



LATRINE OPTION SELECTION GUIDE

By

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1 INTRODUCTION

1.1 What is a Latrine

A latrine is a safe and private place to be used for defecation. There are two types of latrine which are improved latrine and unimproved latrine. An unimproved latrine does not hygienically separate excreta from humans. This implies, in using unimproved latrine there is the high possibility of excreta coming into contact with human or users. Improved latrine on the other hand is a latrine that:

-  Breaks contact between humans and faeces
-  Prevents faeces exposure to insects and other vectors
-  Prevents contamination of water bodies
-  Prevents unpleasant odour
-  Well constructed, safe and easy-to-clean slab

1.2 Benefits of Using Improved Latrine

The use of improved sanitation facilities has a lot of benefits. According to a study by the WHO in 2012, for every US\$1 invested in sanitation, there is a return of US\$5.50 in lower health costs, more productivity and fewer premature deaths. Other benefits of improved sanitation are:

-  Promotes dignity and boosting safety, particularly among women and girls.
-  Acts as a barrier to transmission cycle of sanitation related diseases.
-  Promotes school attendance: girls' school attendance is particularly boosted by the provision of separate sanitary facilities.
-  Potential recovery of water, renewable energy and nutrients from faecal waste.
-  Improves health conditions of users and protects the environment.
-  Reduced smell and improves hygiene

1.3 Objectives of Latrine Option Guide

The selection of an appropriate household sanitation technology from a range of options is critical to the successful and sustainable operation and maintenance of any sanitation facility. The object of this latrine option guide is to provide information to assist households and institutions in the selection of the most appropriate household or institutional toilet technology for different conditions in the urban, rural and peri-urban settings of Ghana. It provides information on how to identify latrines according to the needs and ability of users and also serves as a means of communication in selecting latrine technology. In addition, it also provides information on the steps or processes to follow when selecting a sanitation facility for a household.

This decision guide may be used as an initial guide to select a suitable household sanitation technology option for implementation.

1.4 Who Can Use This Document?

This document is a guide for engineers, planners, local/District/Municipal Authorities, artisans, householders planning and all stakeholders in the sanitation sector to select an appropriate sanitation technology suitable to the context of their local environment. The

purpose of this guide is to assist local decision-makers, technicians and householders in the choice of sanitation technologies best suited to their location given the ground conditions, availability of space, water supply, available local materials and income level.

2 TYPES OF LATRINETECHNOLOGIES

Latrine types can be broadly split into two categories; on-site and off-site systems. Off-site systems are associated more with the developed world, cities and high density areas and often take on the form of sewerage systems which require a reliable water supply and the provision of wastewater treatment. Alternative on-site systems are isolated and provide some level of treatment or containment at the toilet location. However, on-site systems need regular emptying. On-site technologies can be grouped into two; dry and wet latrine technologies.

Dry toilets - A dry toilet is a toilet that operates without flushwater. The dry toilet may be a raised pedestal on which the user can sit, or a squat pan over which the user squats. In both cases, excreta (both urine and faeces) fall through a drop hole. Examples of dry systems include simple pit latrine, Ventilated Improved Pit (VIP), Kumasi-Ventilated Improved Pit (KVIP) latrine, Enviro Loo toilet, Ecological Sanitation toilet (Composting and Urine Diverting Dry Toilet),

Wet toilets – These are systems that rely on water to be functional. Wet systems could be off-site or on-site.

- On-site systems – With these systems human excreta are isolated, stored and treated on the site of defecation in a way that is hygienic and does not adversely affect the

environment. Examples of on-site systems include Pour flush toilets, water closet with septic tanks, Biofil toilet, biogas digester, aqua privy etc

- off-site systems—These systems often take on the form of sewerage systems which require a reliable water supply and the provision of wastewater treatment plants. Off-site sanitation systems generally involve the construction of long lengths of permanent infrastructure. Examples of off-site systems include conventional, simplified, condominial and settled sewerage systems . off-site systems are associated more with the developed world, cities and high-density areas.

2.1 Criteria for a Latrine

Latrine has a direct impacts on the health of users. In order for a latrine not to have negative health implications on its users, the following criteria has to be met:

- ✚ The surface soil should not be contaminated.
- ✚ There should be no contamination of ground water
- ✚ There should be no contamination of surface water.
- ✚ Excreta should not be accessible to flies or animals.
- ✚ There should be no handling of fresh excreta
- ✚ There should be freedom from foul odours or unsightly conditions.
- ✚ The method used should be simple, inexpensive in construction and operation.

2.2 Sustainability of a Latrine

Sustainable latrine is complementary to development. To make sustainability more specific, it should be adjudged according to:

Socio-Cultural Aspects - Latrine is mostly regarded as a socio-cultural issue rather than technical or economic. That is, a latrine must be accepted socially and should be able to adopt.

Health and Economy - There should be no health risk with the use of latrine. A latrine should be affordable to common people with least operation and maintenance costs. The use of improved is directly linked to improved health and productivity.

Technical function -Sustainability of any latrine depends on the technical function, ease of operation and maintenance. Recurring expenditure on maintenance of a latrine may be normally be feasible for majority of rural communities.

Environment –Improved latrine with a well-planned solid and liquid waste management does not just lead to an improved quality of life but also helps restore environment rather than disturbing the ecosystem.

The importance of above aspects varies widely depending on socio-cultural and economic aspects of the community and also with the nature and magnitude of the development work.

2.3 General Considerations for Selecting an On-Site Latrine

There are several latrine designs and technology options available for use by households. But several inter-related factors play important role in the selection and installation of a particular

toilet technology. In a given context, the technology choice generally depends on factors such as

- Affordability
- Hygiene and safety
- Land / Space Availability
- Geographical conditions
- Cultural habits
- Availability of water/scarcity of water
- Availability of skilled or semi-skilled labour
- Operation and maintenance requirements
- Type and quantity of input materials
- Availability of local materials

Below are detailed descriptions of some of the above mentioned criteria for selection latrine technologies

Land/Space Requirements

The land requirement relates to the required surface area available for installing sanitation facilities

- *Small/Low- Requires an area of less than 2m² to install the technology*
- *Medium – Requires an area of 2-4m² to install the technology*
- *Large/High – Requires an area greater than 4m² to be able to install the technology*

Degree of Skilled Labour

- *Unskilled- Requires on formal training*
- *Skilled – Require some level of formal training*
- *Highly Skilled – Require special formal training specific to the task*

Water Requirements

This requirement relates to the minimum amount of water that is required for the toilet system to function properly. The water requirements are categorized into;

- *Low – Requires less than 3litre of water*
- *Medium – Requires between 3-6 litres of water*
- *High – Requires an amount of water higher than 6 litres*

Capital Investment and Operation Cost of Technology

The cost of the technology is used to assess the financial effort required to install the technology. The operating cost assesses the recurring costs that need to be met by households/institutions to ensure the service functions correctly

- *Low-cost – Requires less than or equal to GHC 700 to install*
- *Medium-cost – Requires an amount between GHC 800-2,000 to install*
- *High-cost – Requires an amount greater than GHC 2,000 to install*

Maintenance Requirements

It is the technical skills required to ensure that facilities are kept in good working condition.

- *High maintenance requires the services of specialised engineer or technician to repair the system. If specialised technician is not locally available, the technology is not appropriate for the location.*
- *Low maintenance – means that the technology does not require the services of a specialised technician. The system can be maintained by local artisan or craftsman.*

Acceptability

- *High Acceptance – means households and sanitation professionals have no particular issue with the technology*
- *Low Acceptance- means households and sanitation professionals have some issues with some aspects of the technology (usually excreta handling, and hygiene conditions (odour, insects))*

2.4 Latrine Site Selection

Getting the location right is very important in ensuring the use of the facility, reducing risk to public health and environmental nuisance. Right positioning of the facility away from adverse environmental conditions can enhance the operational life. In selecting a site for a latrine, the location of wells and surface water sources, for example ponds, swamps, creeks, rivers etc. must be clearly established. The location of food markets, kitchen, cook shops and restaurants must be clearly identified. The following guidelines as simplified in figure 1 above shall be used for the siting of latrines:

For wet latrines, hydrological expertise should be sought; and the following factors should be considered: -

- A latrine must not be located over a surface water body and should be at least 100 feet (30 m) from the edge of the flood plain of a surface water body.
- Public latrines shall be at least 50 meters from nearest residence or as far as practicable.
- Latrines shall be sited away from trees to prevent obstruction of vent pipes.
- Latrines shall be constructed with enough space for vehicle access and movement during desludging.
- In the selection of soil conditions on which to construct the latrines, avoid (if possible) rocky outcrops, unstable ground conditions and depressions with shallow water table.
- Latrines shall be constructed with adequate drainage to ensure that rain water does not flood the pit.

3 LATRINE TECHNOLOGY OPTIONS

There are several technologies for disposal of excreta from households. Technology options can be broadly grouped as under:

1. Above ground called Superstructure: This part wholly consists of roof, frame and walls. In practice, however, these required parts will depend on the ability of the household or users.
2. On the ground called Slab: It covers the pit, and provides footrests. It can be made of any material which is strong enough to support the users
3. Underground called pit: It is an underground hole that can be square, round or rectangular, but a round pit is the strongest. Maximum depth depends on the soil conditions and groundwater levels in the rainy season. In unstable soils, the pit may have to be fully or partly lined with woven bamboo, bricks, concrete rings, etc.

Appropriate low cost on-site latrine technologies which are affordable, hygienic, culturally acceptable, environmentally friendly and sustainable are the best option for household.

The sections below describe some of the the available household toilet technologies and the criteria for selection

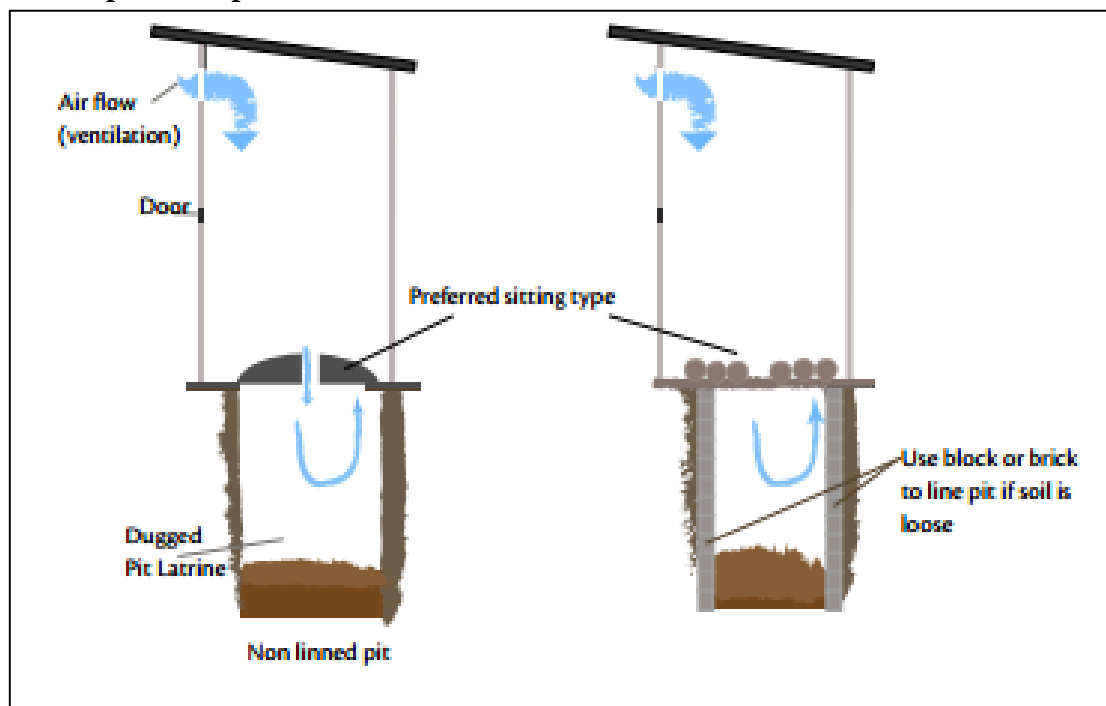
3.1 Simple pit latrines

Simple pit latrines are one of the oldest forms of formal sanitation in the world. The pit latrine is based on the use of a single dug pit to collect and store excreta.

An Improved Pit Latrine has two major components: an underground pit to accumulate the excreta, and the superstructure for squatting, protection from rain, sun etc., and privacy. The pit is covered either by concrete or plastic slab. The pit may or may not be lined. The drop hole on the slab is covered by a lid when the latrine is not being used. The superstructure is

made of locally available materials like bricks, wood etc. for the walls and thatch or corrugated iron for the roof. The user has the choice of material. This type of latrine is appropriate for rural and low-income urban areas, where it is mainly used as a household facility and for rural institutions. The cost for this type of latrine includes: materials, transport, and local labour. The cost of the latrine is dependent on the volume of the pit, quality of lining (when lining has been applied), slab and superstructure, the use of locally available materials, and the region of implementation (Tilley et al., 2014; UNICEF, 2006).

3.1.1 Graphical Representation



3.1.2 Criteria for Selection

- **Land requirement-** Small land area required
- **Ground conditions-** Suitable for permeable soils but not suitable for high water table or rocky soils
- **Degree of skilled labour-** skilledlabour is not required.
- **Water requirement-** Does not require water
- **O&M practices-** low cost of maintenance and can be repaired with locally available materials
- **Hygiene standard** -not hygienic since odour, flies and other insects are normally noticeable
- **Cost of technology-** the technology is affordable since the capital cost is low and it can be built with locally available materials.
- **End-use of sludge-** Sludge require secondary treatment before use or can be used at least 2 years after closing
- **Socio-cultural acceptability-** Acceptable but with possible health risk

3.1.3 Required Operation and Maintenance

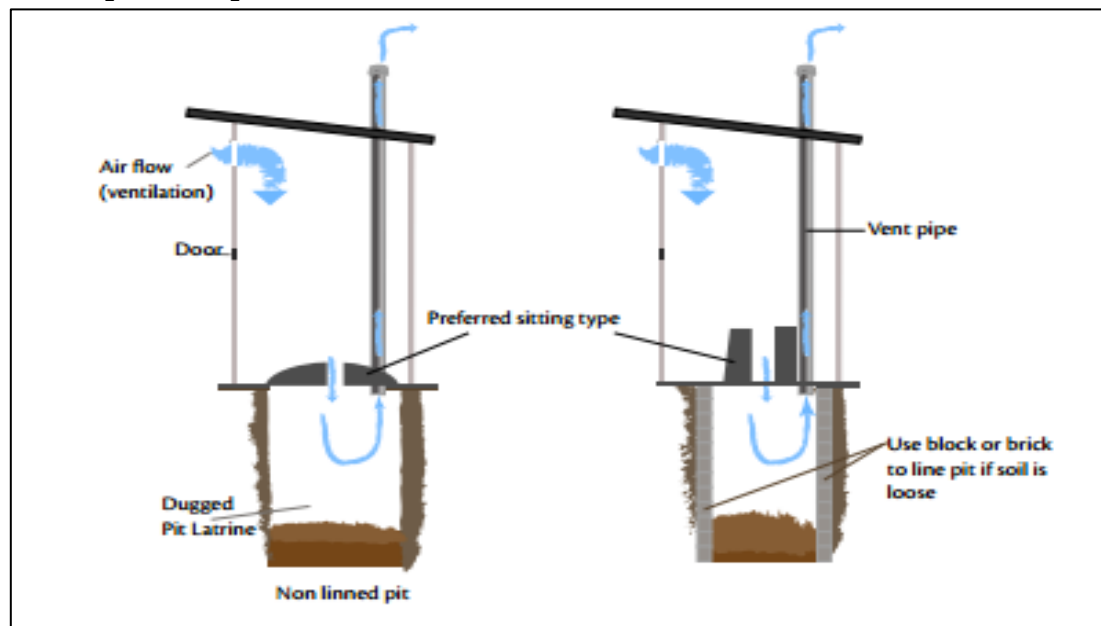
- The tight fitting lid has to be replaced after use to ensure insect control and smell reduction.
- Ash can be sprinkled in the pit to reduce smell and insect breeding.
- Non-biodegradable materials like stones, plastic, rags etc. should not be thrown into the pit as they reduce the effective volume of the pit and hinder mechanical emptying.
- Decision should be made on where to relocate the sludge; timely digging of another pit and transfer the slab and the superstructure to the new pit (where the slab and superstructure materials are reusable).
- The contents of an old pit should be covered with at least 0.5m of top soil to provide a hygienic seal.

3.2 Ventilated improved pit latrines (VIP)

A VIP latrine is similar to simple pit latrine with the advantage of having a vent pipe attached to the pit that ventilates out the foul air from the pit, with a fly screen attached to the vent pipe, it is able to control flies' nuisance. This is a much-improved version of the simple pit latrine; the design ensures that nuisance from odours, flies and mosquitoes is minimal. The design is simple and does not depend upon a regular water supply. An open drop hole and dark squatting space are desirable for effectiveness of air ventilation and flies control in the VIP latrines. A VIP latrine is appropriate for rural or peri-urban areas for household and public use. The cost for this type of latrine includes: materials, transport, and local labour. Just like the simple pit latrine, the cost of the VIP also depends on the volume of the pit, quality of lining (when lining has been applied), slab and superstructure, the use of locally available materials, and the region of implementation. The price of VIP latrine is higher than the Simple traditional pit latrine, because of the vent pipe. The VIP can be single or double, with each pit having its own vent pipe under one superstructure. In summary a typical VIP latrine should have the following basic components;

- the substructure (i.e. a pit lined or unlined),
- slab with a drop hole / squat hole
- superstructure (the toilet room with roof and latched door)
- Vent pipe with a fly screen, a single netted opening / window sited above the door to allow for adequate ventilation.

3.2.1 Graphical Representation



3.2.2 Criteria for Selection

- **Land requirement-** small land area is required
- **Ground conditions-** Suitable for permeable soils but not suitable for high water table or rocky soils
- **Degree of skilled labour-** moderately skilled labour is required
- **Water requirement:** does not require water
- **O&M practices-** can be repaired with locally available materials but cost of desludging can be significant compared to capital cost
- **Hygiene standard** – produce less odour, flies and other insects compared with the simple pit latrine
- **Cost of technology-** technology is affordable since local materials can be used. But capital cost can vary depending on the depth of pit.
- **End-use of sludge-** sludge require secondary treatment before use or can be used at least 2 years after closing
- **Socio-cultural acceptability** - Acceptable but with possible health risk

3.2.3 Required Operation and Maintenance

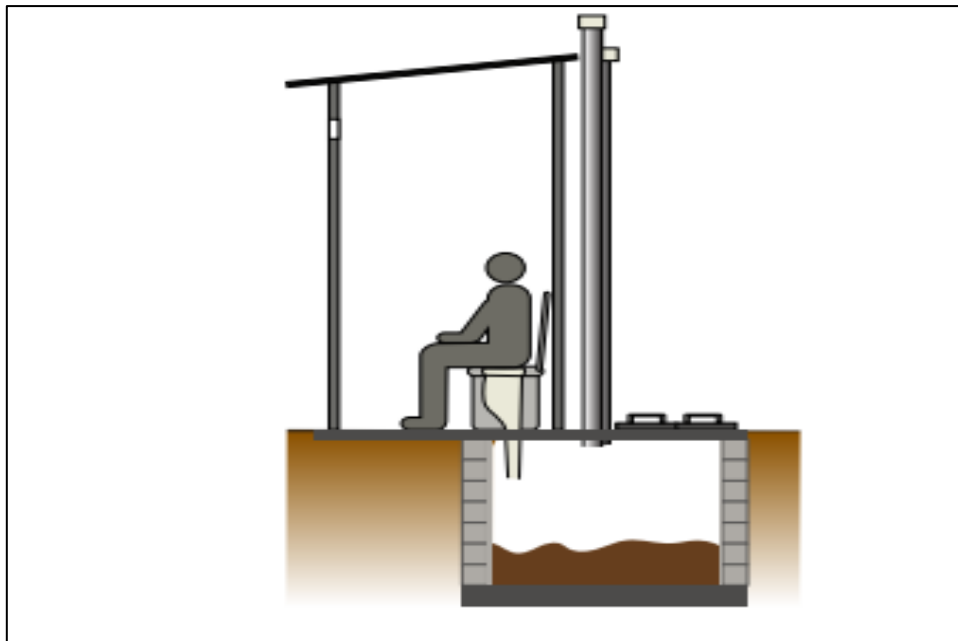
- The door must always be closed and the roof should be covered so the superstructure remains dark inside.
- The drop hole should never be covered as this hinders airflow. Appropriate anal cleansing materials should be available in or near the latrine.
- If the superstructure allows too much light into the vault through the squatting hole, flies will be attracted by the light to go up through the squat hole and fly out into the superstructure instead of going up through the vent pipe where they will be trapped by the vent pipe mesh cover.
- When the contents of the pit reach the 0.5m below the slab, a new pit should be dug and the old pit covered with top soil. The old pit could be emptied mechanically, but

this should not be done when the excreta is fresh, as this could pose a major health risk. In a twin pit system, the other pit (KVIP) can be used when one is full. The full pit can be emptied safely by hand after its contents have been standing for a year or more.

3.3 Kumasi Ventilated Improved Pit (KVIP)

The KVIP toilet is a double pit dry on-site system, which doesn't require water to operate. It is a VIP with double pits which are used alternatively. It has the advantage of an alternative pit that allows it to be used continuously and permits safer and easier desludging of sludge content in pit (Tilley et al., 2014).

3.3.1 Graphical Representation



3.3.2 Criteria for Selection

- **Land requirement-** Relatively large land area is required
- **Ground conditions-** Suitable for permeable soils but not suitable for high water table or rocky soils
- **Degree of skilled labour-** Moderately skilled labour is required
- **Water requirement:** Does not require
- **O&M practices-** Can be repaired with locally available materials but cost of desludging can be significant compared to capital cost
- **Hygiene standard** – Produce less odour, flies and other insects compared with the simple pit latrine
- **Cost of technology-** Cost of technology is high compared with the VIP.
- **End-use of sludge-** Sludge from system is not safe for immediate use but can be used at least 2 years after closing
- **Socio-cultural acceptability** - Acceptable without health risk

3.3.3 Required Operation and Maintenance

Same for Ventilated Improved Pit

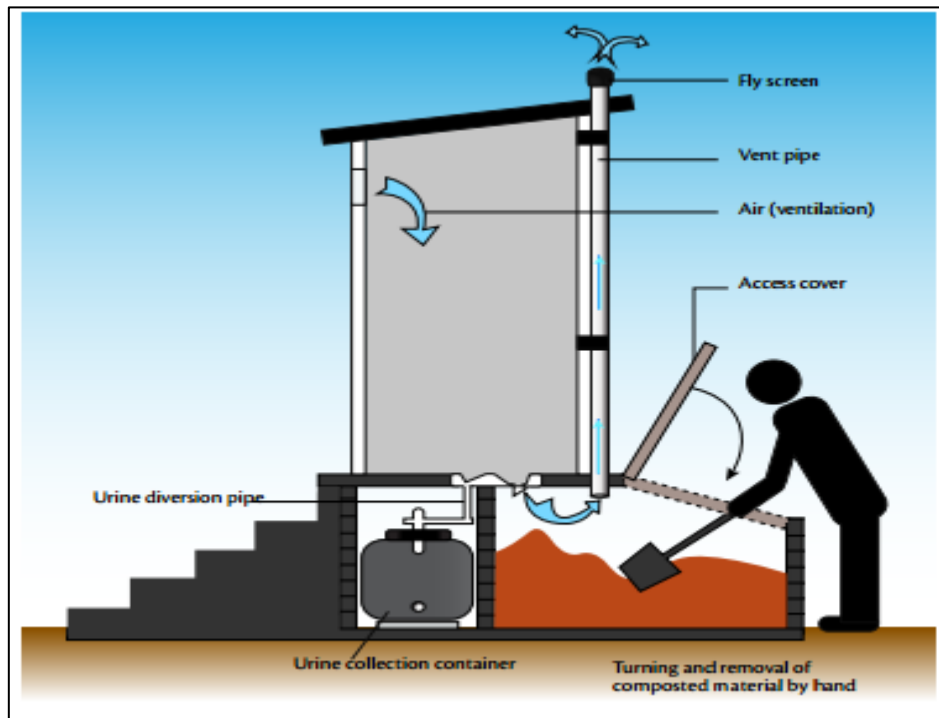
3.4 Urine diverting dry toilets/Compost latrines/Ecosan Toilet

An Ecosan (ecological sanitation) latrine allows the storage of urine, faeces and waste water from anal cleansing in composting (Ecosan) latrine. An Ecosan latrine is environmentally friendly, as it returns plant nutrients in human urine and faeces to the soil, thereby providing organic fertilisers and improving the soil structure, instead of polluting the environment. With the Ecosan technology, excreta disposed of is stabilized and often composted to recycle the nutrients for agricultural application. Ecosan toilets come in different options but the most common ones are the Urine diverting dry toilet (UDDT) and Compost latrine. The UDDT operates by using a dry disposal system in which urine and faeces are managed separately. Ash or sawdust or activated carbon is periodically added to the vault after every usage / visit. The design is such that one vault is used initially till it gets full and is sealed before the usage of the second vault commences. The volume of the vault is carefully computed to allow for at one to two years' storage to ensure that the stored waste can be re-used for agricultural applications without any pathogen load or pathogen load reduced to level that may not pose health risks to agricultural application. In order to effectively reduce the pathogen load or pathogen survival the following factors must be implemented:

- Longer storage time (between 1.5 to 2 years' storage) to be achieved by increasing the volume of pit or vault
- Increasing the pH within the pit to above 10 (by periodic addition of lime or wood ash; this though may have negative impact on the effectiveness of the final waste product that will be used as fertilizer.
- Reducing the moisture in the vault by efficient urine separation or retention of heat within vault to ensure evaporation of moisture. This could be achieved by prevention of creating many windows within the toilet superstructure so that temperature within will be above 36C.
- Provide conditions that will ensure the presence of other microorganisms (by adding soil containing fungi and micro-organisms capable of predation.

The advantages of this technology are reduced odour; ideal where the affected population normally uses Eco-San latrines and agricultural activity occurs; raised latrines can be used to prevent groundwater contamination.

3.4.1 Graphical Representation



3.4.2 Criteria for Selection

- **Land requirement-** Relatively large land area is required
- **Ground conditions-** Suitable for any ground condition including high water table or rocky soils
- **Degree of skilled labour-** Highly skilled labour is required
- **Water requirement:** Does not require
- **O&M practices-** Difficult to operate and maintain since faeces and urine removal must be done regularly
- **Hygiene standard** – No real problem with odour and flies if maintained correctly.
- **Cost of technology-** Investment cost of technology is high.
- **End-use of sludge-** Sludge from system is safe for immediate use since it is sanitized.
- **Socio-cultural acceptability** - Can be culturally difficult to accept but acceptable in areas where compost is in demand

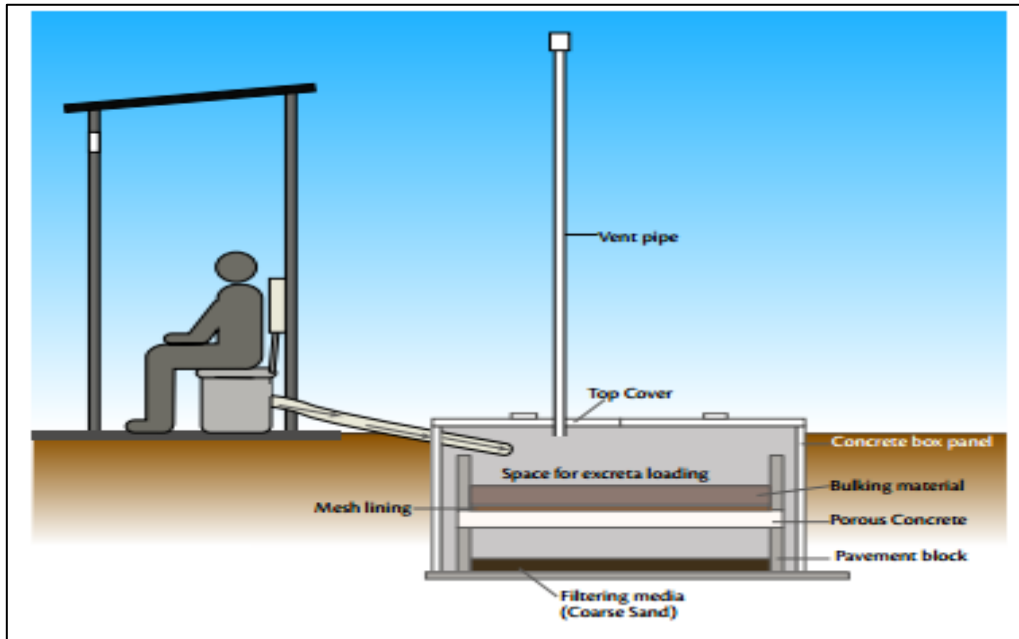
3.5 Biofil latrines

The Biofil toilet is a relatively new system developed in Ghana. The Biofil Digester is a simple compact on-site organic waste treatment system that uniquely combines the benefits of the flush toilet system and those of the composting toilets and eliminates the disadvantages and drawbacks of both systems. The Biofil Digester technology mimics the decomposition found under forests' floors and other natural environments. Living organisms (both microorganisms and macro-organisms such as earthworms) in an enclosed environment treats all organic degradable matter through the natural process of aerobic decomposition. It is designed to rapidly separate the liquid portion of excreta from the solid part using porous filter. The Biofil digester comes as a packaged system with a full or micro cistern using 9-12 or 0.15-1L of water for flushing.

Key features of the biofil toilet include the following:

- ❖ Sitting unit.
- ❖ Pedal for flushing excreta.
- ❖ Hand washing basin connected to squatting unit to serve as water seal.
- ❖ Biofil digester.

3.5.1 Graphical Representation



3.5.2 Criteria for Selection

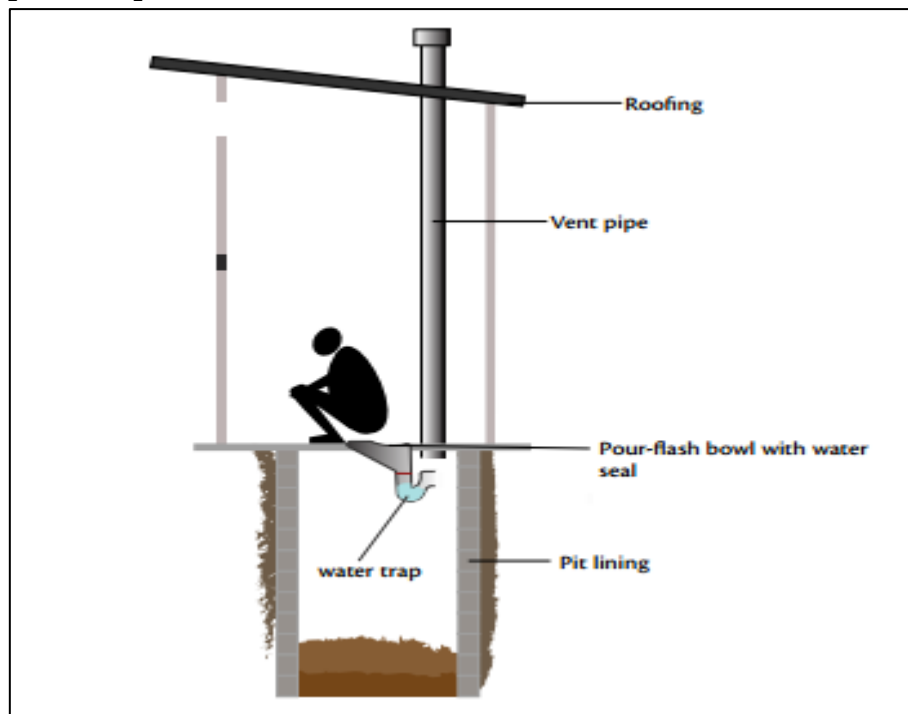
- **Land requirement-** Small land area is required
- **Ground conditions-** Suitable for any soil condition including high water table or rocky soil but not areas prone to flooding
- **Degree of skilled labour-** Highly skilled labour is required
- **Water requirement:** Requires about 1-2litres of water for flush
- **O&M practices-** Difficult to operate and maintain
- **Hygiene standard** – Very hygienic
- **Cost of technology-** The technology has high investment cost
- **End-use of sludge-** Low reuse potential since the technology produces less sludge
- **Socio-cultural acceptability** – The technology is culturally acceptable

3.6 Pour flush (Direct water sealed type and Offset water sealed type)

The pour flush toilet is similar to a water closet (WC) and has a squatting pan with a water seal, in addition to a leaching pit and the superstructure. The pour flush latrine relies on water to act as a hygienic seal and to help remove excreta to a wet or dry disposal system. The latrine pan is built to incorporate a shallow U-bend which retains the water as a seal. The squatting pan and the water seal can be fixed independently or on top of the pit. When the pan is fixed independently, a connecting pipe is necessary to convey the excreta with the flushed out water to the leaching pit. This type of on-site sanitation facility is appropriate for rural and peri-urban areas where there is sufficient water for flushing and the soil is

permeable. About 1 to 5 litres of water is required for flushing depending mainly on the pan design and the distance to the pit. In the operation of the toilet less water (about 1 – 5 litres) is needed for flushing. The amount of water required to flush the system will depend on the type and size of the water – seal construction. A 90 mm (3'') U- bend normally requires 2 – 3 litres to flush effectively, while a 120 mm (4'') U-bend generally requires 4 -5 litres to flush. The quantities are significantly less than the amount required to flush most water – closet toilets which may use as much as 10 - 12 litres per flush. With the pour flush toilet system, there is lack of odour and is ideal where water is used for anal cleansing. It has a reduced construction cost relative to ordinary flush toilet (i.e. WC with septic tank). The area of land required is less and the sub-surface drainage for soaking away the effluent is reduced (IDE, 2016; UNICEF, 2006).

3.6.1 Graphical Representation



3.6.2 Criteria for Selection

- **Land requirement-** Small land area is required
- **Ground conditions-** Suitable for permeable soil but not suitable for high water table or rocky soil.
- **Degree of skilled labour-** Moderately skilled labour is required
- **Water requirement:** Requires about 1-2litres of water for flush
- **O&M practices-** Easy to operate and maintain since it can be repaired with local materials
- **Hygiene standard** – Very hygienic
- **Cost of technology-** The technology is affordable since local materials can be used.
- **End-use of sludge-** Sludge from system is not safe for immediate use but can be used at least 2 years after closing

- **Socio-cultural acceptability** – The technology is culturally acceptable

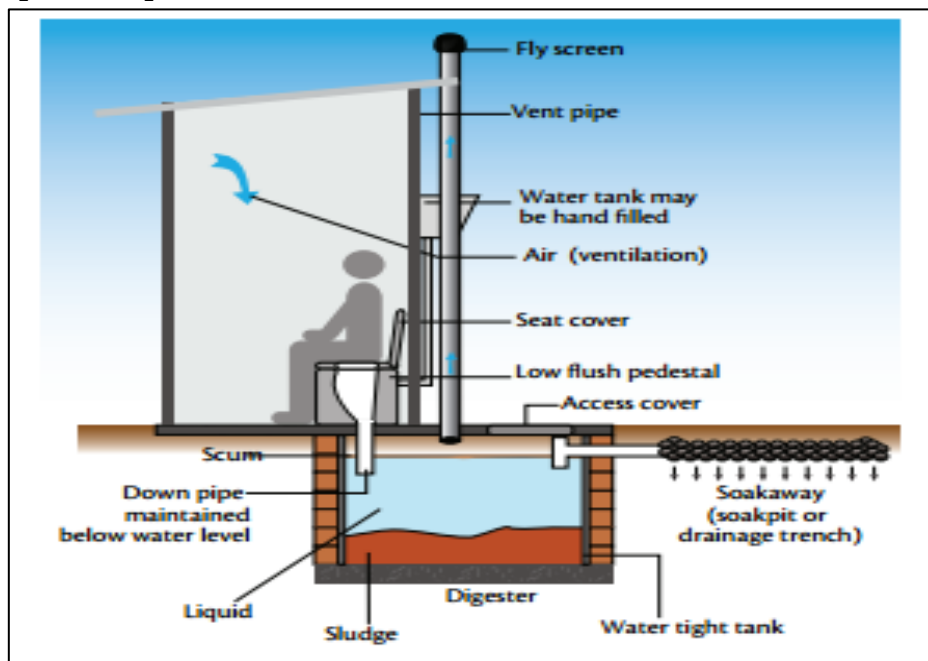
3.6.3 *Required Operation and Maintenance*

- Before use the pan is wetted with a little water to avoid faeces sticking to the pan.
- If water is scarce, laundry, bathing or any other waste water may be used.
- No material that could obstruct the U trap should be thrown into the pan.
- Wastewater from bathing or washing clothes should not be drained into the pit (unless used for flushing), but disposed of elsewhere.
- Rain water should not be allowed to enter the leach pits.
- Monthly checks of the pan and U-trap for damage, and the diversion box for blockage must be conducted.
- If the excreta are not flush away quickly, the PVC pipes or diversion box may be choked. Immediate unblocking using scoops and long twigs are recommended.
- Single pits have to be abandoned and covered with at least 0.5m soil when full, or be emptied by mechanical means.
- In a double pit system, the user should regularly monitor the level of contents in the pit.
- The pipe leading to the full pit should be sealed and the flow diverted to the empty pit.

3.7 *Aqua-Privy*

The aqua privy is basically a small septic tank sited directly below a squatting plate with a connecting pipe extending below the liquid level in the tank to form a simple water seal. To prevent odour, insects' nuisance in the toilet, the water seal has to be preserved by adding adequate water each time the toilet is used, through the connecting pipe to replace any losses. The excreta are deposited directly into the tank where they are decomposed anaerobically similar to a septic tank (WSP, 2007).

3.7.1 *Graphical Representation*



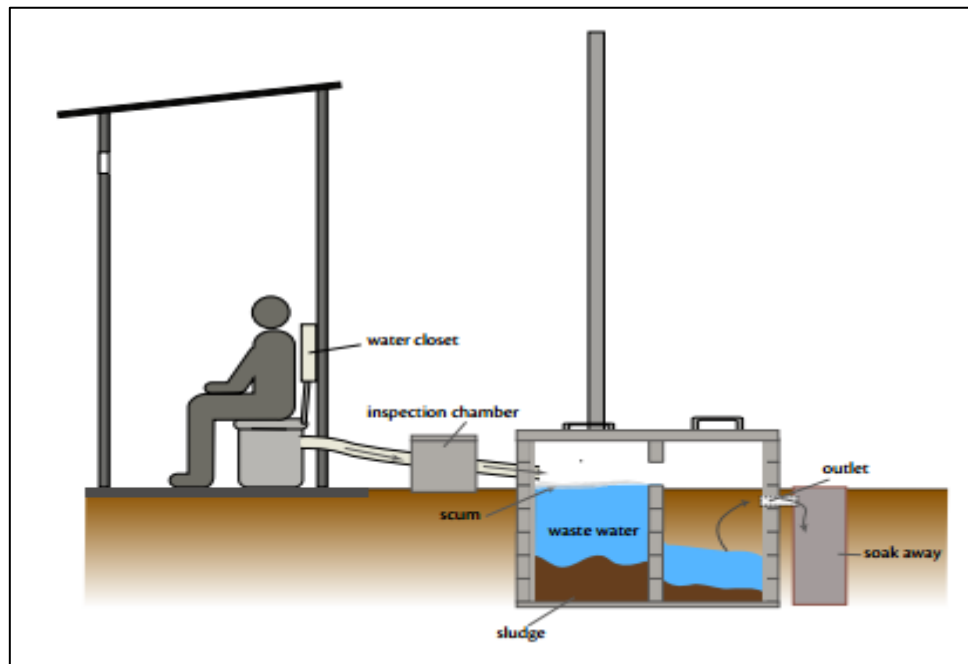
3.7.2 Criteria for Selection

- **Land requirement-** A considerable land area is required
- **Ground conditions-** Suitable for stable soil but not rocky soil and areas prone to flooding
- **Degree of skilled labour-** Highly skilled labour is required
- **Water requirement:** A small volume of water is used
- **O&M practices-** Not too difficult to maintain
- **Hygiene standard** – The system is hygienic
- **Cost of technology-** The technology has high investment cost
- **End-use of sludge-** Sludge from system is not safe for immediate use. Need secondary treatment.
- **Socio-cultural acceptability** – The technology is culturally acceptable with low health risk

3.8 WC with Septic Tank

Septic tanks are underground watertight tanks with inlet and outlet pipes designed to collect and store Blackwater and greywater. They usually constructed with two compartments that store and pre-treat wastewater (excreta and greywater) using settling and anaerobic processes. A concrete/sandcrete tank serve as a containment of sewage and allowed to decompose through bacterial activity and onward draining of effluent safely by means of soakaway. The conventional septic tank comes in different forms (regular rectangular or cylindrical) depending on the space available and the type of tank. The cost of the septic tank is hugely dependant on the size and environment for which it is installed (Monvois et al., 2010; Tilley et al., 2014; UNICEF, 2006; WSP, 2007).

3.8.1 Graphical Representation



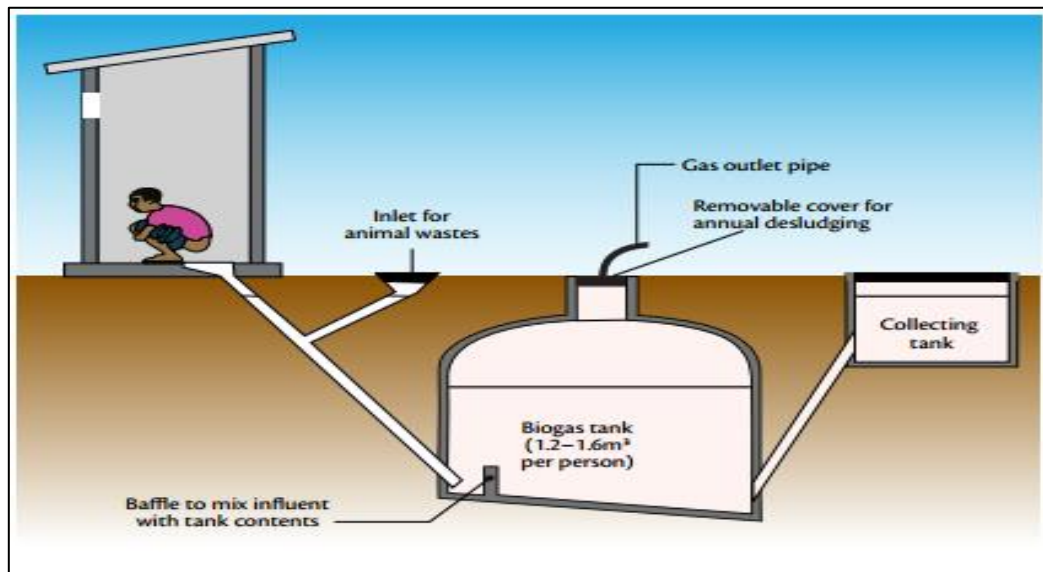
3.8.2 Criteria for Selection

- **Land requirement-** Large land area is required
- **Ground conditions-** Suitable for stable soil but not rocky soil and areas prone to flooding
- **Degree of skilled labour-** Highly skilled labour is required
- **Water requirement:** Requires large volume of water (10-15litres) for flushing
- **O&M practices-** Difficult and expensive to maintain
- **Hygiene standard** – Very hygienic
- **Cost of technology-** The technology has very high investment cost
- **End-use of sludge-** Sludge from system is not safe for immediate use. Need secondary treatment.
- **Socio-cultural acceptability** – The technology is culturally acceptable

3.9 The Biogas Digester

Biogas digester is an anaerobic technology that produces a digested slurry that can be used as manure and biogas that can be used for energy. The biogas reactor is an airtight chamber that facilitates the anaerobic decomposition of blackwater or sludge. The biogas that is produced is a by-product of anaerobic decomposition of organic matter, such as animal manure, human waste, sewage sludge, dried leaves, and crop residues. It is an alternative source of energy for use in household cooking, heating, lighting and for municipal and industrial use (Monvois et al., 2010; Tilley et al., 2014).

3.9.1 Graphical Representation



3.9.2 Criteria for Selection

- **Land requirement-** Large land area is required
- **Ground conditions-** Suitable for stable soil but not rocky soil and areas prone to flooding
- **Degree of skilled labour-** Highly skilled labour is required
- **Water requirement:** Requires considerable amount of water

- **O&M practices-** Difficult and expensive to maintain since it needs special training
- **Hygiene standard** – Very hygienic
- **Cost of technology-** The technology has very high investment cost
- **End-use of sludge-** Biogas generated is used as biofuel for cooking and power generation. However, Sludge from system is not safe for immediate use. Need secondary treatment.
- **Socio-cultural acceptability** – The technology is culturally acceptable

3.9.3 Required Operation and Maintenance

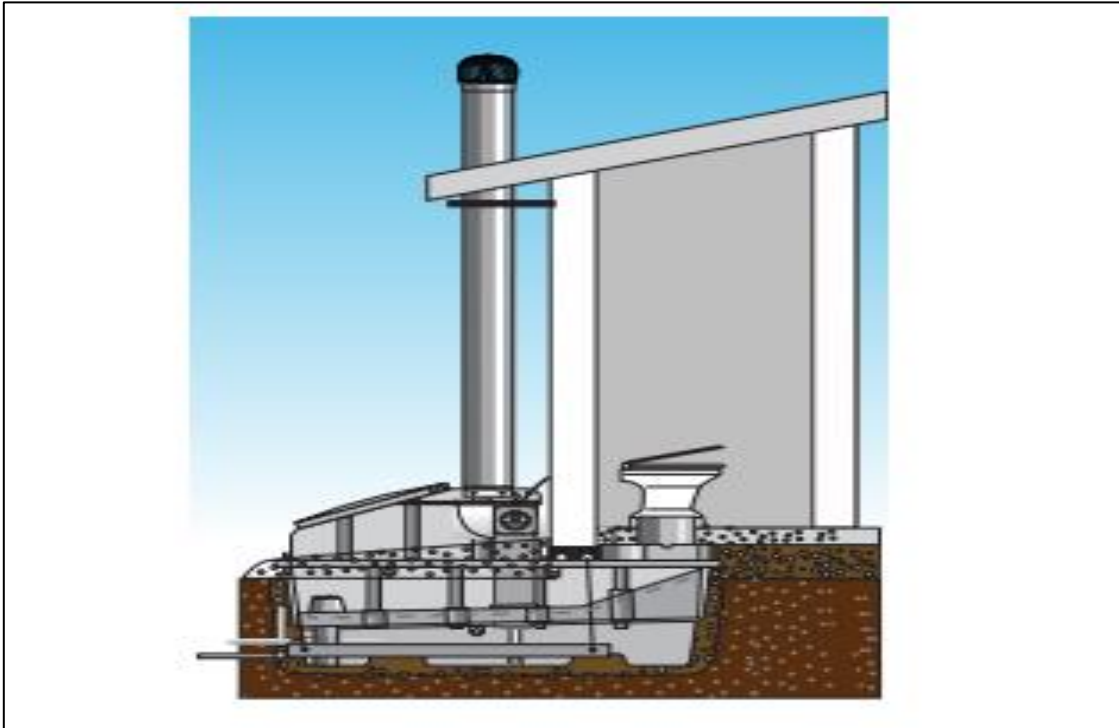
- If the reactor is properly designed and built, repairs should be minimal.
- To start the reactor, it should be inoculated with anaerobic bacteria, e.g., by adding cow dung or Septic Tank sludge.
- Organic waste used as substrate should be shredded and mixed with water or digestate prior to feeding.
- Gas equipment should be carefully and regularly cleaned so that corrosion and leaks are prevented.
- Grit and sand that have settled to the bottom should be removed.
- Depending on the design and the inputs, the reactor should be emptied once every 5 to 10 years.

3.10 Enviro Loo

The Enviro Loo is a dry or waterless sanitation system that employs a dehydrating process over a lengthy retention period with an ancillary, lesser composting process. It uses no water and chemicals. It enables the processes of dehydration and evaporation to occur naturally without any soil or water contamination as the decomposition takes place in a sealed unit. In the design there is no contact between people and the system. The annual maintenance and servicing costs are minimal.

The Enviro Loo comprise a superstructure, urinal evaporative tank, ventilation extracting unit, outlet vent pipe, vent pipe wall bracket, urinal bowl and toilet bowl.

3.10.1 Graphical Representation



3.10.2 Criteria for Selection

- **Land requirement-** A considerable area of land is required
- **Ground conditions-** Suitable for any soil condition including rocky soil and high-water table area.
- **Degree of skilled labour-** Highly skilled labour is required
- **Water requirement:** No water is required
- **O&M practices-** Difficult to maintain
- **Hygiene standard** – Very hygienic
- **Cost of technology-** The technology has high investment cost
- **End-use of sludge-** Sludge from system is safe for immediate use as manure.
- **Socio-cultural acceptability** – The technology is acceptable in areas where compost is in demand

3.10.3 Required Operation and Maintenance

- Initially, a layer of absorbent material (sand and gravel) is put in the vault and after each use, the faeces is covered with ash (or lime, sawdust, shredded leaves or vegetable matter) to deodorize the faeces, soak-up excessive moisture and improve the carbon/nitrogen ratio, which ensures that sufficient nitrogen is retained to make a good fertilizer.
- In a single-vault Ecosan latrine, when the vault is full, the contents should be removed to another composting location and should decompose anaerobically.
- In double vault Ecosan latrines, when the first vault is three quarters full, it is completely filled with dry powdered earth and sealed. The contents are left untouched for at least a year to decompose anaerobically and available for use as fertiliser. The second vault is used until it is three quarters full and the first vault is emptied by hand.

3.11 General Operation and Maintenance of Toilet

The overall management, operation and maintenance responsibility including replacement of household latrines lies with the individual household. The roles and responsibilities of the household towards operation and maintenance includes the following;

- The cleanliness and hygienic conditions of the household latrine shall be regularly maintained
- Pits shall be desludged or composted when the free board is reduced to 0.5m.
- Disinfectants shall not be put in the pits.
- Appropriate anal cleansing material shall be used and shall be put in the pit.

3.11.1 Basic Cleaning Tools, Equipment and Materials

Basic tools, equipment and materials required for cleaning toilets will include the following:

NO.	Item Description
1.	Scrubbing Brush
2.	Long Broom
3.	Local Broom
4.	Toilet Paper
5.	Gloves (pair)
6.	Wellington Boots (pair)
7.	Nose Mask
8.	Detergent/Liquid Soap
9.	Water Storage Containers
10.	Bucket (size 34, plastic)
11.	Handwash Bowl
12.	Cutlass

3.11.2 Required Frequency of Cleansing and Maintenance Activities

The required frequency for cleansing and maintenance activities for a household latrine will include the following:

NO	Activity	Frequency
1.	Sweeping	Daily
2.	Cleaning of Toilet Bowls & Drop Holes	Daily
3.	Cleaning of Walls and Floors	Daily
4.	General cleaning of Building & Surroundings	Weekly
5.	Weeding around facilities	As necessary
6.	Inspect and repair of technical components (Vents, nets, chambers, plumbing etc.)	Monthly
7.	Painting	As necessary
8.	General repairs of structure, chambers etc.	As necessary
9.	Emptying of pits, tanks etc.	As necessary

3.12 Household Latrine Selection Matrix

Household Latrine Selection Guide

	Latrine Technology Option												
Latrine Technologies													
Indicators													
Land Requirement	Low	Low	Low-Medium	Low-medium	Low-medium	Low-medium	Low-Medium	Medium	High	Low	High	Medium	Very Low
Degree of Skilled Labour	Low	Medium	Medium	High	Medium-High	Very high	Medium	Medium	High	High	Very High	High	Low
Ground Conditions	Suitable for permeable soils but not suitable for high water table or rocky soils	Suitable for permeable soils but not suitable for high water table or rocky soils	Suitable for permeable soils but not suitable for high water table or rocky soils	Suitable for any soil condition including rocky and high water table	Suitable for any soil condition including rocky and high water table	Suitable for any soil condition including rocky and high water table	Suitable for permeable soils but not suitable for high water table or rocky soils	Suitable for permeable soils but not suitable for high water table or rocky soils	Suitable for stable soils but not for rocky soils	Suitable for any soil condition including rocky and high water table	Suitable for stable soils but not for rocky soils	Suitable for stable soils but not for rocky soils	Suitable for any soil condition including rocky and high water table
Water Requirement	No water required	No water required	No water required	No water	No water required	No water	Medium (1-3 litres per use)	Medium (1-3 litres per use)	High	Medium (1-3 litres)	Medium	Low	Low
O&M practices	Easy	Easy	Fairly Easy	Difficult	Difficult	Difficult	Fairly easy	Fairly easy	Difficult	Difficult	Very difficult**	Fairly easy	Difficult
Hygiene Standard	Low	Medium	Medium	High	High	High	Medium	High	High*	High	High	Medium	High
Cost of Technology	Low	Low-Medium	Medium	High	Medium-High	High	Low-medium	Medium	High	High	Very High	Medium	Low
End-use of sludge	Not suitable for immediate reuse but can be used as soil conditioner at least 2 years after closing pit	Not suitable for immediate reuse but can be used as soil conditioner at least 2 years after closing pit	Not suitable for immediate reuse but can be used as soil conditioner at least 2 years after closing pit	Yes, safe reuse of excreta and urine as manure	Yes, safe reuse of excreta and urine as manure	Yes, safe reuse of excreta and urine as manure	No. Needs manual or mechanical desludging	Yes. Safe reuse of compost for agricultural purpose	Disposal of sludge and effluent could be a problem	Low reuse potential	Biogas generated is used as biofuel for cooking and power generation	Disposal of sludge and effluent could be a problem	Sludge can be composted for agricultural purposes
Socio-cultural Acceptability	Acceptable but with possible health risk	Acceptable but with possible health risk	Acceptable without health risk	Acceptable where compost is in demand	Acceptable where compost is in demand	Acceptable where compost is in demand	Acceptable but with possible health risk	Acceptable without health risk	Acceptable	Acceptable	Acceptable	Acceptable with low health risk	Acceptable with no health risk

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