COMPOSTING LATRINE HANDBOOK

EWB-Kenya and EWB at Montana State University

Updated July 2016



Introduction

This handbook is intended to aid in the operation and maintenance of composting latrines implemented by EWB at Montana State University in Khwisero. Engineers Without Borders (EWB) at Montana State University began our partnership with the Khwisero community in 2004, after receiving a project proposal from Ronald Omyonga, our project initiator. Our project defines our mission as "To give water and sanitation to all primary schools in Khwisero."

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Safety

Whenever the latrine is emptied it is very important that all the compost is contained throughout the process. The compost must reach the appropriate temperature before it is put on crops. You can **NOT** put the compost on any crops after it is emptied.

Personal Protective Equipment

Whenever the latrine is being cleaned, compost is being handled, or urine is being removed, **it is VERY important that you wear gloves.** If you do not wear gloves it is unsafe and you may get a very harmful disease. You must also wear close-toed shoes when emptying the latrine. After you are done handling the compost it is very important that you **wash your hands** as well! If you need gloves please contact Public Health Office (0715124656).

Composting Latrine Advantages over Pit Latrines

Composting latrines have more benefits than pit latrines. Building these composting latrines can help keep the groundwater clean which helps keep school children and staff without disease. Long term composting latrines are better than pit latrines.

- Cleaner conditions for students and staff.
- No danger of falling into latrine.
- Never needs to be moved, rebuilt, or re-dug.
- Pit latrine holes leave unsanitary and unstable ground after use.
- Produces fertilizer that can be sold or used on crops.
- Building is stronger and nicer.
- Lower chance of groundwater pollution.
- Incinerator can burn feminine waste and other waste.
- Smells better and keeps flies away.

Pit Latrine Advantages over Composting Latrines

Construction and use of pit latrines is simpler than composting latrines.

- Costs less initially.
- Building is cheaper but lower quality.
- No education required for use.
- Simpler to use and maintain.
- Can also be used as a garbage pit.



Figure 1: The pollution from pit latrines.

Composting Latrine Overview

Management

EWB partners with primary schools to construct a composting latrine. Once completed, the school is fully responsible for the cleaning, maintenance, and repairs of the latrine.



Design

A typical EWB-MSU composting latrine consists of 4-6 stalls over two compost collection chambers (2-3 stalls per chamber). Only one chamber is used at a time.

Each composting latrine has special features. A separate hole for urine feeds into a urine diversion system. An incinerator is used to burn feminine hygiene products. A rainwater catchment system on the latrine's roof feeds water into a handwashing station.

EWB-MSU often makes design changes for each new latrine that is built. These changes improve the structure, safety, and ease of use. EWB-MSU welcomes input on different aspects of the latrine from school officials, students, and the community. Community input is the best method to know all parts of the composting latrine are working the way they should be.

Figure 2: Example of a 2-chamber composting latrine.

Process Benefits

Composting is a very unique process that allows us to return the nutrients from our waste back to the soil. If done correctly, crops can grow better and healthier. When we eat healthier crops, we become healthier.

Farming takes nutrients out of the soil. It takes a long time for those nutrients to come back to the soil naturally. Artificial fertilizers are very expensive and often times wash away with rain. Compost provides nutrients for the soil naturally and is cheaper than artificial fertilizers. Compost also absorbs water and keeps it in the soil, available for plants to use.



Figure 3: The successful nutrient cycle.

Composting Timeline

The composting process occurs in three stages, filling, primary composting, and secondary composting. If the directions in this handbook are not followed correctly, the composting process will not succeed.

Filling the latrine is the first step to the composting process.

Next, the primary composting stage begins after a composting chamber is filled. In this stage, the compost is left alone for one year. Some harmful pathogens will be killed in this process, but not all. After one year, the compost can begin the secondary composting stage.

In the secondary composting stage, the compost is moved out of the chamber and mixed into a pile with bulking material such as dry grass, weeds, or corn stalks. The addition of bulking materials will allow air to enter the pile. The compost pile will heat up and kill the rest of the harmful pathogens. Cover the secondary compost pile to protect from rain. After two weeks of this stage, with care and maintenance, the compost is ready to be added to crops. The application of compost to crops is the last step of the composting process.

Filling the chamber.	Primary composting.	Secondary composting.	Put on crops or sell.
	1 year	1-4 weeks	

Latrine Operation

Before Use

Before using the latrine, line the compost chamber with about 15 cm of dry leaves or other dry plant material. This will help lessen the smell and make the compost easier to take out. Make sure there is at least two buckets to collect urine from the urine diversion system as well. Finally, make sure there is a bucket of dried plant matter such as leaves, grass, or ash in each stall.

After Each Use

Each time a student uses the feces hole, they should put enough handfuls of plant matter, like ash or grass, in the hole to cover the feces. Students should be reminded to **NEVER** put plant matter, solid waste, or **ANY** other solid down the urine diversion hole for **ANY** reason, as this will clog the system.

Every Day

The latrine should be cleaned daily. The floors should be swept with a broom. After sweeping, the floor can be wiped down with wet rags, if needed. Care should be taken to prevent water from going into either of the compost holes. If water gets into the compost chambers below, it will harm the compost. The urine diversion hole should be checked for any solid material such as sticks, mud, leaves, paper, or fecal material. If there is any solid material in the urine hole, remove it with gloves. The buckets containing the plant matter should also be refilled.

The urine diversion bucket should also be checked daily to ensure that it doesn't overflow or tip over. The amount of urine collected can change each day, so it is important to check the bucket daily even if not much urine was collected the day before.

Every Week

The compost chamber should be checked for excessive moisture or flies and to make sure that the students are adding a proper amount of plant matter. The hand washing station, gutter, and pipes should be checked for anything that could clog the pipe. If the latrine needs to be mopped, only use wet rags to clean the floor. But again make sure no water gets into the latrine holes.

Composting Process

After a Compost Chamber is Filled

A composting chamber is full once the compost is approximately 4 inches from the edge. The stalls and holes on the full side should be closed off for a year and students should use the stalls on the other side of the latrine. The holes **not** in use should be covered. **Make sure there is 6 inches of dry material on the bottom of the next chambers so they are ready for use.**

Primary Composting

Once a compost chamber has been filled, it should sit untouched for approximately one year. In this time, the compost will undergo its primary composting stage. Some pathogens will be killed and the compost will dry out a lot, making it smaller and lighter. After one-year, the compost should be dry enough to be removed from the chamber to begin the secondary composting process.

Secondary Composting

Secondary composting is the most important part of operation and maintenance of a composting latrine. Without secondary composting the human waste will be full of germs and will spread disease to school children, and adults in the community. If the secondary composting process is completed successfully, then human waste will be turned into germ free compost that is useful in agriculture. Remember that when dealing with the human waste before the composting process is completely finished, **proper protective equipment like gloves and practices should be used**. Also, remember to wash your hands after handling compost.

For more information on this look at page 3.

Secondary Composting

Selecting a Composting Area

The location of the composting area is very important. It should **NOT** be in an area that water runs through, should be placed far away from water sources, and should be kept outside. The pile should also be protected from students and animals. The pile should be fenced off, and covered from the rain. Be sure that water from the pile does not run outside of the fence. If students or animals have access to the pile in any way, then they could spread disease to the surrounding community.



Figure 4: A properly sized, covered compost pile.



Figure 5: The MSU Bobcats composting using bulking material

Temperature/Turning

The pile should heat up noticeably within four days of being created. It should get to a temperature of 50°C for a period of at least one day each time it is turned. The pile should get to this temperature every 2 to 4 days. Because only the top of the pile is usually hot, the pile must be turned so that every section of the pile spends some time at the top of the pile, where the germs are killed. After the top of the pile has maintained a temperature of 50°C or above for 1 day the pile should be turned. Below is a table of the amount of time spent at each temperature before the pile can be turned. It is important you try to reach 50°C, but 46°C can work. **You must turn the pile 4 times before putting on crops.**

Temperature (°C)	Duration (Time)
60°C	12 hours
50-59°C	1 day
46-49°C	1 week
30-44°C	Contact Jackson

Pile Size

Pile size is very important to the success of the composting process. Make sure the pile is at least 1 cubic meter in size. The pile should be about 50% bulking material, like dry grass, corn stalks, or plants, and 50% compost. If there is not enough material from the latrine to make a 1 cubic meter pile, do not proceed with the secondary composting process. The bigger the pile is the better secondary composting will be. A 3 cubic meter pile is better than a 1 cubic meter pile, and a 4 cubic meter pile is better than a 3 cubic meter pile.



Figure 6: Graph of safe composting temps.



When turning the pile, it should be stirred with the goal of transferring the outside and bottom of the pile to the middle. The pile should be turned every time it gets up to 50°C until it no longer rises up to this temperature. If the pile has reached the correct temperature 4 or more times, then it is safe to use. If the pile hasn't, then the compost should be carefully disposed of by burning it, like you would burn trash. If the pile fails to heat when formed please consult the troubleshooting section of the manual. Be sure to include temperature readings every other day from this process in the log.

Figure 7: Steaming compost pile from reaching temperature.

Urine Diversion

Human Urine as Fertilizer

The remaining urine from the urine diversion system can be used as fertilizer on crops after it has been diluted with water. Remember to put on gloves before handling the urine and wash your hands after. **The urine must sit in storage for 5 days before it can be put on crops**. Urine must be mixed with water, after storage, before it is put on crops. When diluting the urine the ratio of water:urine is 3:1. **3 parts water to 1 part urine**. For example, half a bucket of urine must be mixed with one and a half buckets of water. If the urine sits for more than 7 days it needs to be disposed of safely away from crops and children.

Storage of Urine

The urine from the urine diversion system should be stored in a place where animals and children won't get to it. The urine must be stored for 5 days and must be diluted with water to be safe to put on crops. The major disadvantage of storing urine for long periods of time is that it will start to smell and become unsafe.

Use on Compost Piles

EWB recommends saving some urine from the urine diversion system for use on secondary composting piles. Allowing the urine to sit for 5 days before adding it to a composting pile is ideal, but if the urine begins to smell or attract flies it can be added to the pile at that time.

Maintenance

Odor or Flies

If there is an issue with odor and/or flies in the composting latrine, the compost is probably too wet. Add dry leaves or ash to the pile to cover it and stop the smell.

Urine Diversion

If the urine diversion bucket is filling very slowly, the urine diversion pipes may be broken or clogged. **Put on gloves before handling urine and wash your hands afterwards**. First check all urine diversion holes for clogs such as dirt or plant matter. If no clog is found, the pipes may need to be visually checked from the composting chambers for major rusting or holes. If a hole is found in a urine diversion pipe, the pipe should be replaced as soon as possible by contacting a fundi. Patches may be able to temporarily fix small holes found in the pipes.

It is important that any issues with the urine diversion system get fixed in a timely manner. If urine leaks into the composting chambers, it may make the compost too wet to get to the correct temperature and complete the primary composting process. Contact a fundi yourself as soon as possible to make any repairs.

Incinerator Maintenance

Girls composting latrines include an incinerator for disposing of sanitary pads. The incinerator has access doors on the inside of the latrine for girls to place the waste privately. The waste is placed in the incinerator. The contents of the incinerator should be burned weekly by a designated teacher. The fire can be started using dry paper, sticks, twigs, dried leaves, or any non-plastic material. Depending on the age and amount of ladies using the latrine, the material in the incinerator may need to be burned daily. The sanitation teacher or member of the Composting Latrine Committee, who is responsible for dealing with the incinerator, will need to check the waste often in order to make sure it is not too full. It may not be necessary to remove the remaining ash after it is burned each time, but the ash should be periodically removed before the chamber gets too full. Once the ash has been removed it may be placed in a container inside the latrine stall for students to add to the compost.

Hand Washing Station and Rainwater Catchment System

The purpose of the rainwater catchment system is to provide a way for students to wash their hands after using the latrine. By attaching the rainwater catchment system to the Composting Latrine, the children using the latrine will be able to wash their hands immediately after they use it. It is important to make sure that the hand washing station always has soap available in order to ensure that all germs are killed. It will be the responsibility of the Composting Latrine Committee and the school to maintain the rainwater catchment system and ensure that it is functioning properly. Regular cleaning of the gutters and tank should be done to prevent the development of rust or mold. If any parts are broken or are not functioning properly, they must be fixed. If any repairs are needed on any part of the system, contact a fundi.

Troubleshooting

Composting

First put on gloves for protection and wash your hands after handling compost.

If the pile fails to reach 50°C initially:

Check the moisture of the pile: It should be like a wrung out sponge. When squeezed it should feel moist, but no water should come out. If the pile is too dry add urine to the pile until it reaches the correct moisture content. If water comes out of the pile when a portion is squeezed add dry plant material such as leaves or grass to the pile.

How big the pile is:

If the pile is not at least a cubic meter or bigger, do not continue with the secondary composting process. Contact Jackson immediately.

If the pile smells:

Check the moisture of the pile: If it is too moist, there could be too much urine in the pile. This can lead to the release of ammonia into the air. This isn't harmful. To reduce the smell add more bulking agent to the pile. Add a layer of bulking agent around the pile. This cover material should reduce smell.



Urine Diversion Troubleshooting

First put on gloves for protection and wash your hands after handling urine.

If there is no urine coming from the urine system or there is urine flooding the stalls:

There may be a couple of problems. First check all of the urine diversion holes in the stalls to make sure they is no solid matter clogging them. If they are clogged wear gloves to unclog the holes. Second open the compost chambers and check the pipe for any holes in the piping. If there are holes in the pipe, contact a fundi to replace it. If a bucket breaks, replace it as soon as possible. If the lid to the urine diversion chamber breaks, contact a fundi to replace it.

Structural Troubleshooting

No water from hand-washing station:

If no water is coming from the tap, there can be a couple of different problems. There may be a hole or clog in the gutter. If this is the case, clean the gutter or contact a fundi to fix the hole. There may be a clog in the pipe between the tank and the tap. If this is the case, contact a fundi to fix it. The faucet may be broken. If this is the case, contact a fundi to fix it. If there's no soap, find soap for the students to use.

Other Problems:

If there are any other structural problems with the latrine, contact a fundi to fix it. If it is a problem that affects the safety of students/staff please contact Jackson.

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Composting Log

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Contacts

Glossary				
Plumber	(0708414097)			
Joshua Fundi	(0710906909)			
Mukanga for Structural Maintenance	(07109140092)			
Jackson	(0726932758)			
Public Health Office	(0715124656)			

Personal Protective Equipment: Gloves, hand washing, and safely handling compost to prevent the spread of germs and disease.

Bulking Material: Dry plant matter added to a compost pile in order to increase the air flow into the pile. Ash, dry leaves, or dry grass clippings can be used.

Composting Latrine: A permanent latrine that holds human waste and preforms the primary composting stage within the latrine chamber.

Pathogens: Very small, harmful organisms that live in the human waste before it is composted correctly. They can cause disease.

Pit Latrine: A temporary latrine that is a hole dug into the ground. When the hole is filled with waste, a new hole must be dug.

Primary Composting: The composting stage that is done inside of the latrine chamber. The compost sits for a year and breaks down.

Secondary Composting: The composting stage in which the compost gets up to 50°C and turns into dirt.

Urine Diversion System: A system marked by a separate hole in the latrine specifically for urine. The urine is piped to a bucket that holds the urine until it can be used.

Turning Compost: the act of moving around the compost to kill all the germs. This is done after the pile remains at a certain temperature for a certain amount of time. See page 7.

Safe Composting: composting in a correct manner so that all germs and disease are killed. Once this is done compost can be used on crops or sold.

Saving Money: This should be done so that there is enough money to repair the latrine. The board of management and parents should raise funds to fix the latrine.

Responsibility: The latrine that is given to the school is now their responsibility. It is their job to educate about composting, compost properly, and fix and clean the latrine.

Ownership: This is what the schools should feel about their latrine. They should take pride in their latrine and the work they do one the latrine. Composting correctly is a very amazing process if done correctly and students and teachers should be very happy when they successfully compost!