



MINISTRY OF SANITATION
AND WATER RESOURCES

MANUAL FOR EMPTYING BIODIGESTER TOILETS



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TABLE OF CONTENTS

| | | |
|----------|---|-----------|
| 1 | INTRODUCTION | 4 |
| 1.1 | Global and national context | 4 |
| 1.2 | Background | 5 |
| 1.3 | Rationale | 6 |
| 1.4 | Who should use this manual? | 6 |
| 2 | THE BIODIGESTER TOILET (Principles of Operation) | 8 |
| 3 | EMPTYING AND TRANSPORT | 10 |
| 3.1 | Conditions that may point to a biodigester which is full or needs servicing | 10 |
| 3.2 | Tools/equipment, materials and protective wears | 11 |
| 3.3 | Minimum operating standards for emptying biodigester toilets | 15 |
| 3.4 | Emptying the biodigester | 16 |
| 3.5 | Transport | 29 |
| 3.6 | Biodigester emptying and transport risk management | 30 |
| 4 | ENABLING INSTITUTIONAL AND REGULATORY ARRANGEMENTS | 33 |
| 4.1 | Licensing of faecal sludge emptying and transport | 33 |
| 4.2 | Monitoring of emptying and transport activities | 34 |
| 4.3 | Sanctions and penalties | 35 |
| 4.4 | Record-keeping and reporting | 35 |
| 5 | ESTIMATED QUOTATION FOR EMPTYING A STANDARD BIODIGESTER TOILET | 36 |
| 6 | References | 38 |

1.0 INTRODUCTION

1.1 Global and national context

Globally a huge number of people rely, for their sanitation, on non-sewered or onsite systems, which generate a mix of solid and liquid wastes generally termed faecal sludge. Faecal sludge (FS) is the general term given to undigested and partially digested slurry or solids resulting from storage or treatment of blackwater or excreta. In low-income urban communities and rapidly expanding cities, faecal sludge represents a growing challenge, generating significant adverse public health and environmental risks. Without proper management, faecal sludge is often allowed to accumulate in poorly designed pits, is discharged into storm drains and open water bodies, or is dumped into waterways, wastelands, and unsanitary landfill sites. Only a small percentage of faecal sludge is managed and treated appropriately.

The sanitation targets of the Sustainable Development Goals go beyond measuring how many people have access to an adequate toilet and define outcomes in terms of safe human waste management across the service chain in all settlement contexts along the rural-urban continuum. To meet SDG targets by 2030, it will be necessary to improve sanitation services, including the safe handling, treatment, disposal, and recycling of excreta.

Access to safe management of faecal sludge remains a challenge in many cities in Ghana, particularly in poor and informal neighbourhoods. Expanding sanitation systems like the biodigester in Ghana have helped reduce the amount of untreated sludge dumped into the urban environment. However, the way faecal sludge is currently managed needs to be improved.

1.2 Background

The Government of Ghana, acting through the Ministry of Sanitation and Water Resources (MSWR), is implementing the Greater Accra Metropolitan Area (GAMA) Sanitation and Water Project (GAMA SWP). The overall project development objective is to increase access to improved sanitation and improved water supply as well as strengthen the management of environmental sanitation in the GAMA and Greater Kumasi Metropolitan Area (GKMA), with emphasis on low-income urban communities. The original (parent) GAMA SWP was implemented from August 2014 to December 2020 in GAMA. Following the successful implementation of the parent GAMA SWP, the Ministry (MSWR) received additional financing to support:

- i. At least 550,000 people living in low-income urban communities within GAMA and GKMA, who will gain access to improved sanitation and water services.
- ii. Population of GAMA and GKMA in general, who will benefit from improved planning, implementation and management of environmental sanitation services and decreased pollution.

A key component of the project is the provision of improved household toilet facilities for low-income urban communities within the Metropolitan and Municipal Assemblies (MMAs) in GAMA and GKMA. The biodigester toilet is the dominant toilet technology under the Project, accounting for over 98% of all toilets constructed. The biodigester has gained much popularity since its introduction into the Ghanaian market in 2005 by Biofilcom. Under the parent project, about 28,000 onsite biodigester household toilet facilities were provided for low-income urban communities in GAMA and additional 42,000 onsite household toilets have been planned to be provided under the AF in GAMA and GKMA.

1.3 Rationale

Onsite sanitation systems (OSSs) are designed to store human excreta at or near households (onsite), where they may be treated and disposed of in situ or periodically removed and transported for treatment elsewhere. Safely managed sanitation includes safe excreta management at each step of the sanitation service chain. The sanitation service chain, therefore, describes the chain of activities that safely contain and remove excreta from the human environment. It includes storage (containment), collection (emptying), transport, treatment, and eventual disposal or reuse of Faecal Sludge (FS). This chain of sanitation services is collectively referred to as Faecal Sludge Management (FSM) (Medland et al., 2016). Achieving safely managed sanitation services requires that all parts of the service chain function sustainably so that excreta from sanitation systems are safely treated and disposed of (USAID, 2020).

The gains made towards sanitation coverage under the GAMA-SWP with the provision of the biodigester toilet are at the containment stage of the sanitation chain. Beyond containment, the faecal sludge should be safely emptied and transported for further treatment (if need be) or safely disposed of. This manual aims to provide technical details on the key steps of emptying the biodigester toilet.

1.4 Who should use this manual?

The intended primary users of this manual are sanitation technicians (artisans) engaged in biodigester toilet construction, emptying and transport. Further to these artisans, it is designed for government workers, international and local non-governmental organizations (NGOs), and agencies looking to venture into biodigester

toilets in peri-urban and urban areas. It can also be used as reference material for teaching and training on biodigester toilet technology.

2.0 THE BIODIGESTER TOILET (Principles of Operation)

The biodigester toilets are onsite toilets designed to rapidly separate human excreta from blackwater for degradation under aerobic conditions through the interaction of micro and macro organisms. The blackwater (raw excreta + flush water and anal cleansing material) undergoes rapid solid-liquid separation through a porous filter in the biodigester. Solid materials are retained on the porous filter, broken down aerobically by micro-organisms and macro-invertebrates. The effluent (liquid) after solid-liquid separation is biologically pre-treated and discharged directly into the subsurface soil via drain field pipes or soakaway. The biodigester is illustrated in the schematic below (Figure 1.0). The key features of the bio-digester toilet system that makes it attractive include: (1) relatively less space required for construction as compared to septic tanks or pit latrines; (2) relatively longer desludging or emptying frequency (3) the ability to convert faecal matter into soil conditioner and (4) relatively less expensive than conventional onsite systems.

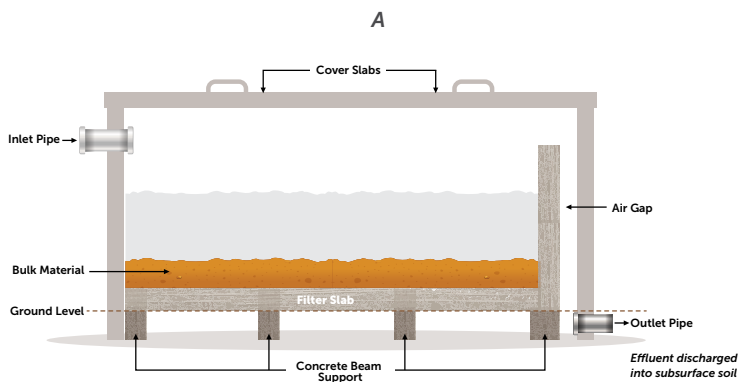


Figure 1:
A - Schematic diagram of the biodigester (Source: Biodigester toilet construction and installation manual, 2020)

B



Figure 1 B:
*Photo of a
biodigester
installation.*

3.0 EMPTYING AND TRANSPORT

The biodigester toilet is used to collect and store faecal sludge (FS). The stored FS undergoes some level of degradation and treatment and, with time, accumulates until the digester gets full. For biodigesters to continue functioning properly, they must be periodically desludged or emptied and transported for treatment. Collection or emptying refers to the deliberate removal of accumulated faecal sludge from biodigesters for transport to a treatment facility.

This section presents the process and minimum requirements for emptying and transport of faecal sludge from biodigester toilets.

3.1 Conditions that may point to a biodigester which is full or needs servicing

The following are conditions that may indicate that the biodigester need to be serviced or emptied.

Weak flushing

A weak-flushing toilet could mean a local clog or a full biodigester.

Gurgling sound

The sound of gurgling water usually means your pipes are backing up. If you hear gurgling noises coming from your pipes, your tank is most likely full.

Bad smell

Bad smells are usually coming from the toilet or around the biodigester. If you get a

whiff of a bad, sewage-like smell, it may likely be that the biodigester is full.

The wetness of the biodigester

Sometimes there is visible wetness, especially at the corners (joints) of the biodigester. This wetness may be seen to the upper (top) parts of the biodigester. In other cases, pooling water is seen around the biodigester.

3.2 Tools/equipment, materials and protective wears

The basic tools and materials used for emptying biodigesters are presented in Table 1.



| Tools/Equipment/ Protective Wears | Use | Photo |
|--------------------------------------|---|---|
| Tools/Equipment | | |
| Hammer | To gently break the mortar which holds the cover slabs in place. In case the mortar is hard, the hammer is used together with the chisel to break the mortar. |  |
| Chisel | To break mortar at the edges of cover slabs. Used together with the hammer. |  |

Table 1:
*Tools and materials
required*

Tools/Equipment

Hand
Trowel

To smoothen out
freshly placed
mortar.



Masonry
float

To level and smooth
mortar before the
final finish. Also,
to hold mortar for
application.



Long Hoe

This is especially
needed in emptying
standalone
installations to pull
back sludge under
the privy room for
easy scooping with
the shovel.



Shovel

To scoop out sludge
from biodigester and
mix mortar.



Tricycle

To transport sludge
off the site.



Wheelbarrow

To transport sludge to tricycle at locations not accessible with the tricycle.



Materials

Sand

To make mortar



Cement

To make mortar.



Nylon mesh (net)

Placed over porous concrete in case the existing one is damaged.



Polythene bags

In which Scooped sludge is placed for transport.



Liquid soap

For washing tools after emptying.



Protective Wears

Hand gloves

To keep hands clean and lessen the chance of coming into contact with disease-causing organisms



Protective coverall

For general body cover.



Hard hat

To protect the head from any potential injury while working.



Nose mask

To provide protection from inhaling obnoxious gases.



Protective footwear

To protect the foot from injury and contact with disease-causing organisms.



3.3 Minimum operating standards for emptying biodigester toilets

The following minimum operating standards shall be applied at all steps of the desludging/emptying process:

- i. Biodigester-emptying workers shall receive training on hygiene and standard operating procedures for desludging. This shall cover the handling of wastewater and/or faecal sludge, principles of transmission and prevention of faecal-related diseases and be equipped to follow standard operating procedures.
- ii. Emptying workers shall be provided with personal protective equipment such as an overall, hard hat, face protection, eye protection, boots, and gloves.
- iii. All direct contact with sludge must be avoided unless the worker is wearing gloves.
- iv. Two sets of working clothes shall be provided for each worker, which shall be dedicated to being used only during the emptying process. Clothes worn during the desludging process should be removed before the workers return home.
- v. All clothing (PPE and under layers) should be laundered daily, and all rubber boots and gloves should be cleaned with water and disinfectant such as lime and chlorine solution.
- vi. After removing their clothing, workers must take a shower before putting on their home clothes at the treatment site.
- vii. Workers should wash their hands with disinfectants such as lime, antiseptic or alcohol-based sanitiser before eating.
- viii. All workers should be provided with regular health checks, receive medical advice and treatment (e.g., deworming), and be adequately vaccinated

against potential infections (such as tetanus, polio, typhoid fever, hepatitis A and B (CDC), depending on the epidemiological context.

3.4 Emptying the biodigester

This section presents a step-by-step guide to emptying the biodigester toilet. For this manual, two types of installations are considered as follows:

“**Digester-only Toilet**”: refers to installations where the biodigester is offset from the privy room. In this type of installation, the full length of the digester is directly accessible.



Figure 2:
Digester only toilet

“Standalone Toilet”: refers to installations where about one-third of the digester is constructed beneath the privy room. In this installation, the full length of the biodigester is not directly accessible for emptying.



Figure 3:
*A stand-alone
biodigester toilet*

Before starting the emptying, the toilet users should be informed of the activity so that they do not flush the toilet while emptying. Preferably the inlet pipe into the digester should be blocked. Also, children should not be permitted to come close to the digester.

STEP 01

Opening of Digester (Removal of Cover Slab)

1. Carefully chisel off the mortar joint from the cover slab.



Figure 4:
Biodigester emptier carefully chiselling off mortar to open the biodigester

2. Take off the slab and gently place it on the long edge at a convenient location closest to the digester (to avoid contamination of surroundings, it should be as close as possible).



Figure 5:
Cover slab of biodigester being taken off.

STEP 02

Checking the Dryness of the Sludge

This is carried out to check if the moisture content is okay for desludging. If the moisture content is not okay, the cover slab should be placed back (do not seal with mortar) and left for 1 – 3 days for further dewatering and check the soak pit or drain field to ensure that dewatering of the digester is taking place. To determine if a biodigester sludge is ready for removal, the following should be carried out.

1. Place a dipstick vertically through the sludge mass until it hits the biodigester bed.



Figure 6:
Dipstick being inserted in sludge to check the moisture content

2. Gently pull out the dipstick from the sludge mass.
3. Suppose some sludge sticks to the dipstick; it indicates that the sludge is okay to be scooped. If not, the cover slab (do not seal with mortar) should be placed back and left for 1 – 3 days for further dewatering and check the soak pit or drain field to ensure that dewatering of the digester is taking place.



Figure 7:
Some sludge stick to the dipstick showing moisture content is okay for emptying

Note:

If the biodigester is found to be flooded (too watery), add some quantity of sawdust (depending on the water content) and leave for at least a day. The sawdust will soak up the water and make the content drier for easy scooping.

STEP 03

Scooping Sludge Out

1. Open a polythene bag and place it conveniently close to the digester. Preferably place one polythene into another to have a double film to make it firmer.



Figure 8:
Polythene bag to receive emptied sludge from the biodigester

2. Carefully scoop the sludge from the biodigester into the opened polythene bag to half full. Continue with another set of polythene until the entire sludge is entirely emptied from biodigester. For the standalone, use the long hoe to pull sludge from the front area to the back and scoop sludge.



Figure 9:
Content of biodigester being scooped out into the polythene bags



3. Carefully tie the filled polythene and place them close to the digester.



Figure 10:
*Polythene bag with
sludge being tied
carefully*

STEP 04

Washing of Digester

The importance of this step is to check the functionality of the net and pervious/porous concrete. The net and pervious/porous concrete allow rapid solid-liquid separation within the digester. Washing the digester also helps clear the pores within the net and pervious/porous concrete

1. Begin by pouring water over the net and pervious/porous concrete using a water hose or a bucket. Hold the bucket or hose about 0.5m above the concrete to apply some pressure without causing splashing.
2. Observe how the water passes through the porous media and check for any damage to the net. If the water percolates quickly through the porous media and the net is not damaged, the system is functioning well. However, if the surface is inundated and the net is damaged, both the pervious/porous media and the net must be replaced.
3. Clean the influent pipes by pouring water through the toilet access. This will remove any stagnant sludge or odours that may have accumulated in the pipes.
4. In cases where the porous media is completely clogged, the porous slabs may be removed and washed separately to remove any clogs. After cleaning, check the functionality of the slabs.



Figure 11:
Washing the digester by pouring water directly from the bucket.

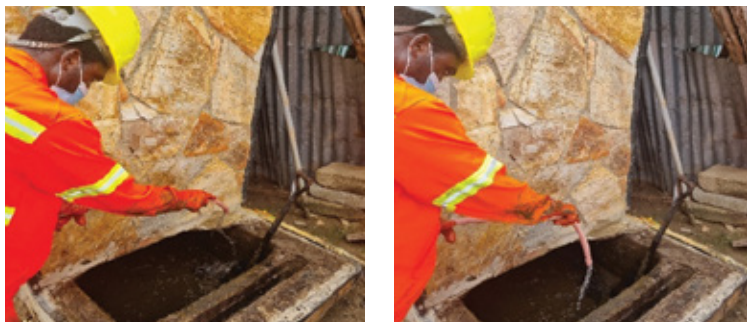


Figure 12:
*Washing the digester
using a water hose.*

STEP 05

Placing Bulking Material & Seeding Biodigester

1. Carefully place bulking material (coconut fibre or wood shaving) into the digester. This should be spread evenly in the digester. In the case of the digester only, place some bulking material in the basket. Place the basket directly beneath the inlet pipe.



Figure 13:
Placing bulking material into the biodigester



2. Seed the digester with some of the scooped sludge. The seed sludge should be spread evenly over bulking material (thinly).

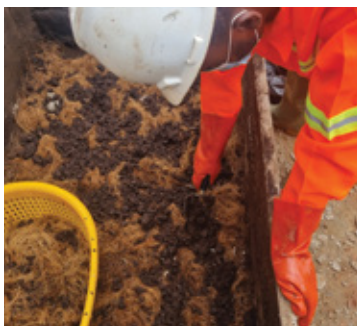


Figure 14:
*seeding the digester
with scooped sludge*

STEP 06

Covering the Biodigester (Placing the Cover Slab)

1. Carefully cover the biodigester with the cover slab(s).



Figure 15:
*Biodigester emptier
putting the cover
slab back in position
after emptying*

2. Seal the joints with mortar (mortar ratio 1:4)



Figure 16:
*Sealing the cover
slab with mortar
after opening for
emptying*

Note:

When foreign materials are found in the biodigester, training should be given to users of the facility on the dangers of introducing foreign materials and proper use.

To avoid contamination of the immediate environs, foreign materials should not be removed in situ, but this sorting should be carried out at the final disposal site.

3.5 Transport

1. Carefully place the bags containing the sludge in the trunk of the tricycle.
2. In areas where the toilet installation is not accessible by the tricycle, place the bags into a wheelbarrow and cart them to the tricycle.



Figure 17:
*Transporting
Scooped sludge off
the site.*

3. Emptied sludge shall be transported directly to the approved final disposal site without making unnecessary stops unless during an emergency.
4. The driver shall plan the emptying and transport of digester sludge to arrive at the disposal site within the specified site operating hours.
5. The driver shall follow all traffic regulations en route to and away from the final disposal site.

6. During the transport, the tricycle driver shall ensure that the sludge does not spill onto the road or the environment.
7. All biodigester sludge transporting vehicles or tricycles shall be equipped, always, with a disinfectant such as lime or chlorine bleach for cleaning the environment in case of spillage.

3.6 Biodigester emptying and transport risk management

Biodigester sludge must be emptied and transported to protect service providers, households, communities, and the environment. Biodigester sludge can be a major source of pathogens, such as bacteria, viruses, protozoa, and helminths, that cause diseases. Emptying as well can also pose safety and health risks, such as:

- i. Injury from opening and removing sludge from biodigesters.
- ii. Workers breathing in harmful gases from the biodigesters.
- iii. Contact with faecal sludge.

Many protective measures should be implemented when emptying and transporting biodigester sludge. The table below shows barriers that can be used to avoid the spread of pathogens and protect public health.

The barrier to protecting your health

Action



Use protective wears

Wear protective equipment such as clothing, gloves, boots and a mask. Clean and disinfect the wear used.

Table 2:

The barrier to protecting your health



Wash hands

Wash hands with soap after handling biogas digester sludge and equipment.



Clean tools

Disinfect the tools used for emptying and transport, and only use them for this activity. Safely store the tools, so people do not touch them or use them for another purpose. Wash off tools into the digester to prevent contaminating the immediate surroundings.



Clean and disinfect the area where biodigester sludge may have spilt.

Keep site clean



Train service providers on proper emptying and transport procedures and hygiene practices.

Train



Provide treatment for helminth infection to service providers and their families to stop the transmission cycle.

Deworm

4.0 ENABLING INSTITUTIONAL AND REGULATORY ARRANGEMENTS

The existing institutional and regulatory framework puts the municipal assembly (MA) as the regulator for emptying and transport of all forms of faecal matter within its jurisdiction. Their mandate will include but not be limited to licensing, monitoring and putting in place appropriate sanctions for private entities involved in emptying and transport of biodigester sludge.

4.1 Licensing of faecal sludge emptying and transport

- i. The local assembly shall be the sole authority to register the individuals or companies interested in emptying and transporting biodigester sludge in its jurisdiction.
- ii. The local assembly shall lead in a collaborative effort with the Private Sector to undertake Information, Education & Communication (IEC) campaigns and activities for the operators, including their staff, where they shall be sensitized and trained to employ best practices for safe emptying & transportation of biodigester sludge.
- iii. Once the individual or entity thinks that s/he complies successfully with the licensing criteria, s/he shall apply for it by requesting and filling out the licensing application form.
- iv. After an applicant has complied with all requirements, the local assembly shall issue a license to the individual or entity for emptying and transport of biodigester sludge to notified location(s).

- v. The license issued shall be valid for one (1) year from the date of issue, unless revoked earlier, and shall be renewable on its expiry subject to fulfilment of terms and conditions by the Licensed Operator and payment of a fee prescribed.

4.2 Monitoring of emptying and transport activities

To ensure safe emptying and disposal of biodigester sludge, an effective monitoring system should be put in place to monitor the activities of operators. The following system is proposed for effective monitoring.

- i. If the local assembly facilitates the training of individuals for emptying and transportation, all trained individuals should be duly registered and licensed with the local assembly.
- ii. If installers of the biodigester are involved in emptying and transport services, a formal servicing contract should be signed between the local assembly and the installers.
- iii. In both scenarios proposed in (i) and (ii), there should be a clear arrangement on licensing fees to be charged and the cost of emptying regulated by the assembly.
- iv. A desk should be created at the local assembly directly in charge of monitoring the emptying and transportation services.
- v. Assemblies should regulate the operations of emptying service providers by tracking their activities via GPS to identify indiscriminate dumping and permit corresponding penalties.
- vi. Assemblies should monitor backend processes to verify compliance with service level standards and customer perception through feedback to improve digester emptiers' service.

4.3 Sanctions and penalties

Operators who violate license conditions should be liable to sanctions as spelt out in the conditions of engagement.

4.4 Record-keeping and reporting

- Assemblies under which service providers operate must provide a computerized MIS platform record keeping and reporting.
- The Assemblies should ensure that the service providers keep detailed records of their operations, including information on households, type and location of the biodigester, age of biodigester, date of desludging, the quantity of sludge removed, user charges collected, accidents and spillages, and the next desludging scheduled.

5.0 ESTIMATED QUOTATION FOR EMPTYING A STANDARD BIODIGESTER TOILET

Biodigester toilets require regular emptying to ensure that they function properly. This may include checking and replacing parts as needed, cleaning the system and labour costs. The cost of emptying a biodigester toilet can vary depending on its size, location, and emptying schedule. The emptying cost can range from a few hundred to a few thousand Ghana Cedis.

The Key cost elements to be considered when estimating the maintenance of a biodigester are;

- Emptying costs
 - Polythene to hold sludge
 - Cement to seal biodigester after opening
 - Replacement of Nylon Mesh
 - Replacement of the filter media
 - Replacement of bulking materials (eg fibre, seeding with worms, sawdust)
 - Cleaning of the desludging site (bucket, mop, antiseptic/disinfectant etc)
 - Disposable PPEs (nose mask, hand gloves etc)
 - Optional cost for replacement of broken top slab of the biodigester.
- Emptying fee/service charge

Below are estimated quotations for the emptying of a standard biodigester toilet;

Table 3: Estimated cost breakdown for the maintenance of a biodigester toilet

| No. | Item | Amount (GHS)* | Remarks |
|----------|--|---------------|--|
| 1 | Emptying costs | | |
| 1.1 | Polythene to hold sludge | 20.00 | |
| 1.2 | Cement to seal biodigester after opening | 30.00 | |
| 1.3 | Replacement of nylon mesh | 10.00 | |
| 1.4 | Replacement of the filter media | 250.00 | Total change rarely happens. There was no report of a change of porous concrete. |
| 1.5 | Replacement of bulking materials (eg fibre, seeding with worms, sawdust) | 20.00 | |
| 1.6 | Replacement of broken cover slab of the biodigester | 250.00 | Total change rarely happens. There was no report of change of porous concrete. |
| 1.7 | Transport | 100.00 | |
| 3 | Emptying Fee/Service Charge | 200.00 | This includes amounts for the purchase of disinfectants for cleaning surrounding, PPE's, first aid and labour costs. |

*Amounts were as of December 2022. The costs may vary depending on the extent of maintenance activities required

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hand Washing Basin at
GHS 700.00

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at GHS1,200.⁰⁰

- No more toilet queues - Very convenient



For more information, contact
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