Case study of sustainable sanitation projects

Otji toilets for peri-urban informal households Omaruru, Namibia

Fig. 1: Project location.

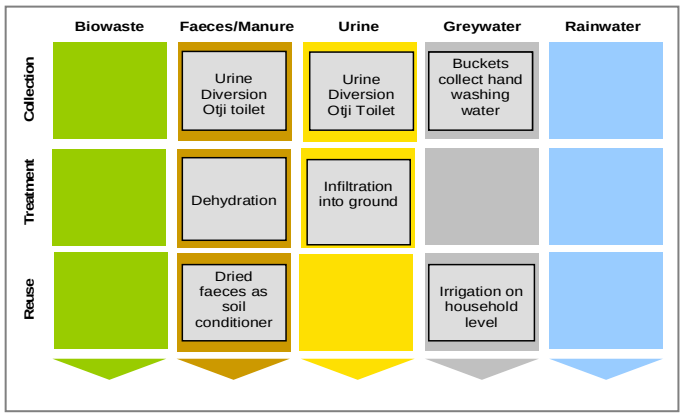

Fig. 2: Applied sanitation components in this project (Otji toilets work like UDDTs.

1 General data

Type of project:
Pilot scale urine diversion dehydration toilets for peri-urban informal households

Project period:
Construction period: Dec. 2010
Start of operation: Dec. 2010

Project scale:
Number of dry toilets: 21
Number of inhabitants covered: approx. 140
Total investment: EUR 17,000

Address of Project Location:
Hakahana, Omaruru, Namibia

Planning institution:
Namibian Water Resource Management – Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, Wilhelm Zeraua Rd, Old Rossing Foundation Building, Omaruru, Namibia

Executing institution:
Namibian Water Resource Management – Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH & Omaruru Basin Management Committee (OmBmc)

Support institutions:
German Federal Ministry of Economic Cooperation and Development (BMZ)

Note: The name Otji toilet is used in Namibia, where the rights on the name "Otji toilets" (but not the rights on the technology) have been reserved by the CHP. The name is well-known in Namibia. Technically speaking it is a urine diversion dehydration toilet (UDDT).

2 Objective and motivation of the project

As Namibia is the driest country in southern Africa, a toilet system flushed by fresh water is not sustainable in the long run. To provide access to safe, affordable sanitation for all Namibians, it is essential to consider dry sanitation as a proactive measure to water shortages and as a way to save precious water resources in the wake of climate change. Not only do dry toilets save water and thus facilitate drought adaptation strategies; ideally, they also produce fertiliser to sustain crops and can thus effectively eliminate the need to dispose of human waste via a centralised sewage system.

Against this background, the Omaruru Basin Management Committee decided to pilot 21 Otji toilets in Omaruru. People living in the project area have no access to safe sanitation. Especially for women and children the traditional way of "going to the bush" is dangerous. During the rainy season, water related health problems such as diarrhoea are increasing. The project was planned as a pilot study to show that dehydration toilets with urine infiltration are an appropriate sanitation solution for the informal settlements of Omaruru, Namibia.

The aim of the project was also to involve the local authorities in such a way that they can implement sanitation facilities in the future based on the findings of the pilot study.

Fig. 3: Otji toilet with attached hand washing basin (source: GIZ, Kleemann, 2011)

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3 Location and conditions

Omaruru lies about 200 km northwest of Namibia's capital city Windhoek, on an altitude of 1200 m above sea level, in the Erongo region. The climate in the area is arid with a yearly precipitation of 280 mm on average. The depth of the groundwater table in the Omaruru basin varies two borehole measurements in the area reflected a depth of 2.46 metres and 3.40 metres respectively[1].

Omaruru has about 12,000 inhabitants. The population lives spatially separated in the town of Omaruru (2,000 inhabitants), and the partly informal settlements of Hakahana (6,000 inhabitants) and Ozondje (4,000 inhabitants). The project area is located on the edge of Hakahana and can be describes as informal and peri-urban.

Many people live in self built shacks made from scrap metal and wood, some buildings are also made from bricks. Drinking water is provided through taps. Depending on the location of their house, people have to walk up to 300 m to get water. Sanitation facilities are not available in this area. For the people living in the town, sanitation is provided through septic tanks, suction trucks and oxidation ponds.

Farming and tourism are the main economic factors in Omaruru. Due to the Omaruru River the water level is quite high and vegetation is relatively dense. About 30% of the population are unemployed. Socio-cultural conditions are diverse. Most of the white population, from different origins, live in the town itself. The majority of the black population consider themselves as Ovambo. Besides that, mostly Herero and Damara people live in Omaruru.

The under-five child mortality rate in Namibia is relatively low for a developing country at 40 children per 1000, and it has been decreasing during the last twenty years[2].

4 Project history

The need for proper sanitation was raised at one of the Omaruru Basin Management Committee (OmBMC) Meetings in the beginning of 2010. Members of the OmBMC travelled to the Clay House Project (CHP) in Otjiwarongo, a town 100 km from Omaruru, to learn about the construction of dry toilets and to have a look at examples in this town which were already built and in use.

During this exposure trip for members of the OmBMC GIZ gave a presentation on different sanitation options and discussed with the members the most feasible options. The Otji toilet was first developed in 2003 in Namibia and there are approximately 1200 installations across Namibia. The Otji toilet was the example shown in the exposure visit.
The Clay House Project (CHP) is a non-governmental organisation, based in Otjiwarongo in Namibia. Its overall aim is to promote environmental and socially sustainable development. The European Community is currently funding the project "Dry toilets - an alternative sanitation solution for squatter areas in an arid country – Namibia" which aims to promote the building of 600 Otji toilets in Otjiwarongo and all over Namibia. The funding started in February 2008 and continues to the end of 2011.

The selection of the pilot project area and beneficiaries was based on a rapid baseline survey including a demand assessment as well as a movie show of the toilet system conducted by the OmBMC in cooperation with GIZ. In the area water is limited and has to be carried up to 300 m from standpipes. There are no sewers and no septic tanks in the area which could be used as discharge points for flush toilets. Beneficiaries were selected on a "first pay first served" basis and in coordination with the ongoing formalisation process of the Omaruru Municipality.

The construction of 21 toilets was completed by the end of 2010. Since then, the toilets are being maintained by the owners. An awareness campaign for a period of one week was conducted to further promote the toilets and to highlight the importance of washing hands after using the toilets. After the dry toilets have been in use for about three months GIZ and the OmBMC carried out a small survey in order to assess the satisfaction among toilet users. All users were happy to have this toilet!

Only 21 pilot toilets were built in Omaruru so far, but the OmBMC has evidence for a demand of additional 100 toilets. Until now, however, funds for additional toilets have not been approved from the Municipality and the Regional Council.

Future
The future of the applied sanitation system in Omaruru is highly dependent on the political decisions made. Even though the system proved to be appropriate, there is still a tendency towards water based sanitation systems. A major challenge will therefore be to persuade and consult the responsible decision makers. Apart from that, the OmBMC will further raise awareness also among farmers and in the tourism sector.

Depending on the further development of the project in Hakahana (which is part of Omaruru) a strategy for the reuse of the sanitation products will be developed. Persons were identified who would be willing to empty the toilets. GIZ is considering possible public private partnership (PPP) strategies[3]. The objective is to support a local business in establishing a production scheme of the Otji toilets in the area.

Additional information about the Otji toilets:
According to an email from Peter Arndt from CHP on 28 May 2011: Since the development of the Otji toilet in 2003 about 1,200 Otji toilets have been installed nationwide across Namibia[4] and about 100 self builder sets have been sold.

[1] In the Omaruru Basin at borehole ww40139 – under the bridge in the riverbed the average depth is 2.46 m and at borehole ww40144-east of Omaruru in the riverbed the average depth is 3.40 m.

[2] 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.childmortality.org and http://www.childinfo.org/).

[3] One PPP that was being investigated at the time of writing this case study was with the company Pupkewitz. This company has started as building supplier with meanwhile about 15 branches in Namibia. Later they have added many other business, like car dealing and mobile phones etc. They do not produce, nor build. See their website for more details http://www.pupkewitz.com/. Concerns were that CHP could be ruined by the involvement of a big company and mass production of the toilets.

[4] The SuSanA partner EcoSur has also built "Otji style" UDDTs in Latin America, where they are called "Inodoro Seco". The Otji toilet made its way from Namibia to Latin America since the CHP is partner

The breakdown of where the 1200 Otji toilets were installed is as follows: 600 for an EU-Toilet-Programme; 83 for an EU housing programme; the Municipality Otjiwarongo bought 100 in connection with the development of Erven where the CHP have built clay houses. The Municipality paid for the toilets which were built inside the houses (heat ventilated by solar radiation inside the toilets). The Municipality of Outjo bought 200 and Aranos bought 40 Self-Builder-Sets. The Oshikoto Region bought 49 Otji toilets and the City of Windhoek 57. Other customers included NGOs (for example: the Desert Research Foundation of Namibia (DRFN)), farmers and Safari Lodges (for staff and camp sites).

In the future the CHP will promote more the Self-Builder-Set so as to encourage local builders to create a job opportunity for themselves.

5 Technologies applied

The Otji toilet is based on dehydration and was considered especially suitable for a region with intense solar radiation and low precipitation.

The functional plan (Fig. 5) shows the main features of the Otji toilet. The ventilation and dehydration is driven by the sun. Therefore, the “back” of the toilet is always oriented north (in southern hemisphere). Air then circulates through the toilet into the drying area and out through the ventilation pipe, which makes the toilet odourless. The collection container (90 liter container) is situated under the toilet bowl and moved to the adjacent drying area when full. The container with the dried faeces is later emptied and moved back beneath the toilet bowl. It is estimated, that four people can use one container for about six months.

The urine diversion toilet bowl is designed in such a way that urine touching the wall of the bowl is collected in a small trough (Fig. 4), drained away through a pipe and infiltrated into the ground. No problems of blockages of the collection trough or the urine pipe, which is 20 mm in diameter, have been reported. The new urine diversion bowl has been in use since early 2010. The perforated collection container is still used but the excreta contain significantly less liquid once the urine is collected separately.

In 2009 CHP had installed some units for testing purposes and since 2010 CHP has installed it to customers (City of Windhoeck 57, Omaruru 21, Oshikoto 115, Gobabis 30, Gibeon 40 plus several individual customers).

Who manufactures them? Is it painted concrete?

Fig. 4: Cross section of the new urine diversion bowl (left) made from painted concrete where urine collects in the little trough at the bottom as demonstrated in urine diversion bowl (right) (source: CHP, 2009a).

Alternatively, the urine could be collected in containers and stored for reuse. The faeces are collected in a 90 litre container which is perforated. Faeces and paper stay in the container, whereas liquid infiltrates into the ground. Thereby, dehydration is more effective. Some users have indicated that they use ash to cover the faeces after defecation, but this is not widely practiced at the moment. As the pilot project finished only about four months ago, no containers had to be emptied until now.

The toilets were built by staff members of the CHP in Otjiwarongo and locally available labour from Omaruru. Except for the brick construction, the toilets were prefabricated in Otjiwarongo and delivered as “self building sets”. The team of the CHP was important to ensure the proper construction of the toilets and to train local labour for possible future projects. In some cases, the beneficiaries contributed to the construction of the toilet by digging and painting.

There are no rights reserved on the Otji toilet technology nor on its name. However the Urine Diversion System (UDS) bowl is a registered patent in South Africa and Namibia. The UDS-bowl was developed at the end of 2008. Since the beginning of 2009 a number of prototypes have been in use at the Clay House Project compound in Otjiwarongo, Namibia. Since 2010 about 100 units have been installed at different places nationwide in Namibia. The most installations are in Windhoek with 57 units.

of EcoSur and hence Peter Arndt from the CHP came to Latin America for several exchange visits introducing the Otji toilet technology and later also the new urine diversion bowl. EcoSur Ecuador built the first Otji style dry toilet in Latin America in 2007 (EcoSur, n.d.)
Currently over 120 dry toilets have been built in Ecuador and El Salvador and there are plans for around 300 toilets. For more details visit: http://www.ecosur.org/

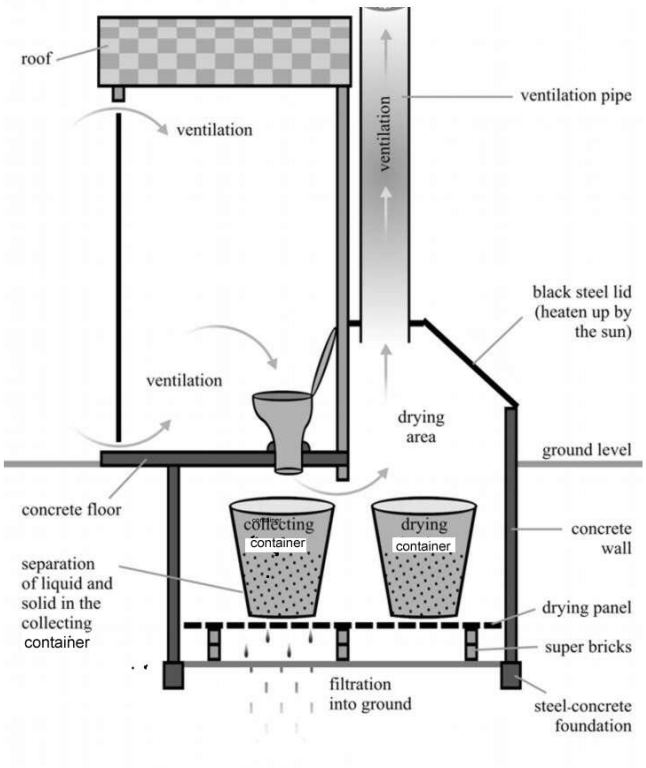

Fig. 5: Functional plan of the Otji toilet without urine diversion bowl as shown in Fig. 4 which was developed later (source: CHP, 2009b)

6 Design information

The prefabrication at the CHP is based on empowerment of local communities and low technology. Toilets are designed to work with a minimum of maintenance. Except for the toilet bowl, all toilet parts are made in Otjiwarongo. Once the toilets are built no further investments are necessary as the emptying can be done by household members or locally available labour.

As mentioned above the toilets were partly prefabricated by the CHP. The most important parts were made from metal (lid box, door, doorframe, roof structure, ventilation pipe, steel foundation ring) and concrete (dry plates, floor plates, side plates for lid box). Apart from that, the toilet bowl was delivered through the CHP and materials such as screws, nuts silicon and wire were used. For the toilet house, bricks, cement and sand were used. The roof tiles were also fabricated by the CHP and designed to keep the toilet cool compared to the drying chamber.

Further information, including the self building manuals of the CHP are available under the links given in Section 13 and 14.

In previous designs CHP suggested to include a windventilator (whirlybird) on top of the ventilation pipe. This was revised since it was observed, that this additional feature brought no real benefit for the ventilation of the toilet. Only at the coast, where a constant wind blows they may have an impact and consequently the approx. 100 Euro investment coast were regarded to be a waste of money in most cases.

Can Otji toilets be located indoors?

As Otji toilets are heat ventilated by solar radiation they have only a limited suitability for indoor installations as they develop some odour nuisance during the night when the sun (heat) ventilation stops. After sunset it about 3-4 hours to cool down and from then the toilet starts to smell a bit. Indoor Otji toilets therefore would need to be equipped with electric ventilation[5]. The installation of indoor Otji toilets in an existing house is quite complicated because of the need to cut through the foundation of the house as half of the underground tank is underneath the house (under the pedestal) while the other half is outside (opening lid box). Even the inclusion of an Otji toilet in a newly constructed house does not really save costs (when compared to the construction of a separated outside Otji toilet) as the space that is needed for the Otji toilet causes additional construction cost and even more important because off the required expensive electric ventilation. Consequently, CHP currently recommends indoor Otji toilets only for middle income houses.

7 Type and level of reuse

The small scale of the project makes it difficult to establish a reuse scheme other than the use on household level. There is a potential for reuse, as many of the toilet owners or their neighbours have a small garden on their compound. However, not all of the toilet owners can imagine using urine or dried faeces as a fertiliser. The oxidation ponds of the Municipality are not far away and could be used to treat dried faeces, which are not reused.

There are certain design parameters of the toilet which indicate the focus on providing safe sanitation rather than reusing excreta. In the following, reuse possibilities are outlined.

Urine
The toilets currently used in Omaruru all infiltrate the urine into the ground and the urine remains unused. However, urine can be easily collected through the urine diversion bowl and an attached container at the end of the pipe. Then it can be used as fertiliser. Therefore, awareness raising among the population and trainings would be necessary.

Faeces
The dried faeces can be used as soil amendment or can be co-composted with other biodegradable material. On a small scale the material can easily be used on the compound of the households. Some of the users can imagine using the material, others are reluctant. Again, awareness raising among the population and trainings would be necessary.

Greywater
Water from the attached handwashing facilities is collected and used for irrigating gardens. Most people use the greywater on their compound and often it is directly applied to irrigate plants.

[5] CHP built 110 inside toilets in Otjiwarongo and equipped them with 12 Volt photovoltaic systems which costs about 250 Euro. Using a solar system was meant as an appropriate solution for poor households. However, according to Peter Arndt from the CHP (email from 26 October 2011), misuse of the solar battery (households connect radios or lights to the system) has frequently caused failure of the ventilation system. User education by the CHP was so far effective in changing this behavior.

8 Further project components

In addition to the construction of the toilets basic handwashing facilities were attached to the toilets. To raise awareness among the population a dry toilet and handwashing campaign was initiated.

The GIZ and the OmBMC are currently trying to upscale the project. There is demand for about 100 additional toilets in Omaruru.

To make the project financially sustainable the funding for additional toilets should come from the Municipality of Omaruru or Namibian Ministries as a general service provision. Additionally, GIZ works on a concept to support the application for funds from the national government.

Fig. 6: Basic handwashing facilities attached to the toilets. The pink bucket provides fresh water, the cup is used to fill the basin and the black bucket collects the greywater which can be used for irrigation (source: GIZ, Kleemann, 2011).

9 Costs and economics

One Otji toilet costs about EUR 776 (see Table 1), which makes it an unaffordable commodity for the people living in the target area. Costs for the toilets of the pilot project were covered by the German Federal Ministry of Economic Cooperation and Development (BMZ). Beneficiaries contributed a minor part of EUR 15 to the toilet. The contribution served as a "registration fee" and was important to create a feeling of ownership to secure that people look after the toilets and maintain them well.

Table 1: Costs for the material, labour and transport needed to construct one Otji toilet (source: CHP, 2009).

Item	Price in EUR
Lid box	61
Ventilation pipe	27
Door	56
Door frame	20
Steel roof structure	28
Foundation steel ring	20
Roof tiles (cool tiles)	9
Urine separation toilet bowl	60
Pipes and fittings	15
Perforated 90 l containers (2 containers)	45
Side plates	20
Dry plates 70 x 70 cm	15
Floor plate	14
Silicon, wire, etc.	5
Superbricks (what are superbricks?)	96
Cement bag	24
Sand	10
Paint	29
Total materials costs	**554**
Estimated labour and transport costs[6]	**222**
Total costs	**776**

Because the toilets are custom-made by the CHP and many parts are especially produced for these toilets, it was not possible to compare the price of an Otji toilet with market prices of other suppliers. Currently, the concrete UDS-bowls are produced in Otjiwarongo which is about 140 km from Omaruru[7]. With the establishment of a local producer (potentially a franchise of CHP) in Omaruru, it might be possible to lower the prices.

From a financial point of view, the contribution of the beneficiaries was very low in this project. However, to reach the poorest among the population, there is the need of highly subsidised facilities, as these people will not be able to save money to get a toilet in the first place.

As the price level in Namibia is quite high the Otji toilets are yet not affordable for the poor. In the future, the toilets should be built with local money as part of the general service for the inhabitants of a settlement.
Further options for cost reductions? Surely it has to be possible.

Operation and maintenance costs are very low. With four people using one toilet, it takes about six months for the 90 l container to fill up. After the first year of operation, the container with the dried faecal matter has to be emptied every six months depending on the number of people using the toilet.

10 Operation and maintenance

When investigating the toilets three months after the construction, all of them were in use and well maintained. Most owners lock their toilets when they are not around.

Until now no maintenance was necessary, except for regular cleaning of the toilet bowl, as none of the containers were full. Some toilet users indicated that they will empty their toilet on their own and use the material on their compound as fertiliser or bury it. As there are only a few Otji toilets existing until now, it seems reasonable to engage one or two persons willing and able to undertake the emptying.

One possibility for the Municipality to meet its obligation of providing a general service to the people would be to instruct someone within the Municipality or a company to collect the material and bring it either to the nearby oxidation ponds, to the local dumpsite or to supply it to a local gardener. This service should attract a service fee.

[6] Obviously the transport costs are dependent on the distance from the place where the toilets are prefabricated (in this case Otjiwarongo, about 140 km).

[7] Prior to the introduction of the new (concrete) UDS-bowls the (plastic and non-UDS) toilet bowls had to be imported from where?.

For transport a pickup truck would be ideal. Because the number of toilets is relatively low so far, a wheelbarrow or a donkey cart could serve the purpose in the beginning. It is important to brief the contracted person of where to dump the material and to monitor this carefully.

The payment for the emptying could be established informally but should in the long run be covered by the municipality and financed through waste collection fees or water charges. If the toilet owners were to charge for the use of their toilets, the emptying cost could also be covered. On a household level that seems not likely, though, as many people do not want other people to use "their" toilet. For small pubs, however, this could be a good solution.

11 Practical experience and lessons learnt

The Otji toilet is an appropriate technology for the conditions of the project area. It is independent from other infrastructure and can be built almost anywhere at short notice.

The acceptance of the toilets is high, which is not surprising, as people who were without sanitation facilities before now have one and appreciate it. Many of the users are especially happy to have a dry system, as they do not have to pay for water.

The main issue is the difficulty to persuade decision makers of the appropriateness of the system. There are many people who still favour water based sanitation. Also some users are keen to have a flush toilet. It is important to remember, however, that many people cannot afford water for the toilets. Without the support of decision makers it will not be possible to establish a dry sanitation system on a large scale.

The pilot project was, however, very important to persuade some decision makers and people of the appropriateness of the technology.

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] No reuse is taking place.

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 www.susana.org: the SuSanA Vision document "Towards more sustainable solutions" (www.susana.org).

With regards to the long-term impacts of the project, the main expected impact of the project is to provide relevant information for decision makers and to persuade them about the necessity of saving water by introducing appropriate sanitation systems. Furthermore, improved public health and safety, especially for women and children are key aspects of the project.

13 Available documents and references

CHP (2009a): Dry toilet systems, Clay House Project, Otjiwarongo, Namibia http://www.otjitoilet.org/

CHP (2009b): The Otji toilet: self builder manual, Clay House Project, Otjiwarongo, Namibia, http://susana.org/lang-en/library?view=ccbktypeitem&type=2&id=916

CHP (2009c): The Otji toilet, Clay House Project Otjiwarongo, Namibia, http://susana.org/lang-en/library?view=ccbktypeitem&type=2&id=915

EcoSur (n.d.) Dry toilets in Latin America, http://www.english.ecosur.org/index.php/component/content/article/97-news/480-dry-toilets-in-latin-america

More photos:
http://www.flickr.com/photos/gtzecosan/sets/72157625326275173/with/5201186408/

Video about Otji toilets:
http://www.youtube.com/watch?v=mRXFSAdlmgA

14 Institutions, organisations and contact persons

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SuSanA 2011

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