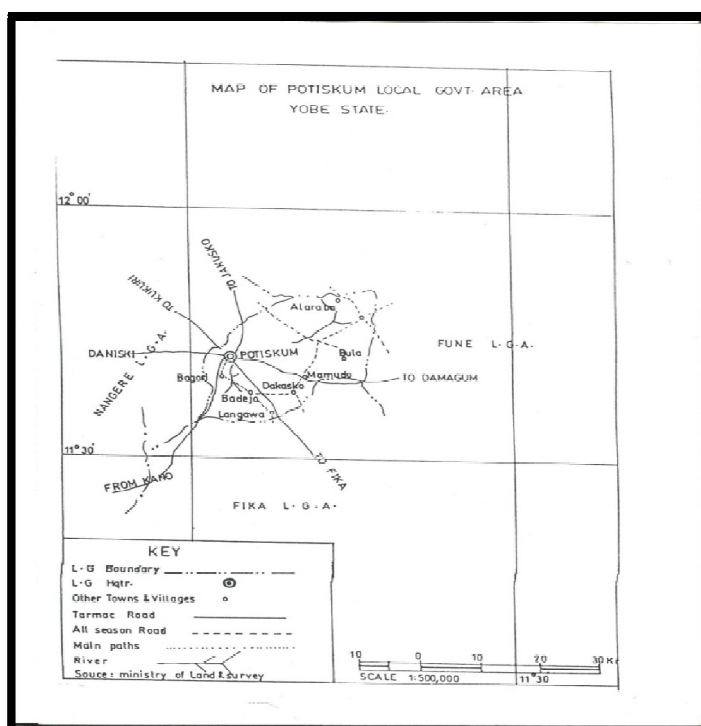


Figure 4: Administrative Map of Potiskum Local Government Area
Source: Yobe State Ministry of Land and Survey, Damaturu

22. Data presentation and Discussion

The findings in this research have been presented at this stage where physiocho chemical and heavy metals analysis were shown.

SN	Location	Ph	EC	Ntu	DO	TDS	NO3	NO2	So4	Po4	Cr	Ca	Mg	Le	Cd	Fe	Co
1	Lamba I	8.7	116	11.4	21.6	203	2.52	0.11	12.1	0.24	0.03	25.4	0.1	0.0	.001	0.5	0.8
2	Dallari J	8.3	97.0	7.31	21.2	116	0.98	0.09	11.2	0.91	0.04	11.3	0.22	0.0	.001	0.38	0.5
3	Alh Ish.	7.8	691	0.00	23.0	325	18.2	38.1	1.25	0.27	0.02	2.22	0.78	0.0	0.00	0.35	1.3
4	Yaroro	8.1	83.0	0.05	17.2	150	0.58	0.10	0.83	0.81	0.02	8.40	0.12	0.0	0.00	0.06	0.0
5	Kukar	8.2	91.1	0.02	16.3	102	0.87	0.00	1.20	0.25	0.03	12.1	0.20	0.0	0.00	0.11	0.1
6	Yindiski	9.2	1370	15.2	20.8	257	1.54	0.9	2.25	0.24	0.02	2.50	0.05	0.0	0.00	0.48	0.3
7	New Std	7.8	88.0	3.48	15.1	88.0	0.78	0.01	1.20	0.32	0.03	1.30	0.08	0.0	0.00	0.18	0.1
8	M Hosp	8.3	93.0	6.50	17.2	121	2.31	0.01	0.00	0.25	0.05	1.52	0.09	0.0	0.00	2.96	0.2
9	S. Baka	8.4	93.2	6.99	23.1	66.8	12.2	0.02	1.21	0.54	0.04	0.85	0.18	0.0	0.20	0.31	0.1
10	Furan D	8.3	102.0	53.8	11.3	40.8	0.88	0.00	1.50	0.20	0.01	1.24	0.11	0.0	0.00	2.43	0.2
11	S. Total	7.9	810.0	1.15	21.8	122	23.5	1.20	0.00	0.37	0.01	3.20	0.82	0.0	0.00	5.00	1.5
12	Ang Jaji	7.5	620	0.00	19.8	320	4.58	0.52	0.64	0.24	0.01	4.21	0.80	0.0	0.00	1.42	1.0
13	Mazaga	7.5	770.0	0.00	16.2	254	33.0	2.25	1.20	0.87	0.00	12.3	0.98	0.0	0.00	0.85	0.5
14	Jigawa	8.2	88.00	6.01	11.4	181	0.99	0.01	0.30	0.06	0.00	1.04	0.24	0.0	0.00	0.15	0.0
15	Mu azu	7.5	51.00	0.00	6.60	214	1.21	0.00	0.24	0.11	0.00	0.75	0.13	0.0	0.00	0.22	0.3
16	T Junct.	8.0	73.6	3.87	12.0	55.8	1.10	0.00	0.56	0.61	0.00	1.23	0.06	0.0	0.01	0.28	0.4
17	R Fulani	7.6	55.00	2.13	8.84	73.0	0.88	0.01	0.68	0.01	0.00	0.88	0.15	0.0	0.00	0.35	0.5
18	B. Abdu	8.0	76.8	0.56	5.30	120	2.25	0.04	0.22	0.00	0.00	1.12	0.31	0.0	0.00	0.74	0.1
19	M.Salala	8.3	90.00	1.37	11.0	108	2.03	0.00	0.20	0.14	0.02	2.19	0.12	0.0	0.00	0.24	0.1
20	Farafara	7.8	695.0	0.38	18.2	125	0.90	0.03	0.56	0.45	0.00	12.1	0.40	0.0	0.00	0.28	0.1
21	G Gaga	7.9	690.0	9.54	11.0	151	0.80	0.03	0.00	0.20	0.00	0.98	0.08	0.0	0.00	0.10	0.2
22	G Danga	8.1	850.0	0.00	8.25	124	0.51	0.03	0.53	0.40	0.00	0.78	0.54	0.0	0.00	0.52	0.2
23	Malka	7.5	560.0	3.97	5.00	88.5	1.25	0.07	0.41	0.77	0.00	0.48	0.42	0.0	0.00	0.08	0.0
24	Sadiya F	8.0	775.0	6.26	14.2	147	2.01	0.05	0.80	0.42	0.00	1.60	0.32	0.0	0.00	0.47	0.2
25	CatI mkt	8.5	822.0	2.25	1.90	210.0	0.80	0.05	0.58	0.45	0.02	1.45	0.88	0.0	0.00	0.55	0.3

Table 3: Physiocho Chemical Analysis of Hand Duck Well and Boreholes in Potiskum 2017
Source: Field Work 2018

From the table above, it shows clearly that twenty-five water sample from both hands dug wells and boreholes were collected and analyzed in chemistry department as contained in the methodology of the previous chapter. Heavy

metals including Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD) and color of the sampled water did not appear in the table. This shows that the water is perfected for drinking except for other components which include lead, Nitrite, Nitrate, Sulphate, Total Dissolved Solid (TDS) Magnesium, Chromium, PH, Copper, Calcium and Iron is seen for each location.

SN	Locations	PH	EC	NO3	NO2	SO4	PO4	Cr	Ca	Mg	Le	Cd	Fe	Co
1	Lamba I	8.22	235	6.54	0.22	15.3	12.5	0.31	19.7	1.21	0.23	0.32	2.50	1.25
2	Dallari J.	8.10	242	12.5	0.90	14.2	1.10	1.12	13.1	2.30	0.02	0.01	5.50	0.77
3	Alh Ish.	7.90	655	20.0	2.50	2.25	1.20	0.42	2.50	1.20	0.21	0.20	1.55	2.40
4	S. yaroro	7.98	142	1.40	0.14	1.35	1.60	0.13	18.0	0.54	0.00	0.02	0.55	0.19
5	Kukar M.	8.20	190	1.12	0.02	2.02	0.12	0.07	15.4	0.38	0.01	0.03	0.45	0.27
6	Yindisji	7.88	980	2.50	0.50	1.89	1.14	0.28	2.00	1.86	0.21	0.00	1.32	1.50
7	New sdt	8.00	210	2.30	0.25	2.80	1.31	0.14	3.33	0.17	0.13	0.07	1.07	1.17
8	M Hosp	7.90	152	3.12	0.21	0.04	1.88	2.07	2.11	0.12	2.41	0.02	3.22	0.46
9	S Baka	8.45	205	12.2	0.02	1.40	1.20	0.15	4.80	1.21	0.02	0.00	1.33	1.12
10	Furan D.	8.20	126	1.20	0.00	1.60	0.20	3.20	1.58	0.48	0.01	0.00	2.75	0.55
11	S. Total	8.15	758	30.3	1.80	0.12	1.30	0.40	4.30	1.00	0.28	0.16	6.00	1.90
12	An. Jaji	7.80	630	5.15	0.50	0.70	0.30	0.01	6.80	1.12	0.41	0.00	1.65	0.98
13	Mazaga	7.80	810	38.0	2.80	2.40	1.25	0.24	12.6	1.12	0.15	0.11	2.25	1.12
14	Jigawa	8.16	89.5	1.02	0.05	0.30	0.10	1.10	1.51	0.30	0.00	0.00	0.15	0.08
15	M.Muazu	7.90	150	1.97	0.28	0.88	1.19	0.23	1.29	0.45	0.35	0.10	1.18	0.58
16	T. Junct.	8.12	530	2.40	0.23	1.20	1.10	0.25	2.25	1.21	0.35	0.28	1.31	2.50
17	Riga Fulani	8.20	189	1.80	0.35	1.45	1.22	0.45	2.12	1.12	0.08	0.20	0.91	1.20
18	Baffa Ab	8.20	425	2.54	0.07	1.15	0.05	0.18	2.50	0.89	0.20	0.26	1.10	3.00
19	M. Salala	8.00	191	3.80	0.25	1.53	2.10	0.42	3.70	0.88	0.11	0.29	1.30	1.20
20	Farafara	8.10	730	12.0	0.88	1.22	2.55	0.11	13.8	1.10	0.25	0.15	2.50	2.30
21	G. Gaga	8.25	752	2.89	0.55	0.02	2.50	0.28	3.85	1.10	0.40	0.84	1.45	1.28
22	G. Danga	7.00	888	1.40	0.34	1.40	1.28	0.12	3.02	1.12	0.32	0.25	2.55	2.40
23	Malka	8.00	600	2.80	0.20	1.30	2.90	0.40	2.45	1.10	0.50	0.32	3.42	1.50
24	Sadiya F	8.00	700	2.55	0.10	2.50	0.88	0.27	4.20	0.32	0.00	0.00	2.34	2.00
25	Catle mkt	8.20	830	1.78	0.26	2.32	1.55	0.42	2.91	1.12	0.15	0.11	2.86	1.71

Table 4: Physiocho Chemical Analysis of Soil Sample in Potiskum

The table above shows the analysis of soil sample collected from 25 dumpsites that falls within the study area. This correspond with the water sample collected from the hand dug wells and boreholes at specified distance so as to assess the level of contamination and create an avenue for comparison at each location. Heavy metals that were analyzed in chemistry laboratory include lead, Nitrite, Nitrate, Sulphate, Total Dissolved Solid (TDS) Magnesium, Chromium, PH, Copper, Calcium and Iron.

Parameters	Unit	Max.	Lab.	Health impact	Note
Cadmium	mg/L	0.003	0.003	cancer, abdominal pain and skin lesions	
Lead	mg/L	0.01	0.04	increased blood pressure, hearing and vision impairment,	
Nitrate (NO3)		50	33.00		
Nitrite (NO2)		0.2	33.00		
Sulphate (SO4)		100	2.25		
Total Dissolved Solids	TDS	500	324.00	gastro-intestinal irritation.	
Magnesium (Mg+2)		0.20	0.980		
Chromium (Cr6+)		0.05	0.055	skin rashes, upset stomachs and ulcers	
PH		6.5 - 8.8	9.15	affects mucous membrane	
Copper		1	1.520	lung tissue bloodstream disease	
Calcium	mg/L	60 (soft)	6.00		
Iron (Fe+2)		0.1	4.900	liver and kidney diseases, high blood pressures	

Table 5: Acceptable Chemicals Units and That of Laboratory for Water Sample
Source: Field Work 2018

Table 5 above shows the level of concentration of heavy metals in the water sample compared with the acceptable level from World Health Organization (WHO). Nitrate has 33, Iron with 4.900, copper 1.520, and magnesium with 0.980 all beyond the acceptable levels 0.2, 0.1 0.2 and 1 respectively. This revealed that the water cannot be recommended for human consumption considering the world standard. High concentration of these chemicals can have its resultant consequences as can be seen in health impact column of the table

Parameters	Unit	Max.	Lab.	Health impact	Note
Cadmium	mg/L	0.003	0.84	cancer, abdominal pain and skin lesions	
Lead	mg/L	0.01	2.20	increased blood pressure, hearing and vision impairment,	
Nitrate (NO ₃)		50	37.50		
Nitrite (NO ₂)		0.2	2.80		
Sulphate (SO ₄)		100	15.30		
Total Dissolved Solids	TDS	500	324.00	gastro-intestinal irritation.	
Magnesium (Mg ⁺²)		0.20	2.30		
Chromium (Cr ⁶⁺)		0.05	3.30	skin rashes, upset stomachs and ulcers	
PH		6.5 - 8.8	7.22-8.22	affects mucous membrane	
Copper		1	2.88	lung tissue bloodstream disease	
Calcium	mg/L	60 (soft)	19.70		
Iron (Fe ⁺²)		0.1	5.88	liver and kidney diseases, high blood pressures	

Table 6: Acceptable Chemical Parameters Units and That of Laboratory for Soil Sample
Source: Field Work 2018

The table above shows the concentration of heavy metals in the soil sample and the acceptable level of World Health Organization (WHO). Except Nitrate with 37.50, sulphate 15.30 calcium 19.70 which are below the maximum level Others are above the acceptable level including Cadmium 0.84, lead 2.20, can cause increased blood pressure, hearing and vision impairment as shown in table 6. Nitrite 2.80, Magnesium 2.30, chromium, 3.30, copper 2.88 and Iron 5.88 This indicate that most of the chemicals have high level of concentration in the soil sample can easily be dissolve by runoff and sink downward thereby polluting the underground water

Location	Lab Nitrite	Max.	TDS Lab	Max
Baffa Abdu	0.04	0.2		
Maijakuna	0.8	0.2	324	500
Malam Muaazu			24.50	500
Yindiski Ganuwa	0.88	0.2		
Anguwar Jaji	2.25	0.2		

Table 7: Nitrite and Total Dissolve Solid (Tds) Level in Water Sample
Source: Field Work 2018

The table above shows the concentration of Nitrite and Total Dissolve Solid (TDS) in the water sample analyzed from the laboratory. The results revealed that out of the twenty-five water points, five points contained high Nitrite concentration which is a clear indication that it is not recommended for drinking. Except for one location (Baffa Abdu) with 0.04, other locations which include Maijakuna with 0.8, Yindiski Ganuwa with 0.88 and Anguwar Jaji with the highest level of 2.25 compared to the World Health Organization Standard with acceptable level at 0.2. For Total Dissolve Solid (TDS), the water sample has the highest concentration at Maijakuna with 324 and malam Muazu with 24.50 both of which are below the maximum level of 500. The water in terms of Nitrite content is not acceptable for human consumption in the study area.

Location	Magnesium	WHO	Iron	WHO
Dallari	0.210	0.20	0.350	0.1
Umar Jigawa	0.249	0.20	0.150	0.1
Baffa Abdu	0.30	0.20	0.740	0.1
Abd. Farafara	0.400	0.20	0.280	0.1
Lawan Hosp.			2.960	0.1
Furan Danko			2.430	0.1
Garin Danga	0.540	0.20	0.520	0.1
Malka	0.420	0.20		
Sadiya	0.320	0.20	0.420	0.1
Cattle mkt	0.880	0.20	0.550	0.1
Mai Jakuna	0.790	0.20	0.280	0.1
Sule Total	0.820	0.20	4.900	0.1
Anguwan Jaji	0.800	0.20	0.310	0.1
Mazaga	0.980	0.20	0.850	0.1

Table 8: Level of Magnesium and Iron Concentration in the Water Sample
Source: Field Work 2018

The concentration of both Magnesium and Iron level in the water sample is shown in the table above. It revealed that twelve water points including Mazaga with a mean value of 0.98 as the highest magnesium value in the research area. This shows that magnesium content is greater than the acceptable level 0.20 in the water sample. For Iron concentration, thirteen water points are considered as toxic for drinking in the area compared to the maximum level at 0.1. Musa lawan Hospital has a mean value of 2.960, Furan Danko with 2.430 and Sule Total with the highest at 4.900. By virtue of world drinking water standard therefore, the water points in the table above is not suitable for consumption due to its high magnesium and iron level which contravened the acceptable limit.

Location	Cadmium	WHO	Nitrite	WHO	Chromium	WHO
Lamba Idriss	0.34	0.003			0.31	0.05
Garin Gaga	0.84	0.003				
Dallari	0.23	0.003	0.90	0.2	1.12	0.05
New Stadium	0.13	0.003			0.12	0.05
Hospital	2.20	0.003			2.07	0.05
Furan Danko		0.003			3.20	0.05
T Junction	0.35	0.003	2.50	0.2	0.42	0.05
Baffa Abdu	0.20	0.003			0.18	0.05
Farafara	0.25	0.003	0.88	0.2		
Garin Gaga	0.40	0.003	0.55	0.2	0.28	0.05
Garin Danga	0.30	0.003			0.25	0.05
Malka	0.50	0.003			0.40	0.05
Cattle mkt	0.15	0.003			0.31	0.05
Jakuna	0.21	0.003				
Yindiski	0.21	0.003				
Sule Total	0.24	0.003	1.80	0.2	0.40	0.05
Anguwan Jaji	0.41	0.003	0.45	0.2		
Mazaga	0.12	0.003	2.80	0.2	0.24	0.05

Table 9: Level of Cadmium, Chromium and Nitrite Concentration in Soil Sample
Source: Field Work 2018

Cadmium can be accumulated by many organisms, particularly by the presence of micro-organisms. Chronic exposure to cadmium as a metal produces a wide variety of acute and chronic effects in mammals similar to those seen in humans. Kidney damage and lung emphysema are the primary effects of high Cadmium in the body. Mean values of Cadmium in this study ranged from 0.000 to 0.32 at lamba Jibrin which is greater than the maximum level 0.003. Cadmium is known to be one of the most toxic elements with reported carcinogenic effects to human's health. High concentration of cadmium has been found to lead to chronic kidney dysfunction. Cadmium accumulation at all levels can lead to destruction of both aquatic and terrestrial food chains cancer, abdominal pain and skin rashes increased blood pressure, hearing and vision impairment,

Cadmium contaminations in surface water bodies could be attributed to the discharge of contaminants including animal wastes, nickel-cadmium batteries. Some other activities which has contributed to cadmium concentration into these environments include electroplating and plastic manufacture. Nitrite concentration in the soil ranged from 0.45 to 2.50 much greater than the limited acceptable level 0.2. For Chromium, it has thirteen locations with a mean value ranged from 0.18 at Baffa Abdu and 3.20 at Furan Danko which all fall above the maximum level 0.05. Chromium high

concentration can lead to skin rashes, upset stomachs and ulcers, effects mucous membrane, lung tissue bloodstream disease, liver and kidney diseases, high blood pressures and so on.

Location	Magnesium	WHO	Copper	WHO	Iron	WHO
Kukar M.	0.32	0.20				
Garin Gaga						
Sadiya Farm	0.32	0.20			2.30	0.1
Dallari	2.30	0.20			5.50	0.1
Sule Yaroro	0.54	0.20				
Furan Danko	0.40	0.20			2.75	0.1
T Junction	1.20	0.20	2.00	1	1.23	0.1
Baffa Abdu	0.83	0.20	2.88	1	1.04	0.1
Farafara	0.95	0.20	2.30	1	2.00	0.1
Garin Gaga	0.98	0.20			1.16	0.1
Garin Danga	1.12	0.20	2.40	1	2.55	0.1
Malka	0.80	0.20			3.20	0.1
Cattle mkt	1.12	0.20			2.55	0.1
Jakuna			2.38	1	1.40	0.1
Yindiski	1.86	0.20			1.20	0.1
Sule Total	1.00	0.20			5.88	0.1
Anguwan Jaji	1.02	0.20			1.65	0.1
Mazaga	1.12	0.20			2.20	0.1
Salala	0.80	0.20			1.30	0.1
Sarkin Baka	1.21	0.20			1.33	0.1

Table 10: Level of Magnesium, Copper and Iron Concentration in Soil Sample
Source: Field Work 2018

The table above revealed that out of 18 soil samples only one sample at T- Junction is within the acceptable Magnesium level with a mean value of 0.20 and the rest are significantly beyond the maximum level with jibrin Dallari recorded the highest 2.30. Whilst copper on the other hand have 2.00 at T Junction, 2.30 at Abdu farafara, 2.38 at Mai jakuna, 2.40 at Garin Danga and 2.88 at Baffa Abdu which all fall above the acceptable level. Iron as a metal has its concentration in the soil sample above the acceptable level at 17 dumpsites out of 25. Iron concentration level ranges between 1.20 at Yindiski Ganuwa mean value and 2.88 at Sule Total all above the maximum level of WHO at 0.1.

Location	NTU Mean Value	Lab
Lamba Idris	11.40-11.50	1.5
Jibrin Dallari	7.31- 7.33	1.5
Kukar makabarta	0.00 – 0.02	1.5
Lawan Hosp.	6.50 -6.56	1.5
Sarkin Baka	6.98 -7.00	1.5
Furan Danko	53.34 -53.80	1.5
Umar Kurasati	5.80 -6.01	1.5
Garin Gaga	9.54	1.5
Sadiya Farm	6.26 -6.35	1.5
Yindiski Ganuwa	15.29 -15.40	1.5

Table 11: Level of Turbidity (NTU) In Water Samples
Source: Field Work 2018

Turbidity level is high in nine locations with mean values which exceeded the health base guidelines of 1.5. With the exception of one location namely Kukar makabarta with a mean value ranged from 0.00 to 0.02 which is below the permitted level, all other locations have a high value with 15.29 to 15.40 at Yindiski Ganuwa. Concentrations of the substance at or below the health-based guideline value given by the World Health Organization (WHO) may affect the appearance, taste or odor of the water, leading to consumer complaints. This can be depicted in the above table showing all the locations and their respective mean values.

23. Recommendations

Based on the findings of this research, the following recommendations become pertinent:

- Sensitisation of the general public on the effects of urban livestock rearing associated with contamination of groundwater.
- Wells and boreholes should be properly covered without any link for surface runoff containing pollutant of any form to sink into the wells.

- National programmes on quality of the environment in collaboration with environmental health workers to be enhanced; this will also create awareness to the general public.
- There is the need for the implementation of environmental laws on indiscriminate disposal of solid waste on the street, water ways and or inside the buildings as this can lead to urban flood, destruction of properties and structures as well as creation of slum like conditions and its resultant consequences.
- Urban livestock keepers should be given soft loan to increase their residential plots sizes so as to reduce direct contact of human and animals which is one of the bases for zoonotic quick transmission.
- Solid waste as source of income to the urban livestock keepers should be recycled as manure to be used on farmland in the rural areas. This will go a long way in the clearance of heaps of dumpsites in the study area.
- Adequate access to veterinary services should be given to the urban livestock keepers so as to take proactive measure at any time when there is zoonotic outbreak
- Sitting and construction of sanitary landfills particularly in rapidly growing urban areas such that the disposal of waste does not constitute health hazard.
- Monitoring the quality and nature of the groundwater reservoirs in the vicinity of the site.
- Determination of the ideal treatment that can be applied where ground water resources are contaminated.

24. Conclusion

Urban livestock management for commercial or non commercial purposes should be conducted in a more sustainable manner through collaborative and integrated efforts of government, individual or group purpose so as to minimally reduce its risk of underground water contamination as well as spread of zoonotic diseases as many human infection diseases has been transmitted by livestock

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