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Peri-Urban Community Perceptions towards Greywater Use: A Case Study of the Kotoko Community in Suame (Kumasi), Ghana

Roland. S. Kabange[1] Andrews Nkansah[2]
1.Civil Engineering Department, Faculty of Engineering, Kumasi Polytechnic, PO Box 854, Kumasi, Ghana
2.Department of Energy & Environmental Engineering, University of Energy & Natural Resources, PO Box 214, Sunyani, Ghana

Abstract
Increasing water scarcity, compounded by population explosion, urbanization and climate change makes greywater (GW) integration into water resources critical. Resource-rich greywater use (GWU) acceptance can potentially improve not only water availability, but also sanitation, household food security and poverty reduction. Perceptions however largely determine GWU acceptability. Though understanding of community perceptions and acceptance of GWU in the largely non-sewered areas of Ghana is a key research area, very little work (if any) is so far done. Therefore GW studies in Kotoko community were useful to inform GWU promotion and stigmatization reduction strategies in Ghana. Kotoko community was selected for the study owing to its importance in terms of multi-ethnicity, status and low-income high-density peri-urban community located near Kumasi city-centre (Kejetia). Out of the community population of 2,230 inhabitants, 128 respondents (or 6% of the population) were interviewed through purposive and random selection.
The questionnaire had three sections: GWU and perceptions, GWU options, and reasons for support. 17 GWU options were divided into three categories: low, medium, and high contact options. A mix of quantitative and qualitative methods was used to explore data. Five main GWU practices were reported by respondents – construction industry, toilet flushing, watering gardens, washing and animal drinking. The results showed fairly positive attitudes towards low contact options, whereas women without formal education were less positive – an interesting finding that linked personal characteristics to attitudes towards GWU. A "typical objector" to GWU was female aged 10 – 29 years, without formal education, and an ordinary household member. Public support for treated GWU increased with decreasing degree of contact. GWU projects were likely to succeed in the Kotoko community if implementation commences in a sustainable way with the low and medium contact options.
Keywords: perceptions, peri-urban, greywater use, community, Ghana

1. Introduction

Greywater (GW) is domestic wastewater that excludes toilet wastewater (Cotton & Franceys, 1988; Rodda et. al., 2011; Ilemobade et. al., 2013). GW generation and use is directly linked to household water consumption (Orlowsky et. al., 2014). Increasing water scarcity puts enormous pressure on the limited water resources for agriculture which demands high volume of water use for irrigation purposes – prompting the need for resource-rich greywater use (GWU). This makes wastewater an asset (not a liability), and rethinking how best to use it remains the current challenge (Meehan et. al., 2013). The water scarcity challenge is aggravated by global population explosion, rapid urbanization, aging and deteriorating infrastructure, and climate change, further diminishing the supply of fresh surface and groundwater (Khatri and Vairavamoorthy, 2007). Treated GW is a unique and new consumer product but poses new challenges to marketing: consumers are yet to develop positive attitudes towards its use (Dolnicar and Saunders, 2005). Social marketing principles, which is the application of marketing to achieve behaviour change for social good, is generally ineffective in influencing people to use GW (Jenkins and Scott, 2007).

Significant is the general public support for GWU, as they ultimately pay for, use, and might be affected by its use. A Melbourne survey showed that people were interested in GWU from the bathroom and laundry, with a high preference for using it for gardening (Christova-Boal et al., 1996). A South African study also showed a significant proportion of the citizenry preferred non-potable water use for flushing in comparison to other non-potable uses (Ilemobade et. al., 2009). Public opposition has the potential to ground GWU projects before, during, or after execution. The relationship between water and culture, spiritual and religious issues play a crucial role in determining GWU acceptance (Strang, 2004). Due to variation in culture, water availability, economy and climate change, public attitude research on GWU is required in each national and sub-national context (Friedler et al., 2006) to inform policy direction. For instance, a Doha (Qatar) survey revealed that contrary to most results elsewhere, a large proportion of respondents opposed low and medium contact use options such as farming (92%), lawn and garden irrigation (50%), car washing (50%), and 80% industrial use (Ahmad, 1991). This opposition seems logical in a country where water is scarce and household GWU is prioritized over others uses. The findings therefore seem to address another question – how to manage water resources and not misuse them. Perceptions have therefore largely determined the acceptability of GWU in some countries (Ilemobade et. al., 2013).

2. Research aim and objective

The alarming freshwater depletion globally requires that alternative water resources are considered (Kabange, 2014), and GW represents a good fit, as it is resource-rich, contains less pathogens, and readily available in households for treatment. An understanding of community perceptions, opinions and acceptance of resource-rich GW can potentially improve sanitation, water availability, household food security, and reduce poverty. GW management and use has not been given priority in urban areas despite being the largest household wastewater stream (Katukiza et. al., 2012). Though GW offers a sensible way forward, it has not received the attention it deserves (Mcllwaine & Redwood, 2010). Its use is also undermined and stigmatized by consumer perceptions – a grey area that needs further research if its potential benefits could be fully tapped. Very little research (if any) has been conducted in the largely non-sewered areas of Ghana on GW perceptions and use. Therefore in this study, the following objectives are set to:

- Identify major GWU practices in the study area;
- Determine peri-urban community perceptions towards various GWU options;
- Evaluate likely linkages between community perceptions towards GWU and respondents' personal characteristics; and
- Make recommendations on the study community GWU potential.

3. Kumasi and the research community (Kotoko)

As Ghana's second largest city and capital of the most populous region (Ashanti), Kumasi has one of the largest market centres in West Africa. Predominantly being a Christian (79%) and Muslim (16%) community, it has a rough population of 1.6 million (Millennium Cities Initiative, 2008). Kotoko is therefore a multi-ethnic low-income high-density peri-urban community located close to Kumasi city-centre (Kejetia) with 67 households and about 2,320 inhabitants. Houses are built largely from mud and bamboo, and roofed with old rusted and often leaking corrugated iron sheets. Characterized by inadequate infrastructure and land tenure challenges, the community is of mixed socio-economic profile.

4. Survey methodology

Three peri-urban communities (Kotoko, Akwatia Line and Race Course) were short-listed, and Kotoko in Suame (Kumasi) was selected. Elements of a peri-urban community and physical information such as topography, population density, and estimated level of community co-operation were factors considered for the selection. Before the research commenced, informed-consent and willingness to participate was sought through meetings at three levels – elders, unit committee and community. Permission was obtained from Kumasi Metropolitan Assembly (KMA), and a translator was available since most community members had no formal education. A transect walk conducted observed the community's water and greywater use situation.

4.1 Sampling and questionnaire design

A draft questionnaire was designed, randomly tested, and reviewed before administration. Deficiencies in content, format and wording were thus identified and corrected to enhance questionnaire quality. The questionnaire contained general instructions on questionnaire completion, research purpose, confidentiality information, and respondents' discretionary decision to complete them. 128 respondents (or 6% of the population) were sampled and interviewed. At least one adult from each household who had adequate knowledge on sanitation issues was randomly selected and interviewed. Where respondents were educated, they independently completed the questionnaire in English. However, if they had no formal education, precise translations were provided for the respondents' own choice options.

The GW questionnaire had 17 GWU options divided into three categories: low contact, medium contact and high contact. Whereas the high contact category involved intensive GW contact with users (and included direct and indirect drinking), medium contact involved direct or indirect GW contact with users. The low contact category did not involve direct GW contact with users. The questionnaire contained four sections as explained below:

- GWU and environmental perceptions: participants graded a number of questions to identify their perceptions on GW and environmental issues.
- GWU options: participants marked each of the various identified options on a scale from zero to four (0 = strongly oppose, 1 = oppose, 2 = indifferent, 3 = supportive, and 4 = strongly supportive).
- Reasons for support: participants who supported GWU were then graded from 0 to 4 how each of the following affected their support – GWU is good for the environment, will save the fresh water, will reduce infrastructure cost and improve economy, will minimize the community's dependency on imported water, promote food security and alleviate poverty, cost savings, prevent bad odour, minimize disease prevalence, and reduce water-logging, among others.
- Demographic characteristics: gender, age, educational level, and household status.

4.2 Data analysis

Completed questionnaire and collected data were coded and analysed with the aid of Statistical Package for Social Scientists (SPSS) using tabulation, cross-tabulation, graphs and charts, measures of central tendency (mean, median and mode) and dispersion (standard deviation and range). Other analytical techniques such as documentation, coding and categorization were however used for qualitative data. Filtering was used to analyse specific selected subset of data.

5. Results and discussion

This research referred to a family as a person(s) who lived together in a structure (or part of it) and were catered for as a unit with the same house-keeping arrangement. A household was however defined as a single or multiple families living in a single compound structure. A worker meant anyone who did any form of activity that directly or indirectly brought monetary rewards to support the family.

5.1 Community and respondents' demographics

There were huge variations in household and family sizes in the research community of 67 households. The average household size was 33, whilst household sizes ranged from three to 113. The average household size of 33 is similar to data 6,302 sampled households in Ghana (MICS, 2006). 543 families had an average family size of four. Though a full survey of all households was not made, the demographic data was an actual head-count and covered demographics of every household member. The demographics in particular (Table 1) can therefore be used to make inferences about the whole community. Out of 128 interviewed respondents, most 63% (81) were women. A reasonable proportion of 37% (48) of respondents were 10 – 29 years old. The older year group (66 years and above) constituted 7% (9) of respondents. A large proportion 60% (77) of respondents was between 10 – 39 years. Respondents who had no formal education constituted 52% (66), and most 69% (88) were ordinary household members.

Table 1: Demographics of respondents

Characteristic	No. of respondents	% of respondents
Gender		
Female	81	63
Male	47	37
Age group (years)		
10 – 29	48	37
30 – 39	29	23
40 – 49	24	19
50 – 65	18	14
66+	9	7
Educational status		
Graduate	2	2
Senior secondary graduate	17	13
Junior secondary graduate	18	14
Not completed junior secondary	25	19
No formal education	66	52
Household status		
Household head	9	7
Family head	11	8
Housewife	20	16
Ordinary family member	88	69

5.2 Study community GWU

Initial exploratory work in the community suggested that there was lack of water. Though GW can be a threat to public health, it is a potential resource if appropriately managed. Community attitudes to GWU are therefore important in assessing the potential for GWU.

5.2.1 Current GWU practices in community

Five main GWU practices reported by respondents were construction industry, toilet flushing of private and community facilities, watering gardens, washing and animal drinking. While 40% (51) of respondents reported GWU was not practiced in the community, 60% (77) reported at least one of the five GW uses was practiced. Young women and people without formal education were more inclined to report GWU was not practiced in the study community – finding consistent with the characterization of a typical objector highlighted in Section 5.4. Among the 77 respondents who reported GWU was in practice, 14% (11) reported its use for building in the

construction industry, 8% (6) cited its use in watering gardens, 13% (10) reported its use for washing. Other reported uses were toilet flushing of private and community facilities – 14% (11); and animal drinking – 13% (10). Of the 51 respondents who reported GWU was not practiced, 41% (21) opposed greywater technology introduction to treat it for community use. The major concerns raised for opposition were that the treated water would be unclean and therefore unsafe for community use.

5.2.2 Analysis of GWU options and categories

A weighted grade system applied by Friedler et. al. (2006) on reuse options in Israel was adopted to correlate level of support and personal characteristics, and to analyze differences between the three GWU categories. Each GWU option was given a relative weighting factor reflective of the chances of personal contact (intentional or unintentional) or its impact as perceived by the investigator, but ensuring that the sum of all weighting factors in each category was unity (Table 2).

Table 2: Relative weights, average opinions and grades of GWU options

GW categories & options	Relative weight of option *	Average opinion (0 – 4)**	Average grade (%)***
Low contact			
Crop (e.g., maize, millet irrigation)	1/3	2.86	71.5
Fruit crop (e.g., mango, orchard irrigation)	1/3	2.93	73.2
Tuber crop (e.g., cassava, yam irrigation)	1/3	2.78	69.5
Medium contact			
Backyard gardening	3/13	2.88	72.0
Domestic toilet flushing	3/13	3.14	78.5
Public park irrigation	2/13	3.05	76.2
Car washing	2/13	2.52	63.0
Fire fighting	1/13	3.42	85.5
Landscaping	1/13	2.87	71.8
Construction industry	1/13	3.05	76.2
High contact			
Domestic laundry (washing, rinsing)	2/16	2.01	50.2
Vegetables (salad, spinach irrigation)	2/16	2.52	63.0
Bathing	3/16	1.70	42.5
Aquifer recharge	1/16	2.53	63.2
Food preservation	3/16	1.98	49.5
Animal drinking	2/16	2.65	66.2
Human drinking	3/16	1.12	28.0

*The relative weight is an indication of the importance the author attached to the GWU option.

** The average opinion is the mean of all answers given by respondents to each GWU option.

*** Normalized between 0 – 100 %, the average grade is the mean of all answers given by respondents to each GWU option.

For instance, crop, fruit crop and tuber crop irrigations under the low contact category were each assigned a weighting factor of 1/3 because the investigator thought their impact or chances of personal contact were about the same. Regarding the medium contact weighting, the grading was based on the possibility of contact with the community and the chances of unintentional cross-contact between GW and portable water. Irrigation of private backyard garden for example had a factor of 3/13 as against 2/13 for irrigation of public parks. There is a higher possibility of contact in the private gardening GWU option (e.g., children playing with water) and a higher chance of unintentional cross-contact between portable water and greywater.

17 GWU options were divided into three categories – low, medium and high. The low contact options did not involve any direct contact, whether intentional or unintentional, with users (e. g., tuber and fruit crops irrigation). The medium contact options did not involve intentional contact but may involve unintentional contact. High contact options however involved intensive contact. Under the high contact category, bathing was given a factor of 3/16, whilst domestic laundry had a factor of 2/16, as the investigator thought the impact of the first option was higher than that of the second.

The average of all answers on each GWU option was calculated and normalized on a scale from 0 – 100 (Figure 1), where 0 is a complete rejection and 100 is a complete acceptance. The weighted grade of each GWU category (low, medium and high contact) in each questionnaire was then calculated using the formula (Friedler et al., 2006):

$$G_c = 100 \sum_{i=1}^{i=n} \frac{S_i W_i}{4 \sum_{i=1}^{i=n} W_i} \quad \text{.....(1)}$$

where G_C is the GWU category weighted grade in the particular questionnaire on a scale from 0 –

100%; S_i is the score of a particular GWU option as reported by respondent on a scale of 0 to 4; $W_i$is the weighting factor of each GWU option within its category; and n is the number of GWU options in each category. Thus in this survey, for low contact, n= 3; for medium contact, n= 7; and for high contact, n= 7.

The 4 in the denominator of equation (1) converts the weighted grade into a proportion ranging from 0 – 1, which was finally converted into a percentage by multiplying the proportion by 100 to get the weighted grade. Thus, a respondent who gave all GWU options in one category a score of 4, the proportion of the category would be 1 and the weighted grade 100%. Similarly, a respondent who scored 2 in all GWU options in a category would result in a weighted grade of 50%. Based on this principle, weighted grades of 56% and above were considered supportive, grades below 44% – opposed, and grades between 44% – 56% were considered indifferent or had no firm opinion on GWU.

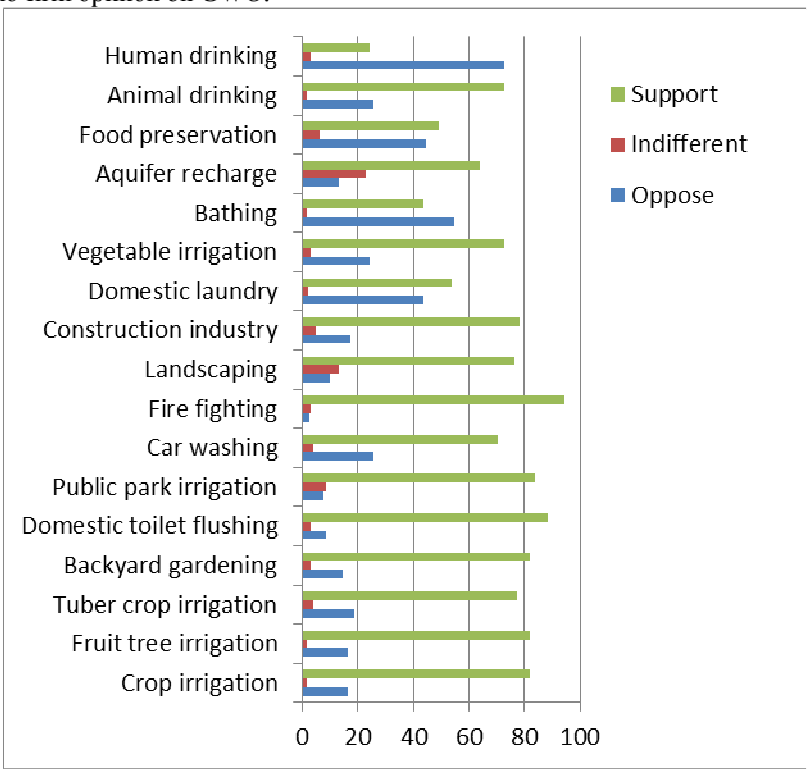
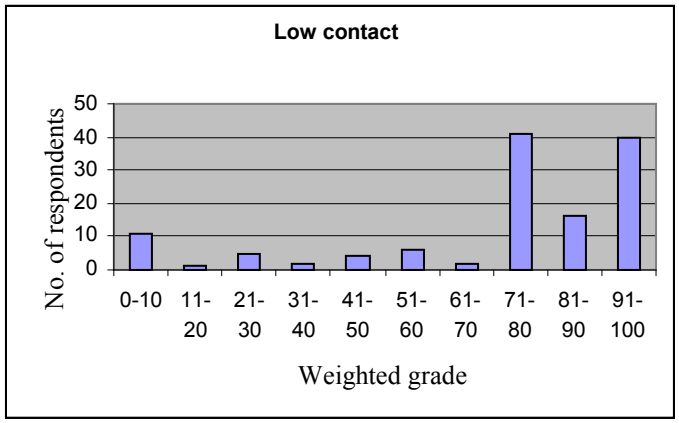
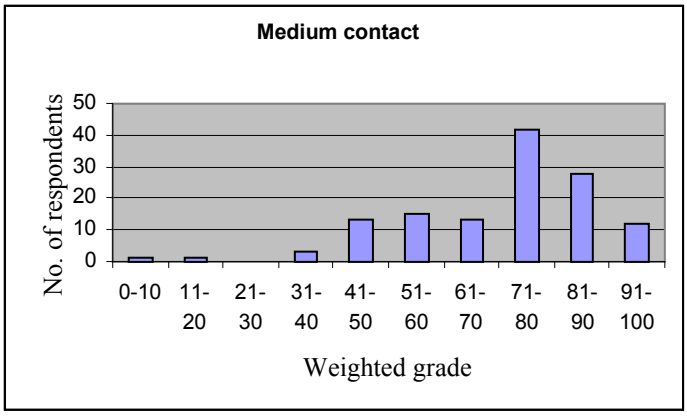


Figure 1: Proportion of respondents supportive, indifferent and opposed to the 17 GWU options considered in the survey

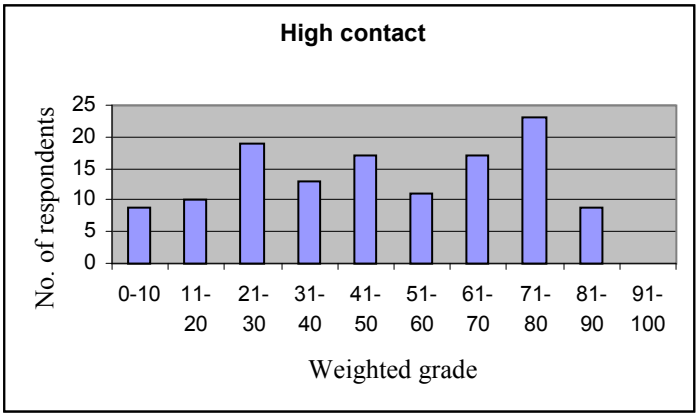
The weighted grades of the three GWU categories were calculated for each of the completed 128 questionnaires using equation 1. Respondents' perceptions towards the three categories (low, medium, and high) were then analyzed by transforming the results into three sets of histograms that represented supportive, indifferent, and opposition to the three contact categories (Figure 2). The histograms show that public support for GWU increases with decreasing degree of contact with the GW. This finding confirms that GWU is more acceptable to potential beneficiaries when the possibility of their contact with GW is lower (Ilemobade et. al., 2013). For example, 32% of the respondents expressed complete support (91 –100 points) for the low contact category, 9% for the medium category, and 0% for the high contact category. GWU is therefore likely to be successful in the study community, but implementation may have to commence with the low and medium contact options. Research however shows that sustainable GWU implementation is recommended (Ilemobade et. al., 2013).



(a) Average grade: 71.5; STD: 3.2; Median: 75.5



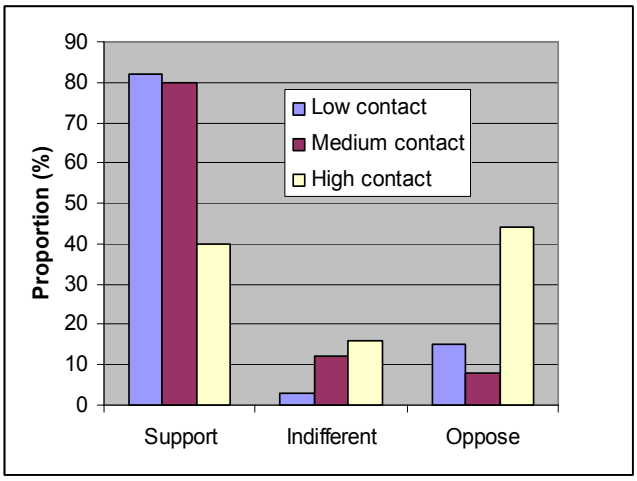
(b) Average grade: 71.2; STD: 2.0; Median: 75.5



(c) Average grade: 48.0; STD: 3.5; Median: 45.5

Figure 2: Histograms showing the weighted grade frequency distribution for the three contact categories (low, medium and high)

Very high support was for the low contact category with an average grade of 71.5 and median of 75.5 (Figure 2). This represented the average of the 32% who gave a weighted grade of 71 – 80, and the 31.3% who gave a weighted grade of 91 – 100. Respondents' support for the medium contact category was also generally high, with an average grade of 71.2 and median of 75.5 − the average of 32.8% had a weighted grade of 71 – 80 and 21.8% had a grade of 81 – 90 (Figure 2). Respondents showed low support for high contact GWU (Figure 2), with the average grade of 48 and median 45.5, representing the average of the 17.9% who gave a weighted grade of 71 – 80.



Supportive: weighted grade 56 – 100; Without opinion: weighted grade 46 – 56; and opposed: weighted grade 0 – 44.

Figure 3: Proportion of respondents supportive, without opinion, and opposed to low, medium and high contact GWU options.

The weighted grades were grouped into three: supportive − grades 56 – 100; indifferent or undecided − grades 44 – 56; and opposed − grades 0 – 44 (Figure 3). There was again high support for low and medium contact categories. The average support for low, medium and high contact GWU categories were respectively 82%, 80% and 40%, as against the opposition which were 15%, 8% and 44% respectively. Public proportion without opinion on the three categories was also 3%, 12% and 16% respectively.

5.3 Low contact category characteristics

A comparison of the responses and demographics for the low contact category was made to assess any possible linkages. The highest supports for the low contact category were 100% support by graduates, 89% support by respondents aged 30 – 39, 85% support by household heads, 84% by respondents who did not complete Junior Secondary School (JSS), and 82% support by males. The greatest oppositions to the low contact category were 30% opposition by JSS graduates, 30% opposition by respondents aged 50 – 65, 27% opposition by housewives, and 17% opposition by females. Respondents without opinion were not wide spread across the demographics and ranged from 0% for university graduates to 10% for Senior Secondary School (SSS) graduates. By gender and household status, the highest opposition was by females and housewives. It could thus be suggested that future GWU campaigns might consider concentrating on the older fraction of the population, JSS graduates, and housewives, as they were less receptive. Amongst the respondents (Figure 4), 82% (105) supported the medium contact category, 81% (104) supported the low contact category, and 55% (70) supported the high contact category. However, the highest opposition was for the high contact category – 40% (51), 17% (22) opposition for the low contact category, and 12% (15) opposition for the medium category. Therefore, the highest support and least opposition were for the medium contact categories.

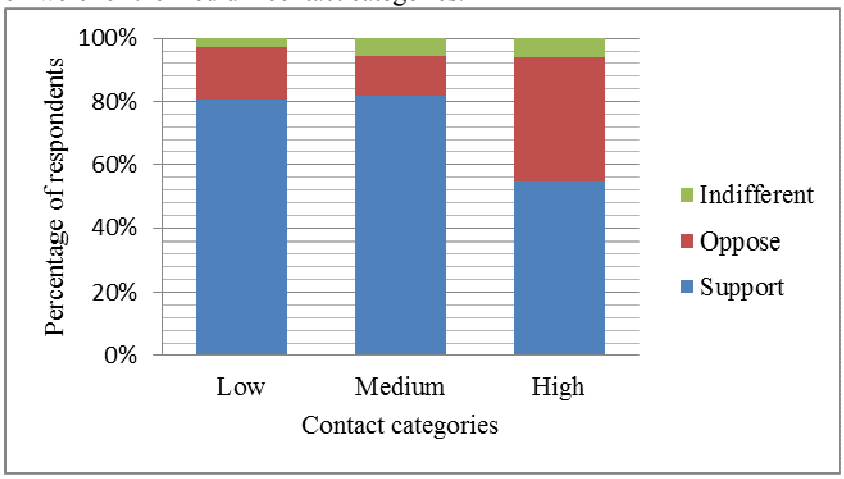


Figure 4: Respondents' average opinions on GWU in the three contact categories (low, medium and high)

5.4. Greywater use "objector" characteristics, and a "typical objector"

Respondents who opposed eight or more of the 17 GWU options (questions 17 – 33 of the questionnaire) out of the 128 interviewed were considered objectors. It was found that 20% (25) of respondents were objectors. Objectors' responses were then matched with their demographics (gender, age, educational level, and household status). The most frequent occurring demographics in this objector group were then determined and used to characterize a typical objector. A typical objector to GWU was female aged 10 – 29, without formal education, and an ordinary household member. The interpretation associated with the typical objector would be that they were a group of young women in the community without formal education who were less positive to GWU, and were therefore less exposed to take a stand on public matter and so prefer to play safe in order not to risk disapproval.

Out of the 25 objectors, 20% (5) of them met the "typical objectors" characteristics. All typical objectors reported that kitchen and shower waters were of low or very low quality, and were of no benefit to the community even in the absence of alternative water sources. They all reportedly opposed to the use of GW technology for the treatment of GW for community use on the grounds that it was unclean and therefore unsafe to use. The opinions of typical objectors on GWU were thus found to be at complete variance with the opinions of the broader section of the respondents, as the majority supported GWU technology. People are generally reluctant to introduce new things when they are not sure they will help them, save time and easy to use (Wijk-Sijbesma, 2001). Typical objectors' objection to GWU could therefore be attributed to that GWU was seen as a new community practice and so could not accept it.

6. Conclusions and recommendations

This research conducted in the Kotoko community in Suame (Kumasi) on community perceptions and opinions towards GWU to inform strategies for its promotion and stigmatization reduction arrived at the following conclusions and recommendations:

- Five main GWU practices were reported by respondents, namely construction industry, toilet flushing, watering gardens, washing and animal drinking.
- Analysis of the three GWU categories showed that public support for GWU increases with decreasing degree of contact with the GW, confirming that GWU is more acceptable to potential beneficiaries when the chances of their contact with it is lower;
- A "typical objector" to GWU was female aged 10 – 29, without formal education, and an ordinary household member. Typical objectors were thus a group of young women in the community without formal education who were less positive to GWU and less exposed to take a stand on public matter, and so preferred to play safe in order not to risk disapproval.
- All "typical objectors" reported that kitchen and shower waters had low or very low quality, and they were of no benefit to the community even in the absence of alternative water sources. They all also reportedly opposed to GW treatment technology for community use because it was unclean and therefore unsafe;
- The results showed fairly positive attitudes towards low contact options, whereas women without formal education were less positive – an interesting finding that linked personal characteristics to attitudes towards GWU. Typical objectors' opinions on GWU were completely at variance with the broader opinions of respondents; and
- GWU projects are likely to be successful in the Kotoko community. It is however recommended that project implementation commences in a sustainable manner with the low and medium contact options. It is further recommended that future GWU sensitization campaigns concentrated on the older fraction of the population, JSS graduates and housewives since they were less receptive to GWU.

7. Limitations

Individual and household responses in crowded peri-urban communities such as Kotoko could be a challenge because of high likelihood of information leakage that can affect data reliability. The wide household sizes ranging from 3 – 113 in the research community also presents representativeness challenges.

References

Ahmad, S. (1991). Public attitude towards water and water reuse. *Water Science and Technology* **23**, 2165 − 2170.

Christova-Boal, D., Eden, R. E. and McFarlane, S. (1996). An investigation into greywater reuse for urban residential properties. *Desalination* **106**, 392 − 397.

Cotton, A. P. and Franceys, R. W. A. (1988). Urban infrastructure: trends, needs and the role of aid**.** *Habitat International* **12** (3), 139 – 147.

Dolnicar, S. and Saunders, C. (2005). Marketing recycled water: review of past studies and research agenda.

Available: www.ro.uow.edu.au.commpapers/69

Friedler, E., Lahav, O., Jizhaki, H. and Lahav, T. (2006). Study of urban population attitude towards wastewater reuse options: Israel as a case study. *Journal of Environmental Management* **81** (4), 360 − 370.

Ilemobade, A. A., Olanrewaju, O. O. and Griffioen, M. L. (2013). Greywater reuse for toilet flushing at a university academic and residential building. *Water SA, **39** (*3)

Jenkins, M.W. and Scott, B. (2007). Behavioral indicators of household decision-making and demand for sanitation and potential gains from social marketing in Ghana. *Journal of Social Science and Medicine* **64** (12), 2427 – 2442.

Kabange, R. S. (2014). *Low-Cost Sanitation in Peri-Urban Ghana.* PhD Thesis: Leeds University.

Katukiza, A. Y., Ronteltap, M., Niwagaba, C., Foppen, J. W. A., Kansiime, F. and Lens, P.N.L. (2012). Sustainable sanitation technology options for urban slums. *Biotechnology Advances* – Article in Press

Khatri, K. B. and Vairavamoorthy, K. (2007). Challenges for urban water supply and sanitation in the developing countries. *Discussion Draft Paper for the Session on Urbanization.* Delft, The Netherlands: UNESCO-IHE Institute for Water Education.

Maoulidi, M. (2010). A water and sanitation needs assessment for Kumasi, Ghana. *MCI Social Sector Working Paper Series No. 16/2010.*

Mcllwaine, S. and Redwood, M. (2010). *Greywater Use in the Middle East: Technical, Social, Economic and Policy Issues.* United Kingdom: Practical Action Publishing Limited

Meeham, K., Ormerod, K. J. and Moore, S. A. (2013). Remaking waste as water: the governance of recycled effluent for portable water supply. *Water Alternatives* **6** (1), 67 – 85.

MICS (2006). *Ghana: Monitoring the Situation of Children, Women and Men.*

Millennium Cities Initiative (2008). *Invest in Ghana: Focus Kumasi.* Canada: Columbia University.

Mohammed, B., Abeer, A. and Theib, O. (2013). Assessing the efficiency of greywater reuse at household level and its suitability for sustainable rural and human development. *British Journal of Applied Science and Technology* **3** (4), 962 – 972

Orlowsky, B., Hoekstra, A. Y., Gudmundsson, L. and Seneviratne, S. I. (2014). Today's virtual water consumption and trade under future water scarcity. *Environmental Research Letters* **9**

Rodda, N, Carden, K., Armitage, N. and Plessis, H. M. (2011). Development of guidelines for sustainable irrigation use of greywater for gardens and small-scale agriculture in South Africa. *Water SA* **37** *(5)*

Strang, V. (2004). *The Meaning of Water.* Berg, Oxford.

Wijk-Sijbesma, C. (2001). *The Best of Two Worlds? Methodology for Participatory Assessment of Community Water Services*. Wageningen: IRC International Water and sanitation Centre.

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