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Evaluating Access to Potable Water and Basic Sanitation in Ghana's Largest Urban Slum Community: Old Fadama, Accra

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Abstract
Access to potable water and basic sanitation in urban poor communities remains a critical issue in the developing world. This paper examines access to potable water and basic sanitation in Ghana's largest urban slum and the level of commitment by stakeholders to improve the current conditions. It drew on an extensive field survey, interviews, focus group discussions and drinking water quality analyses. The study revealed that the community depend entirely on vended water for their daily water supply needs. Apart from being sold at exorbitant prices, the sources of drinking water is also contaminated with attendant health risks. Household toilets are non-existent in the community and thus residents rely exclusively on public latrines; KVIP and pan latrines which are also inadequate. This partly accounts for the practice of open defecation in the community with possible health effects such as diarrhea and cholera. Indiscriminate dumping of refuse, choked drains and pools of stagnant water are ubiquitous thereby posing health threats. There is a low level of commitment to improving access to water and sanitation in the community by major stakeholders in spite of the glaring health effects. The outcomes of this study will be useful to relevant stakeholders and authorities in developing suitable strategies for improving access to water and sanitation for urban poor communities.
Keywords: Accra, health, Old Fadama, sanitation, slum, water

Introduction

Globally, it is estimated that 50% of the world's population now live in urban areas and by 2030, this figure is projected to reach 61% (Nguendo Yongsi, 2009; UNFPA, 2007). This phenomenon of global urbanization, according to UN-Habitat (2003a), is more pronounced in the developing world which has an average annual urban population growth rate of 2.3% compared to the developed world's rate of 0.4%. Available statistics indicate that the urban proportion in the developing world was 18% in 1950 which had increased to 40% by 2000 and projected to be 56% urban by 2030 (UN-Habitat, 2003a; UN-Habitat, 2003b). However this explosion in urban population in the developing world, as pointed out by available literature (UN-Habitat, 2006; WaterAid, 2008; UN-Habitat, 2010) translates into slum proliferation due to a disproportionate improvement in infrastructure. Global statistics depict that, over 1 billion people live in slums and more than 90% of slums are in the developing world (UN-Habitat, 2006; WaterAid, 2008). In the developing world, sub-Saharan Africa has the highest prevalence of urban slums with 62% of urban dwellers currently living in slums (WHO/UNICEF 2012).

In Ghana, Accra is both the national capital and the hub for all the major industries in the country unlike other countries where economic, political and financial capitals are located in other different regions. This has created a pull factor for most people in rural areas seeking a better standard of living. In spite of this however, city authorities have not adequately factored this phenomenon into the land use planning of the city. Consequently, low income rural migrants are left with no other option than to resort to poorly constructed houses in areas without any secured tenure leading to creation of slums and proliferation of existing ones. Out of the current urban proportion of 51% as per WHO/UNICEF (2012), most current estimate by UN-Habitat (2009) indicate that 45% of these urban dwellers live in slums as against 26.4% urban slum population in 2001 reported by UN-Habitat (2010). According to Beddow (2010) about 60% of the population of Accra alone lived in low-income high density settlements typical of slums in 2007.

However, urban slums are areas where people live in squalor with poor access to essential basic services such as potable water supply, basic sanitation, electricity, in addition to high prevalence of communicable diseases and exposure to harsh conditions including floods, violence and fire outbreaks (UN-Habitat, 2003b ; Foroutan, 2009; Amoako & Cobbinah, 2011). As a result, the spate of increasing slum population presents serious challenges to

all aspects of human development. Foroutan (2009) asserts that the proliferation of slums in urban centres is one of the biggest challenges to public health in recent times. The lack of access to potable water, good hygiene and basic sanitation in slums is particularly perturbing since these pose grave effects on human health, social and economic development as available literature (Unger & Riley 2007; Mara *et al.,* 2010; Bartram & Cairncross 2010) indicate. In spite of this, Uwejamomere & Northover (2008) reported that, there is an unacceptably weak policy response to the water and sanitation crisis in the rapidly expanding slum areas of the developing world which could set off an unimaginable health, education and economic crisis if not attended to. Redoubled efforts are required to improve the conditions of slum dwellers as spelt out in Target 7d of the Millennium Development Goals.

In order to develop strategies to address these challenges appropriately with regards to access to potable water and sanitation in slums, an understanding of the existing conditions and magnitude of problem are required. It is against this backdrop that this paper examines access to safe water and basic sanitation in Ghana's biggest slum, the likely health effects on slum dwellers and the strategies that can be adopted to improve the situation. Specifically the study looks at the sources of water; level of service viz. cost of water, quality of drinking water, accessibility of water; coping strategies; types, adequacy and hygienic conditions of sanitation systems as well as waste disposal mechanisms available in the slum. The study findings can be used to stakeholders and policy makers in developing apposite strategies aimed at enhancing the current living conditions in urban poor communities in Ghana and the developing world as a whole.

Methods

Old Fadama, Ghana's biggest urban slum community is located in the national capital, Accra. It covers an estimated land area of 31.3ha and has approximately 80,000 residents mostly living in wooden structures. It is located between the Odaw and Agbogbloshie drains (Figure 1) making it susceptible to floods during the wet season. Residents in the community are believed to have migrated from the northern part of Ghana in search of security and greener pastures in the national capital. It is an informal settlement and lacks official authorization by city authorities. As a result it is largely disregarded and has no place on the city's planning and development agenda. Although there are plans to relocate the community to another part of the capital, the commitment to such development is rather weak (Kanton *et al., 2*010).

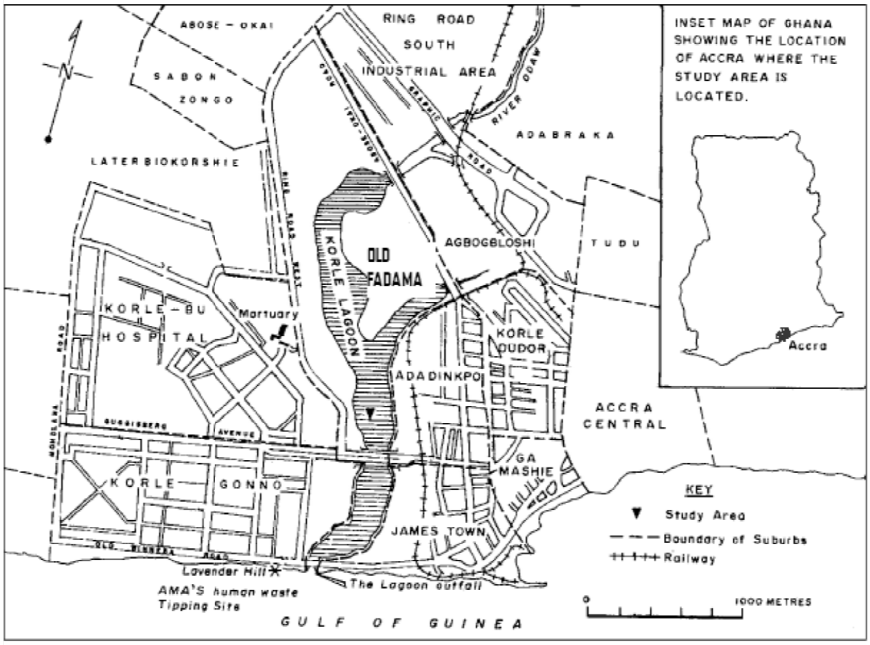

Figure 1: Location of Old Fadama (Source: Armah *et al*. 2009)

Data collection for the study was undertaken through questionnaires, focus group discussions, extensive field surveys and interview of key stakeholders. Structured questionnaires with both open and close-ended questions were used. At a confidence level of 95% and a confidence interval of 0.1, a total of 100 questionnaires were administered to residents randomly selected from all parts of the community. The sample size (S) was computed from the equation adapted from Jaisingh (2000); $S = \frac{Z^2 \times p \times (1-p)}{c^2}$ where Z = Z value (1.96 for 95% confidence level); p = percentage picking a choice, expressed as decimal (0.5 used for sample size needed) c = confidence interval, expressed as decimal (0.1). Focus group discussions with some residents and extensive field surveys

were used to verify findings from the questionnaires. Moreover, interviews with key stakeholders such as Ministry of Water Resources Works and Housing (MWRWH), People's Dialogue Ghana (PDG) and Accra Metropolitan Assembly (AMA) also focused on past and current efforts by policy makers to improve upon the living conditions (water supply, sanitation, housing, etc) of slum dwellers, the challenges they face in doing so and the current policies with respect to upgrading of slums. Water quality analysis of some drinking water sources was carried out to determine the general physico-chemical and microbial quality of drinking water using standard methods by the American Public Health Association (APHA). This was achieved through analyses of grab samples collected from five randomly selected pipe-borne water sources stored in concrete tanks.

Results and discussion

Out of 100 residents who responded to the questionnaires, females formed the majority (53%). Respondents were also predominantly between the age groups of 18 and 40 with only 4% being above 40 years (Figure 2). This agrees with findings by Armah *et al.* (2009) which found a predominantly youthful population in the community based on their age structure and probably in other urban areas in sub-Saharan Africa. The level of education of respondents is very low; 41% with no formal education and confirms earlier studies by People's Dialogue on Human Settlements (2010). 76% of respondents are married and 90% are self-employed. From the field surveys, it was observed that most residents earn their livelihoods from a nearby market, the Agbobloshie market by engaging in a wide range of trading activities such as hawking, food vending, scrap metal collection, hair dressing, shop keeping, etc.

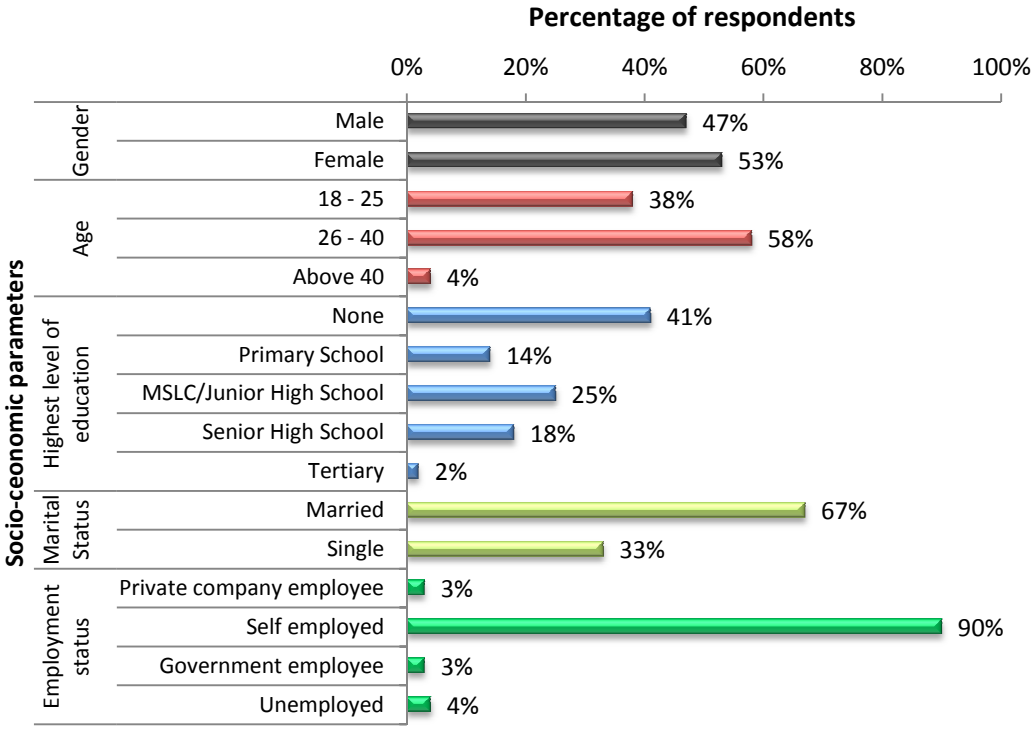

Figure 2: Basic socio-economic profile of 100 residents interviewed

Residents in the community depend on two main sources of water for their daily water supply needs; pipe-borne water from secondary vendors and packaged (sachet) water - 500ml of water in a plastic bag heat-sealed on either end. There are no house/yard connections to water in the community and so residents depend solely on water vendors for their daily water supply needs and confirms previous studies by Kanton *et al.* (2010).

Thus, the community depends on unimproved sources of water supply as per the classification of water supply sources by the WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation (WHO, 2007; Hunter *et al*., 2010). This finding disagrees with that of Adubofour *et al.* (2013) in two urban slum communities in Kumasi which revealed adequate levels of improved water coverage. Pipe-borne water provided by the public urban water utility provider; Ghana Water Company Limited (GWCL) is the primary source of water for domestic purposes in the community. This is mostly stored by water vendors in approximately $12m^3$ ground level concrete tanks (Figure 3a) due to the sporadic water flow. This confirms findings by El Fadel (2011) which found about 96% of households (n = 300) in Tebbaneh - an urban poor community in Tripoli storing water in tanks for their household activities. Estimates by some water vendors who responded to questionnaires indicate

that the pipe-borne water flows for about 4 hours a day and very erratic. According to them, at certain times water does not flow for about three weeks and under such conditions residents depend almost entirely on water tanker operators whiles others purchase sachet water for their domestic activities. Although all water vendors claim they clean these tanks often, it was noticed from the accumulation of algae in some of the tanks that these tanks observed that they are rarely cleaned. Some pipelines conveying to these tanks are exposed and in some cases run through earth drains containing wastewater (Figure 3b).

a) b)

Figure 3: Water supply in Old Fadama a) Concrete tank for water storage b) Pipelines running through drains

Moreover, some leaking pipelines were tied with plastic bags. These factors make the quality of water which serves as the source of drinking water to some residents (20% of respondents to questionnaires) questionable (Figure 4). In addition, it was gathered from interviews that an 18L bucket of water from these vendors costs GH¢0.3 (US$0.15). However, compared with commercial rates stipulated by GWCL (GH¢ 0.0015 per litre) the cost of water in the slum is almost 11 times higher. This is comparable to findings by Abraham *et al.* (2007) who found the cost of water in urban poor communities in Accra to be 2.6 to 9 times higher than the water utility direct commercial rate. It also corroborates findings by Fisher (2012) who reported that
slum dwellers in the Kibera slum, Nairobi pay large sums of their daily income for drinkable water. In case of acute shortage of water in the community, 72% of respondents depend on water provided by water tankers for almost all their domestic activities whiles 28% depend on sachet water (Figure 4). During these times the cost of water could even be much higher since the cost of water from tanker operators are not regulated. Some residents also rely exclusively on sachet water during these times because a bag of sachet water is relatively cheaper (GH¢ 0.9 per 15L) as compared to that of the tanker operators (GH¢1.5 per 18L). The cost of water can therefore be said to be expensive as confirmed by 98% of respondents in the community (Figure 4).

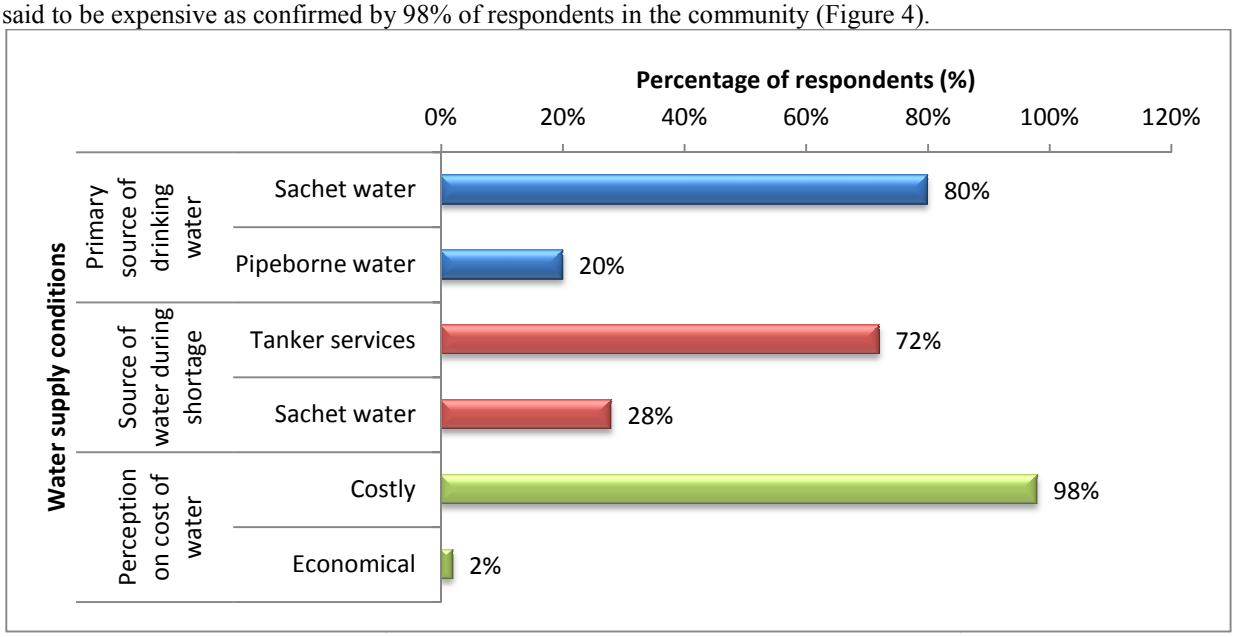

Figure 4: Access to water in Old Fadama

From the foregoing results, it can be deduced that, although Ghana has achieved the national MDG target for water coverage even in advance as reported by WHO/UNICEF (2013), this does not reflect in this slum community. There is therefore the need to reconsider efforts being made towards MDG 7 which seeks to achieve

universal access to safe water and improved sanitation and improve the lives of slum dwellers to ensure that they incorporate the interest of the urban poor.

Results of water quality analysis carried out for five randomly selected pipe-borne water samples in the study area indicated that this source of water is both chemically and bacteriologically compromised. This however served as a source of drinking water for some of the residents (20% of residents interviewed) whiles majority 80% of respondents relied primarily on sachet water for drinking purposes. Similar studies conducted by El Fadel (2011) after a survey of 300 households in urban poor areas in Tripoli reported that about 26% of respondents supplemented water from the public water supply network with bottled water. Although the quality of sachet water in the slum has not been determined in this work, its poor quality and related health effects have been extensively reported in available literature (Addo *et al*., 2009; Stoler *et al*., 2012). For the water samples analysed all the physico-chemical parameters but Copper, Lead and Cadmium were within acceptable limits for drinking water as recommended by the Ghana Standards Board (GSB) as shown in Table 1.

Table 1: Quality of pipe-borne water in stored in concrete tanks

PARAMETERS	UNITS	MEAN±STANDARD DEVIATION	GSB GUIDELINE VALUE
pH		6.98±0.24	6.5-8.5
EC	µS/cm	291.67±10.69	5000
TDS	mg/L	145±7.13	1000
Nitrogen-nitrate	mg/L	0.64±0.23	50
Iron	mg/L	0.02±0.005	0.3
Calcium Hardness	mg/L	42±5.29	-
Total Hardness	mg/L	76.67±7.02	500
E. coli	CFU/100mL	$3.4x10^{9}$±$5.5x10^{8}$*	0
Total coliforms	CFU/100mL	$4.6x10^{9}$±$5.7x10^{8}$*	0
Mercury	mg/L	bdl	0.001
Zinc	mg/L	0.009±0.003	3
Copper	mg/L	0.049±0.003*	0.01
Lead	mg/L	0.062±0.010*	0.01
Cadmium	mg/L	0.012±0.003*	0.003

*Recorded values are above drinking water standards by the Ghana Standards Board
bdl – below detectable limit

The level of faecal coliforms in the water (Table 1) was well within the infectious dose of 10^{6} – 10^{10} as reported by Awuah (2006). With this high amount of faecal coliforms consumers (particularly young children) are likely to be affected cholera and diarrheal diseases (Hunter *et al*. 2010).

According to the WHO (2004a); WHO (2004b), the concentrations of copper in drinking-water differ extensively as a result of variations in water characteristics, such as pH, hardness and copper availability in the distribution system primarily it originating from the corrosion of interior copper plumbing. Although, copper is an essential nutrient to prevent anaemia and keep the skeletal, reproductive and nervous system in good shape, Potera (2004) observed that, when copper concentrations reach 4.0 to 6.0 mg/L, gastrointestinal symptoms such as nausea, abdominal pain, diarrhoea and vomiting occur. Therefore a guideline value of 2mg/L is deemed to be protective against the adverse effects of copper and to provide an adequate margin of safety in populations with normal copper homeostasis (WHO, 2004b). Compared with the WHO guideline value for copper, the concentration of copper in the pipe borne water from this community is lower but higher than that of the GSB of 0.01mg/L. This could indicate possible health threat.

Lead is known to be a highly toxic substance which upon exposure can lead to irreversible health effects before signs and symptoms are seen or felt (Organisation for Economic Co-operation and Development (OECD) 2007). Depending on the level and duration of exposure, the effects of lead in humans may range from inhibition of enzymes to the production of marked morphological changes and death (Holm *et al*., 2002). Other non-fatal effects, as stated by the WHO (2007b) include renal effects; acceleration of skeletal maturation; alteration of hormone levels and immunity parameters; and encephalopathy (at high exposure) and various other diseases of the nervous system among which cognitive and neurobehavioral deficits in children at low levels of exposure are of particular concern. In children with blood lead levels well below 30mg/dl, the WHO (2004a) asserts that, there is electrophysiological evidence of effects on the nervous system.

The critical health effect of cadmium, according to current knowledge (Holm *et al*., 2002; WHO, 2007b) is kidney damage (renal tubular damage) both in the general population and in occupational exposed workers. In the kidney (renal cortex), the accumulation of cadmium results in failure of the kidney with impaired reabsorption of, for instance, proteins, glucose and amino acids (Holm *et al*., 2002). Other effects of Cadmium exposure are disturbances in calcium metabolism, hypercalciuria and formation of renal stones.

Access to basic sanitation is a huge challenge to residents in the slum, in that the facilities available are not only inadequate but also unimproved as per the classification of the WHO/UNICEF Joint Monitoring Programme. No household toilet facilities are available in the community thereby making residents depend exclusively on poorly maintained public toilets whilst others resort to open defecation. The lack of landspace in the community due to high population density precludes residents from constructing household toilets. Two types of toilet systems are available in the community; Kumasi Ventilated Improved Pits (KVIPs) and Pan latrines which costs between Gh¢0.10 and Gh¢0.20 (US$0.1) per visit. According to Jenkins and Curtis (2005), access to these unimproved sanitation facilities results not only in fecal contamination of the environment and transmission of gastroenteric infections but also loss of dignity and quality of life.

There are 39 of these public shared toilet facilities out of which 76% are Pan Latrines and 24% are KVIPs. However, the hygienic conditions on these facilities are appalling. Apart from lack of privacy on these facilities, findings from interviews, focus group discussions and verified by personal observations revealed offensive odour, fly nuisance and unsightly conditions on the facilities. Altogether, there are 635 squat holes for the public toilets serving the entire population of approximately 80,000. By inference it connotes that at any one point in time approximately 126 users could use a squat hole. This is grossly inadequate compared to a standard of 50 users per squat hole for communal toilets (The Sphere Project 2004) and partly accounts for the practice of open defecation in the community. This corroborates findings previous studies (Amoako & Cobbinah, 2011; Adubofour *et al.*, 2013) which found extremely low sanitation coverage in urban slum communities in Kumasi. Amoako & Cobbinah (2011) reported that only four public toilet facilities served almost 1,700 slum dwellers in Ayigya, Kumasi. Similar findings of limited access to toilet facilities in urban slums leading to indiscriminate defecation have also been reported in the Dharavi slum in Mumbai, India by Fisher (2012). With regards to their willingness to pay for improvement on the conditions of the facilities, 98% of respondents were affirmative and were willing to pay for a 100% increment if the better facilities are provided. On the other hand 2% stated they cannot afford any further increase in the cost per visit to the toilet facilities due to lack of money. Although no resident confirmed practicing open defecation during the interview, findings from the Focus Group Discussions (FGDs) and field surveys indicated that open defecation is practiced mostly by children and men even in broad daylight. The reasons given from the focus group discussions included lack of money, queues at the toilet facilities during rush hours and offensive odour from the toilet facilities. With regards to children who practice open defecation, residents asserted that their parents are either not willing or cannot afford to pay for their children to visit the public latrines. For some instances also, children who are given the money to pay their user fees at the public latrines also keep the money and resort to open defecation.

Sanitary conditions in the slum is also in a deplorable state due to indiscriminate dumping of waste and choked drains with stagnant water serving as breeding grounds for mosquitoes. Piles of waste are not uncommon sights in the community generating offensive smell to residents some of whom sell food just beside them. However, there is an allocated refuse dump site in the community where residents are expected to dump their waste. As a result, informal waste collectors convey refuse from some residents to the dump site. Twenty two percent of respondents to questionnaires indicated that they pay between GH¢0.2 (US$0.1) and GH¢0.5 (US$0.3) depending on the quantity of waste to informal refuse collectors to convey them to the final disposal site located along the Korle Lagoon. Although there are no communal skip containers for residents at Old Fadama, their patronage of informal waste collectors shows some level of willingness to pay for commercial waste collection if they are provided with this service at a reasonable fee. All respondents to questionnaires indicated their awareness of the effects of this practice on the Korle Lagoon but claimed to have no other option.

Considering the poor living conditions of this slum community which has been in existence for almost three decades (UN Habitat, 2010) it could be deduced that efforts by stakeholders over the years have not yielded the needed results. Information gathered through interviews indicate that, the Accra Metropolitan Assembly, which is tasked with, among others, the infrastructural planning and development in Accra, has since 2002 tried unsuccessfully on several occasions to forcefully evict residents from the slum. This is due to the advocacy role by People's Dialogue Ghana (PDG) which has engaged persistently with authorities to find alternative approaches to the current situation. Consequently, there are plans currently to relocate the community to another location in Accra. This has however not materialized due to low political commitment leaving the slum residents in their current plight. Moreover, although the Ministry of Water Resources Works and Housing has drafted a housing policy which seeks among other things to address the growing incidence of slums in urban centres in Ghana, it is yet to go through rigorous examination and approval by the Parliament of Ghana. Therefore, there is currently no roadmap to improving the plight of urban slum dwellers in the country. This weak political commitment to addressing the challenges faced by urban slum residents is really an affront to poverty reduction as the MDGs generally seeks to achieve. There is the need for a multi-sectoral collaboration to ensure that poverty reduction strategies include access to potable water and basic sanitation for the urban poor and efforts intensified in this regard.

Conclusion

This study reveals that residents in the urban slum community depend solely on vended water; pipeborne water and sachet water as the only source of water supply for their daily activities. Pipe-borne water is sold at exorbitant prices to residents; approximately 11 times stipulated commercial rates. The plight of the slum dwellers is further exacerbated by the fact that vended water contaminated with high levels of fecal coliforms $3.4x10^9 \pm 5.5x10^8$CFU/100mL partly due to ingress of wastewater into pipelines passing earth drains; Copper (0.049±0.003mg/L), Lead (0.062±0.010mg/L) and Cadmium (0.012±0.003mg/L). As a result the residents are exposed to adverse health effects. Erratic flow of pipeborne water in the community has necessitated storage of pipeborne water in ground level concrete tanks which contributes to contamination of water. The community depends entirely on poorly maintained public latrines (pan latrines and KVIP) with offensive odour, fly nuisance and lack user privacy. These factors in addition to inadequate facilities, lack of money and behavioral factors contribute to the practice of open defecation in the slum. Indiscriminate dumping of refuse in the slum as a result of lack of waste collection containers also poses health risks to residents. There is however the willingness to pay for waste collection services in the slum. A low level of political commitment to improving the conditions in the slums exists in that efforts over the years to improve water and sanitation across the country has been targeted at only certain parts of the country to the neglect of slums. The study recommends the provision of adequate and well-maintained mobile household toilet facilities by private sanitation service providers due to the fact that the community lacks adequate land space to construct household latrines and an improvement in the operation of public latrines in the community. In addition, since there are plans to relocate the slum dwellers to another location, temporary toilet facilities would be the most appropriate option. Health education of residents would also be very instrumental in ensuring a change in attitude with regards to indiscriminate dumping of waste and open defecation in the community. Adequate number of communal skip containers need to be provided at vantage points in the community to collect refuse in the community. Pipelines carrying potable water should be completely covered to prevent ingress of external contaminants through pipe joints and these should be connected to elevated polyethylene tanks instead of ground level concrete tanks. Moreover, there is the need for the formation of a water vendors association in order to ensure effective management and price regulation of water supply services in the community. In sum, efforts to improve the living conditions of urban slum areas and curtail urban slum formation should be intensified and be given the necessary political commitment to ward off the numerous health risks to which urban slum dwellers are exposed.

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References

- Abraham, E.M., van Rooijen D., Cofie, O. & Liqa Raschid-Sally, L. (2007). Planning urban water – dependent livelihood opportunities for the poor in Accra, Ghana. SWITCH Scientific Meeting, Birmingham, UK.
- Addo, K. K., Mensah, G.I., Bekoe, M., Bonsu, C. & Akyeh M.L. (2009). Bacteriological quality of sachet water produced and sold in Teshie-Nungua suburbs of Accra, Ghana. *African Journal of Food Agriculture Nutrition and Development.* 9(4), 1019-1030
- Adubofour, K., Obiri-Danso, K. & Quansah, C. (201)3. Sanitation survey of two urban slum Muslim communities in the Kumasi metropolis, Ghana. *Environment & Urbanization*, 25 (1),189-207.
- Amoako, C. & Cobbinah, P.B. (2011). Slum Improvements in the Kumasi Metropolis, Ghana - A Review of Approaches and Results. *Journal of Sustainable Development in Africa*. 8, 150 - 170
- Armah, F. A. Yawson, D.O. & Johanna, A.O. (2009). The gap between theory and practice of stakeholder participation: the case of management of the Korle Lagoon, Ghana. *Law, Environment and Development Journal* 5(1), 73 - 89
- Bartram, J. & Cairncross, S. (2010). Hygiene, Sanitation, and Water: Forgotten Foundations of Health. *PLoS Med* 7(11)
- Beddow, V. (2010). Accra: Sanitation status. [Retrieved from: http://www.iwawaterwiki.org/xwiki/bin/view/Articles/2)+ACCRA+(Ghana)+3 Date accessed: 29 July, 2012]
- El-Fadel, M. (2011). Participatory Improvement of Water and Sanitation Services in Tripoli through a Comparative Analysis with Irbid. IDRC and American University of Beirut, Lebanon.
- Fisher, J. R. (2012). Massive Urban Slums in Developing Countries. http://geography.about.com/od/urbaneconomicgeography/a/Urban-Slums.htm. Date accessed: 12 September, 2013)

- Foroutan, N. (2009). Slums: the new faces of the developing world cities. School of Population Health, University of Auckland, New Zealand.
- Holm, O., Hansen, E., Lassen, C., Stuer-Lauridsen, F. & Jesper, K. (2002). Heavy Metals in Waste – Final Report. European Commission DG ENV. E3, Project ENV.E.3/ETU/2000/0058. Denmark.
- Hunter, P.R., MacDonald, A.M., & Carter, R.C. (2010). Water Supply and Health. *PLoS Med* 7(11)
- Jaisingh, L. R. (2000). Statistics for the Utterly Confused. McGraw-Hill Companies, Inc. USA.
- Jenkins, M. W. & Curtis, V. (2005). Achieving the 'good life': Why some people want latrines in rural Benin. *Social Science & Medicine* 61, 2446–2459.
- Kanton, I. O., Abdul-Rahim L., Songsore, J., Farouk, R. B. & Mulenga, M. (2010). Urban Water and Sanitation in Ghana: How Local Action is making a Difference. International Institute for Environment and Development. Human Settlements Working Paper Series. Water and Sanitation 25, 12.
- Mara, D., Lane, J., Scott, B., & Trouba, D. (2010). Sanitation and Health. *PLoS Med* 7(11)
- Nguendo Yongsi, H. B. (2009). Wastewater Disposal Practices: an Ecological Risk Factor for Health in Young Children in Sub-Saharan Africa Cities : Case Study of Yaoundé in Cameroon. *Research Journal of Medicine and Medical Sciences*, 4(1). 26 – 41.
- Organisation for Economic Co-Operation and Development (OECD) (2007). *Handbook on Lead-bismuth Eutectic Alloy and Lead Properties, Materials Compatibility, Thermal-hydraulics and Technologies.* Organisation for Economic Co-Operation and Development. Nuclear Energy Agency No. 6195 pp 663.
- People's Dialogue on Human Settlements (2010). Community-Led Enumeration of Old Fadama Community. Housing the Masses. Special Report to the Government of Ghana. Accra, Ghana.
- Potera, C. (2004). Copper in Drinking Water: Using symptoms of exposure to define safety. *Environmental Health Perspectives*. 112 (10). A568 – A569
- Stoler, J., Weeks, J.R. & Fink, G. (2012). Sachet drinking water in Ghana's Accra-Tema metropolitan area: past, present, and future. *Journal of Water, Sanitation and Hygiene for Development*. 2 (4). 223 - 240.
- The Sphere Project (2004). Humanitarian Charter and Minimum Standards in Disaster Response. Oxfam Publishing, Oxford. UK.
- Unger, A. & Riley, L. W. (2007). Slum Health: From Understanding to Action. *Public Library of Science Medicine*. 4 (10).
- UN-Habitat (2003a). The Challenge of Slums: Global Report on Human Settlements. United Nations Human Settlements Programme. Earthscan Publications Ltd, London, UK
- UN-Habitat (2003b). Slums of the World: The Face of Urban Poverty in the New Millennium? Monitoring the Millennium Development Goal, Target 11- World-wide Slum Dweller Estimation. Working Paper.
- UN-Habitat (2006) The State of the World's Cities 2006/2007. The Millennium Development Goals and Urban Sustainability: 30 Years of Shaping the Habitat Agenda. United Nations Human Settlements Programme. Earthscan Publications Ltd, London, UK.
- UN-Habitat (2009). Ghana Urban Profile. United Nations Human Settlements Programme. UNON. Publishing Services Section, Nairobi, Kenya.
- UN-Habitat (2010). Housing as a Strategy for Poverty Reduction in Ghana. United Nations Human Settlements Programme. UNON, Publishing Services Section, Nairobi. Kenya.
- United Nations Population Fund (UNFPA) (2007). State of the World Population 2007: Unleashing the Potential Of Urban Growth. New York, USA.
- WaterAid (2008). Urban Sector Assessment Report. [Retrieved from: www.WaterAid.org Date accessed: 29th September, 2012]
- WHO & UNICEF Joint Monitoring Programme for Water Supply and Sanitation (2012). Progress on drinking water and sanitation:2012 update. New York, USA.
- WHO & UNICEF Joint Monitoring Programme for Water Supply and Sanitation (2013). Progress on drinking water and sanitation: 2013 update. WHO Press, Geneva, Switzerland.
- World Health Organization (2004a). Guidelines for Drinking-water Quality. Volume 1, 3rd Edition. Geneva.
- World Health Organization (2004b). Copper in Drinking-water. Background document for development of WHO Guidelines for Drinking-water Quality.
- World Health Organization (2007a). Economic and Health Effects of Increasing Coverage of Low Cost Household Drinking-water Supply and Sanitation Interventions to Countries off-track to Meet MDG Target 10. Background document to the Human Development Report. WHO Press, Geneva, Switzerland.
- World Health Organization (2007b). Health Risks of Heavy Metals from Long-range Transboundary Air Pollution. Joint WHO/Convention Task Force on the Health Aspects of Air Pollution. Germany.