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GUIDE TO AUTHORS

ENVIRONMENTAL ISSUES is a journal of the Department of Geography University of Ilorin, Nigeria. The aim of the journal is to publish original research, technical, empirical and theoretical papers on issues bordering on the environment with particular reference to the tropical areas. Scholarly papers are thus expected from Geography, Geology, Ecology, Botany, Conservation Studies, Water Resources, Urban Studies, Environmental Design and Management, Agricultural and Forestry, Engineering, Environmental Science, Law, Health Sciences, Architecture, Town Planning, Estate Management, Indigenous Knowledge System, etc. environmental issues will be published bi-annually in march and august.

1 Format of Manuscript:

Manuscript should be typed doubled-spaced on one side of A4 paper with generous margins, at least 2.5cm. It should not exceed 15 pages, including tables and illustration. Use font 12 and Time New Roman.

- The title page abstract and reference should be typed on separate sheets. The title page should include the title of the paper, the full name(s) of the author(s), postal address, telephone and fax numbers, Email address and the institutional affiliation
- The paper proper should start on page 2, with Title, Abstract, Introduction, etc.
- The Abstract should contain objective, materials and methods, major findings and conclusion of the study.
- The work should contain abstract, introduction, methodology, results, discussion, conclusion, recommendation (if necessary).

2 Table, Illustration and Plates:

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Nitrate Concentration in Shallow Wells of a Sub-Urban Settlement: the case of Budo-Nuhu, Ilorin; Kwara State Nigeria.

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Abstract: Budo-Nuhu, a sub-urban community of Ilorin, has a population of about 1,500 people; it has no access to modern water supply system. Residents mainly rely on shallow wells for both domestic and commercial activities. However, lack of sewerage network and poor living condition of the people have led to progressive deterioration of groundwater quality in the area. This is due to closeness of the settlement to farmsteads, high rate of animal domestication, widespread use of open dumps and liquid waste disposal through surface impoundments. This paper seeks to examine the concentration of nitrate in shallow wells in Budo Nuhu, 23 water wells were sampled, and the water samples were analyzed for nitrate concentration using cadmium reduction method. The result of chemical analysis revealed high nitrate concentration in wells as 62% of the wells have nitrate values above the 50mg/l upper limit recommended by WHO (1984) for drinking water. The study thus suggest ways of reducing the impact of excessive nitrate concentration in wells.

Keywords: sub-urban, shallow well, sewerage, nitrate, cadmium reduction, animal domestication, drinking water standard.

Introduction

According to Ayoade, (1988) the uses of water is controlled by its quality. Therefore, water quality investigation is an important component of water resource evaluation. According to Rao (2006), water quality is used to describe the biological, physical and chemical properties of water which determine its fitness for use. Omorinbola (1979), Ayoade (1998), Foster and Chilton (1993) and Shiklomanov (2002) observed that excellent natural quality which groundwater possesses makes it the most preferred for domestic purposes over other sources of water from ponds, rivers to mention a few. Groundwater is generally believed to be less easily polluted and is usually free from pathogenic bacteria and odour.

However, the surface conditions of shallow well environment have a direct bearing on the quality of water drawn from such well. This is because, dissolved contaminants such as nitrate, chloride and tetrahydrofuran can travel through most host sediment and rocks with little attenuation other than dilution (Fetter, 2007). Sometimes, these materials can get into the

wells through well openings. Furthermore, pollution problems are also common in places where unconsolidated material are close to sources of groundwater recharged. This explains the high rates of water related diseases in developing countries (WHO, 2000). According to UNEP (2007), over three million people die from preventable water borne diseases each year in developing countries. However, the major contaminants are microbial pathogens and excessive nutrients loads. The report further observed that water contaminated by microbes remains the greatest cause of human illness and death on a global scale, this is because the quality of water man ingest plays a critical role in determining the overall quality of his life.

Nitrate is one of the most common groundwater contaminants (Edmunds and Gaye, 1997) and its presence can be due to agricultural activities (Hallberg and Reeney, 1993), though, atmospheric deposition of nitrogen can also be an important source. Studies by Grisak (1975) and Sinton (1982) have shown from case studies that nitrate derived by oxidation and leaching of natural organic nitrogen in the soil is more often

responsible for widespread nitrate contamination of shallow groundwater. Nitrate, according to findings, reaches the water table through leaching and flushing through the unsaturated zone by infiltration of percolating water. High concentration of nitrate in drinking water is unwholesome (Ward et. al; 1996). This is because its consumption causes a reduction in oxygen carrying capacity of the blood, thereby leading to health condition called methaemoglobin anemia or the blue baby disease which is usually fatal in young babies (Hamill and Bell, 1987; Rao, 2006). High concentration of nitrate has also been linked with gastric and oesophageal cancer, because of the reaction of nitrate with amines in the diet forming carcinogenic nitrosamines (WHO, 1984; Chettri and Smith, 1995).

This study thus investigates nitrate concentration in shallow wells of a sub-urban community of Ilorin, Nigeria.

The Study Area

The study area of this investigation is Budo Nuhu, a rural nucleated community with a population of about 1,500 inhabitants. The

settlement which lies on latitude $8^{\circ}3^{\prime}$ North of the Equator and longitude $4^{\circ}35^{\prime}$ East of the Greenwich meridian is about 2kms away from Ilorin in the south-west direction (Fig. 1).

Budo Nuhu occupies an approximate area of about 900sq meters. It shares the same climatic characteristics with Ilorin as both locations falls within the same climatic zone (Fagbemi and Okulaja 1970). Rainy season in the study area usually begin in April when tropical maritime air mass is prevalent and ends in October often abruptly. Dry season in the settlement usually begins with the onset of tropical continental air mass in November and last till March. The mean annual rainfall in the area is 1,200mm (Olaniran, 2000). Rainfall scarcely occur in Budo Nuhu in the months of December, January and February, while rainfall concentration is usually between the months of April and October exhibiting two peak periods in the months of June and September. This is of high significance in this study as previous studies such as Omorinbola (1979); Ogunkoya et. al (1984) and Iroye (2006) have linked well yield to seasonal variation in rainfall pattern.

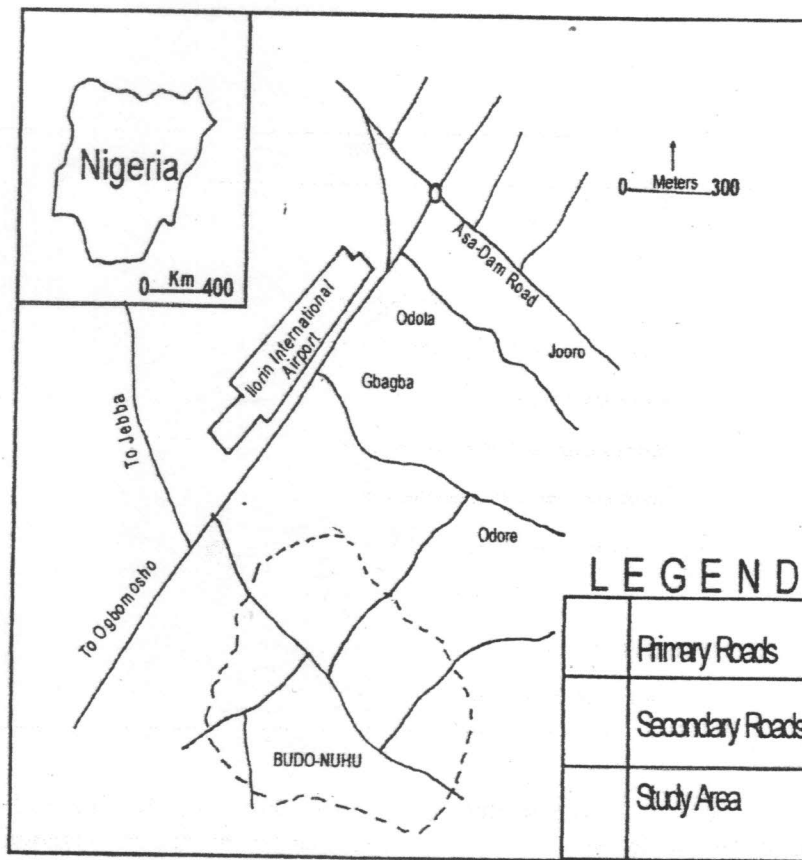


Fig. 1: Map of the Study Area
Source: Author's Fieldwork (2009)

Budo Nuhu is covered mainly by ferruginous tropical soil on crystalline acidic

rock (Areola, 1978). This soil type has both sandy and clayey deposits lying on each other. Table 1 shows a typical borehole log for underground lithology in the area.

Table 1: Phillip Morris Borehole Log

Thickness of bed (m)	Lithology	Presence water
0-0.3	Brown top soil	No water
0.3 - 0.9	Laterite	"
0.9 - 2.0	Weathered micaceous crystalline rocks	"
2.0 - 4.0	Weathered micaceous quartz feldspathic rock (clay)	"
4.0 - 5.5	Kaolinitised feldspathic rock (clay)	Water present
5.5 - 10.0	White kaolinitised feldspathic rock (clay)	"
10.0 - 12.5	Weathered schistose crystalline rock	"
12.5 - 13.0	Quartz feldspathic pegmatic rock	"
13.0 - 16.5	Weathered schistose micaceous crystalline rock	"
16.5 - 21.0	Pegmatic rock	"
Below 21.0	Granite crystalline rock	"

Source: Oyegun,(1983)

The above borehole log shows that water can be found at 4m depth in the study area.

Budo Nuhu is drained only by Odo-Igbo stream which is highly seasonal, hence the high reliance on shallow wells by inhabitants, both for domestic and commercial needs; since pipe borne water supply is wholly lacking.

Methodology

Data used in this study were collected from fieldwork exercise. This involves direct collection of water samples with the aid of sterilized 50cl capacity plastic bottles from all the twenty three accessible well points across the

settlement (Fig. 2). The collection was carried out in the month of September, 2009 when the rainy season was at its peak in the study area. Water samples collected were subsequently analyzed for nitrate concentration in Department of Chemistry Laboratory, University of Ilorin using cadmium reduction method. This test which used Nitrovers as reagent registers both nitrate and nitrite present in the water sample. The test was carried out in accordance with the standard method for water examination (SMEWW, 1971). The result of water analysis was later compared with the WHO (1984) Drinking Water Standard of 50mg/l for drinking water.

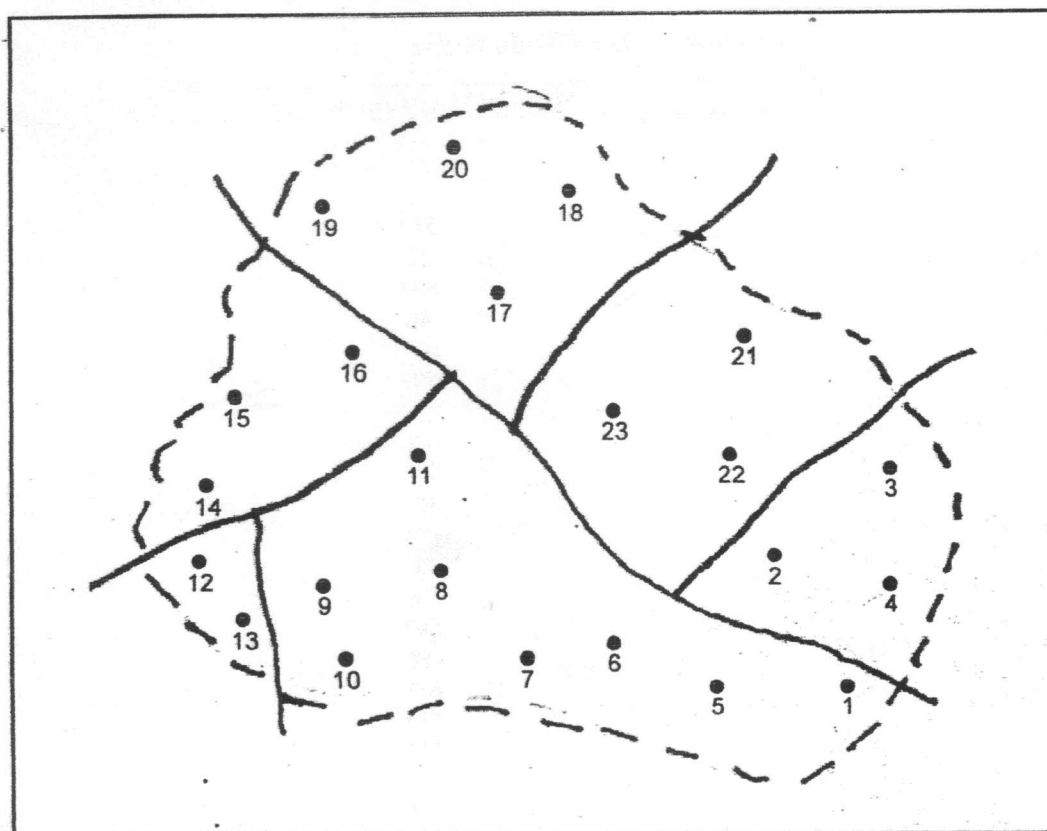


Fig. 2: Map of the Study Area Showing Location of Well Points
Source: Author's Fieldwork (2009)

Results and Discussions

Usability of water is a function of quality, hence WHO (1984) and Davies and De Wiest (1966) identified two main criteria for examination when studying the quality of drinking water as presence of objectionable

taste, odors and colours, and presence of substance with adverse physiological (health) effects.

The result of laboratory analysis is presented in Table 2.

Table 2: Nitrate concentration in shallow wells of Budo Nuhu

Sample points	Nitrate Concentration (mg/l)
1	32
2	59*
3	33
4	56*
5	32
6	84*
7	46
8	67*
9	57*
10	127*
11	43
12	93*
13	86*
14	69*
15	53*
16	36
17	54*
18	48
19	67*
20	53*
21	71*
22	61*
23	39
Mean	59*
Standard Deviation	22
Coefficient Variation	96

Source: Author's fieldwork (2009)

Note - *represent values above the WHO permissible Drinking Water Standard

According to Table 2 nitrate concentration in the twenty three studied wells range between 33 and 127mg/l. Fifteen out of the twenty three sampled wells representing about 65% of the total sampled well had values exceeding the WHO (1984) permissible level of 50mg/l for drinking water (Fig 3). Though 59mg/l was computed as the mean value of nitrate concentration in the studied wells, coefficient of variation indicates high level of homogeneity in nitrate concentration in the hand

dug wells. Most wells that recorded high nitrate concentration (>50mg/l) were observed to be dispersedly located at the fringe of the settlement (Fig. 4), particularly in the south-west portion; where three of the studied wells (well numbers 10, 12 and 13) recorded nitrate values greater than 70mg/l. This area is likely to contain an open refuse dump for the village and also have higher livestock population compared to other areas.

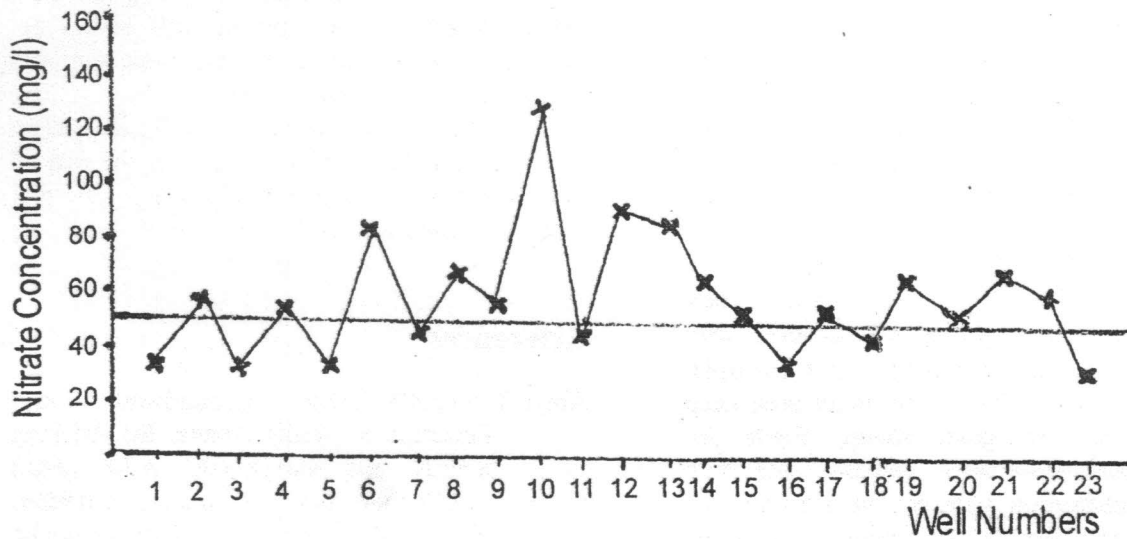


Fig. 3: Fluctuations in Nitrate Concentration in the Studied Wells
Source: Author's Fieldwork (2009)

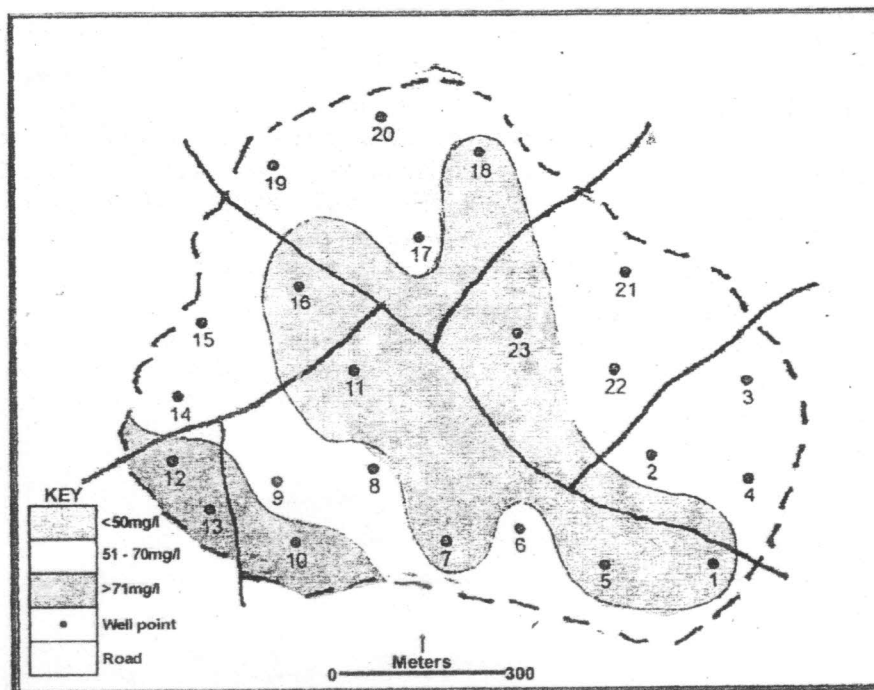


Fig. 4: Spatial Pattern of Nitrate Contamination in the Studied Wells
Source: Author's Fieldwork (2009)

While the high concentration of nitrate in wells located at the fringe of the settlement, particularly in the south-west direction can also be linked to farming activities around these areas; the high concentration of nitrate in wells located at the core of the settlement can be linked to low topography of the sites where the wells are found.

However, the general high nitrate concentration in the shallow groundwater body of Budo Nuhu may not be unconnected with high rate of animal husbandry. For example, virtually all households in the study area keep livestock such as goat, sheep, fowls for economic and sustenance reasons. The high nitrate concentration will not be unconnected with improper disposal of wastes around the wells, poor well construction and defective sewerage systems. Abiye (2009) observed that widespread unplanned interaction of human beings with the physical environment, especially in developing countries has a potential to reduce water quality through biological and chemical wastes.

Conclusion and Recommendations

The study has revealed that most wells located in the study area failed the WHO (1984) recommended nitrate limit of 50mg/l for drinking water. The high nitrate level observed can be linked to anthropogenic activities such as agriculture, improper disposal of waste, animal husbandry and from septic tanks. These situations thus exposes the inhabitants of Budo-Nuhu to high risk of feacal oral diseases associated with high nitrate level in drinking water. This calls for concerted efforts at checking the occurrence of nitrate diseases in drinking water. There is therefore a need for the following:

- i. Frequent check of sewage leakage into groundwater. Sewage leakage may result from defective sewer pipe, poor workmanship of breakage by tree roots amongst others,
- ii. Control of indiscriminate animal husbandry. For example, animal shed or pen houses should be located a distance away from wells.

iii. Some level of elementary hygiene also recommended such as placing well covers on wells, and keeping to elementary basic sanitary procedure while fetching water.

iv. There is a need for awareness campaign on basic sanitation practices, such as the use of simple bleach for local water treatment, the use of filter, boiling of water before use, etc.

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