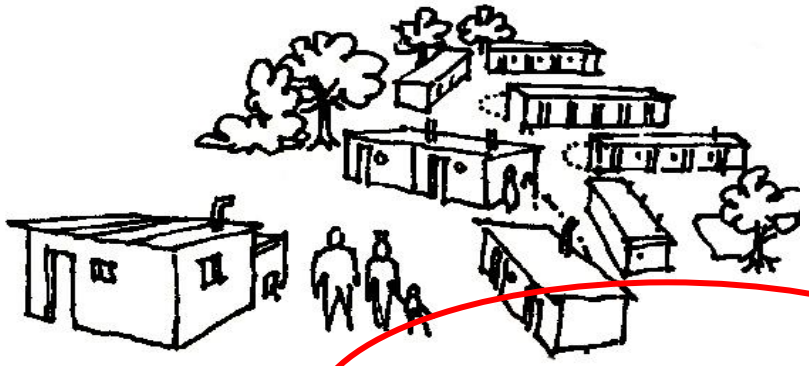
Dry on-site sanitation & reuse-oriented dry sanitation systems

06. – 08. September 2010

Mtwara SuSan Workshop

Elke Müllegger l EcoSan Club

What is the focus of this presentation?



SOLID WASTE | STORMWATER | URINE | FAECES | GREYWATER

(anal cleansing water)

Processes → Collection / Storage – Transport – Treatment – Utilisation

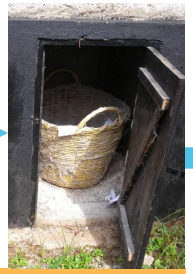
Management → Planning – Financing – Implementing
Operation & Maintenance – Regulation & Enforcement

Linkage of processing steps

User Interface
e.g. VIP, UDDT

Transport
e.g. sewer, human power

(Semi)-Centralised Treatment
e.g. constructed wetland, drying area



Collection and Storage/ Treatment
e.g. dehydration vaults

Use and/or Disposal
e.g. composting, irrigation

Processing steps have to be linked to a sanitation system

Technologies for on-site sanitation

User Interface	Collection and Storage/ Treatment	Conveyance / Transport	(Semi-) Centralised Treatment	Use and/or Disposal
DRY ON-SITE: •Pit latrine • VIP **REUSE-ORIENTED:** • Composting toilet • Fossa alterna • UDDT • Urinal	**DRY ON-SITE:** •Single pit • Single VIP **REUSE-ORIENTED:** • Dehydration vaults • Containers • Jerry can / tank • Composting chamber	• Human-powered emptying and transport • Motorized emptying and transport	• Sedimentation • Drying beds • Co-composting	• Application of sludge • Compost **REUSE-ORIENTED:** • Application of urine • Application of dried / composted faeces

Only selected combinations of technologies will lead to sanitation systems.

Technologies for the user interface

INPUT PRODUCTS	USER INTERFACE	OUTPUT PRODUCTS
Urine	Pit latrine	Urine
Faeces	VIP	Faeces
Anal cleansing water	Composting toilet	Excreta
	UDDT	Compost
	Fossa alterna	Beigewater
	Waterless urinal	

Dry on-site sanitation - Pit latrine

INPUT PRODUCTS

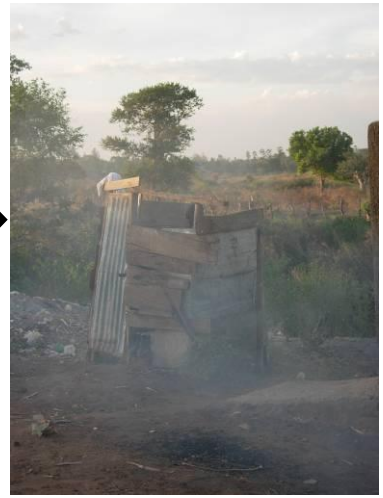
USER INTERFACE

OUTPUT PRODUCTS

Urine

Faeces

Anal cleansing water



Pit latrine

Urine

Faeces

Excreta

Compost

Beigewater

Pit latrine

Technique

- The single pit is one of the most widely used sanitation technology.
- Excreta and anal cleansing material are deposit into a pit.
- Not suitable for rocky and compacted soils (difficult to dig) or for flooding areas.

O&M

- No daily maintenance.
- When the pit is full, it can be pumped out (sludge needs sec. treatment) or construction of a new pit (often a problem in more densely populated areas).
- Sludge requires secondary treatment and / or appropriate discharge.

Health aspects

- Leachate can contaminate groundwater – low reduction of BOD and pathogens.
- Stagnant water in pits may promote insect breeding.
- Pits may overflow during floods.

Socio-cultural aspects

- Normally constructed fare from homes.

Ventilated Improved Pit Latrine (VIP)

INPUT PRODUCTS

USER INTERFACE

OUTPUT PRODUCTS

Urine

Faeces

Anal cleansing water

VIP

Urine

Faeces

Excreta

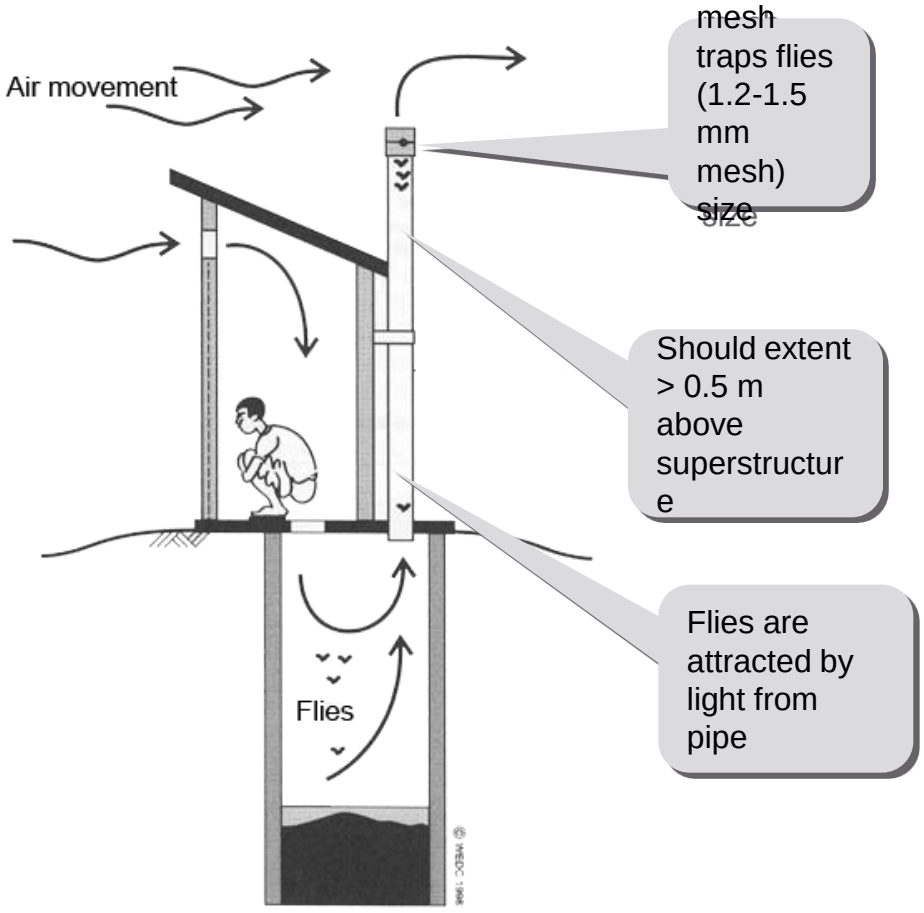
Compost

Beigewater

VIP latrine

Technique

- VIPs are an improvement over pit latrines. A continuous airflow through the ventilation pipe vents odours and acts as a trap for flies as they escape towards the light.
- Excreta and anal cleansing material are deposit into a pit.
- Not suitable for rocky and compacted soils (difficult to dig) or for flooding areas.
- Appropriate when water is scarce and where there is a low groundwater table.



VIP latrine

O&M

- Cleaning the ventilation screen to ensure a good flow of air.
- When the pit is full, it can be pumped out (sludge needs sec. treatment) or construction of a new pit (often a problem in more densely populated areas).

Health aspects

- Leachate can contaminate groundwater - treatment processes are limited. Pathogen reduction and organic degradation is not significant.
- Sludge requires secondary treatment and / or appropriate discharge.
- Health risks from flies are not completely removed by ventilation.
- Pits may overflow during floods.

Socio-cultural aspects

- Normally constructed fare from homes.

Resource- oriented dry sanitation - Fossa alterna

INPUT PRODUCTS

USER INTERFACE

OUTPUT PRODUCTS

Urine

Faeces

Anal cleansing water

Fossa alterna

Urine

Faeces

Excreta

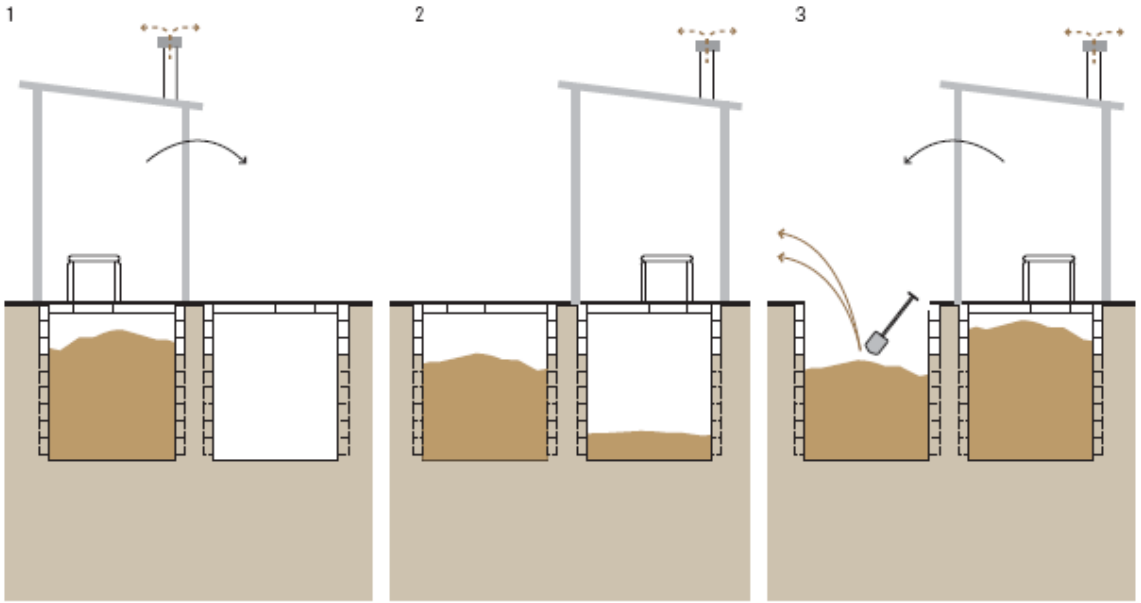
Compost

Beigewater

Fossa alterna

Technique

- A fossa alterna is an alternating, waterless double pit technology.
- The pits are filled alternating. The full pit degrades during the period of time that the second pit is filling. The material in the full pit will degrade into a dry, earth-like mixture that can be easily removed manually.
- Soil, ash, and/or leaves should be added to the pit after defecation.



Source: Tilley, Elizabeth et al, 2008. Compendium of Sanitation Systems and Technology. Eawag.

Fossa alterna

O&M

- Emptying the Fossa Alterna is easier than emptying other pits: the pits are shallower (depth of 1,5m) and the addition of soil / ash / leaves means that the material is less compact.
- The mounded material should be pushed to the sides of the pits for an even distribution.
- Emptying every year (one pit shall fill within one year for a family of six).

Health aspects

- By covering faeces with soil / ash, flies and odors are kept to a minimum.
- Significant reduction in pathogens, but may still contaminate groundwater through leachate.

Socio-cultural aspects

- For users there is no big difference to a pit latrine / VIP, except of adding soil / ash after defecation.

Fossa alterna in practice

Arba Minch (Ethiopia)

- Middle size town in Ethiopia (75.000 inhabitants).
- Pilot city of the ROSA project.
- 30 fossa alterna have been constructed in 2008/2009.
- Compost is either used in the households´ compounds or collected from solid waste collectors for further co-composting and sale.



Fossa alterna in Arba Minch (Ethiopia)

Composting toilet

www.ecosan.at

EcoSan Club

INPUT PRODUCTS

USER INTERFACE

OUTPUT PRODUCTS

Urine

Faeces

Anal cleansing water

Composting toilet

Urine

Faeces

Excreta

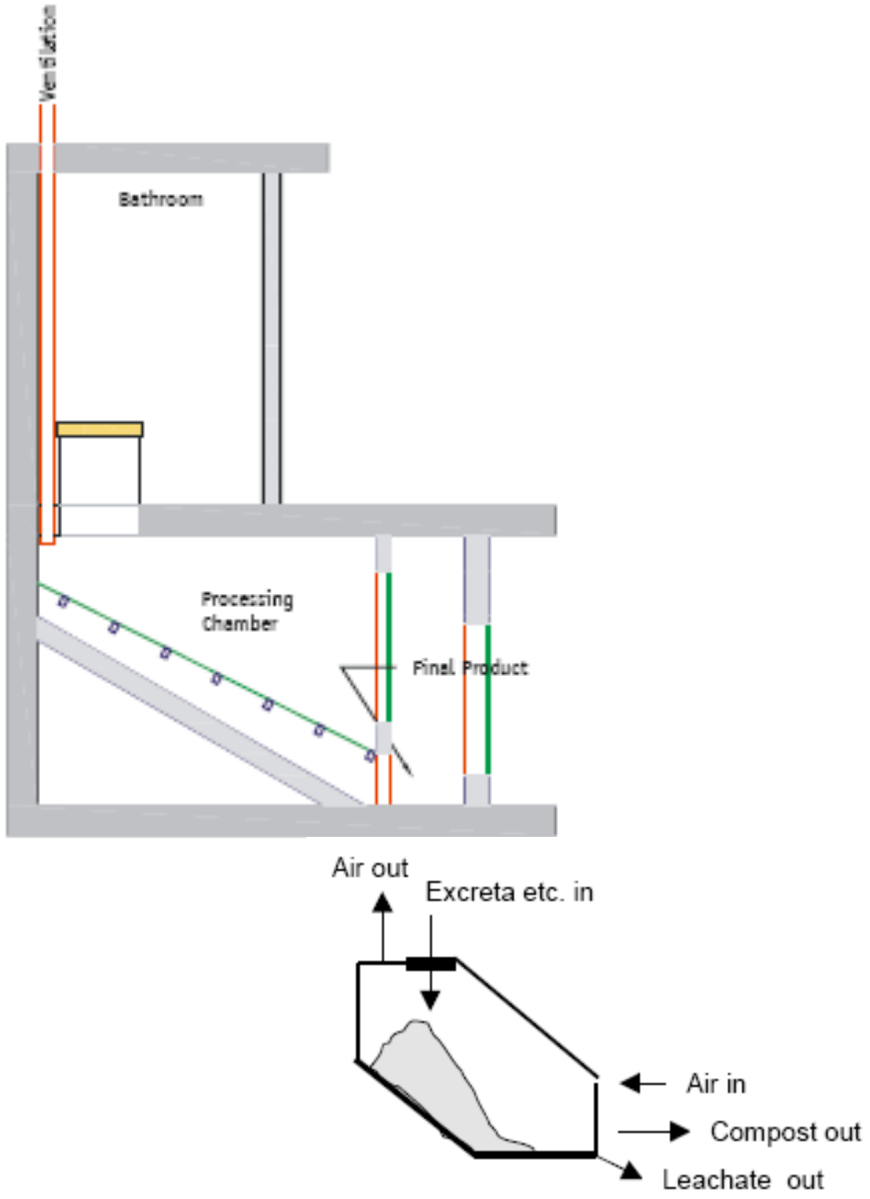
Compost

Beigewater

Composting toilet

Technique

- Composting refers to the process by which biodegradable components are biologically decomposed under controlled conditions by microorganisms under aerobic and thermophilic conditions.
- A composting toilet system contains and processes excreta, toilet paper, carbon additive (such as leaves, hay, straw, sawdust, wood chips and chopped corn stalks.), and sometimes, food waste.
- No diversion of urine and faeces.
- Anal cleaning water has to be treated separately.



Composting toilet

O&M

- Regular O&M is of utmost importance (adding organic bulking agent, like grass clippings, leaves, sawdust, or chopped straw, dry elephant grass; periodic mixing or raking of composting material; removal of compost).
- If proper composting has taken place, the end-product should be inoffensive and safe to handle. The compost can be used as fertilizer or soil conditioner.

Health aspects

- Destruction of pathogens in composting toilets is a function of temperature and storage time.
- Since practical experiences show that keeping sufficiently high temperatures (above 60°) is rarely achieved in composting toilets, a sufficiently long storage period should be considered. Keeping a storage time of 6 to 12 months will allow for pathogen die-off also at lower temperatures.
- A well functioning composting toilet should not produce odors. There should be no problems with flies or insects.

Socio-cultural aspects

- For users there is no big difference to a pit latrine / VIP.

Composting toilets in practice

St. Joseph Hospital (Kitgum, Uganda)

- In operation since 2008.
- One toilet block with 6 toilets (3 for men and 3 for women).
- For patients and patients attendants of St. Joseph Hospital (Kitgum, Uganda).
- Care-taker responsible for regular operation and daily maintenance.
- Works very well, but needs people who understand the principle of composting and take care of the system.

Composting toilet in Kitgum (Uganda)

Urine Diverting Dry Toilet (UDDT)

www.ecosan.at

EcoSan Club

INPUT PRODUCTS

USER INTERFACE

OUTPUT PRODUCTS

Urine

Faeces

Anal cleansing water

UDDT

Urine

Faeces

Excreta

Compost

Beigewater

UDDT

Technique

- Operates without water.
- Diversion of urine and faeces. 3-hole separating toilets allow anal cleansing water to be diverted from the urine and the faeces into a third, dedicated hole.
- Require a specially designed seat riser or squatting pan to avoid urine and faeces getting mixed - a dividing wall separates urine from faeces.
- Drying material such as lime, ash or earth should be added into the same hole after defecating to absorb liquid.
- Can be attached to the house – indoor toilet.

UDDT in Arusha (Tanzania)

UDDT

Single vault UDDT

- One vault which is collecting faeces (and urine).
- Collection and storage of faeces and urine in containers / tanks, which are changed when getting full.

\+ UDDT is smaller and cheaper.

Single vault UDDT in Arusha (Tanzania)

Double vault UDDT

- Two alternating vaults allow the faeces to dehydrate in one vault while the other vault fills. When one vault is full it is sealed with a lid and the UDDT is moved to the second vault.

\- More expensive than single vault UDDTs.

Double vault UDDT in Kabale (Uganda)

UDDT

O&M

- It is important that the faeces remain separate and dry. When the toilet is cleaned with water, care should be taken to ensure that the faeces are not mixed with water.
- Urine pipes can become blocked over time and may require occasional maintenance.
- Collected faeces and urine have to be removed regularly.

Health aspects

- No real problems with odors and flies if used and maintained correctly (i.e. kept dry).
- Faeces should be very dry and relatively safe to handle provided they were continuously covered with drying material and not allowed to get wet.
- There is a low health risk for those whom have to empty or change the urine container. Faeces that have been dried for at least 6 month also pose a low health risk.

Socio-cultural aspects

- Requires education and acceptance to be used correctly – is prone to misuse.
- Users may have problems to handle urine and faeces.

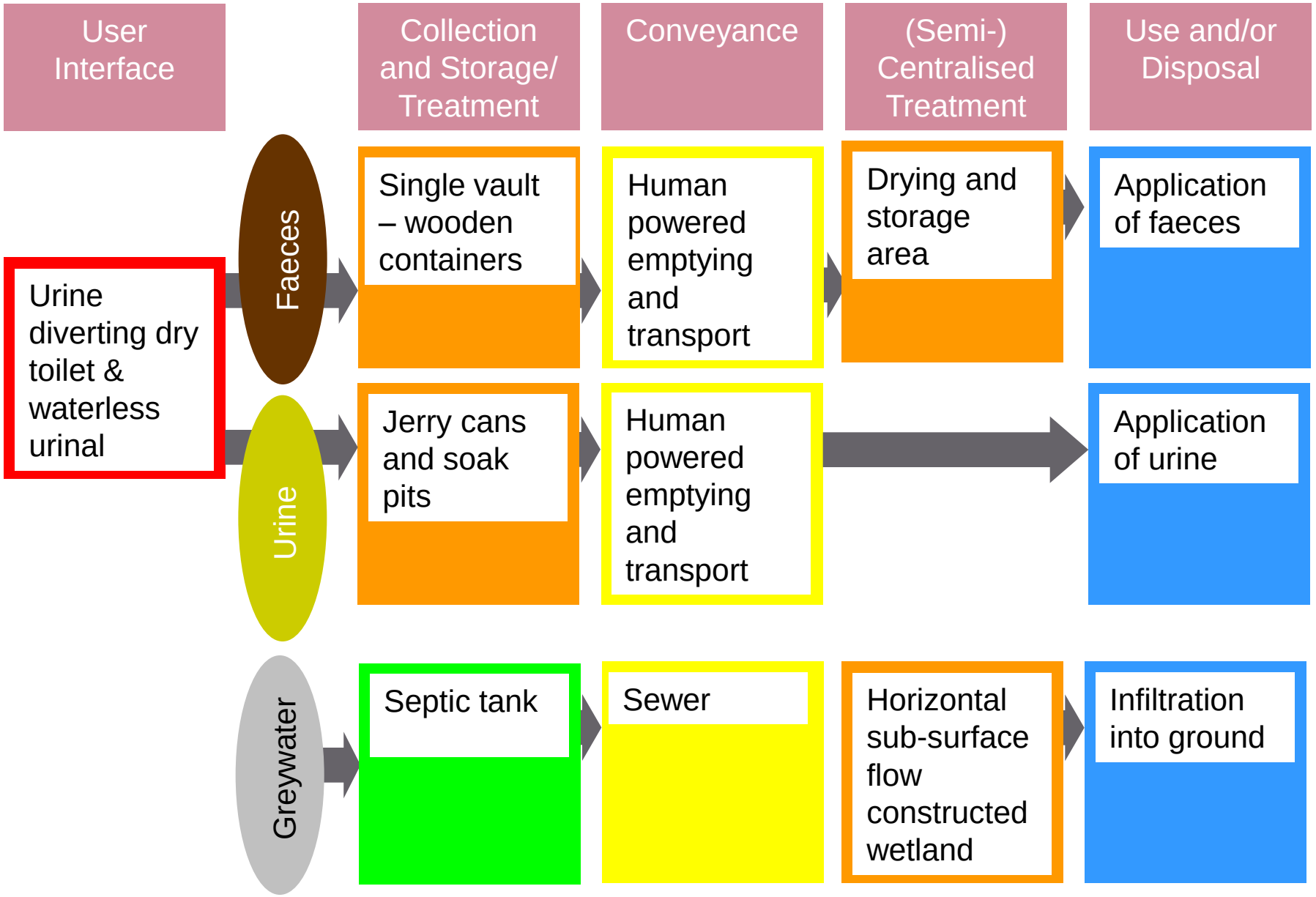
UDDTs in practice – example 1

Kalungu Girls Secondary School (Kalungu, Uganda)

- In operation since 2004.
- 45 single vault UDDTs for 450 students and a toilet block for 50 teachers.
- Students are responsible for regular maintenance and a care-taker is responsible for overall O&M.
- Collection containers are emptied after every school term and material is transported to a drying and storage area.
- Dried faeces are used in the school garden. Urine is partly used for bananas and matoke.
- A horizontal sub-surface flow constructed wetland for greywater treatment.
- The school became famous because of the toilets. Since 2009 the school administration introduced an admission fee (between 17.50 EUR and 35 EUR, depending on the type of visiting delegation) for visitors.

Kalungu Girls Sec. School (Uganda)

UDDTs in practice



UDDTs in practice – example 2

Wieserhoisl farm (Deutschlandsberg, Austria)

- In operation since 2007.
- Single vault UDDT for a private household (10 people) and visitors.
- Faeces are co-composted after drying.
- Urine is directly used in agriculture and added to co-compost.
- Treatment of wastewater in a vertical flow constructed wetland system.




UDDT at Wieserhoisl farm (Austria)

Arusha municipality – Rosa Unit

Waterless urinal

www.ecosan.at

EcoSan Club

INPUT PRODUCTS | USER INTERFACE | OUTPUT PRODUCTS

Urine

Faeces

Anal cleansing water (ladies)

Urinal

Urine

Faeces

Excreta

Compost

Beigewater

Waterless urinals

Technique

- Used for collecting urine. No water required.
- Usually for men, models for women are available.

O&M

- Minerals and salts maybe built up in pipes – regular cleaning.

Health aspects

- Allows a separate collection of urine and reduced cross-contamination with faeces.

Socio-cultural aspects

- Well accepted.
- Urinals are usefull to prevent misuse of UDDTs.

Waterless urinals for boys and girls (Nakuru, Kenya)

Why is O&M importent?

Technology alone does NOT guarantee a sustainable sanitation system!

- Every technology needs O&M – it is of utmost importance for durable implementation.
- Institutional responsibility and service model (“Sanitation as a business”) needed to ensure O&M.

O&M in practise – lessons learnt

ROSA project

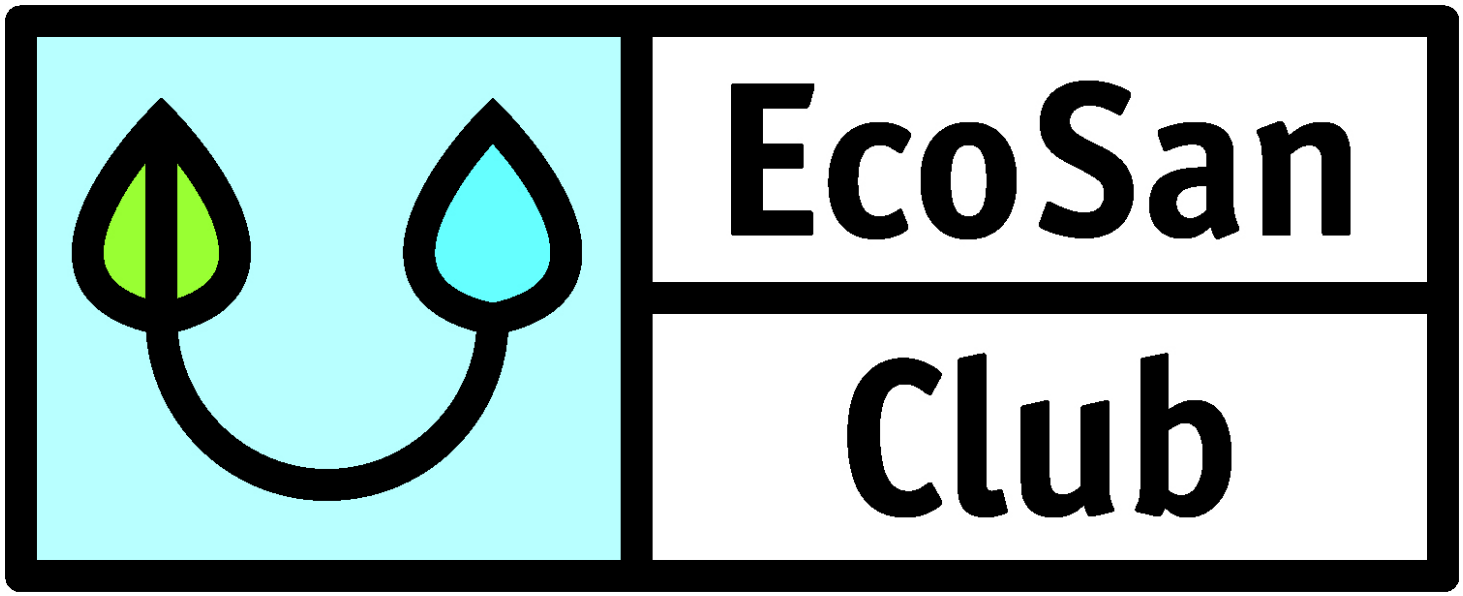
- Start: Oct. 2006; End: March 2010
- EU funded research project (6th framework programme)
- Location:
  - Nakuru (Kenya)
  - Arba Minch (Ethiopia)
  - Kitgum (Uganda)
  - Arusha (Tanzania)

O&M on household level

- Most people in (peri) urban settings have no use for faecal matter.
- Households / Institutions with agricultural land are using faeces / urine as fertiliser.
- Urine is in most cases soaked away.
- Clear responsibilities for O&M needed.
- Households are willing to pay for O&M services (for collection and transport).

O&M by the private sector

- Private sector shows interest, but number of toilets have to increase for business (Arusha).
- Solid waste collectors are offering toilet emptying services (Nakuru and Arba Minch).
- Main challenges:
  - Development of a market for faecal compost and urine.
  - Collection and transportation of urine, because of the quantities.
- Institutions have employees who are responsible for day-to-day operation activities.



Contact:
EcoSan Club
Wiener Strasse 2
A-3424 Muckendorf, Austria

Email: elke.muellegger@ecosan.at

References

Eawag/Sandec, 2008: Sanitation systems & technology. Sandec training tool 1.0 – Module 4.

Resource-Oriented Sanitation concepts for peri-urban areas in Africa (ROSA) project; Contract No. 037025-GOCE; duration: 1.10.2006 – 30.9.2009), a Specific Target REsearch Project (STREP) funded within the EU 6th Framework Programme, Sub-priority "Global Change and Ecosystems". The ROSA team is grateful for the support.

Tilley, Elizabeth et al, 2008. Compendium of Sanitation Systems and Technology. Eawag.