sustainable sanitation alliance

Case study of sustainable sanitation projects

Low cost greywater treatment for households Lilongwe, Central Region, Malawi (draft)

Fig. 1: Project location

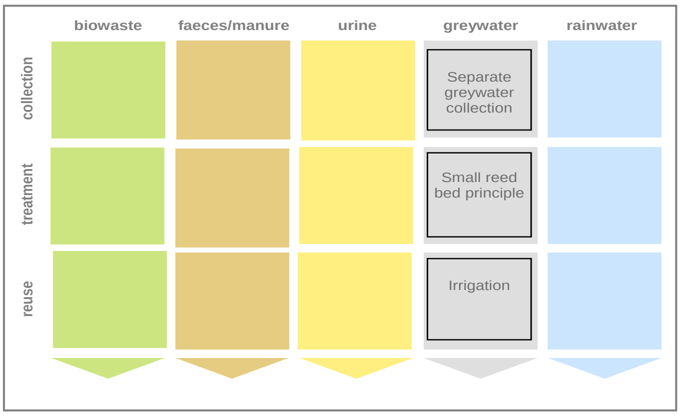

Fig. 2: Applied sanitation components in this project

1 General data

Type of project:
Urban upgrading and/or low cost housing, individually-based sanitation, pilot scale

Project period:
Start of construction: 05/2010
End of construction: 05/2010
Start of operation: 05/2010
Ongoing monitoring period planned for: 1.5 years
Project end: pilot scheme successfully finished

Project scale:
Number of treatment plants: 2
Number of people covered: 2 families
Size of treatment plant: 0.5 m^2
Total investment (in EUR): 35

Address of project location:
Lilongwe, Area 25, Habitat for Humanity-neighbourhood

Planning institution:
GIZ Malawi & Ministry of Lands, Housing and Urban Development, Malawi

Executing institution:
GIZ Malawi & Green Water, Mombasa, Kenya

Supporting agency:
GIZ Malawi & Habitat for Humanity, Malawi

2 Objective and motivation of the project

Greywater treatment is not part of any low cost housing development – informal or even formal. However, greywater contains soap, fats, oils, and other particles which clog the soil when being evacuated on the ground. The soil looses its capability to infiltrate water, which causes standing waters, soil erosion and flooding. These are causes for unsanitary conditions especially in densely populated neighbourhoods.
The project tested and demonstrated a sustainable low cost water treatment option for households to prevent standing greywater and clogging of soils. It also avoid open disposal of untreated waste water into public space or to neighbour's plots. This would improve general sanitation and public health conditions.

Greywater is currently often conducted into pit latrines, which causes environmental damage and is a threat to public health because of the infiltration of faeces into the ground and thereby caused ground water contamination. This practice is also being discouraged by the project.

Fig. 3: The greywater treatment system after installation (source: A. Ilberg, 2010)

3 Location and conditions

In rural and rapidly growing poor urban settlements in sub-Saharan Africa the common practice is to dispose untreated greywater into watercourses or any available empty space. These practices however are known to present potential risks of transmission of water-related diseases. In few cases septic tanks and pit-latrines serve as the discharge points for greywater (Ecosan Club, 2009).

Domestic greywater is usually only treated where households use a septic tank. In Malawi, only a small percentage of households are connected to sewer systems. This pilot project is located in Area 25 which is a popular high to mid-density populated neighbourhood of the Malawian capital Lilongwe. The housing standard in this area is relatively low with most houses being regular low cost houses or upgraded informal houses without any waste water treatment facilities.

The project is meant to address neighbourhoods without appropriate sanitation and wastewater standards, treatment/ and sewage systems. It offers a decentralized approach to make improvements through an affordable, low cost solution. This system and approach is suitable for big household which is normally the case in this pilot neighbourhood.

Fig. 4: A household with the greywater treatment plant (right side of photo) (source: A. Ilberg, 2010)

A model treatment system was built installed in the house of a regular Malawian low income family with four small children.

Health and hygiene:
The continuous discard of untreated greywater in to the environment clogs the soil. This causes smelly and hazardous, unhygienic standing waters, which is especially problematic during the rainy season when plots and public streets are flooded. The low cost solution provides for dry compounds while keeping the habit of washing in exactly the same spot.

In Malawi, the under-five child mortality rate[1] is currently 92 children per 1,000 live births, and there has been a clear and consistent decreasing trend since 1960.

Environment and natural resources:
The system helps prevent environmental degradation, through release of treated waste water into environment, and prevention of soil erosion trough controlled water disposal.

4 Project history

The project evolved as a practical demonstration and test while starting the revision process of the Town and Country Planning Guidelines and Standards from 1987[2] – the National planning framework. The revision process was led by the Ministry of Lands, Housing and Urban Development, which is the policy maker for Physical Planning in Malawi. This ministry is also responsible for the support of Local Governments with the in decentralizing Physical Planning and Development Management functions.

One goal of the new guidelines was to complement them with an extensive chapter on Environment and Sanitation.

5 Technologies applied

An illustration of the design of the technology used is presented in fig. 4 below. The applied technology involves a simple manual collection of greywater. Greywater is poured into a sieve (1) placed inside a funnel (2), functioning as primary filter on top of the grease trap and thereby pre-treated by removing big solid particles with the help of the sieve. Oils and fats contained in the water are trapped in the container acting as grease trap (3) by floating onto the surface of the water, while water from the bottom of the container is led through the pipes (4) of the reed bed. The water is distributed evenly over the surface area of the reed bed with percolated PVC pipes. The water is treated through infiltration through a small scale reed bed with different layers being gravel on top of sand (5), separated by a mesh (6). It is advantageous to elevate the system so that the treatment unit might be connected to a gravity-fed irrigation system (7). However, this is not necessary for proper functioning of the system.

As the treatment unit is designed as a domestic system which is installed within the housing compound, transport over considerable distances is not a problem. An in-depth interview conducted among potential users about their day-to-day handling of greywater production and collection. This has informed the adaptation of the system to their specific plot

[1] The under-five mortality rate is the probability (expressed as a rate per 1,000 live births) of a child born in a specified year dying before reaching the age of five if subject to current age-specific mortality rates (www.childinfo.org/mortality.html and www.childmortality.org/).

[2] Government of Malawi: Town and Country Planning Guidelines and Standards, 1987. The revision process consulted resulted in the Draft Land Use Planning and Development Management Guidelines and Standards, 2011

characteristics and infrastructure (water, toilet, and shower) in place.

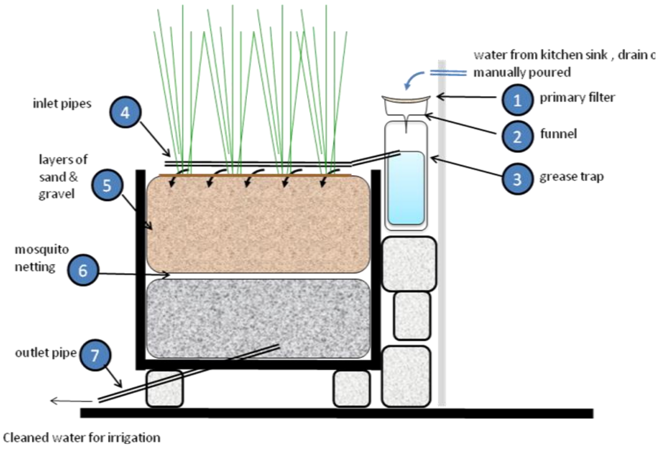

Fig. 5: Schema of the greywater treatment system

6 Design information

The resources required to build this greywater treatment system are: a defined box or impermeable area, sand, gravel, some water-loving plants, pipes, a plastic container and a sieve. No replacement is needed, except for the sieve every few years. The treated effluent can be reused for irrigation. It was assumed that a single household with 5 members would produce up to 100 liters of waste water per day. In the case of the pilot installation, the household has piped water on the plot.

The construction materials used are as follows:

1) Grey-Water treatment box:

40mm PVC pipe	6m
40mm PVC 90°bend	5 pieces
40mm PVC caps	4 pieces
40mm PVC T sections	3 pieces
Inner tube strips	3m
Rubber washers	6 pieces
20mm PVC pipe	6
20mm PVC T sections	3 pieces
20mm PVC 90°bend	3 pieces
Container	1 absorption area of 0.5 m^2
Blocks/bricks	60
Sand - clean and coarse	3 wheelbarrows
Gravel - clean ½"	3 wheelbarrows
Mesh netting	2m
Plants	

2) Grease trap

1 x 20l plastic jerry can	
1 x plastic collander	mesh should catch rice size particles
1 x 10l mineral water bottle	need the upper (neck) section only or use plastic funnel

3) Tools

1 x shovel	
1 x machete	
1 x small knife	
1 x hacksaw	
1 x drill with bit size 10, or use hot nail	to make holes in inlet pipes
2 pairs gloves	

It takes one day to complete the construction of the treatment facility.

Fig. 6: Construction of the greywater treatment box (source: A. Ilberg, 2010)

7 Type and level of reuse

The treated greywater is free from suspended particles and most dissolved matter. It is reused for irrigation of the domestic gardens, which commonly provide for subsistence agriculture. Since most of the households have a garden, it can help improve the yields from gardens and thus improve food security in such neighbourhoods.

The cleaning process is fast and the treated water can be used a few minutes after feeding the domestic greywater into the treatment unit.

8 Further project components

The project is purposely limited to finding a cheap and effective domestic greywater treatment option applicable to both, upgrading of existing housing, and to newly built low cost housing. The system is appropriate in areas without a functioning sewer system and where septic tanks are not an option, either due to economic or environmental reasons.

The greywater treatment system is proposed to become part of the low cost model homes financed by the Habitat for Humanity programme for low and lower mid-income households. The integration of the system can also be expanded as part of other housing programmes. Though currently not the case, but the project can also lead to a business model for artisans like plumber, welder, construction material providers to provide a construction skills and resources. This can create employment and income generation for the people involved.

9 Costs and economics

Investment costs:	40 EUR
Container	8 EUR
Plumbing	18 EUR
Primary filter, grease trap and mesh	6 EUR
Sand/gravel filter incl. transport	8 EUR
Operation and maintenance costs:	0
Total	**80 EUR**

A total of 80 EUR is required to construct a single unit of the greywater treatment system. This is expensive for the ordinary household, especially in a country like Malawi, where more than half of the population still live below the poverty line (earning less than US$1 per day). However when a proper business model it is when mass produced, costs would be lowered because of efficient use of all materials.

In a broader perspective, as stated by Parkinson et al. (2012), improve sanitation as a result of this system can have some general economic benefits to the society as a whole. This includes avoided deaths and morbidity. This means under-five mortality can improve; people would save money on cost of healthcare because of reduced occurrence of sanitation related diseases.

10 Operation and maintenance

The only requirement for constant operation is the regular cleaning of the sieve acting as primary filter from solids contained in the greywater. Also, regular but infrequent removal of the accumulate fats on the water surface in the grease trap is required. These maintenance tasks can easily be done by the user family at no costs. The sieve is expected to be replaced about every 2-3 years.

No regular washing of the sand and gravel in the treatment box is required. However, if flooding occurs during rainy season or if the system is not correctly installed the pipe exits may require unclogging.

12 Sustainability assessment and long-term impacts

The main expected long-term impact of the project is improved sanitation and public health, combined with reduced soil erosion and environmental degradation because the infiltration capability of the soil is maintained. The system helps protect the ground water because it promotes the separation of the greywater from pit latrines.

A basic assessment (Table 1) was carried out to indicate in which of the five sustainability criteria for sanitation (according to the SuSanA Vision document "Towards more sustainable sanitation"[3]) this project has its strengths and which aspects were not emphasised (weaknesses).

Table 1: Qualitative indication of sustainability of system. A cross in the respective column shows assessment of the relative sustainability of project (+ means: strong point of project; o means: average strength for this aspect and – means: no emphasis on this aspect for this project).

	collection			treatment			transport and reuse		
Sustainability criteria:	+	o	-	+	o	-	+	o	-
• health and hygiene	X			X				X	
• environmental and natural resources	X				X			X	
• technology and operation		X		X				X	
• finance and economics	X			X			X		
• socio-cultural and institutional	X			X			X		

Sustainability criteria for sanitation:

Health and hygiene include the risk of exposure to pathogens and hazardous substances and improvement of livelihood achieved by the application of a certain sanitation system.

Environment and natural resources involve the resources needed in the project as well as the degree of recycling and reuse practiced and the effects of these.

Technology and operation relate to the functionality and ease of constructing, operating and monitoring the entire system as well as its robustness and adaptability to existing systems.

Financial and economic issues include the capacity of households and communities to cover the costs for sanitation as well as the benefit, such as from fertiliser and the external impact on the economy.

Socio-cultural and institutional aspects refer to the socio-cultural acceptance and appropriateness of the system, perceptions, gender issues and compliance with legal and institutional frameworks.

For details on these criteria, please see the SuSanA Vision document "Towards more sustainable solutions" (www.susana.org).

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[3] www.susana.org/lang-en/library?view=ccbktypeitem&type=2&id=267

13 Available documents and references

Ecosan Club (ed.) (2009). Greywater - treatment and reuse. Sustainable Sanitation Practice (SSP), Issue 1. EcoSan Club, Austria. www.susana.org/lang-en/library?view=ccbktypeitem&type=2&id=1044

MLHUD, Green Water, GIZ (2009). Construction of a Domestic Greywater Treatment System – ppt presentation. Sustainable Sanitation Alliance (SuSanA). www.susana.org/lang-en/library?view=ccbktypeitem&type=2&id=1547

Parkinson, J., Hutton, G., Pfeiffer, V., Blume, S., Feiereisen, P. (2012). Financial and economic analysis – Factsheet of Working Group 2. Sustainable Sanitation Alliance (SuSanA). www.susana.org/lang-en/library?view=ccbktypeitem&type=2&id=609

More photos on the project are available: www.flickr.com/photos/gtzecosan/sets/72157629836338203/

14 Institutions, organisations and contact persons

Sarah den Haring, Green Water, Mombasa; technical assistance, and provided solution, led construction event; email: info@green-water.org, website: www.green-water.org

Sara Kampira, Habitat for Humanity, Malawi; organisational support and link to involved citizens and beneficiaries;
e-mail: sarakampira@yahoo.co.uk ,
website: www.habitat.org/intl/ame/123.aspx

Dr. Antje Ilberg, GIZ Malawi; problem identification, concept and initiative, and organisation of construction event;
email: antje.ilberg@gmail.com, website: www.giz.de

Dr. Silvio Decurtins, Team Leader GIZ Malawi, Democratic Decentralization, email: silvio.decurtins@giz.de, website: www.gtz.de/en/weltweit/afrika/malawi/13047.htm

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Authors: Dr. Antje Ilberg (GIZ, antje.ilberg@gmail.com)

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