Case study of sustainable sanitation projects

Household UDDTs in flood-response resettlement project Guara-Guara, Sofala province, Mozambique

Fig. 1: Project location

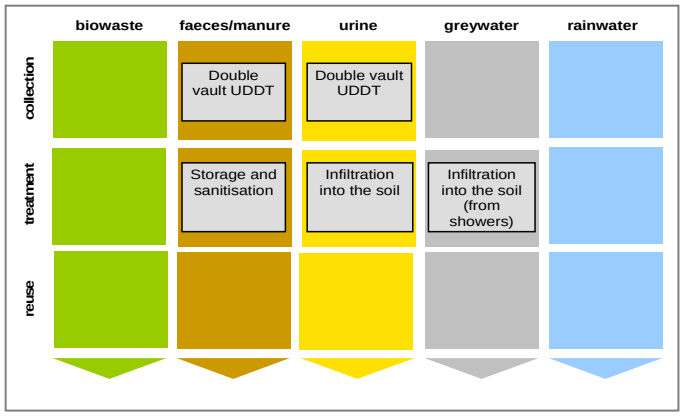

Fig. 2: Applied sanitation components in this project. UDDT stands for urine diversion dehydration toilet.

1 General data

Type of project:
Resettlement area in rural setting with individual and community-based sanitation (public and school toilets).

Project period:
First phase (UDDTs):
Start of construction: August 2002
End of construction: April 2003
Start of operation: August 2002
Project end: April 2003.
Second phase (mostly or entirely VIP latrines):
May 2004 until Sept. 2005: Partnership between UNICEF and the government.
An ongoing formal monitoring period was not planned.

Project scale:
Number of inhabitants covered: approx. 4,000
575 family UDDTs (200 built with ADA/PAARSS funds, 375 with UNICEF funds; average household size is 7)
10 public toilets
Total investment: EUR 315,210

Address of project location:
Bairro de Reassentamento de Guara-Guara
Distrito do Búzi, Província de Sofala, Mozambique

Planning institution:
PAARSS – in Portuguese: Projecto de Abastecimento e Agua Rural e Saneamento em Sofala (Programme for Rural Water Supply and Sanitation in Sofala)

Executing institution:
PAARSS, UNICEF

Supporting agency:
First phase: Austrian Development Agency (ADA) on behalf of Austrian Government
Second phase: UNICEF

(USD converted into EUR with an exchange rate of USD 1 = EUR 0.75, as of 1 August 2002)

2 Objective and motivation of the project

The project aimed at providing safe water supply and sanitation to the population resettled – after floods – in the less flood-prone Guara-Guara region in the Sofala Province in Mozambique. Fulfilling these objectives in an area characterised by high groundwater tables required a toilet technology that does not contaminate the groundwater, and thus does not threaten public health (unlike pit latrines that can contaminate the groundwater).

3 Location and conditions

Guara-Guara is located approximately 700 km from the capital Maputo, situated close to the Indian Ocean. Guara-Guara is a 15 minutes drive on meandering tar roads from the administrative post of Buzi, following the river of Buzi. Guara-Guara is situated on the crossroads between two major roads that were however destroyed during the 30 years of civil war and war for independence.

Fig. 3: Well maintained household UDDT in Guara-Guara 8 years after construction (source: A. Leitner, 2011).

Recurrent floods tend to occur in the low-lying areas close to Guara-Guara (but not in Guara-Guara itself as it is situated higher). Buzi River and the small town of Buzi are situated below sea level or at the same level. Major parts of Buzi were flooded in 2000 as well as all the lowlands close to the river. Droughts are also a problem in the area.

During the war years, Guara-Guara had been abandoned. However in 2000, as it is higher situated than the administrative village Buzi, it was a suitable place for resettlement and future development of the fast growing village. Hence, with the resettlement areas, Guara-Guara became a suburb of Buzi and a centre of reference. It had approx. 4000 inhabitants after the resettlement (based on the official figures announced by the District Government of Búzi in the end of the resettlement process in early 2002).

The following criteria characterise the project region:

- Climate: sub-tropical climate; one hot and wet season (October - April) and one dry season (May - September)
- Geographical conditions: river basin
- Economic situation: very low income
- Hydro-geological: high groundwater table (less than 1.5 meters from the surface)
- General water and sanitation situation: most of the water for household consumption comes from shallow wells. The previous toilet type was mainly pit latrines.
- Agricultural aspects: silty sand, subsistence rain fed
- Institutional and legal framework: Guara-Guara is part of the administrative post of Buzi, under the district government jurisdiction.
- Socio-cultural conditions: aversion to fresh faecal matter; open defecation is not socially acceptable.

In Mozambique the under-five child mortality rate is currently (in 2009) 142 per 1000 children[1]. By comparison, in 1990 the rate was still as high as 232 per 1000 children.

4 Project history

The program PAARSS (a Rural Water Supply and Sanitation Project in the Sofala Province) initiated the activities in the Sofala province in 1999. PAARSS was conceived as part of the existing decentralised cooperation between the provincial government in Sofala and the Austrian Federal Government through the Austrian Development Cooperation (called ADA). The programme aimed at improving the livelihood of rural poor through access to sustainable water points and basic sanitation infrastructure in rural areas and in small towns.

In this context, PAARSS conducted pilot projects that introduced ecological sanitation (ecosan) technologies, in particular urine diversion dehydration toilets (UDDTs) in Dondo and in Madjimane, Beira.

In 2000, some parts of Mozambique experienced major floods. In the district of Buzi, 4000 people were displaced because of floods. PAARSS was one of the first actors involved in the emergency support, since it had already been operating in the area.

In the immediate emergency phase, PAARSS constructed 16 emergency latrines using drums with a capacity of 210 litres. Subsequently, in the stabilised emergency phase, when the government decided to resettle the displaced people to a safer place (Guara-Guara), PAARSS was supporting the local government responsible for planning the future water supply in the resettlement.

Sanitation was a serious problem in Guara-Guara since the groundwater table in this region is high (less than 1.5 m below the surface) and thus the entire water supply originated from shallow wells. As a means to provide safe sanitation without contaminating the groundwater, PAARSS decided to implement UDDTs in the resettlement area, where pit latrines were considered to be a danger to public health.

During the planning and implementation phases, technicians from the provincial directorates and staff from district administration were trained in the principles of ecosan. Ten local artisans were identified and trained to produce urine diversion slabs and construct the infrastructure needed.

Along with the sensitisation promoted by the local radio station and a local theatre group, seven local activists were trained to disseminate the ecosan concept, to raise awareness, and to give long-term support to users. Their activities contributed to the active participation of the users, firstly by choosing the technology within the planning phase, secondly by providing material (sand and stones) within the implementation phase, and thereafter as the main actors responsible for the maintenance of the facilities.

The involvement and collaboration of the public sector, the private sector and the beneficiaries (users) allowed for a successful construction of 200 family toilets and 10 communal toilets. The acceptance of the technology by the local people encouraged UNICEF to continue the project, thus constructing 375 additional UDDTs in Guara-Guara (2004 to 2005), and therefore providing an adequate sanitation solution for the entire community (at a later stage, UNICEF built VIP latrines instead of UDDTs).

Fig. 4: Construction of a double vault UDDT in 2003; the two faeces vaults are visible at the front (source: M. Fogde, 2003).

[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 (http://www.childinfo.org/mortality.html and http://www.childmortality.org/).

Project update in March 2011:

In March 2011, Andrea Leitner visited this project site for one day (she was working for GIZ Mozambique, e-mail address: andrea.leitner_dedmoz@yahoo.de). She visited **six household toilets and two public toilets** built by PAARSS which corresponds to 1% of all household UDDTs and 20% of public UDDTs (see Appendix for more details). Hence, her survey was just a *small snapshot but gives some general ideas*.

Ms. Leitner talked with the people who knew of the toilets and with people involved in the project. Based on this information, we updated this case study. The original text of the case study which refers to the situation up to 2006 has mostly been left unchanged, and the new observations are added in each chapter after the heading *March 2011.*

The number of UDDTs built was reported to Ms. Leitner to be 663 in total, i.e. even more than stated in this document. Name lists of people that received a UDDT for their families were presented on demand. According to Mr. da Silva Beto (from Buzi administration) all actions and transactions were done from the capital Maputo. Also, the reports were prepared and archived there and are not available at the district administration.

According to the information given to Ms. Leitner, UNICEF built common VIP latrines instead of UDDTs in Phase 2. It is yet unclear why UNICEF decided on that particular toilet type, since it has been pointed out that pits are a threat for groundwater contamination in that area. Despite several attempts by the case study reviewers, no reply was received by UNICEF on this question[2].

Ms. Leitner formed the impression that a large proportion of all the UDDTs built were abandoned or dysfunctional. Instead, people were using pit latrines.

5 Technologies applied

The technology was chosen by the future toilet owners to whom three types of UDDTs were offered. The chosen and implemented technology was: ventilated double vault UDDT, with faeces vaults above the ground and with a shower cubicle.

This type of toilet works with one faeces chamber at a time. As soon as one chamber is filled up, it is sealed and the other one is used. The full chamber will dry for 6 months. Charcoal ash is added after each defecation event to accelerate the drying process of the excreta. The faeces vaults are emptied manually with the aid of buckets, plastic bags or other medium at hand.

A shower cubicle amendment was added, as requested by the users, since showering (using a bucket filled with water) is an important aspect of the local Ndau culture.

The shower water does not affect the drying chambers since the greywater and the urine are canalised separately and infiltrated into the ground. Thereafter, if not collected for reuse purposes, they are mixed and sunk into a drain.

[2] We have been unable to verify this exactly. Madeleine Fogde stated that UNICEF built also UDDTs in Phase 2.

Fig. 5: Inside a *new* UDDT; the faeces hole is covered with a lid; the urine separation part is fitted with a sieve. You can see the ventilation pipe at the back left (source: M. Fogde, 2003).

Fig. 6: Very dirty and not well maintained UDDT (inside), 8 years after construction. It seems that both faeces vaults are used at the same time. Note the two round wooden lids to cover the faeces holes (source: A. Leitner, 2011).

Fig. 7: A public UDDT in Guara-Guara 8 years after construction (source: A. Leitner, 2011).

6 Design information

The entire construction is made of both conventional material acquired in Beira (cement, uPVC pipes, zinc sheets, steel rods, chicken wire, and smaller components), and local material (gravel, stones, sticks, wood and water) provided by local masons and toilet owners.

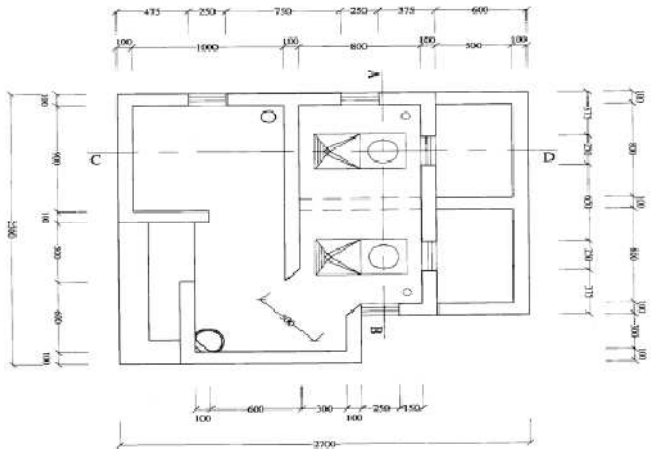

Fig. 8: Drawing of a household UDDT with a shower cubicle on the left (source: PAARSS).

Project update in March 2011:

Some construction shortcomings and maintenance failures have become apparent:

- Cracks in the walls of the faeces vaults, rainwater can enter.
- Rainwater entering through the gaps around the ventilation pipe at the roof.
- Cracks in the urine drain pipes, urine can enter faeces vaults.
- In some cases, the floor of the UDDT or shower cubicle was broken.
- The narrow doors and steep stairs leading into the UDDTs are not conducive for people with disabilities. According to Madeleine Fogde, the users never complained about this as they are generally skinny. The advantage of this arrangement is that no door is necessary (thus saving costs).

Since the faeces vaults of the UDDTs were built very large, it took a very long time for them to fill up. In 2006 when the intensive monitoring ended, i.e. 3 years after construction, the faeces vaults were still not full. By the time the faeces vaults finally filled up (some time after 2006), people did not know anymore how to empty the faeces vaults.

Fig. 9: Situation 8 years after construction: Left: walls of faeces vault with deep cracks. Right: bathing cubicle's concrete floor is broken (source: A. Leitner, 2011).

Fig. 10: The entrance to the UDDTs is very narrow (source A. Leitner, 2011).

7 Type and level of reuse

The main objective of the project was to introduce a sanitation technology that would protect the groundwater. So far, some cases of using dried faeces and urine for growing vegetables have been reported, but the reuse component of ecosan has not been actively promoted nor monitored by the project partners as it was not the main aim of the project.

The project implementers of the UDDTs report that synergies with agriculture projects for the reuse of urine and faecal matter were intended. Therefore, workshops, study visits etc. were provided for extension workers, agricultures engineers, local administrators, etc. in order to become familiar with the concept.

However, due to limited human resources for the supervision, the project could not be taken further and the overall success in terms of reuse was low. This was especially due to the fact that the particular region in Mozambique was hit by serious drought periods during the years 2003, 2004 and 2005, and therefore families were very vulnerable in terms of food security.

Since agricultural activity always requires rainfall, it was feared that urine would burn the crops in case the process was not adequately supervised. That would have been a disastrous thing to do, in the midst of a serious food shortage.

The main conclusion remains: in order to implement the agricultural reuse component of ecosan in an integrated manner, a proper project design and staffing is needed. As a pure WASH program, PAARSS had unfortunately no structure to implement the agricultural reuse component as well.

8 Further project components

In addition to sanitation facilities, PAARSS constructed six communal water points (hand pumps). Schools were also involved in the program as they are focal points where students can learn about hygiene and the potential of ecosan.

9 Costs and economics

The costs shown in Table 1 include both, Phase 1 by PAARSS and Phase 2 by the Department for Water and Sanitation (DAS)/UNICEF with PAARSS' remote advice. Unit costs are based on direct investment on infrastructure only. A cost breakdown for the UDDTs is not available.

The average total cost per double vault UDDT for households, financed by ADA and UNICEF, was **EUR 458**, although initially as much as EUR 1017 had been expected and calculated. Two important factors contributed to the lowering of the costs per unit. Firstly, economies of scale, due to buying large quantities of material, lowered the costs by 30%. Secondly, the involvement and contribution of future toilet owners lowered the costs by 25% (labour and construction material locally available).

Table 1: Total project costs financed by ADA and UNICEF (labour costs are most likely included).

Activity	Total EUR[a]	Beneficiary/users
575 family toilets (UDDT)	263,350	575 families (7 members per household), i.e. 4025 people
10 public toilets (UDDT)	7,120	Entire community of about 4000 people
Community education	15,250	Entire community
Consultancy	14,240	not applicable
Supervision	15,250	not applicable
Total	**315,210**	

[a] USD 1 = EUR 0.7468, exchange rate as of 1 August 2002

When converting the total project costs (EUR 315,210) by the number of users (4025 people), a value of about EUR 80 per user is derived. These costs are very high; however, the UDDTs built under this project were purposefully not built in the cheapest possible manner but in an impressive, beautiful and long-lasting style. This was done because the project wanted to show people (users, planners and engineers) what UDDTs can look like and make them into desirable objects. For this reason, they were also built at important places such as mosques. The UDDTs built under this project were the first UDDTs in the country.

Project update in March 2011:

There is no information regarding how the labour costs were calculated. Ms. Leitner was told that the total amount from ADA and PAARSS went to the implementing construction agency GATEAR. In this amount, labour costs were included. Subsequently, the selection was done through tenders. The distribution of funds was the responsibility of GATEAR.

10 Operation and maintenance

Each family signed a memorandum of understanding when requesting a UDDT. It is jointly agreed that the families have to contribute with labour and construction materials. After receiving the toilet, each family takes care of O&M measures such as checking the collected material, replacing ash, emptying, etc.

The trained activists thereby supervise the latrine owners. If the owners have technical problems, they contact the artisan responsible for the construction (this is happening in a free sanitation market and there is no more need for facilitation).

There are ten public toilets, four of which are located in schools. These are operated by teachers and school children who are taught how to use the toilets. Maintenance is organised in small groups and supervised by the school guard, who also benefits from the compost. Pupils bring charcoal ashes to school on a daily basis (for covering the faecal matter). The operation of the other public latrines follow the same rationale: people in charge of the functioning of a particular latrine are responsible to find a suitable management option for its maintenance. Accordingly, the latrines located close to a water point or within a market are operated by committees and local authorities are responsible for the latrine located within their headquarters.

Project update in March 2011:

It seems that maintenance was the biggest problem for keeping the UDDTs clean and usable. Despite the fact that all locals who were interviewed in March 2011, expressed their general satisfaction with the sanitation system built by PAARSS, the reality looked somewhat different (see photos provided here and in flickr photo database, link is in Section 13).

Only two out of six visited household UDDTs were still usable and well maintained 8 years after construction (i.e. one third). The other ones, including public UDDTs, were abandoned, also due to the fact that UNICEF sometimes built new VIP latrines just besides existing UDDTs for the same households.

There was no indication that any of the faeces vaults got emptied at one point in time. Rather, the vaults were sealed once they were full (this took a long time as the vaults are very big), since the users did apparently not know how to empty the vaults and what to do with the dried faeces. Therefore, reuse of UDDT end products did not occur, at least in most of the cases. It seems that especially the aspect of awareness creation failed, e.g. why the faeces holes should be closed with a lid, etc.

According to one local mason, one of the reasons why many UDDTs had deteriorated over time was that costs were too high for maintaining the UDDT. Apparently, good quality material to do the refurbishments is simply too expensive for the locals.

On the other hand, there is evidence that some people used their UDDTs properly: Two out of the visited household UDDTs were still in good condition. It would be useful to understand why some households continued to use their UDDTs while the majority did not (more monitoring needed).

Fig. 11: Discussions about the current state of the UDDTs. This UDDT is no longer in use, note empty faeces vaults and the vault cover on the ground (source: A. Leitner, 2011).

11 Practical experience and lessons learnt

The practical experiences listed here are based on information up until 2006 (see also the mid-term report of Borowczak and Parkinson (2005) in Section 13). In 2006, the PAARSS project was rated to be very successful.

Guara-Guara was the first location in Mozambique where UDDTs got implemented at a reasonable scale. When PAARSS first introduced UDDTs in the Dondo Municipality, most professionals from different sectors, including those from the water sector, were very cynical and rather negative regarding its acceptance among rural citizens. However, after Guara-Guara, they changed completely their views and the cynicism vanished.

Hence, the technology is by now well accepted by the local community and decision makers as a durable and long lasting investment, despite initial worries about cultural conflicts and costs. Today, UDDTs are recommended by Mozambique's national guidelines when the groundwater level is less than 1.5 metres from the surface[3].

The UDDT technology solves problems of sanitation in adverse hydro-geological conditions and protects the environment. Furthermore, the technology enables the reuse of sanitised urine and faeces, which could further add agricultural and economical benefits to the community.

Users should be involved in the choice of the sanitation technology and structure design, as community participation in such decisions contributes to appropriate use and maintenance, due to better knowledge of the technology and increased ownership.

Even in post-emergency situations, project cost sharing amongst beneficiaries is possible. Community participation in project implementation reduced the unit cost by a factor of 25%, allowing the project to reach out for more people than initially planned.

The technology has been applied by other local initiatives in the area of Guara-Guara as well as in other towns or districts:

- UNICEF constructed 375 additional UDDTs in Guara-Guara, 43 in Marromeu, and 50 in Beira[4]. In regards of Beira, the same community as the one where PAARSS started its interventions has been served. In total, there are now 575 UDDTs in Guara-Guara.
- Mozambican Red Cross constructed 12 UDDTs in Nhamatanda district and Beira.
- Rotary Club of Beira constructed 4 toilets in Beira and constructed 4 new ones in Mussassa primary school. These are twin houses with shared toilets but separate showers (for more information, please see Borowczak and Parkinson (2005), p. 31 and 33 (see Section 13)).

In 2006 it was estimated that there are about 5200 users of UDDTs in the entire Sofala Province.

Fig. 12: Household UDDT in good condition, 8 years after construction; note metal faeces vault covers are still in place (source: A. Leitner, 2011).

Project update in March 2011:

It appears that awareness creation was neither sufficient nor sustainable. Most of the locals simply do not know the

[3] We have been unable to obtain a copy of these guidelines, it is not totally clear if they really exist. According to Ms. Leitner: "*None of the local authorities could provide concrete information on this. Since in Phase 2 UNICEF together with the government decided to build VIP latrines instead of UDDTs, it is doubtful that UDDTs have become a national standard and got incorporated in the national strategy*".

[4] We tried to verify this in March 2011 but have been unable to do so, since UNICEF did not reply yet.

advantages of UDDTs and what to do with the end products. Successful long-term awareness creation and understanding for the UDDT system was furthermore constrained by the change of technology: from UDDTs in Phase 1 (PAARSS) to VIP latrines in Phase 2 (UNICEF). One can assume that this led to confusion amongst users and stakeholders.

Another important lesson is that faeces vaults should be designed to fill up after only one year so that the users get into the routine of emptying one faeces vault each year.

12 Sustainability assessment and long-term impacts

A basic assessment (Table 2) was carried out to indicate in which of the five sustainability criteria for sanitation (according to the SuSanA Vision Document 1) this project has its strengths and which aspects were not emphasised (weaknesses).

Table 2: 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 and transport			treatment			transport and reuse[a]		
Sustainability criteria	+	o	-	+	o	-	+	o	-
• health and hygiene	X			X					
• environmental and natural resources	X			X					
• technology and operation	X			X					
• finance and economics			X		X				
• socio-cultural and institutional	X			X					

[a] During the time of project implementation, local communities did not implement reuse (see Section 7 for details).

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).

The expected long term impacts are to continuously provide safe water and sanitation services in a resettlement area characterised by high water tables. Thus, the major goals of the project were to protect human health and consequently the environment which has been achieved.

However, the UDDTs were very expensive, thus spontaneous replication without outside financial support has hardly occurred. Some water technicians and administrators have apparently constructed UDDTs on their own initiative.

This pilot project had impacts that go beyond Guara-Guara alone, since it was well publicised and well documented in many publications and helped spread awareness about ecosan in Mozambique and the region. The central government is currently mainly pursuing CLTS (community-led total sanitation) for the rural areas with assistance by UNICEF, but UDDTs are also part of national strategies.

Project update in March 2011:

Visits to the project areas after 2006 by one of the authors, Luis Macario, have led to the estimate that about 80% of the families continue to use the UDDTs. Nearly 5% of the households and UDDTs are abandoned, and the other 5% are used in a very seasonal form (farmers whose fields are far away from Guara-Guara and people who got jobs in Búzi Town or elsewhere).

With respect to the percentage of UDDTs still in use, a rough estimate by Ms. Leitner came to a maximum of only 30%. This indicates that this project was not a failure, but that certain shortcomings – especially regarding awareness creation and ongoing monitoring and support – severely limited the *long-term* success of the project.

13 Available documents and references

More photos from this project are available in the flickr photo collection of SuSanA and GIZ: http://www.flickr.com/photos/gtzecosan/sets/72157625791958930/

Until 2006, this project was documented with many publications (but no reports are available since then):

Anonymous (2003) Austria: A case study on commitments-related best practice or lessons learnt in water, http://www.un.org/esa/sustdev/csd/csd13/casestudies/case/caseaustria.pdf

Borowczak, W., Parkinson, J. (2005) Project for rural water supply and sanitation in the province of Sofala / Mozambique-PAARSS (2003-01/03), Austrian Development Agency (ADA), Mid-term review, Final Report Version 2.1, 10.10.2005, http://www.entwicklung.at/uploads/media/4.1.8._ADA__Mid_Term_Review_PAARSS_10_2005.pdf

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PAARSS,
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14 Institutions, organisations and contact persons

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Case study of SuSanA projects

Household UDDTs in flood-response resettlement project Guara-Guara, Sofala province, Mozambique

SuSanA 2011

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This document is available from:
www.susana.org

Appendix: Details of the 1-day visit of Andrea Leitner

Places visited
District: Buzi
Town: Buzi
Met with: Sr. Beto Fernando da Silva (administration Buzi), construction technician during Phase 1 (PAARSS 2002-2003) via the company GATEAR.
Visited 3 household toilets (3 x PAARSS), and spoke to several household members.

Town: Guara-Guara
Met with: Sr. Simao dos Santos Pita (administration Guara-Guara), Sra Belia Frederico (administration Guara-Guara), Sr. Fernando Hoyo-Hoyo (union leader and mason of Phase 2 (UNICEF- pit latrines))
Visited 3 household toilets (2 x PAARSS, 1 x UNICEF), and spoke to several household members; 3 public toilets (2 x PAARSS, 1 x UNICEF).

[5] DAS is the government institution responsible for the implementation of all water and sanitation activities in the Sofala province with 10 districts. PAARSS was a support project to this institution, with funding for implementation of infrastructure in 5 districts (one of them was Buzi where Guara-Guara is located).