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NATURE OF HYDROGEOLOGY, WATER SUPPLY AND THE ROLE OF WOMEN IN THE MANAGEMENT OF WATER IN URBAN AND PERI-URBAN KANO, NIGERIA

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Abstract

The study examined nature of hydrogeology and role of gender in water supply in parts of Kano Metropolis and its immediate surroundings. Five local government areas were randomly selected through balloting process from Urban and Peri-Urban Kano. In each of the selected local government areas two sampling site were selected. Data on number of bore holes, open wells, taps and other sources of water supply were collected through field observation. Responses on sources of water supply, water storage, water management, water usage, water supply and role of women, water and family size were collected through interview. Nature of hydrogeology was obtained through reclassifying hydrogeological map of the study areas in GIS environment. Water table was obtained through pumping test records of existing boreholes in the areas. Findings of the research shows that borehole is the major source of drinking water with a total of 83 (27.6%) followed by open well with 69 (23%) and Tap and well with least 4 (1.3%). It can be seen that Hotoron Masallaci with Dior Granite has the highest number of bore holes 18 and open well 7 and a water table of about 506 – 560m. Lambu has 15 boreholes and 7 wells and is with coarse pink and Black granite and water table of 456 – 507m. It can be observed that Rijiyar Lemo with 3 boreholes and 2 wells and Kurnar Asabe with 3 boreholes and 9 wells are all having Pink and white granites which signifies low ground water and high water table values of 666 – 717m. It is deduced that 92% of the respondents store their water in drums. It was established that there is significant differences with regards to water storage among the study locations. Result also shows that water management is mostly controlled by women. It shows that 92% uses water for cooking. It is proved that 57% of the respondents said water availability rest with women, 45% by men and 3% by children. It is established that groundwater availability is associated with nature of hydrogeology and this significantly affect role of women in water supply. It is recommended that Government and stakeholders should development of a well-designed project for integrated water supply in the areas of low water table.

Keywords: Hydrogeology, Water Supply, Management, Women, Kano

Introduction

Water is essential for all forms of life and crucial for human development. Water systems, coastal zones, surface waters and aquifers provide a vast majority of environmental goods and services, including drinking water transport and food. As the world population has tripled over the last century the use of renewable water resources has grown six fold. Water sustaining role in the ecosystems remains undervalued despite the fact that minimum flows in water bodies are needed to support environmental health and increasing human

demands. It is expected that by the year 2025, almost two thirds of the world's population are likely to experience some type of water stress, and for 1 billion of them, the shortage will be severe and socially disruptive (WHO and UNICEF, 2000). Water scarcity hits the poor and the most vulnerable first and hardest who are mostly women and children. The availability of groundwater is influenced by the nature of hydrogeology and technology among other factors.

According to Adelana*et al* (2008), groundwater has proven to be the most reliable source for meeting rural water supply demand in sub-Saharan Africa. Its availability is affected by geology of an area. Nigeria's geology is made up of two main rock types: Basement Complex and the Sedimentary Basins, which are equally dispersed. Other minor formations are the volcanic plateau and the river alluvium. In the Basement Complex terrain (comprising the west, north central and the south east blocks) rock types are predominantly of migmatite and granitic gneisses, quartzites, slightly migmatised to unmigmatised meta-sedimentary schist and dioritic rocks (Sarah and Charles, 1988).

Groundwater distribution and flow of groundwater is controlled by geological factors such as the lithology, texture and structure of the rocks; and also hydrological and meteorological factors such as stream flow and rainfall. Aquifer distribution in Nigeria is categorized into two systems: basement fluvio-volcanic aquifers and sedimentary aquifers. The roles and responsibilities, and access to resources are highly differentiated both in men and women and amongst the women themselves (GWA, 2006; Panda, 2007).

Various studies were conducted on water supply and gender for example Varsh (2015) in Maharashtra India conducted studies on water management among various Communities. Data was gathered using interview. Result revealed that 66.66% of the population have continuous drinking water supply. Martin (2007) undertake study on hydrogeology and water supply in Catoctin Mountain Park. Data collection and analysis were done through analytical hierarchy process and overlay method in GIS environment. Findings of the research indicated that groundwater in the park occurred in regolith zone overlying unweathered bedrock and within fracture zones in bedrocks. Also groundwater occurs in joints, faults and other fractures in metamorphosed shale and quartzites and in such areas women and children supper less in sourcing domestic water.

In Nigeria Nwankwola (2011) investigated the strategy for rural sanitation and water supply. Data was collected using interview. Their results shows that time and energy savings, particularly for women and children can be invested review access to less than 50% of water used by the population. In another development Sobawale, Adewumi and Bomgboye (2015) conducted study in south western Nigeria on gender and water supply using questionnaire survey. Result shows that women contribute more than men in water supply. Also Okoro, Ezeabasili and Dominic (2015) studied condition of water supply in rural and Peri-Urban communities in Adamawa. The study was conducted using existing literatures and available secondary data. The result shows that there is the need for communities to consider water issues and women while electing leaders.

UNDP (2006) investigated how gender can be mainstreamed in water management in some developing countries. The data was collected using questionnaire survey. Their findings indicated that 90% of work done in houses including collection of water is done by women, Girls of 6-14 age spend more than one hour to collect water while their brothers spend less than 25 minutes. In another development Sara *et al* (2014) assesses the role of women in water management and conflict resolution in Marsabit Kenya. The data was collected using questionnaire survey. Result revealed that women's contributions toward water management were valued in the study area. Most of the studies conducted do not consider nature of hydrogeology, water supply and the role of women in water resources management for development. That is why this study is targeted toward achieving these objectives that is to identify water potential based on hydrogeology and

major sources of water, to investigate water availability, storage, and factors of water supply and role of women for effective water supply in the identified areas. It also aimed at testing whether there is significant difference among methods of storing water in the communities under study.

Materials and methods

The Study Area

The study was carried out in selected parts of Urban and Peri Urban Kano which lies within latitudes 11°40′N and 12° 30′N and longitudes 8° 10′ to 8°50′ E. It is bordered to the North by Danbatta and Bichi local Government areas in the South by Garinmallam and Kura Local Government areas, to the north by Rimingado and Bichi Local Government areas and to the east by Wudil and Kura Local Government areas. Specifically however, the study was conducted in five out of the eleven local government areas of the Urban and Peri Urban Kano (Figure 1).

The selected local government areas are located on the High Plains of Hausa Land. The areas are underlain by the Basement Complex Rocks of Precambrian era. These Basement Complex Rocks form part of the pan African mobile belt and lies between the West African craton and the Tuareg shield. Earlier workers have intricately linked the overall emplacement of the Nigerian Basement Complex to the earliest orogenic events that affected the African continent. The basement complex rocks include gneisses, migmatites and metasediments of Precambrian ages that have been intruded by a series of pan African age rocks. These rocks have been variably metamorphosed and granitised through tectonometamorphic cycles, so that they have largely converted to migmatite and granite-gneiss (Oyawoye, 1964). Also Sara and Charles (1988) pointed out that the geology underlying parts of Kano State is the basement complex and consisting of variety of metamorphic and igneous rocks ranging in age from Precambrian to Jurassic. Metamorphic rocks are migmatite, gneiss, schist and some quartzite which have been deformed structurally into antiforms, synforms and down faulted.

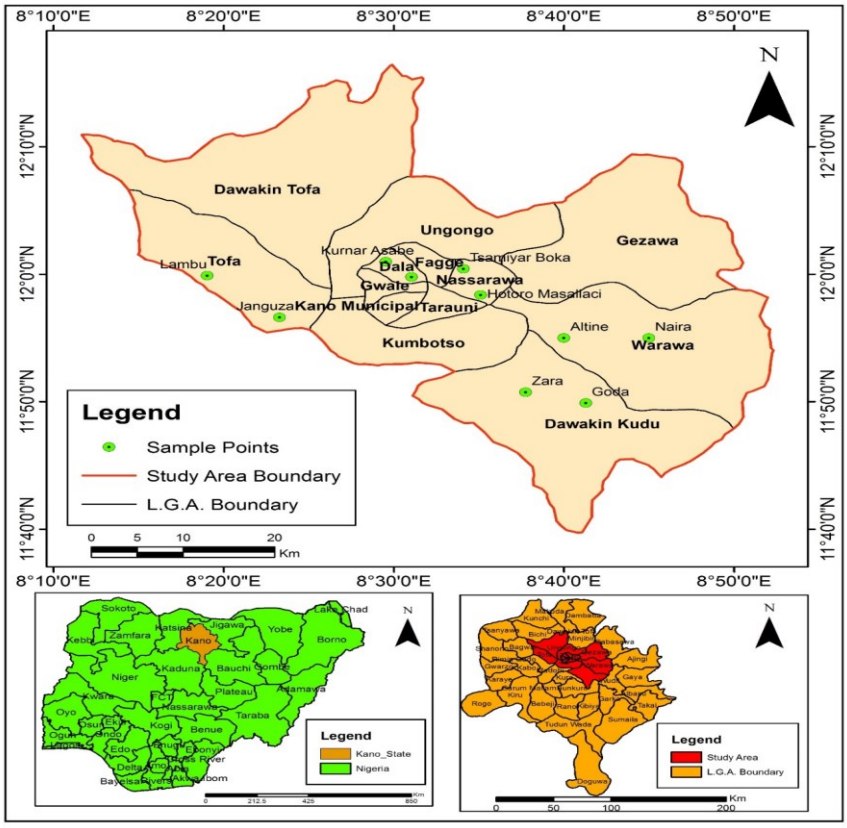

Figure 1 Part Urban and Peri-Urban Kano Showing the study Locations

Source Cartography and GIS Lab ABU, Zaria

Methods of Data Collection

Sample points were selected with a view to examine the nature of the hydrogeology and how it has impacted on women's water management strategies. Study locations were selected using purposive sampling method based on areas affected most by water scarcity. Base on this eleven sampling locations were randomly selected for the study (Table 1 and Figure 1).

Data was collected using self-administered interview and the questionnaire for the women responses. Pumping test results were obtained from borehole drillers and were used to determine water table of the study locations. Open wells, boreholes and other water sources were identified through observation.

Methods of Data Analysis

For data analysis Hydro geological map of the study areas was developed and overlaid on the pumping test result in GIS environment. Data was analysed using simple statistics and inferential statistics such as Chi square in SPSS.

Table 1: Sample sites

Sample Points	Location	Sample Size	
		Female	%
Janguza	11^0 55′N and 8^0 25′ E	35	11.67
Lambu	12^0 00′N and 8^0 20′E	25	8.33
Zara	11^0 50′N and 8^0 40′E	20	6.67
Goda	11^0 50′N and 8^0 42′E	20	6.67
All Tini	11^0 55′N and $8^0$40′E	25	8.33
Naira	11^0 55′N and $8^0$45′E	25	8.33
TsamiyarBoka	12^0 00′N and 8^0 35′E	40	13.33
HotoroMasallachi	12^0 00 N and 8^0 36′E	40	13.33
RijiyarLemu	12^0 00N and $8^0$40′E	30	10
KurnarAsabe	12^0 00 N and $8^0$35′E	40	13.33
Total		**300**	**100**

Source Field Survey, 2016

Results and discussion

The result indicated that the major sources of drinking water in the study area is borehole with 83 responses (27.6%), open well 69 responses (23%), tap and well 4 responses (1.3%). TsamiyarBoka recorded the highest number of boreholes with 23 followed by HotoroMasallaci 18,Lambu with 15 then Alltine with 14. In terms of open wells Goda recorded 20 followed by Zara with 11 (table 2).

Result shows that Lambu with water table of 456 – 507m with coarse pink and black and white granite is high groundwater, Hotoromasallaci with water table of 506 – 560m and Pink and White Granite is also having high groundwater prospect. Areas with moderate prospects are Janguza and Alltine. This result is in line with that of Martin (2007). Areas with low prospects are RijiyarLemo, Zara, Goda, Kurna, Naira and TsamiyarBoka all with high water table values and pink and White granite, Dior granite, Metamorphic Suitand Pink and White

Granite as nature of hydrogeology of the areas. (Table 2 and Figure 2). The result is substantiated by the work of Martin (2007) who concluded all areas with metamorphic suits are of poor groundwater prospect.

Table 2: Nature of Hydrogeology, Water table and groundwater condition

Sample Points	Nature of hydrogeology	Water Table(M)	Remark
Janguza	Coarse pink	560 – 678	Moderate
Lambu	Black and white granite and Coarse Pink	456 – 507	High
Zara	Dior granite	678 – 708	Low
Goda	Pink and white granite	645 – 700	Low
All Tini	Quartzite	520 – 578	Moderate
Naira	Pink and White Granite	670 – 689	Low
TsamiyarBoka	Metamorphic suit	568 – 690	Low
HotoroMasallachi	Pink and White Granite	506 – 560	High
RijiyarLemu	Pink and White Granite	666 – 717	Low
KurnarAsabe	Pink and White Granite	666 – 717	Low

Source Data Analysis, 2016

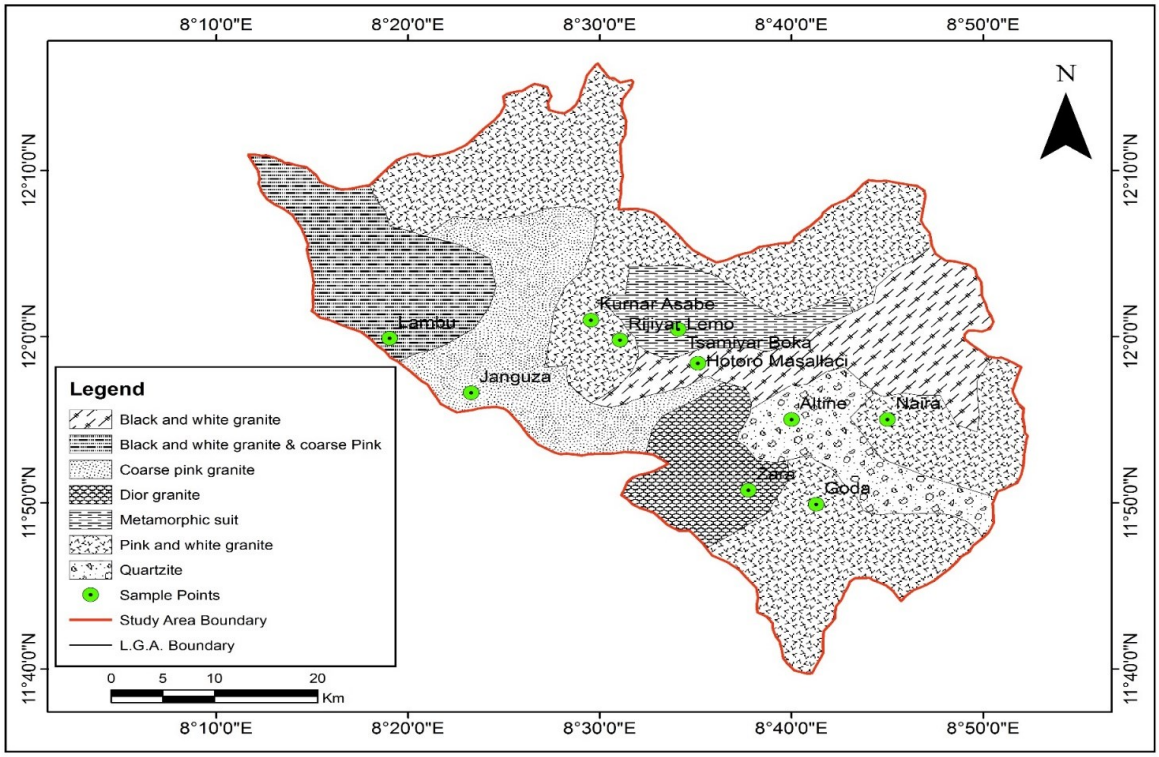

Figure 2 nature of Hydrogeology of the Study Locations
Source: Data Analysis, 2016

The result on personal characteristics of the respondents showed that majority 46.3% had Qur'anic education 31% had primary education, 27% had secondary education while 16.3% had tertiary education. It was found that those with tertiary education are living close to the metropolitan.

As far as the occupation of the respondents is concerned 58% were into petty trading, 30% handcraft and weaving, 10% were civil servants and 2% were farmers. The respondents are wives with their spouse and children. Table 1 show that 44.5% of the respondents have between 5-8 children. This could be the result of early marriage which is a common practice among the women in the study area. The main sources of water are public and private which could be in form of wells and boreholes and tap water, which is usually available in private homes and a time available in public places. Streams and ponds are naturally occurring source of water available for the use of the public in the settlements.

The majority of water users in the study area source their water mainly from tap (20.3%), Borehole (29.7%) well (21 %) and streams (8.7%). Majority of those who source their water from the well and streams did so because they are not served with public tap water in addition to these sources 40% of all the respondents do use sachet water purchased from vendors for drinking. Rain water harvestingis another common source that cuts through all the study settlements.

Table 3: Sources of Water in the Study environment

	SOURCES OF WATER IN THE VILLAGE								
Villages	Tap	B/hole	Well	Stream	Tap&Well	B/hole&well	B/h&Tap	Total	%
Janguza	13	3	3	6	0	0	5	30	10
Lambu	3	15	7	2	0	3	0	30	10
Zara	0	4	11	0	0	5	0	20	6.7
Goda	0	0	20	0	0	0	0	20	6.7
All tini	0	14	3	8	0	0	0	25	8.3
Naira	0	0	0	25	0	0	0	25	8.3
TsamiyarBoka	4	23	7	0	2	4	0	40	13.3
Hotoro	8	18	7	0	0	0	7	40	13.3
Masallachi									
Rijiyarlemo	16	3	2	0	2	0	7	30	10
KurnarAsabe	14	3	9	0	0	0	14	40	13.3
Total	58	83	69	41	4	12	33	300	100

Source: Field work, 2016

Findings shows that the commonest methods of storing water by the respondents in the study area is by means of drums, large containers, surface tanks, underground reservoir, and others such as buckets. (92%) of the respondents store their water using drums/containers, a close range percentage (6%) of the respondents store their water using the surface/reservoir tanks and only (2%) of other methods like jerry cans, buckets, local pots and so on (see plates). The chi square tests of significant difference showed there is a significant difference among methods of storing water in the communities studied (table 4).

Table 4: Chi-Square Tests on the methods of storing water in the study areas

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	44.672[a]	18	.000
Likelihood Ratio	44.925	18	.000
Linear-by-Linear Association	.725	1	.395
N of Valid Cases	300		

a. 20 cells (66.7%) have expected count less than 5. The minimum expected count is .20.

Source: Data Analysis, 2016

The research findings indicates that most of the respondents 92% said they use water for cooking, washing, bathing, drinking and others. It ca be seen that (36%) said they try saving water when washing the dishes by using collected water, another 32% use left over for cooking , 22% use water saving detergents to wash clothes, and only 10% said they bath once or may not bath in a day especially in times of scarcity . The quantity of water used is however a factor of the Household size as shown in tables 5, where those with between five and eight children 11% of them use between over 400litres of water where they have sources in their homes more water than those in other categories. This result is in accordance with that of Amani (2011) who stated that larger percentage of water usage is consumed by domestic activities.

Table 5: Number of children and quantity of water used in liters

N/Children	QUANTITY OF WATER IN LITRES						
	Less 100	100-200	201-300	301-400	Over 400	Total	% total
1-4	37	60	21	13	2	118	39.3
5-8	19	27	29	32	11	133	44.5
9-11	9	4	5	10	0	28	9.3
Over 11	5	0	11	5	0	21	7.0
Total	70	91	66	60	13	300	100

Source: Field work, 2016.

It was found that the average water use in the study area was not evenly distributed as shown in table 5.To confirm this, the chi square tests of significant difference. The decision related to availability and transportation of water in the homes in all the settlements rests on the father (70%), the mother (8.3%) the children (16%) and in some other cases it rests on all the above categories (5.7%). This contradicts the findings of a study of Sara (2014) that in Niamey despite similarity in culture and religion with that of Kano it is deduced that responsibility of transporting water into the homes is for women and children.

It also contradicts the findings of a study carried out in the southern part of Nigeria where the responsibility of ensuring availability of water rest first and foremost with women 57% men 45% and their children3%in the house. where it was found that women and children are the main people responsible for collecting water in these communities, although men sometimes do help their wives when they are sick and or when the nearest water sources in the village is broken down or not functional. This is because they have to go to the other alternative sources which are in most instances far away from the villages and sometimes quite difficult for the women and children to collect the water.

The result shows that 30.6% of the respondents claimed that water shortage in the study area is as a result of low water table which can be attributed to over burden use of water resources attributed to anthropogenic and climatic factors (Olofin 1987). Some respondents opined that open wells dried up which made them to re-dig deeper wells and others had to switch to other sources of water. Many factors contribute to low water table such as population increase and some blame the community itself which contributes to the problem for example each household having individual borehole and/or well.

It can be seen that for the artificial scarcity of water in the study area, most of the respondents (64.4%) claimed that the government is to be blamed for water shortage for not providing adequate and reliable tap/boreholes across the settlement especially in areas of water deficit by virtue of the nature of the underlying rocks in such places. In addition to the above there is bad attitude of the people towards government's property Vis a Vis non-payment of water bills and lack of maintenance culture. This is in association with findings of Ishaku*et al*(2011) who revealed that over 70% of households in rural communities do not have access to improved water supply.

Result indicate that about 64.4% of the respondents suggested that the Government and water authorities should provide adequate pipe borne water, a proportion of 11.1% of the respondents think construction of more public boreholes and wells will be a solution to water shortage, and about 24.4% of the respondents believe the community itself should fight for water supply in the area for example reporting pipe leakages, reducing indiscriminate construction of boreholes, involving women in water decision making. This is substantiated by the works Martin (2007), Amani (2011) Sara (2014) and Okoro*etat* (2015), that there is the need from government and community for sustainable integrated water resource management.

On a daily basis a family of between 5-8 children without a secured source of water spend between #100-#200 to purchase 30 litres of water which falls short of the minimum requirement for a healthy living. To save costs women in addition to various management techniques identified earlier also minimise use of water by reducing the number of times children and other members of the family wash clothes and take bath once in two days or in a week, the use of minimal water for washing vegetables and food items. The health implications of this cannot be overemphasized, as a result of which cholera and diarrhoea is a common illness in the study environment. These findings are substantiated by that of UNDP (2006) which concluded that 90% of work done in houses including water collection is done by women and girls of age 6-14 spend more than an hour and boys spend less than 25 minutes to patch water for domestic uses.

Conclusion and Recommendations

It is concluded that in the study locations nature of hydrogeology is having direct link with water supply and gender since, a water table of 456 – 507m with coarse pink and black and white granite represent areas of higher groundwater and areas with water table of 506 – 560m and Pink and White Granite is also having high groundwater prospect. Areas with low prospects are those with high water table values and pink and White granite, Dior granite, Metamorphic Suitand Pink and White Granite. In areas with poor groundwater prospects women supper much in sourcing and managing water. It is also concluded that women being the primary users of water should be in a better position to preserve and manage water and their ability to preserve and manage water well, will translate into ample time for other productive activities which will invariably mean more income and savings for the welfare of the family. In areas of hydrogeology that favour groundwater storage women benefitted immensely in the water sector and have easy asses to water for effective management and utilisation.

Based on the findings it can be recommended that Government and stakeholders should encourage the development of a well-designed project for integrated water supply in the area. This should include construction of more public wells, boreholes such as the new improved solar powered boreholes, and also the provision of clean, safe, and reliable pipe borne water especially in those settlement that have difficulty in accessing the ground water. High yielding bore holes should be constructed in areas of good groundwater prospects while in areas of poor groundwater potential low yielding bore holes with hand pumps are the best options. Government and stakeholders should encourage the development of a well-designed project for integrated water supply in the area.

The people in general need to be more informed on proper water management techniques and maintenance culture necessary to save time and costs. Broken pipes need to be reported in good times so that repairs can be affected immediately. There is also the need for the people to be more alive to their responsibility by paying their water bills regularly.

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