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Domestic Rainwater Harvesting as an Alternative Source of Water Supply in Ribadu Cantonment, Kaduna, Nigeria

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Abstract: The paper investigates the practice of domestic rainwater harvesting by residents of the study area to supplement intermittent water supplies from the public water works. Data was collected through the use of questionnaire in August 2016 and 2017, the peak of the rainy season. Results showed overwhelming percentage of respondents collects rainwater (99%) but do not drink the water collected (96%). The harvested rainwater is used for domestic needs and provides savings in income and time in search of water by residents.

Keywords: domestic, rainwater, harvesting, Ribadu Cantonment, Kaduna, Nigeria.

INTRODUCTION

Throughout history rainwater harvesting has been one of the techniques of water resources management. Evidence showed that the technique has been practised in Jordan even before 3000 BC [1]. Abdulla and Al -Shareef [2] have also traced some of the structures used in rainwater harvesting still found in Roman pools near Ajlun, Madaba and Mwagger all in Jordan. Mbilinyi *et al.,* [3] also reported the use of indigenous knowledge passed on from generation to generation in the harnessing of rainwater to aid agricultural production in the Kilimanjaro region of Tanzania.

Rainwater harvesting is, therefore, the capturing of storm water runoff, typically from a rooftop and storing it in cistern for later use [4].

Helmreich and Horn [5] categorised three major forms of rainwater harvesting. They are:

- *In situ* collection and storing of rainwater in the soil where it falls;
- Agricultural use in which runoff is collected from elsewhere and stored offside; and
- Domestic use where water is collected from roofs, streets and courtyard runoffs.

The practice of capturing rainwater is found in all parts of the world. According to Jones and Hunt [4] due to drought in North Carolina, United States, restrictions on potable water use necessitated reliance on rainwater harvesting for outdoor water use, such as lawn irrigation in Craven County, Kinston and Raleigh. In Brazil Ghisi *et al*., [6] assessed the potential of using rainwater for car washing in petrol stations in Brasilia; the savings on potable water were very significant due to the large roof area of the petrol stations and the rainwater's contribution to the daily water balance.

In communities in Rajastan, India, rainwater is captured in the wet season for drinking, irrigation and domestic animals [7]. In Banda Aceh, Indonesia, an area devastated by a tsunami in 2004, Song *et al*., [8] studied the problems of water supply in which residents spend up to 16% of their income on the purchase of water and the feasibility of an economic and sustainable way of obtaining water through rainwater harvesting and associated public awareness. The study concluded that it is a feasible option considering the high amounts of rainfall recorded in the whole of Indonesia without distinct differences between dry and wet seasons.

According to Abdulla and Al-Shareef [2] the consequences of arid climatic conditions and rapidly growing population has led to a government strategy in 1995 of harvesting rainwater for water use in Jordan. This has led to an assessment of the potential of potable water savings determined to be about 5.6% of the total domestic water supply in 2005.

In order to meet the millennium development goal (MDG 7), Kahinda *et al*., [9] looked at the feasibility of domestic rainwater harvesting (DRWH) halving by 2015 the proportion of people without sustainable access to safe drinking water and basic sanitation in South Africa, where millions of people mostly in rural areas lack access to any form of water supply infrastructure or have it at basic level of service.

The study found out that it is feasible but that the sustainability of DRWH depends on co-operation between Governments, non-governmental organisations (NGO), Scientists (private sector) and rural households, together with approach to ensure the quality and quantity of the water supplied and the associated costs.

In neighbouring Namibia, Sturn *et al.*, [10] studied the feasibility of rainwater harvesting as an alternative water source with the attendant decrease of dependence on the Kunene river, earth dams and hand dug wells. The study involved techniques such as the use of roofing with ferro cement and block work and concluded that it is reasonable and suitable in terms of dependency and vulnerability and viable to apply decentralised techniques of capturing the water in areas such as Epyeshona. Handia *et al.*, [11] investigated rainwater harvesting in peri urban areas of Lusaka, Zambia. The study found the style and the quality of harvested rainwater using roof catchments, buckets put under eaves to catch the rainwater. The study concluded that some of the rainwater was drunk as it has met World Health Organization (WHO) Guidelines.

This study investigated the practice of rainwater harvesting as alternative source of water supply by residents of Ribadu Cantonment, Kaduna, Kaduna State, Nigeria. The objectives were:

- To assess the different uses of harvested rainwater.
- To evaluate the potential for potable water savings by using rainwater in the study area.

MATERIALS AND METHODS

Study area

Ribadu Cantonment is the largest military base in Kaduna Metropolis. It comprises of offices and residential accommodation of the Postgraduate School, Nigerian Defence Academy and 1 Division, Nigerian Army. Kaduna is the capital of Kaduna State, one of the 36 states that comprise the Federal Republic of Nigeria, see Figures 1 & 2.

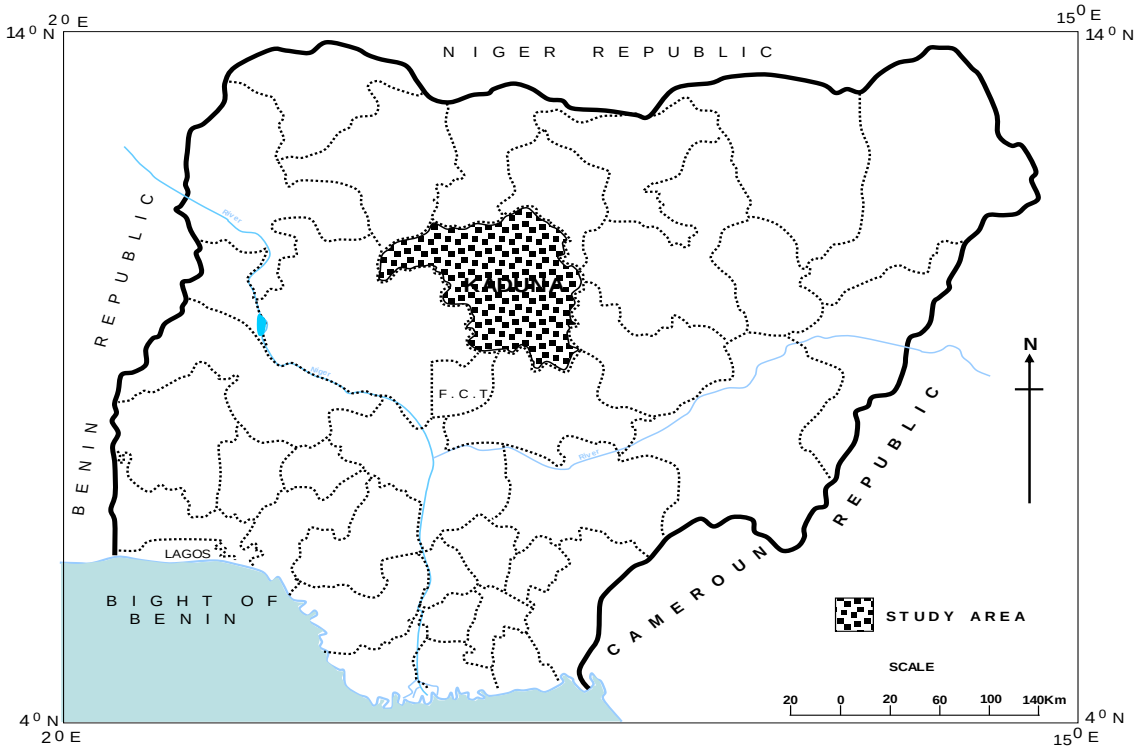

Fig-1: Map of Nigeria showing Kaduna State

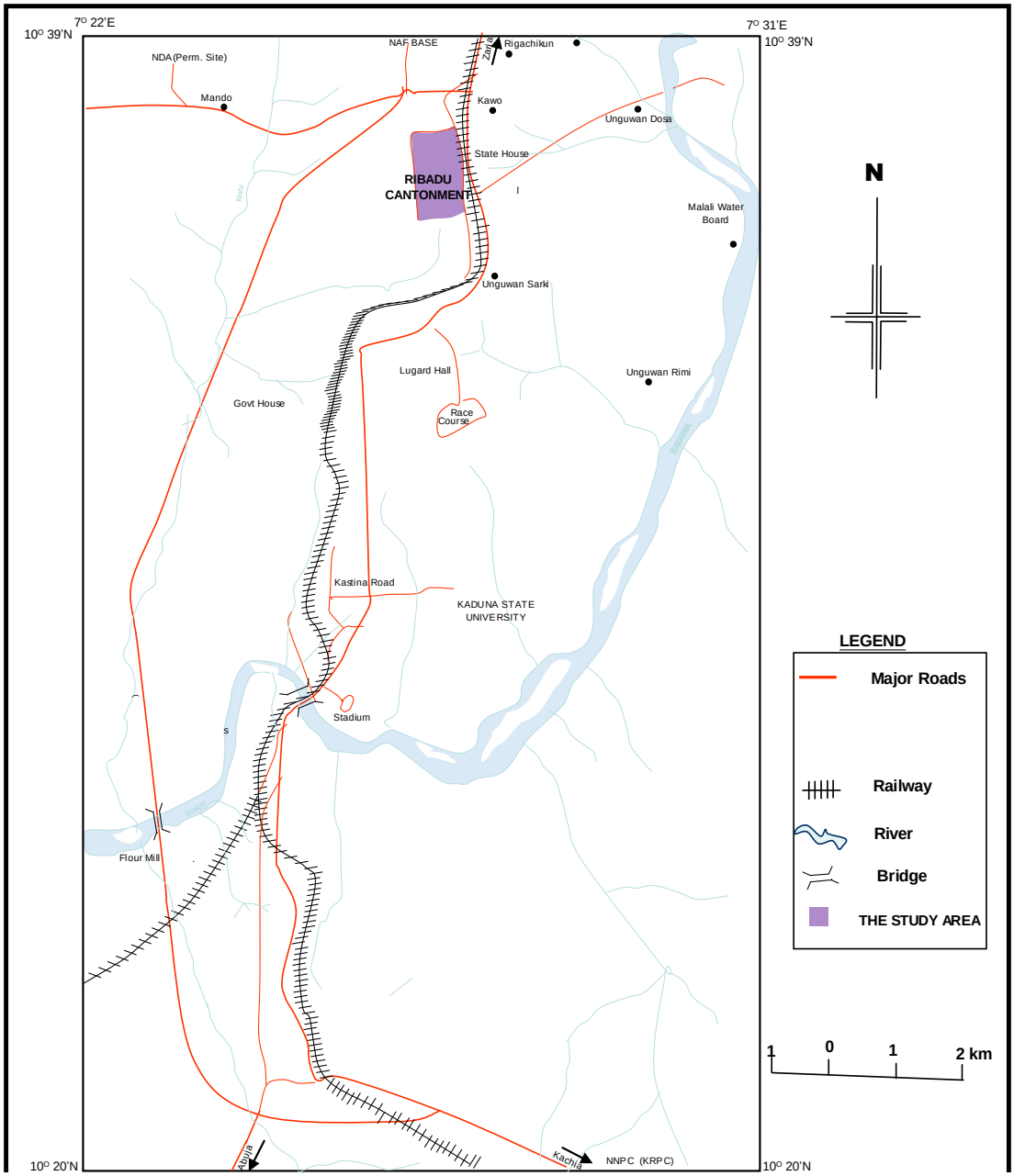

Fig-2: Kaduna metropolis showing the study area (Ribadu Cantonment)

METHODS OF DATA COLLECTION

To accomplish the study's objectives a census of all the residences in the study area was conducted and formed the basis for the distribution of questionnaire. This covered residential accommodation, mammy markets and places of worship. It did not include offices and schools. Data for the study were obtained in August 2016 and 2017 which is the peak month of the rainy season. The categories are shown in Table-1 below.

Table-1: Categories of sampling sites

Category	No of Houses	2016 Respondents	2017 Respondents
Officers' Quarters	329	30	25
Boys Quarters	140	14	20
Soldiers Quarters	4826	483	500
Mammy Markets	3	50	50
Mosques	15	50	50
Total	5313	557	575

For the purpose of questionnaire administration about 10% of all the categories of residential accommodation were selected (Table-1). A sample questionnaire is shown in appendix A.

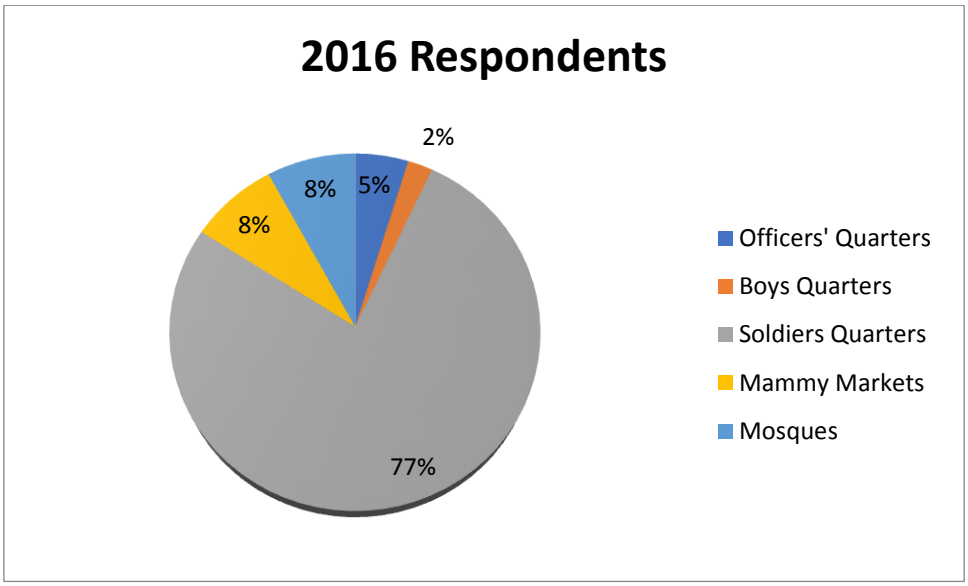

Fig-3: Categories of respondents for 2016

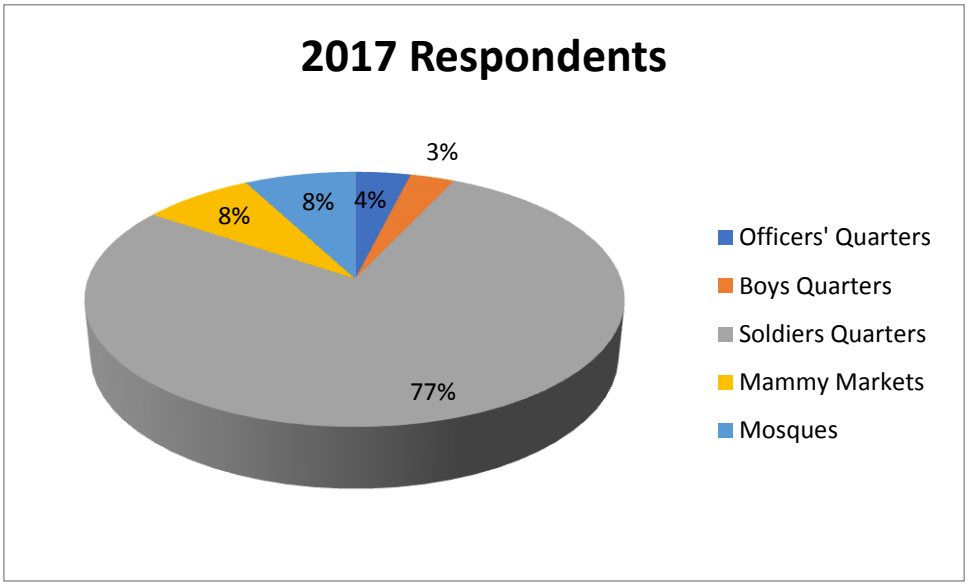

Fig-4: Categories of respondents for 2017

RESULTS AND DISCUSSION

The results showed that an overwhelming number of respondents (99%) harvest rainwater to supplement erratic supply from the public water works. The negligible 1% that does not use rainwater in any form has bore holes drilled in their compounds which supply all their water needs (Figure-5).

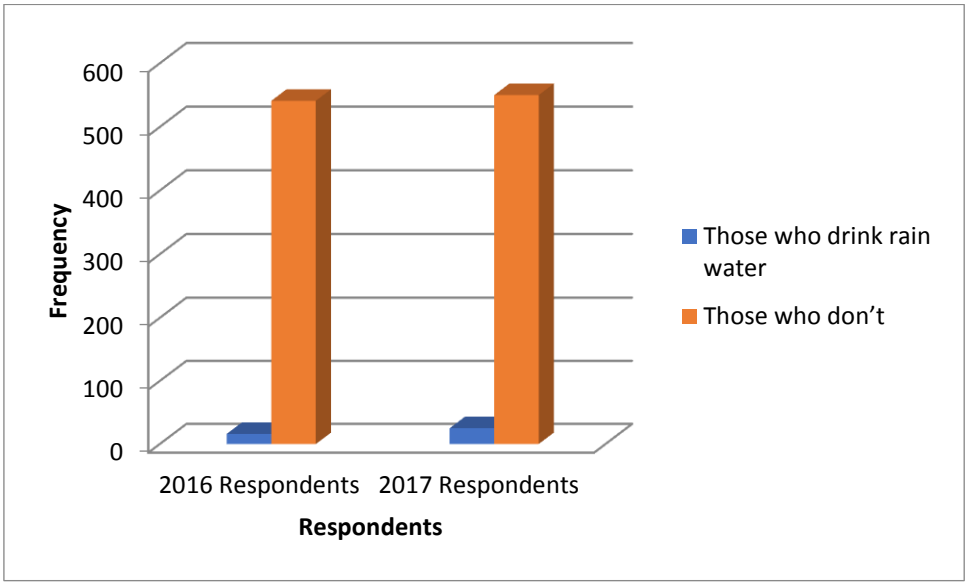

Fig-5: Categories of respondents' use of rainwater

It was observed that rainwater was collected through the use of simple means, such as drums and buckets and plastic containers of various sizes put under roofs and eaves, with individuals mostly women and children collecting for their households. The quantity collected by each household depends on its containers and the intensity and duration of each storm.

All the respondents that collect rainwater use it in cooking and washing of clothes, kitchen appliances, cars, motorcycles and bicycles as well as sanitation and the watering of animals. Due to the type of roofing, namely asbestos. Only about 1% of the respondents drink the harvested rainwater because of small asbestos fragments found in the water making it, in their opinions, hazardous to health. The harvested water is not used in agriculture or lawn irrigation. It is used in non-potable uses during the rainy period as reported by Neto, Calijuri, Carvalho and Santiago [12].

Majority of the respondents recognised the role of rainwater as alternative source of water supply and its potential for savings in domestic water use. For the officers with fairly high incomes the potential savings could be negligible. Regarding soldiers of lower ranks with low incomes the savings are in time spent by their wives in search of water which could otherwise be devoted to socio- economic pursuits; in addition, children now have time to go to schools early since they spend less time in search of water for their household uses during rainy seasons. The construction of rainwater harvesting systems in the open spaces between the blocks would help in the maximum storage and use of rainwater for domestic activities in the study area.

Appendix A

Sample questionnaire to obtain data on rainwater harvesting in Ribadu Cantonment, Kaduna, Nigeria. Please underline where applicable.

Name (optional)
Rank- Officer, Soldier, Civilian
Age (optional)
How many people in your household
Educational attainment – Degree, Diploma, Secondary level, Primary level, other (specify)
Do you harvest rainwater during rainfall- always, often, not often, never
Reasons for the above question
How do you harvest rainwater? (techniques)
What do you use the harvested rainwater for- drinking, cooking, washing, sanitation, farming, other (specify)
How many litres of rainwater do you collect after a heavy storm?
What savings do you make from rainwater harvesting- money as % of income, time (man hours), others
Do you think rainwater collection is important source of water?
How do you think collection can be improved?

CONCLUSION

The study revealed the following findings: -

- The overwhelming majority (99%) of the residents harvest rainwater.
- Harvested rainwater is used for domestic activities

- Harvested water is not used in agriculture and lawn irrigation
- The water is consumed only by an insignificant number of respondents (4%)
- Harvesting rainwater helps in savings in income and the time spent by residents obtaining daily water supplies.
- Constructing simple structures would ensure maximum harvesting of rainwater in the many open spaces in the Cantonment for use of the residents.

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