Water conservation within planetary boundaries: residents’ perception of recycled water use

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Abstract: Fresh water use is one of the nine planetary boundaries that must not be transgressed if the earth must continue to exist. Climate change has necessitated the need for conservation of natural resources, including fresh water. Infrastructure provision for recycling water is one thing: accepting to use the recycled water is another. This paper assessed residents’ perception on recycled water use. It adopted a qualitative research design. Findings reveal that residents are willing to use recycled water, however, motivations of residents to use recycled water is different from the motivations suggested by the scientific community which focuses on climate change issues such as drought and conservation. The study recommends that water authorities should possess the required competencies for treating recycled water so that health risks associated with the use of recycled water can be minimized.

1. Introduction

Fresh water use is one of nine planetary boundaries proposed by [1,2]. Climate change has altered weather patterns leading to reduced amount of rainfall and diminishing underground water. Moreover, there is great pressure on the existing water resources due to population growth and unsustainable water consumption patterns. This situation calls for conservation of available water resources.

Recycling water has been suggested as one of the means of conserving water [3,4]. Recycled water is community waste water that is treated to a re-usable quality [3]. It involves the treatment of community waste water for the replacement and conservation of available fresh water [5]. In some parts of the world, like the US, UK, Belgium, Australia, South Africa and Namibia recycled water has been used to augment available water [3,6,7]. Even so, only a minute portion is used to supplement available fresh water. In the US for example, only one-tenth of 1% of community waste water is recycled [8].

The full potential of water recycling is however hampered by stiff oppositions from end users. The literature is replete with evidences of public resistance to use of recycle water mainly because of the perceived health risks associated with recycled water [9,3,6] and the thought that recycled water originates from human waste i.e. the ‘yuck’/ ‘disgust’ factor [9,10].

Empirical evidences [11, 12, 10] show that the quality of recycled water is better than water from conventional sources. Moreover, water recycling systems have been operating for decades without any reported cases of epidemics traceable to the use of recycled water [9]. Yet, public use of recycled water has remained relatively low; not necessarily because end users do not believe that recycled
water can be of higher quality but because they perceive that decision makers may compromise the quality of recycled water at some point, or may not take them seriously or fail to consult with them [13, 14, 15].

On the Lagos Island in Nigeria, much land is reclaimed to meet the demand of teeming population and this has a toll on available water resources. [16] revealed that the main source of residents’ dissatisfaction with public housing was poor access to services and infrastructure like water. However, public opinion about re-use of treated waste water to augment fresh water is unclear. Since the public is a key stakeholder as the intended user of recycled water, their attitude towards recycled water use is important in order to avoid futile investment in water recycling infrastructure and to ultimately promote water conservation. Hence, the aim of this paper was to assess residents’ perception on recycled water for domestic use.

2. The Need for Recycling Water
Global population is increasing at an alarming rate with about 7.6 billion people on the earth today and an estimated 9.8 billion by the year 2050 [17]. Humans depend on water for sustenance and for almost every endeavour. Water is used for domestic purposes, agriculture and manufacturing.

However, the earth’s growing population is placing great pressure on the existing global water resources of which just 1/3 is fresh. Climate change has further worsened the water challenge by altering weather patterns resulting in reduced rainfall and drought in some parts of the world. According to [18] the prevalence of strong climactic seasonal variations worsens water challenges in tropical regions. Moreover, underground water is used up more than it is being replaced.

 Besides, icecaps (where much of the world’s fresh water is trapped) is melting at an alarming rate due to global warming. Furthermore, unsustainable waste disposal constitutes an environmental threat because large quantities of waste end up in streams, lakes other rivers thereby, contaminating available water. With the development of advanced water technologies, waste water can be treated to high quality.

The growing demand for fresh water fuelled by population increase, climate change , unsustainable disposal of waste water and developments in water technology has made researchers and world agencies such as the United Nations to seek ways of conserving existing fresh water system of which recycling is one.

2.1 Public Perception on the Use of Recycled Water
Public support and agreement is vital for implementing effective waste water reuse projects. Although some recycled water reuse programmes have been successful in the UK, US, Australia, Belgium, South Africa and Namibia [17], many of such schemes witnessed stiff resistance from the public.

Some proposed water recycling projects were aborted prematurely while others were abandoned after completion because of fierce resistance from the general public [18]. [3] noted that public resistance is a major challenge in recycled water programmes. Some factors responsible for public resistance of recycled water use are as follows: the disgust factor, perceived health risks, use and source of recycled water, trust, demographic factors, environmental stewardship, scarcity of fresh water.

3. Methodology
Quantitative research paradigm with the use of questionnaire survey was the primary data collection strategy used. Some researchers [6, 5] used a similar approach. A 5 point Likert scale questionnaire type was used to elicit information randomly from 250 residents in Ajah, Lagos- Nigeria. Descriptive statistics of frequencies and mean item score were used for data analysis.
3.1.1 Respondents’ Characteristics

Table 1. Respondents Characteristics

| Characteristics   | Frequency |
|-------------------|-----------|
| **Gender**        |           |
| Male              | 153       |
| Female            | 97        |
| Total             | 250       |
| **Age**           |           |
| <25               | 39        |
| 25-35             | 67        |
| 36-45             | 94        |
| 46-55             | 27        |
| >55               | 23        |
| Total             | 250       |
| **Educational Level** |         |
| Secondary school education | 26 |
| Graduates of higher institutions | 138 |
| Advanced degree holders | 86 |
| Total             | 250       |
| **Religion**      |           |
| Christianity      | 147       |
| Islam             | 103       |
| Total             | 250       |

Table 1 shows the demography of respondents that participated in the survey. Male respondents were 153 while females were 97. The respondents fell within the age bracket <25, 25-35, 36-45, 46-55, >55 with 39, 67, 94, 27 and 23 respondents respectively. For educational level, 26, 138 and 86 respondents had received secondary school, undergraduate and post graduate education respectively. One hundred and forty seven of the respondents were Christians while the remaining 103 were Muslims. In summary, there were more males than females in the sample. The greatest age bracket studied was ages 36-45. Majority of the respondents had obtained at least an undergraduate degree and most of them were Christians.

3.1.2 Respondents’ Willingness to use recycled water (in percentage)

Table 2. Willingness to use recycled water (in percentage)

| Recycled water reuse option | SA  | A   | NS  | DA  | SD  | MIS* |
|-----------------------------|-----|-----|-----|-----|-----|------|
| Toilet flushing             | 69.6| 28.3| 3   |     |     | 0.94 |
| Gardening                   | 57.2| 38.8| 0.4 | 1.2 | 2.4 | 0.89 |
| Water fountain              | 49.2| 33.6| 2.0 | 10.8| 4.4 | 0.82 |
| Car washing                 | 41.2| 36.4| 2.8 | 12.4| 7.2 | 0.78 |
| Clothes washing             | 38.3| 29.6| 2.8 | 18.4| 10.4| 0.74 |
| Bathing                     | 8.8 | 10.4| 10.4| 29.6| 40.8| 0.43 |
| Dish washing                | 2.8 | 6.4 | 1.2 | 41.2| 48.4| 0.35 |
| Cooking                     | 2.0 | 4.0 | 1.6 | 41.2| 51.2| 0.33 |
| Drinking                    | 0.8 | 3.2 | 0.8 | 30.0| 65.2| 0.29 |

*MIS - mean item score
Table 2 shows the agreement level of the respondents in recycled water use. Recycled water use for toilet was ranked highest with an MIS of 0.94. This is followed by gardening (MIS = 0.89) and water fountain (MIS = 0.82). The three least uses of recycled water by the residents surveyed are dish washing (MIS=0.35), cooking (MIS = 0.33) and drinking (MIS = 0.29). Even though residents are willing to use treated waste water, their willingness is limited to the source of the treated waste water. Most residents support recycled water reuse to the extent that it is used indirectly without having direct contact with it as in toilet flushing, gardening, water fountain. [19] also found a sharp decline in recycled water use once it becomes too personal.

3.1.3 Strategies for improving the use of recycled water

| Strategy                                      | MIS* |
|----------------------------------------------|------|
| Public awareness                              | 0.93 |
| Evidence of successful recycled water project | 0.85 |
| Public participation in recycled water use discourse | 0.70 |
| Recycled water project simulation             | 0.53 |

*MIS - mean item score

From table 3, it can be seen that the most effective strategy for improving residents’ use of recycled water is public awareness (MIS=0.93). Other strategies are evidence of successful water recycling project (MIS=0.85) public participation (MIS=0.70) and project participation (MIS=0.85). The most effective strategy for improving residents’ use of recycled water is public awareness. The second most effective strategy for improving residents’ use of recycled water is evidence of successful water recycling project. [20] also discovered that evidence of successful water recycling projects can be a useful strategy for improving residents’ use of recycled water. Public participation in recycled water use discourse was found to be the third most significant strategy for improving residents’ use of recycled water. [21,22] also found that public engagement and participation in recycled water reuse discourse can improve residents’ use of recycled water.

3.1.4 Factors influencing use of recycled water

| Factors                                    | MIS*  |
|-------------------------------------------|-------|
| Source                                    | 0.96  |
| Use                                       | 0.90  |
| Competence                                | 0.86  |
| Health Risk                               | 0.81  |
| Cost                                      | 0.62  |
| Drought                                   | 0.60  |
| Reports from the scientific community     | 0.45  |
| Conservation                              | 0.43  |

*MIS - mean item score

Table 4 indicates the factors that will influence residents’ use of recycled water. The most significant factor influencing residents’ use of treated waste water is the source of the recycled water (MIS=0.96). This is followed by the usage of the recycled water and competence of water authorities (MIS=0.90 and 0.86) respectively. The 3 least significant factors influences residents’ use of recycled water are drought (MIS = 0.60), reports from the scientific community (MIS = 0.45) and the need for conservation (MIS = 0.43). The most significant factor that will influence residents’ use of recycled water is the source.
water is the source of the recycled water. The ‘dirtier’ the source of the recycled water, the more averse residents will be towards using it. People have always seen recycled water as disgusting because of the belief that it has a faecal origin. Hence, the source of the recycled water is the most significant factor that will influence residents’ use of recycled water. The second most important factor that will likely influence residents use of recycled water is the use of the recycled water. Residents are willing to use recycled water provided it does not come in contact with them. Many residents prefer to use recycled water for toilet flushing, gardening and water fountain. The third most significant factor is competence of water authority. Residents believe that a competent water authority will be able to recycle water efficiently and this will reduce the risk of health challenges arising from the use of recycled water. The least factors affecting residents’ use of recycled water are drought, reports from scientific community and need for conservation. Whilst these factors are the major drivers of water recycling by global agencies like the United Nations, local residents are influenced by other issues that boarder around safety of recycled water such as source and use of water and competencies of water authority.

4. Conclusions
Residents are willing to use recycled water provided it is limited to non-portable uses. Residents’ willingness to use recycled water is not influenced by global issues like drought, reports from scientific community and need for conservation. It is recommended that public awareness at local levels be carried out to increase residents’ awareness of global issues like population growth and climate change and how these issues exert pressure on existing water systems. Hopefully, better understanding of the global pressures driving water recycling will improve residents’ agreement to use recycled water.

Appreciation
The writers are grateful to Covenant University for sponsorship

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