# Domestic Water Conservation in the Federal Capital Territory of Nigeria: Perceptions and Practices

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## Abstract

*Many regions in Nigeria currently experience physical or economic water scarcity; a situation that is expected to worsen because of the nation's rapid population growth, which has resulted in increased pressure on available freshwater resources. This study, therefore, examines water conservation practices in the Federal Capital Territory (FCT), one of the fastest-growing areas in Nigeria. A questionnaire was administered to 649 respondents, from across the six Area Councils that make up the Territory. The findings revealed that water investments in the FCT have not yielded 100% public water supply coverage for residents. About half of the respondents (48.7%) reduced their water use by minimizing the water used for washing, and a slightly higher proportion (53.5%) minimized water used for bathing. While rain harvesting was the most widespread conservation practice, with 65.3% of the respondents adopting it, the least practised conservation method is wastewater reuse, where only about 41% of the respondents adopted it. Although the majority of the respondents were literates, education did not impact their conservation practice. The age and gender of respondents played no significant role in the adoption of conservation practices. More public awareness and water education are needed to promote greater domestic water conservation among residents.*

**Keywords**: FCT, rainwater harvesting, water conservation, water scarcity

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## Introduction

By the year 2050, the global demand for freshwater may increase by 50% (Kaur & Mahajan, 2016). It was estimated, through modelling, that over 3 billion people might be exposed to water stress by 2050, particularly vulnerable are cities and areas that have to support large populations (Hanasaki et al., 2013). One in four cities in the world is classified as water-stressed, and some cities that have suffered water shortages have experienced serious disruptions to socio-economic and agricultural outputs (McDonald et al., 2014; Besada & Werner, 2015; Nobre et al., 2016).

In Nigeria, both physical and economic water scarcity are experienced across the different regions of the country. Cases of physical water scarcity are present in several northern states, especially in the areas located between 10°N and 14°N. These are areas characterized by long periods of dry season, which sometimes lasts for as long as six months. Not only has the amount of rainfall been on the decline since the 1960s, but it is also highly variable. Both surface and groundwater reduce substantially during the dry season. Many inhabitants of this region are therefore subjected to varying levels of water scarcity. The problem of decaying water infrastructure and climate change has exacerbated the problem of water scarcity in the northern region; leading to water rationing in many parts (Ita Enang et al., 2016; Abdullah et al., 2019).

While physical water scarcity is a perennial phenomenon in the northern region of Nigeria, water scarcity is also experienced in the humid southern region of the country, particularly the urban areas and semi-urban areas; because of the insufficient water infrastructures. (Lade & Oloke, 2015; Federal Government of Nigeria, 2016). With Nigeria's population projected to be over 400 million by 2050, water demand is expected to rise and the problem of water scarcity become exacerbated by population growth along with other factors (Yeboua et al., 2022)

Traditionally, water agencies and water managers' response to high freshwater demand is to increase water supplies through the provision of government-subsidized water infrastructures. However, the decline in funding, the finite nature of fresh water as a resource and the growing concerns over the environmental consequences of some of the large water infrastructures have necessitated calls for alternative approaches (Wutich et al., 2014; Thomson, 2020).

Water conservation is one of the alternative measures being advocated to address the current unsustainable water use (Adewusi, 2015; Mthethwa, 2017). Water conservation is intentional actions taken to promote the beneficial use of water and reduce water loss and waste. Domestic water conservation which is water conservation for household purposes and activities include; shortening time spent in the shower, insulation of water pipes; turning off the sink while washing face/brushing teeth, prompt repair of leaks, limited watering of lawns, and purchase of water-saving appliances (Kumari & Singh, 2016; Eickhoff, 2018).

While several studies on water scarcity and the insufficiency of water infrastructures have been conducted in the FCT (e.g Ita Enang et al., 2016; Ainiuwu, 2016; Adeniran, 2022), here is a dearth of literature on how domestic water demand and waste can be reduced. Therefore, this paper examines domestic water conservation practices in the FCT, aimed at filling the research gap.

## Literature Review

Water conservation cuts across all three basic freshwater use: industrial, agricultural and domestic. Although the largest use of freshwater worldwide is for agricultural activities, and agricultural conservation practices are being promoted globally; domestic water conservation practices are just as important (Fan et al., 2014; Eickhoff, 2018). Domestic water conservation, which entails all actions taken at the household level to reduce domestic water demand, water loss and waste, covers indoor water use (such as washing, laundry, toilet flushing, household hygiene and kitchen water use) and outdoor water use such as landscape or lawn maintenance (Rasoulkhani et al., 2018; Thomson, 2020).

To promote domestic water conservation, diverse price-based and non-price-based strategies are employed. Some of the price-based strategies include water extraction levies and tariffs, whereas the non-price-based strategies include installing water-saving toilets, education and awareness campaign, regulatory standards and legislation, rainwater harvesting and greywater reuse (New Hampshire Department of Environmental Services, 2008; Gholson et al., 2019; Cotterill, 2021; Shia et al., 2022).

Advances in technology have introduced retrofittable water-saving devices such as toilet cistern bags, shower timers, or aerated taps/showerheads. These water conservation technologies, one of the non-priced-based water conservation strategies, have substantially reduced water use in Europe from between 20-100 litres/property/day (Cotterill, 2021). However, the same huge gains made in Europe and North America with water conservation technologies are not prevalent in other regions of the world since its adoption is hampered by the additional costs required in their acquisition (Rasoulkhani et al., 2018; Shia et al., 2022).

Regulatory instruments are now being used to help reduce water use in homes, examples are building regulations with minimum fittings standards for water appliances; while some nations did not specify the allowable limits for the fitting others like the United States, England and Wales provided specific component level targets in new buildings with the permissible flow rate of individual fixtures and fittings (New Hampshire Department of Environmental Services, 2008; Cotterill, 2021).

Education and awareness are major non-priced-based water conservation strategies, which can change the behaviour of households. Turning off the faucet while not in use and taking shorter showers are the major behavioural changes that have been observed to have the largest net benefits. However, insufficient information about personal water use and difficulty in changing habits could be barriers to the expected positive behavioural change (Dobroski, 2016; Eickhoff, 2018; Cotterill, 2021; Thomson, 2022).

Rainwater harvesting and greywater use are two measures of domestic water conservation that reduce the volume of potable water used, by making available alternative non-potable water supply. Captured rainwater is used either treated or untreated for purpose-fit activities in households. Greywater, which comprises wastewater generated within homes excluding toilet water has been reused for several non-potable uses such as landscaping, toilet flushing and watering outdoor gardens. Its use for potable purposes is very limited as it requires extensive treatment and many people's attitudes to its potable use are negative (Dobroski, 2016; Kumarasamy et al., 2017).

Water price, a price-based conservation strategy, could either be volumetric pricing or non-volumetric pricing regimes. In the case of volumetric pricing, the cost has been a disincentive to increase water demand in households; thus, helping to conserve available water supplies. The argument put forward concerning water pricing is that the price should be 'socially efficient' such that it can promote sustainable water use without pushing poor households into poverty through water deprivation (Dlamini, 2015).

## Materials and Methods

### *Study area*

The Federal Capital Territory of Nigeria lies between longitude 6° 45' and 7° 39' east of the Greenwich Meridian and latitude 8° 25' and 9° 20' North of the equator (see Fig. 1). It covers an area of approximately 8,000 km² and consists of six Area Councils, namely; Abuja Municipal

Area Council (AMAC), Abaji, Gwagwalada, Kuje, Bwari and Kwali (Abubakar, 2014). In 2011, the population of the FCT was 2,238,751 with an annual growth rate placed at 2.8 % (National Bureau of Statistics, 2012), the population of the study area in 2021, using an exponential growth equation, was estimated to be 2,950,780. The most populated of the Area Councils is the Abuja Municipal Area Council (AMAC) while the least populated is Abaji.

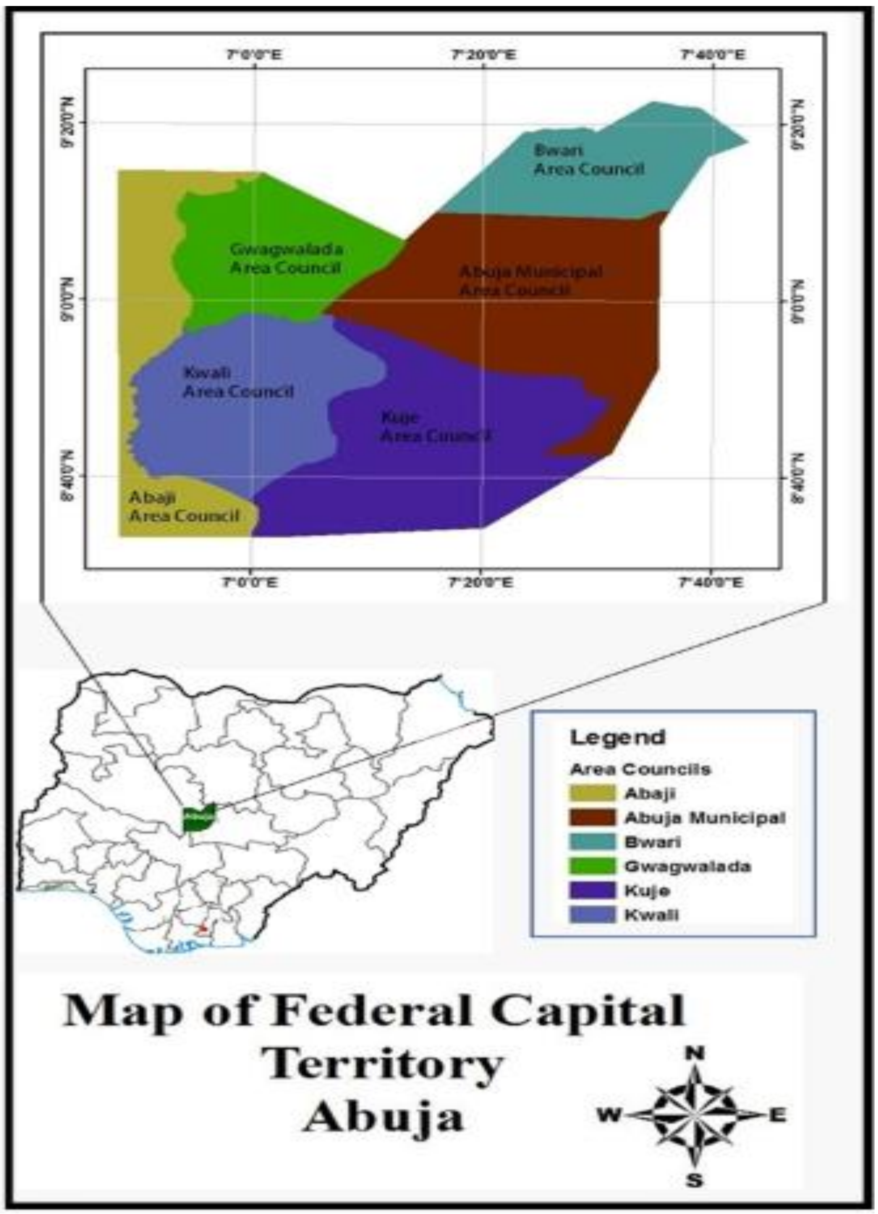


Figure 1: Administrative/Area Councils of Abuja FCT

***Study design***

The mixed methods research approach was adopted for this study, which combined face-to-face interviews and a questionnaire (or structured interview schedule). The mixed method strategy in this study aims at seeking "complementarity"; where the face-to-face interview is used to elaborate, enhance and clarify the outcomes of a structured interview schedule as found in the mixed-method design matrix developed by Johnson & Onwuegbuzie (2004). However, the questionnaire had the dominant status in the study.

A stratified random sampling technique was used in the selection of wards used in this study. The stratification was based primarily on the six Area Councils, whose boundaries are easily identified. Within each Area Council, four wards were randomly selected; using the lottery method. Thereafter, systematic sampling was used in the selection of households from each selected ward. Using the steps stipulated for systematic sampling in Etikan and Bala (2017), the first household was selected at random and the remaining households are selected using a fixed interval; in this study, the interval used was ten. From the selected households, one respondent per household was administered the questionnaire. Six hundred and forty-nine (649) of the seven hundred and twenty-two (722) administered questionnaires were retrieved (see Table 1).

The questionnaire consisted of close-ended questions. Respondents chose from the options produced by the researchers. The questionnaire consisted of three sections, namely; the section on respondents' demographics, practice of water conservation and perceptions of water adequacy in the Territory. A purposive sampling technique was used in the selection of participants from across the six Area Councils for the oral face-to-face interview. A list of issues about the study were drawn up, and participants that matched the full range of the issues were sought and included in the study. There were two participants from four of the Area Councils (Kwali, Bwari, Abaji and

Kuje), while from the most populous Area Councils AMAC and Gwagwalada, five and four participants were included respectively. A total of 17 persons were involved in the face-to-face interviews for the study.

Table 1: Selected wards and sample size for questionnaire administration per Area Council

| Area Council | Selected Wards | Sample Size | |
|---|---|---|---|
| | | Frequency | Percent (%) |
| Abaji | Yaba, Agyana, Abaji North East and Abaji Central | 28 | 4.3 |
| AMAC | Gwarinpa, Garki, Wuse and Nyanya | 344 | 53.0 |
| Bwari | Dutse Alhaji, Ushafa, Kubwa and Usuma | 100 | 15.4 |
| Gwagwalada | Tunga Maje, Gwako, Gwagwalada Central and University staff quarters | 94 | 14.5 |
| Kuje | Chibiri, Kuje, Guabe and Rubochi | 45 | 6.9 |
| Kwali | Yangoji, Kwali, Kilankwa and Kundu | 38 | 5.9 |
| Total | | 649 | 100 |

***Statistical Analysis***

The Statistical Package for the Social Sciences (SPSS) V23.0 and Microsoft Excel software was used to analyse data obtained from the questionnaire, using descriptive and inferential techniques. The descriptive measures were range, frequency and percentage while the inferential measures were tests of differences (independent t-test and multivariate analysis of variance [MANOVA]). To be able to conduct the inferential analysis, the respondents' answers to the Likert-scaled questions were recoded numerically (strongly disagree =1, disagree = 2, neutral =3, agree = 4 and strongly agree = 5). The qualitative data (audio recordings) from the face-to-face interviews, were transcribed through direct translation in Microsoft Word. The transcripts were analysed using NVivo software to know the common themes.

## Results and Discussion

### *Demographic Characteristics of the Respondents*

The prevalence of males in the respondents reflects gender participation in the data-gathering process. In many homesteads, women are not as accessible as men due to cultural reasons.

The majority (64%) of the respondents in this study are aged between 25 – 45 years (see Table 2). This age range is when people are most active in domestic and physical activities. in addition, within this age range, there are people with young families who as heads of households, have a greater say in the use of water in their homes. This implies that most of the data were obtained from the segment of the population that are most active and are in a position to give valuable insight into the issues under investigation.

The respondents who work in the agricultural sector account for less than a tenth (6.2%) of the respondents in the survey.  The indigenous population of the FCT are the ones who largely engaged in the agricultural sector as their primary occupation. The FCT is the administrative capital of Nigeria, hence more than a fifth of respondents are civil servants, 22.3%, howbeit it was not the occupation that had the highest representation among the respondents, as it was surpassed by the number of those in business. The private sector in the FCT, particularly those who are business owners or are employees in business ventures account for the highest proportion, 37.9%. There are diverse kinds of markets in the territory, the ones that are modern where facilities are well structured and buying and selling occur every day and other markets with make-shift stalls where buying and selling are held once or twice a week. These markets have grown in size to meet the demands of the increasing population, hence many respondents, close to a tenth (9.5%) of respondents are traders. Artisans (4.3%), like farming and fishing, are negligible in the survey.

As indicated in Table 2, most of the respondents (96%) surveyed have a form of formal education. Over 66% of the respondents have at least a Diploma. This is expected as the Federal Capital Territory enjoys relatively good quality educational facilities. The prevalence of educational institutions is reflected in the high literacy rate among the young people aged between 25 -45 years (82%) in the FCT as against the national average literacy rate of 66.7% (National Bureau of Statistics, 2017). About 64% of the respondents in this study fall within this highly literate group (see Table 2). The high level of literacy of the respondents means that they are capable of comprehending the issues being asked and are more likely to give reliable answers which will help in addressing the research objectives.

***Major Sources of Domestic Water in the FCT***

Table 3 shows the major domestic water sources available for residents of the FCT. The major sources as shown are public water main, hand-dug well (with average depths of 14m and average distance to the water point being 30 meters), borehole (depth in most of the Area Councils range from 50m to 120m), stream and commercial water vendor.

Table 2: Respondents' demographics

| Characteristics | | Frequency | Percent |
|---|---|---|---|
| | Male | 403 | 62.1 |
| Gender | Female | 246 | 37.9 |
| | Total | 649 | 100 |
| | 18-24years | 141 | 21.7 |
| | 25-35years | 261 | 40.2 |
| Age | 36-45years | 149 | 23 |
| | 46-55years | 68 | 10.5 |
| | over 55 years | 30 | 4.6 |
| | Total | 649 | 100 |
| Occupation | Farming | 24 | 3.7 |
| | Fishing | 16 | 2.5 |
| | Business | 246 | 37.9 |
| | Civil Servant | 145 | 22.3 |
| | Artisan | 28 | 4.3 |
| | Trading | 61 | 9.4 |
| | Others | 129 | 19.9 |
| | Total | 649 | 100 |
| | No Formal education | 26 | 4 |
| Highest Education Attained | Primary/Secondary school | 181 | 27.9 |
| | Diploma/NCE | 191 | 29.4 |
| | First Degree | 191 | 29.4 |
| | Masters | 43 | 6.6 |
| | Others | 17 | 2.6 |
| | Total | 649 | 100 |

Only about a third, 35.4% of the respondents, have their domestic water supply from the public water main. Studies have shown that many urban centres in Nigeria lack total water coverage, the Federal Government of Nigeria (2011) and Ladan (2013) report that about 50% of the population in Nigeria does not have access to potable water. The Standard Organisation of Nigeria's Standard for Drinking Water Quality being temperature – ambient, pH – 6.5 -8.5, taste/odour – unobjectionable, cadmium – < 0.003mg/L, fluoride <1.5mg/L, Sulphate – <500mg/L, total dissolved solids – <500 mg/L, pesticides <0.01 mg/L (Standard Organisation of Nigeria, 2015). The proportion of respondents whose dominant water source is not public main in the FCT is higher, as 64.6% of them depend on other sources. This outcome shows that in the FCT, the investments in water supply infrastructure such as dams, reservoirs, treatment plants and the centralisation of public water authorities have not sufficiently led to high water coverage. The water distribution infrastructure in the FCT is limited to a few planned settlements while people outside these planned areas lack access to public mains and have to depend on alternative water sources. With the population growth of the FCT being faster than the Nigerian national average growth rate of 2.8% (Oyekale, 2015), more pressure is expected on the public mains and the number of the residents of the Territory being served by the public main could drop in the future or more rationing of water could ensue.

Groundwater sources (hand-dug well and borehole) are the major sources of domestic water in the FCT, since 52.7% of the respondents indicate that it is their predominant source of domestic water (see Table 3). There are several areas in the FCT where groundwater is found in sufficient quantities to support a large number of people (Omada & Obayomi, 2012). The geology of the Territory and the high rainfall prevalent replenishes the groundwater with the thickness of the ground aquifer being postulated to be as high as 70m (Omada & Obayomi, 2012). About 8% of the geology of Abuja FCT is made up of igneous and metamorphic rocks of the Pre-Cambrian Basement Complex (Olugbenga & Dahiru, 2016). There is the presence of joints and fractures in the geology of the FCT, which are indicative of the groundwater potential. These fractures tend to lie northerly in the NNE-SSW, and NNW-SSE directions (Omada & Obayomi, 2012). Elsewhere in the FCT, the geology is composed of an overlay of thick regolith comprising decayed and decaying rock fragments. These rocks are loosely arranged, thus, creating large and numerous spaces that allow infiltration of rainfall. Subsequently, high rainfall prevalent replenishes the groundwater into deeper basement storage sites provided by the dense fracture networks. The thickness of the ground aquifer can be as high as 70m (Abam & Ngah, 2013). Yields of the boreholes vary but can be as high as $20m^3/hr$ –$40m^3/h$ with static groundwater levels in the FCT ranging from as shallow as 3.1m in Bwari, Abaji and parts of Gwagwalada Area Councils to 19 meters in Garki (Abam & Ngah, 2013).

According to Adewumi (2021), the FCT's main water system reservoir has a capacity of 100 million cubic meters and reticulation was completed in 1990. Major expansion works to increase capacity was completed in 2013. In this study, it was observed that the gap created by the absence of a public main in most parts of Abuja FCT is also filled by commercial water suppliers. Table 3 shows about a tenth of the respondents, 9.6%, depending on water supply from commercial water vendors. Water vending is an important water source across every region in Nigeria (Ahmad, 2017), howbeit, in the FCT, it serves a relatively fewer proportion than those who use the public main and groundwater sources. People who live along the streams and rivers in the FCT and do not have access to public mains and groundwater sources rely on stream water for domestic purposes. However, the proportion of those respondents who use stream water is relatively low, 1.7%. This low usage of stream water could be attributed to the fact that very few settlements are situated along river banks. Also, for many FCT residents, surface water is seen as one of the most polluted water sources as human activities introduce pollutants into it. In other areas, wastewater is channelled to soakaways or is allowed to flow into open sewers to join natural drainage channels. This is a major source of pollution in surface water which renders it unhealthy for domestic purposes.

Table 3: Respondents' major source of domestic water

| Source | Frequency | Percent |
|---|---|---|
| Public Water Main | 230 | 35.4 |
| Hand-dug Well | 106 | 16.3 |
| Borehole | 236 | 36.4 |
| Stream | 11 | 1.7 |
| Commercial Water Vendor | 62 | 9.6 |
| Others | 4 | 0.6 |
| Total | 649 | 100 |

***Common Domestic Water Conservation Practices in the FCT***

Respondents' domestic water conservation practices are varied (reuse of water, reduction in water usage and rainwater harvesting) as shown in Table 4. The use of water for bathing and washing takes up much potable water, hence, any action that reduces the quantity of water used promotes domestic water conservation. About half of the respondents (48.7%) do actively try to use less water when washing while 51.3% of the respondents do not take measures that promote reduced usage of water for washing. Bathing is an activity in households that every member does, hence on daily basis water is used to bathe.  More than half of the respondents, 53.3%admit using a minimum amount of water for bathing. The reduction was usually done by minimal use of showers or the use of buckets rather than showers, which helps in the reduction of the quantity of water used.

The reuse of laundry wastewater was adopted by 40.8% of the respondents, while the remaining respondents did not engage in the reuse of wastewater. Some people consider wastewater as un-usable, a reflection of the old paradigm of water management, which is far removed from what is obtained in the emerging paradigm of water management, where water can be used multiple times from higher to lower quality needs and by reclamation treatment for a return to the supply.

Rainwater harvesting is widespread in the FCT, about two-thirds of the respondents, 65.3%, harvest rainwater as against one-third, 34.7%, who do not harvest rainwater. Out of the three common measures adopted in water conservation in the FCT, rain harvesting has the highest proportion (65.3%). Because rainwater harvesting increases the available water to households and it is considered as clean water by many (unlike wastewater), it has a greater level of adoption. However, it is a practice that is not feasible during the dry season (from November to March); thus, its practice is limited to 6-7 months in the year when rain falls.

The enquiries during the qualitative data gathering show that the interviewees who use less water do so primarily because of economic reasons, to save cost, especially in the less affluent areas of the FCT. This outcome is similar to the findings made by Dadvar, Mahapatra and Forss (2021) and Shia et al. (2022). In Shia et al.'s (2022) study of Jiaozuo City, about 43% of the residents were motivated to conserve water because of economic reasons. The interviewees in this study who were not positively inclined to reduce their domestic water use feel they are using the bare minimum and any less will affect their quality of life adversely and may not be able to keep clean and maintain personal hygiene. Their responses also show that more water is used as greywater during the dry season on account of water shortages. Rainwater harvesting is meant to augment domestic supply and it is more prevalent in areas not covered by Municipal water services, as shown by the responses of people interviewed.

Table 4: Domestic Water Conservation practices in the study area

| Methods of Water Conservation | Responses | Frequency | Percent |
|---|---|---|---|
| Reduction in Water Use | | | |
| I actively try to use less water when washing | Yes | 316 | 48.7 |
| | No | 333 | 51.3 |
| | Total | 649 | 100 |
| I make use of a minimum amount of water for bathing | Yes | 347 | 53.5 |
| | No | 302 | 46.5 |
| | Total | 649 | 100 |
| Reuse of Wastewater | | | |
| I reuse wastewater from my laundry | Yes | 265 | 40.8 |
| | No | 384 | 59.2 |
| | Total | 649 | 100 |
| Rainwater Harvesting | | | |
| I harvest rainwater for use | Yes | 424 | 65.3 |
| | No | 225 | 34.7 |
| | Total | 649 | 100 |

Table 5 shows the group statistics of respondents' conservation practices, where the mean values per group were presented. Four conservation practices falling into three conservation methods, namely; reduction in water usage, reuse of laundry wastewater and rainwater harvesting were presented based on gender. To determine if there were significant differences in the mean values, an independent t-test was conducted, and the outcome is shown in Table 6.

There was no significant difference in their effort to try to use less water when washing between male respondents (M= 3.1818, SD = 1.13709) and female respondents (M= 3.1829, SD = 1.16193); t(647)= -.019, p= 0.985. In respondents' effort to use the minimum amount of water for bathing, there was no significant difference between male respondents (M= 3.3226, SD = 1.08135) and female respondents (M= 3.2358, SD= 1.05816); t (647) = 1.0, p= 0.318. The reuse of wastewater from laundry by respondents was not significantly different between male respondents (M= 2.9107, SD = 1.29367) and female respondents (M= 2.8455, SD= 1.34336); t (647) = 0.613, p = 0.540. The reuse of wastewater from laundry by respondents was not significantly different between male respondents (M=2.9107, SD = 1.29367) and female respondents (M= 2.8455, SD= 1.34336); t (647) = 0.613, p= 0.540. There was no significant difference in their harvest of rainwater for use between male respondents (M=3.5484, SD = 1.10157) and female respondents (M=3.5325, SD =1.09775); t (647) = 0.178, p = 0.859. The finding made in this study runs contrary to what is established by Diakite et al. (2020), where gender was a demographic characteristic that impacted water conservation, as women were found to have greater levels of water conservation practices. But in Malik et al. (2021) men were observed to have a higher level of water conservation practices. According to Garcetti and Kevany (2013) cited in Diakite et al. (2020), women and girls feel the impact of water scarcity more (particularly in rural areas), as they are usually saddled with the responsibility of collecting and transporting water in such situations, the outcome of this study which shows that there are insignificant differences in the level of domestic water conservation practices by the male and female respondents does imply that conservation practices bear equal importance to both genders. Women who are usually more involved in household chores and use water in the process; and men who are the major decision-makers in homes are both actively contributing to domestic water conservation in similar measures. This is an advantage, as both genders share the responsibility for domestic water conservation and promotes its wide acceptance among residents.

The descriptive statistics, outlining the mean values, standard deviation and standard error of respondents' conservation practices (reduction in water usage, reuse of laundry wastewater and rainwater harvesting) based on age are shown in Table 7. A multivariate analysis of variance (MANOVA) test result of respondents' conservation practices is shown in Table 8.

Table 5: Group statistics for conservation practices in the study area based on gender

| | Sex | N | Mean | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|---|
| I actively try to use less water when washing | Male | 403 | 3.1811 | 1.13709 | 0.05664 |
| | Female | 246 | 3.1829 | 1.16193 | 0.07408 |
| I reuse wastewater from my laundry | Male | 403 | 2.9107 | 1.29367 | 0.06444 |
| | Female | 246 | 2.8455 | 1.34336 | 0.08565 |
| I harvest rainwater for use | Male | 403 | 3.5484 | 1.10157 | 0.05487 |
| | Female | 246 | 3.5325 | 1.09775 | 0.06999 |
| I make use of a minimum amount of water for bathing | Male | 403 | 3.3226 | 1.08135 | 0.05387 |
| | Female | 246 | 3.2358 | 1.05816 | 0.06747 |

A multivariate analysis of variance (MANOVA) test was used to establish if there are differences in the conservation practices (reuse of water, reduction in water use and rainwater harvesting) adopted between the different age groups (see Table 8). The outcome of the MANOVA test using Wilk's Lambda test, where the alpha level was .05, shows Wilk's   = .981, F(16, 1958.925) = 774, p = .717. This indicates there was no significant difference in the conservation practices between the age groups represented in the study. This finding is consistent with what has been established by earlier scholars such as (Ramsey et al., 2017; Onyenankeya, et al., 2019; Malik et al., 2021); although in Kwakwa et al.'s (2023) study, age was identified as one of the drivers of water conservation practices. In traditional settings, younger members of households are responsible for chores, some of which could be connected to water use, thus, a high level of domestic water conservation practices amongst them could have a greater impact on the overall water conservation in homes. In this study, the insignificant difference in the conservation practices between the age groups means the younger respondents (18- 45-year-olds) did not have the desired positive effects in having greater domestic water conservation practices in households.

Table 6: Result of Independent Samples Test for conservation practices in the study area

| Independent Samples Test | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Levene's Test for Equality of Variances | | t-test for Equality of Means | | | | | | |
| | | F | Sig. | t | df | Sig. (2-tailed) | Mean Difference | Std. Error Difference | 95% Confidence Interval of the Difference Lower | Upper |
| I actively try to use less water when washing | Equal variances assumed | .001 | .977 | -.019 | 647 | .985 | -.00179 | .09277 | -.1840 | .1804 |
| | Equal variances not assumed | | | -.019 | 509.1 | .985 | -.00179 | .09325 | -.1850 | .1814 |
| I reuse waste water from my laundry | Equal variances assumed | .971 | .325 | .613 | 647 | .540 | .06514 | .10621 | -.1434 | .2737 |
| | Equal variances not assumed | | | .608 | 502.7 | .544 | .06514 | .10719 | -.1454 | .2757 |
| I harvest rainwater for use | Equal variances assumed | .097 | .756 | .178 | 647 | .859 | .01587 | .08901 | -.1589 | .1907 |
| | Equal variances not assumed | | | .178 | 519.2 | .858 | .01587 | .08894 | -.1588 | .1906 |
| I make use of the minimum amount of water for bathing | Equal variances assumed | .275 | .600 | 1.000 | 647 | .318 | .08681 | .08679 | -.0836 | .25722 |
| | Equal variances not assumed | | | 1.006 | 526.5 | .315 | .08681 | .08633 | -.0828 | .25640 |

The descriptive statistics, outlining the mean values, standard deviation and standard error of respondents' conservation practices (reduction in water usage, reuse of laundry wastewater and rainwater harvesting) based on age are shown in Table 7. A multivariate analysis of variance (MANOVA) test result of respondents’ conservation practices is shown in Table 8.

A multivariate analysis of variance (MANOVA) test was used to establish if there are differences in the conservation practices (reuse of water, reduction in water use and rainwater harvesting) adopted between the different age groups (see Table 8). The outcome of the MANOVA test using Wilk’s Lambda test, where the alpha level was .05, shows Wilk’s = .981, F (16, 1958.925) = 774, p = .717. This indicates there was no significant difference in the conservation practices between the age groups represented in the study. This finding is consistent with what has been established by earlier scholars such as (Ramsey et al., 2017; Onyenankeya, et al., 2019; Malik et al., 2021); although in Kwakwa et al.’s (2023) study, age was identified as one of the drivers of water conservation practices. In traditional settings, younger members of households are responsible for chores, some of which could be connected to water use, thus, a high level of domestic water conservation practices amongst them could have a greater impact on the overall water conservation in homes. In this study, the insignificant difference in the conservation practices between the age groups means the younger respondents (18- 45-year-olds) did not have the desired positive effects in having greater domestic water conservation practices in households.

Table 7: Descriptive statistics for conservation practices based on age in the study area

| | Age | Mean | Std. Deviation | N |
|---|---|---|---|---|
| I actively try to use less water when washing | 18-24years | 3.2553 | 1.20951 | 141 |
| | 25-35years | 3.1992 | 1.16295 | 261 |
| | 36-45years | 3.1007 | 1.07014 | 149 |
| | 46-55years | 3.3088 | 1.09623 | 68 |
| | over 55 years | 2.8 | 1.12648 | 30 |
| | Total | 3.1818 | 1.14567 | 649 |
| I reuse wastewater from my laundry | 18-24years | 2.8156 | 1.33952 | 141 |
| | 25-35years | 2.9349 | 1.31543 | 261 |
| | 36-45years | 2.906 | 1.29104 | 149 |
| | 46-55years | 3.0294 | 1.26928 | 68 |
| | over 55 years | 2.3667 | 1.29943 | 30 |
| | Total | 2.886 | 1.31208 | 649 |
| I harvest rainwater for use | 18-24years | 3.5745 | 1.13537 | 141 |
| | 25-35years | 3.5862 | 1.1491 | 261 |
| | 36-45years | 3.5302 | 1.03033 | 149 |
| | 46-55years | 3.4118 | 1.04002 | 68 |
| | over 55 years | 3.3667 | 0.96431 | 30 |
| | Total | 3.5424 | 1.0993 | 649 |
| I make use of the minimum amount of water for bathing | 18-24years | 3.2908 | 1.11828 | 141 |
| | 25-35years | 3.2989 | 1.08254 | 261 |
| | 36-45years | 3.2752 | 1.04532 | 149 |
| | 46-55years | 3.3529 | 0.98896 | 68 |
| | over 55 years | 3.1333 | 1.13664 | 30 |
| | Total | 3.2897 | 1.07263 | 649 |

Table 8: Multivariate tests result for conservation practices based on age in the study area

| Effect | | Value | F | Hypothesis df | Error df | Sig. |
|---|---|---|---|---|---|---|
| Intercept | Pillai's Trace | 0.926 | 1991.414b | 4 | 641 | 0 |
| | Wilks' Lambda | 0.074 | 1991.414b | 4 | 641 | 0 |
| | Hotelling's Trace | 12.427 | 1991.414b | 4 | 641 | 0 |
| | Roy's Largest Root | 12.427 | 1991.414b | 4 | 641 | 0 |
| Age | Pillai's Trace | 0.019 | 0.775 | 16 | 2576 | 0.715 |
| | Wilks' Lambda | 0.981 | 0.774 | 16 | 1958.925 | 0.717 |
| | Hotelling's Trace | 0.019 | 0.773 | 16 | 2558 | 0.718 |
| | Roy's Largest Root | 0.012 | 1.926c | 4 | 644 | 0.104 |

a. Design: Intercept + Age
b. Exact statistic
c. The statistic is an upper bound on F that yields a lower bound on the significance level.

Tables 9 and 10 show the descriptive statistics and MANOVA test results of respondents' conservation practices based on their educational levels. To assess the differences in the conservation practices (reuse of water, reduction in water use and rainwater harvesting) adopted by the respondents across their various educational levels, a MANOVA test was conducted. The outcome of the MANOVA test using Wilk's Lambda test, where the alpha level that was chosen was .05, shows Wilk's = .960, F (20, 2123.590) = 1.326, p = .151. This indicates there was no significant difference in the conservation practices based on education levels. The results of this study are similar to the outcome of the study conducted by Fielding et al. (2012). A contrary finding was made by Onyenankeya et al. (2019) and Gregory & Di Leo (2003) cited in Malik et al. (2021), as education level was identified as a factor that influenced water conservation behaviours. In Onyenankeya et al.'s (2019) study of peri-urban households in the Eastern Cape Province of South Africa, households with higher education have greater levels of domestic water conservation practices. The insignificant difference in the conservation practices based on education in this study is an indication that the Nigerian government has not sufficiently prioritized water education in its curricula across the different tiers of formal education, despite water resources being one of the basic resources that sustain life on Earth. The expected influence formal education is meant to have on the level of adoption of water conservation practices is absent among educated respondents, thus, the conservation habits of those exposed to formal education were largely similar to those without formal education.

Table 9: Educational Level and Conservation Practices

| | Educational Background | Mean | Std. Deviation | N |
|---|---|---|---|---|
| I actively try to use less water when washing | No Formal education | 3.4231 | 0.85665 | 26 |
| | Primary/Secondary school | 3.1989 | 1.20379 | 181 |
| | Diploma/NCE | 3.1518 | 1.16663 | 191 |
| | First Degree | 3.1937 | 1.08539 | 191 |
| | Masters | 3.1395 | 1.16663 | 43 |
| | Others | 2.9412 | 1.34493 | 17 |
| | Total | 3.1818 | 1.14567 | 649 |
| I reuse wastewater from my laundry | No Formal education | 3.1923 | 1.23351 | 26 |
| | Primary/Secondary school | 3.0663 | 1.29358 | 181 |
| | Diploma/NCE | 2.9267 | 1.33175 | 191 |
| | First Degree | 2.7225 | 1.31448 | 191 |
| | Masters | 2.6977 | 1.33693 | 43 |
| | Others | 2.3529 | 0.99632 | 17 |
| | Total | 2.886 | 1.31208 | 649 |
| I harvest rainwater for use | No Formal education | 3.6154 | 0.94136 | 26 |
| | Primary/Secondary school | 3.7403 | 1.0187 | 181 |
| | Diploma/NCE | 3.534 | 1.1228 | 191 |
| | First Degree | 3.4084 | 1.10536 | 191 |
| | Masters | 3.2558 | 1.25533 | 43 |
| | Others | 3.6471 | 1.16946 | 17 |
| | Total | 3.5424 | 1.0993 | 649 |
| I make use of the minimum amount of water for bathing | No Formal education | 3.1154 | 1.07059 | 26 |
| | Primary/Secondary school | 3.326 | 1.08977 | 181 |
| | Diploma/NCE | 3.2775 | 1.06695 | 191 |
| | First Degree | 3.2723 | 1.05092 | 191 |
| | Masters | 3.3256 | 1.14893 | 43 |
| | Others | 3.4118 | 1.12132 | 17 |
| | Total | 3.2897 | 1.07263 | 649 |

Table 8: Multivariate tests result for conservation practices based on age in the study area

| Effect | | Value | F | Hypothesis df | Error df | Sig. |
|---|---|---|---|---|---|---|
| Intercept | Pillai's Trace | 0.898 | 1409.341b | 4 | 640 | 0 |
| | Wilks' Lambda | 0.102 | 1409.341b | 4 | 640 | 0 |
| | Hotelling's Trace | 8.808 | 1409.341b | 4 | 640 | 0 |
| | Roy's Largest Root | 8.808 | 1409.341b | 4 | 640 | 0 |
| Education | Pillai's Trace | 0.041 | 1.32 | 20 | 2572 | 0.154 |
| | Wilks' Lambda | 0.96 | 1.326 | 20 | 2123.59 | 0.151 |
| | Hotelling's Trace | 0.042 | 1.33 | 20 | 2554 | 0.148 |
| | Roy's Largest Root | 0.031 | 4.035c | 5 | 643 | 0.001 |

a. Design: Intercept + Age
b. Exact statistic
c. The statistic is an upper bound on F that yields a lower bound on the significance level.

## Conclusion and Recommendations

This research examined the extent to which FCT residents conserve domestic water through intentional actions that reduce domestic water use and waste. Reduction of water usage through minimizing the water used for bathing and washing; reuse of laundry wastewater and rain harvesting are the common domestic water conservation practices in the study area. The most widely adopted domestic water conservation was rainwater harvesting and the least practised was the reuse of wastewater. The differences in domestic water conservation practices of the respondents based on their demographics (gender, age and education qualifications) were not statistically significant.

The seasonality of rain makes it impossible to undertake rainwater harvesting all year round; hence the need to encourage greater acceptance and adoption of wastewater reuse and reduction of water used for bathing and washing in households. This could be done through public awareness, using different media, and the inclusion of water education into school curricula at all tiers of education. In addition, water conservation should also be given prime attention in the mainstream national discourse.

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