



Urine Diverting Dehydration Latrine

An alternative to the pit-latrine (October 2009)

Application in Eastern Chad

Overview

The urine diverting dehydrating toilet, also known as the “EcoSan,” toilet is one technical option in the large family of ecological sanitation. The idea is to collect urine and faeces separately, allowing the appropriate treatment of the two different types of excreta. Water is not used to evacuate the waste. The faeces are treated through dehydration, aided by heat from the sun, ventilation and the addition of dry absorbent material such as ashes, lime, sand or earth. The addition of ashes or lime increases the pH levels and creates a basic environment that discourages the proliferation of germs. Separating urine helps to dehydrate the faeces, reducing problems such as odours and flies. The urine, which is generally free of pathogens, is funnelled into a container. As a precautionary measure, urine should be treated by being stored for at least one month. The two types of excreta, thus sanitised, no longer pose any health risks and can be used as agricultural fertiliser.

Domain of Validity in Eastern Chad

- The urine diverting dehydration latrine is adapted to **hot, dry climates**.
- The urine diverting dehydration latrine is adapted to both **permanently populated zones, as well as zones with high population densities, stable over relatively long periods of time**. Examples include densely populated village or town centres (such as Abéché, Goz Beida or Iriba), zones of returnee populations, sites of displaced populations in the process of settling and refugee camps. This latrine requires building a permanent structure and therefore initially involves a greater investment than the traditional pit-latrine. Questions surrounding property rights are also important. For **displaced persons and refugees**, the installation of these latrines could be limited due to the absence of property rights.
- Even if at first the urine diverting dehydration latrine doesn't seem adapted to a **socio-cultural** context dominated by the use of water for anal cleansing, and there is a reluctance to handle human waste, this should not be seen as an entirely insurmountable obstacle. An analysis of the agronomical situation (for a means of re-using the excreta) and issues relating to food security activities should be conducted on a case by case basis.
- The urine diverting dehydration latrine is perfectly adapted to **work and living bases of NGOs**. By experimenting themselves with these techniques, the NGOs will test their local feasibility, reduce their own impact locally on an environment already under stress and lead a good example.

Opportunities

- Once the acute emergency phase has passed, there is time available for “development” activities.
- Human resources – EcoSan experience or expertise in most organizations that conduct programmes in Chad.
- Awareness and interest of certain populations (in particular the Sudanese) for the reuse of compost in agriculture.
- Custom of certain populations in Eastern Chad (more common with the Sudanese) to separate urine at the source.
- Available space for the reuse of EcoSan latrine by-products (soils depleted of nutrients and humus).
- Need for an alternative to the pit-latrine (lack of space, etc.).

Strengths

- Possibility to reuse by-products/create income generating activities.
- Very long system lifetime.
- Easy to empty, it can be done by the family.
- Solution that saves space and is therefore adapted to densely populated zones. The EcoSan latrine can be used continuously so it is not necessary to dig new pits (the pit is repeatedly emptied),
- Solution adapted to zones that are periodically liable to floods, have a high water table or rocky soil that is impossible to dig in.
- Generates few odours and a small volume of matter to be treated.
- Ecological sanitation systems facilitate the link between emergency and development and have high acceptance rates by the populations since they are more sustainable and have low recurring costs.

Threats

- Construction technique that is more complex than the pit-latrine.
- Lack of knowledge of the technique or a negative attitude towards EcoSan by humanitarian actors due to previous projects that have failed.
- Need for available space to reuse the by-products (difficulties to access land).
- Active participation of the user is essential to ensure that liquids are separated at the source. This remains a challenge.

Weaknesses

- Higher initial investment costs.
- Adapted strictly to household contexts.
- Requires a change of habits and must be used regularly.
- There must always be additive (dry absorbent material) available.
- If the households are not interested in reusing the by-products, other users need to be identified and a collection and transportation system put in place.
- The stairs for going up to the cabin can be prohibitive for older and handicapped people.

Details about the Operation of Urine Diverting Dehydration Latrines

HARDWARE: Design

- The **faeces** fall into one of the **two storage compartments** of which the alternative use ensures the hygienic safety of the person in charge of emptying the latrine, who should never empty a compartment that contains fresh, unsanitised faeces.
- Each compartment should have an autonomy of at least 6 months (the size is calculated according to the number of users). Each should also be separately accessible during the emptying process. This could be done using an opening that is covered with a door or a piece of sheet metal (ideally painted black); however, there is a risk that it will rust over time. For this reason, in the Sahel (known for periods of high temperatures), an alternative could be to close the opening using bricks joined with a light mortar, which are then removed when the compartment needs to be emptied.
- A passive **ventilation pipe** (ideally painted black) for the storage compartments promotes the dehydration of the faeces and prevents the risk of odours. It is possible to use one single ventilation pipe if there is a space left in the wall between the two compartments.
- The **urine** is either directed into a storage container to be reused later as fertiliser (it is rich in nitrates) or it is infiltrated into the ground nearby with the anal-washing water.
- The **anal-washing water** is directed outside of the latrine where it is left to filter into the ground, ideally used to water vegetation such as bushes or fruit trees. The user must move slightly after defecation to clean themselves in order to prevent water from entering the pit. The cleaning space should be designed in consultation with the users.
- The **superstructure** is made according to local customs and with locally available materials such as seko, among others. A roof is recommended to prevent rainwater from entering the pit. Failing that, the defecation hole should have a good cover that will prevent water from entering.
- **Sizing the pits:** The volume of the pits is calculated in the following way. $V_u = N \times A \times T \times F$, where N = number of users, A = faeces accumulation rate (20-30 litres/user/year), T = time required for sanitization in years (6-8 months = 6/12 to 8/12 years), F = rate of usage (0.5 to 1, $F = 0.5$ for a school, $F = 1$ for a household). This volume is the "useful volume." During construction about 30% should be added to this "useful volume."

Example:

The pit dimensions proposed on the right are 0.8 m x 0.8 m x 0.7 m (L x w x h) which gives a volume of 0.448 m³.

This volume is largely sufficient for 12 months:

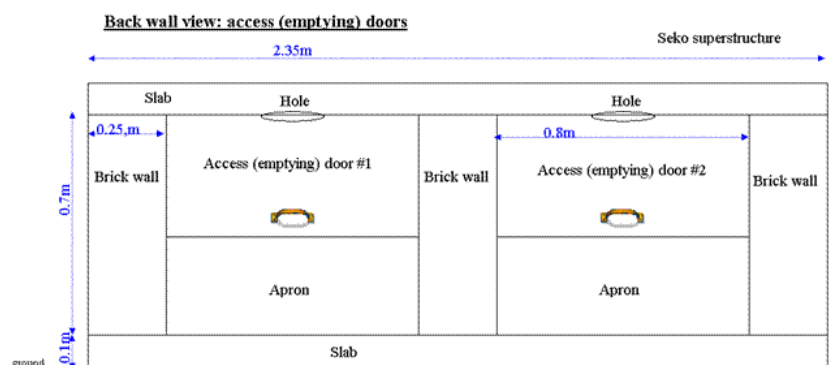
250 l + 30%, or 325 l (1 m³ equals 1,000 litres)

These dimensions take into account the required space for the user (a face-to-face design).

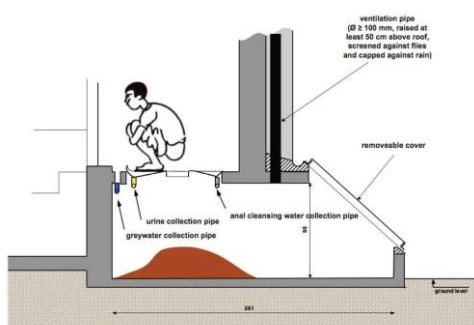
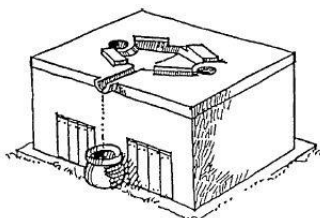
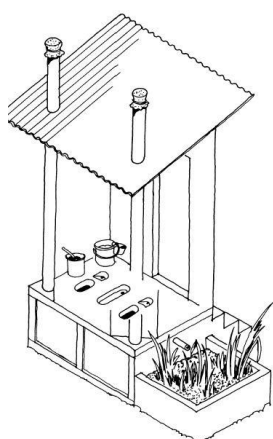
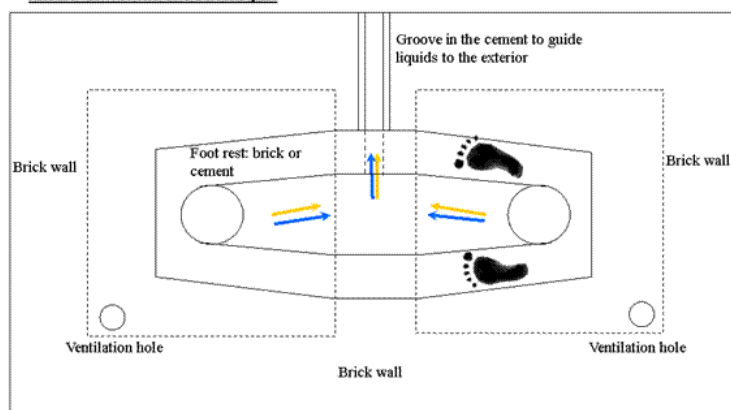
A **construction completely above ground** could be preferable to a partially buried construction for several reasons:

- Easy emptying from the outside. There is no need to remove the concrete slabs (which could involve breaking the liquid-separating masonry work).
- Protection of the access (emptying) door against infiltration (in case of hard rains or floods) through a short apron about 30 cm high.
- Accumulation without risk of faecal matter against the apron and not against the access (emptying) door.

The cost of such a two-pit construction, using kiln-fired bricks is estimated to be between 150,000 and 200,000 CFA (see details below).



Aerial view of the two latrine pits



Cost estimation for the kiln-fired brick option:

Average high-end prices in Abéché and Farchana:

<i>material</i>	<i>quantity</i>	<i>price in CFA francs</i>
cement	50 kg sack	15 000
water	20 l	25
sand	200 l	1 500
brick quality 1	25x10x5	25
brick quality 2	25x10x5	20
gravel	1 m3	5 000
parpen	20x40	250
metal parpen mold		1 500
Iron (8 to 12 m)	1 bar	4 000

The technique chosen for the bottom of the pit is determined by the type of earth underneath:

OPTION 1. If there is a risk of contaminating the water table, an impermeable base is required, such as a 10 cm thick ferroconcrete slab.

OPTION 2. If there is no risk of contaminating the water table (because it is very low) or of water coming in, the slab is not necessary. On the contrary, its absence allows excess liquids to filter into the ground. A concrete foundation which the vault walls are built onto is recommended.

OPTION 3. If the ground is unstable and not uniform, a foundation and a slab are necessary.

<i>material</i>	<i>quantity</i>	<i>price in CFAF</i>
bricks	900	22 500
<i>mortar for walls and masonry</i>		
cement	1	15 000
sand	1	1 500
water	20 l	50
<i>slab</i>		
cement	2	30 000
water	40 l	100
sandy gravel	300 l	1 667
iron	24 m	8 000
<i>foundations</i>		
cement	2	30 000
water	40 l	100
sandy gravel	400 l	2 000
iron	18 m	6 000
<i>doors</i>	1x 0.6 m ² x2	<i>to be estimated</i>
<i>labor</i>		30 000
<i>stairs</i>	<i>to be estimated according to the technique used</i>	
<i>superstructure</i>	<i>to be estimated according to the technique used</i>	
<i>TOTAL according to the type of the earth and the selected option</i>		
option 1		148 583
option 2		146 917
option 3		186 683

It is important to understand the general principals of EcoSan systems in order to be able to adapt them to the local preferences and constraints on a case-by-case basis. The technical solution proposed in this brief should be considered as a source of inspiration, to be adapted to the local context.

SOFTWARE: Acceptance is Essential for a Successful Project

- Target a limited number of identified users, with clearly established responsibilities, to ensure an effective monitoring of the system throughout its lifetime. Household scale systems meet these criteria.
 - Start by testing the model in the NGO work and living spaces, using them to discover the advantages/disadvantages. Make the necessary modifications before installing them with the populations.
 - Provide information about ecological sanitation, which may not be familiar to everyone. Do not underestimate the importance of taking time for explanations.
 - Even before construction the household members should understand the maintenance tasks and decide on roles between themselves. Who will clean the cabin? Who will ensure that there is always an additive (dry material) in the cabin? Who will change the urine container when it is full? Who will un-clog the urine pipe if it is clogged? Who will spread the faeces cone that will form in the pit? Who will empty the faeces compartments?
 - Have a clear idea about the development of the collected by-products, before constructing the latrine. The volume of urine can be surprising (> 1 litre per person per day!). Where will the urine be stored? Where will the urine be reused? How will the by-products be transported? Anticipate sufficient storage space or alternatives.
 - Anticipate visual information posters and instructions painted or fixed onto the latrine walls, even on the slab if there are seko walls).
 - Reflect on the integration of these new techniques into current sanitary customs.
 - Place user/beneficiary preferences about the system at the centre of the decision making process (including those who reuse the faecal matter, if they are not the same people).
 - Take into account the motivations and constraints of each stakeholder.
 - Involve and allow the participation of all concerned parties from the start of the design process. This means that the technical options proposed in this brief are to be considered as possible solutions, to be discussed collectively.
- Socio-cultural considerations are absolutely essential.**
- Use the appropriate tools and methods to create a truly participatory approach.
 - Anticipate and effectively carry out monitoring, evaluation and feedback activities for each step of the project, in order to be able to implement the required readjustments, if need be.

Emptiable Latrine Experiment, SECADEV

Faced with the problem of a lack of space to dig new latrines and the collapse of several hundred pit-latrines in sandy soil, the NGO Secadev has been leading an emptiable latrine pilot project in the refugee camps of Farchana, Kounougou and Mile, since the end of 2008. Secadev is also implementing another project in 2010 to build several hundred latrines using a technical design close to the one presented in this brief (two pits used alternately).

See the appendix for more details about this experiment.

Other Opportunities to be Explored

1. Testing of ecological composting latrines. For these types of latrines the faeces are treated through the process of composting (and not through dehydration). In addition, instead of being constructed above ground, composting latrines are often shallow, below-ground pits (1 – 1.5 metres deep). The composting process requires the regular addition of carbonous material (such as dried vegetation) into the pit. There are several ways to design the composting latrine. Either the faeces and urine are mixed, or they are separated at the source like with the urine diverting dehydration latrine. The contents of the pit should not be too moist for the composting process to work correctly. For this reason the daily urine and anal-cleansing water should be diverted from the pit. A potentially adapted system (in a country like Chad where the usage of water for anal-cleansing after defecation is very common) could be to separate the urine but to allow anal-cleansing water to enter the pit (not, however, the large quantities of water used for bathing!). This is easier for the user who no longer needs to move after defecating to clean themselves. A roof is not necessary since the faecal matter is composted rather than dehydrated, and less affected by an additional (small) amount of water. This type of latrine was installed in Aguié in Niger, described in the link below. This is an integrated “Sanitation and food security” project that uses the two types of ecological latrines (dehydration and compost), monitored by CREPA. The project is interesting for Chad because the climatic conditions and the cultural customs are similar.

Concerning composting latrines where the urine and faeces are treated together, consult Peter Morgan’s publication (link below) and the arborloo project lead by ACF in Dogdoré.

2. Testing of a pit constructed with sun-dried blocks. This technique uses a double coating. The first layer uses a mix of cement (or lime, if available) and earth, while the second uses a classic coating of cement (or lime) plus sand. This technique considerably reduces costs and helps ease the shortage of kiln-fired bricks, all in preserving timber resources. The use of earth construction for the lower parts of ecological latrines is well known in South America. The project in Aguié is also interesting in this respect because the pits of the latrines are constructed with sun-dried bricks (two rows of bricks) with cement finishing coatings on the interior and exterior.

For More Information

- “Recommendations for the safe use of urine and fecal matter in ecological sanitation systems,” C. Schönning et T.A. Stenström, 2004: www.ecosanres.org/pdf_files/ESR_Publications_2004/ESR1web.pdf
- CREPA (Regional Centre for Potable Water and Sanitation) EcoSan Toolbox (in French): www.reseaucrepa.org/page/577
- Aguié Project, Niger: www.ecosanres.org/aquie/aidememoirs.htm
- GTZ EcoSan Technical Briefs: www.gtz.de/en/themen/umwelt-infrastruktur/wasser/9397.htm
- Arborloo: “Toilets That Make Compost: Low-cost, sanitary toilets that produce valuable compost for crops in an African context,” Peter Morgan: www.ecosanres.org/pdf_files/ToiletsThatMakeCompost.pdf

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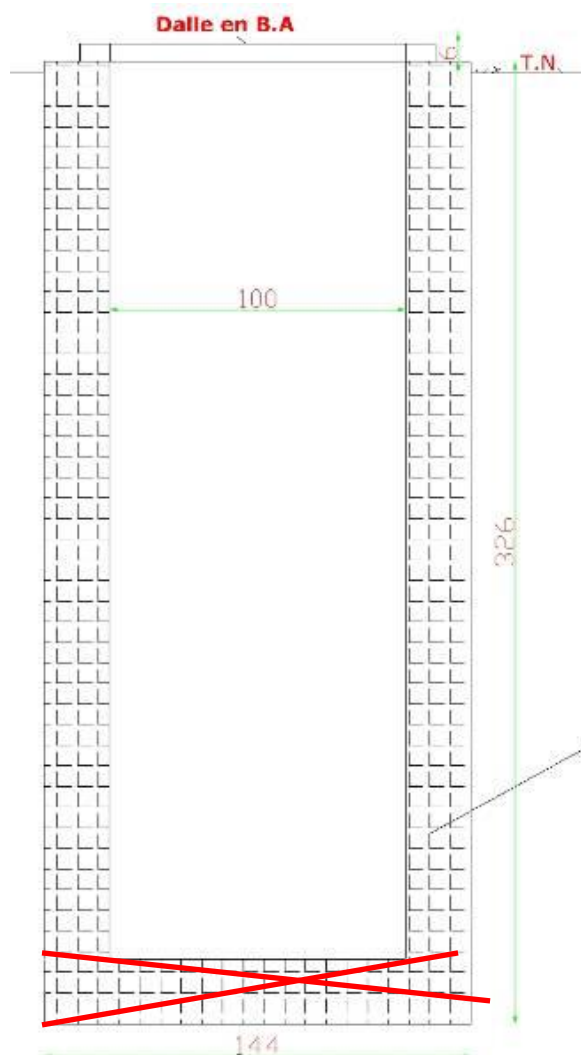
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Appendix A: Detailed Secadev Experiment

This latrine uses only one in-ground pit, which does not allow a sufficient storage time for the faecal matter to be effectively sanitized, unless the usage of the latrine is stopped for several months. The drawing to the left shows a depth of 3 metres (326 cm including brick base shown in the drawing), but the real depth of the pit varies between 2 and 3 metres according to the nature of the ground it is dug in. The bottom slab shown in the drawing was not actually used in the field. Without it liquids in the surrounding ground can filter in to the pit, which hinders the dehydration process.



The pit is reinforced from top to bottom with kiln-fired bricks, joined with cement. This sanitation system is therefore built with materials that are more durable and costly than the refugees' shelters. The pits are manually emptiable (using shovels and carts) so the contents can be reused in agriculture. The majority of the liquids (urine, anal-washing water) flow separately over the slab that is designed slightly inclined, if need be, and drain off to the outside (see image below). When the latrine is also used for bathing, waste water drains out in the same way. Secadev decided to encourage the practice of separating liquids at the source (the pit being reserved specifically for faeces) since it was already a relatively common practice among the Sudanese refugees in Farchana and Touloum camps.

The possibility to reuse the by-products in order to restore the agronomic potential of the earth is a technique the refugees are already familiar with and was even practised in Sudan by some facilitators in Farchana camp (prior to displacement). Before reuse the faeces must undergo a secondary treatment through composting in pre-designated areas for this use.

For the first emptying, (which should be in two or three years' time), Secadev is currently reflecting on the different technical options. Certain aspects relating to the management of by-products still need to be clarified. One possibility for the reuse would be the reforestation site (15 ha) managed by Secadev's environment team, located a few kilometres from the camp.

This system, with an in-ground pit (especially without a base slab) assumes that the water table is sufficiently low so as not to be contaminated.

Lengthwise view of an emptiable latrine pit (source: Secadev)

(Note: dalle en B.A. = reinforced concrete slab; T.N. = ground level; all measurements in cm)

Cost Comparison of a pit-latrine and a single-pit emptiable latrine in the Farchana refugee camp:

Emptiable latrine		Pit latrine
hole	15,000	
bricks + transport	35,000	
4 barrels of sand	6,000	
construction slab	35,000	
3 barrels of gravel	4,500	
5 bags of cement	87,500	
labor	30,000	
total CFAF	213,000	55,000

