

UDDTs at a residential plot
Nakuru, Kenya



Figure 1 Project location

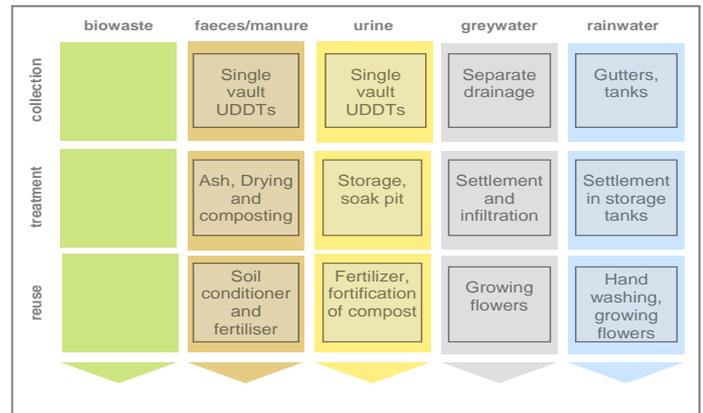


Figure 2 Applied sanitation components

1 General data

Type of project:

Urine diversion dehydration toilets (UDDT's) in a residential plot in Nakuru, Kenya

Project period:

Start of construction: August 2008
 End of construction: September 2008
 Start of operation: December 2008
 Monitoring period: Jan. 2009 – Dec. 2009
 Project end: 31 March 2010

Project scale:

Design and construction of a masonry toilet block consisting of 3 single vault UDDTs for a population of 28 households (84 users) at costs of EUR 1,640

Total investment of the project described: EUR 1,940

Planning institution:

Egerton University/Rosa Project, Egerton, Kenya

Executing institution:

Nakuru Municipal Council/ ROSA project, Nakuru, Kenya

Supporting agency:

European Union



The work was carried out within the project ROSA (Resource-Oriented Sanitation concepts for peri-urban areas in Africa; Contract No. 037025-GOCE; duration: 1.10.2006 – 31.3.2010), a Specific Target REsearch Project (STREP) funded within the EU 6th Framework Programme, Sub-priority "Global Change and Ecosystems".

2 Objective and motivation of the project

The objectives of this project were mainly to improve sanitation by establishing urine diversion dehydration toilets thereby reducing groundwater pollution and health risks associated with pit latrines. The motivation was also to contribute towards achieving the MGDs and Kenya Vision 2030 (GOK 2007) by promoting sustainable sanitation.

3 Location and conditions

The residential plot is located in Hilton estate, a high density low income settlement in the North-Western part of Nakuru town.

The town hosts people with different cultures, ideologies, religious, political, social and economic aspirations. It is the fourth largest town in Kenya, with a population of approximately 500,000 people and is located 160 km north west of the capital Nairobi (MCN et al., 1999).

The pilot area has little or no connection to the main sewer line. Most of the tenants are unemployed and engaged in small scale enterprises of selling basic household goods and sorting waste in the dump site while others are artisans who are employed on temporary basis.



Figure 3 Front view of plot-based UDDT for 28 households

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The majority of the women are housewives. The residential pilot plot consists of 28 households with an average of 3 members per household.



Figure 4 Nakuru-Hilton estate settlement. All photos in this document are from the ROSA project in 2008.

The main sanitation system used in this area is onsite sanitation where 85% of the population including the residential plot use pit latrines.



Figure 5 Existing pit latrines (left) and a buried filled up pit latrine in the front on which the new UDDT was constructed

The geology of Hilton estate is characterised by very shallow soils and occurrence of hard rock on the surface. In some parts geological fault lines pass through the area. The site had hard rock outcrop and it was not possible to dig a deep pit latrine. Already the plot had a filled pit latrine and the one in use was also almost filling up. To create more volume for the pit, some residents constructed raised pits since it is more expensive to dig on rock.

4 Project history

In a study carried out by the ROSA team in November-December 2007, it was observed that the main problem facing Hilton estate residents was lack of adequate water supply and lack of proper sanitation. Most pit latrines were very shallow and therefore filled up frequently costing the landlord a fee of Kenyan Shillings (Kshs) 3,500, about EUR 35, to exhaust the pit latrines. ROSA identified this plot as a pilot because its conditions were representative for the majority of the other plots and it is expected that the success of this pilot would

lead to other landlords adopting the systems in their plots. The other factors that led to selecting this site were:

- The landlord was willing to experiment on the new sanitation concept.
- The plot was very close (less than 50m) to an organic composting shed which provided an opportunity to dry and treat the faeces from the UDDT.
- The landlord was a local leader, engaged in environmental management and together with a CBO known as MEWEREMA interested in providing collection services and co-composting the organic matter with compost.

Two awareness creation workshops were conducted in 2008 to sensitise the landlord, the tenants and local residents on ROSA systems (Resource-Oriented Sanitation concepts for peri-urban areas in Africa). Topics were the UDDT technology, utilisation of urine and dried sanitised faeces.

After discussion of the proposed design, the implementation commenced at the end of August 2008 and completed after one month at the beginning of October 2008. In November 2008, the tenants were trained on the use, operation and maintenance of the UDDTs which was later officially opened by the Treasurer to the Nakuru municipal council in December 2009.

Monitoring in May 2011:

A monitoring of the ROSA projects in and around Nakuru was done in May 2011 by the consultant Laura Kraft (e-mail address: kraft_laura@yahoo.de) on behalf of GIZ sustainable sanitation program (Kraft, L. 2011). The overall objective of the monitoring was to update the SuSanA case study in regard to present status and lessons learned from the project.

For monitoring and evaluation three methods were used to gather information:

- Desk review, field observations and interviews

During the desk study different online documents were reviewed to understand the project approach and to access the latest information on the project status. This knowledge was used to prepare monitoring sheets and questionnaires for interviews with UDDT users, related service providers for excreta management and other relevant stakeholders.

The ROSA project sites described by SuSanA case studies were visited to assess the status of the UDDTs and other related facilities within the ROSA project. Interviews were conducted with teachers, students, landlords, CBO/ NGO leaders and the Municipal Council. For documentation purpose digital pictures were taken during the monitoring and uploaded on flickr (see link in Section 13).

During the visit of the residential plot interviews were conducted with the landlord and chairman of the CBO MEWAREMA. The state of the toilet facility and the drying shed was assessed using the monitoring sheet.

Based on the resultant information, the case study was updated. The original text referring to the project state in 2009 was maintained with minimal alterations in addition to the new observations added under the headings "Project update May 2011".

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5 Technologies applied

The various sanitation options including ArborLoo, composting toilet, urine diversion dry toilets (UDDTs) with both single vault and double vault were considered. The UDDT was chosen due to its advantage of separately collecting the urine and faeces such that the treatment for each fraction can be specific as required. UDDTs are dry sanitation systems that have two collection systems which separate and store the urine and the faeces fractions of the excreta at source in order to simplify their safe recycling and utilization of their nutrient content separately.

Due to the limited space available for construction, single vault UDDTs were chosen over the double vault UDDTs. During the training workshops, members opted for container collection arguing that it would be more hygienic to handle the faeces while contained, instead of allowing them to drop on the floor of the chamber.

The faeces are collected in 70 - 100 litre plastic containers placed in the vault underneath the toilet chamber. Once the containers are filled, they are pushed aside to place empty ones directly under the faeces hole. One of the toilets is assigned to men including a plastic waterless urinal installed at a corner. The other two are assigned for women and children, respectively.



Figure 6 On the left: Inside the single vault UDDT showing the urine diversion pedestal, men's urinal and a bucket for storing ash. On the right: greywater settling chamber

Urine is collected in a 50 liter plastic tank, when the tank is filled, the urine is discharged through an overflow pipe into a soak pit. Urine can be collected for agricultural use by removing the collection tank from the chamber behind.

Rainwater is harvested from the roof into a 100 liter tank which is connected to washing basin in front of the toilets. The grey water is directed to a flower bed after passing through a settlement tank.

6 Design information

The dimensions of the UDD toilets block are 3.3m length and 1.4m width, housing three single vault UDDTs.

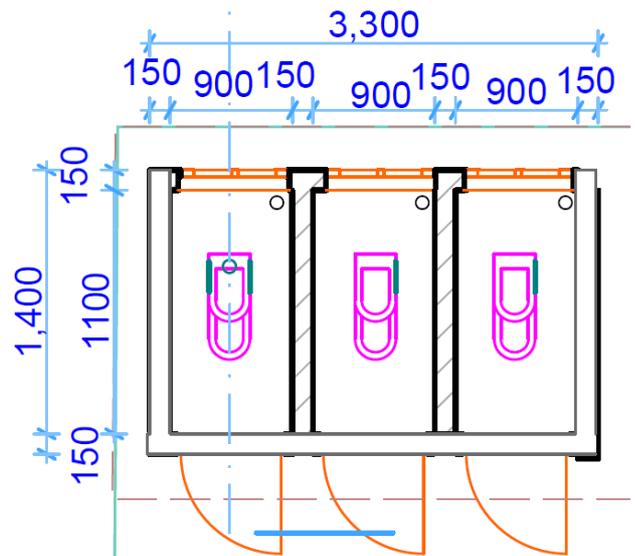


Figure 7 Floor plan of the residential UDDT.

To save costs, the floor area for each single toilet (1.1m x 0.9m) was designed to meet the minimum but adequate toilet floor area requirement of approximately 1 m² (Harvey, 2002).

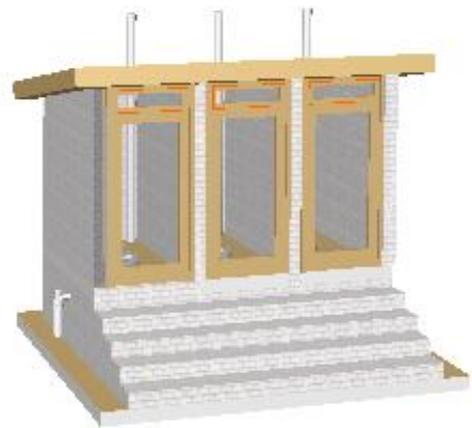


Figure 8 Front elevation of the residential.

The toilet was constructed above an old pit that had been backfilled with stones and compacted. A 1m thick base concrete slab was placed over the compacted stones and the super structure constructed above this. The designed vault size is 1.1m x 0.9m x 0.75m which can receive 0.6 m³ (600 litres) of faecal matter when 80% full. However, when using containers, only a maximum of 300 litres can be collected using 3 x 100 litre containers. It is calculated that it will take 45 days to fill one 100 liter container, hence three 100 liter containers last for 135 days, resulting that the faeces may be emptied every 135 days (4 ½ months).

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Figure 9 The rear of the UDDT showing vault doors and a shade for temporary storing the faeces for further drying before utilisation/disposal.

The interior of the toilet is well ventilated and lighted by a vent space above the door that is covered with a gauze wire to avoid flies, while each vault has a vent pipe that rises 1m above the roof for effective air circulation from the vaults to the atmosphere.

Monitoring outcomes from May 2011:

Generally the superstructure was in good condition only some of the stairs were cracked. The hand wash facility was in place, functioning and water was available.

There was only one cubical and one urinal in use, the other two toilets were locked as the containers were filled up (Fig.10).



Figure 10 On the left, the old pit-latrines used by the tenants are located next to the UDDT facility with greywater settling chamber in front. Right: Only one cubical and one urinal of the UDDT are currently used by the landlord and his family (L. Kraft, May 2011)

7 Type and level of reuse

It is planned that the collection, transportation and treatment of the faeces from this plot will be done by a service provider. So far the faeces and urine produced in this UDDT have not been reused due to lack of demand. The plot area is covered with buildings and no space is available for urban agriculture. The dried faeces emptied from the vaults are disposed at a

dump site that is only 50m from the plot, while the excess urine goes to a soak pit.

The local garbage compost company (MEWAREMA) will collect and transport the next load of dried faeces to the new drying shed which is located at the dump site for further treatment.



Figure 11 Drying shed at the dump site for centralized composting (source: Sustainable sanitation Practice, Issue2. 01/2010, EcoSan Club)

The Initial cost estimates indicated that a charge of Ksh 100 to 400 for emptying service depending on the amount and the distance to the drying shed could be allocated.

Monitoring outcomes from May 2011:

Urine and faeces are not collected and reused. Urine overflows in the pit of the old pit latrine. The owner of the UDDT had exchanged the filled up container twice by himself as there was no collection service. The faeces were once disposed at the dumpsite and once the containers were exchanged and kept in one of the bathrooms next to the old pit toilet (Fig.12).



Figure 12 Old, filled up faeces container stored in the bathroom next to the pit-latrine (Source: L. Kraft, May 2011)

Collection, transport and treatment service (MEWAREMA)

The Menengai Waste Recycling Management (MEWAREMA) is a CBO and licensed as operator for solid waste collection within the peri-urban areas Hilton and London. They are also experienced in organic compost production which was done by a women group collecting biodegradable waste from the dump site and supported by Practical Action.

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During the ROSA project they agreed to offer a collection, transport and treatment service for the faecal matter from UDDTs. Unfortunately since the end of the project no collection of faeces was done by MEWAREMA.

The following challenges were identified:

- No market for urine and faeces or co-compost
- High investment cost in the beginning
- No access to loans as they do not have enough capital
- No profit will be made in the first years of operation
- There are no subsidies available for supporting the collection service in the beginning before it can make profit.

MEWAREMA is still willing to do the collection, transport and treatment of the faecal matter but the challenges mentioned above seem hard to overcome. They had a donkey cart (financed by Practical Action) and two donkeys which the group bought for the collection although the drying shed (provided by ROSA) was destroyed during a storm (Fig.13).



Figure 13 Drying shed was destroyed during a storm (Source: L. Kraft, May 2011)

Marketing and selling of co-composted faeces and urine (NAWACOM)

According to the ROSA operation and maintenance strategy MEWAREMA should sell the co-compost to NAWACOM (Nakuru Waste Collectors and Recyclers) who should be responsible for marketing and compost selling.

Challenges:

- Marketing is a challenge as people value chemical fertilizer more than organic fertilizer
- Many people believe that chemical fertilizer is having a better effect than organic fertilizer
- Compost containing urine and faeces cannot be marketed openly but can be used as long as customers do not know (compost from “organic waste”)
- Doubts if produced co-compost is “safe”, they would only buy when lab tests are done and prove that it has no high amount of heavy metals, pathogens or other harmful substances

8 Further project components

The following activities are in progress at the residential plot UDDT:

- Monitoring O&M of the facilities
- Research on O&M and the involvement of private sector in the business of collection, transport, treatment and marketing of compost
- Construction and management of drying shed

9 Costs

The cost of construction of the 3 single vault residential plot UDDTs is shown in Table 1.

Table 1: Construction costs for the 3 single vault UDDT (all provisional inclusive of labour).

Item	Description	Amount (EUR)
1	Excavation and earthworks	74
2	Concreting	238
3	Walling	474
4	Roofing	160
5	Doors	252
6	Sanitary installations	252
7	Finishes	188
Total		1.638

A comparison of the operation and maintenance cost for three types of toilets namely: UDDT, pit latrine and flush toilets are given in Table 2.

Table 2: Comparison of estimated costs of operation and maintenance for three different sanitation options (annual costs in Euro)

Description	UDDT	Pit latrine	Flush toilet
Emptying	12	12	-
Empt. Urine	12	-	-
Service charge for sewer/water?	-	-	120
Cleaning	52	52	120
Disinfectant	-	24	10
Income from product	(36)	0	0
Total	76	88	250

The table shows that the operation and maintenance cost of flush toilet is much higher compared the other two. The operation and maintenance (O&M) costs for the UDDT and pit latrine show no significant difference. However, if recycling and reuse of products from the UDDTs is realised, earnings from the sales of the product (1200 kg at EUR 0.03 per kg = EUR 36) may reduce the overall expenditure hence making the UDDT more profitable. The costs for awareness creation workshop and training were EUR 300.

10 Operation and maintenance

It was the sole responsibility of the landlord to manage the UDDT implemented by ROSA in his plot. A memorandum of understanding was signed by the ROSA project and the landlord that he takes over all responsibilities after ROSA project ends. The ROSA project, however, has continued

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helping and backstopping as and whenever need arose especially on technical matters. The landlord's wife and some female tenants were responsible for the daily cleaning and operation of the toilets. They cleaned the toilet floor regularly and ensured that there is ash available.

The landlord on the other hand was supposed to arrange collection and transportation of the faecal matter, to do repair work and general maintenance when need arises.



Figure 14 A mother assisting her kid on using the UDDT at the plot.

To ensure proper use and basic operation and maintenance on the UDDT, occasional training and demonstration was conducted by the ROSA team to the users. The main activity of emptying the containers by a private provider/CBO will be done once per 4 months or earlier if the containers are full or have been mixed and therefore emitting smell.



Figure 15 A community based organization (MEWAREMA) from the area that is in the process of acquiring a cart and two donkeys for providing collection and transporting service.

Monitoring outcomes from May 2011:

The toilet in use was clean but there was no ash inside the toilet, ash was stored outside under the sink. Therefore fresh faeces were not covered, looked wet and flies were observed in the toilet. There were no instructions on the right use of the UDDT in or outside the toilet.

11 Practical experience and lessons learnt

The UDDT was generally well maintained most of the time. Smell was detected and flies noticed 4 times of the 20 times visited by project staff. The main operation problem observed was the misuse of the toilets by visitors and strangers who were not familiar with the proper use, leading to mixing of urine and faeces. The children were also reported to put ash into the urine hole occasionally leading to blockage of the system.

To solve these problems, a new toilet management system has been put in place where the 3 UDDTs are divided among the 28 households, who are supposed to take care and maintain the toilets. The toilets are now closed and each group has their own keys.

The frequency of the 100 litre container filling with faeces was observed to be 45 days with an average of 20 people using the toilet per day.

Approximately 100 litres of urine is collected per week into the 50 litre container with an overflow that discharges into a soak pit. No market is available for the urine or the faecal matter from this toilet at the moment. It is realised that a proper re-use concept must be in place prior to operation of toilets or a safe disposal option being available as an alternative.

Continuous monitoring is required by the ROSA team in order to ensure the facility is operating properly and the management is committed to its success.

Up-scaling of UDDT implementation is in progress and approximately 15 landlords/landladies have benefited the loan and constructed improved sanitation facilities.

Monitoring outcomes from May 2011:

Different households with UDDTs were visited within the peri-urban areas London and Hilton. Many people said the UDDT superstructure is of good quality and they like the design. The underground is very rocky in the area therefore people prefer the raised UDDT because digging a pit is expensive. UDDTs were also preferred as they do not fill up and are easily emptied.

Many people took a loan from Family Bank to finance a UDDT¹ but since there was no collection service most of this UDDTs are not in use anymore. Many users shifted back to the pit latrines after the containers filled up.

The main challenges are faced with the lack of a functioning collecting, transport, treatment and marketing system of urine and faeces as well as minor operation and maintenance:

- The responsible and licensed waste collector and processor is MEWAREMA that has not ventured into the business of human excreta since there is no market for the end product compost. The purchased transport equipment was donated in vain.
- NAWACOM as a local NGO that sells organic fertilizer called "MAZINGIRA" currently see no potential in fertiliser containing urine and faeces

¹ More information on this financing option can be obtained from WASTE – contact: Gert de Bruijne – WASTE advisor gdebruijne@waste.nl

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- Usage of ash is not practised by all users therefore faeces are often wet and smell

The key constraint is the lack of marketing of the UDDT products as an organic fertilizer. It is crucial to invest in different marketing strategies to increase the demand on organic fertilizer containing urine and treated faeces.

This could be done through:

1. Demonstration fields
2. Free fertilizer distribution or at a very low cost
3. Awareness creation on benefits
4. Advertisement
5. Workshops
6. Direct contacting potential customers like tree nurseries or flower farms

A different solution could be that urine and faeces are reused in another way for example to produce biogas or to feed larvae of black soldier flies which are very nutritious and can be used to feed animals.

There is an urgent need to overcome the challenges otherwise a lot of users have no other option than demolishing or abandoning their UDDTs and return to the pit latrines or flying toilets they used before.

12 Sustainability assessment and long-term impacts

A basic assessment (Table 3) 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 3: 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).

Sustainability criteria	collection and transport			treatment			transport and reuse		
	+	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	

For long term sustainability and for economic sanitation, the following is recommended:

- Encourage the landlord to have a sense of ownership and to ensure good operation, maintenance and management

- Encourage users to correct use and to spread the knowledge of the ROSA system to the communities they live in, so as to create a critical mass.
- To demonstrate the additional economic benefits arising from the utilisation of the products, this is an important factor in the success of the system.
- To carry out pathogen tests at different stages of the faecal storage to determine health effects of handling faeces and urine during collection, transportation, treatment and reuse. This is meant to serve as a source of researched information that can be used in the decision making on utilisation of products.
- To confirm the calculated costs of operation and maintenance with the actual costs.

As showed in Section 11 there is a challenge in marketing of the UDDT products as an organic fertilizer in order to create a incentive based collection and treatment services. In order for the sustainability of the project it is crucial that these services can be organized on a solid and permanent basis. Otherwise there is no sustainability achieved.

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, e.g. from fertilizer 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).

13 Available documents and references

The following documents are available:

Photos from this project are available on flickr:

<http://www.flickr.com/photos/gtzecosan/sets/72157624222612155/with/4730407176/>

Publications:

- Sustainable Sanitation Practice “Operation and Maintenance – Successful models for O&M of sanitation systems, Issue 2. 01/2010 <http://www.ecosan.at/ssp/>
- Manual how to use urine as natural fertilizer in Kiswahili http://rosa.boku.ac.at/images/stories/Public%20Docs/urine_use_kiswahili.pdf
- Manual how to use urine as natural fertilizer in English http://rosa.boku.ac.at/images/stories/Public%20Docs/urine_use_english.pdf

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- ROSA IEC Posters Kenya
http://rosa.boku.ac.at/images/stories/Public%20Docs/nakuru_iec_posters.pdf
- ROSA Brochure Kenya
http://rosa.boku.ac.at/images/stories/Public%20Docs/nakuru_brochure.pdf
- Further information is available from ROSA homepage
http://rosa.boku.ac.at/index.php?option=com_frontpage&Itemid=1
- Kraft, L. (2011) Monitoring and evaluation of ROSA projects in Nakuru. Results of field observations and questionnaires, GIZ
<http://www.susana.org/lang-en/library?view=ccbctypeitem&type=2&id=1196>

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<http://www.planning.go.ke>;
- MCN, (1999). Municipal Council Nakuru Strategic Structure Plan. Action Plan for Sustainable Urban Development of Nakuru town and its Environs, Volume 1. GOK

14 Institutions, organisations and contact persons

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http://rosa.boku.ac.at/index.php?option=com_frontpage&Itemid=1

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Case study of SuSanA projects

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SuSanA 2010

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