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Introducing Sustainable Sanitation in Kyrgyzstan

An analysis of success factors and barriers

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Contents

Project partners from Kyrgyzstan and Germany visiting a newly built toilet and discussing construction issues.

Summary

People in rural areas of Kyrgyzstan are confronted with health problems linked to the highly problematic predominant sanitation system, which consists of pit latrines and untreated discharge of greywater. From 2006 – 2008, a coalition of four Kyrgyz NGOs, members of the WECF network, supported by the WECF secretariat, implemented the project "A sustainable decentralized wastewater management for Kyrgyzstan" to demonstrate and further explore ecological sanitation as a solution to the sanitation problem. The direct goal of the project was to establish starting conditions for a nationwide introduction of sustainable sanitation. Three methods were used to achieve this goal: knowledge transfer and gathering of practical experience, construction and monitoring of demonstration objects, and creating publicity and tools for up-scaling. The project focused on demonstrating, testing, and monitoring UDDTs (Urine Diverting Dry Toilets). In the framework of the project, 16 UDDT and 2 soil filters were constructed and monitored. This study presents the results of the monitoring.
The analysis of the project activities and local acceptance of the toilets revealed the following: The average cost of the outdoor household UDDT constructed in the context of the project is 368 Euro with a standard deviation of ± 120 Euro. The main motivators for people to construct UDDTs were:

- dissatisfaction with the pit latrine, especially smell and difficulties with cleaning
- in areas with high groundwater level the necessity to move the pit latrine often
- an interest in obtaining cheap fertilizer, such as urine and composted faeces

The main barriers were: perception of the flush toilet as the best sanitation solution, combined with scepticism towards something unknown. Of the 15 toilets analysed in this study, 73% were fully and partly accepted by summer 2008, about one year after their construction. This figure rose to 87% by late autumn 2008. 6 main indicators were defined to analyse the reasons for the acceptance or non-acceptance: smell prevention, who constructed the toilet, who was trained, number of vaults for storing faeces, financial contribution of UDDT owner, and the groundwater table.

This study shows that a successful implementation of Ecosan technologies should not only build on good quality of technical construction but also on adequate knowledge transfer and participation of interested persons. Introduction of UDDT on a wider scale has to pay attention to the following three aspects in order to be successful:

1. Training and support of the users by experts. Especially smell problems have to be solved. Proactive support of users in operation and maintenance is needed.

2. Involvement and feeling of ownership for the toilet owners: The decision to construct a UDDT for the household should be taken by wife and husband together. Households should significantly contribute both with labour and materially. Given the difficult economic situation, a system for financial support is needed. Micro-credit and revolving funds are a practicable option.

3. The chances for UDDT to be accepted are significantly higher in areas with a high groundwater table. They are also high with farmer-oriented households facing a shortage of fertilizer.

Introduction

In December 2006, four Kyrgyz NGOs, supported by the WECF secretariat, started working in partnership on a two-year project to introduce the concept of sustainable sanitation to Kyrgyzstan.
The core aim of this project was to construct and successfully introduce Urine Diverting Dry Toilets (UDDTs).
Kyrgyzstan is one of the poorest countries in the EECCA region. The sanitation systems in rural areas, mostly limited to pit latrines, contribute to an increasing disease burden. The country also faces a food crisis: prices for food and fertilizers are rising, while the food production is declining.

How can toilets contribute to alleviating both problems? It is well known that death and diarrhoea incidences decrease by 15% when water quality is improved and by 55% in case of better sanitation combined with higher water quality and quantities.[1]
So, from a health point of view, Urine Diverting Dry Toilets provide a considerable improvement compared to pit latrines. But they also have economic potential: urine and faeces are made available as a precious resource in the form of fertilizer rich in nitrogen, phosphorus and potassium. Kyrgyzstan's consumption of chemical fertilizer per year is about 27,000 metric tons.[2] Prices for fertilizer have risen, and good quality fertilizers are less easily available. This has led to a decrease in the overall use of fertilizer by about 4,000 tons since 1990. And complex fertilizers such as NPK are barely in use any more, with only the cheaper nitrogen fertilizers (*selitra*) widely available. Especially rural people with small plots and low incomes do not use fertilizers at all. Yet Kyrgyzstan's population produces roughly 12,000 tons of nitrogen per year from urine alone.[3] Fertilizer from human excreta has a potential to provide a significant economic input for agriculture in Kyrgyzstan.

This case study presents the project approaches and the most important results. Semi-structured interviews were conducted with most UDDT owners (men, women or both); once during the building process and once when the toilets were in use. Data was cross-checked with Kyrgyz NGOs and key respondents in villages via informal interviews. In summer 2008, the project and results were evaluated and discussed by Kyrgyz partners together with WECF.

The case study is structured as follows:

Chapter 1 provides a short introduction to the country, a description of the project areas and their sanitation problems.
Chapter 2 explains the concepts of sustainable and ecological sanitation, as well as the principles of the technologies applied in the project.
Chapter 3 provides a description of the concepts applied in the project.
Chapter 4 presents and discusses the results of the project in terms of technical implementation, use, perception, and acceptance.
Finally, in **Chapter 5**, conclusions and recommendation are presented.

When entering the office of Public Association ULGU in Kerben, you pass by the newly constructed toilet. Before the toilet entrance, there is a constant information stand on Ecological Sanitation and the project.

Below: 97% of Kyrgyzstan's rural population have to use pit latrines

1 | Kyrgyzstan: health problems linked to unsafe sanitation

Kyrgyzstan is a country of dramatic scenery and picturesque mountainous landscapes. But it is also among the poorest EECCA states: 40% of the 5.36 million population are estimated to live below the poverty line. The infant mortality rate is estimated at 34,5 deaths per 1000 births. 57.7% of women suffer from anaemia due to problematic nutrition.[4] The human development index according to UNDP puts it at position 122 of 179 countries.[5]

FAO estimated in 2003 that 66% of the population lives in rural areas.[6] The average poor rural household has normally no more than a small piece of land, whose products are mainly used for subsistence. Most households do not have permanent sources of income as job opportunities are often scarce. The systems of the Soviet period supplying the population with water, energy, work,food and consumer goods have mostly collapsed. Agricultural infrastructure has been deteriorating; resources to invest are lacking. Practically only nitrogen fertilizers are available, but at rising prices and unaffordable for a growing percentage of the rural population. For 20 percent of the population, about 1 million people, considered to be severely food insecure, the proportion of spending on food has increased sharply in 2008 to 74% of all spending. High food prices are reversing recent progress made in decreasing poverty levels.[7]

Next to poverty, a major problem is the decline in drinking water supply, especially for the rural population: in 2006 fewer than 10% of the rural population had piped water inside their houses, down from 28% in 1997. Only 1% of the rural population in Kyrgyzstan has access to an inside toilet, 97% use outside pit latrines, and 2% do not have a toilet at all.[8] In the villages there are sometimes wastewater treatment plants, which were built in Soviet times but are no longer functioning. A case study in 35 villages in Issyk-Kul, Naryn, and Talas provinces found a sewage connection rate of just 3% in rural areas.[9] This inadequate access to safe water and sanitation is likely to cause infectious diseases like diarrhoea. WHO lists unsafe water, sanitation, and hygiene among the 10 leading risk factors in the burden of disease.[10] This is especially valid in areas with relative high ground water levels where pit latrines easily contaminate the drinking water. Out of 1,400 school children examined from three provinces, at least one of the four common parasites Giardia lamblia, Enterobius vermicularis, Hymenolepis nana, Ascaris lumbriocides infection was found in the faeces of 75%, 61 % and 79% of the children in Talas, Naryn and Issyk-Kul provinces respectively.[11]

The project presented in this study was conducted in rural or peri-urban regions in Chui, Issyk-Kul, and Jalalabat provinces. The described conditions hold true in all or most aspects for all of the project sites.

2 | Sustainable Sanitation

2.1 Sustainable Sanitation – Ecological Sanitation

In this study, the terms "sustainable sanitation" and "ecological sanitation" are used. The project implemented ecological sanitation technologies, which are one way to apply sustainable sanitation principles through practical solutions.

Sustainable sanitation is defined by the following principles formulated at the meeting of sanitation and hygiene specialists in Bellagio, Italy, on February 1-4, 2000:[12]

- human dignity, quality of life, and ecological safety on the level of both households and society should be at the heart of any approach to solve problems of sanitation;
- gender equality should be observed in any decision making and participation of all involved parties should be guaranteed;
- human waste, such as faeces and urine, should be considered as resources in the circle of nutrients;
- specific technological solutions of sanitation problems (latrines, waste water collection and treatment) should be designed to the minimum practicable size (e.g. household, neighbourhood)

"Ecological Sanitation" technologies in this document are defined as technologies preventing the penetration of untreated human excreta and wastewater into the environment (also known as containment), sanitizing human excreta, and safely reusing the nutrients human excreta contain. Ecological Sanitation solutions thus comply with sustainable sanitation principles. Ecological sanitation – or Ecosan - is best known and most associated with systems separating at the source, such as Urine Diverting Dry Toilets.

The WHO has issued "Guidelines on safe use of wastewater, excreta, and greywater", which provide rules for safely sanitizing and reusing human excreta. Ecological sanitation adheres to these rules.[13]

The following sections describe the ecological sanitation solutions implemented in the project. Ecological Sanitation methods of treatment range from simple low-tech solutions to high-tech variants. Given the conditions of rural areas in Kyrgyzstan, affordable low-tech variants were chosen for this project: Urine Diverting Dry Toilets (UDDTs) and soil filters for greywater treatment.

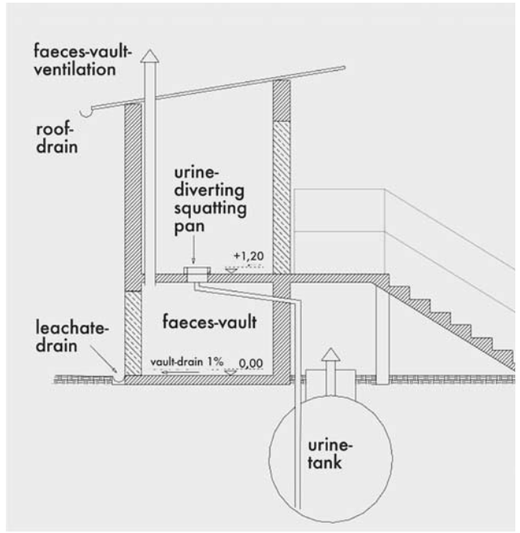


Figure 1. Cross section of UDDT. Source: WECF.

2.2 Urine Diverting Dry Toilets

In a Urine Diverting Dry Toilet (UDDT) no water is used for flushing. The principle of a UDDT is to keep faeces and urine separated. For this purpose special seats or slabs are needed, which safeguard the separation. Such slabs are industrially produced in e.g. China, but can also be constructed locally. After the separation the faeces are covered with an adsorbing organic material and kept directly in a special faeces chamber or in a container placed in the faeces chamber of the toilet. The urine is stored in a tank. The volume of urine tanks for households usually ranges from 5–10 liter canisters to 1-2 m^3 tanks. Generally 10 to 20 l canisters are common, as it allows the urine to be carried and applied easily on the fields. Larger tanks make longer storage periods possible, which can be helpful especially in winter, when application is more difficult and the fertilizing effect is less than in spring.[14]

Due to the separation, urine can be used easily and safely as fertilizer on household level without extra sanitizing. If urine is used as fertilizer for large scale commercial farming, higher infection risks are involved and therefore urine has to be stored at least for six months. In colder climates a longer storage time can be suggested. In this case two tanks can be used; the volume of one tank should be enough to collect urine for more than 6 months.

Before faeces can safely be used, they have to be sanitized, i.e. pathogens have to be eliminated. This is achieved by different methods, such as alkaline treatment with ashes, adding soil and sawdust, and storing. During storing time, a dehydration and/or composting process takes place. The whole storage and/or composting time depends mainly on the temperature. The WHO Guidelines recommend 2 years for temperate climates (2-20°C).[15]

Two main types of UDDT can be discerned: UDDT with one faeces chamber (single vault) or two chambers (double vault). Both have their advantages and disadvantages.

Single Vault UDDT: The faeces chamber of a single vault toilet has only one compartment. An external container is put into the chamber in order to collect the faeces. When the container is filled it should be taken out and stored for drying. Another empty container is put into the chamber for collection. A single vault system should have 2 or more containers to prevent the handling of fresh faeces. After drying the faeces should be composted additionally. The container should not be too big because it has to be carried by hand. The floor of the faeces chamber should not be used for faeces storage.

Double Vault UDDT: As indicated in its name, this type of toilet consists of 2 compartments in the faeces chamber. The idea behind is to collect the faeces in one chamber until it is filled and then to use the other chamber for collection by changing the position of the toilet seat so that it is above the second chamber. While the second chamber is used for collection, the faeces in the first chamber can be dried without a need to take them out of the chamber. When the second chamber is also filled up, the first chamber has to be emptied. In this kind of UDDT the chambers should be big enough to allow for the necessary storage time. After the storage, additional composting is recommended.

1 *World Health Organization. Guidelines for drinking water quality. 3rd ed. Recommendations, vol. 1. Geneva: WHO 2004*
2 *FAO, Food and Agriculture Indicators, 2006, available at: http://www.fao.org/es/ess/compendium_2006/pdf/KYR_ESS_E.pdf*
3 *Estimation based on: average NH4-N content of 6 g/l urine (WECF Analyses results, see TABLE 4), 500 l/ capita urine excretion per year, total population 5.3 Mio people, 1 Mio of which is not in the country because of labour migration.*
4 *http://www.unfpa.org.kg/english/info.html, 7.7.2006*
5 *http://hdrstats.undp.org/2008/countries/country_fact_sheets/cty_fs_KGZ.html*
6 *FAOSTAT database, available at: www.fao.org*
7 *http://www.fao.org/isfp/country-information/kyrgyzstan/en/*
8 *McKee et al. (2006), Access to water in the countries of the former Soviet Union - Public Health (2006) 120, pp 364–372. Cf. also Joint Monitoring Programme for Water Supply and Sanitaiton, Coverage Estimates Improved Sanitation, and Coverage Estimates Improved Drinking Water, Kyrgyzstan, available at: http://www.wssinfo.org/*
9 *http://www.gender.cawater-info.net/knowledge_base/case_study/kyrgyzstan_taza_suu_e.htm*
10 *World Health Organization. Guidelines for drinking water quality. 3rd ed. Recommendations, vol. 1. Geneva: WHO 2004. Highlights on Health in Kyrgyzstan,WHO 2006, p. 11, available at: http://www.euro.who.int/document/e88739.pdf*
11 *Meimanaliev et al. (2005), Kyrgyz Public Health Promotion, presentation at 6th IUHPE European Conference, 3. June 2005, available at: http://www.bestpractice2005.se/files/fr201-212.pdf*
12 *On sustainable sanitation, see www.susana.org*
13 *http://www.who.int/water_sanitation_health/wastewater/gsuww/en/index.html, esp. Volume 4. See also: Anna Richert Stintzing et.al., Urine Diverting Toilets in Climates with Cold Winters, WECF 2007.*
14 *For more detailed information on construction, use, and maintenance see: Stefan Deegener et. al., Urine Diverting Toilets: Principles, Operation, and Construction, WECF 2006.*
15 *For conditions in climates with cold winters, a longer period or a combination of several methods can be applied. But data comparable to the WHO guidelines does not yet exist. Cf. Anna Richert Stintzing et.al., Urine Diverting Toilets in Climates with Cold Winters, WECF 2007, pp. 16-17*

2.3 Soil Filters

A soil filter is a natural treatment method, in which biologically degradable material is removed by biological processes. Two basic types of soil filters can be discerned: constructed wetlands and simplified filters.

Constructed wetlands consist of three main parts; sedimentation tank, filter and last storage for infiltration or reuse, where also the effluent can be sampled and monitored. The filter consists of gravel and sand of different sizes. Constructed wetlands can also be made using low-tech equipment; a pump, pipes and foil; clay can be used as a sealant as well. If there is enough slope a pump may not be needed. Soil filter beds are generally planted with reeds.[16]

Simplified filters are filter beds with or without a pre-sedimentation. They are very cheap compared to the constructed wetlands. They are not sealed away from groundwater; instead the effluent water trickles through it and then infiltrates to the ground. Therefore it is not possible to take samples of the effluent and to check the performance of the filter. Thus these simplified filters are recommended only for wastewaters that are not so dangerous for the groundwater.

In general, soil filters are a low-tech treatment method; but the construction cost of constructed wetlands can be quite high, as is the needed area per capita (2-5 m^2/capita). Especially sand, gravel prices and area cost play an important role in the total cost. Depending on the flow direction in the filter the soil filters will be denoted as vertical or horizontal. Vertical filters need less area than horizontal filters but they generally need a pump to overcome height differences and piping or distribution of wastewater over/on the filter is more complicated.

The advantage of a soil filter in comparison to conventional technologies is the lower energy demand and the lower need for maintenance, which adds up to low running costs. Energy is only needed for pumping (if not enough slope) and the only needed maintenance is to empty the sedimentation tank (if applicable, maybe once a year) and harvesting the plants. A well-designed system can have a life span of more than 20 years, before the filter material has to be cleaned or changed. In the design phase, the amount of space and the type of sand needed have to be chosen carefully in order to prevent the filter from clogging problems, which can lead to very high maintenance costs.

Cost and area needed depend on the type of wastewater treated. Constructed wetlands can treat both greywater from bath and kitchen, and blackwater from toilets – in this case the area demand is high (about 5 m^2 per capita). If only greywater from bath and kitchen is to be treated, the needed area fora constructed wetland is already much smaller (about 2 m^2 per capita). A simplified filter with a sedimentation tank can also be used. If only bathroom greywater is to be treated, a simplified filter without a sedimentation tank can be used.

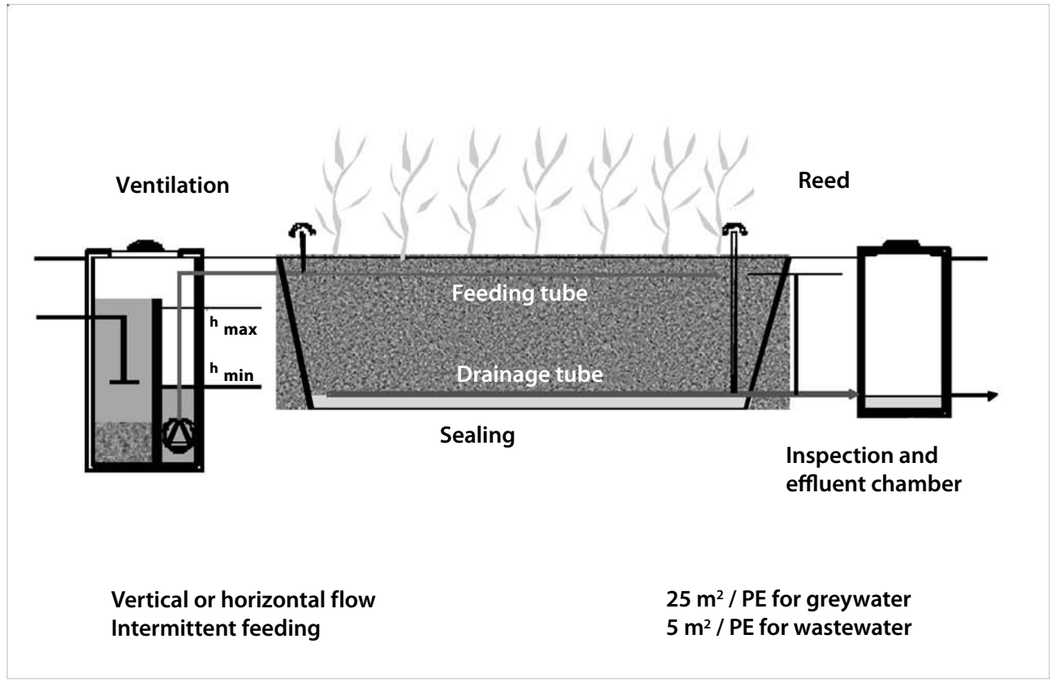


Figure 2: Cross-section of a vertical constructed wetland. Source: TUHH.

16 *See: Principles for the Dimensioning, Construction and Operation of Plant Beds for Communal Wastewater, DWA technical advisory leaflet A-262, DWA 2006*

Ecological Sanitation

Urine Diverting Dry Toilets

This garden is fertilized with urine collected in the UDDT in the background. The owners remarked that everything grows much better than before.

Old and new: pit-latine (left) and UDDT. Faeces chamber doors are on the right side.

Inside UDDT: the squatting slab is imported from Chine. The bucket is filled with sawdust for "flushing".

Urine collection in a 20-l canister.

Single vault UDDT: faeces are collected in the blue bucket, which can be moved out on rails.

UDDT at the office of Public Association ULGU. The toilet building is constructed directly adjacent to the office building.

Double vault UDDT. Faeces chamber doors are opened for demonstration. The ventilation pipe seen here has too small a diameter and was replaced later.

Urine Diverting Dry Toilets
A variety of solutions

Interested neighbors visit the construction site of a UDDT in Kerben, South Kyrgyzstan. The opportunity is used for information and training by PA ULGU.

Hygiene is important: note the washstand on the right side of the toilet.

Ismat Karimov explaining the fly-trap.

Urine diverting seat riser made from concrete.

Self-made squatting slabs of a double vault UDDT.

Retro-fitted pit latrine. The funnel for collecting urine is made from a 5-l water bottle.

Site visit of the project partners from Europe and Kyrgyzstan to a UDDT in Bishkek.

3 | The Project

The project "A sustainable decentralized wastewater management for Kyrgyzstan" was implemented for 24 months (December 2006 to December 2008). It was funded by the German Federal Environment Ministry. The main goal of the project was to establish starting conditions for a nationwide introduction of sustainable sanitation. The project focused on Urine Diverting Dry Toilets.
Constructed wetlands were also introduced and tested, but to a considerably lesser extent. The project was executed by four Kyrgyz NGOs, members of the WECF network: Rural Women's NGO ALGA, Ecological Movement BIOM, Habitat Foundation Kyrgyzstan, and Public Association ULGU (see annex 4). They were supported by the WECF secretariat. Sustainable sanitation technologies, as we have seen, reduce environmental anthropogenic pollution caused by untreated wastewater and human excreta, making the nutrients available for reuse. At the same time, they offer an improvement of quality of life. When the project was formulated, it was deemed important that the demonstrated methods could be easily replicated by local capacity. The selected methods had to be low technology, cheap to install, easy to manage and environmentally friendly. Therefore, the project opted for the described ecological sanitation technologies.

Three methods were applied to reach the project goal:
Knowledge transfer, gathering of practical experience, learning by doing.

WECF transferred knowledge on sustainable sanitation to the four participating Kyrgyz NGOs. WECF did so in cooperation with the Hamburg University of Technology (TUHH) using also ist own experiences from previous projects on sustainable sanitation. In December 2006, a training of trainers (TOT) was conducted on constructing UDDTs. The 4 Kyrgyz organisations received further continuous support via email and telephone, and through site visits by WECF field staff and a TUHH engineer. They also exchanged their experiences. A training combined with construction of a planted soil filter was conducted in April 2008.
The Kyrgyz partner NGOs conducted trainings and seminars for potential project communities, and then for selected beneficiaries. The transferred knowledge was thus replicated. The construction, operation, and maintenance of the demonstration objects also allowed all five NGOs to build up considerable experience following the principle "learning by doing". Each of the Kyrgyz partner organisations was able to build on their own distinctive strengths for the practical realisation of the sustainable sanitation technologies. Each of them accordingly chose the method how to adapt the training and information materials for their target groups, which they reached by workshops, seminars, discussion groups or just by verbal communication. Most partners began by conducting informational seminars in the villages to which key persons were often invited, such as formal and informal village leaders, teachers, doctors, farmers, mullahs, and imams. All partners agreed on common criteria to be considered when choosing households (or other places) where to build the toilets. The criteria included: interest, type of household, accessibility, possibility to use as demonstration for excursions and trainings, ecological criteria (e.g. groundwater table), availability of a garden for applying fertilizer, willingness of household to share in costs and labour, and accept guests for demonstrations, amount of constant users. But each organisation used its own approach how to practically devise this process and the relations to the chosen households. Taken together, the partners conducted 17 trainings with 403 participants.

Construction of demonstration objects and monitoring

The four Kyrgyz partner organisations constructed demonstration objects: 16 UDDTs, and 2 constructed wetlands. Different models of UDDT were constructed, and different materials used. All demonstration objects and their operation were monitored. This accumulation of data allowed for important conclusions for further upscaling of sustainable sanitation in Kyrgyzstan. After the informational seminars, the partner organisations gave more into depth trainings, selected the beneficiaries. In the following, two examples are given:

ULGU had a rather broad approach where 161 women and men were trained on sustainable sanitation. Being a farmers' organization active in promoting organic agriculture, ULGU could build on an existing network. Consequently, two farmers of this network were selected because of their interest in UDDTs. During the toilet construction ULGU invited neighbours to watch and learn about the building process, and the results of urine application in 2 demonstration fields were presented to farmers, representatives of NGOs, local authorities and school children in the second year of the project. The organisation also decided to construct a UDDT for its own office as an example.

HABITAT took a rather different approach based on micro credits. Following the informational meetings, families were selected based on criteria such as their degree of motivation, active participation in village life, and availability of a garden to apply urine and faeces. Three families were individually trained on UDDT construction by HABITAT staff. Two members of the household (wife and husband) had to sign a contract which obliged them to make a design, an estimation of costs, purchase building materials and carry out the construction work together with HABITAT supervisors. In some cases the neighbours were involved in the construction process. The construction time was restricted to 2 months. Furthermore the contract stated that each family had to pay the purchased materials back in the form of an interest-free loan for 3 years. Every month the family has to return about 5 Euro back to the organisation. Initially, three toilets were built in 2007. The money paid back was used to construct two more UDDT in late 2008. The monitoring was undertaken by the partner organisations, and by members of the WECF secretariat. The main findings are summarised in this study.

Creating publicity and tools for up-scaling.

The project partners made the project results known to the Kyrgyz public. This was achieved by various ways. All partners were in constant contact with media (internet, newspapers), which covered project activities. Most important was the high-level conference "International Year of Sanitation and Ecological Safety in Kyrgyzstan. Challenges and New Opportunities of Increase in Sanitation Safety in Rural Areas", which was held in November 2008 in Bishkek under the auspices of the government of the Kyrgyz Republic. The conference was covered widely in Kyrgyz media. The 200 participants to the conference agreed on the "Bishkek Resolution on Ecological Safety", calling upon the governments and societies of the Central Asian states to realise the principles of sustainable sanitation (see annex 1).

The project also produced two publications: this case study and a handbook on sustainable sanitation, providing background information and practical instructions for construction of UDDTs and soil filters. A follow-up workshop was held directly after the conference at lake Issyk-Kul.

4 | Introducing Sustainable Sanitation – success factors and barriers

Wherever you are in the world, toilets are not a topic most people feel comfortable talking about –they are a sensitive issue.

Early in 2006, a WECF secretariat staff member visited Kyrgyzstan to find organisations interested in cooperating in this project. During his visit to ULGU, he was shown around the project villages – and he always went to see the toilets, taking photographs.

This bemused local villagers and raised questions: has he some infection? And why is he taking all these photographs? ULGU´s director reacted to the first presentation of the ecological sanitation principle with quite some scepticism: "My first thought was: this guy can't be serious!"

During the project implementation too, the partner organisations faced the same initial reactions. Yet, by late 2008, 16 toilets had been constructed, 4 more than had been planned; and one existing toilet had been adapted. Almost 90% of them are being used, and most people using them are satisfied. All partners note a big interest in the concept and many people who have seen the toilets function well also want to construct such a toilet for themselves. In this chapter, the process of acceptance will be analysed, and positive motivating factors as well as barriers identified. As described in chapter 3, different designs and approaches have been tried out. The purpose was to identify the best methods of implementation. Here adequate implementation is understood as to provide quality, satisfaction of use and acceptance among beneficiaries, thus providing good demonstration examples for long-term replication.

The process of acceptance is still ongoing – the tendency visible so far is positive.

4.1 The introduction of Sustainable Sanitation to communities: motivators, barriers and level of acceptance

"15 people took part in the meeting in Balykchi… It should be pointed out that during the first part of the meeting people reacted with scepticism; it was difficult to start discussing the thorny issue of toilets with them. But during the second part of the meeting they pointed out the importance of such activities, especially for the Issyk-Kul region, because they perceive a serious problem of pollution of the lake Issyk-Kul here. And as a result of the meeting, afterwards participants asked for the description of how to construct dry toilets."[17] This description is a typical example of the typical path of scepticism/ability to relate to local problems/interest/motivation which occurs when the concept of Ecological Sanitation is first introduced to communities. Through practical experience and interviews with toilet owners, the following motives and barriers for the decision to construct a Urine Diverting Dry Toilet could be discerned.

Motives for changing to UDDT

The top motivator without exception amongst 10 UDDT owners questioned was a practical and personal one: the bad state of their current toilet, mostly regarding the smell. Additionally, the cold in winter as well as draught coming frequently out of the pit were mentioned as major perceived shortcomings of the pit latrines. Environmental pollution was another, but secondary motivator. For women, ease of cleaning was a strong motivator, since this falls under their responsibilities. Some male farmers showed especially interest in the free fertilizer aspect. One partner organisation mentioned that privacy probably also plays a role since their current toilets consisted of reed walls that easily could be looked through from outside. In some cases status and the local traditions of hospitality also played a role. Some people receiving important guests wished for a better and more comfortable toilet to offer. In areas with a high groundwater table, the pit latrine has to be moved often because it is impossible to dig a deep pit, or the pit is filled with water which causes bad smells. People living in such areas were more interested to try UDDT than those in areas with deep groundwater tables.

Initial Barriers

The introduction of UDDT had to overcome one very fundamental barrier. People expressed interest, but at the same time could not really believe that UDDTs would function as promised. Flush toilets are seen as the "civilized" sanitation standard; and most people who currently use pit latrines wish to achieve this standard. Therefore, education and raising awareness was crucial; all partner NGOs indicated this to be one of the most important success factors of their project. The fear of bad smells proved to be another important barrier, and people remained sceptical abou smell prior to the construction of their new UDDT toilet. In all cases the toilets were built outside the house except one toilet attached to an office. When the toilet-owners were asked why they built the toilet outside, they cited risk of bad smells as the reason. They tried to find a balance between walking distance and risk of smell near the house. Nevertheless, the new UDDT was often built closer to the house then the old toilet, which shows a cautious trust in UDDT as likely to smell less than traditional latrines. Some respondents with a functioning UDDT answered in a second interview that they would be happy for the toilet to be inside the house now. The application of urine and faeces as fertilizer was also met with scepticism. People were especially reluctant to apply them to edible plants because of health and hygiene reasons. In some cases, women were reluctant because they would have to clean a UDDT toilet. Many pit latrines are never cleaned – the idea to have to clean a toilet at all proved to be very offputting for these women.

The role of acceptance and behaviour change in the process of changing sanitation systems

The decision to construct a UDDT also involved the willingness to invest time and money. The project provided only advice and guidance in the construction process and covered about 75% of the cost, in some cases less or even none at all. Not all toilets were really used even one year after they had been built. Changing from one sanitation system to another involves a change in behaviour. This is a long process. In one case, the owner decided it would actually be a pity to use this new nice toilet every day and dirty it, especially by children. Hence, it was kept like a front room or parlour, and only used on special occasions. The old pit latrine continued to be the toilet used most. It took the owners about a year to gradually switch to using the UDDT until finally, when the old pit latrine was full, they decided not to move it to a new place and completely switched to using the UDDT. As the following diagrams show, 57% of the 15 toilets were fully accepted by summer 2008, about one year after their construction, 73% fully and partly. These figures rose to 73% and 87% respectively, by late autumn 2008.

4.2 Designs & materials

Project partners had the task to try different designs and material in order to test their advantages and disadvantages. Consequently, the designs of UDDT constructed differed widely. Partners and households made their own designs. They were often very creative. Different materials were used: cement bricks, burnt bricks, adobe bricks, cane reed, and wood.

The project had planned for 12 demonstration toilets, but 16 were actually constructed, 14 of which are included in this analysis.[19]

Foundation

All toilets rest on a rectangular concrete foundation reaching about 3 to 10 cm above surface level; some reinforced by iron frames. The quality of cement available on markets varies, the cement-sand ratio therefore ranged from 1/3 to 1/6. The size of the foundation varies from 1.5-2.3m in length to 1.5-2.0m in width.

Faeces chambers

All faeces chambers are built from stone, concrete, or burnt bricks. One exception is a self-funded additional toilet, which was made from clay bricks. The double vault toilets use no additional containers for faeces collection – but some of the single vault toilets do.

The faeces chamber doors are between 0.5-0.7m x 0.5-0.7m in size. They are made from wood or metal. A problem that arose was that some doors were not hermetically sealed, allowing air in and causing ventilation and smell problems.

Ventilation

A functioning ventilation system is essential for smell prevention. The ventilation pipes were mostly plastic (PVC or PP) 50mm pipes. This was not wide enough in many cases and had to be changed to 100 mm pipes. It improves ventilation to paint pipes black: the pipe heats up during sunshine and thus stimulates the ventilation flow. Ventilation pipes were either installed inside the toilet superstructure or attached to its outside wall – both seem to function equally well. A common problem was a 90-degree angle in the pipe, which hinders the airflow. It turned out that 45 degrees is a better variant. It is easier to avoid angles if the pipe is installed inside

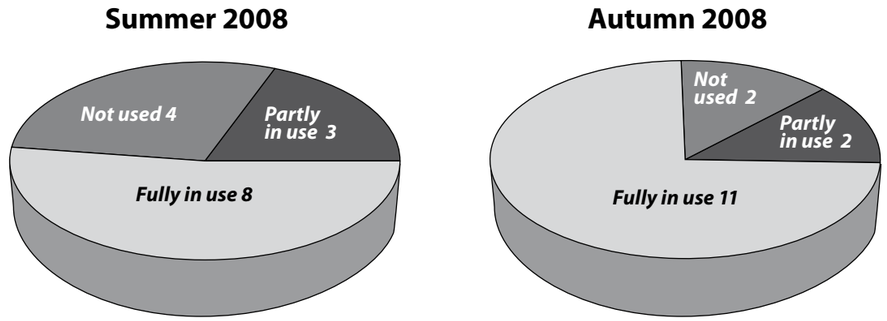


Figure 3: UDDT acceptance.[18]

17 *Citation from Project progress report of BIOM, 1 July 2007*

18 *The categories are defined as such:* **Fully in use**: *all family members use the toilet throughout the whole year.* **Partly in use:** *not all family members use the toilet, and / or it is not used throughout the whole year.* **Not used:** *the toilet is not used at all*

19 *The two toilets not included were constructed additionally towards the end of the project duration.*

inside the superstructure. Another common problem with pipes attached to the outside wall was that pipes did not go through the roof, blocking the ventilation flow. In a few cases the pipes were not covered, which can result in smell because of rain leaking into the faeces chamber.

Superstructure and roof

Five of the 14 UDDT superstructures were constructed from wood (35%), 9 from bricks (64%) and one from reed.

About half of the people used zinc-coated metal for the roof of the toilet; the other half used sheets consisting of cement and asbestos (known as *shifr*). The use of asbestos was strongly discouraged by WECF, but difficult to control. People in Kyrgyzstan as a rule are not aware of the dangers of asbestos.

Urine-diverting toilet seat

In most cases UD-toilet slabs (for squatting) were imported from China. These slabs are easy to install, clean and have a nice appearance, which makes them attractive for many people. However, the big disadvantage is that these slabs have to be imported. Importing is not easy, which is a barrier to replication.

Therefore slabs and seats were also constructed from locally available materials. In one toilet two buckets were installed: one where the bottom was cut out for the faeces and one with a little hole for urine collection. The urine bucket did not function well because urine did not flow properly away, causing smell. The bucket was replaced by a funnel, which worked better.

Another solution was a slab made of zinc coated metal sheet. This solution works well. In the long term, corrosion might become a problem.

Urinals were either bought on the market (ceramic) or cut out of plastic canisters/bottles. Both solutions work well as long as the urine inlet is small and all urine flows away. In case of ceramic urinals this means that most of the holes designed to let the water/urine flow away when flushing have to be sealed, otherwise too much urine escapes.

Toilet room

From inside, the toilet room was in some cases left very simply, but decorated nicely with tiles in other cases. All toilets contain a bucket with the cover material. About half of the people used sawdust and the other half ashes sometimes mixed with black soil. Most families have ovens (*tandyr*) where they bake bread regularly. Ashes are thus available. In most households, women's sanitary articles and in some cases toilet paper was collected separately.

Retro-fitted pit latrine

A minimalist, yet very practical solution was demonstrated in the case of one villager, who once he understood the principle of source separating systems, transformed his pit latrine into a UDDT. He cut a 5 l plastic bottle and placed it in front of the toilet seat for urine diversion above the pit. A pipe leads the urine to a canister while the faeces are still collected in the pit. In total he spent 20 euro for this. Such an adapted toilet can be considered as ecological sanitation if urine and faeces are being sanitized and reused, and the ground water level is deep enough and no water enters in the pit so that the faeces are not contaminating the groundwater. This is the case with the given toilet. But even if these criteria are not met, it is already a big improvement compared to the normal pit latrine.

4.3 Costs

The average cost of the outdoor household UDDT constructed in the context of the project is 368 euro with a standard deviation of ± 120 euro. The cheapest toilets cost 203 EUR, the most expensive 590 EUR. For this calculation, only material costs count, as owners had to construct themselves, or hire labour themselves. Excluded from the calculation are two semi-public toilets, one of which was constructed at the office of the NGO ULGU in Kerben (1800 EUR material cost), the other at a tourist camp (600 EUR material cost).

The differences in costs depend mostly on the design. The choice of materials and the type of the toilet have only limited influence on the overall costs, as can be seen from ***table 1***. It could be expected that single vault UDDT would be less expensive than double vault UDDT because only one vault needs to be constructed. But the average cost difference between the two types is small, the standard deviation in both cases high. This finding is supported by data from other WECF sanitation projects.

Type	Average (Euro)	St. Deviation (Euro)
Single vault (3)	355,-	138,-
Double vault (9)	372,-	123,-

Table 1: average cost of different toilet types.

Table 2 shows a slight indication that wooden toilets are cheaper then brick toilets. Again, the standard deviation is quite high. Especially wood is not equally available in different parts of Kyrgyzstan.

Material	Average (Euro)	St. Deviation (Euro)
Wood (5)	333,-	167,-
Bricks (9)	386,-	136,-

Table 2 average cost of toilet according to superstructure materials.

Prices for wood thus differ considerably.

Also the relation between the size (L x W) and the costs has been assessed for 8 UDDTs. However just a minor correlation has been found (R^2=0,01).

4.4 Reuse of nutrients

Sanitization

Correct sanitization of the faeces (and in some cases urine) and the reuse of the nutrients are integral parts of sustainable sanitation. All partners taught the new UDDT owners about the WHO "Guidelines on safe use of Wastewater, Excreta, and Greywater" and the owners decided to sanitize the faeces for at least two years. Hence, faeces were – with one exception – not yet applied as fertilizer. The urine of household toilets needed no further sanitization and could be applied right away.

The urine collected in the two public toilets (at the office and the tourist camp) was applied to the vegetation in the vicinity or to fruit trees. This chapter will deal with the experiences made with applying urine in the households participating in the project.

Sample	E. Coli	Streptococcus faecalis	Total coliform	Pathogens	Helminthes
Faeces 1	$5x10^8$	$4x10^5$	not analyzed	none	none
Faeces 2	$3x10^3$	$<1x10^1$	not analyzed	none	none
Urine	$<1x10^1$	$<1x10^1$	$8x10^2$	not analyzed	not analyzed

Table 3: Analyses of faeces and urine on pathogenic bacteria, nr. of bacteria per 1,0 gram, CGSEN Bishkek, July 2008.

	TOC mg/l	TC mg/l	TN mg/l	NH4-N mg/l	TP mg/l	pH	Electrical conductivity mS/cm
Sample 1	2360	5640	6820	5350	401	9,10	43,0
Sample 2	1960	5110	7520	6390	330	9,22	44,2

Table 4: Nutrient content of urine.

In the framework of the project it had been planned to analyze urine and faeces on pathogenic bacteria. This turned out to be very difficult, as most laboratories could not – or refused to – conduct the necessary analyses. Thus, only a limited number of analyses were possible: ***table 3*** shows the result of the analyses of faeces from chambers in use (faeces 1, faeces 2) and of urine from a household toilet (fresh). The faeces analyses provide a starting point for analyses documenting the sanitization process during and after the sanitization period.[20] The urine analysis confirmed its safety for use as fertilizer.

Fertilizing effects

The effectiveness of human urine and faeces as fertilizer has been well proven in many projects. They have basically the same effects and can be applied the same way as animal manure.[21] Urine from two toilets was analyzed on its nutrient content in summer 2008 ***(see table 4)***. The results are in the range of what is normal worldwide; the Nitrate content is relatively high, the Phosphorus content relatively low.[22]

Tests with applying urine as fertilizer and documenting the effects were thus conducted in the framework of the project in order to produce clear and visible demonstrations of the fertilizing effect and not to scientifically explore this effect further. The following table shows the results of a fertilizing experiment that was conducted in 2007. The urine was obtained from a kindergarten. The control fields were directly next to the experimental fields, and were treated exactly the same way, but not fertilized at all.

Many respondents among the interviewed owners pointed out higher harvests after urine application, without measuring exactly their harvests or keeping defined control fields. In the context of this project, it was important and sufficient that people convinced themselves of the positive effect, since it is one of the motivations for using ecological sanitation. ***Table 5*** shows the results of experiments with urine as fertilizer.

Conditions	Results
- 50m² maize - urine dilution: 1:2 - application: once per month, Mai – July	30 % more harvest weight in comparison to the control field. The plants grew about 45-50 cm higher than in the control field.
- 50m² lucerne - urine dilution: 1:2 - application: one-time, April	25 % more harvest weight in comparison to the control field. The plants grew about 5-10 cm higher than in the control field.
- 20 trees of young poplar - urine dilution: 1:2 - application: once per month, March – October	Gain in height on average 20-30 cm more than control trees. Leaves of experimental trees have dried 10-15 days later than control trees.

Table 5: experiments with using urine as fertilizer, Public Association ULGU, 2007.

20 *According to the WHO guidelines <1x10³ E.coli per gram total solids of faeces is acceptable for agricultural use. Guidelines for the safe use of Wastewater, excreta and greywater, Volume 4: Excreta and greywateruse in agriculture, WHO 2006, p. 63*

21 *See e.g. Moussa Bonzi, Experiences and opportunities for Human Excreta Fertilizers in improving small scale Agriculture, paper given at Stockholm World Water Week, 17 August 2008, available at: http://www.ecosanres.org/pdf_files/www2008/Dr_Bonzi_14.pdf; Guidelines on the Use of Urine and Faeces in Crop Production, Ecosanres Factsheet 6, available at: http://www.ecosanres.org/factsheets.htm.*

22 *Cf. fn. 21 for data for comparison.*

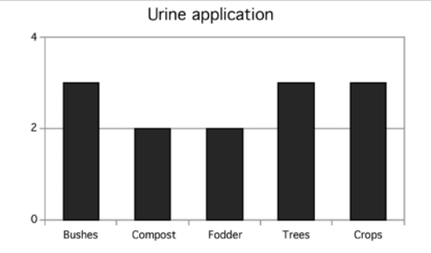


Figure 4: Application of urine.

Trust in safe application

Handling urine and faeces, and applying them to plants that will be eaten proved to be an idea most people met with much scepticism. The owners of the 13 toilets in use were interviewed about how they deal with the urine and faeces in practice. The results are summed up in ***figure 4***. The table does not include application of urine to several categories of plants, but only the category most of the urine is applied to.

Most toilet owners decided not to apply urine to plants directly intended for human consumption with a short "psychological distance" between the fertilizer and the crop. This was done only in 3 of 13 cases with application on crops growing close to the ground like cucumber, tomato, cabbage, watermelon, and potatoes. The "psychological distance" is short, since the crop/fruit in these cases is close to, or even in, the ground. Seven owners applied the urine as fertilizer to plants not directly intended for human consumption, or with a big "psychological distance", such as fruit trees (the fruit are higher up on the branches when compared to e.g. cabbage) or compost (where there is a bigger distance in time and the additional composting process between applying fertilizer and application to a plant). Only in 3 cases the urine was not used as a fertilizer, but simply discharged to the environment nearby the toilet (in most cases bushes) without the intention to have better crop production. These include the two toilets of public character.

Asking why they do not apply urine on their crops, respondents referred to the idea of eating vegetables and fruits fertilized by urine being unpleasant. They also cited hygienic aspects, displaying distrust in the safeness of application even according to sanitization guidelines. As one toilet-owner said: "If my guests know that the tomatoes are fertilized with urine, they will not eat them". Not surprisingly, farmer orientated households (who sell agricultural products to the markets) were applying the urine more effectively: during the development phase of the plant and crops with a high nitrogen demand. Also nitrogen enrichment of compost by urine application seems to require some specific agricultural knowledge – this was practiced only by farmer-orientated households. In one village, the toilet owner indicated to have no need for fertilizers because cow manure was available in abundance.

Only one farmer had already used the faeces of his single vault UDDT. After composting he spread them around his fruit trees. When asked about the prospect of applying sanitized faeces, many respondents admitted they were reticent because of hygiene aspects. Some planned to put the faeces on a heap covered with soil after the two years sanitizing time for further composting. Others explained they would incorporate it in the soil but on safe places like for trees or flowers. Only three persons, who are familiar with composting, wanted to compost the faeces together with other organic matter and apply it in their gardens on edible plants.

4.5 Factors of success and barriers

In this section factors that were identified as being decisive for the acceptance of the Urine Diverting Dry Toilets are discussed. We have seen that some toilets were well accepted and fully used, some partly, and some not at all. 6 Indicators were chosen to analyse the reasons for acceptance or non-acceptance of Ecological Sanitation. These indicators are listed below. Each indicator can assume a value which is positive or negative for acceptance. The negative value is listed in the column to the right (see table 5).

	Indicator	Negative value
1	Proper smell prevention	No
2	Who constructed the toilet	External constructors
3	Who was trained	Only husband or only wife
4	Nr. of vaults	Single vault
5	Financial contribution of UDDT owner	Low financial contribution
6	Deep or high groundwater table	High groundwater table

Table 5: Indicators of reasons for toilet acceptance and their negative values.

All of these negative values held true for two of the four toilets not being used in summer 2008, and some of them for the other two not being used ***(see table 6)***. All four toilet owners and their families had been given support and it had been discussed with them intensely how to solve the problems. But those two owners for whom all 6 factors held true decided not to start using the UDDT by autumn 2008. See annex 2 for an overview of the indicators for all toilets.

Toilet not in use, Summer 2008	1. No proper smell prevention	2. External constructor	3. Only husband or only wife trained	4. Single vault	5. Low financial contribution	6. High groundwater table	Total negative indicators	Toilet being used in autumn 2008
UDDT 1	X	X	X	X	X	X	6	
UDDT 2	X	X	X	X	X	X	6	
UDDT 3		X		X		X	3	X
UDDT 4	X	X	X				3	X

Table 6: Indicator values for the four toilets not accepted.

The 6 indicators and some additional aspects will be discussed below. Most of these indicators have to do with two main aspects: training and support from project staff (indicators 1-4), and with involvement and feeling of ownership on the side of the toilet owners (indicators 3-5). A third aspect are external conditions like the groundwater table (indicator 6). All these three aspects are key to successful UDDT implementation.

It is noteworthy that of all these indicators, the best full acceptance level (100%) was reached when the toilets were built by the owners themselves, and the lowest (20%) when they were built by hired constructors.

Indicators for reasons of UDDT – acceptance, non-acceptance and actual use

Smell prevention

A crucial factor in user satisfaction is the absence of smell. In most cases of toilets not being used, smell played the major role in keeping owners loyal to their old pit latrine.

From a construction point of view, proper smell prevention is provided for UDDTs via: 1) correct diameter of ventilation pipes >100mm, 2) proper slope in urine pipes, 3) water-resistant cover on the floor. The following criteria have to be fulfilled by the user: 4) proper separation, 5) usage of cover material, and 6) regular cleaning.

Seven out of the fifteen UDDTs fulfilled all requirements in autumn 2008. It has to be noted that only a few toilets not meeting all smell prevention criteria actually caused bad smells.

In many cases, toilets faced initial problems with smell that could be solved easily by improving the construction. The major technical problems creating smell proved to occur with ventilation, urine pipes, and self-made Urine Diverting seats or slabs (see also chapter 4.2).

When these technical problems were not solved, the risk of the toilet not being used was high. Consequently, in one case the old toilet continued to be used just because of a simple technical mistake: the urine pipe did not slope continuously downwards.

The toilets with a superstructure made of wood often also have a wooden floor. Here the risk is that urine might easily penetrate the wood and cause a smell. The problem can also occur with cement floors. Therefore the floor has to be covered well with water-resistant paint or linoleum on the floor. However, two respondents indicated linoleum would become very slippery in the winter, which is why they decided not to cover the floor.

Improper use also proved to be a cause of smell leading to the toilet not being used. In three cases the owners did not use any cover materials for the faeces, causing smell. In two cases this was accepted by the (male) household members, but in one case this smell was the reason why the toilet was not used at all. After this problem was identified and the owners switched to proper covering, the smell problem was solved and the toilets fully accepted.

All these cases show that one-time instruction, information, and training on construction and use of the toilets is not enough to ensure good functioning and acceptance. In all cases, toilet owners needed additional information and support to be able to cope with initial problems and change their sanitation systems and behaviour.

Involvement in construction

Five out of the 15 UDDTs were built by hired constructors. wAll other UDDT were built by the men of the household who were often supported by NGO-staff and or neighbours. Those who constructed the toilets themselves explained in the interviews that they did not perceive the construction as difficult. The whole construction period often covered several months in these cases because they only could work in their spare time. All of these toilets are fully in use.

Of the 5 toilets built by hired constructors, only one is fully used, while two are not used at all. What had happened was that the hired constructors were not trained properly enough and therefore the constructions showed deficiencies leading to e.g. smell problems. Also, the owners had become less familiar with ecological sanitation. They did not show the same interest in solving technical problems like those who had constructed themselves.

While it would be wrong to conclude that household UDDT should not be built by hired constructors, this indicator clearly shows the importance of proper information and training, as well as personal commitment.

Who has been trained: the gender aspect

For 10 of the 15 toilets, either only the husband or both husband and wife had been trained and informed directly by the responsible organization. All these 10 toilets were fully or partly in use. In 4 cases, only the housewife had been trained – 2 of these toilets are among those not used at all. It seems that often the person who decided to build the toilet did also participate in the trainings.

In general it can be said that women focused more on hygiene aspects of the toilet while men paid more attention to technical aspects, and in some cases were especially focused on the reuse of nutrients. With the toilets fully in use and functioning properly, as a rule, men construct the toilets and / or repair them, while women clean them and make sure the family (e.g. children) uses it properly. Application of urine is done both by men and women, depending on the family. Owners indicated it would be the men who would have to deal with the faeces.

In many cases of poorly maintained toilets, the men of the family had taken the decision to build and constructed the toilet without involving their wives. In both cases of toilets not used by autumn 2008, the wives had not involved their husbands. They explained the toilets had technical defects that could only be repaired by their husbands. However, the men in households were sceptical about the toilet and not willing to invest time and money in fixing the technical problems, which they also did not understand well. Instead, they planned to turn the building into a shower. One husband was angry because the toilet was funded entirely by the family. "We could have built 8 pit latrines from the money", he said.

These cases indicate that proper involvement of both men and women in the decision making, as well as in training and information is another crucial factor. Furthermore it can be considered to conduct target-orientated trainings where women are trained on maintenance and operation and men in construction of UDDT toilets.

Single and double vault

Two different types of UDDT have been tried out in the project: single vault (5 toilets) and double vault types (10 toilets).

The evaluation shows clearly the better partial or full acceptance of the double vault toilets (100%) in comparison to the single vault toilets (60%).

Closer analysis of the problem with the single vault UDDT not being used revealed that problems in design and misunderstandings how to use were the reason.

Both of the problematic single vault toilets did not have a proper container to collect the faeces. In one case, the faeces chamber door was too small and did not allow for placing a sufficiently sized container in the chamber. The interviews made clear that the principle of UDDT was not understood by the toilet owner. She thought that the faeces had to be removed out of the chamber every time after defecating. The owner of the other toilet not in use was disappointed because all the other villagers had two chamber toilets. Nobody in the household wanted to empty the faeces container on to the compost heap and she refused to do it herself.

The owners of single vault toilets in use likewise often mentioned carrying the faeces as a disadvantage.

Single vault toilets need extra attention to ensure a proper use and a working technical design. In the two cases cited above, not enough attention had been paid to these aspects.

In the case of the three functioning single vault toilets, this attention had been paid: In one case a farmer built a compost site next to the toilet and does not perceive it as a problem to empty the faeces container to it every three months. In another single vault toilet the container was placed on rails and can thus easily be removed. The single vault toilet in the tourist camp is used only in summer. During winter and spring the faeces dry in the chambers, from which they are removed to a compost site with shovels when the camp opens again. They are no longer fresh and less unpleasant to handle.

Possible further solutions include: using two or more containers and extra space in the faeces chamber to let the faeces dry in the container before they are removed. The use of two or more containers prevents the necessity to handle fresh faeces.

Financial contribution

In all cases beneficiaries had a contribution to their UDDT ranging from 9-52% of the cost. In the cases where micro-credit was provided, beneficiaries reached a 100% contribution. Two toilets were constructed in addition by interested people without any financial support from the project funds. It should be expected that the purely owner-funded toilets would be better accepted, due to the implied high levels of motivation. The chances for acceptance are indeed higher if the cost share of the owner is above 50%. But the distribution of costs between project funds and the owners has no automatic link to acceptance – 2 cases of initial non-acceptance were found among toilets funded completely by their owners. But in both cases the family switched to using the toilets after technical problems were solved.

Groundwater level

The groundwater level is considered to be high if it is less than 2 meters from the surface. At this height it can interfere with the pit latrine, causing a lot of smell. A high groundwater level also means that the pit latrine has to be moved often, because it is impossible to dig a deep pit. In some areas, where the groundwater level is only about 50 cm below the ground surface in the irrigation season, this means moving the pit latrine every 3 months.

As has already been shown, such conditions prompted a higher interest in constructing a UDDT. It is in line with these results that UDDT in areas with high groundwater levels faced no acceptance problems. All toilets which were or still are not being used are in areas with low groundwater levels.

Further issues

Freezing in winter

Kyrgyzstan has long cold winters with temperatures well below 10°C. This can lead to freezing of urine, which under certain conditions can lead to owners not using the UDDT for this time. Freezing of faeces does not pose any problems. One farmer did not use his toilet during winter because of the risk that the urine might freeze and the canister will break. He indicated to be not well prepared for it. The local NGO gave him some consultation and now he knows how to prevent freezing. His urine collection device is dug into the ground and surrounded by clothes and styrofoam. Others resorted to collecting urine in a conical bucket, from which the frozen urine could easily be removed, or to simply letting the urine freeze on the ground next to the toilet and then removed it with shovels. But these are only provisional solutions.

Still others used several canisters and simply stored the canisters filled with frozen urine until it became warm again. This method was applied by owners experienced with fertilizing. They pointed out they wanted to keep the urine as fertilizer to apply effectively during the development stage of the crops.

Probably the best solution to the freezing problem is to keep urine in tanks big enough to collect the urine of several months. The urine can then be removed with a pump.

4.6 Soil filters

Two constructed wetlands were built within the context of the project for demonstration purposes, one in Ivanovka village, Chui province, and one in Jetygen, Aksy raion, Jalalabat province.

The constructed wetland in Jetygen was built in Autumn 2008. It is designed for greywater from kitchen and bathroom. The filter has worked well during winter – in spite of the cold temperatures water did not freeze. No analyses of the effluent have been made to date – the effectiveness of the filter is so far demonstrated only by the visible reduction of turbidity (see photo of Greywater treatment in Jetygen, opposite page). The constructed wetland in Ivanovka was designed for greywater including shower and kitchen wastewater from a household of 7 persons. The construction ended in May 2008 and took 10 days. Unfortunately the kitchen and shower were still under construction at the time this report was written and due to that there is no data available yet regarding the performance

Soil Filters

Ecological treatment of greywater

Training and discussion on greywater treatment, Lake Issyk Kul, November 2008.

How does a constructed wetland work?
Training, Lake Issyk Kul, November 2008.

Constructed wetland in Ivanovka, Summer 2008.

Sedimentation tanks of Ivanovka constructed wetland.

Greywater treatment in Jetygen (from right to left): influent, after pre-treatment, effluent.

Constructed wetland in Jetygen. The filter never froze even at outside temperatures of -20°C.

Constructed wetland in Ivanovka. The fence keeps dogs away. November 2008.

"Sustainable Sanitation: our standard! How can we reach this?" Participants to the follow-up workshop, Issyk-Kul, November 2008

Farmer Risali shows his corn field fertilized with urine. After the succesful experiment, he constructed a UDDT at his house.

Merniz Niyazaliev (right) supports his neighbours in constructing new UDDTs.

"In the evenings, I like to sit on the stairs of our new toilet and relax." Bishkek, Summer 2008.

"Rural people support Ecological Sanitation!" Banner of PA ULGU at the Conference "International Year of Sanitation and Ecological Safety in Kyrgyzstan", Bishkek, November 2008.

Kyrgyzstan's deputy minister of Health, Sabirjan Abdykerimov (second from left) being interviewed by state television during the Conference "International Year of Sanitation and Ecological Safety in Kyrgyzstan", Bishkek, November 2008.

of the constructed wetland. During the construction process it was discovered that the needed material (gravel of different size, washed sand, watertight cement and foil for sealing) was not easy to find in the area and construction was not as easy as expected.

In both cases during and after the construction the interest in the soil filter was high. People liked the idea of having such an easy system to treat their wastewater. Given the scarcity of water in many regions of Kyrgyzstan, the possibility to have treated water available for watering plants was often mentioned as a reason for the interest. Also, it is not such a sensitive topic as toilets.

The total cost for each of the constructed wetlands was about 1100 Euros including labour, material and construction costs. The design costs are not included in this amount. Designing bigger systems requires better knowledge of soil filters.

The costs and the area needed for a constructed wetland were mentioned by interested people as barriers to constructing such a system for themselves. One possible solution would be the connection of several households to one constructed wetland as treatment plant, which would be more cost effective. But the construction of such a system is not an easy task and should be made only by people who have in-depth knowledge of such a system. Simplified filters are a low-cost option for individual households.

An analysis of the costs of the constructed wetland in Ivanovka shows that the highest cost is the construction of the sedimentation tank (see Figure 5). The sedimentation tank is made from watertight concrete and is a crucial step for the treatment system. By trying out different tank systems like from polyethylene or EMAS technology low cost concrete tanks, the cost may be reduced for this part.[23] Quite a lot of labour was needed especially for excavation of the soil, since in this case the slope was not enough and the aim was to avoid having to use a pump. By choosing households and areas with a favourable slope direction and also using a different tank system, the excavation and consequently the need for labour can be reduced. For smaller systems sand and gravel with different properties could be tried out. Also the amount bought was more than needed since the gravel and sand can be bought only as truckloads. This can be avoided by building more constructed wetlands in the same area. As a last note it should be mentioned that the cost of the first pilot system cannot be taken as a cost basis since it will be much cheaper to build more systems in one area.

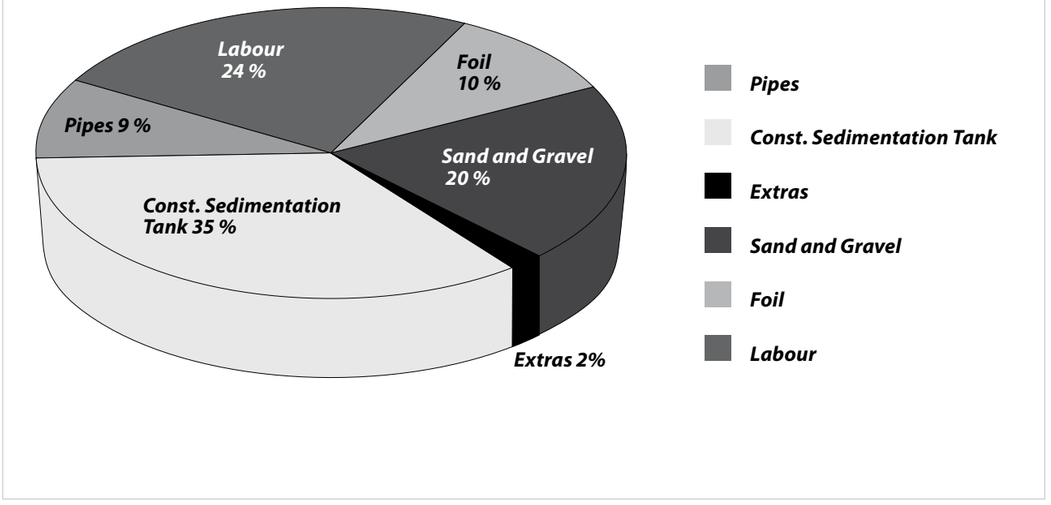


Figure 5: The construction cost of one soil filter divided into different categories: Total cost was 1100 Euros.

23 See http://www.emas-international.de

5 | Conclusions, lessons learned and follow-up

Kyrgyzstan's rural areas face a clear sanitation problem: the predominant pit latrines (97% of all households) and absence of wastewater treatment are a major source of diseases and waste of precious water and nutrient resources.

The project "A sustainable decentralized wastewater management for Kyrgyzstan" has shown that sustainable sanitation is an applicable solution to this sanitation problem. The simple technologies tested and demonstrated pose a challenge to predominant sanitation habits, a challenge, however, that can successfully be met. Ecological sanitation technologies are more cost-effective than constructing centralized systems with flush toilets and treatment plants.[24] Advantages over the conventional systems are also that UDDT function independently of the water supply, allow for a better safety control and reuse nutrients safely. The technology is easy enough to be replicated by people themselves if they receive proper training.

The project has shown that UDDTs have good chances to be accepted by the population. This study shows that a successful implementation of Ecosan technologies should not only build on good quality of technical construction but also on adequate knowledge transfer and participation of interested persons, confirming the findings of other recent research on development work. Introduction of UDDT on a wider scale has to pay attention to the following three aspects in order to be successful:

- training and support of the users by experts
- involvement and feeling of ownership on the side of the toilet owners
- external conditions

Put into practice, this means it is recommended that a programme for wide-scale introduction adheres to the following:

1. Proper smell prevention and construction, operation and maintenance principles have to be well understood and applied. Men and women have to be trained taking into account gender specific roles (e.g. construction by men, cleaning by women). Expert support has to be available for the households if they cannot solve occurring problems themselves. This support should best be offered proactively, and regular monitoring should be carried out. The necessary expert knowledge should be built up locally by strengthening the capacity of communities. Good demonstration units should be provided locally; preferably by the experts themselves.

2. The decision to construct a UDDT for the household should be taken by wife and husband together. Households should significantly contribute both with labour and materially. Given the economic situation a system for financial support is needed. The approach of the Habitat Foundation shows micro-credit and revolving funds are a practicable option for this support. They can be offered by community-based organisations offering also expert support. Contracts between owners, experts, and structures providing financial support could be an important part of a regulatory framework.

3. The chances for UDDT to be accepted are significantly higher in areas with a high groundwater table. They are also high with farmer-oriented households facing a shortage of fertilizer.

4. Greywater treatment from kitchen, bath and laundry needs to be addressed if UDDT are implemented. Constructed wetlands are an option for several households together – their implementation needs the involvement of professional experts. Simplified filters can provide an affordable and low-tech solution for single households.

24 Rosemarin A, Ekane N, Caldwell I, Kvarnstrom E, McConville J, Ruben C, Fogde M. (2008). Pathways for Sustainable Sanitation: Achieving the Millennium Development Goals. Stockholm Environment Institute, p. 48, available at: http://www.ecosanres.org/pdf_files/MDGRep/SustMDG31Auglowres.pdf

Annex 1– The Bishkek Resolution on Sanitation and Ecological Safety in Kyrgyzstan

CONFERENCE RESOLUTION

INTERNATIONAL YEAR OF SANITATION AND ECOLOGICAL SAFETY IN KYRGYZSTAN
Challenges and New Opportunities of Increase in Sanitation Safety in Rural Areas

We, the participants of this international conference, are representatives of state and international organizations, civil society and business sector of Central Asia and Europe. Supporting the United Nations' initiative of proclaiming 2008 the Year of Sanitation, we exchanged ideas on solutions of the safe water, population health and sustainable sanitation problems. We also discussed the possible actions in promoting the ideas that could mobilize the society and enable the policy-making to progress to improved sanitary conditions.

We, the conference participants,

- express our concern about the rural population's insufficient access to clean drinking water and sanitation, which results in high levels of contagious and parasitic diseases.
- note that the current projects on sanitation and water safety in Kyrgyzstan are disintegrated; the information exchange is poor; the projects lack consistency, coordination and cooperation.
- state that Kyrgyzstan's ecological safety – comprising safe water, human health and sustainable sanitation – is an important strategic aspect of the country's sustainable development; it is directly connected to the quality of life of both present and future generations.
- highlight that the current programs, as well as the legislative and financial practices, do not succeed in protecting well human health, water resources and environment, while the present waste-water treatment technologies are, as a rule, ineffective and expensive.
- affirm that an adequate state policy must ensure all people's access to a decent standard of living, safe water and good sanitary conditions, as well as sustainable sanitation and clean water in all schools.

Unanimously, we agree that sustainable sanitation is based on the following principles[1]:

- human dignity, quality of life, and ecological safety on the level of both households and society should be at the heart of any approach to solve problems of sanitation;
- gender equality should be observed in any decision making as well as participation of all involved parties should be guaranteed;
- human waste, such as feces and urine, should be considered as resources in the circle of nutrients;
- specific technological solutions of sanitation problems (latrines, waste water collection and treatment) should be designed to the minimum practicable size (e.g. household, neighborhood)
- ecological sanitation technologies[2] as an alternative solution to the treatment of biological/organic waste and its utilization should be applied according to the international practices of mandatory sanitization and safe reuse of nutrients.

1 The sustainable sanitation principles are based on the Bellagio principles (WSSCC and Sandec, 2000) formulated at the meeting of the sanitation and hygiene specialists in Bellagio, Italy, on February 1-4, 2000. It was held under the aegis of the Federal Institute of Natural Sciences and Technologies, Switzerland (EAWAG/SANDEC).
2 sustainable, or Ecological, sanitation technologies in this document are defined as technologies preventing the penetration of untreated human waste into the environment, sanitizing human waste and safely reusing the nutrients human waste contains.

To achieve the Millennium Development Goals, the international conference participants call on the government of the Kyrgyz Republic to include the WHO recommendations on safe reuse of human waste and water in agriculture into the state legislation.

The sanitary facilities should ensure sanitization and storage of solid organic substances, as well as prevention of these substances' penetrating into the environment. Pit latrines and unsealed septic tanks cannot prevent this penetration.

To preserve common transboundary water resources, we appeal to the governments of Kyrgyzstan and other countries of Central Asia to

- join the International Protocol on Water and Health.
- develop innovative technologies in sustainable sanitation and water safety, applying positive experiences of other countries.
- preserve natural ecosystems, thereby improving recreational zones and attracting bigger investments.
- create and implement sustainable sanitation ideas into educational programs.
- build international cooperation and engage international organizations and foundations in solving problems of water supply and sustainable sanitation.
- establish a Coordination Council on Water and Sanitation to include all stakeholders from governmental organizations and civil society.

We apply to Kyrgyzstan's business sector to build a broad market of sustainable sanitation technologies, making it broadly available and affordable.

The participants appeal to the Global Sanitation Fund and the Water Supply and Sanitation Collaborative Council to turn their attention to the problems of Kyrgyzstan and other countries of Central Asia.

We call upon the International Donor Organizations to support sustainable sanitation programs.

The conference participants and public organizations share the conference ideas and commit to

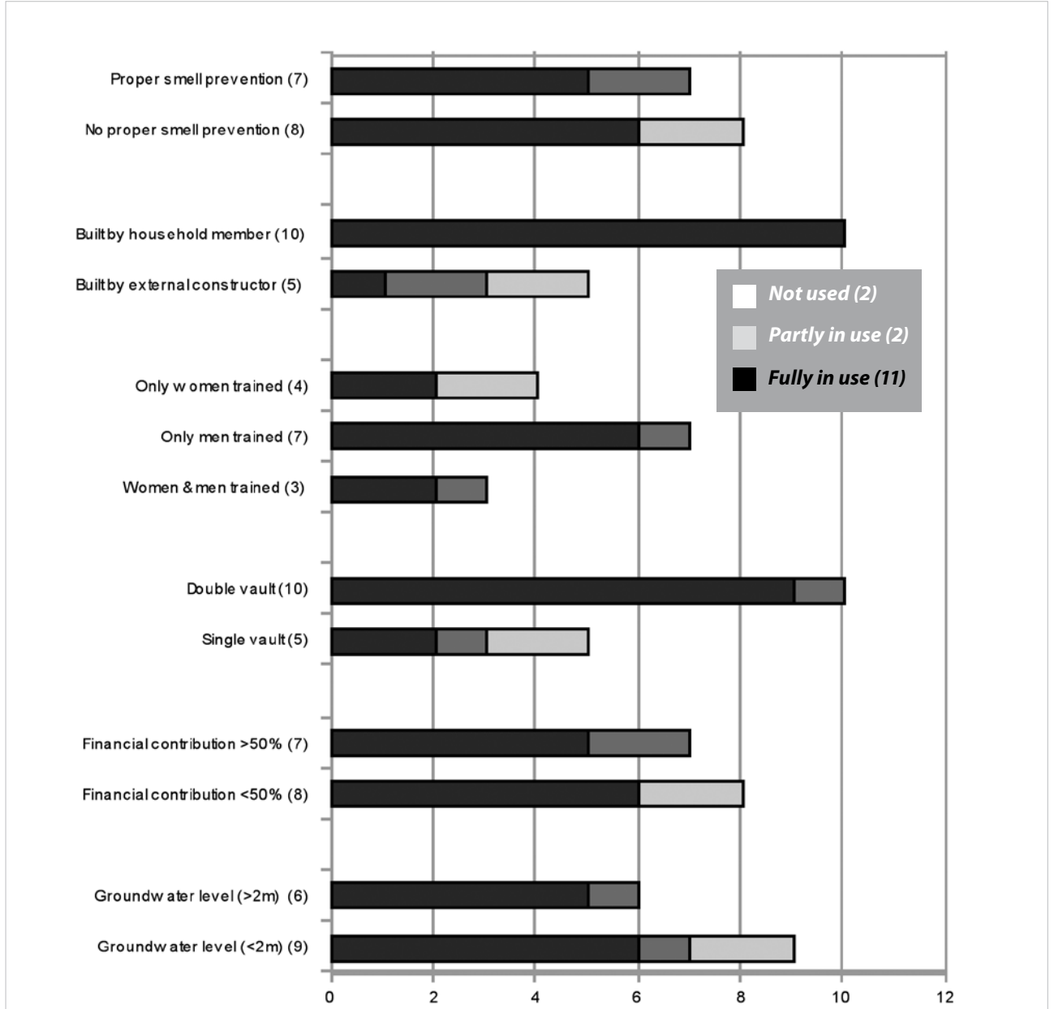
- promote ideas and implement projects on public hygiene and sustainable sanitation in their countries.
- engage experts to monitor and assess the impact of implemented projects.
- conduct educational and informational campaigns on ecological safety, health problems and sustainable sanitation among diverse groups of people.
- cooperate with business sector to promote ecological sanitation technologies.
- support fully the governments in promoting and implementing international conventions at the national level.
- participate actively in the development of sustainable sanitation methodology and techniques.

We appeal to the civil society, educational institutions and governments of Central Asia to educate the population and conduct a broad information campaign on the direct interrelation of water, health, sanitation and ecological safety in the region.

Bishkek, November 11-12, 2008

Annex 2 – Indicators for reasons of UDDT acceptance

(including retro-fitted pit latrine), and degree of use, autumn 2008.



Annex 3 – Questionnaire used during and after toilet construction for interviews with toilet owners

Acceptance and use
Why did you decide to construct a UDDT?
Why did you choose this location?
Which problems do you face during usage?
How did you solve the problems?
Are there family members not using the toilet? If not, what is the reason for not using it?
Is the toilet used the whole year long? If not, what is the reason?
Did you receive enough information about the reuse of the nutrients?
In your opinion, what are the main advantages of UDDTs?
In your opinion, what are the main disadvantages of UDDTs?
How do you deal with guests?
What is the guests' opinion about UDDT?
Capacity building and support
What are the main advantages of an UD toilet?
What are the main disadvantages of an UD toilet?
Trainings received by owner/ builder and men/wife? How many days?
Who did participate in trainings: owner/ builder and men/wife? How many days of trainings?
Did you receive enough information about the construction of the new toilet?
Did you receive enough information about the usage and maintenance of the new toilet?
How often did the supporting NGO visit you during construction? Did you receive enough support?
How often did the supporting NGO visit you after construction? Which time intervals?
Sanitizing and reuse
How do you treat the faeces?
Frequency of emptying the faeces chamber?
How do you sanitise faeces (by storage, by composting, for which time)?
How do you collect the urine?
Frequency of emptying the urine canister?
How do you transport the urine?
Do you have problems with the collection /transportation of the urine?
Where do you apply the urine?
Which kind of plants/crops/fruits do you apply it to?
How many litres are applied usually?
Details about application: size of field, dilution?
Which effects of using urine as fertilizer do you perceive?
Do you sell agricultural products to the market?
How do you perceive the quality of the soil of your plot?
Do your neighbors know that you re-use the products?
What is their opinion about re-use?
General (information provided by the supporting NGO)
How many UDDT have been built in the village?
Other project activities in the village?
How was the knowledge transfer organized - how many trained trainers are in the village?
How was this village selected?
By whom was this beneficiary selected?
What were the selection criteria?
How is the toilet owner participating in the project?

Annex 4 – Partner Organisations

Name Organization	Ecological Movement "BIOM"
Address	Bishkek, Abdymomunov St., 328, The Kyrgyz National University, room 105 For correspondence: 720000, Kyrgyzstan, Bishkek, Central Post Station, P/B 1878, Kyrgyzstan
Telephone numbers	+ (996 – 312) 65 – 01 – 36; + (996 – 312) 55 – 06 – 07
Name of director	Korotenko Vladimir
Names of contact persons	Kirilenko Anna (annakir7@gmail.com)

Name Organization	Habitat Kyrgyzstan Foundation
Address	52 Prospect Mira, Bishkek, 720004, Kyrgyzstan
Telephone numbers	+996 - 312 54 - 15 - 99
Name of director	Marat Jidebaev
Names of contact persons	Indira Aseyin (npdm@habitat.elcat.kg)

Name Organization	Rural Women's NGO "ALGA"
Address	35 Aidarbekov street, Jerkazar village, Yaykata raion, Chui oblast, 722177, Kyrgyzstan
Telephone numbers	+996 (312) 61 01 36
Name of director	Olga Djanaeva
Names of contact persons	Aijamal Bakashova (alga@infotel.kg)

Name Organization	Public Association ULGU
Address	Index: 715700 Kyrgyzstan Jalalabat oblast, Aksy region, Kerben town, Niyazaly street, Cultural Center. Kyrgyzstan
Telephone numbers	+996 3742 2 12 55
Name of director	Myrzabay Dooranov
Names of contact persons	Elmira Aiylchieva (npoulgu@rambler.ru)

Annex 5 – Glossary and Abbreviations

Blackwater	Water containing fecal matter and urine. It is also known as brown water, foul water, or sewage.
Double vault UDDT	UDDT where the faeces are collected in two alternating chambers. The first chamber is used until it is full. The seat is switched to the second chamber. After the drying period, the first chamber can be emptied and used again.
Greywater	Non-industrial wastewater generated from domestic processes such as dish washing, laundry and bathing.
NGO	Non Government Organization
Single vault UDDT	UDDT where a container is used to collect the faeces. When it is full the feaces have to stored or compost. The full container has to be replaced by an empty one.
UDDT	Urine Diverting Dry Toilet

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