Public disposition to household water saving devices in Akure Southwestern Nigeria

J R Adewumi1, 2

1 Department of Civil Engineering, Landmark University, Omu-Aran, Nigeria
2Department of Civil Engineering, Federal University of Technology, Akure, Nigeria

E mail: adewumi.james@lmu.edu.ng ; jradewumi@futa.edu.ng

Abstract. Water scarcity has become a perennial problem affecting many households in Nigeria. While water resources in Nigeria are constrained, demand for water has increased and outstripped supply. This is largely due to rapid population growth, economic and agricultural growth, climate change and high standard of living among certain cadres. This paper examines the level of public awareness on the choice of plumbing materials in household water conservation. A well-structured questionnaire was administered to homeowners, plumbers and plumbing materials vendors. The result shows that the choice of plumbing materials is largely based on durability, aesthetic and affordability of the product. The research also revealed that many home owners and plumbers in Akure are not aware of water saving devices which is a common water demand conservation strategy that have recorded high degree of success in many developed and developing countries. It is recommended that government should embark on aggressive public enlightenment campaign through government agencies like National Orientation Agencies (NOA), Standard Organization of Nigeria (SON), Federal and State Ministry of Water Resources to sensitize public on the use of household water conservation devices to reduce water demand.

Keywords: water scarcity, water conservation, plumbing materials, public enlightenment.

1. Introduction

One of the necessary and critical natural resources need for the development and maintenance of public health is the availability of clean potable water. All efforts to maintain public health will fail woefully in the absence of clean water. Access to clean potable water becomes critical as more developed and developing countries grow their economies and struggle to improve quality of life and standard of living for their citizens. Most of these countries lack in capital for large-scale development of water resources project that will improve wellbeing of her citizens and environment.

Water resources conservation is specifically the activities designed to reduce water demand and improve efficient use of the resources. In order to ensure the sustainability of fresh water resources for future generations, there is need for change in habits and altering the manner in which we conduct our daily routines. Water conservation involves both physical and hydrologic process that involves using less water and a behavioural concept that emphasizes using water more efficiently and economically, thereby preserving and extending limited supplies.
Water conservation can be cost effective in reducing the demands against the available supplies when compared to the building of new dams, treatment units and its storage and distribution facilities. Water conservation can include technological changes, such as replacing old toilets, faucets, showerheads, dishwashers, and laundry machines with newer and more efficient appliances [1]. Wallander [2] reported that new appliances use less water per flush, or per wash cycle and thereby reduce associated leaks which will ultimately contributes to significant water savings.

Domestic water consumption is a significant component of water usage in any urban or semi urban city. The conservation of water through the reduction of demand has long been considered an important component of water management [3][4][5]. There are a growing number of products available to help reduce domestic water use in any building. Installation of water conserving equipment and implementation of water efficient procedures are capable of providing considerable cost-effective savings, particularly in areas where water is metered and costs are directly proportional to usage. The aim of any water conservation communication strategy will be to move a proportion of water users from a position of wasting water to one using it efficiently. Many Planners and water managers have made good efforts to estimate reductions in water demand and water savings from conservation programs and measures [6][7][8].

The conservation of water through the reduction of demand has long been considered an important component of water management and has been applied in many places [3]. WEPIA [9] prepared an estimate of the anticipated water savings for different retrofitting alternative for both public and private sectors in Jordan. Their finding shows that total water saving of 4.44 million cubic meters is expected over ten years if 85% of the large consumers of public entities are retrofitted with Water Saving Devices (WDSs). Within the same period, if 25% of these buildings are retrofitted, a saving of 1.61 million cubic meters is expected. Among the different fixtures, retrofitting western toilets, urinals, showerheads and faucets presents the most water savings. In contrast, [10] reported that there was no significant difference in household water usage before and after installation of WSDs due to pre-installed aerators WSDs were significantly effective in restaurants, mosques, hotels and government buildings.

Also, through the use of water saving device and public awareness campaign, the city of Zaragoga in Spain reduced overall water use by 1 600 million litres on average each year between 1995 and 2008 despite significant population growth [11]. In the use of water saving devices, toilet flushing accounts for about 25–30 % of total domestic water use. As such, savings of 30 litres per property per day can be achieved by using dual flush and low flush toilets [12]. Research by [13] revealed that outdoor water conservation devices (i.e. garden irrigation devices) can also reduce water use by 10 %.

Factor affecting water demand management campaigns has been listed to include climate, consumer willingness to change behaviour, existing level of water shortage, level of awareness, attitudes, beliefs, habits, demographic, psychosocial, behavioral, emotions, motivation [12][13][14][15][16][17][18]. Clarke and Brown [19] surveyed 2,600 residents of the Bayside area to know and understand factors that influences water conservation in Melbourne using three water use behaviours and appliance. The authors reported that the key barrier to a widespread practice of conservation and alternative water usage are difficulty of implementation, cost and renter status. Addo et al. [20] investigated factors that influences household water conservation behaviour and identifies capability, opportunity and motivation as the barriers and drivers that influence household water conservation.

Water conservation needs to be part of any community water resource plan. It is important to project how much water reasonably could be saved through a water conservation program and to establish a realistic and achievable goal for how much the community will save. Numerous U.S. cities and towns have reduced overall water consumption by 10 to 25 percent by installing water-saving devices and implementing leak detection programs. Based on estimated savings, communities should set a goal that can be achieved by retrofitting either a total number of households or a given number of households per year over some given time frame [21].

In many cities across Nigeria, most house owners depend on the use of personal wells for water supply due to failure of government in meeting water demand for its citizenry. Water scarcity is a common phenomenon in many parts of Nigeria cities during dry season especially between the months of December to April; hence, the need to investigate the efficiency of the available plumbing materials in the market and factors that determine the choice of home owners cannot be overemphasized. The main aim of this paper is to determine public disposition to household water saving devices in Akure.
2. Methodology

2.1 Description of the study area

Akure is a city in southwestern Nigeria (Fig. 1), which lies between latitude 7°15’ N - 5°11’ E and longitude 7.25°N - 5.195°E. It is the largest city and capital of Ondo State. The city has a population of 420,594. The people are of Yoruba ethnic group. The climate is hot and humid, influenced by rain-bearing southwest monsoon winds from the ocean and dry northwest winds from the Sahara Desert. The rainy season lasts from April to October, with rainfall of about 1,524mm per year. Temperatures vary from 28°C – 31°C with mean annual relative humidity of about 80% [22]. Akure does not lag behind in terms of development. The city is the economic and commercial hub of Ondo State. The city is bordered by smaller towns and villages and connects to other Nigerian cities of Ibadan, Lagos, Benin and Ado-Ekiti.

2.2 Design of questionnaires

A well-designed questionnaire was prepared based on the information obtained from literature and personal experience. Three sets of questionnaires were prepared and administered to:

i. Home owners;
ii. Plumbers, and
iii. Plumbing materials vendors.

![Location map of the study area](image)

**Figure 1.** Location map of the study area

2.3 Questionnaires administration

In order to ease the process of questionnaire administration, meetings of various association involved was exploited. An informal interaction on the aim of the research was made known to the Chairmen of the following Associations:

i. Some Communities Landlord Association;
ii. Association of Plumbing Materials Sellers and
iii. Ondo State Plumber Association (OSPA).

The Chairmen of these Associations thereafter provided avenue for the author to attend to members during their monthly meetings. This affords an opportunity of meeting many people from each group of interest at the same time. In general, the administrations of the questionnaires and retrieval rate are shown in Table 1.
### Table 1: Questionnaires administration and retrieval rate

| Questionnaire categories        | Numbers administered | Numbers retrieved | Percentage Received |
|--------------------------------|----------------------|-------------------|---------------------|
| Home owners                    | 250                  | 225               | 90 %                |
| Plumbers                       | 65                   | 47                | 72 %                |
| Plumbing materials vendor      | 48                   | 31                | 65 %                |

3. Results analysis and discussions

3.1 Home owners

As indicated in Table 1, the number of questionnaires administered to home owners was 250 out of which 225 were retrieved back. The retrieved number of questionnaires represent 90% of the administered number. This could be adjudged an impressive turnout when compared with other questionnaires administered to different groups. The questionnaire was administered in the newly developed areas where owners developed and occupied their facilities not more than four years to the time of survey to reflect the current situation in using water saving devices. The results obtained from the questionnaires administered are discussed below.

3.1.1 Background Information

The background information contained six questions and the results obtained are shown in Table 2.

| Table 2: Background information of the home owners |
|-----------------------------------------------|
| Information                        | Response | Percentage |
| ---                               | ---       | ---         |
| Gender                            | Male: 190 | 85.00 %     |
|                                  | Female: 35| 15.00 %     |
| Age                               | 20 – 30: 4| 1.80 %      |
|                                  | 31 – 40: 32| 14.20 %     |
|                                  | 41 – 50: 104| 46.20 %    |
|                                  | > 50: 85  | 37.80 %     |
| Marital Status                    | Single: 12| 5.00 %      |
|                                  | Married: 191| 85.00 %    |
|                                  | Divorced/widow(er): 22| 10.00 % |
| Education                         | No formal education: 0 | 0.00 %    |
|                                  | Primary School: 16 | 7.20 %      |
|                                  | Secondary School: 35| 15.50 %     |
|                                  | Tertiary: 174   | 77.30 %     |
| Occupation                        | Trader: 25  | 11.10 %     |
|                                  | Artisan: 17   | 7.50 %      |
|                                  | Civil servant: 183| 81.40 %    |
| No of occupant                   | 2 to 9     |             |

Respondents’ answers to other questions are:

3.1.2 Age of installation

Responses to this question shows that the oldest installation age was four (4) years while the most recent installation was 6 months. This shows that all the installations were done recently and it is expected to reflect modern plumbing devices commonly in use.
3.1.3 Source of water supply
All respondents are using privately owned water source form either shallow or deep well. The responses also indicated that 210 respondents (about 93%) of the home visited have an overhead tank for water storage. On the availability of water throughout the year, only 124 (55%) of the respondents have water in their well all year round while 101 respondents always have water shortage that last between two to three months.

3.1.4 Size of private tanks
The size of various tanks in many household ranges from 1500 litres to 3500 litres. Responses also show that the size of the tank is greatly influenced by the number of occupants in a home.

3.1.5 Pumping interval
About 81% (182) of the respondents are pumping at an interval of two days while 14% (31) are pumping at an interval of 3 days. The remaining 5% (12) pumps daily.

3.1.6 Factors influencing choice of plumbing materials
Four factors used to measure the choice of plumbing materials were categorized under affordability, aesthetic, durability and water conservation. Responses show that many respondents choose more than one factor under this category. The breakdown is as follows:

- Affordability: 208 (92%)
- Aesthetic: 45 (20%)
- Durability: 225 (100%)
- Water conservation: 5 (2%)

The result is a clear indication that durability and affordability is the major consideration of home owners in choosing plumbing materials.

3.1.7 Awareness of water saving devices
The result obtained under this section shows that many homeowners are highly ignorant of the water saving devices. The results showed that 170 (75%) of the respondents are completely ignorant of water saving devices while the remaining 55 (25%) of the respondents who are aware of water saving devices got to know about it when they travelled outside the country or through their professions as Engineer, Architect, Estate Valuers, Quantity Surveyor etc.

3.1.8 Willingness to change to water saving devices
All respondents are willing to change to water saving device if it is durable and affordable. Incidentally, these two reasons are major factors that actually affect the selection of plumbing materials.

3.1.9 Attitudinal behaviours
The following questions were asked respondents to measure attitudinal behaviours:
- do you turn off water when brushing teeth?
- do you wash dishes under running water?
- do you regulate cloth washing machine?
- do you check regularly for any plumbing leakages?

All respondents are positive in their responses to these attitudinal behaviours. This is probably due to the fact that all respondents are using privately owned source of water supply where the maintenance is solely the responsibility of individual. The pride of ownership is a motivation for judicial use of resources.

3.2 Plumbers
As indicated in Table 1, the number of questionnaires administered to plumbers was 65 out of which 47 were retrieved back. The retrieved questionnaires represent 72% of the administered number. The questionnaires were administered through the Association of Plumbers. Contact was established with the chairman of the Association who permitted the administering of the questionnaire to members who are literate during their monthly meeting.
The results obtained from the questionnaire are discussed below.

3.2.1 Background Information
The background information contained five questions and the results obtained are shown in Table 3.

| Information            | Response | Percentage |
|------------------------|----------|------------|
| Gender                 | Male: 47 | 100.00 %   |
|                        | Female: 0| 0.00 %     |
| Age                    | 20 – 30: 6 | 12.70 %   |
|                        | 31 – 40: 21 | 44.60 %   |
|                        | 41 – 50: 17 | 36.30 %   |
|                        | > 50: 3     | 6.40 %     |
| Marital Status         | Single: 4  | 8.50 %     |
|                        | Married: 41 | 87.20 %   |
|                        | Divorced/widow(er): 2 | 4.30 %   |
| Education              | No formal education: 0 | 0.00 %   |
|                        | Primary School: 2 | 4.30 %   |
|                        | Secondary School: 39 | 83.00 %  |
|                        | Tertiary: 6   | 12.70 %    |
| Year of practicing     | < 5 years: 4  | 8.00 %     |
|                        | 5 – 15 years: 28 | 60.00 %   |
|                        | > 15 years: 15 | 32.00 %   |

Respondents' answers to other questions are as follows:

3.2.2 Plumber experience
Most of the respondents in this category are experienced plumbers that have handled more than 50 buildings (71%) while 22% have handled between thirty (30) to fifty (50) buildings. The remaining 7% have handled between ten (10) to thirty (30) building projects.

3.2.3 Awareness of water saving devices
It is unfortunate that ninety-two percent (92 %) of the plumbers are not aware of water saving devices during their time of apprenticeship but only got to know through practice. This is a clear indication that there is poor awareness of water saving devices among plumbers. This poor awareness also has great influence on their choice of materials to homeowners in relation to water conservation.

3.2.4 Plumbing material in Nigeria with water saving devices
Plumbers were asked if they are aware of water saving devices in shower rose head, toilet water closet, cloth washers, dishwashers and taps. The result shows that eighty-five percent (85%) of the plumbers are not sure of the available water saving devices while 15% of the plumbers are aware of these water saving devices through practicing.

3.2.5 Factors influencing Plumbers advice to home owners on the choice of plumbing materials
Similar to the questions asked the homeowners, four factors used to measure the choice of plumbing materials were categorized under affordability, aesthetic, durability and water conservation. It was observed that all the respondents select durability and affordability as the main factor that influence plumbers’ advice to client on the choice of plumbing materials.

3.3 Plumbing materials vendors
In Table 1, the number of questionnaires administered to plumbing material vendors was 48 out of which
31 were retrieved back. The retrieved number of questionnaires represents 68% of the administered number. The questionnaire was administered through the Association of Plumbing Materials Seller’s Association. Contact was established with the chairman of the association who permitted the administering of the questionnaires to members who are literate. The results obtained from the questionnaire are discussed below:

3.3.1  Background Information
The background information contained five questions and the results obtained are shown in Table 4

| Information        | Response | Percentage |
|--------------------|----------|------------|
| Gender             | Male: 31 | 100.00 %   |
|                    | Female: 0| 0.0 %      |
| Age                | 20 - 30: 6| 20.00 %   |
|                    | 31 – 40: 18| 56.00 %  |
|                    | 41 – 50: 7| 24.00 %   |
|                    | > 50: 0   | 0.00 %     |
| Marital Status     | Single: 20| 65.00 %   |
|                    | Married: 11| 35.00 %  |
|                    | Divorced/widow(er): 0| 0.00% |
| Education          | No formal education: 0| 0.00 % |
|                    | Primary School: 8| 26.00 % |
|                    | Secondary School: 23| 74.00 % |
|                    | Tertiary: 0   | 0.0 %      |
| Year of Practicing | < 5 years: 3| 10.00 %  |
|                    | 5 – 10 years: 10| 32.00 %  |
|                    | > 10 years: 18| 58.00 %  |

3.3.2  Plumbing Installations
Questions asked under plumbing installations that cut across experience in the business of selling plumbing materials, water saving devices and factors that influence home owners’ choice of plumbing materials. Below are the respondents’ answers to various questions:

3.3.3  Experience in Selling Plumbing Materials
Similar to plumbers administered questionnaire to, most of the plumbing materials vendors administered questionnaires to have experience in the sales. Majority of them have spent more than 10 years in the business (85%) while the remaining 15% have spent between five and ten years in the business.

3.3.4  Awareness of Water Saving Devices
They are aware of water saving devices but this does not affect the choice of the plumbing materials they sell. This is because customers do not make their request based on water saving capability of the devices but based on durability, aesthetic and affordability. This supports the findings from homeowners and plumbers.
3.3.5 Plumbing Material in Nigeria with Water Saving Devices
Responses to this question were similar to the previous results. Water saving devices are not in regular demand by homeowners but available in Nigeria market. The demand for these products is always from institutions and co-operate organizations. The purchase of such device is always based on special order and request.

3.3.6 Factors Influencing Plumbers Advice to Home Owners on Choice of Plumbing Materials
In the same vain as the questions asked the homeowners and plumbers, four factors used to measure the choice of plumbing materials were categorized under affordability, aesthetic, durability and water conservation. It was observed that all the respondents select durability and affordability as the main factor that influence plumbers’ advice to client on the choice of plumbing materials.

4. Conclusion
Water scarcity is militating against efficient sanitary systems and basic domestic water requirement for public and many private sectors in Nigeria. As water supply is under immense pressure as demand continues to rise, many researchers have identified the use of water saving device to reduce water consumption in both domestic and industrial settlements. This paper examines the choice of plumbing materials in household water conservation using a well-structured questionnaire administered to homeowners, plumbers and plumbing materials vendors. The result shows that the choice of plumbing materials is based on durability and affordability of the product. The research also revealed that many home owners and plumbers in Akure are not aware of water saving devices which is a common water demand mitigation strategy that have recorded high degree of success in many developed and developing countries.

5. Recommendation
This paper revealed that public are not aware of water saving devices. This has greatly affected the choice of selecting plumbing materials. In line with this revelation, the following recommendations are made:

i. Government should embark on aggressive public enlightenment campaign through government agencies like National Orientation Agencies (NOA), Standard Organization of Nigeria (SON), Federal and State Ministry of Water Resources etc. on the importance of household water conservation devices

ii. Government should monitor plumbing materials available in the country through SON to ensure Nigeria is not a dumping ground for none water saving devices that are currently in the process of facing out in many developed countries

iii. Government should sponsor researches in Universities and other research institutes on the use of local materials to manufacture water saving devices at low costs.

iv. Government should begin by defining the basic requirements of a water conservation program, including goals, budgets, plumbing codes, installation, and public relations as well as the appropriate audiences for each of these activities

v. Government should organize training and retraining programs for plumber on the use of water saving devices.

References
[1] Dolnicar S and Hurlimann A 2010. Australians’ Water Conservation Behaviours and Attitudes Austr. J. Wat. Res. 14 (1): 43-53
[2] Wallander S 2009. Essays on the Economics of Water and Energy Conservation. Unpublished PhD Dissertation. Yale University, New Haven, CT
[3] Postel S (1985) Conserving Water: The Untapped Alternative. The World Watch Institute, Washington
[4] Ramulongo L, Nethengwe N S and Musyoki A 2017. The nature of urban household water demand and consumption in Makhado Local Municipality: A case study of Makhado Newtown. Proc. Env. Sci. 37: 182 – 94
[5] Yanga L, Yang S, Magierac E, Froelich W, Jach T and laspidou C 2017. Domestic water consumption monitoring and behaviour intervention by employing the internet of things technologies. *Proc. Env. Sci.* **111**: 367 – 75.

[6] Buchberger S G and G J Wells 1996. Intensity, duration, and frequency of residential water demands *J Wat. Res. Plan. Man.* **122**(1): 11-19

[7] Michelsen A M, McGuckin J T and Stump D 1999. Non-price water conservation programs as a demand management tool. *J. Amer. Wat. Res. Asso.* **35**(3): 593-602

[8] Kenney D S, Goemans C, Klein R, Lowrey J and Reidy K 2008. Residential water demand management: Lessons from Aurora, Colorado *J. Amer. Wat. Res. Asso.* **44**(1): 192- 07

[9] Water Efficiency and Public Information for Action (WEPIA) 2000. Assessment of Water Saving Devices (WSDs) Sector in Jordan Cooperative Agreement No. 278-A-00-00-00201-00 Submitted to U. S. Agency for International Development

[10] Rahman H A A, Al-Farsi H A, Ahmed M and Goosen M F A 2016. Evaluation of some water saving devices in urban areas: A case study from the Sultanate of Oman *J. Agri. Mar. Sci.* **22**(1): 18 – 26

[11] Shirley-Smith C, Cheeseman C and Butler D 2008. Sustainability of water management in Zaragoza city *Wat. Env. J.*, **22**: 287– 96

[12] Waterwise (2010) Evidence base for large-scale water efficiency in homes — Phase II interim report. [http://www.waterwise.org.uk/data/resources/14/evidence-base-for-large-scale-water-efficiency-in-homes-phase-ii-interim-report.pdf](http://www.waterwise.org.uk/data/resources/14/evidence-base-for-large-scale-water-efficiency-in-homes-phase-ii-interim-report.pdf) accessed 3 December 2015

[13] Dukes M D 2012. Water Conservation Potential of Landscape Irrigation Smart Controllers *Trans. ASABE* **55**(2): 571– 80

[14] Fielding K S, Russell S, Spinks A and Mankad A 2012. Determinants of household water conservation: The role of demographic, infrastructure, behavior, and psychosocial variables *Wat. Res. Res.* **48**: 1 – 12

[15] Jorgensen B, Graymore M and O’Toole K 2009. Household water use behavior: An integrated model *J. Env. Man.* **91**(1): 227 – 36.

[16] Millock K and Nauges C 2010. Household adoption of water-efficient equipment: the role of socioeconomic factors, environmental attitudes and policy *Env. Res. Econ.* **46**(4): 539 – 65

[17] Russell S and Fielding K 2010. Water demand management research: A psychological perspective. *Wat. Res. Res.* **46**(5): 1 – 12

[18] Goette L, Leong C and Qian N 2019. Motivating household water conservation: A field experiment in Singapore. *PLoS ONE* **14**(3): 1 – 15 e0211891. [https://doi.org/10.1371/journal.pone.0211891](https://doi.org/10.1371/journal.pone.0211891)

[19] Clarke J and Brown R (2006) Understanding the factors that influence domestic water consumption within Melbourne *Austr. J. Wat. Res.* **10**(3): 261- 8

[20] Addo I B, Thomas M C and Parsons M 2018. Barriers and Drivers of Household Water-Conservation Behavior: A Profiling Approach. *Wat.* **10**(1794): 1 – 15. doi:10.3390/w10121794

[21] Fletcher P W and William E S 1998. Water Conservation Methods to Meet Pennsylvania’s Water Needs *J. Amer. Wat. Wor. Asso.* **70**(4): 200- 03

[22] NIMET 2003. Nigerian Meteorological Agency, Directorate of Research and Training, research Division, Oshodi, Lagos