gtz Partner für Perspektiven. Weltweit.

Sustainable Sanitation workshop, Mtwara, Tanzania 08.09.2010

Costs and benefits of sanitation

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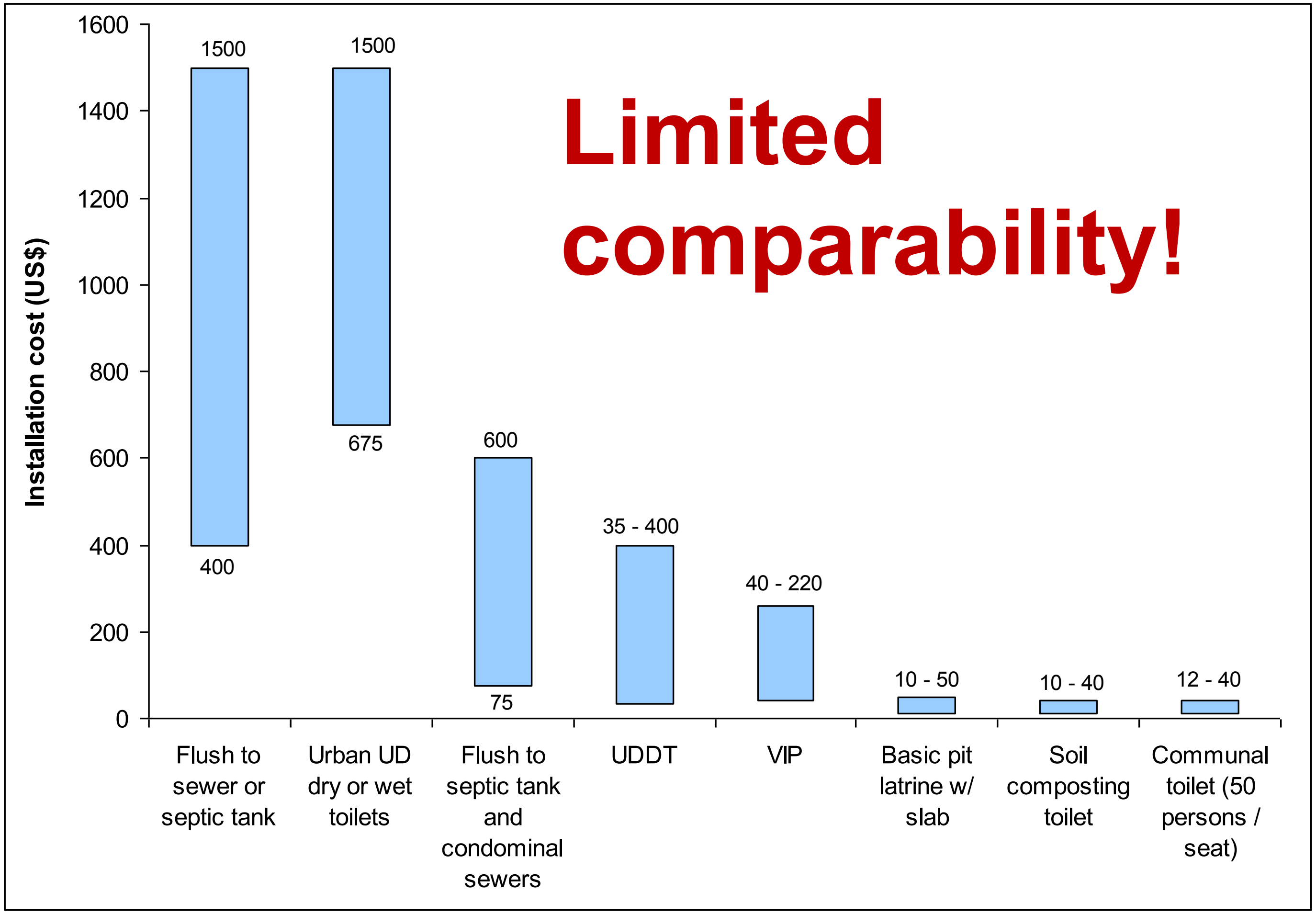
(GTZ Sustainable sanitation)

Content:

1. Introduction
2. Cost types
3. Examples of Costs
4. Benefits of Sanitation
5. Examples (incl. Benefits)
6. Discussion

1. Introduction

Investment cost for sanitation systems

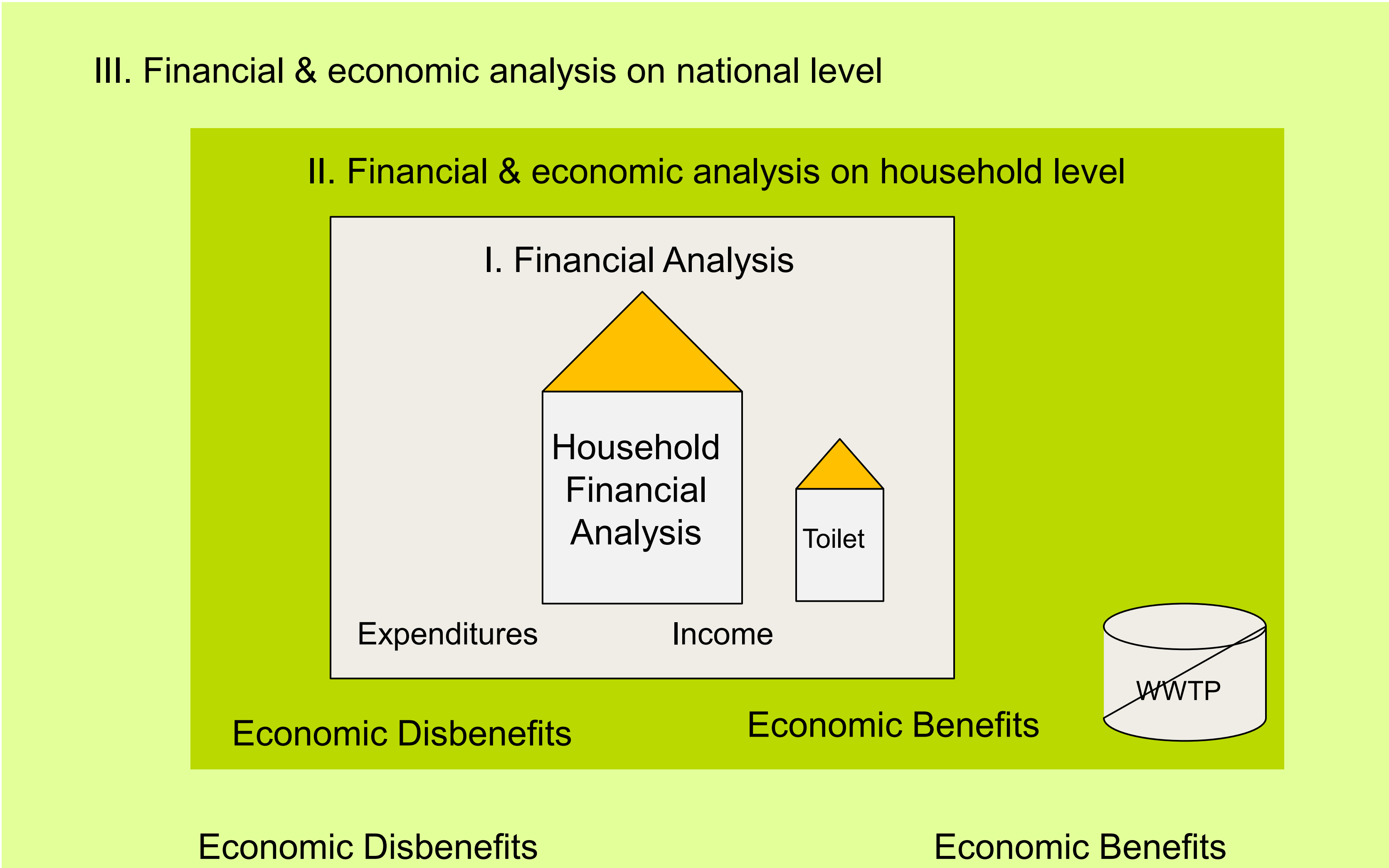


Source: Rosemarin, A. et al. (2008). „Pathways for Sustainable Sanitation – achieving the Millennium Development Goals“

Limited comparability due to different study boarders

- not compare apple with oranges
- same setting and level of the data is important
- Studies do not always compare same sanitation systems and project environments

Level of comparison



Adopted from WSP (2009)

2. Costs types

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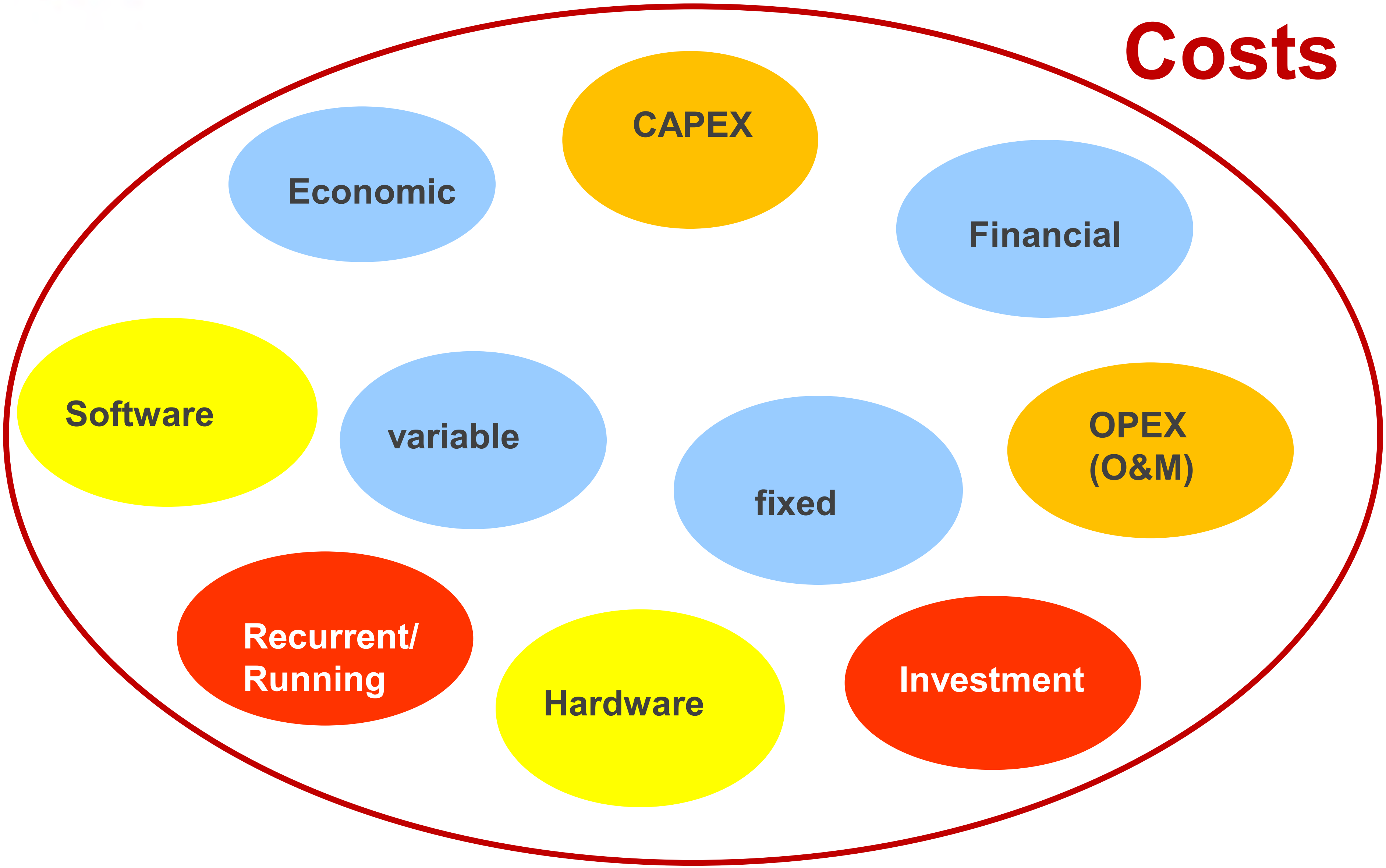
Which costs do exist?

2 min

Costs


CAPEX
Economic
Financial
Software
variable
fixed
OPEX (O&M)
Recurrent/ Running
Hardware
Investment

Typical financial & economic costs

Financial costs

- Can be paid with cash
- e.g. training, planning, construction, material, personnel
- Operational costs
- Fertilizer value

Economic costs

- Household labor (in-kind) for investment,
- O&M economic benefit: economies of time.
- Reuse of nutrients, water and energy.
- Health impact: avoided deaths and avoided morbidity.
- Perceived improvement of living quality such as privacy, dignity, convenience and status.
- Environmental impact such as reduced water pollution
- Increased attractiveness for tourism.

Software costs

- Project planning and monitoring
- For capacity development and trainings
- Hygiene promotion
- Public relations - public information and awareness-raising campaigns

CApital and OPeration EXpenditures

CAPEX

- At the beginning of the project period
- Unique costs for purchase and installation
- e.g. for area, feasibility studies, planning, machines

OPEX (O&M)

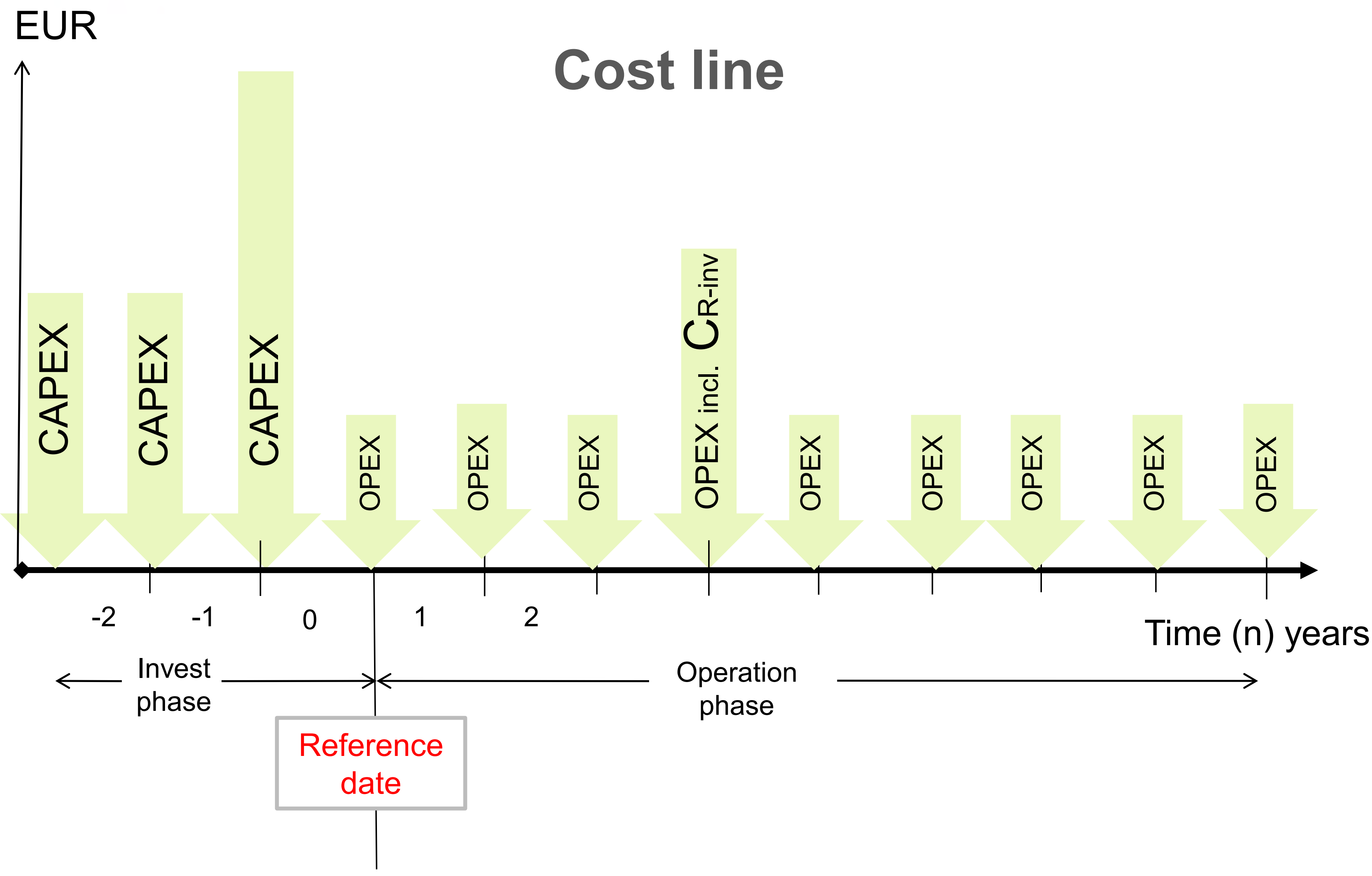
- Daily operational costs (e.g.cleaning)
- regular/irregular costs for operation and smale scale repair (e.g. labor, administration, operating material, electricity)

Reinvest costs

$C_{R\text{-}inv}$

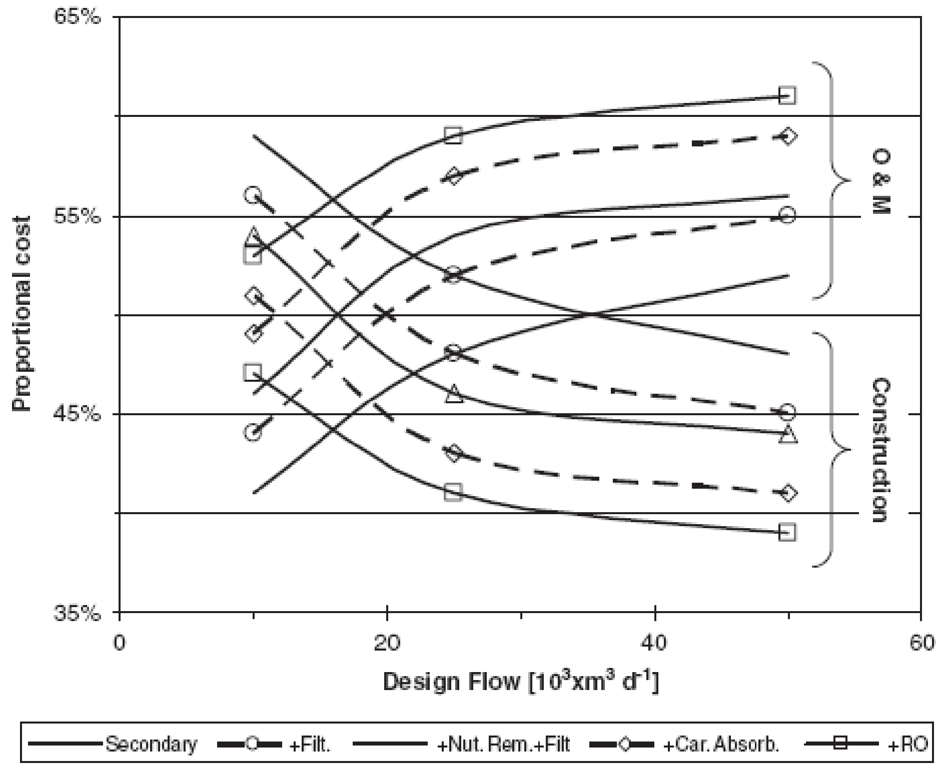
- Regular/inregular costs for rehabiliation, replacement reinvestment
- For machines and pumpes earlier than for civil work

Cost line


EUR
CAPEX
CAPEX
CAPEX
OPEX
OPEX
OPEX
OPEX incl. CR-inv
OPEX
OPEX
OPEX
OPEX
OPEX
-2
-1
0
1
2
Time (n) years
Invest phase
Operation phase
Reference date

Construction vs O&M costs

(for waste water treatment systems in Israel)



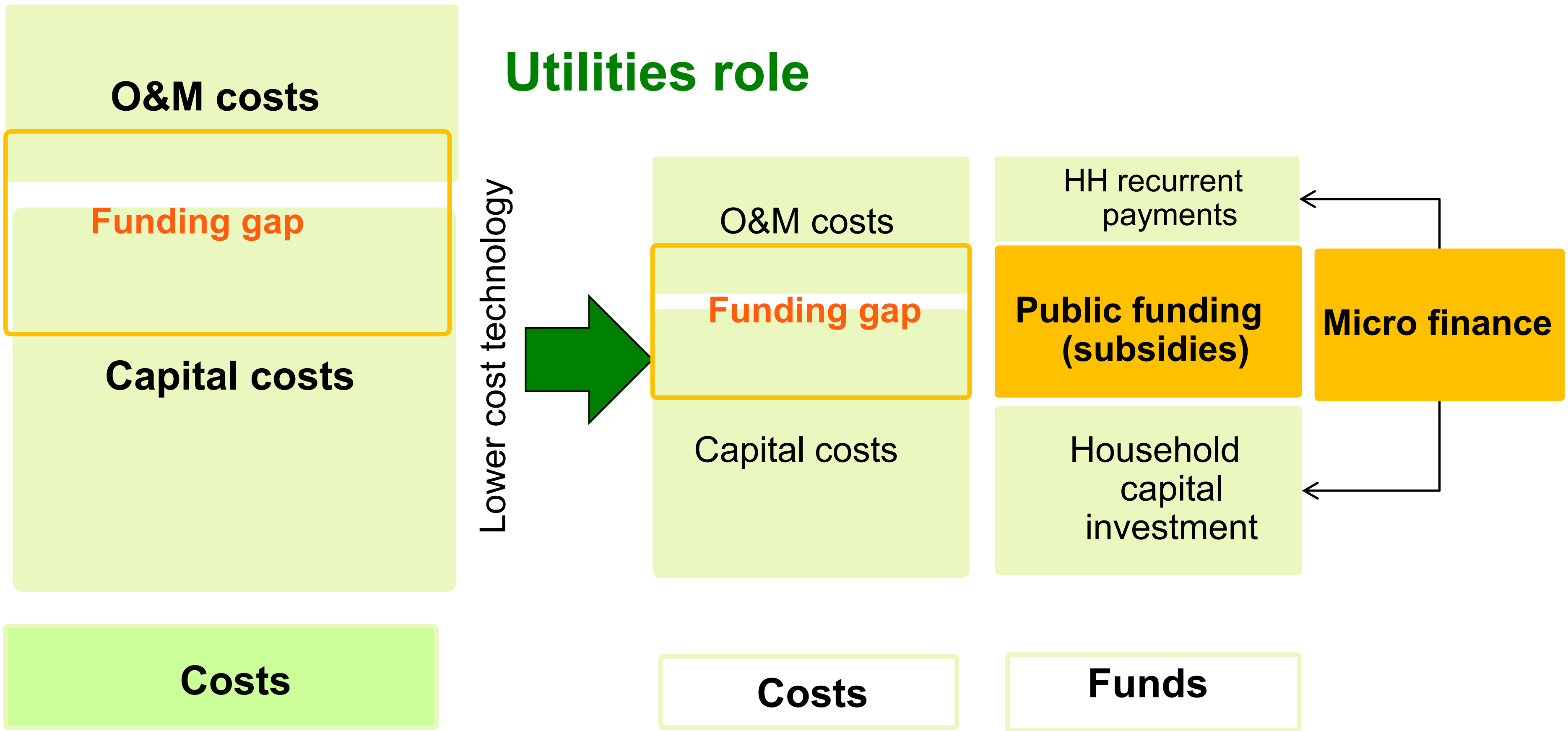
Source: Friedler & Pisanty (2006)

The bigger the system, the higher the O&M costs!

Who pays the bill?

2 min

Reducing the funding gap

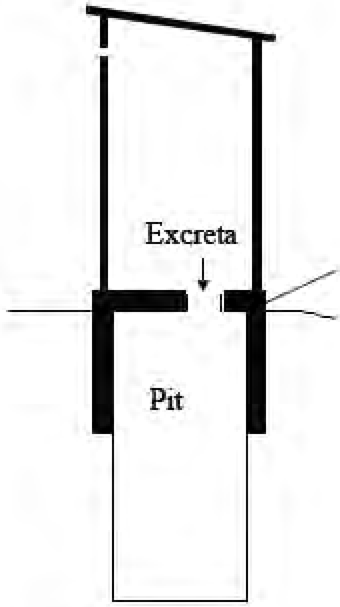


Source: adopted from Evans et al. targeting the Poor – Facilities and Improved Services

3. EXAMPLES (A)

I. Project design level

Cost comparison of sanitation technologies



Source: Sanimas

Pit Latrine

Source: seecon

UDDT

Source: Sanimas

Water borne system

On overview of technologies (in SA Rand)

	Type of toilet	Estimated capital cost per toilet at 2008 prices	
Off-site handling of sewage	Full conventional waterborne	R10 250	Water required [2]
	Shallow waterborne	R4 500	
	Small bore solids-free [1]	R12 000	
On-site handling of sewage	Septic tank [1]	R11 000	
	Loflos / aquaprivy [1]	R4 500	
	Composting (UDS)	R7 500	No water required [2]
	VIP (double)	R6 000	
	VIP (single)	R4 500	

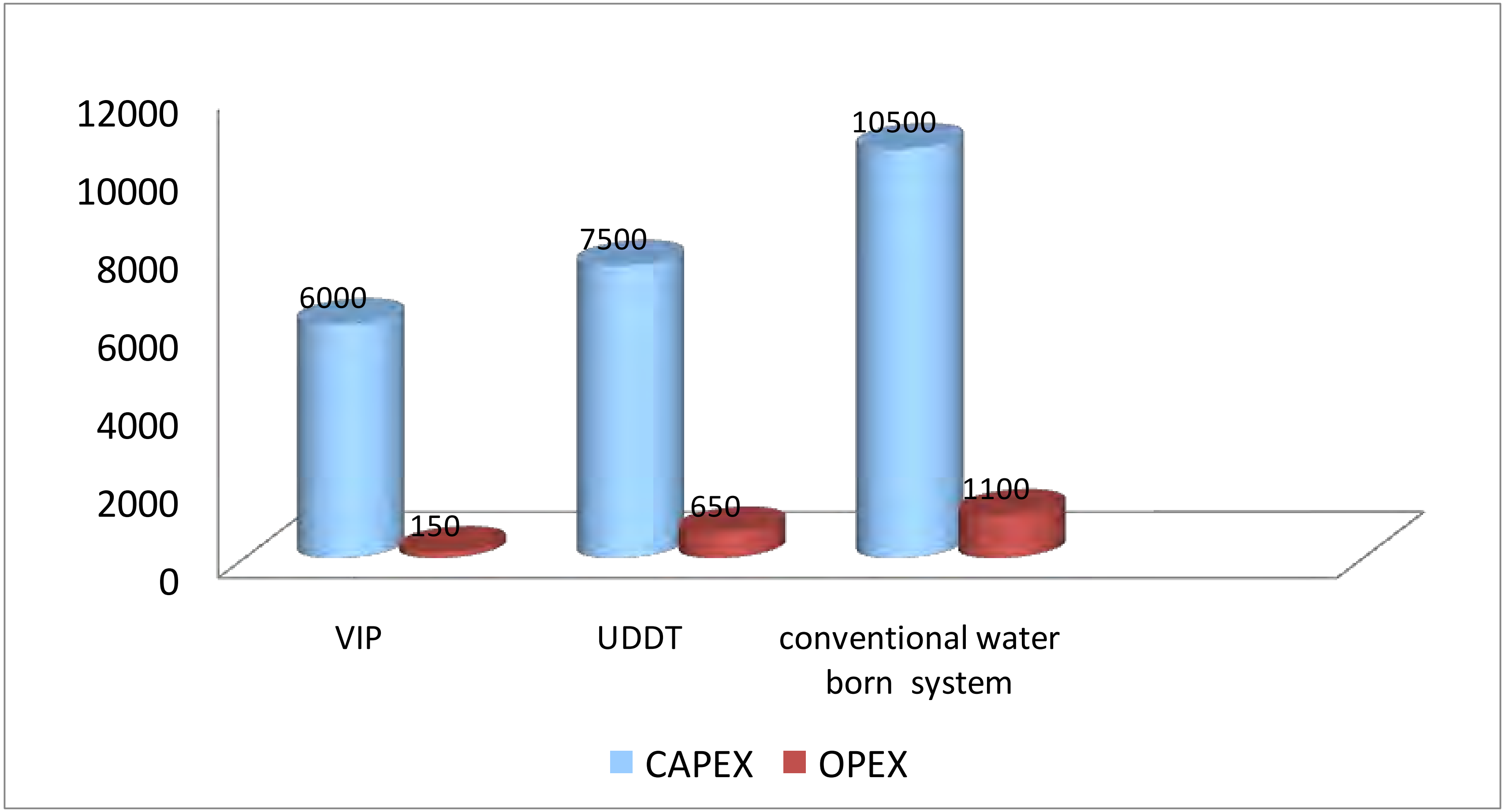
Exchange rate:
1Rand = 200 Tanzanian Shilling (TS)
1 EUR = 10 Rand (2008)

1. Sewage handled on-site and off-site (off-site de-sludging, although not always done in practice)
2. By the toilet *per se*

Source: Richard M., Pieter P. (2009)

Cost comparison (in South-African Rand)

Exchange rate: 1 R = 200 TS

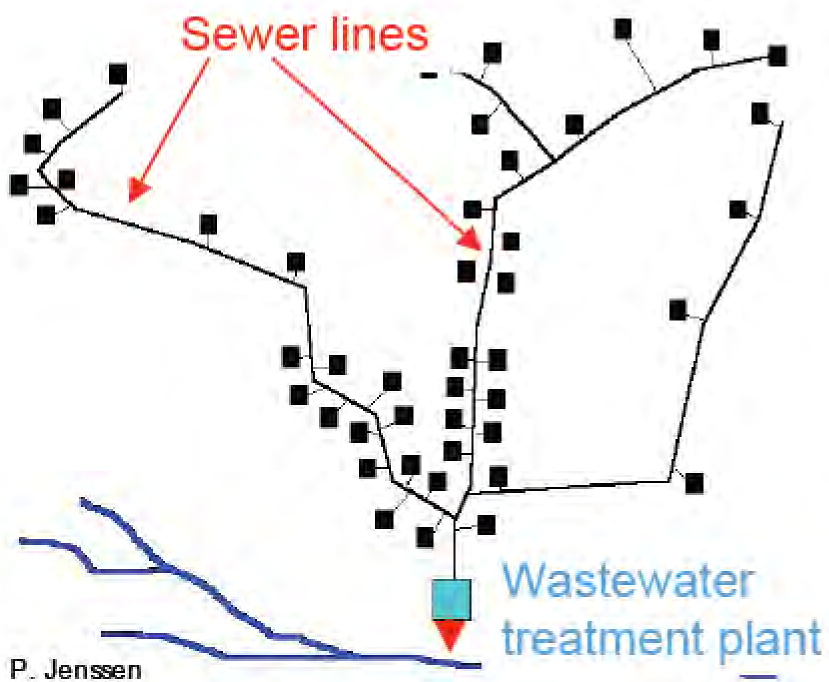


Cost comparision of sanitation systems

COSTS:		Simple Pit Latrine	UDD Toilet	Conventional Sanitation System
Investment costs:	Toilet structure	low	low-medium	low-medium
	Transport (pipe) system	nil	very low	very high
	Sewage treatment	nil	low	very high
Running costs:	Operation & Maintenance	low	low-medium	high
	Energy	nil	nil	high
	Water	nil	nil	very high
Software costs:	Training, Awareness raising	low	high	low-medium

Source: seecon

Investment costs for conventional wet sanitation is high!



- **Sewer invest. costs: 50-100 EUR/m**
- **WWTP + sewer**

→ 500 – 1000 EUR/pers)

- **O&M: 30 – 70 EUR/person**

Lechner (2010)

Costs of simplified sewer systems

State	Simplified sewerage cost US$/household	Conventional sewerage cost: US$/household	Notes
Rio Grande do Norte	350	≈ 1500	1983 costs[5]
São Paulo	440–790	800 – 1550	1988 costs[11]
Federal District	170–340	500 – 1500	1997 costs[8]
Pará	56	94	1997 costs[4]

Table 1. Capital costs of simplified and conventional sewerage in Brazil

Source: Broome and Mara (2008). Sewerage: a return to basics to benefit the poor
www.personal.leeds.ac.uk/~cen6ddm/pdf%27s%202008+/muen.2008.161.4.pdf

Can you effort to use water for the transport of waste?

- “20 - 40 % of the water consumption in sewered western cities is due to the water toilet.”

  Source: Gardner, G. (1997):
- Rough estimation:

  per flush 5 – 10 Liter x 2 times a day x 5 persons per family

  → 50 – 100 Liter/day

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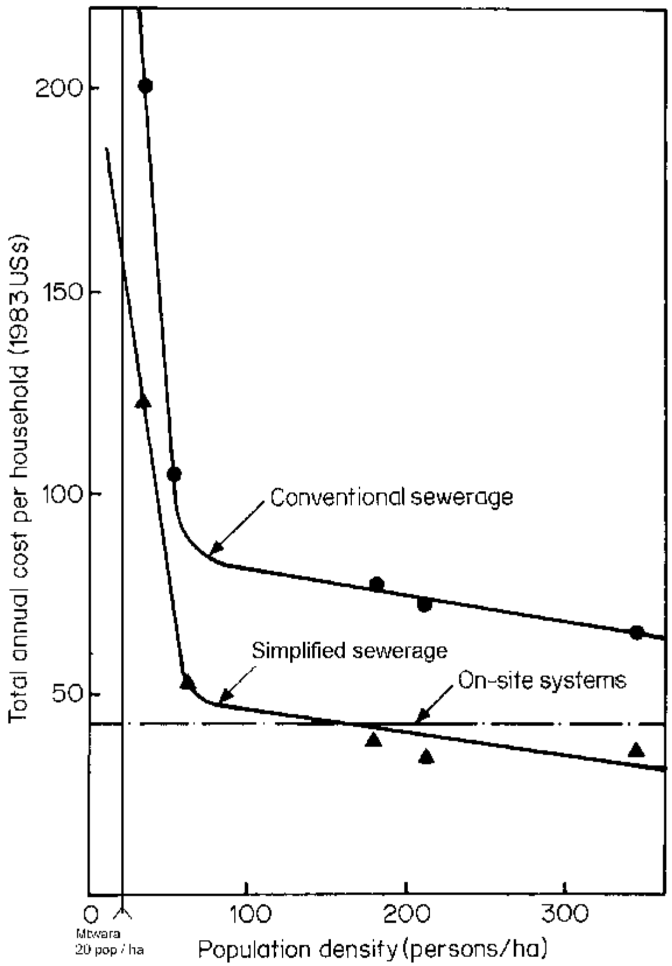
Costs of conventional and simplified sewerage and on-site sanitation North Brasil 1983



Source: Sinnatamby (1983)

More info:
www.personal.leeds.ac.uk/~cen6ddm/CommunalSanitation.html
www.personal.leeds.ac.uk/~cen6ddm/simpsew.html

Can sewerage be a pro low income solution?

- Yes, in certain situations: *though often onsite solutions will often be more cost-effective and sustainable.*

- What specific situations?
  - High population densities
  - Water availability
  - Sufficient institutional capacity
  - Sufficient capital resources

3. EXAMPLES (B)

II. Sanitation programming

Example 1: Uganda, Kabale

Technology

- Extension of the sewer system (6 km new sewer lines, 18km hh connection, a pumping station)
- Construction of a stabilisation pond and sludge emptying trucks

O&M

- National Water and Sewerage Company
- Treatment plant operates well
- Maintenance of sewer system is difficult, stolen manhole covers, blockages of the network

Lessons learnt

- Good treatment efficiency
- High per capita costs (14%of annual hh income)
- Low connection rate → too expensive technology!

Example 1: Uganda, Kabale

Costs

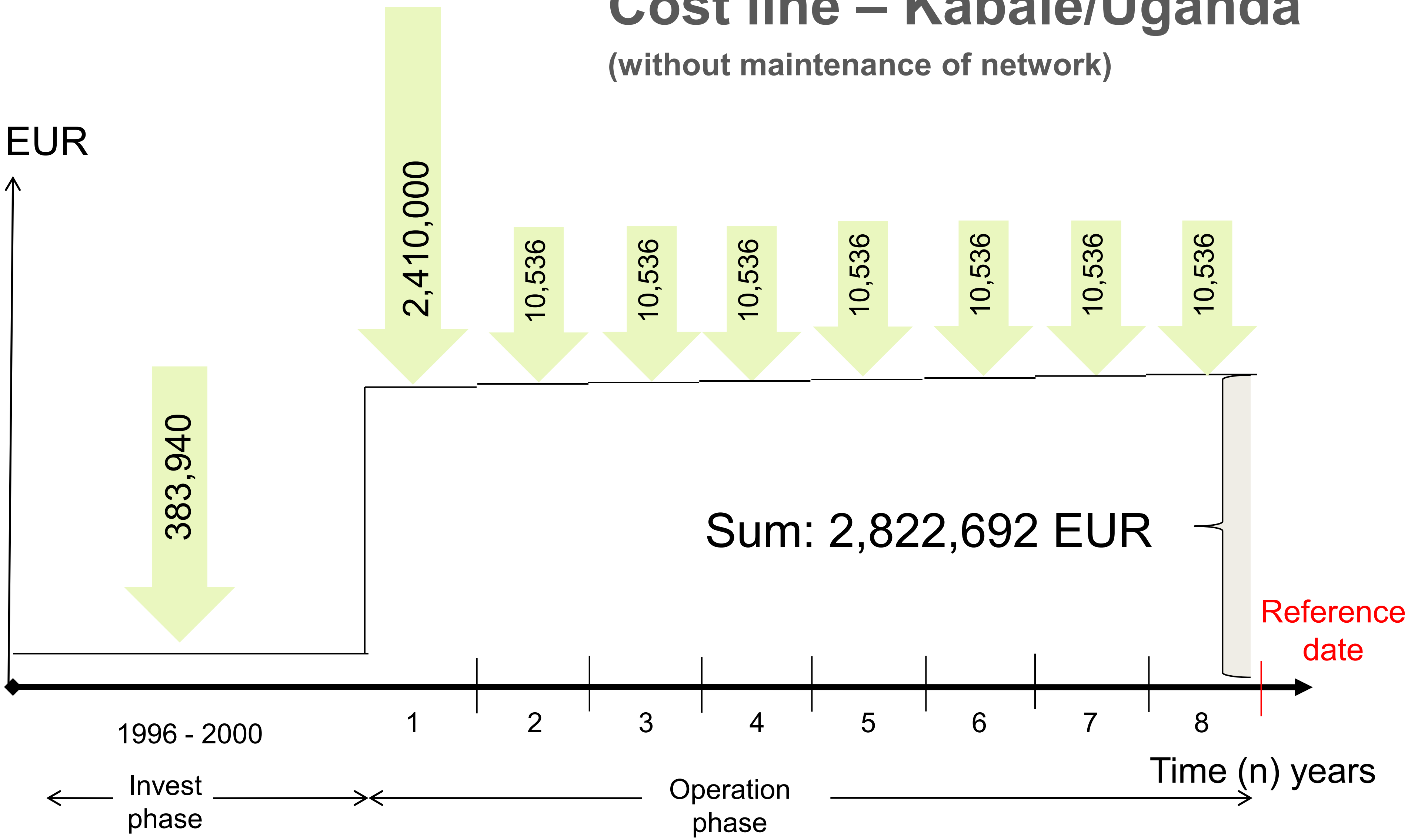
- O&M 10,536 - without network! → in reality much more expenditures
- waste water tariff in 2007 was EUR 0.45 /m3 for HH, EUR 0.94 /m3 for commercial clients and EUR 0.75 /m3 for governmental and public institutions.
- annual user fee for sewerage is EUR 13/hh.

Costs (EUR)	**Hardware Construction**	**Software Hygiene & training**	**O&M**	**LRMC**
Total	2,410,000	383,940	10,536*	
Per person (3,312)	728	115	3.2	27
Per person (8,000)	301	48	1.3	11

* Without maintenance for network

Cost line – Kabale/Uganda

(without maintenance of network)



Long Run Marginal Costs*

- includes CAPEX and OPEX over a certain lifetime and beneficiary number
- expressed per inhabitant served and year
- can give a first indication on ***required tariffs***
- comparison to local / regional or national household income gives an indication on ***affordability***

*Read more in the Factsheet of the SuSanA WG on costs and economics:
http://www.susana.org/images/documents/05-working-groups/wg02/factsheet/susana-factsheet-costs-economics.pdf

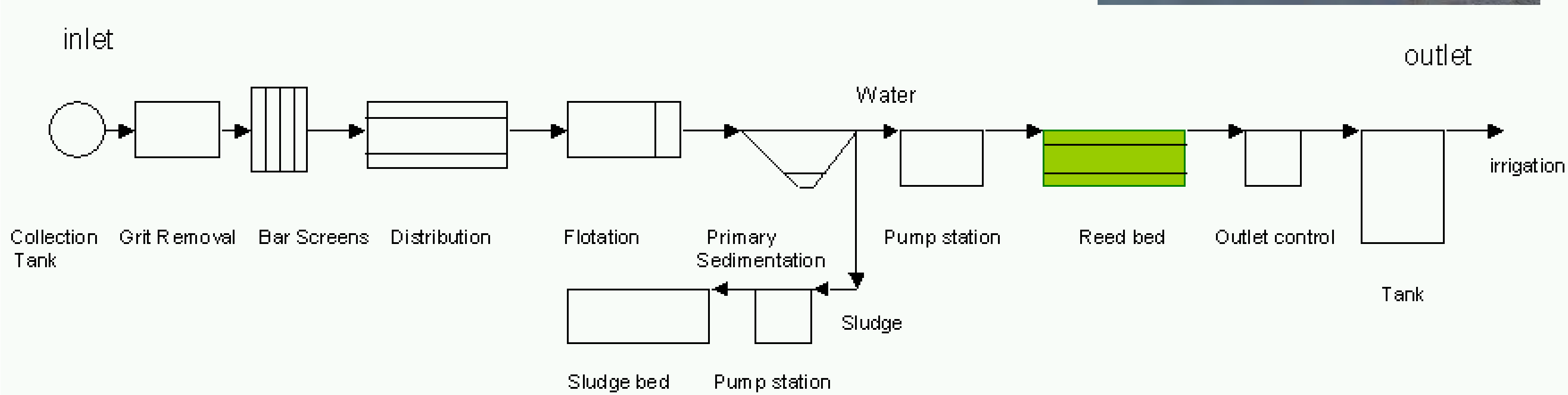
LRMC (without discount rate)

Year	annualized **Investment**	O&M	Yearly costs	beneficiaries	LRMC (EUR/pers*a)
1	80, 300 (2,410,000/30)	10,536	90,900	3,312	27
2	80, 300 (2,410,000/30)	10,536	90,900	3,312	27
3	80, 300 (2,410,000/30)	10,536	90,900	3,312	27
4	80, 300 (2,410,000/30)	10,536	90,900	3,312	27
…	…	…	..	…	…
30	80, 300 (2,410,000/30)	10,536	90,900	3,312	27

EXAMPLE 2: GTZ project in Syria, Haran-Al-Awamied

- 14.000 p.e. operating since 2000
- Pre-treatment with manually-raked bar screens
- Primary treatment with circular settling tank
- Two sub-surface reed beds (0.5/m^2 p.e. only)
- One reed bed for sludge treatment
- Collection tank for treated wastewater


Circular primary settling tank



http://www.susana.org/images/documents/06-case-studies/en-susana-cs-syria-constructed-wetland-2009.pdf

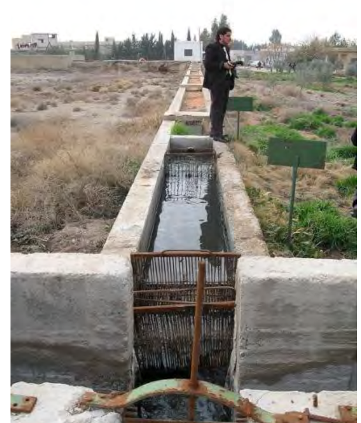
EXAMPLE 2: GTZ project in Syria

View of village Haran-Al-Awamied, from which the wastewater is treated

Grey- or wastewater

Influent raw wastewater (note grey colour in glass jar)

Channel for grit and fat removal



Simple screens for wastewater screening

Reed beds (after about 2 years of growth)

14.09.2

Primary sludge drying bed in front of reed bed. At the front you can see the sludge pipe from the primary settling tank.

Operator showing effluent quality

Pump which pumps treated effluent to the fields

Pipe with treated effluent to irrigation site

Olive trees which can be irrigated with treated effluent

EXAMPLE 2: Cost implications

Costs (EUR)	Hardware Construction	O&M	LRMC
Total	95,900*	9,000	
Per person (Total 14,000)	6.8	0.6	0.95

- Operational cost includes: salaries for operators and security guard, electricity for pumps (primary sludge pump), laboratory reagents and the cost to cut the reed.
- **Feasibility study** → comparable treatment systems more expensive

Costs (EUR p.p*a)	Const. Wetland	Aerated lagoon	Activated sludge
Investment	6.8*	19	25
O&M	0.6	5.7	3.8

* Reed bed only

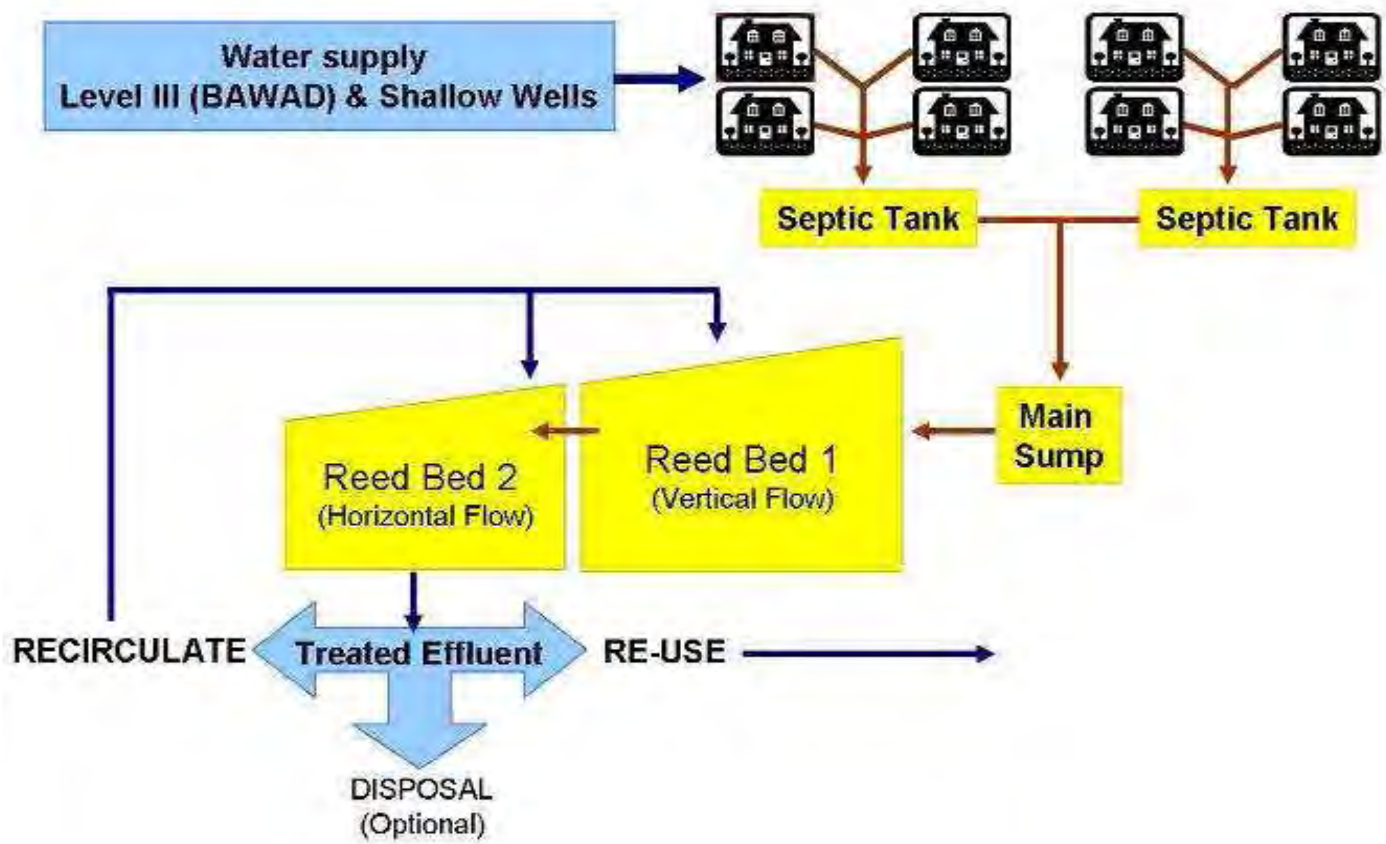
EXAMPLE 3: Constr. Wetland Bayawan, Philippines, (GTZ, 2006)

- Peri-urban upgrading of a settlement; domestic wastewater treatment with constructed wetland
- 676 houses (average household size of 5 people) → design figure: 3,380 people
- 2680 m2 and the wetland has a specific surface area of 0.9 m2 per person

Source:Robert Gensch 2009

http://www.susana.org/images/documents/06-case-studies/en-susana-cs-philippines-bayawan-constr-wetlands-2009.pdf

EXAMPLE 3: Constr. Wetland Bayawan, Philippines, (GTZ, 2006)



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EXAMPLE 3: Constr. Wetland Bayawan, Philippines, (GTZ, 2006)

Drying beds located at the Bayawan City Waste Management and Ecology Center

Planning institution:
City of Bayawan, Philippines
Oekotec GmbH, Belzig, Germany
Gerry F. Parco & Marc Mulingbayan, Philippines

Executing institution:
City of Bayawan, City Engineering Office

Supporting agency:
- Financed by Bayawan City with help of Worldbank
- Department of the Interior and Local Government (DILG)-GTZ Water & Sanitation Program (but only for consultancy fees and various technical assistance – not for construction itself which was financed by Bayawan City)

→ Bayawan City planed to build additional constructed wetlands in strategic areas of the city. They started with a wastewater treatment facility for the District Hospital. In Sept. 2009 this wastewater system of the hospital was almost finished!

EXAMPLE 3: CW, Bayawan, Philippines, (GTZ, 2006)

O&M:

- O&M training for City Engineering and members of the village association
- City engineering teams do field operations, engineering and maintenance and water quality monitoring

Lessons learnt:

- Constructed wetlands relatively easy to construct and maintain
- international and a local consultant team facilitated an intensive knowledge exchange
- Only one pump → low energy costs (EUR 200 per month)
- Further projects planned → success story

http://www.susana.org/images/documents/06-case-studies/en-susana-cs-philippines-bayawan-constr-wetlands-2009.pdf

EXAMPLE 3: CW, Bayawan, Philippines, (GTZ, 2006)

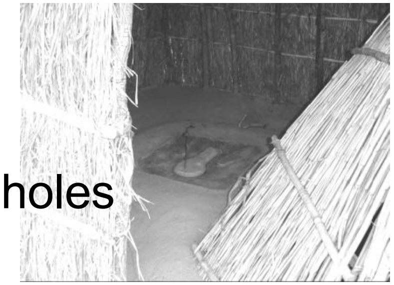
- Bayawan City financed the bulk of this construction cost with Worldbank credit
- Software (consultant, workshops, community participation and social preparation sessions) paid by GTZ –DILG program

Costs (EUR)	CAPEX	OPEX	LRMC
Total	160,000*	3,500	
Per person (Total 3,380)	47	1.05	3.60

* For complete constructed wetland system

http://www.susana.org/images/documents/06-case-studies/en-susana-cs-philippines-bayawan-constr-wetlands-2009.pdf

EXAMPLE 4: Balaga, Mongoshi Malawi



Technology/aproach

- water supply and sanitation (1050 new + 180 rehabilitated, boreholes 44,800 sand plats [cover panels for latrines])
- intensive hygiene and health education

O&M

- Users are responsible for keeping their latrines clean and maintaining the superstructure.
- no provisions for emptying the pits → ones it is full user has to dig a new pit

Lessons learnt

- Hygiene campaign, training were much more important than physical investment
- Successful and sustainable increase of usage of latrines and hand washing facilities
- Very low investment costs

http://www.susana.org/images/documents/06-case-studies/en-susana-cs-syria-constructed-wetland-2009.pdf

EXAMPLE 4: Malawi - Cost implications

- sanitation component of the programme financed the distribution of concrete sandplats (EUR 5.75)
- beneficiaries (pit digging and superstructure) was quite significant but difficult to quantify

Costs (EUR)	Hardware Construction	Software Hygiene	LRMC
Total	257,000	1,209,600	
Per person (Total 196,000)	1.31	6.17	1.29

EXAPMLE 5: Ghana, Ashanti (2005 – 2006, KfW)

Technology/approach

- hygiene awareness campaign and demand increase for sanitation
- Artisans training in latrine (VIP) construction (reinforced walls, ring beam and concrete slab)

O&M

- HH is responsible for cleaning and maintaining their latrines

Lessons learnt

- it takes time to trigger demand for household latrines → planned 3,400 VIPs will not be reached
- Subsidies might not accelerate but slow down the process towards improved sanitation.
- overuse of the KVIPs in schools from communities → pits will fill up much sooner than estimated → higher reinvest costs.

EXAPMLE 5: Ghana, Ashanti (2005 – 2006, KfW)

Costs:

- Overall cost for sanitation component is EUR 1.5 million
- Households have to finance the remaining 50% of the estimated EUR 169 cost of one VIP (of which EUR 90 for stones, sand, pit digging and other labour).

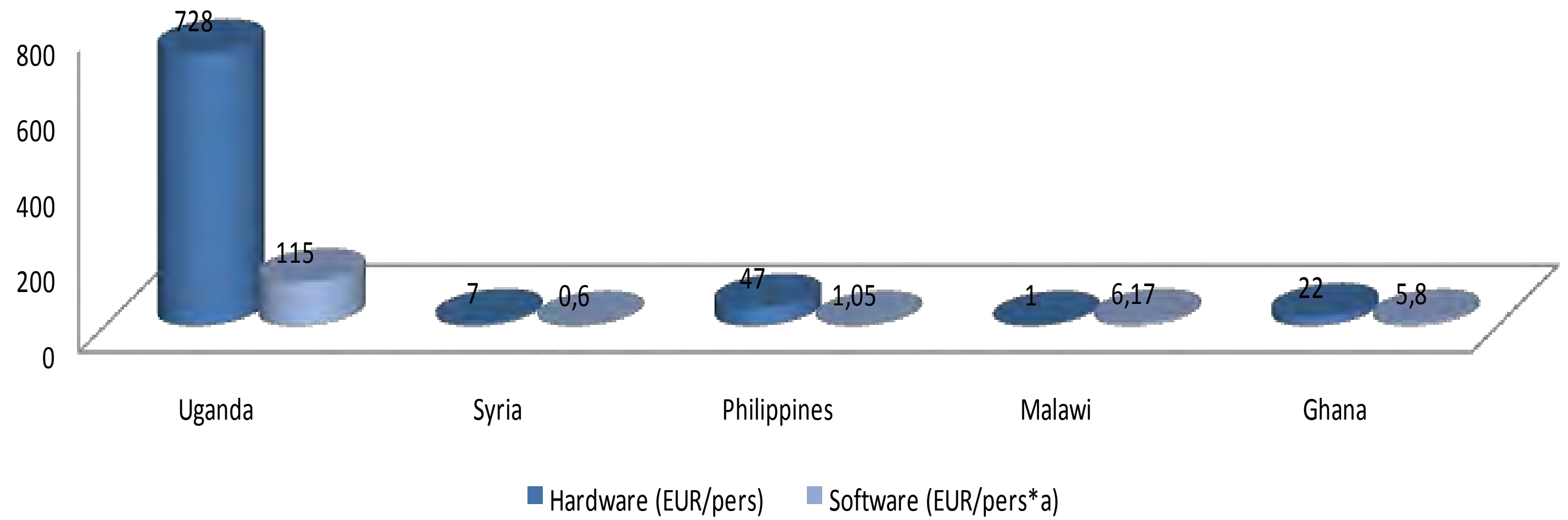
Costs (EUR)	**CAPEX**	**Software Hygiene**	**LRMC**
Total	573,810	146,455	
Per person (Total 25,500)	22.5	5.8	4

Overview:

Project	Bene-ficiaries	Hardware Investment (per person)	Software (per person)	LRMC in EUR Person*a	LRMC as % of or GDP
Uganda WWTP, network	3,312 (planned 8,000)	2,410,000 (728)	383,940 (115)	27	14%
Malawi, Hygiene training, sandplats	196,000 (rural)	257,000 (1.31)	1,209,600 (6.17)	1,29	0.9%
Ghana VIP, artisan training	25,500 (rural)	573,810 (22.5)	146,455 (5.8)	4	0.8%
Syria Constructed Wetland*	14,000 (rural)	95,900 (6.8)	O&M → 9,000 (0.6)	0.95	0.4%
Philippines** Constructed Wetland	3,312 (semi-urban)	160,000 (47)	O&M → 3,500 (1.05)	3.6	1.4%

* Reed bed only
** complete constructed wetland system

Costs comparison (in EUR/person)



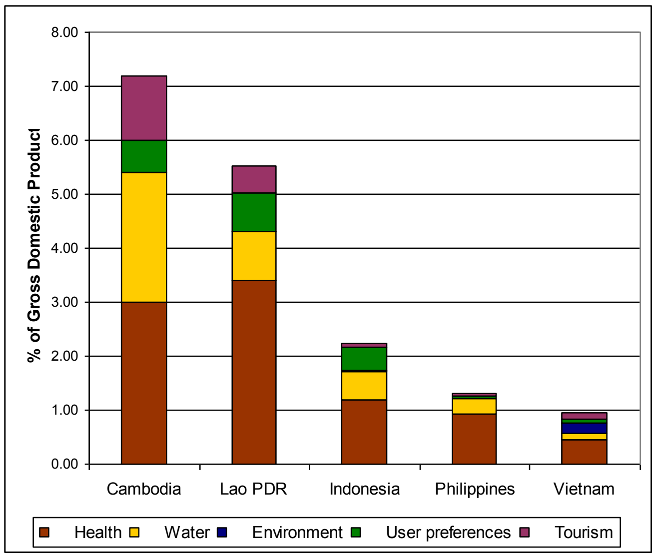
4. Benefits of sanitation

Which Benefits does sanitation create?

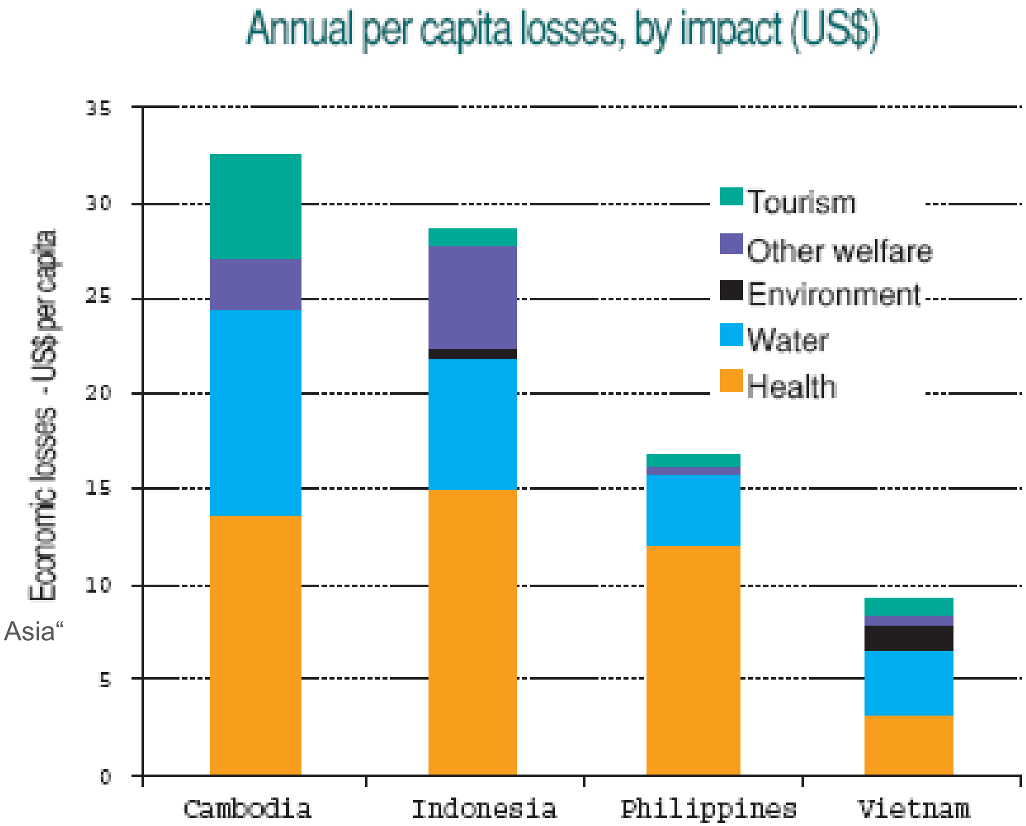
2 min

Benefits

Economic costs from poor sanitation:

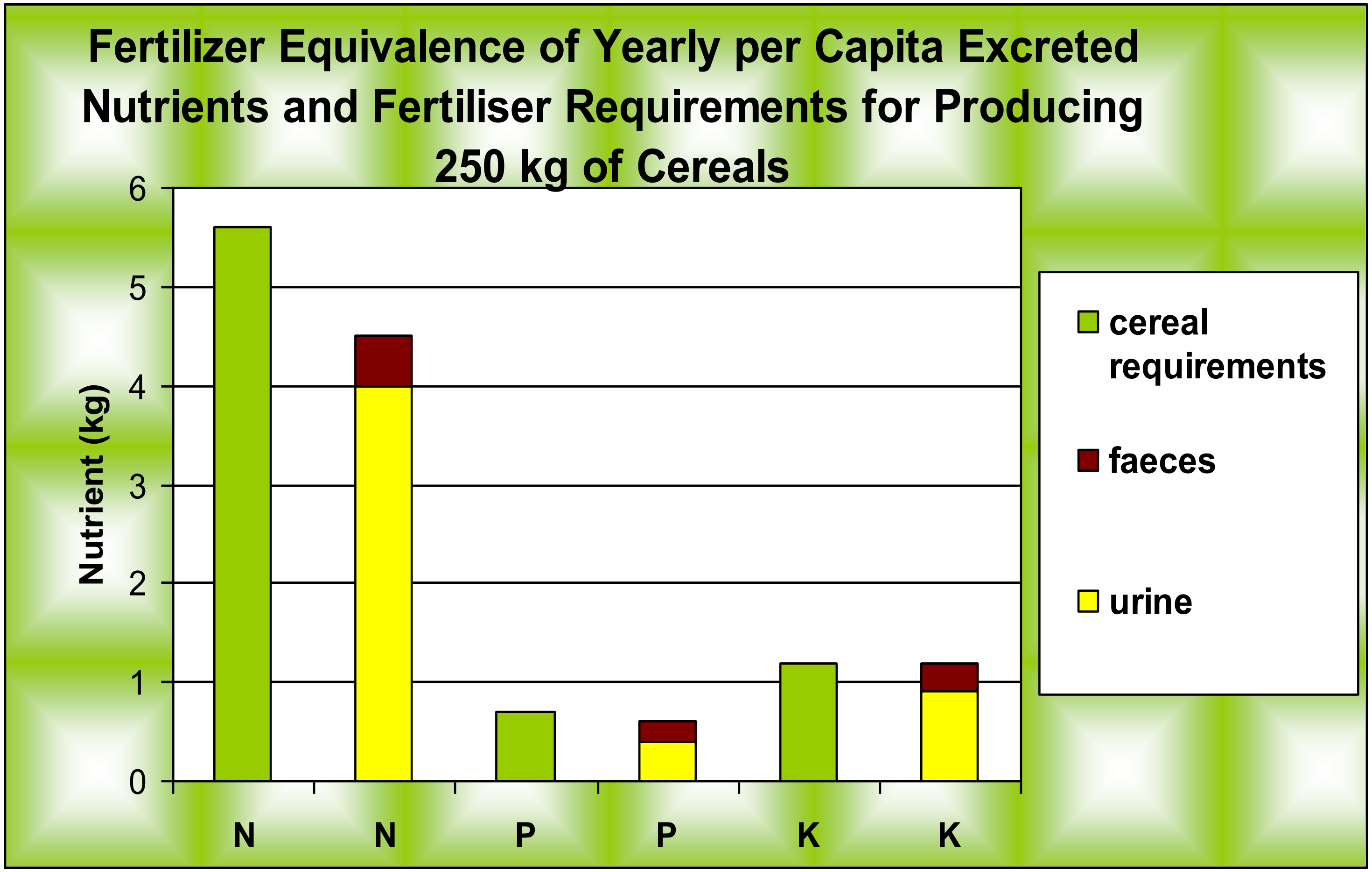


Source: WSP, 2008 „Economic impacts of sanitation in South East Asia“



→ affects everyone, but especially poor and vulnerable people

Fertilizer potential of human excreta

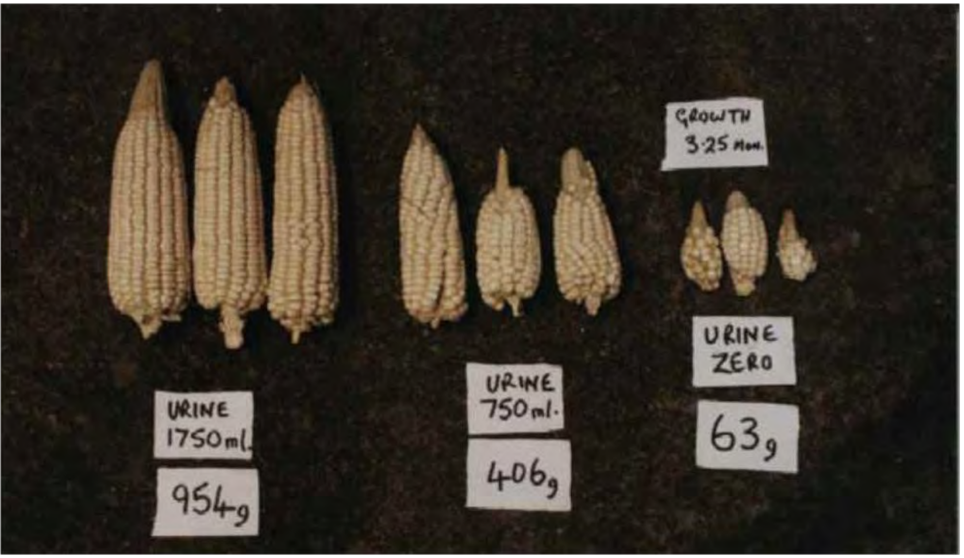


Fertilizer use of human excreta

Fertilizer value of human excreta

Human excreta values 5 – 10 US$ per person/year due to:

- higher yields or selling as fertilizer



5. EXAMPLES

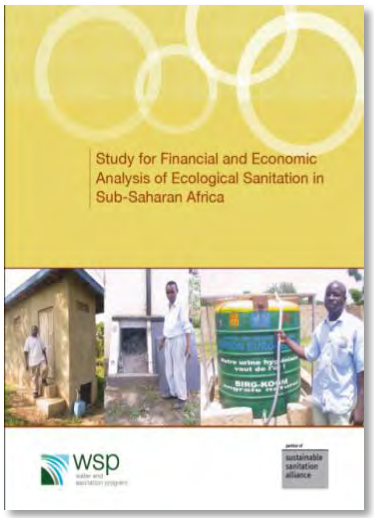
II. Sanitation programming &
III. Policy decision

Net Present Value

Sum of all present values of the annual cash flows during the life of the project, minus the initial investment.

When economic NPV is positive → profitable! (sufficient revenue can be generated from selling fertilizer or crops from the land that is fertilized using excreta)

“Financial and Economic Analysis of ecosan in SSA“ (WSP)



- Computer based model analyse of 3 case studies to compare UDDTs with VIPs and conventional systems
- Real case studies from Uganda, South Afrika, Burkina Faso (no subsidy, basis for comparisment 5,000 people, three scenarios)

RESULTS - WSP‘s study

Project 1: Kabale, Uganda

- Population of 83,000 people
- 500 connections to the sewer network (CAPEX per sewer connected toilet approx. US$ 563 [without treatment costs))
- 150 UDDTs managed by the individual household (CAPEX in US$ 340 – 882)
- No subsidies needed to finance the installation of UDDTs
- monetary value of reuse is US$ 102 per household per year from UDDT

RESULTS - WSP's study

Project 1: Kabale, Uganda

- High cost option UDDT is most favorable for hh
- Low cost UDDT generate positive economic NPV (good agricultural conditions)
- Sewerage is unattractive solution

Table 3: Uganda: Financial and economic NPV (no subsidies)

		UDDT		VIP		Sewerage
		Low cost	High cost	Low cost	High cost	High cost
		US$	US$	US$	US$	US$
Financial NPV	Household	- 55	- 484	- 301	- 647	- 605
	Project	- 123	- 123	- 30	- 30	- 203
	Total	- 178	- 607	- 331	- 677	- 808
Economic NPV		+ 111	- 345	- 124	- 492	- 890

RESULTS - WSP's study

Project 2: eThekwini, South Africa

- Metropolian area comprising the City of Durban,
- 74,000 use UDDTs (no reuse), 90,000 septic tanks and VIPs, 425,000 have sewer connections
- UDDTs promoted by the town because problems and costs associated with desludging pits in remote areas
- Heavy subsidies for all sanitation options
- CAPEX: UDDT 1,245 US$; VIP 958 US$;

RESULTS - WSP's study

Project 2: eThekwini, South Africa

- 1. Sewerage is most expensive
- 2. UDDT option is the cheapest option for hh when subsidies are applied, but when these are removed, the financial NPV increases significantly
- 3. CAPEX cost for UDDTs promotion

Table 5: eThekwini: Financial and economic NPV (household and project perspective) with and without subsidies

		UDDT	VIP	Sewerage
		High cost	High cost	
With subsidies		US$	US$	US$
Financial NPV	Household	-9	-137	-652
	Project	-1,367	-930	-2,020
	Total	-1,376	-1,067	-2,672
Economic NPV	-	1,518	-1,148	-1,578
No subsidies		US$	US$	US$
Financial NPV	Household	-1,217	-1,230	-3,037
	Project	-158	-44	-215
	Total	-1,376	-1,273	-3,252
Economic NPV	-	-1,518	-1,148	-1,578

RESULTS - WSP‘s study

Project 3: Ouagadougou, Burkina Faso

- Peri-urban areas of Ouagadougou
- 930 UDDTs, 82,000 conventional on site facilities (mostly traditional latrines), and 200 connections to the sewerage network
- UDDTs (US$ 229 – US$ 410); VIPs (US$ 612); Traditional pit latrine rehabilitation (US$ 177)
- Collection and storage system and distributed system for excreta reuse

1a. Double vault in cement with cement brick superstructure (US$ 410)

1b. Double vault in cement with adobe brick superstructure (US$ 339)

2. Single vault integrated into the house (Variable cost)

3. Double vault with sub- and superstructure in adobe (US$ 279)

4. Box with adobe superstructure (US$ 229)

RESULTS - WSP‘s study

Project 3: Ouagadougou, Burkina Faso

- Transport system for urine, dried feces (initially fully subsidized) → sensitisation of urine and feces → 800 farmers
- Farmer pay US$ 0,20 per jerry can and 0,1 US$ per kg dry hygienized feces
- hh pay small fee for collection
- Excreta value: 36,3 US$ per hh and year

RESULTS - WSP‘s study

Project 3: Ouagadougou, Burkina Faso

- UDDT option is the most favorable option from hh perspective
- Low-cost VIP is cheaper from the project perspective
- Sewerage option is most expesive

		UDDT		VIP		Sewered option
		High cost	Low cost	High cost	Low cost	
With subsidies		US$	US$	US$	US$	US$
Financial NPV	Household	-198	-48	-682	-259	-1,721
	Project	-493	-493	-168	-168	-192
	Total	-691	-541	-850	-427	-1,913
Economic NPV		-560	-396	-840	-378	-1,055
No subsidies		US$	US$	US$	US$	US$
Financial NPV	Household	-342	-192	-759	-336	-1,721
	Project	-349	-349	-91	-91	-192
	Total	-691	-541	-850	-427	-1,913
Economic NPV		- 560	-396	-842	-380	-1,055

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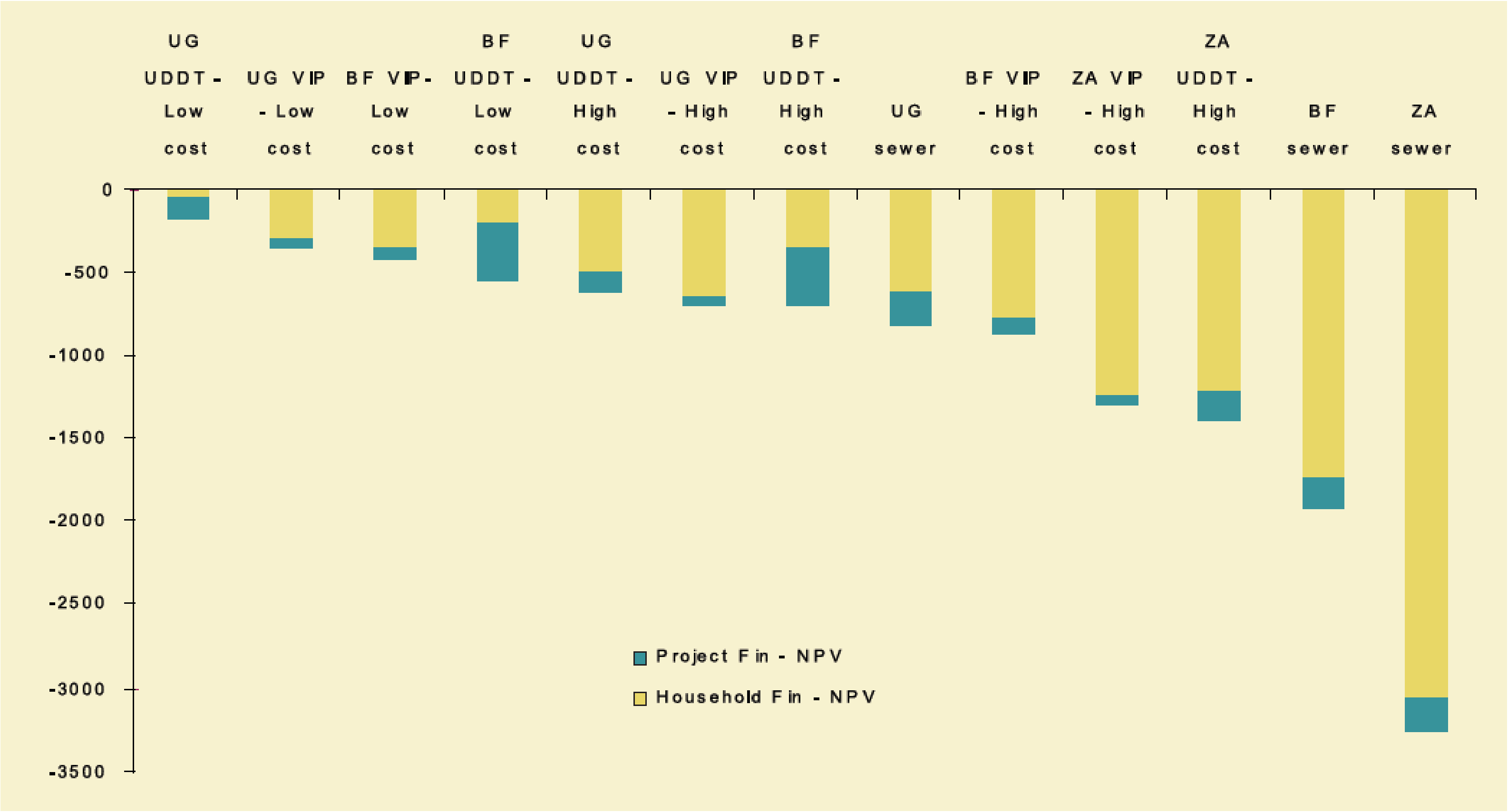
RESULTS - WSP's study

Cross country comparison: Ranking of sanitation options – financial NPV

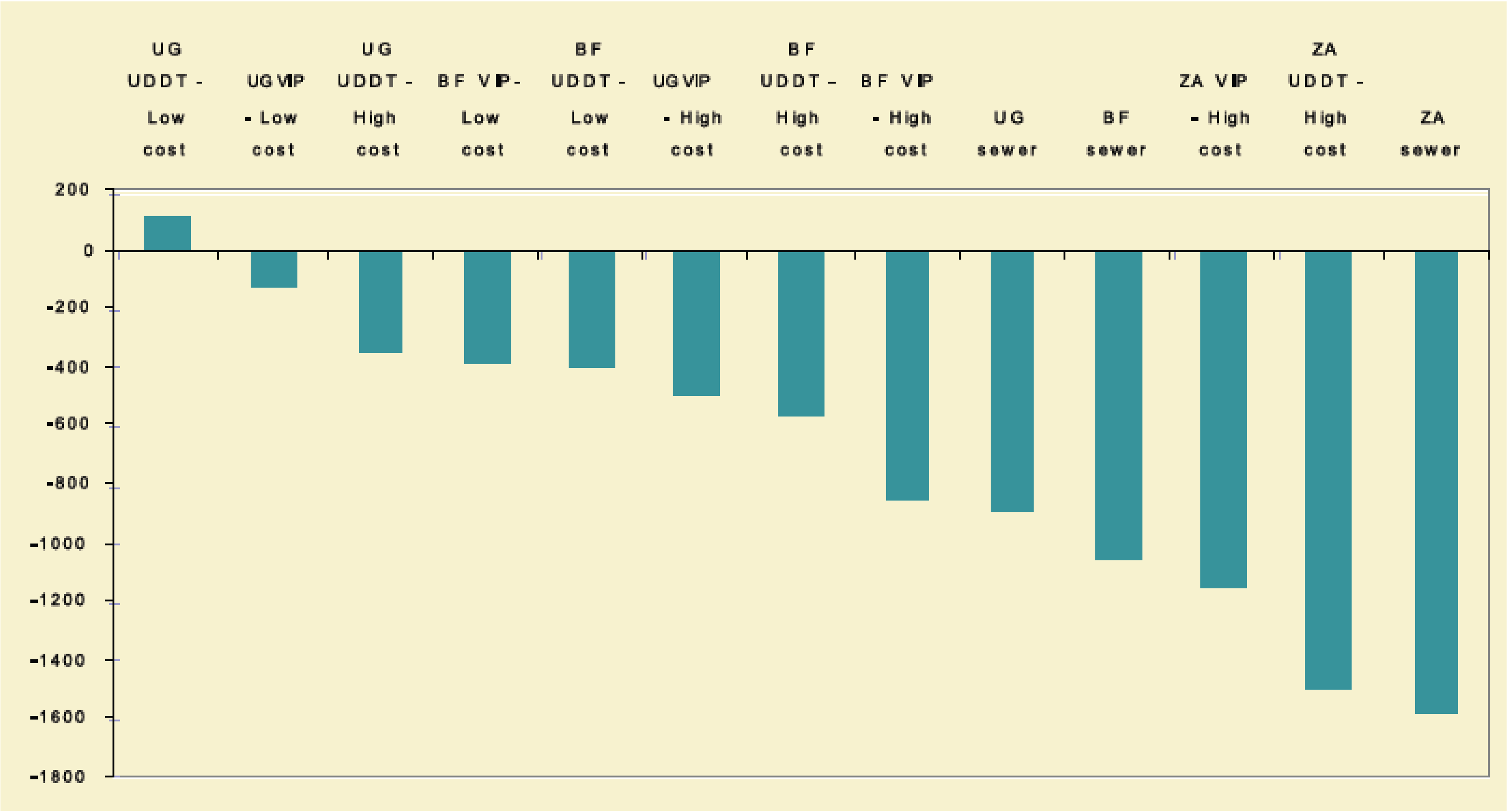


(UG – Uganda, BF – Burkina Faso, ZA – South Africa)

WSP, 2009 "Study for Financial and Economic Analysis of Ecological Sanitation in Sub-Saharan Africa, Water and Sanitation Program"

RESULTS - WSP's study

Cross country comparison: Ranking of sanitation options – economic NPV



(UG – Uganda, BF – Burkina Faso, ZA – South Africa)

WSP, 2009 "Study for Financial and Economic Analysis of Ecological Sanitation in Sub-Saharan Africa"

Conclusion

Conclusions

- Costs must be affordable for future users
- Water, money, and fertilisers are scarce resources while labour is cheap and available → conventional wastewater systems (water intensive + costly infrastructure) are not appropriate
- Sewerage is most expensive solution
- Reuse of nutrients can generate net financial benefit for low cost versions → use the value chain

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Asante Sana!

Contact: **steffen.blume@gtz.de**

Further info:

- **http://www.susana.org/**
- **www.gtz.de/ecosan**

Resources

- Evans et al. targeting the Poor – Facilities and Improved Services, presentation during Symposia Improving hygiene awareness and sanitation, KfW Water Symposium, October 8 and 9, 2009, Frankfurt
- Friedler E. and *Pisanty E*., 2006. Effects of design flow and treatment level on construction and operation costs of municipal wastewater treatment plants and their implications on policy making. *Wat. Res.*, 40(20): 3751-3758.
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- Richard M., Pieter P. (2009) DEVELOPMENT OF A MODEL FOR DETERMINING AFFORDABLE AND SUSTAINABLE SANITATION DEMAND IN DENSE SETTLEMENTS OF SOUTH AFRICA
- SuSanA (2009) SuSanA *Factsheet of the working group on sustainable sanitation and costs and economics* http://www.susana.org/images/documents/05-working-groups/wg02/factsheet/susana-factsheet-costs-economics.pdf (accessed 17 June 2009)
- UNEP (2004): Financing wastewater collection and treatment in relation to the Millennium Development Goals and World Summit on Sustainable Development targets on water and sanitation. Eighth special session of the Governing Council/ Global Ministerial Environment Forum Jeju, Republic of Korea, 29-31 March 2004. UNEP/GCSS.VIII/INF/4
- WSP, 2008 „Economic impacts of sanitation in South East Asia“ http://www.susana.org/docs_ccbk/susana_download/2-581-hutton-et-al-2008-sanitation-impact-cambodia-wsp-esi-en.pdf
- WSP (2009) *Study for Financial and Economic Analysis of Ecological Sanitation in Sub-Saharan Africa*. A Final Synthesis Report, Water and Sanitation Program http://www.susana.org/images/documents/07-cap-dev/a-material-topic-wg/wg02/wsp-schuen-2009-study-financial-economical-analysis-ecosan-ssa.pdf

Appendix

Appendix

Why data has limited comparability?

- No general expression for costs possible
- Studies do not compare same sanitation systems and project environments
- Some times apple are with oranges

→ case to case analysis required!

Net Present Vaule

Net present values will be calculated based on the following:

$$NPV = \sum_{t=0}^{t=T} \frac{(B - C)}{(1 + r)^t}$$

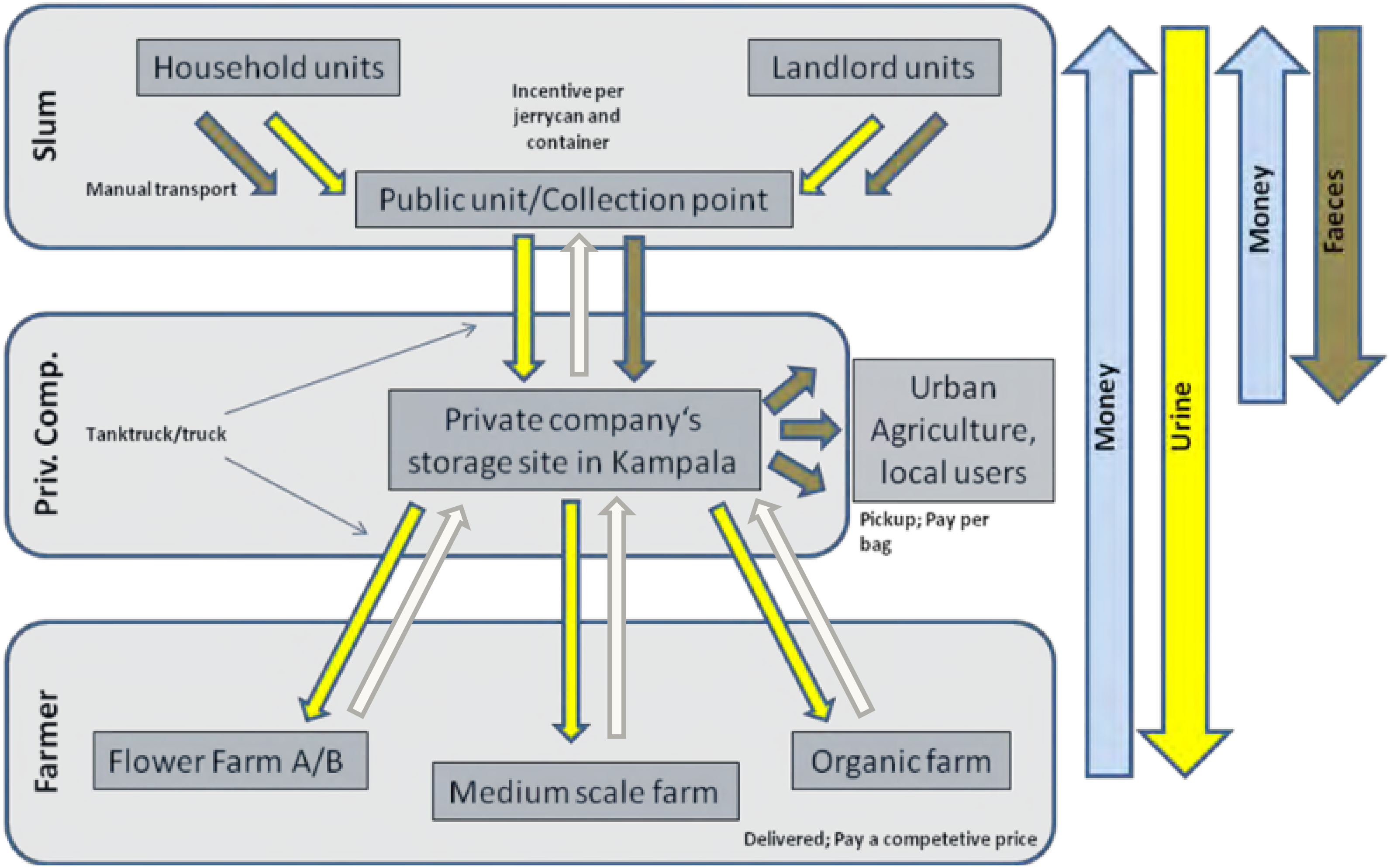
Where:

NPV is the net present value
B is the monetary value of benefits
C is the monetary value of costs (annuitised where appropriate)
r is the discount rate; and
T is the number of years in the planning horizon

Costs of logistics

Logistic system (B)

Source: Marketing Human Excreta, Enno Schroeder, 2010



System B:
Cost calculation – Assumptions

- General framework: same as for system A
- Additional income from faeces fertiliser bags sales
- Collection efficiency of faeces: 50%
- Urea costs: 0.46 EUR/kg (4% are added per weight unit)
- Incentive per container: 0.04 EUR
- Upfront investments that were included in the calculation (20% interest rate):
  - "PooBoxes" for exchange at the collection points
  - Lorries
  - Drying bed

(For more details please see the underlying study)

System B: Cost calculation – Results

	Small scale I	Small scale II	Large scale I
N demand [kg/month]	1,200	1,808	11,663
Urine equivalent [l/month]	398,182	599,927	3,869,995
# Of people producing it	44,242	66,659	429,999
Amount of faeces [kg/month]	92,909	139,983	902,999
Workload indicator urine (Bad workload = 0; Good workload = 1)	0.664	1.000	0.992
Workload indicator faeces (Bad workload = 0; Good workload = 1)	0.310	0.467	0.752
Monthly income from urine fertiliser sales [EUR]	4,267	6,429	41,472
Monthly income from the "Faecifert" sales [EUR]	2,860	4,309	27,794
Total monthly income [EUR]	7,127	10,738	69,267
Monthly costs [EUR]	8,587	10,076	56,917
Monthly balance [EUR]	-1,460	662	12,349
Monthly return on sales [%]	**n/a**	**6**	**18**
Start-up investment [EUR]	160.022	163,376	843,427
Repayment period [yrs]	**n/a**	**21**	**6**

- Small scale I: All input parameters are based on a flower farm where one interview took place. In this case the system was not working to full capacity.

- Small scale II: Equal to "Small scale I", but working to full capacity.
- Large scale I: Calculations have been made for a system covering all people living in slum settlements in Kampala.

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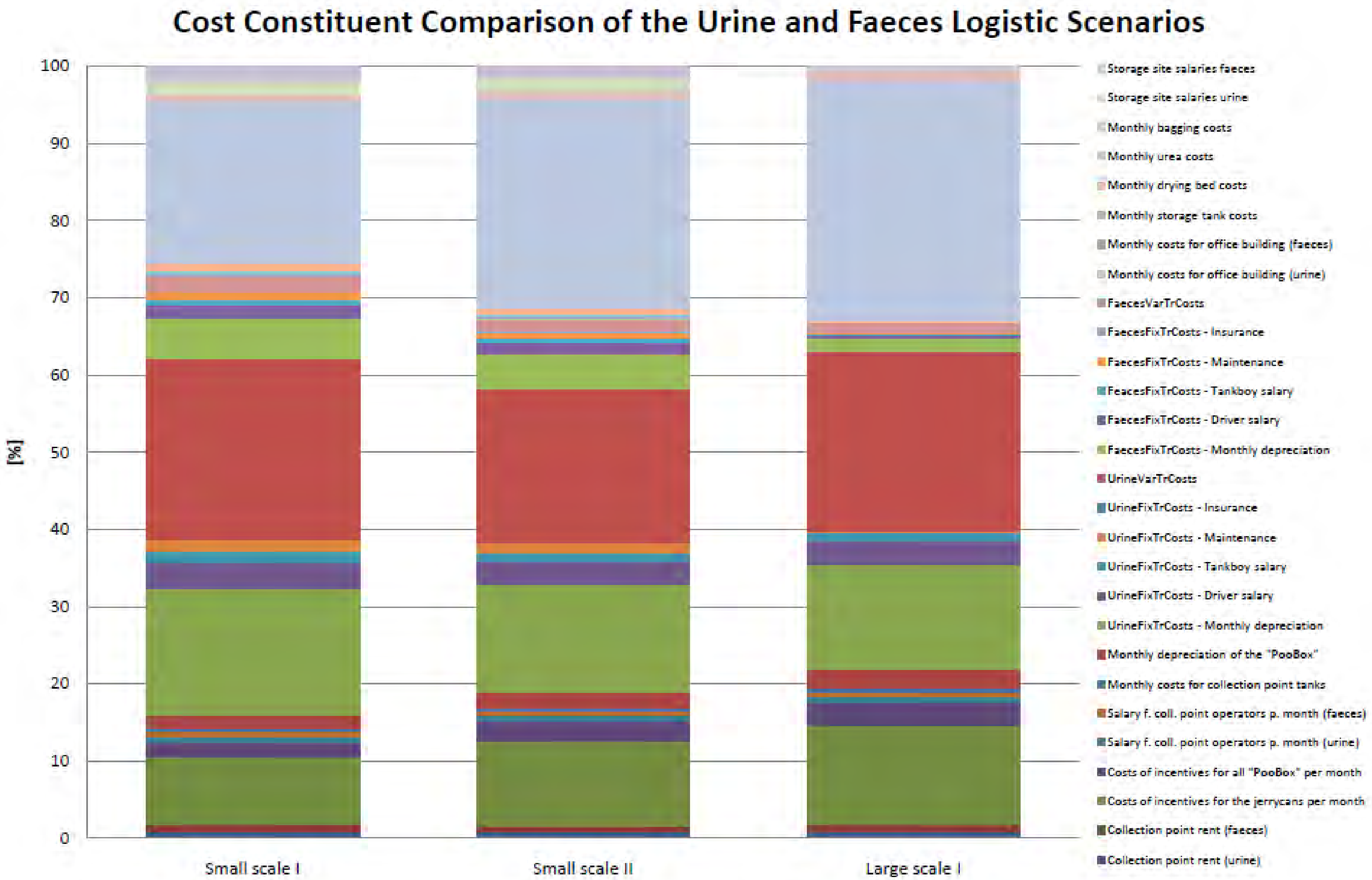
System B: Cost constituents

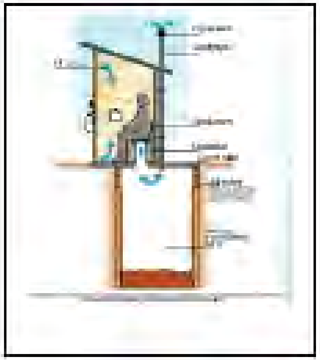
Source: Marketing Human Excreta, Enno Schroeder, 2010



Detailed examples

Experience from South Africa

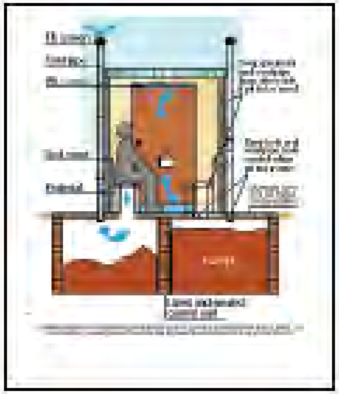
Exchange rate: 1 R = 200 TS

Type of Sanitation Option	Capital cost (2008)	Maintenance cost p. a. (2008)
1. Ventilated Improved Pit (VIP) toilet:  Consumer responses: Widely used in dense settlement areas of SA. Application requirements: No water or sewer networks needed. Suitable in arid and semi-arid areas (most of South Africa).	R4 500	R250 p.a.

Source: Richard M., Pieter P. (2009) DEVELOPMENT OF A MODEL FOR DETERMINING AFFORDABLE AND SUSTAINABLE SANITATION DEMAND IN DENSE SETTLEMENTS OF SOUTH AFRICA

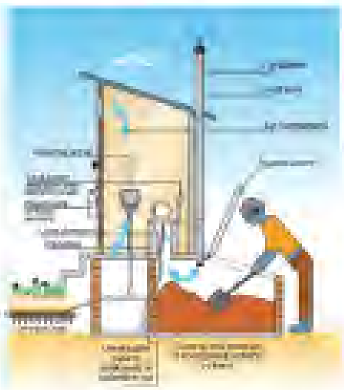
Experience from South Africa

Exchange rate: 1 R = 200 TS

2. Ventilated Improved Double Pit (VIDP):  Consumer responses: Excellent and affordable solution, but emptying the full pit is not always acceptable to consumers. Application requirements: No water or sewer networks needed. Suitable in dry conditions and where soil conditions make deeper excavations for a single pit infeasible.	R6 000	R150 p.a.

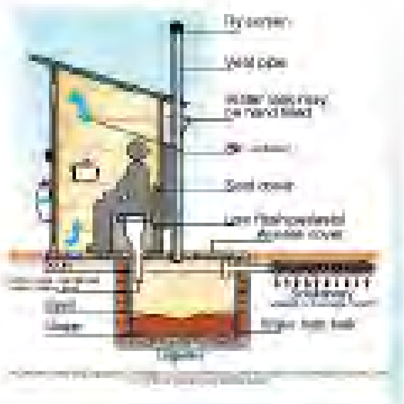
Experience from South Africa

Exchange rate: 1 R = 200 TS

3. Composting or desiccating (e g UDS) toilet  Consumer responses: Not in wide use in SA yet – still being monitored and tested. More expensive than VIPs. Application requirements: No water or sewer networks needed. If moisture is not kept separate and controlled, this toilet may become malodorous. A bit sensitive to handle.	R7 500	No financial benefits considered! R650 p.a.

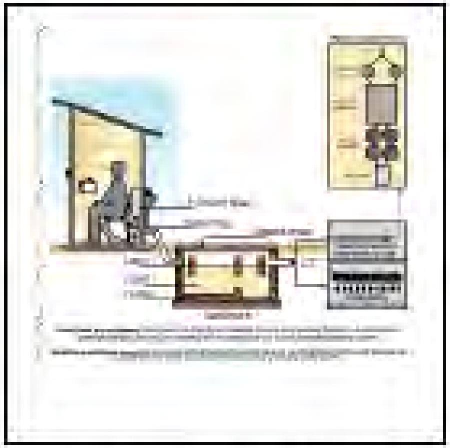
Experience from South Africa

Exchange rate: 1 R = 200 TS

4. <u>Loflos or aquaprivy toilet with a soakaway</u>:  <u>Consumer responses</u>: Not widely used in SA. Many failures occurred. <u>Application requirements</u>: Water is required and soil conditions must be favourable – otherwise the soakaways get clogged.	R4 500	R400 p.a.

Experience from South Africa

Exchange rate: 1 R = 200 TS

5. <u>Septic tank toilet with a soak-away</u>:  <u>Consumer responses</u>: Widely used in remote areas (rural households, resorts, clinics and farming areas) in SA where water is available. <u>Application requirements</u>: Expensive and water is required. Soil conditions must be favourable – soakaways may get clogged, especially in the long run.	R11 000	R600 p.a.

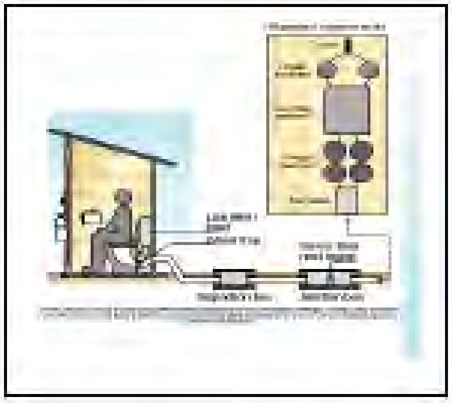
Experience from South Africa

Exchange rate: 1 R = 200 TS

6. Small bore solids-free sewers:  Consumer responses: Not widely used in SA. Application requirements: Water and sewer reticulation networks are needed as well as wastewater treatment works. Expensive. Soil conditions must be favourable – soakaways may get clogged, especially in the long run.	R12 000	R700 p.a.

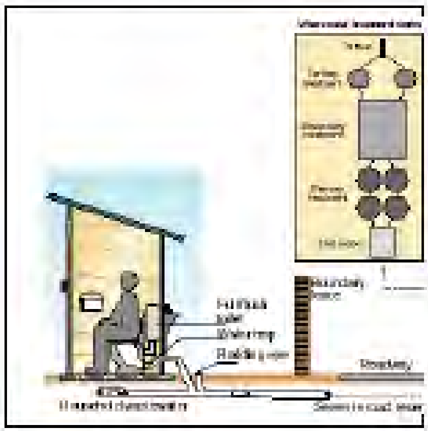
Experience from South Africa

Exchange rate: 1 R = 200 TS

7. <u>Shallow waterborne sewerage system</u>:  <u>Consumer responses</u>: A new concept in South Africa. <u>Application requirements</u>: Water and sewer reticulation networks are needed as well as wastewater treatment plants. Shallow pipes may break due to external loads, despite much lower costs than full conventional waterborne systems.	R4 500	R600 p.a.

Experience from South Africa

Exchange rate: 1 R = 200 TS

8. Full conventional waterborne sewerage system:  Consumer responses: Top of the range. The aspiration of most South Africans, although not affordable to many. Cost recovery sometimes problematic. Application requirements: Both water and sewer networks are needed, as well as wastewater treatment plants. Very costly. Health consequences of failure of wastewater treatment plants are enormous in comparison with failure of dry, on-site sanitation systems.	R10 250	R1 100 p.a.