Journal of Engineering and Applied Sciences 5 (2): 125-133, 2010
ISSN: 1816-949X

Improving Sanitation in Ghana-Role of Sanitary Biogas Plants

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Abstract: This study assesses the state of sanitation in Ghana from a global perspective and discusses policies and strategies for improving sanitation in Ghana. It outlines milestones of biosanitation programmes in Ghana, highlighting socio-cultural, technical and environmental challenges facing dissemination of sanitary biodigesters. The state of twenty sanitary biogas plants at various locations in Ghana is captured and problems and complaints from users are discussed. This study recommends the linking up of public toilets with biogas (anaerobic treatment) digesters as a way of improving communal hygiene and combating hygiene-related communicable diseases including cholera and dysentery. This study, however, cautions that such a project should come into gear only after solution to technical challenges such as inappropriate designs of latrines, inlet channels of biodigesters and effluent disposal systems are found. Social-cultural challenges such as the use of digested slurry in agriculture and irrigation and the use of gas for cooking must also be addressed. This study advocates for the development of a national biosanitation programme aimed at disseminating standardized sanitary biogas plants in Ghana with active involvement of the Community Water and Sanitation Agency and Metropolitan, Municipal and District Assemblies.

Key words: Sanitation, sanitary biodigesters, biosanitation, public toilets, communicable diseases, biogas, agriculture

INTRODUCTION

Global overview of sanitation: Sanitation is fundamental to human development in view of that sanitation-deprived people are confronted with dwindled opportunities to realizing their potential as human beings. Poor sanitation is among the greatest drivers of global impoverishment and inequality. The 2006 Human Development Report Beyond Scarcity: Power, Poverty and the Global Water Crisis drew the world's attention to the global crisis in water and sanitation by giving examples from developing countries to show the nexus between poverty and poor sanitation and water services (UNDP, 2006). During the World Summit on Sustainable Development in Johannesburg, the International Community reaffirmed their commitment towards the realization of the Millennium Development Goals (MDGs). One of the goals of the 2000 United Nations Millennium Declaration is to halve the proportion of people without access to safe drinking water and basic sanitation by 2015. The challenge to improving sanitation, as enshrined in the MDGs has been found to be more daunting as the world will need to provide improved sanitation to 125 million people each year in order to realise MDG 3 (UNESCO, 2007). According to UNDP (2006), >2.6 billion people in developing countries lack access to adequate sanitation as shown in Fig. 1 and 2 , moreover, >2.2 million people die each year from diseases related to contaminated drinking water and poor sanitation. Urban areas in Africa are known to have the highest number of the world's most life threatening environments due to the lack of basic sanitation infrastructure, according to a study of 116 cities; only 18% of households are

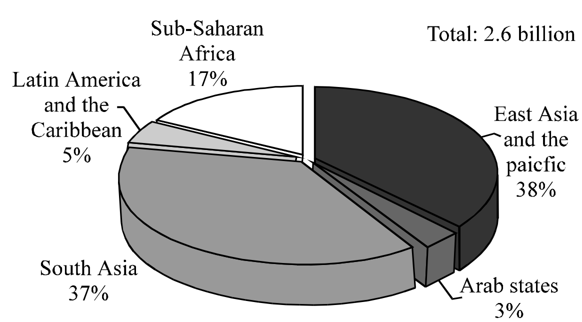

Fig. 1: People lacking access to improved sanitation in 2004 (millions) (UNDP, 2006)

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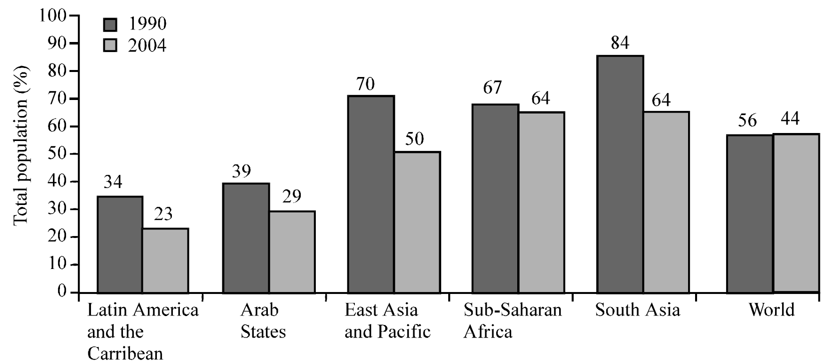

Fig. 2: Share of total population (%) of people lacking access to improved sanitation (UNDP, 2006)

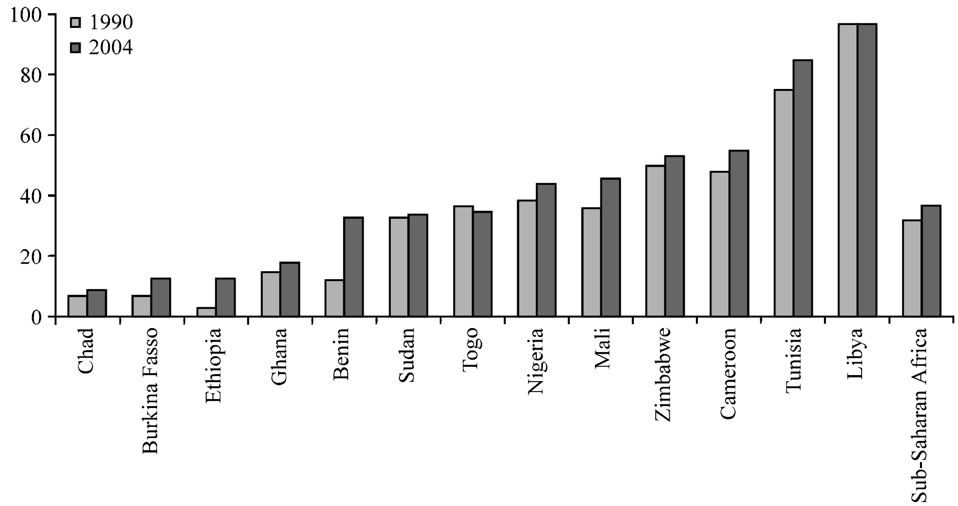

Fig. 3: Percentage of population with access to improved sanitation for selected countries in Africa. Based on data from UNDP (2007)

connected to sewers compared to Asia which has slightly >40% (UNESCO, 2007). Inhabitants of these areas frequently fall victim to hygiene-related diseases like dysentery and cholera.

The case of Ghana: In Ghana sanitation has become a major development issue in recent years. The UNDP in its HDR (2007) estimated that 82% of Ghanaians lacked access to improved sanitation at the end of 2004, a decrease of three percentage points of the 1990 figure of 85%. Ghana has not achieved much progress with regards to sanitation since 1990. Worse still, the 2004 figure of 82% is higher than the sub-Saharan average of 68% (UNDP, 2007). Figure 3 highlights the percentages of people lacking improved sanitation in Ghana and some African countries. According to former health minister of Ghana, Courage Quashigah, eight deaths are caused every hour in Ghana through poor sanitation whiles the Deputy Former Health Minister, Abraham Odoom is on record to have remarked that 80% of all ailments reported to health facilities are associated with inadequate sanitation and are therefore preventable (The Statesman, 2008). In 2007, diarrhoea was responsible for 425,250 outpatient deaths, making the illness the fifth most common mortal ailment in the country (The Statesman, 2008). The earlier assertions are also corroborated by the HDR of 2006 which identified the improvement of latrines as having the potential to increase child survival by 30% with flushing toilets bringing a far larger reduction in child mortality than pit latrines. The lack of adequate sanitation facilities in both rural and urban communities in Ghana is recognized in the Ghana Poverty Reduction Strategy (GPRS) II document which agrees that Ghana has lots of households with no access to improved sanitation (flush/ventilated improved pit). It also recognizes solid waste disposal as being one of the major problems in peri-urban and urban communities (NDPC, 2005). Ghana's sanitation woes can partly be attributed to extremely poor toilet facilities in both domestic and public places. This is clearly affirmed by the Human Development Report of 2006 which rank Ghana among countries with the poorest sanitation. Most public toilets are have been under undue pressure due to the fact that most houses in both rural and urban areas lack adequate toilet facilities moreover, overcrowding in cities and towns, insufficient housing units, illegal structures and streetism have worsened the problem (MWH/CWSA, 2004). Inhabitants of these communities thus rely solely on the public toilet, leading to undue pressure on the toilet facilities. Over usage of the toilet facilities compounds problems regarding the cleaning of the toilets. Inadequate cleaning of these facilities creates conditions that trigger the spreading of excreta-related diseases and infections. In a survey of the biogas potential of 25 Senior High Schools in Ghana, poor sanitation was identified as a major challenge in High Schools in Ghana with some schools recording as low as ten toilet seats to over 1100 students (Bensah and Arthur, 2009). Moreover, most schools visited had dilapidated closets and pit latrines in addition to scarcity of water.

MATERIALS AND METHODS

Policies and strategies for sanitation in Ghana: Ghana recognizes the significance of improved sanitation towards the creation of a healthy and happy people. This is affirmed in the GPRS II a policy document that spells out the country's commitment to fighting poverty. GPRS II sees improvements in sanitation as critical to the reduction of women's workload, improvements in school attendance and prevention of many infectious diseases such as cholera and dysentery (NDPC, 2005). With regards to sanitation, the overall goal of GPRS II is to ensure that all communities have access to adequate sanitation facilities by 2015. Improved sanitation is critical to achieving favourable health outcomes which in turn stimulates economic growth and sustained poverty reduction. GPRS II recognises the need to accelerate on-going programmes on sanitation. Table 1 shows the priority strategies intended to guide the delivery of improved sanitation under GPRS II.

GPRS II further recognizes the role of the Community Water and Sanitation Agency (CWSA). The CWSA is in charge of the implementation of the third Strategic Investment Plan (SIP 3) which aims at providing access to 85% (against the MDG target of 73.2%-reference) of inhabitants of rural communities and small towns with potable water and improved sanitation (KITE, 2006). SIP 3 was designed to support the effort of the National Community Water and Sanitation Programme (NCWSP) which is the medium to long-term national strategy to extending safe water and sanitation facilities to rural communities and small towns in Ghana.

The NCWSP aims at building capacity at the grass-root level and maximizing health benefits of rural folks by integrating water and sanitation promotion interventions such as the promotion of latrine construction capabilities at the village level. The NCWSP approach at combating poor sanitation allows for community participation in the choice of technologies that fit their needs. In addition, communities are empowered to own and manage their sanitation facilities (MWH/CWSA, 2004). This approach is commendable since majority of Ghanaians see the provision of sanitation as the responsibility of government (Nketiah *et al.*, 2007). In Table 2, the CWSA is expected to promote the construction of 1,099,609 latrines in households, communities and institutions. This is expected to considerably reduce the incidence of

Table 1: Key policies and strategies for sanitation under GPRS II

Policy objectives	Strategies
Accelerate the provision of adequate sanitation	Promote the construction and use of domestic latrines
	Improve the treatment and disposal of waste in major towns and cities
	Enforce laws on the provision of sanitation facilities by landlords
	Promote widespread use of simplified sewerage systems in poor areas
	Improve the management of urban sewerage
systems	
	Improve household and institutional sanitation
	Improve the treatment and disposal of waste in major towns and integrate hygiene education into water and sanitation delivery
	Rationalize and update District Assembly bye-laws on safe management of liquid and solid waste at the household level
Improve environmental sanitation	Promote public-private partnership in the management of solid waste
	Build capacity of District Assemblies to better manage environmental sanitation

NDPC (2005)

Table 2: Total water and sanitation systems and investments needed for 85% coverage by 2015

Activity	Units	Cost ($)
Household latrines	1,078,463	158,600,000
Community latrines	17,622	61,700,000
Institutional latrines	3,524	28,200,000
Total	1,099,609	248,500,000

MWH/CWSA (2004)

Table 3: Domestic biogas potential of selected African countries

Country	Potential (thousands)
Benin	254
Burkina Faso	876
Cameroon	488
Ethiopia	916
Ghana	278
Kenya	1259
Nigeria	2241

SNV (2007)

Table 4: How the objectives of B4BL link to the MDGs

MDGs	B4BL Objectives
Eradicate extreme hunger and poverty	Create 100,000 new jobs through the establishment of 800 private biogas companies and 200 biogas appliance manufacturing workshops
Achieve universal primary education	Construction of 1 million biolatrines in institutions including schools
Promote gender equality and empower women	Reduction of drudgery by 2-3 h per household each day in fetching wood, cooking and cleaning the pots
Reduce child mortality and	Improved health and living conditions for women and children, reducing
Improve maternal health	women and children deaths by 5,000 per year. Reduced health costs of around 80-125 US$ per family per year. Construction of biotoilets will reduce the incidence of diarrheal diseases
Combat HV/AIDS, malaria and other diseases	Improved sanitation for millions of Africans through the construction of biolatrines
Ensure environment sustainability	Reduction in the use of inorganic fertilizers due to the use of 80% of the bio-slurry as organic fertiliser. Savings of 6,400 tons of fossil fuel per year

excreta-related diseases thereby improving the public health of Ghanaians. CWSA has relied on local and improved pit-latrine technologies such as Ventilated Improved Pit (VIP) and Kumasi Ventilated Improved Pit (KVIP) in its dissemination programmes. Even though the VIP and KVIP technology hasm served as the main technology for public toilets in Ghana, it falls short in combating the spread of excreta-related diseases and does not seem promising to deal with hygiene problems of contemporary Ghana. The promotion and dissemination of the sanitary biogas plants will overcome this shortfall of the VIP and KVIP.

Biogas for Better Life (B4BL) an african initiative: B4BL is an African biogas programme targeting the construction of domestic biogas plants for >2 million households (over 10 million Africans) by the end of 2020 with an operational rate of 90% (SNV, 2007). It also aims at the construction of 1 million biolatrines. In Table 3, Ghana is said to have a domestic biogas potential of over 270 thousand plants. This programme was launched in Nairobi on May 2007 in a conference attended by 135 delegates from 27 African countries. The B4BL initiative will involve governments, private sector players, civil society agents and international development partners including, Inter Alia, Netherlands Development Agency (SNV), Department for International Development (DFID), Winrock International, Shell Foundation, African Development Bank (AfDB), Eastern and Southern Africa Management Institute (ESAMI) and West African Economic and Monetary Institute (EUMOA). Other noble objectives of the initiative (SNV, 2007; van Nes and Nhete, 2007) and its linkages to the United Nations Millennium Development Goals-MDGs (UN, 2000) are clearly shown in Table 4.

RESULTS AND DISCUSSION

Overview of biogas technology in Ghana: Biogas programmes in Ghana started in the 1970s but received very low interest from the Government and people of Ghana. Majority of the demonstration plants constructed broke down shortly as a result of poor design, poor maintenance culture and the indifference of beneficiaries who saw the technology as one for the poor (Ahiataku-Togobo, 2008; KITE, 2008; Bensah and Brew-Hammond, 2008). However, biogas technology was given attention in 1987 by the Ministry of Energy with the assistance of the Chinese Government and this catapulted with the introduction of the Appolonia Household Programme. Under this programme, a total of 24 domestic plants were built for some households at Appolonia. The MoE went further in 1992 and introduced the Appolonia Rural Biogas Project a programme that culminated in the construction of ten 50 m^3 digesters. The plant provided street lighting for the inhabitants in addition to the generation of organic fertilizer which was initially used for farming. Numerous challenges were encountered and they include, inter alia, problems with dung collection, low patronage of the two public toilets expected to provide feed material to supplement that from the dung, problems with costs associated with the running of the generators and refusal of farmers to use the digested slurry ostensibly due to cultural stigma associated with the use of toilet as fertilizer (Bensah and Brew-Hammond, 2010). Some farmers also avoided the use of the slurry due to the intense drudgery in collecting liquid fertilizer from the plant site to their farms. Even though the entire Appolonia project a programme which was to usher a new era of biogas technology in Ghana did not live up to expectation, the lessons learnt from its failures are expected to guide the development of Ghana's programme under B4BL. Apart from the MoE, biogas projects have also being promoted by GTZ, the Catholic Secretariat and a few private biogas companies. Not much was done by MoE until 1996 when it financed a national assessment of biogas resources in 5 regions of Ghana based on cattle population: Northern (45% coverage), Upper East (65% coverage), Upper West (60% coverage), Volta (30% coverage) and Greater Accra (30% coverage). Major findings and recommendations of the study are enumerated below (Ampofo, 1996):

- A total of 88,144 m^3 of biogas could be produced daily from dung which could generate about 107.7 MWh of energy daily
- Additionally, the Accra Metropolitan Authority (AMA) nightsoil treatment plants was capable of producing 33,600 m^3 of gas daily
- A grand total of 121,700 m^3 of gas could be produced and could replace of 138.8 tonnes of firewood daily

Ampofo (1996) did not estimate the fertilizer potential but Bensah and Brew-Hammond (2008) estimated a potential output of 360,000 tons of liquid organic fertilizer which is capable of fertilizing about 70,000 ha of irrigated farmland or 140,000 ha of dry farmland from the dung portion of the waste. Moreover, the potential health benefits derived from improved sanitation was also not captured even though Ampofo (1996) reported serious outbreaks of cholera and diarrhoea-related diseases due to faecal contamination of water bodies from overdependence on pit and KVIP latrines. Finally, Ampofo (1996) recommended the development of a national programme that champions dissemination of single household digesters for villages with scattered settlements, construction of demonstration units at livestock stations and slaughterhouses, construction of biolatrines in every regional capital of Ghana as a first step towards the ultimate replacement of all KVIPs with biolatrines, the development of new and efficient digester models using local materials for construction and introduction of anaerobic fermentation systems in the treatment of municipal waste. It is obvious that if Ghana had taken the aforementioned recommendations serious as far back as 1996, the country will not have been among countries with the worst sanitation as observed in the Human Development Reports of 2006 and 2008.

KITE (2006) recommended promotion of biolatrines in institutions and communities between 2005 and 2009, as a first approach in combating poor sanitation and reducing the incidence of excreta-related diseases and infections such as dysentery and cholera in Ghana. KITE (2006) further recommended construction of 1,670 6-seater communal biolatrines and about 800 10-seater instituational biolatrines at a total cost of US$ 45,649,000 between 2005-2009. A case was also made for the provision to the CWSA documented evidence from some pilot biolatrine projects undertaken by the Council for Scientific and Industrial Research (CSIR), private biogas service providers and the Ministry of Energy. This, KITE believed, would enable the CWSA to familiarize and adopt the technology as part of its sanitary interventions. Whiles public education in communities and institutions where biolatrines would be deployed as espoused by KITE (2006) is important, it is noteworthy to enumerate the real challenges facing the dissemination of biolatrines in Ghana including poor designs of digester inlets systems, gas leakage problems, disposal/use of the effluent challenges, poor designs of toilet houses and the problems with flies. Experience from Ghana (Bensah and Brew-Hammond, 2010; KITE, 2008), Tanzania (SNV, 2007) and other countries show that poor designs of the inlet pipes lead to the sticking of excreta in the pipes causing aerobic decomposition and thereby producing bad gases which put off users.

In Mali, under the aegis of the Small Grants Programme of the Global Environmental Facility, biogas technology dissemination has progressed steadily in peri-urban areas of Bamako and has significantly contributed towards agriculture improvement, reduction in energy poverty and improvement in sanitation (Kaba, 2007). The success of Mali's pilot programme may be attributed to the promotion of a locally adapted prototype plant. This is what Ghana should do.

Future of biogas technology in Ghana: In a recent study in the assessment of domestic biogas potential of the Northern, Upper East, Upper West and Ashanti Regions of Ghana, under the larger programme of B4BL and financed by the Shell Foundation, KITE (2008) estimated a technical domestic biogas plant potential of 81,527 digesters which is about 71% of the total potential of 114,827 installations. This survey, together with Ampofo (1996)'s findings and the B4BL business document by SNV (2007) have supported the development of the domestic biogas potential of Ghana, contradicting arguments by some biogas experts who favour the dissemination of the technology mainly in institutions. It is obvious that the unattractiveness of biogas service companies to promoting the technology in cattle-raising terrains in Ghana can be attributed to the high cost of digesters which are far beyond the means of majority of rural cattle farmers. KITE (2008) reports the minimum cost of a 6 m^3 digester at $ 1,200 which is very expensive and beyond the means of rural farmers; according to Bensah and Brew-Hammond (2010), average cost of a 10 m^3 biogas plant range from $ 2,800-4,200.

Worse still, the absence of a concrete national programme on biogas technology has completely dwarfed the domestic biogas market. Biogas service providers, in an effort to survive have developed sound marketing strategies targeting institutions such as universities, hospitals, hotels, real estates and rich households in major cities including Accra, Tema and Kumasi to disseminate the technology. The focus is on sewage treatment. The effluent of most plants is usually post-treated in filtration tanks before it is discharge into surrounding bush or into the public drain. Bensah and Brew-Hammond (2008) have argued for the development of a comprehensive national programme under B4BL having a three-pronged approach: sanitation, energy and organic fertilizer (Fig. 4).

The sanitary biogas plant and the biolatrine: A biogas plant refers to any structure that is used to ferment organic waste anaerobically. A schematic of the fixed-dome plant is shown in Fig. 5 (Hohlfeld and Sasse, 1986). The anaerobic fermentation process generates two products: the digested slurry which is rich in plant nutrients such as nitrogen and biogas (gas consisting mainly of methane and carbon dioxide) which is combustible. When a biogas plant is constructed with the main aim to solving a sanitation problem, it is described as a sanitary biogas plant. Sanitary biogas plants are expected to treat organic waste for a period of time known as Hydraulic Retention Time (HRT), such that the effluent from the digester is safe for disposal into the environment since most of the pathogens present have been decimated and also there is an increase in concentration of dissolved nutrients, which provides farmers with an improved organic fertilizer or for composting. The HRT depends primarily on the digestion temperature and the type of waste been digested. Sasse recommends retention times of at least 30 days for plants digesting dung at a mean temperature of 28°C.

Experiences from Ghana, Tanzania, Kenya, China, India and Nepal show the importance of choosing correct retention times especially for the digestion of human excreta. The longer the retention time, the more complete the digestion process and the more pathogens are decimated. Principle micro-organisms such as Typhoid, Para-typhoid, Vibro-cholerae and Dysentery bacteria are destroyed in two weeks, whiles Hookworm and Bilharzia take three weeks; Tapeworm and Roundworm die only when the fermented slurry is sun dried. Bensah (2009) recommends a minimum of 60 days for design of plants that handle of nightsoil in Ghana under mesophilic temperature conditions.

The biolatrine (or biotoilet) is a special type of the sanitary biogas plant whereby the digester receives nightsoil from a community or institutional toilet; excreta enter the digester in a long drop without being mixed with water. The main advantage of the biolatrine is its ability to solve the sanitation problems of public toilets in

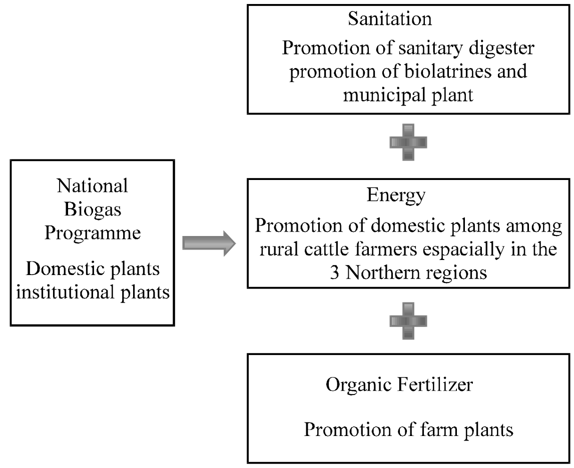

Fig. 4: Proposed three-pronged approach for biogas technology dissemination under B4BL (Bensah and Brew-Hammond, 2008)

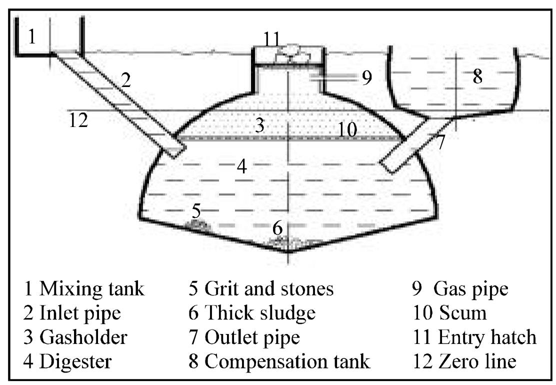

Fig. 5: The fixed-dome plant (Hohlfeld and Sasse, 1986)

communities where water is scarce. The biolatrine can provide a viable solution to the public health and environmental problems posed by improper solid waste disposal. It can also help provide organic fertilizer for agricultural uses. Furthermore, the gas produced from the biolatrine can be used to generate energy for cooking, water heating, lighting and for laboratory experiments in institutions. Even though the biolatrine is generally accepted, the use of the effluent for agricultural purposes and the use of the gas for cooking are among the greatest challenges that must be dealt with. The technology has thus been piloted in institutions such as schools, hospitals, prisons, etc. where it has generally gained acceptability (KITE, 2006). The shortcomings of biolatrine technology are expected to change with the implementation of the Biogas for Better Life initiative for Africa.

Table 5: Major characteristics of sanitary plants visited

Beneficiary/ Location	Operational	Observation
KNUST[a]slaughter house	No	Plant broken down due to scum formation
Tepa slaughter house	No	Plant abandoned due to poor siting of plant
Ejura slaughter house	No	Breakdown of gas appliance, breakdown of digester
Trasacco Valley Estates, Accra	Yes	Lack of maintenance
Time Office, Anglogold Ashanti Ltd. (AAL) Obuasi	Yes	Good maintenance, post-treatment of effluent
Time Office, AAL, Obuasi	Yes	Good maintenance
Anglogold Hospital, Obuasi	Yes	Good maintenance, post treatment of effluent
Holy Family Hospital, Nkawkaw	Yes	Breakdown of post-treatment plant
Eastern Regional Hospital, Koforidua	Yes	Bad smell of the effluent due to poor digestion
Ofori-Panin High School, Koforidua	No	Poor design of biolatrines
Valley View University, Oyibi	Yes	Effluent is not used due to safety concerns
Kinder orphanage Prampram	Yes	Frequent choking of digester inlet
Central University College (CUC)	Yes	Part of the treated effluent is used to flush toilet
GIMPA*, Accra	No	Plant under construction
Kaase Community, Kumasi	No	Poor design responsible for plant collapse
Private residence Dome (G)	Yes	No problem observed
Abeman/Oshiuman Community	Yes	Gas leaks into the toilet house causing discomfort
Beta Construction Ltd., Accra	Yes	Good maintenance
Accra Psychiatric Hospital	Yes	Bad smell of effluent due to inadequate digestion
Adullam Orphanage, Obuasi	Yes	No observed problem

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State of sanitary biogas plants in Ghana: The total number of biogas plants constructed in Ghana is unknown but an updated data from that obtained by Bensah (2009) puts the number of plants at 200. The actual number may well be over 200 plants since some individuals and small companies have also been building biogas plants. Nevertheless, the actual number of installed plants is extremely low compared to Tanzania which has over 4000 plants (Marree *et al*., 2007).

It has also been observed that majority of the plants have been constructed purposely to treat the sewage of households and institutions. In a study to assess the state of sanitary plants in Ghana, a total of 20 installations including 4 biolatrines in the Greater Accra, Ashanti and Eastern Regions of Ghana were visited from 2-16 June 2008 (Table 5). Observations and problems noticed are discussed. Out of 20 plants visited, 4 plants were broken-down, one was temporarily shut down due to design failure (Fig. 6a) and one was abandoned due to poor siting of plant (Fig. 6b). It was also observed that most plants had no trained caretaker to operate the plant. Of the three biolatrines visited, only the biogas plant at Abema in the Greater Accra Regionn was working and the others had broken-down. The major problem with the design of biolatrines pertains to the connection between the toilet seat and the inlet pipe of the digester. If faeces got stuck to the inlet pipe, aerobic digestion takes place and extremely bad smell is produced. The problem of aerobic decomposition was found to be the cause of the collapse of the Guinness-funded Kaase community biolatrine, due to the poor design of the inlet pipe. Even though, experiences from the Kaase project have led to improved designs, there are still problems with gas leakage through the inlet pipe into the toilet house.

Fig. 6: (a) A Broken down twin floating-drum plant at GIMPA; (b) Abandoned floating-drum plant at Tepa slaughterhouse

Gas leakage: Gas leakage is a serious issue. In addition to the discomfort and Asphyxiation caused by inhalation of the gas, there is the potential of fire outbreak since mixtures of biogas and air in some concentrations can be very explosive and may cause damage to human life and property. Moreover, leakage of biogas which contains about 60% methane into the atmosphere offsets any environmental gains made by putting up the plant. Out of the 14 plants that were functioning, 3 of them had gas leakage problems.

At the Holy Family hospital, Nkawkaw, the balloon gasholder is completely deteriorated and gas leaked freely into the air making the biogas stoves completely useless. At the Abeman biolatrine in Greater Accra Region, gas leaked into the toilet chamber through the inlet pipe. Flaring of gas was only done for plants at Anglogold Ashanti Limited, due to the presence of a well trained caretaker.

Effluent (digested slurry) usage: It is obvious that biogas plants built with the ultimate aim of generating organic fertilizer are rare in Ghana. The digested slurry is not seen as a resource and most plants discharge their effluent into the nearby bush or the public drain. Some plants have systems designed to pump the treated effluent for use in flushing toilet. Even though water is conserved, there is the need to conduct a comprehensive analysis of samples of the effluent in order to determine the efficiency of the digestion process of sanitary plants in Ghana especially for plants where the effluent is used for flushing toilet.

Effluent from biolatrines has not been used as fertilizer because of cultural attitudes towards the use of human excreta as manure. In a study to assess the performance of biogas technology in Tanzania, Kellner advocates for the use of the effluent from biolatrines as fertilizer in the cultivation of fodder grass. This approach, if adopted in Ghana will eliminate the stigma regarding the use of human manure in agriculture.

CONCLUSION

Sanitary biogas plants have numerous merits such as nutrient recovery, clean energy provision and hygiene improvement. Biolatrines are currently being deployed successfully in several countries in Asia and Africa and Ghana cannot be left out. There is the need to develop standardized and affordable digester models that are capable of contributing significantly towards sanitation improvement in both urban and rural Ghana. Models to be deployed in slaughterhouses must possess the capability to deal effectively with scum. The development of standardized models must take into account the cost of construction biogas plants and biolatrines which are currently relatively expensive and therefore beyond the means of most households in the country. Problems regarding leakage of biogas into the toilet house must be dealt with. It appears biolatrines are constructed in Ghana without any provision made for the utilization of the gas. Non usage of gas for several days create high pressures in the gasholder, forcing the gas to leak through any available space such as the inlet pipe, the manhole and the exit pipes. Moreover, there must be adequate and safe effluent disposal systems; premium must be given to the use of effluent in growing fodder grass for livestock or in composting. Finally, issues concerning the Retention time to be used in designing biodigesters for handling human excreta, dung and other livestock manure and slaughterhouse effluent must be addressed. It is only when standardized models are developed and tested to ascertain their performance in dealing with the problems facing biolatrines in Ghana should the CWSA consider promoting large-scale construction of biotoilets in Ghana as emphasized in GPRS II and as proposed by KITE (2006).

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