Alternatives to waterborne sanitation
Experiences from Peru

Dr. Heike Hoffmann

Photos / images:
EAWAG/SANDEC
http://www.rotaria.net/peru3/
SuSanA website
Limitation of conventional waterborne sanitation  
= Flush toilet with sewer and treatment plant

- Needs always a **minimum density** for urbanization
- Needs always **significant investments** in order to get started
- Needs always a **wastewater treatment plant**  
  with its necessity of operation and maintenance and needs  
  destination of the “products” – treated water, sludge, biogas
- Needs a **consolidated settling structure** in order to justify the investment,  
  therefore sanitation almost always comes to late  
  it is not a solution for settlements, slums or camps
- **Needs always water for proper functioning of the sanitation system**
The poorest people pay the highest prices for drinking water in almost all over the world.

**Limitation of conventional waterborne sanitation**

UNO: 45% of population worldwide will live with less than 20 L drinking water / day in 2050.

Flush toilets use up to 50% of the daily drinking water of a family.
The poorest population in settlements, rural areas, slums, camps *does not have access to improved sanitary facilities*, affected are:

- Regions without (drinking) water supply
- Regions without access to sewage system
- People without sufficient sanitary education

People who do not have access to hygienic sanitary facilities are socially stigmatized.
People who have toilets do not have automatically sanitation

Waterborne sanitation created the culture of “flush and forget”

Only 10% of the sewage in the world is treated,

And especially for the poorest: Diseases and lack of drinking water

Lack of sanitation always affects the whole society!

Eutrophization

Contamination

Capture  Storage  Transport  Treatment  Disposal/Reuse

Photo: P. Blunier, 2004
On site sanitation traditional: *Arboloo and Fossa Alterna*

Dry latrines (without flush) with pits for urine infiltration are only recommended:
- in situations with enough area for new pits
- in situations with enough soil capacity for infiltration
- in situations without high groundwater levels and storm water infiltration

The treatment process of fecal material must be adequate to the local situation. Natural decomposition of feces is limited and not always possible.
On site sanitation systems – Low flush: 
\textit{Blackwater Treatment}

Advantage: Water flush and odor trap with small amounts of water.
Disadvantage: relatively high operation necessity and certain contamination risks.
On site sanitation systems:
*Flush Toilet with Septic Tank and centralized nightsoil treatment*

Effluent; on site infiltration or treatment (Activated sludge)

1. Effluent treatment

2. Sludge treatment

Nightsoil/sludge: treatment

Condition: water for flushing, larger wastewater volumes, centralized treatment
Disadvantage: operation necessity for sludge and effluent, contamination risks.
The new opportunity for onsite sanitation: Economic Dry Toilet with Urine Separation seats
On site sanitation - improved: *Pit with separation of urine*

**Principle:**
- Urine separation without flush guarantees totally dry excrements,
- Fecal material (with ash or soil) is mineralized in the soil
- Urine is infiltrated in the soil or can be used as a fertilizer

**Recommendations:**
- Arid situation without storm water, without high groundwater level.

**Experiences:**
- Better solution than VIP-Latrine or other Latrine,
- more hygienic, without flies and odor
- **Opportunity to use a clean toilet**
  is necessary for sanitary education.
UDDT is the most natural, hygienic and economic solution to treat fecal material with the opportunity to use the separated sterile urine as fertilizer. UDDT doesn’t suppose people to reuse, but reuse is possible (ecosan)
UDDT - Container Solution (60L)
Filling in 2 - 8 weeks, Feces need further treatment

More simplified installation, more complicate treatment:
Frequent transport of not stabilized fecal material; treatment: heat compost, biogas, terra preta, mineralization.
The situation in **urban areas** as slums and settlements **is different**: difficult access, unorganized construction, high fluctuation, unclear ownership of areas, people are not able or willing to invest in own toilet, have no time left to care for an proper treatment and no area to onsite reuse or disposal of fecal material.

**Limitation: On Site Sanitation technologies have been developed for rural situations**

Urban situations always need controlled treatment and disposal of sewage/ fecal material in order to protect the public health and the environment.

Who has the responsibility for urban sanitation?
Solution: Centralized treatment of Site Sanitation in urban and peri-urban situation

**Capture:** Dry Toilet with one or two chambers, Urine separation, grey water separation

**Storage:** 2 Ventilated vaults (dehydration) or one vault with 2 containers (60L)

**Transport:** Fecal Material: truck, Urine: container (25L) or pipe, greywater: pipe

**Treatment:** Fecal material: Compost, mineralization, urine: storage, greywater: wetland

**Disposal or Reuse:** Composted or dried feces, fertilizer and treated greywater
South Africa Durban: World biggest UDDT Project
75,000 UDDT applied and operated in urban settlements
Efecto del riego con orín:

Dry Urine Separation Toilet an Urinal (recycled PVC)

Bucket with ash

Covered hole of second chamber (toilet change)

Untill now 75.000 UDDT constructed and operated by the Public Water Company

Families get the Toilet for free and 200 L dayly drinking water supply for very economic fee
Rotária del Perú – PPP Project with German Cooperation (GIZ) to introduce UDDT in the sanitation market

- Offer hygienic sanitary condition, no odor, no flies – LOW COSTS
- Sanitary solution without water use and without blackwater production
- Provide a permanent toilet installation: inside the house, with shower

Until now: 500 UDDT built with the owners, designs adapted on the traditional construction and economic conditions in the Peruvian areas.
Peru: > 40% of people without flush toilet; that fact can be seen as opportunity

Lima, settlements 4 Mio people

Informal settlements on the dry coast area

Dispersed communities in Amazon area

Dispersed communities in mountain area
Vaults with bench and all sanitary installation was made in different materials by qualified local persons.

Walls, door, roof were in the responsibility of the owners.
Bench in concrete, wood or adobe as well. The bench is with 2 holes for the toilet seat and 2 for the ventilation pipe (10 cm) with urine diversion, inside is the urine pipe (5cm)
The vaults have are 80 to 100 cm high and need 1 -3 stair to sit down (38 cm). The area for shower can be integrated.
Walls are from different local materials, it is made by the owner. The installation can be integrated in the house, it doesn’t smell.
Important for the people is to have a toilet, but the reuse aspect (ecosan) is secondary:

- Separated Urine is sterile and can be reuse as fertilizer, with high concentration of Nitrogen, Phosphor, and Potassium.
- The indigene population use urine for more things like medicine or for textile fixation of natural plant colors.
- Important: only 25% of people (500 toilets) are willing and able to reuse the urine, the only other let infiltrate it in the soil, the organized reuse, especially in urban settlements will need a collection service.
Management models for Dry Sanitation

Organization:

- **Rural situation:** two chamber system, total dehydration, reuse with the community
- **Peri-urban situation:** two chamber system, recollection twice a year and reuse or one chamber system recollection twice a week and centralized compost with municipal waste
- **Public Toilet:** always one chamber with container and recollection with heat compost.

Economics:

- Family toilet with shower **250-1000 USD** (depend on the participation)
- Public service by wastewater company is **30-70% more economic** than conventional wastewater treatment
- Each family is economizing **50% de of drinking water** (compared with flush toilet system).
Greywater is without fecal bacteria’s - treatment is easy, reuse is economically, as treatment unit can be used for instant Constructed Wetland, in the project were constructed different wetlands:

- **Parques de Carabayllo**: social housing by Peruvian Government, treatment of greywater and reuse for irrigation of 16,000 m² green areas.
- **Casa de Retiro, Cienaguilla**: treatment of 15 m³/d greywater and reuse for flush in all 120 toilets of the hotel.
- **Colegio San Christoferus**, Lima, treatment of 2 m³ greywater and 4 m³/d blackwater and reuse for irrigation of green and productive areas.
- **Casa de Ancianos en Chincha**: Treatment of 7,5 m³ wastewater, irrigation of productive areas.
- **Different houses with dry toilets are reusing the treated greywater in their own garden**

Participation in “Technology Review of Constructed Wetlands” with GIZ, see SuSanA website
Organization of workshop, manual for self construction and for right use and maintenance,

Capacitation is fundamental for sanitation