*International Journal of Latest Engineering Research and Applications (IJLERA) ISSN: 2455-7137*

*Volume – 02, Issue – 09, September – 2017, PP – 63-67*

# Simplified sewerage – "true partner" of the peri-urban poor?

Roland S. Kabange

*Department of Civil Engineering, Faculty of Engineering and Technology (FET), Kumasi Technical University (KsTU), P. O. Box 854, Kumasi, Ghana*

*Email Address: skabange@yahoo.com*

**Abstract:** At the commencement of the 2030 Agenda for Sustainable Development implementation which officially took-off on 1st January 2016 to address unresolved global challenges over the next 15 years under the auspices of the Sustainable Development Goals (SDGs), 2.4 billion people globally are without improved sanitation while unimproved sanitation coverage reduced by only 9% to 32% over the period 2000 – 2015. Most of the unserved are poor and live in water-scarce high-density peri-urban communities of developing countries, often without the basic life amenities. Sanitation is therefore a real challenge for communities with disproportionate number of poor people. This paper reviews peer-reviewed literature for a 'true partner' to serve the 2.4 billion peri-urban poor without improved sanitation. There is no justification for large water quantities use to flush small excreta under global water-stress conditions, particularly when sanitation technology options (STOs) that need minimal (or no) water to efficiently function is available. The need to target resources to regions with slow sanitation coverage progress is now. Pro-poor low-cost STOs that require no (or minimal) water to operate, support excreta reuse, and fit into the socio-cultural settings of these communities are therefore encouraged. The author argues that the achievements of the SDG on sanitation coverage are contingent upon attention payment to, and adoption of, simple but cost-effective and acceptable pro-poor STOs. The author further argues for simplified sewerage (SS) as the likely STO of choice and 'true partner' of the peri-urban poor on grounds that it reflects the conclusive arguments put forward by nearly all authors on the subject. While a strong case is made for SS as a 'true partner' for the peri-urban poor, technical guidelines and policies design to address SS implementation challenges, and successful adoption and roll-out are recommended if SS schemes are to pass the sustainability test and be 'true partner' of the peri-urban poor.

**Keywords:**simplified sewerage, sanitation technology options, true partner, pro-poor peri-urban communities, Ghana

## I. INTRODUCTION

The official implementation of the 2030 Agenda for Sustainable Development under the auspices of the Sustainable Development Goals (SDGs) which commenced on 1st January 2016 seeks to address global challenges over the next 15 years at a time when 2.4 billion people globally are without improved sanitation, among them 946 million people (or 13% of global population) continue to defecate in the open because they have no other option [1]; [2]. The SDGs are therefore refined arrangements to build on the chalked Millennium Development Goals' successes to ensure sustainable global socio-economic progress, eradicate extreme poverty and integrate the economic, social, and environmental dimensions of sustainable development [1]. The SDG target 6 is however to ensure availability and sustainable management of water and sanitation, and to addresses the quality and sustainability of water resources [1].

Further, the 2016 SDGs report indicates that the global population proportion that used unimproved sanitation facilities between 2000 and 2015 decreased marginally over the 15-year period by 9% to 32% [1]; [2] despite the implemented multi-interventional strategies to achieve the MDGs at the time. Based on the post-MDGs assessment, inadequate sanitation facilities are still a reality for about one-third of the global population [1], an alarming statistic which requires concerted efforts in the current SDGs era. Most of the unserved (or inadequately served) are poor and live in densely-populated peri-urban communities, often without the basic life amenities. One of the factors that prevents households from improved sanitation benefits is poverty [3], and so sanitation technology cost is a huge issue to the peri-urban poor. As an intervention towards the SDGs achievement, the need to target resources to regions with slow sanitation coverage progress is now. There is also the need to establish each locality's water situation, as some sanitation technology options (STOs) can only successfully operate when water is available [4].

Water scarcity affects over 2 billion people globally, a figure projected to rise in the future [1]. Ghana's water-stress situation in 2010 was a deficit of 388,576. 39 cubic metres of water per day [5]. There is thus no justification for large water quantities use to flush small excreta under global water-stress conditions, particularly when STOs that use minimal (or no) water to efficiently function is available. Pro-poor low-cost

  

STOs that require no or minimal water to operate, support excreta reuse, and fit into the socio-cultural settings of communities are therefore encouraged [4]. Though the most common STOs for low-income poor countries are pit latrines [6]; [7], current trends suggest a sanitation policy shift towards more improved options [8]. A Kumasi (Ghana) study, for instance, shows Ghana's population preference for 'flush-and-forget' (or sewered) systems as future sanitation solution [9].

Though a Zimbabwean case study on sustainable sanitation systems for low-income urban areas found that financial problems were constraints that restricted poor urban dwellers from building and using latrines, it was not clear whether the financial problems were 'real' or 'perceived' [3]. The debate, however, is not whether financial problems were 'perceived' or 'real', as perceptions hugely matter – they largely determine sanitation facilities acceptability [9], which drives usage to promote health. For instance, a peri-urban socio-cultural preferences study in Kumasi (Ghana) found that the direction one sat (or squat) to defecate mattered – a predominantly Muslim community preferred to squat in the North-South direction to defecate, because they neither wanted to face Mecca nor gave their back to it [10]. Women sanitation practices research in Kenya also showed that they preferred to defecate in plastic bags and throw them on the streets because they did not want to be seen by men using sanitation facilities often [11].

It is argued that conventional sewerage (CS) is an anti-poor sanitation technology due to its high-water requirement and cost (in terms of capital and recurrent costs) [12]. There is however strong support for non-water-based sanitation technologies for densely-populated pro-poor peri-urban communities of developing countries, and further emphasized the inappropriateness of CS not only for developing countries, but even for the developed world [4]. The achievements of the SDGs on sanitation coverage progress are contingent upon attention payment to simple and cost-effective pro-poor sanitation technologies [4]. For the peri-urban poor, dry sanitation technology options which require little (or no) water to function are preferred over the wet water-dependent alternatives. Beyond sanitation technologies costs and water requirement to operate, studies show that the determinants of sanitation choice also depend on household size, educational level of household heads, income, time required to get to sanitation facilities, residence type, type of person using the facility, and number of households sharing the facility (if shared facility) [5].

## II. CASE FOR SIMPLIFIED SEWERAGE

Simplified sewerage (SS) is an off-site sanitation technology designed to remove unsettled household wastewater from its immediate environment for treatment and disposal or reuse [13]; [14]. Otherwise called low-cost solids-transporting sewerage (or shallow sewerage or interceptor sewerage), SS is widely viewed as a sanitation option that merits consideration for implementation in African context [15], and low-income densely-populated areas of developing countries in general. Developed in Brazil in the early 1980s, it is argued SS is the sanitation technology of choice in high-density peri-urban communities with a reasonable water supply [16]; [17]; [18]. Some authors contend that subject to some conditionalities, SS is often the only technologically feasible and economically appropriate STO for densely-populated low-income peri-urban communities [12]. Where on-site sanitation is technically infeasible and CS is financially unaffordable, SS is the appropriate solution [19]. Successful SS development and use are demonstrated in countries such as Bolivia, Colombia, Nicaragua, Paraguay, and Peru. About 6,600 households in 13 low- and medium-income communities in Ramagundam (India) also witnessed a successful SS adoption and implementation [19].

SS precludes the need for pit emptying, which historically puts significant additional cost burden on individuals, households, and communities. A user-minded audit of a community pour-flush latrine in Kumasi (Ghana), for instance, found that around 39% of the latrine operation and maintenance (O & M) cost was on pit emptying [20]. Some arguments also demonstrate that sanitation technology choice is contextual and depends on factors such as water-availability, soil conditions, settlement densities, geo-hydrological and socio-economic conditions [21]. SS suitability for low-income densely-populated communities is also traced to savings in excavation cost by laying small-diameter sewers at shallow gradients, solids interceptor tanks provision at individual household connections, and pipe-laying flexibility between housing blocks and under pavements. Beyond SS suitability for low-income high-density communities of developing countries, it can be easily adopted by the developed world, but to higher design standards – for instance, 56 households with 4,000 litres per day peak wastewater flow and 2.5 Pa minimum tractive tension at peak flow can be served by a 100-mm diameter sewer [22]. SS therefore has the potential to provide high-quality low-cost sanitation services to low-income high-density peri-urban communities in developing countries and elsewhere.

For SS to be a truly pro-poor STO, perception of low-cost STOs as second-class options, lack of (or insufficient) engagement of users, technical standards favoured over innovation, peri-urban community characteristics, insufficient investment on sanitation, and insufficient cost recovery for sanitation services [12] are factors to be addressed. SS is different from CS because it is a system stripped to its basic hydraulic features, characterized by reduced gradients, depths, and pipe diameters without compromising its design principles [23]; [24]; [25]. SS design may be limited to the basic elements, and kept as simple and as few elements as possible without compromising the objective for the intended end user [26]. These basic features allow sewer lines design to be based on tractive force criteria, rather than minimum velocity criteria [19]. Sewer gradient design depends on the initial design flow, while sewer diameter design depends on the final design flow (Mara et. al., 2001). It is known that SS capital costs are about half that for CS [27], and SS is also known to be cheaper than CS and all on-site systems at population densities greater than 160 persons per hectare [16]. The same study suggests that SS may be more cost-effective than VIP, pour-flush latrines, and ecosan toilets.

Rapid urbanization, population explosion, and pressure on sanitation infrastructure in a water-stress environment means that simple, affordable and innovative sanitation solutions are the way forward [19]. Besides Sinnatamby's 1983 Brazilian study which demonstrated that SS cost is a function of population density [16], similar research in Johannesburg (South Africa) found the same result [24]. Population density variation implications research also showed that SS was the most likely cost-effective and acceptable sanitation solution for the high-density peri-urban Kotoko community in Kumasi (Ghana) [28], suggesting that SS may be the only 'true partner' for the densely-populated peri-urban poor. The available evidence therefore suggests that future population rises would only make SS even cheaper. Based on the arguments made by experts and on the strength of the evidence made against other STOs, a strong case is made for SS as a 'true partner' for the peri-urban poor living in densely-populated per-urban communities.

## III. SIMPLIFIED SEWERAGE LIKELY IMPLEMENTATION CHALLENGES

Though SS is known to be the most appropriate and cost-effective sanitation option for low-income high-density peri-urban population, it is not without its challenges. SS applicability in slum communities is likely to record low connections and poor networks because of the illegal and dynamic nature of such communities. Some sanitation projects that applied some SS elements either totally failed or reported serious challenges for some reasons [27]: SS is not well advertised, and so it is not yet well known; the design and construction principles of SS are not well understood, particularly in developing countries where it is most appropriate; and limited knowledge exists on how to best reduce and manage SS operational problems such as blockages.

Mara and Broome further found that SS implementation is often confronted with technical failures due to errors in design, construction standards applied, and materials used; the application and adoption of SS standards and practices for low-cost sewerage provision remains a challenge [27] – the use of interceptor tanks is a typical example – though the interceptor tank may minimize silt quantities entering sewers which could lead to blockages, they potentially reduce sewers' capacity to transport wastewater by peak flow reduction from household connections, and they also increase householders' responsibilities for maintenance when it is often unclear such maintenance will be met; and SS promotion has not been vigorously and effectively carried out compared to others such as ecological sanitation [29]; and lack of data on SS operational costs as against those of conventional sanitation technologies might be one reason for the limited use of SS. To address these implementation challenges for a successful SS adoption and roll-out, it is recommended that technical guidelines and policies are designed.

Today's engineers' task is to make pro-poor sanitation a reality and multidisciplinary by involving social scientists, surveyors, hydrogeologists, environmentalists, and other professionals as a team [12]. Mara & Broome contend that if there is any justification from evidence to review SS design rules, the consistency and simplicity of its design may not be compromised for any such reviews [27]. A practical scenario is in the event of an unacceptable sewer blockage rise, it may be prudent to increase the minimum tractive tension design value than to import conventional out-dated sewerage rules. The author argues that SS schemes will fail the sustainability test as truly pro-poor if these implementation challenges are not addressed.

## IV. CONCLUSIONS AND RECOMMENDATIONS

With a current 2.4 billion people without improved sanitation globally, 946 million of them open defecators, and a decline in unimproved sanitation facilities use by only9% to 32% over a 15-year period (2000 to 2015), the world has a daunting sanitation challenge in achieving the SDG target 6 on sanitation coverage. SS has the potential to provide high-density low-cost sanitation to densely-populated low-income peri-urban communities in developing countries. Since most of the unserved (or inadequately served) are poor and live in densely-populated peri-urban communities, there is the need for pro-poor STOs adoption and targeting resources to regions with low sanitation coverage. Pro-poor low-cost STOs with minimal (or no) water requirement that support excreta reuse and fit into the socio-cultural settings of these communities are encouraged. The author argues that the achievements of the SDG on sanitation coverage are contingent upon attention payment to, and adoption of, simple but cost-effective and acceptable pro-poor STOs. Based on experts' arguments and on the strength of the evidence made against other STOs, a strong case is made for SS as a 'true partner' for the peri-urban poor. However, the SS implementation challenges outlined in this review need to be addressed if SS schemes are to pass the sustainability test and be 'true partner' of the peri-urban poor. It is recommended that technical guidelines and policies are designed to address SS implementation challenges, successful adoption, and subsequent roll-out.

## REFERENCES

[1]. United Nations, *The sustainable development goals report 2016* (New York: United Nations, 2016).

[2]. WHO/UNICEF, *Progress on drinking water, sanitation and hygiene: 2017 update and SDG baseline* (Geneva: United Nations, 2017).

[3]. A. Chenyama, P. Chipato, and E. Mangore, Sustainable sanitation systems for low income urban areas – a case of the city of Bulawayo, Zimbabwe, *Phys. Chem. Earth* **50**, 2012, 233 – 238.

[4]. R. S. Kabange, Low-cost sanitation technology options for low-income high-density peri-urban communities of developing countries, *International Journal of Latest Engineering Research and Applications* (IJLERA), 2017 (**Accepted**) Paper id: 201708444

[5]. P. N. A. Aryitey, *Household choice of water supply and sanitation systems: contemporary Ghanaian analysis*, MPhil thesis, University of Ghana, Accra, 2015.

[6]. A. Tsinda, P. Abbott, S. Pedley, K. Charles, J. Adogo, K. Okurut, and J. Chenoweth, Challenges to achieving sustainable sanitation in informal settlements of Kigali, Rwanda. *International Journal of Environmental Resources and Public Health***10**, 2013, 6939 – 6954. doi: 10.3390/ijerph10126939

[7]. L. Strande, M. Ronteltap, and D. Brdjanovic, Faecal sludge management systems approach for implementation and operation (London: IWA, 2014). http://www.eawag.ch/en/department/sandec/pulikationen/faecal-sludge-management-fsm-book/[acessed 10 May 2017]

[8]. Government of Ghana, *Environmental sanitation policy (revised version) of The Ministry of Local Government and Rural Development (MLGRD)* (Accra: Ghana, 2010).

[9]. R. S. Kabange, and A. Nkansah, Peri-urban community perceptions towards greywater use: a case study of the Kotoko community in Suame (Kumasi), Ghana, *Journal of Civil and Environment Research* **7** (9), 2015a, 1 – 9 of The International Institute for Science, Technology and Education (IISTE)

[10]. R. S. Kabange, and A. Nkansah, Peri-urban community socio-cultural preferences for, and experts' views on, sanitation, sanitation options: a case study of the Kotoko community in Suame (Kumasi), Ghana, *Journal of Environment and Earth Sciences* **5** (18), 2015b, 28 – 35 of The International Institute for Science, Technology and Education (IISTE)

[11]. J. Pearson, and K. Mcphedron, A literature of the non-health impacts of sanitation, *Waterlines* **27** (1), 2008, 48 – 61

[12]. C. Paterson, D. Mara, and T. Curtis, Pro-poor sanitation technologies, *Geoforum***38** (5), 2007, 901 – 907

[13]. A. Bakalian, A. Wright, R. Otis, and J. A. Netto, *Simplified sewerage design guidelines*(UNDP: World Bank Sanitation Program, 1994).

[14]. D. Mara, A. Sleigh, and K. Taylor, *PC-based simplified sewer design (*School of Engineering, University of Leeds, Leeds, 2001)

[15]. G. Norman, and J. Chenoweth, Appropriateness of low-cost sewerage for African cities: a questionnaire survey of expert opinion, *Waterlines* **28** (4), 2009, 311 – 326

[16]. G. S. Sinnatamby, *Low cost sanitation systems for urban peripheral areas in Northeast Brazil,* PhD thesis, University of Leeds, Leeds, West Yorkshire, 1983

[17]. D. D. Mara, Simplified sewerage: a mature and essential sanitation technology, *International Water Association* (IWA) 2004 *Year Book*, 2004, 5 – 7

[18]. J. Broome, Designing sewers for reduced wastewater flows, *Paper Presented at the 35$^{th}$ International WO62 Symposium on Water Supply and Drainage of the Conseil International du Bătiment (CIB) WO62,* held in Dusseldorf, Germany, 7 – 9 September, 2009.

[19]. A. Nema, Simplified sewerage: an appropriate option for rapid coverage in peri-urban areas in India (reviewed paper 226), *34$^{th}$ WEDC International Conference, under theme 'Water, Sanitation, and Hygiene: Sustainable Development and Multi-sectoral Approaches, Addis Ababa, Ethiopia*, 2009

  

[20]. R. S. Kabange, and A. Nkansah, User-minded audit of peri-urban Kotoko community pour-flush latrine usage in Suame (Kumasi), Ghana, *International Journal of Recent Engineering Research and Development* **2** (9), 2017

[21]. C. Fonseca, C.Batchelor, P. Moriarty, A.Naafs, M.Snehalatha, R. Reddy, K. Nyarko, A.Klutse, C. Pezon, A. Potter, and J. Verhoeven, *A multidimensional framework for costing sustainable water and sanitation services in low-income settings: lessons from collecting actual life cycle costs for rural and peri-urban areas of Ghana, Burkina Faso,Mozambique, and Andhra Pradesh* (WASHCost Draft Report V1.0, IRC: International Water and Sanitation, 2010).

[22]. D. D. Mara, and A. S. P. Guimarães, Simplified sewerage: potential applicability in industrialized countries, *Urban Water* **1** (3), 1999, 257 – 259

[23]. P. Courtney, *Determining and economic solution to sanitation in Soweto, South Africa*, Meng. thesis, School of Civil Engineering, University of Leeds, Leeds, 2011.

[24]. M. Manga, *An investigative study to assess the life-cycle costs of low-cost sanitation technology options in the informal settlement and slum areas in Soweto (Johannesburg): focus on simplified sewerage system*, MSc. Thesis, The University of Leeds, Leeds, West Yorkshire, 2011

[25]. J. W. Foppen, and F. Kasiime, SCUSA: Integrated approaches and strategies to address the sanitation crisis in unsewered slum areas in Africa mega cities, R*ev. Environmental Science and Biotechnology***8**, 2012, 305 – 311.

[26]. P. Morgan, Beneficial partnership in rural water supply and sanitation – reflections, *Aquatic Procedia***2**, 2014, 63 – 69

[27]. D. Mara, and J. Broome, Sewerage: a return to basics to benefit the poor, *Municipal Engineer***161 (**ME4), 2008

[28]. R. S. Kabange, and J. Graham, Community population density variation implications on sanitation system cost – the case of Kotoko community in Suame (Kumasi), Ghana, *Journal of Civil and Environmental Research***9** (2), 2017, 46 – 53 of The International Institute for Science, Technology and Education (IISTE)

[29]. D. Mara, Water sector in small urban centres: water supply and sanitation options for small urban centres in developing countries, *UN – Habitat Report on the Water Sector in Small Urban Centres*, 2006. http://www.unhabitat.org

## Author Profile

**Roland S. Kabange** is born in Navrongo (Ghana) to uneducated parents. Roland holds a PhD in Environmental Engineering (sanitation option) from The University of Leeds, West Yorkshire (The United Kingdom), MSc (Irrigation Engineering) and BSc. (Civil Engineering) both from Russian Peoples' Friendship University, Moscow (Russia). He also participated in a certificated Ecological Sanitation Course in Sweden, South Africa, and Ghana

He is the immediate past Head of the Department of Civil Engineering at Kumasi Technical University (KsTU) where he has been working as a Lecturer for the past two decades. Currently a Senior Lecturer, he has about fourteen (14) peer-reviewed publications to his credit, and attendedfifteen (15) relevant workshops and courses. Some of the publications include: Shared Sanitation Facilities – a Reality or Mirage?, American Scientific Journal for Engineering, Technology, and Sciences (ASRJETS), 2015); Community Population Density Variation Implications on Sanitation System Cost – The Case of Kotoko Community in Suame (Kumasi), Ghana, The International Institute for Science, Technology and Education (IISTE), 2017; and From The Great Bubonic Plague Outbreak to PUSH UP in Ghana, International Journal of Recent Engineering Research and Development (IJRERD), 2017. He is an Adjunct Lecturer with Ghana Technology University College (GTUC) in Kumasi (Ghana), and a Reviewer for The African Journal of Environmental Science and Technology (AJEST).

**Dr. Kabange** research interests include promotion of sustainable low-cost sanitation systems for low-income densely-populated peri-urban communities; knowledge, attitude, and practices (KAP) of sanitation; and greywater management and use.