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Enhancing Water Quality Analysis Through Indirect Numerical Methods – A Case Study of Uzairue Community, Etsako, Edo State, Nigeria

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ABSTRACT

This study focuses on enhancing water quality analysis in Uzairue through the application of indirect numerical methods. The analysis identified significant variation in water quality parameters, where several were found that exceed the established regulatory standards. The main problem that lead to the research by administering of questionnaire was confirmed positive with summation of the X responses from the Local Government Staff was 4.44 and the summation of the Y responses from the community was 4.12 was positive and the laboratory analyses shows that some parameters. Example: Manganese (Mn), Zinc(Zn), Cadmium (cd) and Iron (Fe) exceeded SON and Who standard although, parameters like Copper (Cu) and Nitrogen (Ni) are within the regulatory standard the microbial analysis poses health risk where the Total Heterotrophic Bacterial counts is 5 c Fu/ml, Total Heterotrophic fungi count 2 cfum 1 and Total coliform counts 2 cfu/ml, the presence of streptococcus sp. and aspergillus sp. suggest potential contamination from human and animal waste. The findings revealed elevated levels of contaminants, including nitrates, (Ni),Phosphate (P) and some heavy metals suggesting anthropogenic influences and inadequate waste management practices. This underscores the urgency of employing effective monitoring and management strategies to mitigate water pollution in the region. The insight gained from this case study not only highlights the specific challenges facing Uzairue's water supply but also propose a framework for broader application in similar contexts advocating for improved water quality standard and public health protection. The adoption of indirect numerical methods in this study offers a robust approach for local authorities and stakeholders, facilitating effective decision-making and better resource allocation in the fight against water pollution. Continued research and tailored interventions are essential to ensure sustainable water quality improvements for the communities in Uzairue.

Keywords: Water Quality Analysis, Indirect Numerical Methods, Uzairue, Edo State, Nigeria

Aims Research Journal Reference Format:
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1. INTRODUCTION

Water pollution particularly of surface water results from all activities include indiscriminate waste disposal from industries such as effluents into water ways, municipal wastes, abborine and industrial sewage have been continuously added to water bodies which affect the physio – chemical quality of water, making them unfit for use by human, livestock, agricultural and other organisms (Ibhafidion- Momodu , 2008). Effluent discharges into the environment with enhanced concentration of nutrients and sediments will have serious negative impacts on the quality and life forms of the receiving water body when discharged untreated, water pollution by industrial effluent has become a question of considerable public and scientific concern in the light of evidence of their extreme toxicity to human health and to biological ecosystems (Katsuro et al., 2004).

Water is considered polluted if some substance is present to a degree that the water cannot be used for a specific purpose. The pollutants are usually pathogens, sewage, slit, solid waste, soils, disposed foods, cosmetics, automobile emission, construction debris and eroded banks from rivers and other waterways (Bakare and Akinta, 2016). Water quality analysis is crucial for maintaining the health of ecosystems and public health, as contaminated water can lead to a range of health issues and ecological problems. Traditional methods of analysing water quality often involve direct sampling and laboratory tests, which can be time consuming and expensive. Recent advance the efficiency and effectiveness of water quality assessments (Green 2021). Water quality analysis is the process of testing water samples to determine the levels of various contaminants and impurities present in the water. It is an essential practice that aims to ensure safe and clear water for human use and aquatic life (Google, 2023).

Indirect numerical methods of ten involving computation modeling which are increasingly used to enhance water quality analysis by stimulating complex aquatic systems and predicting the impact of various factors on water quality. The method allows more comprehensive understanding of water quality dynamics that can be particularly useful in assessing the effects of pollution sources, climate change and other stressors on water bodies (UNIZIK RR, 2021). Indirect numerical methods leverage statistical and computational models to estimate water quality parameters based on readily available data. This includes the use of machine learning algorithms, remote sensing technologies and hydrological modeling (Smith and Brown, 2022). Applying these techniques, researchers can obtain timely insights into water quality enabling faster decision making and potentially lowering the costs associated with water monitoring.

In this study, Uzairue explores the potential of these indirect numerical methods to improve water quality analysis. The research paper emphasizes the development of a robust framework that integrates various data sources and computational techniques to provide a more comprehensive understanding of water quality dynamics (Uzairue, 2023)

1.1 Sources of Water

As far as water development is concerned, the nature of the water source determines the mode of planning, design, collection, purification, transmission and distribution work. The international standards for Drinking water (W.H.O, 2009) states that water meant for human consumption needs to be free of both organisms and toxic chemical substances that may affect man's health. Good water is 'wholesome and portable' (Oame, and Ibhafidion- Momodu, 2007). For water to be wholesome, it means it is free from disease causing organisms, poisonous substance and excess amount of mineral and organic matter. To be portable, it must be significantly free from colour, turbidity, taste and well aerated (has enough dissolved oxygen. Generally, there are two main sources of water: Surface and ground water.

Surface Water

Surface water is exposed to contamination and invariably. It must be treated before use. It contain both organic and inorganic impurities, gases, and micro – organism. It is generally used for drinking purpose when the ground water supply is inadequate in quantity and in the low income community.
Surface water is a general term describing any water body which if found flowing or standing on the surface, such as runoff, lakes, ponds, streams, rivers, lagoons, springs, seas, ocean and reservoirs e.t.c. Surface water originates from a combination of sources:

(a) Surface run-off rainfall which has fallen onto the surrounding land and that flows directly over the surface in to water body.
(b) Direct precipitation-rainfall which falls directly into the body.
(c) Inter-flow excess soil moisture which constantly draining into the water body and

(d) Water-table discharge where there is an aquifer below the water body and the water-table is high enough, the water will discharge directly from the aquifer into the water body. The quality and quantity of surface water depends on a combination of climatic and geological factors.

However, in rivers and streams where the water is dynamic state of constant movement, the volume of water is very dependent on the preceding weather conditions.

Ground Water

The largest available source of fresh water lies underground. The term ground water refers to the water that is stored by nature underground in the water bearing formation of earth's crust. The total ground water potential is estimated to be one-third the capacity of oceans (Gray, 1999). The main source of ground water is precipitation. A portion of rain falling on the earth surface infiltrates into the ground travels down and when checked by impervious layer to travel further down, forms ground water.

The ground water reservoir consists of water held in voids within a geologic stratum. The ground water can be tapped in the following ways:

(a) From natural spring.
(b) From wells and boreholes.
(c) From infiltration galleries, basin or cribs.
(d) From well and galleries with flow augmented from some other sources.
    (i) Spread on surface of the gathering ground.
    (ii) Carried into changing basins or clitches.
    (iii) Led into diffusion galleries or wells.
(e) From river side radial collector wells.

An aquifer is a substance layer of rock or sediment that stores and transmits ground water. Essentially, it is a natural reservoir of water underground often made of porous materials like sand, gravel, or sandstone. These formations allow water to flow through them, making it possible to extract water through wells.

Formation

Aquifers form when precipitation through the soil and becomes trapped within permeable rock.

Composition

Aquifers can be made of various materials including sand, gravel, sandstone, fractured rock, limestone e.t.c.

Ground water Extraction

Aquifers are tapped by drilling wells into them and pumping out the water for drinking, irrigation and other uses.

Natural Filtration

As water flows through the aquifer, it is often naturally filtered removing impurities and sediment.

Water Storage

The water within an aquifer fills the spaces between the rock or sediment particles, creating a vast underground reservoir.

1.2 Types Of Aquifers

There are different types of aquifer, including confined aquifers (where the water is tapped between impermeable layers) and unconfined aquifers (where the water table is directly accessible). (Ford, and Vappi, 2023)

Unconfined Aquifer

An Unconfined aquifer is one that is recharge where the porous rock is not covered by an impervious layer of soil or other rock. The unstrucurated layer of porous rock is separated from the saturated water-bear layer by an interface known as the water-table. Where the aquifer is one laid by an impermeable layer no water can penetrate into the porous rock from the surface, instead water slowly migrates laterally from unconfined areas.

Confined Aquifer

A confined aquifer is the one in which ground water is confined under pressure greater than atmosphere by overlaying relatively impermeable strata. The static pressure at a point within confined aquifer is equivalent to the elevation of the water table in the recharge area less the loss in head through the aquifer to the joint under consideration. Water enters a confined aquifer in an area where the confining bed series to the surface underground and the aquifer becomes unconfined. Confined aquifers usually have relatively small recharge areas as compared with unconfined aquifers.

Rain Water

(a) From roofs of house and dwellings: Water stored in small underground tank or cistern, for small individual supplies.
(b) From prepared catchments: The surface of catchment is made impervious by tin tab lining material, and suitable slope is given so that water is stored in moderate size reserving. This water is used for communal supplies, mostly for drinking purposes.

Water obtained From Reclamation

a) (a)**Desalination:** Saline or blackish water be rendered useful for drinking purposes by installing desalination plants. The common methods used for desalination are: distillation, reverse osmosis, electro dialysis, freezing and solar evaporation.
b) (b)**Re-use of Treated waste Water:** Effluent or wastewater can be treated suitably so that it may be reused. An example of the controlled indirect reuse is the intentional artificial recharge of ground water aquifers by adequately treated wastewater.

1.3 Uses of Water

It is an age old fact that water is essential to man in his environment, and that water may be used for many purposes. On a broad classification, water may be for domestic, industrial and agricultural purposes.

a) **Domestic water use**: This includes water for drinking and washing, bathing and laundering, for general house-hold cleanings for filling swimming and cleaning pools, for aesthetics such as uses in fountains and water cascades, for conveying household wastes (sewage).
b) **Industrial water use**: This include water for various industrial and allied uses like in beverage and textile industries, as cooling waters in some metal industries, for protecting life and property in fire-fighting, for conveying offensive and possibly dangerous waste from industrial process.
c) **Agricultural water use**: This includes water required for various agricultural processes such as irrigation, livestock production, watering of lawn gardens and flowers.

d) **Public use**: This includes the water required for use in parks, civil building, schools, hospitals, churches, streets and mosques.
e) **Loss and waste**: This includes the leakages from the system meter spillage, unauthorized connection and all other unaccounted water are classified as loss and waste.
f) **Mining use**: Water for the extraction of minerals occurring natural and associated with quarry, well operation, milling and other preparation customarily done at the mine site or as part of the mining activity.
g) **Thermo electrical use**: Water for the process of the generation of thermo electric power use (Solley et al, 1998).

1.4 Impurities in Surface Water

Surface water can contain a variety of impurities, broadly categorized as physical, chemical and bacteriological. These impurities can include sediments, organic matter, dissolved salts, heavy metals, pesticides, bacteria, viruses and even radioactive substances (AOS, 2018).

Physical Impurities

Sediments: Sand slits and clay particles suspended in the water, making it cloudy as well as turbid.
Organic Debris: Leaves, twigs and other decaying plant and animal matter.
Colour: Dissolved organic matter can impart colour to the water making it appear yellow or brown.

Chemical Impurities:

a) **Dissolved Salts:** Sodium chloride (salt), calcium bicarbonate and other salts can be dissolved in water, affecting its taste and potentially causing corrosion.
b) **Heavy Metals:** Lead, Mercury, and other heavy metals can contaminate water, often from industries.
c) **Acid and Bases:** Waste from industries can contain acids or bases, altering the water's PH and affecting aquatic life.
d) **Nutrients:** Excessive Nitrogen and Phosphorus from fertilizers can lead to algal blooms, harming water quality (Quora, 2018).

Biological Impurities:

e) Bacteria and viruses, untreated sewage, and agricultural runoff can introduce harmful bacteria and viruses into surface water.

Effects of Impurities

f) **Health Risks:** Contaminated water can cause a wide range of illness, from gastrointestinal problems to neurological damage.
g) **Environmental Damage:** Impurities can harm aquatic ecosystems, disrupting food chains and causing fish kills.

Human and Animal Fecal

Introduces disease causing micro organism into recreational water that are largely derived from human sewage or excreta from warm blood animals. The most important sources of human fecal contamination of recreational water environments for public health problems are: Sewage and fecal sludge disposed of in the recreational water area through pipes, drains and trucks.

Riverine

(a) Riverine discharge and combined sewer overflow where the rivers is receiving water from sanitation systems (examples sewage discharges, liquid effluent from septic tanks) either is used directly for recreations or discharges near or into a coastal or fresh water area used for recreation.

(b) Contamination from recreational water users (including in deceasing order of human health risk, fecal shedding, vomiting and urine) particularly hazardous at high density of users.

(c) Runoff from surrounding land where open field defection (OFD) and flooding of pits and septic tanks is prevalent. The risk may vary with local circumstance for example, sewage and septic tank effluent being discharge into an estuary with small tidal interchanges may present a greater risk then the same quantity of sewage and effluent discharged into on estuary with large tidal interchanges link wisely, a river discharging into on enclosed bay presents a higher risk than one discharging directly into the open sea.

Animal inputs: Animal sources one generally less impotent to human health risk than human excrete flows. However, in some instance, animal (example gulls, water fool) can have a significant impact on facial indicator bacteria used to measure microbial water quality and could result management actions that are unnecessary in terms of public health (Smith *et al,* 2020) pollution of recreational water with animal excrete can sometimes lead to human health risks because of some zoometric pathogens examples cryptosporidium partum, pathogenic Escherichia coli can be transmitted in animal faces, particular, from intensive livestock raising near water ways (Soller *et al,* 2015) thus, local knowledge of possible sources and environmental pathways of animal pathogens to humans should from part of the sanitary inspection as it the case for shellfish growing waters in many countries.

1.5 Water Borne Diseases

Are the one caused by pathogenic microbes spread via contaminated water, transmission of these pathogens occurs while using infected water for drinking, food preparation and washing clothes among others many developing countries do not have proper water treatment plants, especially is the rural areas. The availability of water is so scarce that some people neither have the time nor money to afford water purifiers or other water treatment mechanisms (Strickly, 2023). Majority of water borne diseases worldwide mainly affect children due to poor hygiene and weak immunity (Adeyika *et al.,* 2014).Majority of these diseases are life threatening the knowledge of the different types of water borne diseases has come to the forefront with the advent of globalization over the past few decades. A lot of pathogenic microorganisms which were previously unknown have become the focus of major research. About 844 million people lack even a basic drinking water service. In fact, approximately 159 million individual are dependent on surface water the World Health Organization (WHO) reports. Additionally, at least 2 million people utilize a drinking water source that is contaminated with feces. These water sources can transmit water borne diseases which have been linked to about 502,000 diarrheal deaths every year (Strickly, 2023).

Water borne diseases and their impact

The pathogenic microorganisms, their toxic exudates, and other contaminants together, cause serious conditions such as cholera lead poisoning diarrhea amoebiasis, hepatitis cryptosporidiosis, polio gastroenteritis, giardiasis, arsenicosis, trachoma, fluorosis, campylobacteriosis, scabies and worm infections to name a few.

a) **Diarrhea:** The most common of all water borne diseases, diarrhea mainly affects children below five years of age. The symptoms include dizziness, dehydration, pale skin and loss of consciousness in serve cases. It normally last for a couple of weeks and turn out to be fatal it is goes untreated.

b) **Amoebiasis:** It is caused by a parasite named Entamoeba histolytic. The protozoan organism is transmitted by unknowingly consuming cysts (an inactive form of the parasitic) in food, and it affects the intestine. The parasite thrives on contaminated soil and feacal matter. The common symptoms of amoebiasis include abdominal cramps and watery stools

c) **Hepatitis A:** The condition mainly affects the liver and is caused hepatitis A virus. The route of contamination is usually, oral while it also spreads through physical contact with on infected person. Hepatitis A patients mantes common symptoms such as fever, nausea and vomiting but can suffer severe complication if they a not treated is time.
d) **Cholera:** It is mainly caused by bacteria named vibrio cholera via consumption of contaminated food or drinking water. The symptoms include diarrhea, vomiting, fever and abdominal cramps. Cholera occurs predominately in children but can also affect adults. It possesses a mortality rate that is alarmingly high among the water- borne diseases.

People with a suppressed immunity, like those who are malnourished or infected with human immunodeficiency virus (HIV) are to be enlightened the risk of death if they are infected with the bacteria.

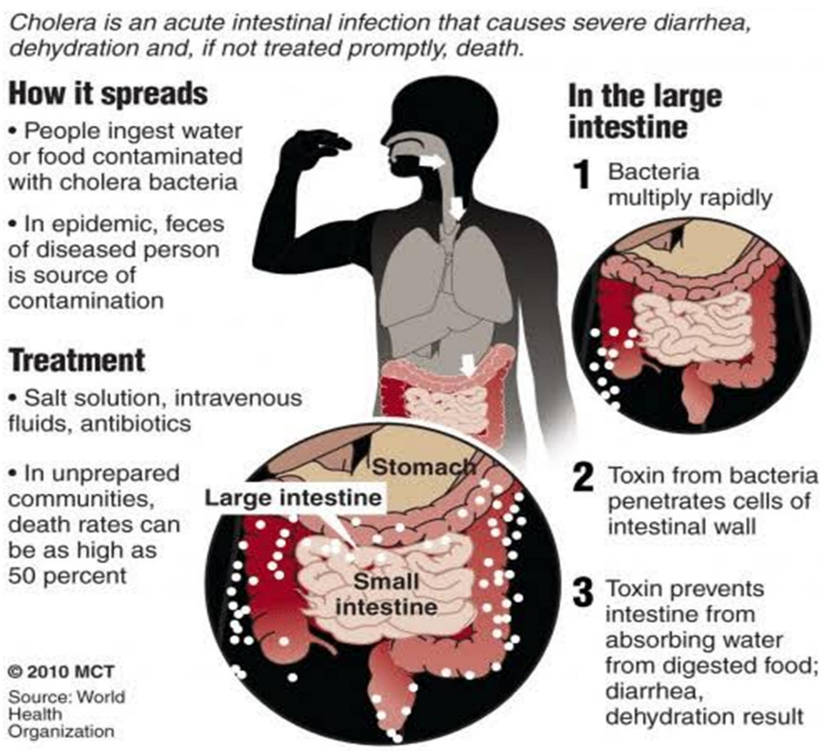


Fig 1:Cholera Cycle
Source: Strickly(2023)

Typhoid fever is cause by Salmonella typhi the pertinent typically suffer from prolonged episodes of fever, loss of appetite, nausea, headache, constipation and loss of body weight.

2. DESIGN

The research was a resembling experiment survey, aimed at eliciting opinions of people in the society, using questionnaire on health problems associated to water resources. A case study of Uzairue in Etsako West Local Government Area. The design was used to obtain relevant data, collected were analyzed and interpretation of findings was based on the research questions while tables were used to give answers to the research question including discussions.

2.1 Area of Study

The area of study is in Uzairue in Etsako West Local Government Area in Edo state.

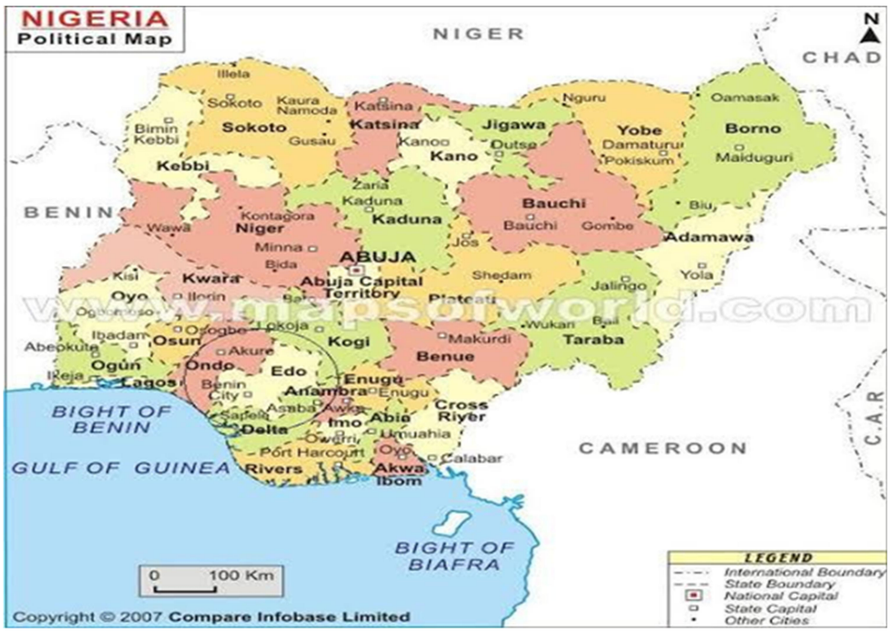


Figure 2: Map of Nigeria showing Edo State. (Source: Alamy, 2024)

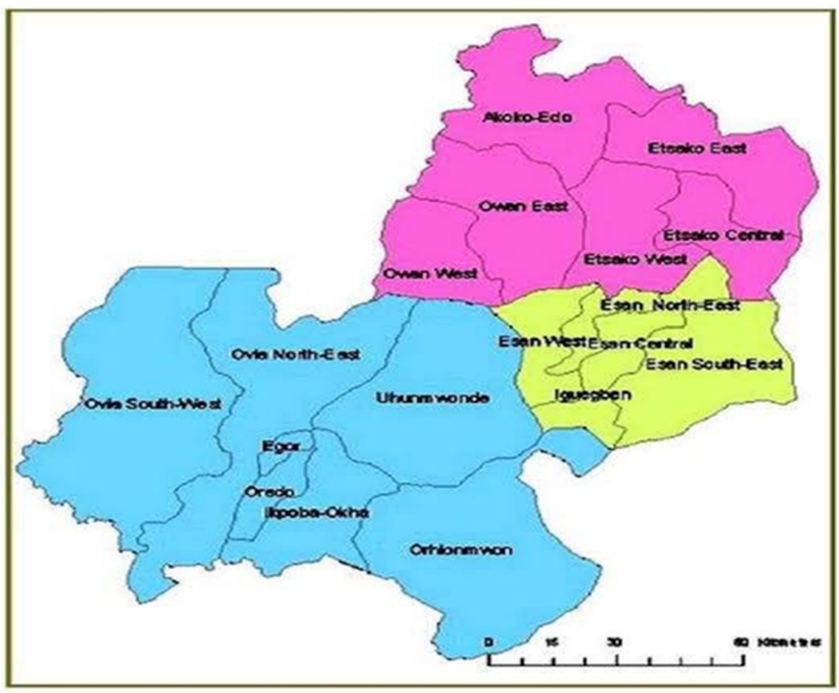


Figure 3: Map of Edo state showing Etsako west LGA. (Source: Alamy, 2024)

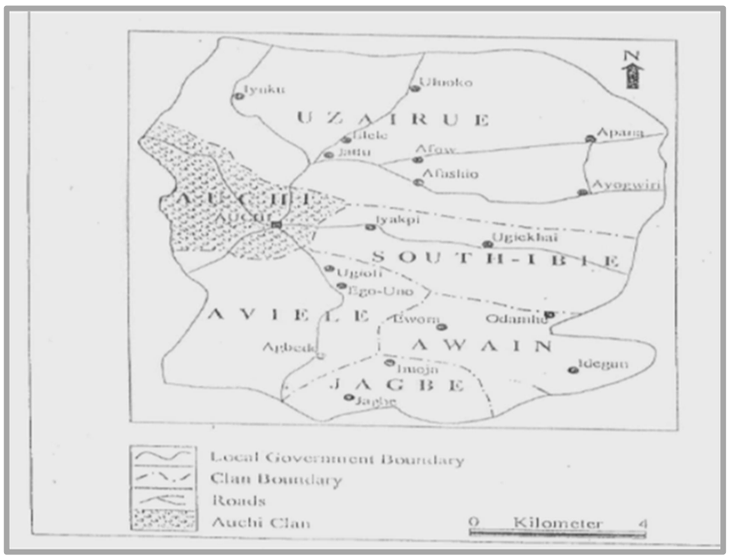


Figure 4: Map of Etsako West LGA Showing the studying area. (Source: Alamy, 2024)

The Population of The Area Of Study

The population of the Uzairue Clan in Etsako West Local Government Area is 32,935 inhabitance as at 2006 census (Gazettes Africa, 2006

Picture of Water Sample

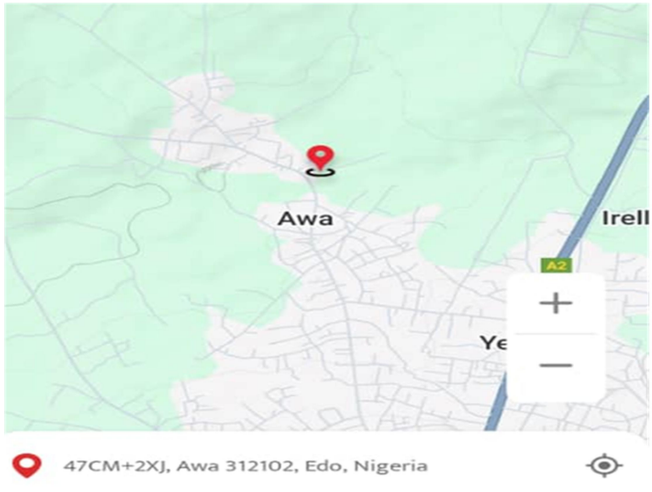


Figure: 5: Uzairue Map where water sample was collected
Source: Google Map, 2024; Latitude:7.1204695; Longitude:6.2851042

Instrument of the Study

Two set of questionnaire formed the instrument of study. One of the questionnaires, which collected data from the people within the study area had twenty-four (24) items with not less than three items focused on collecting data on the eight (8) research questions. The other questionnaire which collected data from the L.G.A staff in Uzairue Clan had twenty-four (24) items with not less than three items focused on collecting data on the eight (8) research questions. Items in the questionnaire have a structured response pattern of:

(a) Strongly Agreed
(b) Agree
(c) Undecided
(d) Strongly Agreed
(e) Disagree

Validity of Instrument

This questionnaire was adopted from the study Eme (2008) from this study it was observed that the instrument has a face validity having been in use for years now. This was also face and content validated by (Mrs). Ibhafidon-Momodu. G.O (2022).

Reliability of the Questionnaire

The reliability coefficient (r) was obtained. Two sets of questionnaires formed the instrument of study. One of the questionnaire, which collected data from the people within the project area focused on the eight (8) research questions represent (Y). The other questionnaires, which collected data from the L.G.A staff in Etsako west Local Government Area, focused on same eight (8) research questions as well represent (X).

3. METHODS

In analyzing the data, the researchers made use of mean scores to answer the research questions that guide the study. In doing this a cut-off mean score of 3.00 and above was regarded as constituting a problem while a mean score of less than 3.00 was regarded as not being a problem. In calculating the mean, the five point rating scale was given the following value by the researchers.

The Sample and Sampling Techniques

Sample was collected from Uzairue Clan in Etsako West Local Government Area in Edo State, Nigeria. During the sample collection the source was distributed thoroughly. Some of the sample was collected at the middle of the source (River) while others were been collected at the side / edge of the source (River). The sample container used was 10 litres of gallon, the gallons was bought newly, and used for the sample collection. Before the sample collection, the gallon was washed properly with the water from the river that is the sample source. The sample was properly labeled at the point of collection from the source (River).

Two sets of questionnaire formed the instrument of study. One of the questionnaires, which collected data from the people within the project area, had

a) Can cryptosporidiosis that targeted the intestine of human by ingesting contaminated water causes watery diarrhea, stomach cramps and fever?
b) Does Arsenicosis poisonous lead to damage of bladder, kidneys and skin?
c) Does lead poison that enters water through old pipes, discharge of toxic chemical and solders cause anaemia in children and problem to adult reproductive system and high blood pressure?
d) Can fluorosis consumed in water affect teeth, bones and abdominal pain?
e) Can trachoma affect human through pathogenic sanitation lead to folding eyelid, in grown eye lashes and cloudiness that can lead to partial blindness or permanent blindness?

f) Does polio virus infection spread through water contaminated with feces from infected person causes headache, vomiting, stiffness of neck and pain in the limbs?
g) Can human and animal waste from sewage and septic system carry harmful microbes into surface water causes giardia, salmonella, coliand cryptosporidium?
h) Can the outbreak of disease in Etsako West Local Government Area. as the result of greenhouse emissions, climate change, flooding, and droughts caused by human activities pollute the surface water?

Questionnaires for Local Government Staff (X)

Table 1: Research Question/Hypothesis

The following research Questions/Hypothesis guided the work

S/NO	Description	5	4	3	2	1
		Strongly agree	Agree	Undecided	Disagree	Strongly disagree
1	Cryptosporidiosis that targeted the intestine of human by ingesting contaminated water causes watery diarrhea.					
2	Cryptosporidiosis that targeted the intestine of human by ingesting contaminated water causes stomach cramps.					
3	Cryptosporidiosis that targeted the intestine of human by ingesting contaminated water causes fever.					
4	Arsenicosis poisonous leads to damage of bladder.					
5	Arsenicosis poisonous leads to damage of kidneys.					
6	Arsenicosis poisonous leads to damage of skin.					
7	Lead to poison that enters water through old pipes, discharge of toxic chemicals and solders causes anemia in children.					
8	Lead to poison that enters water through old pipes, discharge of toxic chemicals and solders causes problem to adult reproductive system.					
9	Lead to poison that enters water through old pipes, discharge of toxic chemicals and solders causes problem to adult high blood pressure.					
10	Fluorosis consumed in water affects teeth.					
11	Fluorosis consumed in water affects bones.					
12	Fluorosis consumed in water abdominal pain.					

13	Trachoma affect human through pathogenic sanitation lead to folding eyelid that can lead to partial blindness or permanent blindness.					
14	Trachoma affect human through pathogenic sanitation lead to ingrown eye lashes to partial blinding or permanent blindness.					
15	Trachoma affect human through pathogenic sanitation lead to partial blinding or permanent blindness.					
16	Polio virus infection spread through water contaminated with feces from infected person causes headache.					
17	Polio virus infection spread through water contaminated with feces from infected person causes vomiting.					
18	Polio virus infection spread through water contaminated with feces from infected person causes stiffness of neck and pain in the limbs.					
19	Human and animal waste from sewage and septic system carry harmful microbes into surface water causes salmonella.					
20	Human and animal waste from sewage and septic system carry harmful microbes into surface water causes E.coli.					
21	Human and animal waste from sewage and septic system carry harmful microbes into surface water causes giardia.					
22	Outbreak of diseases in Auchi as the result of green house caused by Human activities affects surface water.					
23	Outbreak of diseases in Auchi as the result of climate changes caused by Human activities affects surface water.					
24	Outbreak of diseases in Auchi as the result of flooding caused by Human activities affects surface water.					

QUESTIONNAIRES FOR LOCAL GOVERNMENT STAFF (Y)

TABLE 2: RESEARCH QUESTION/HYPOTHESIS

The following research Questions/Hypothesis guided the work

S/NO	Description	5	4	3	2	1
		Strongly agree	Agree	Undecided	Disagree	Strongly disagree
1	Cryptosporidiosis that targeted the intestine of human by ingesting contaminated water causes watery diarrhea.					
2	Cryptosporidiosis that targeted the intestine of human by ingesting contaminated water causes stomach cramps.					
3	Cryptosporidiosis that targeted the intestine of human by ingesting contaminated water causes fever.					
4	Arsenicosis poisonous leads to damage of bladder.					
5	Arsenicosis poisonous leads to damage of kidneys.					
6	Arsenicosis poisonous leads to damage of skin.					
7	Lead to poison that enters water through old pipes, discharge of toxic chemicals and solders causes anemia in children.					
8	Lead to poison that enters water through old pipes, discharge of toxic chemicals and solders causes problem to adult reproductive system.					
9	Lead to poison that enters water through old pipes, discharge of toxic chemicals and solders causes problem to adult high blood pressure.					
10	Fluorosis consumed in water affects teeth.					
11	Fluorosis consumed in water affects bones.					
12	Fluorosis consumed in water abdominal pain.					
13	Trachoma affect human through pathogenic sanitation lead to folding eyelid that can lead to partial blindness or permanent blindness.					
14	Trachoma affect human through pathogenic sanitation lead to ingrown eye lashes to partial blinding or permanent blindness.					
15	Trachoma affect human through pathogenic sanitation lead to partial blinding or permanent blindness.					
16	Polio virus infection spread through water contaminated with feces from infected person causes headache.					
17	Polio virus infection spread through water contaminated with feces from infected person causes vomiting.					

18	Polio virus infection spread through water contaminated with feces from infected person causes stiffness of neck and pain in the limbs.					
19	Human and animal waste from sewage and septic system carry harmful microbes into surface water causes salmonella.					
20	Human and animal waste from sewage and septic system carry harmful microbes into surface water causes E.coli.					
21	Human and animal waste from sewage and septic system carry harmful microbes into surface water causes giardia.					
22	Outbreak of diseases in Auchi as the result of green house caused by Human activities affects surface water.					
23	Outbreak of diseases in Auchi as the result of climate changes caused by Human activities affects surface water.					
24	Outbreak of diseases in Auchi as the result of flooding caused by Human activities affects surface water.					

4. DATA ANALYSIS AND PRESENTATION

The survey data were analysed using mean scores. The analyses are presented in the table under the research questions that guided the study. A brief interpretation of data and discussion of result thus, follows each table. The chapter concludes with a summary of findings.

Uzairue Clan

Research Question 1

Does cryptosporidiosis which targeted the intestine of human by ingesting contaminated water causes watery diarrhea, stomach cramps and fever?

Table 3: Responses on the effect of cryptosporidiosis causing watery diarrhea, stomach cramps and fever by LGA staff.

Item No.	DESCRIPTION	X Score
1	Cryptosporidiosis which targeted the intestine of human by ingesting contaminated water causes watery diarrhea.	4.06
2	Cryptosporidiosis that targeted the intestine of human by ingesting contaminated water cause stomach cramp.	3.58
3	Cryptosporidiosis that targeted the intestine of human by ingesting contaminated water causes fever.	3.40
	Grand Mean X	3.68

However, the Analysis of cryptosporidiosis in Uzairue clan through L.G.A staff (X) that targeted the intestine of human by ingesting contaminated water causes watery diarrhea, stomach cramps and fever is higher than the Average 3.00 with the grand mean (X) 3.68. Therefore, it shows that the problem exists.

Analysis of whether cryptosporidiosis that targeted the intestine of human by ingesting contaminated water causes watery diarrhea, stomach cramps and fever as responded by the communities.

Table 4: Responses on the effect of cryptosporidiosis causing watery diarrhea, stomach cramps and fever by Community.

Item No.	DESCRIPTION	Y Score
1	Cryptosporidiosis that targeted the intestine of human by ingesting contaminated water causes watery diarrhea.	3.04
2	Cryptosporidiosis that targeted the intestine of human by ingesting contaminated water cause stomach cramp.	3.04
3	Cryptosporidiosis that targeted the intestine of human by ingesting contaminated water causes fever.	2.99
	Grand Mean Y	3.02

However, the Analysis of cryptosporidiosis in Uzairue clan communities[Y] that targeted the intestine of human by ingesting contaminated water causes watery diarrhea, stomach cramps and fever is higher than the average 3.00 with the grand mean (Y) 3.02. Therefore, the people are not sure of the situation probably they have not seen a case.

Research Question 2
Does Arsenicosispoisonous lead to the damage of bladder, kidney, and skin?

Table 5:Responses on the effect of Arsenicosispoisonous that lead to the damage of bladder, kidney, and skin by the L.G.A staff.

Item No.	DESCRIPTION	X Score
1	Arsenicosis poisonous leads to damage of bladder.	3.69
2	Arsenicosis poisonous leads to damage of kidney.	3.53
3	Arsenicosis poisonous leads to damage to skin.	3.26
	Grand Mean X	3.49

However, the Analysis of Uzairueclan L.G.A staff (X) with a grand mean (X) 3.49 is higher than the average3.00; therefore, it shows that arsenicosis lead to damage of bladder, kidneys and skin. It also concluded that the problem exists but the people have not seen a case.

Table 6: Responses on the effect of Arsenicosis poisonous that lead to the damage of bladder, kidney, and skin by the communities.

Item No.	DESCRIPTION	Y Score
1	Arsenicosis poisonous leads to damage of bladder.	2.58
2	Arsenicosis poisonous leads to damage of kidney.	2.58
3	Arsenicosis poisonous leads to damage to skin.	2.58
	Grand Mean Y	2.58

However, the Analysis of Uzairueclan communities (Y) with a grand mean (Y) 2.58 is lesser than the average 3.00, therefore, it shows that Arsenicosis don't lead to damage of bladder, kidneys and skin. It also concluded that the problem does not exist.

Research Question 3

Does lead poison that enters water through old pipes, discharge of toxic chemicals and solders causes anemia in children, problem to adult reproductive system, and problem to adult high blood pressure?

Table 7: Responses on the effect of lead poison that enters water through old pipes, discharge of toxic chemicals and solders causes anemia in children, problem to adult reproductive system, and problem to adult high blood pressure by L.G.A staff (X).

Item No.	DESCRIPTION	X Score
1	Lead poison that enters water through old pipes, discharge of toxic chemicals and solders causes anemia in children.	3.54
2	Lead poison that enters water through old pipes, discharge of toxic chemicals and solders causes anemia in children.	3.78
3	Lead poison that enters water through old pipes, discharge of toxic chemicals and solders causes anemia in children.	2.72
	Grand Mean X	3.35

However, the analysis of lead poison in Uzairue clan, through L.G.A staff (X) that enters water through old pipes, discharge of toxic chemicals and solders causes anemia in children, problem to adult reproductive system, and problem to adult high blood pressure is higher than the average 3.00 with the grand mean (X) 3.35. Therefore, it shows that the problem exists but they have not seen a case.

Table 8: Responses on the effects of lead poison that enters water through old pipes, discharge of toxic chemicals and solders causes anemia in children, problem to adult reproductive system, and problem to adult high blood pressure by the communities (Y).

Item No.	DESCRIPTION	Y Score
1	Lead poison that enters water through old pipes, discharge of toxic chemicals and solders causes anemia in children.	2.99
2	Lead poison that enters water through old pipes, discharge of toxic chemicals and solders causes anemia in children.	2.99
3	Lead poison that enters water through old pipes, discharge of toxic chemicals and solders causes anemia in children.	2.99
	Grand Mean Y	2.99

However, the analysis of lead poison in Uzairue clan, through its communities (Y) that enters water through old pipes, discharge of toxic chemicals and solders causes anemia in children, problem to adult reproductive system, and problem to adult high blood pressure is lesser than the average 3.00 with the grand mean(Y) 2.99. Therefore, it shows that the problemdoes not exist.

Research Question 4

Can fluorosis consumed in water affects teeth, bones, and causes abdominal pain?

Table 9:Responses on the effect on fluorosis consumed in water affects teeth, bones, and causes abdominal pain by the L.G.A staff (X)

Item No.	DESCRIPTION	X Score
1	Fluorosis consumed in water affects teeth.	3.62
2	Fluorosis consumed in water affects bones.	3.49
3	Fluorosis consumed in water affects abdominal pain.	3.89
	Grand Mean X	3.67

However, the analysis of Uzairue clan L.G.A staff (X) with a grand mean (X) 3.67 is higher than the average 3.00. Therefore, it shows that fluorosis consumed in water affects teeth, bones and causes abdominal pain. It also concluded that the problem exist.

Table 10: Responses on the effect of fluorosis consumed in water affects teeth, bones, and causes abdominal pain by the communities (Y)

Item No.	DESCRIPTION	Y score
1	Fluorosis consumed in water affects teeth.	2.61
2	Fluorosis consumed in water affects bones.	2.41
3	Fluorosis consumed in water affects abdominal pain.	2.41
	Grand Mean Y	2.48

However, the analysis of Uzairue clan communities (Y) with a grand mean (Y) 2.48 is lesser than the average 3.00. Therefore, it shows that fluorosis consumed in water doesn'taffect teeth, bones and causes abdominal pain. It also concluded that the problem doesnot exist.

Research Question 5

Can trachoma affect human through pathogenic sanitation lead to folding eyelid that can lead to partial blindness or permanent blindness, and partial blinding or permanent blindness?

Table 11: Responses on the effect of trachoma that affect human through pathogenic sanitation lead to folding eyelid that can lead to partial blindness or permanent blindness, in-grow eye lashes to partial blinding or permanent blindness, and partial blinding or permanent blindness by L.G.A staff (X)

Item No.	DESCRIPTION	X score
1	Trachoma affect human through pathogenic sanitation lead to folding eyelid that can lead to partial blindness or permanent blindness.	4.45
2	Trachoma affect human through pathogenic sanitation lead to folding eyelid that can lead to partial blindness or permanent blindness.	4.42
3	Trachoma affect human through pathogenic sanitation lead to folding eyelid that can lead to partial blindness or permanent blindness.	4.23
	Grand Mean X	4.37

However, the analysis of Uzairue clan L.G.A staff (X) with a grand mean (X) 4.37 is high than the average 3.00. Therefore, it shows that trachoma affect human through pathogenic sanitation lead to folding eyelid that can lead to partial blindness or permanent blindness, in-grow eye lashes to partial blindness or permanent blindness, and partial blinding or permanent blindness. It also concluded that the problem exists but they have not seen a case.

Table 12: Responses on the effect of trachoma that affect human through pathogenic sanitation lead to folding eyelid that can lead to partial blindness or permanent blindness, in-grow eye lashes to partial blinding or permanent blindness, and partial blinding or permanent blindness by the communities (Y)

Item No.	DESCRIPTION	Y score
1	Trachoma affect human through pathogenic sanitation lead to folding eyelid that can lead to partial blindness or permanent blindness.	3.42
2	Trachoma affect human through pathogenic sanitation lead to folding eyelid that can lead to partial blindness or permanent blindness.	3.42
3	Trachoma affect human through pathogenic sanitation lead to folding eyelid that can lead to partial blindness or permanent blindness.	3.42
	Grand Mean Y	3.42

However, the analysis of Uzairue clan communities (Y) with a grand mean (Y) .3.42 is high than the average 3.00. Therefore, it shows that trachoma affect human through pathogenic sanitation lead to folding eyelid that can lead to partial blindness or permanent blindness, in-grow eye lashes to partial blindness or permanent blindness, and partial blinding or permanent blindness. It also concluded that the problem exist but they have not seen a case.

Research Question 6

Does polio virus infection spread through water contaminated with faeces from infected person causes headache, vomiting, stiffness of neck and pain in the limbs?

Table 13:Responses on the effect of polio virus infection spread through water contaminated with faeces from infected person causes headache, vomiting, stiffness of neck and pain in the limbs by the L.G.A staff (X).

Item No.	DESCRIPTION	X score
1	Polio virus infection spread through water contaminated with faeces from infected person causes headache.	3.47
2	Polio virus infection spread through water contaminated with faeces from infected person causes vomiting	3.29
3	Polio virus infection spread through water contaminated with faeces from infected person causes stiffness of neck and pain the limbs.	3.49
	Grand Mean X	3.42

However, the analysis of Uzairue clan L.G.A staff (X) with a grand mean (X) 3.42 is higher than the average 3.00. Therefore, it shows that polio virus infection spread through water contaminated with faeces from infected person causes headache, vomiting, stiffness of neck and pain in the limbs. It also concluded that the problems exist but they have not seen a case.

Table 14: Responses on the effect of polio virus infection spread through water contaminated with faeces from infected person causes headache, vomiting, stiffness of neck and pain in the limbs by the communities (Y)

Item No.	DESCRIPTION	Y Score
1	Polio virus infection spread through water contaminated with faeces from infected person causes headache.	3.76
2	Polio virus infection spread through water contaminated with faeces from infected person causes vomiting	3.76
3	Polio virus infection spread through water contaminated with faeces from infected person causes stiffness of neck and pain the limbs.	3.65
	Grand Mean Y	3.72

However, the analyses of Uzairue clan communities (Y) with a grand mean (Y) 3.72 is higher than the average 3.00. Therefore, it shows that polio virus infection spread through water contaminated with faeces from infected person causes headache, vomiting, stiffness of neck and pain in the limbs. It also concluded that the problems exist.

Research Question 7

Can human and animal waste from sewage and septic system carry harmful microbes into surface water causes salmonella, E.coli and giardia?

Table 15: Responses on the effect of human and animal waste from sewage and septic system carry harmful microbes into surface water causes salmonella, E.coli and giardia by the L.G.A staff (X)

Item No.	DESCRIPTION	X score
1	Human and animal waste from sewage and septic system carry harmful microbes into surface water causes salmonella.	4.41
2	Human and animal waste from sewage and septic system carry harmful microbes into surface water causes salmonella.	4.44
3	Human and animal waste from sewage and septic system carry harmful microbes into surface water causes salmonella.	3.67
	Grand Mean X	4.17

However, the analysis of human and animal waste from sewage and septic system carry harmful microbes into surface water causes salmonella, E.coli and giardia in Uzairue clan through L.G.A staff (X) is higher than the average 3.00 with the grand mean (X) 4.17. Therefore, it shows that the problems exist.

Table 16: Responses on the effect of human and animal waste from sewage and septic system carry harmful microbes into surface water cause salmonella, E.coli and giardia by communities (Y).

Item No.	DESCRIPTION	Y score
1	Human and animal waste from sewage and septic system carry harmful microbes into surface water causes salmonella.	3.64
2	Human and animal waste from sewage and septic system carry harmful microbes into surface water causes salmonella.	3.64
3	Human and animal waste from sewage and septic system carry harmful microbes into surface water causes salmonella.	3.58
	Grand Mean Y	3.62

However, the analysis of human and animal waste from sewage and septic system carry harmful microbes into surface water causes salmonella, E.coli and giardia in Uzairue clan through its communities[Y] is higher than the average 3.00 with the grand mean (Y) 3.62. Therefore, it shows that the problems exist.

Research Question 8

Can outbreak of diseases in Uzairue as the result of greenhouse emission, climate change, flooding, and drought caused by human activities pollute the surface water?

Table 17: Reponses on the effect of outbreak of diseases in Uzairue clan as the result of greenhouse emission, climate change, flooding, and droughts caused by human activities pollute the surface water by the L.G.A staff (X).

Item No.	DESCRIPTION	X score
1	Outbreak of diseases in Uzairue as the result of greenhouse caused by human activities affects surface water.	3.88
2	Outbreak of diseases in Uzairue as the result of climate changes caused by human activities affects surface water.	3.80
3	Outbreak of diseases in Uzairue as the result of flooding caused by human activities affects surface water.	4.29
	Grand Mean X	3.99

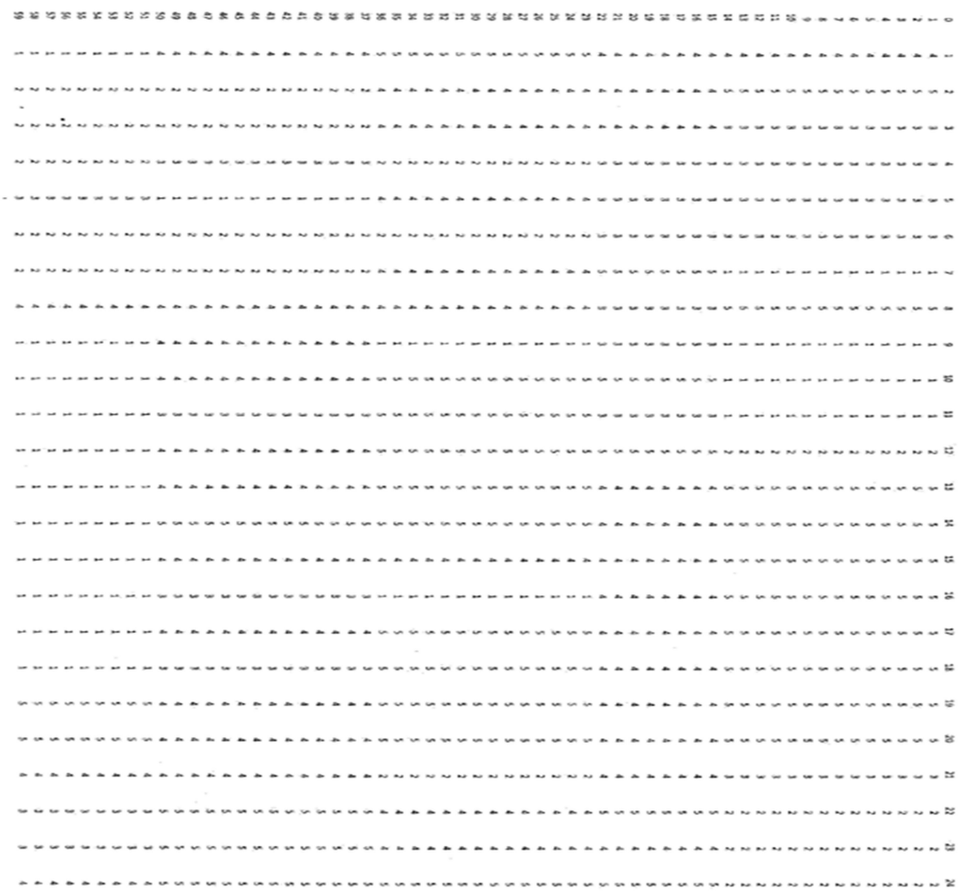
However, the analysis of outbreak of diseases in Uzairue clan as the result of greenhouse emission, climate change, flooding, droughts caused by human activities pollute the surface water in Uzairue clan through the L.G.A staff (X)is higher than the average 3.00 with the grand mean (X) 3.99. Therefore, it shows that the problems exist.

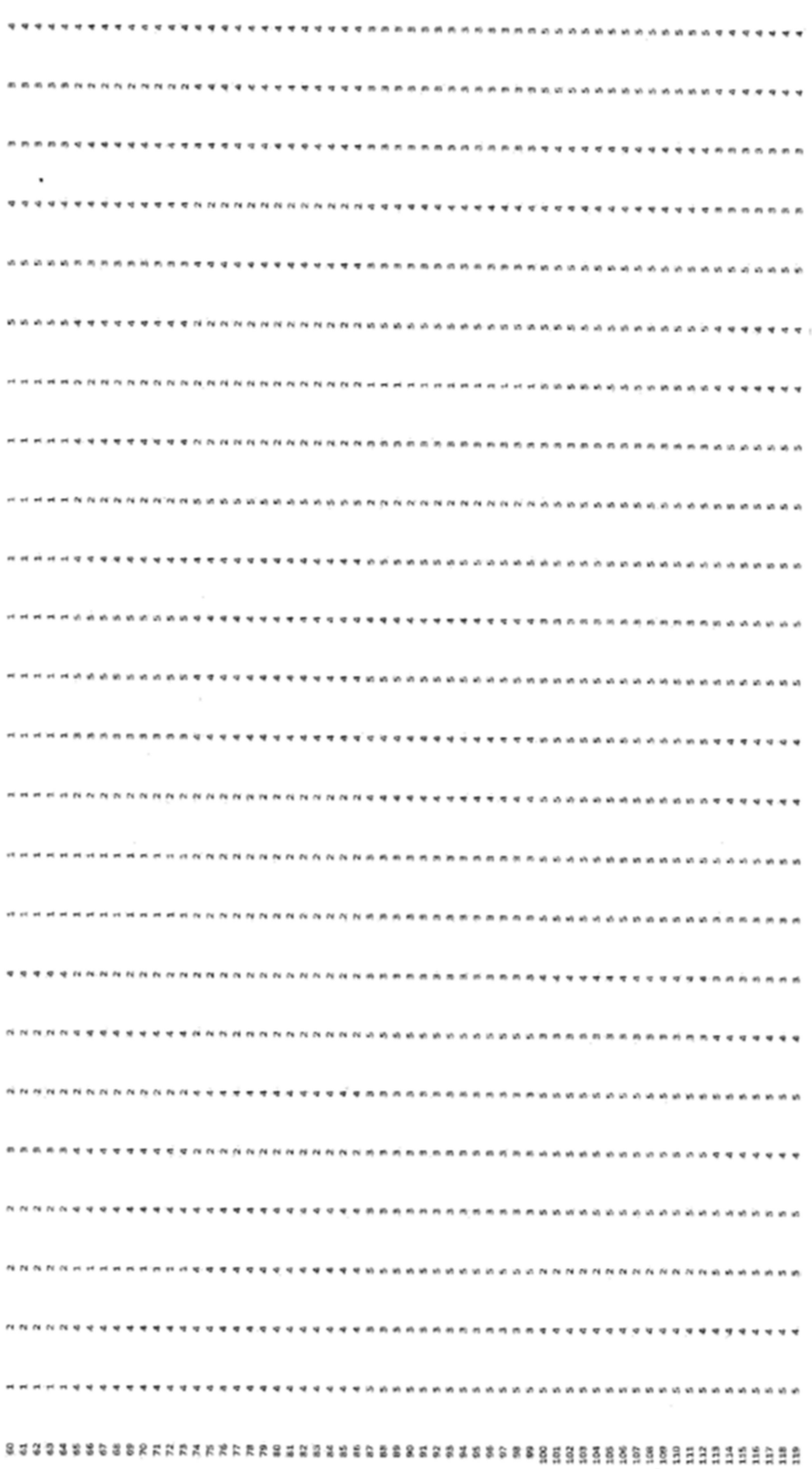
Table 18: Responses on the effect of outbreak of diseases in Uzairueclan as the result of greenhouse emission, climate change, flooding, and droughts caused by human activities pollute the surface water as responded by the communities (Y).

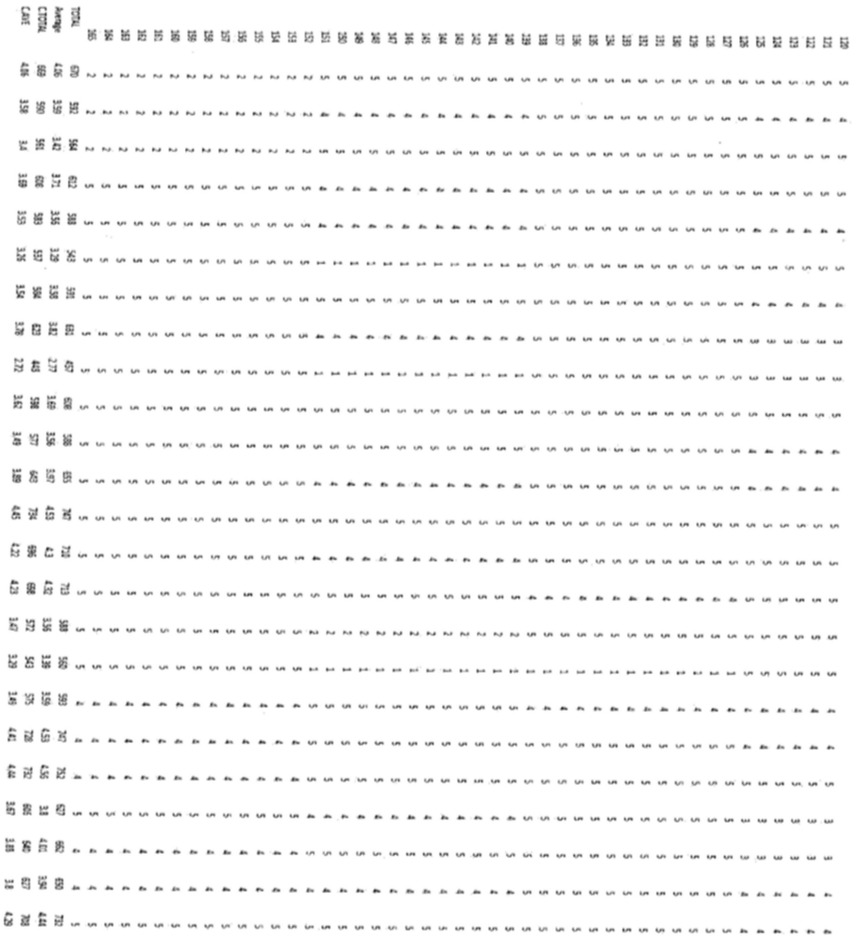
Item No.	DESCRIPTION	Y score
1	Outbreak of diseases in Uzairue as the result of greenhouse caused by human activities affects surface water.	3.83
2	Outbreak of diseases in Uzairue as the result of climate changes caused by human activities affects surface water.	2.83
3	Outbreak of diseases in Uzairue as the result of flooding caused by human activities affects surface water.	3.74
	Grand Mean Y	3.47

However, the analysis of outbreak of diseases in Uzairue clan as the result of greenhouse emission, climate change, flooding, droughts caused by human activities pollute the surface water in Uzairue clan through it's communities [Y] is higher than the average 3.00 with the grand mean (Y) 3.47. Therefore, the people are not sure of the situation probably they have not seen a case.

Coalition Of The Response Of The Questionnaires







$\sum X_8 = 4.88 + 4.48 + 4.88 + 4.88 + 3.52 + 3.99 = {}^{26.63}/_{6} = 4.44$

$\sum Y_8 = 4.37 + 4.49 + 4.37 + 4.37 + 3.66 + 3.47 = {}^{24.73}/_{6} = 4.12$

Note:

With $\sum X_8 = 4.44$ response from the Local Government Staff.

$\sum Y_8 = 4.12$ response from the community.

Shows the response to the questionnaires.

Code	Fe	Mn	Zn	Cu	Cr	Cd	Ni	Pb	V	THC
	mg/l									
River Water	0.510	0.105	0.221	0.087	0.051	0.017	0.013	0.021	0.008	ND
NAFDAC LIMIT	0.3	2.0	5.0	1.0	0.05	0.003	N.S	0.01	N.S	N.S
SON LIMIT	0.3	0.05	5.0	1.0	0.05	0.003	N.S	0.01	N.S	N.S
WHO LIMIT	1	0.1	0.01	0.5	0.05	0.003	N.S	0.01	N.S	N.S

Martlet Environmental Research Laboratory Limited

(A DIVISION OF MACGILL ENGINEERING & TECHNICAL SERVICES LIMITED)

(Environmental Consultancy and Biophysicochemical Analyses)

237, 3rd East Circular Road, Benin City, NIGERIA.

RESULTS OF CHEMICAL ANALYSIS

Name of Client: Engr. Mrs. Ibhafidon-Momodu, . G.O

Type of Sample: Uzairue Clan Ukemi River

Date Received: 3rd July, 2024

Code	Ph	EC	Sal.	Col.	Turb.	TSS	TDS	COD	HCO_3	Na	K	Ca	Mg	Cl	P	NH_4N	NO_2	NO_3	SO_4
		µS/cm	g/l	Pt.Co	NTU	mg/l													
River Way	8.0	72	0.033	2.0	1.4	3.1	36	6.0	61.2	1.74	0.56	4.88	3.01	56.3	0.018	0.214	0.026	0.510	0.333
NAFDAC LIMIT	6.5 – 8.5	1000	N.S	3.0	5.0	1.0	500	N.S	100	N.S	10	75	20	100	N.S	N.S	0.02	10.0	100
SON LIMIT	6.5 – 8.5	1000	N.S	3.0	5.0	1.5	500	N.S	100	N.S	10	75	20	100	N.S	N.S	0.02	10.0	100
WHO LIMIT	7.0 – 8.9	1000	N.S	3.0	5.0	1.0	500	N.S	100	N.S	N.S	N.S	20	200	N.S	N.S	0.02	10.0	250

S/N	SAMPLE	TOTAL HETEROTROPHIC BACTERIAL COUNTS (CFU/ML)	TOTAL HETEROTROPHIC FUNGI COUNTS (CFU/ML)	TOTAL COLIFORM COUNTS (CFU/ML)	TOTAL E. Coli COUNTS (CFU/ML)	TENTATIVE ISOLATES BACTERIA	ISOLATED FUNGI
	River Water	4	2	1	0	*Streptococcus* sp.	*Aspergillus* sp.

AAS MODEL-AA320N

FLAME USED – AIR ACETYLENE FLAME

Approved by.....

(Prof. R. O. Onyeonwu)

Date: 6th July, 2024

Table 19: Result of Samples Collected From Ukemi River Uzairue Clan

S/N	Parameters write in full	Units	Physio-chemical analysis	National Agency for Food and Drug Administration and control	Standard organization of Nigeria (SON)	World Health Organization(WHO)	Federal Ministry of Environment (FME)
1	Temperature	^0C					35
2	pH	ECµS/cm	8.0	6.5 - 8.5	6.5 – 8.5	7.0 - 8.9	6.5-8.5
3	Electric conductivity	EC Ns/cm	72	1000	1000	1000	
4	Salinity	g/l	0.033	N.S	1.2	N.S	
5	Colour	Pt-Co	2.0	3.0	3.0	3.0	7
6	Turbidity	NTU	1.4	5.0	5.0	5.0	10
7	Total Suspended Solids (TSS)	mg/l	3.1	1.0	1.5	1.0	30
8	Total Dissolved solid	mg/l	36	500	500	500	2000
9	Chemical Oxygen Demand COD	mg/l	6.0	N.S	N.S	N.S	40
10	Bicarbonate (HCO_3)	mg/l	61.2	100	1000	100	20
11	Sodium (Na)	mg/l	1.74	N.S	N.S	N.S	
12	Potassium (K)	mg/l	0.56	10	10	N.S	
13	Calcium (Ca)	mg/l	4.88	75	75	N.S	
14	Magnesium (Mg)	mg/l	3.01	20	20	20	20
15	Chlorine (CL)	mg/l	56.3	100	100	200	200
16	Phosphorus (P)	mg/l	0.018	N.S	N.S	N.S	
17	Ammonium (NH_4N)	mg/l	0.214	N.S	N.S	N.S	0.2
18	Nitrogen Deoxide (NO_2)	mg/l	0.026	0.02	0.02	0.2	
19	Nitrate (NO_3)	mg/l	0.510	10.0	10.0	10.0	20
20	Sulphate (SO_4)	mg/l	0.333	100	100	250	200
21	Iron(Fe)	mg/l	0.510	0.3	0.3	1	20
22	Manganese (Mn)	mg/l	0.105	2.0	0.05	0.1	5
23	Zinc (Zn)	mg/l	0.221	5.0	5.0	0.01	1.0
24	Copper (Cu)	mg/l	0.087	1.0	1.0	0.5	
25	Chromium (Cr)	mg/l	0.051	0.05	0.05	0.05	<0.10
26	Cadmium (Cd)	mg/l	0.017	0.003	0.003	0.003	0.1
27	Nitrogen (Ni)	mg/l	0.013	N.S	N.S	N.S	<1
28	Lead (Pb)	mg/l	0.021	0.01	0.01	0.01	0.05
29	Violate (V)	mg/l	0.003	N.S	N.S	N.S	0.01
30	Delta-9-tetrahydrocannbinol (THC)	mg/l	N.S	N.S	N.S	N.S	N/A

Table 20: Microbial

S/N		
1	Total Heterotrophic Bacterial counts (Cfu/ml)	4
2	Total heterotrophic fungi counts (Cfu/ml)	2
3	Total Coliform Counts (Cfu/ml)	1
4	Total E.Coli Counts (CFU/ml)	0
5	Tentative Isolates Bacteria	Streptococcus.sp
6	Isolate D fungi	Aspergillus .sp

Parameters Exceeding Standards

Parameters like copper and nitrogen are within standards.

1. Manganese exceeds SON standard.
2. Calcium exceeds WHO and SON standards.
3. Chromium slightly exceeds standards.
4. Iron exceeds SON standards.
5. Zinc exceeds WHO standards.
6. Lead exceeds WHO and SON standards.

Parameters Within Standards

1. Nitrogen is within FME standards.
2. Copper is within WHO and SON standards.

Specific Observations

1. The rivers have higher level of certain parameters suggesting potential pollution sources.
2. The absence of some standards (e.g Nitrogen) makes it challenging to fully access water quality.
3. Parameters that exceeded standards in these rivers indicating potential water quality issues.

The Comprehensive Results of the Analysis of the Microbial

1. Total Heterotrophic Bacterial Counts: 4 CFU/ML (relatively low)
2. Total Heterotrophic Fungi Counts: 2 CFU/ML (relatively low)
3. Total Coliform Counts: 1CFU/ML (low, but presence indicate potentials contamination)
4. Total E. Coli counts: 0 CFU/ML (within safe limits)
5. Streptococcus. sp. commonly found in water and human/animal waste: caused by bacterial
6. Aspergillus. sp. commonly found in soil and decaying organic matter is caused by fungi.

5. CONCLUSION

Based on the analysis of the surface water sample from Uzairue in Etsako West Local Government these findings have been identified:

1. **Water Quality Issues**: The water samples show elevated levels of contaminants such as heavy metals and microbial pathogens indicating poor water quality.
2. **Health Implications**: The presence of these contaminants poses significant health risk to the community. Exposure to heavy metals can lead to neurological disorders, kidney damage and other abnormalities especially in children. Microbial contamination increases the risk of water borne disease example, cholera, typhoid fever, vomiting etc.
3. **Environmental Concern**: Ecosystem Disruption: The implementations of remote sensing or other indirect methods might require infrastructure (e.g. monitoring stations) that can distrupt local ecosystems construction and maintenance of such infrastructure can have localized environmental impacts, affecting wildlife and natural habitats.

Conclusively, indirect numerical methods offer significant benefits for water quality analysis in Uzairue, it is critical to address these environmental concerns. Collaborative efforts that engage local communities, consider traditional knowledge and ensure data integrity can help mitigate potential negative impacts while enhancing water quality management.

6. RECOMMENDATION

- Water treatment facilities: Establish water treatment facilities equipped to remove heavy metals and microbial contaminants effectively.
- Establish monitoring stations: Set up strategically located monitoring station to collect and validate data on water quality parameters.
- Utilise Remote Monitoring Tools: Implement sensors and iOT devices to gather realtime data, enhancing the timeless and accuracy of water quality analysis.
- Community engagement and education; Involve local stakeholders: Engage community members, local leaders, and organizations in the planning and implementation process. Their insights can guide methods and ensure that the community's needs are addressed.
- Education programmes: Conduct workshops and training sessions to educate the community about the importance of water quality, the methods used and how they can contribute to monitoring efforts.

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