DISCUSSION PAPER

Clean water is not enough – Success factors for sustainable sanitation



IMPROVED QUALITIY OF LIFE BY COMBINING AFFORDABLE INFRASTRUCTURE, GOOD SERVICE, HYGIENE AWARENESS AND ENVIRONMENTAL PROTECTION.

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Success factors for sustainable sanitation
Assessment of projects of German Financial Cooperation and other aid agencies

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Abbreviations

CDM	Clean Development Mechanism
CLTS	Community-led total sanitation
ecosan	Ecological sanitation
FC	Financial Cooperation
GNP	Gross National Product
IRC	International Water and Sanitation Centre
IYOS	International Year of Sanitation
MDG	Millennium Development Goal
WHO	World Health Organisation
WSP	Water and Sanitation Program of the World Bank

Summary

Clean drinking water is an important basis for life. However, the International Year of Sanitation 2008 has made it clear that good water supply alone is not enough. In many countries, health is still subject to considerable risk due to the lack of basic sanitation services and to poor hygiene. Changes are difficult but there are also some large scale success stories of German Finacial Cooperation (FC). So far, these successes have not been well documented. We have therefore assessed a range of FC projects, and compared these with the experiences of other aid agencies (see Appendix for case studies).

After initial external support, sustainable improvement in sanitation must ultimately rely on users, utilities, and local authorities or state institutions. In this assessment we have tried to identify the success factors, and also the risks, for sustainable improvements at the following four levels:

- changes in hygiene practices
- affordable infrastructure and services
- effective institutions
- ecological impact

Changes in hygiene practices require time. The forms of communication used must be adapted to the specific conditions of the individual countries and target groups concerned. German FC and other aid agencies' projects invested funds of below 1% to over 4% of per capita GNP[1] in promotional activities. This investment resulted in considerable changes in behaviour. Often these changes could only be realised once water supply and domestic infrastructure (latrines and grey water infiltration) had been improved. Scientific investigation reveals that modified behaviour is usually long-lasting (see Annex 2).

The annual total costs per capita (investment and operation) of successful FC projects are mostly less than 1% of the national or regional per capita GNP. In these cases, household costs are often not any greater than 1% of household income. Within this cost framework ***infrastructure and services*** appear to be ***affordable***. The costs in relation to GNP are similar to those in Central Europe. Significantly higher per capita annual costs are problematic, because the negative impact of inadequate hygiene on household income is rather low (0.8% of private income in Vietnam, the Philippines, and Indonesia; 3.2% in Cambodia)[2]. The economic costs are higher, especially in countries where hygiene conditions are currently particularly poor (1.3% of GNP in Vietnam, 1.5% in the Philippines, 2.3% in Indonesia, and 7.2% in Cambodia)[2]. The additional economic costs for society derive primarily from increased mortality and the negative impact on the environment, fisheries and tourism.

Sustainably effective institutions are required for all systems that are not solely based on on-site sanitation and disposal under household responsibility. Local participation and local institutions (local communities or private providers) have proved their worth for rural and peri-urban pit emptying and sludge treatment as well as for small-bore sewer systems, Efficient water and wastewater utilities need a legal framework that enables them to levy cost covering fees and the right incentives for good service provision. The feed back from utility customers (e.g. a say on supervisory boards, proper complaints management) also has a significant effect on the quality of service.

Ecological sustainability requires firstly recognising that ground and surface water pollution is a problem, and secondly finding ways of making the reuse of human excreta socially acceptable. The chances for closed loop recycling are good if recycled water and nutrients or energy gains provide direct benefits. In arid regions the use of treated wastewater in irrigation is more and more accepted. In rural areas, nutrients can be used for agriculture close to

[1] Costs per inhabitant as related to per capita GNP of each country or region (e.g. in Brazil or India)
[2] All data from: WSP "Economic Impacts of Sanitation in Southeast Asia"; February 2008

homesteads (e.g. ecosan). In the urban context nutrient reuse has been successful in form of fertiliser produced from the sludge of wastewater treatment (China), or the use of sludge for reforestation. Energy use can play a considerable role in decentralised biogas production (e.g. Nepal) or in sludge digestion in large wastewater treatment plants. This energy use contributes to climate protection, because it avoids the release of methane to the atmosphere.

1 Aim and scope of the assessment

German Development Cooperation has, over the last decades, improved sustainable water supply under a wide range of local conditions by adapting the approach to each situation. The International Year of Sanitation 2008 drew political attention to the fact that good water supply alone was not sufficient to reduce health risks. A lack of basic sanitation and poor hygiene still causes high prevalence of waterborne diseases in many countries. Changes are not always simple. Various FC projects have been successful at large scale. These experiences have so far been less well documented than the lessons learnt in the area of water supply.

We have therefore assessed a range of FC projects. We present the results for discussion so that the experiences can contribute to future project design. In addition, examples and analyses from other aid agencies have been included in the assessment. We have looked particularly at aspects that are not so commonly reported on, such as economic cost-benefit analyses, changes in hygiene behaviour, mobilisation of market mechanisms, public toilet programmes and ecosan projects.

Studies of the World Bank's Water and Sanitation Programme (WSP) evaluate the costs of inadequate sanitation in four Asian countries[3] (see Annex 1). An international analysis coordinated by IRC looked at the factors contributing to sustainable changes in hygiene practices in eight countries (Annex 2). A WSP example from Vietnam throws light on the mobilisation of market mechanisms (Annex 3), and WSP and WaterAid present the financing of public toilets in India (Annex 4) and Bangladesh (Annex 5). Ecosan examples with good data basis exist in China, Mexico, Ecuador and Mozambique (for the example of China see Annex 6).

It was also possible to draw on an ex-post evaluation of 23 FC sanitation projects (central sewer systems) finished between 1991 and 2008. This evaluation revealed that 74% of the projects are ranked as successful. This corresponds approximately to the average success rate across all FC projects.

We analysed in detail FC projects including investment in basic sanitary facilities and various forms of wastewater management. Central to our analysis were the improvement of the quality of human life, reliable and sustainable operation, and affordable service provision. The projects analysed were those that project managers and technical experts rated as successful examples, despite occasional shortcomings. These included projects such as those in Tunisia (Annex 7), India (Annex 8), Brazil (Annex 9), China (Annex 10), Turkey (Annex 11) and Malawi (Annex 15). However, we also looked at projects where sustainability is at risk for various reasons, such as the projects in the Palestinian Territories (Annex 12), Ghana (Annex 13) and Uganda (Annex 14).

2 Success factors for sustainable changes in hygiene practices

Alongside water supply, sanitary facilities and wastewater management, personal hygiene practices play an important role in preventing waterborne diseases. Changes in behaviour can be particularly effective in places where hygiene practices have hitherto been inadequate. A meta-study coordinated by IRC (see Annex 2) compared the sustainability of changes in hygiene practices linked to projects in Ghana, India, Kenya, Nepal, Uganda and Sri Lanka. The results indicate that changes in behaviour are usually long-lasting. In only three

[3] Now a fifth study is available for Lao PDR

of 46 projects analysed hygiene practices were found to have deteriorated again two years after implementation of the project measures.

2.1 Education as a success factor

As a rule there is a very clear correlation between hygiene practices and education. This connection appears to be even more pronounced with women than with men. Conversely this means that communication methods must specifically target the less well-educated (poorer) population groups. This strategy was very successful in the projects in Malawi (Annex 15) and India (Annex 8).

2.2 Public / political support and attention as success factor

The community-led total sanitation (CLTS) approach, first developed in India, relies very heavily on a high degree of public attention and political support to achieve a simple goal: "no open defecation". The peer pressure associated with this approach works to a certain extent. A series of countries in Asia and Sub-Saharan Africa have also adopted the CLTS concept. However, the attention and monitoring activities often focus too much on the construction of latrines. Research by Dr Nandita Singh (KTH Sweden[4]) in India shows that changes in behaviour occur more slowly than some reports of success might suggest. Even when latrines are available they are not always used or are not used by the whole family ("making sure the pit does not fill up too quickly"; "fetching water for flushing is too much effort").

2.3 Choice of appropriate participants and forms of communication

The IRC study indicates that, with hygiene instruction and awareness, the information content must be adapted to the individual target group and must be easily communicable. A combination of diverse means of communication has proved its worth in individual projects. Table 1 gives an overview on promotional activities that have shown a significant correlation with specific behavioural changes in the different projects.

Table 1: Impact of promotional activities
(significant influence on behavioural changes through different forms of communication; IRC study, page 23)

	Countries where study tested this ↓	HW skills	HW practice	Location Soap + water in HH	Latrine is used consistently	Latrine maintained	HH environment free from waste	Drinking water covered/ Safe Storage
Hygiene promotion in general	*All six*	Ghana	India Uganda*	Ghana	Uganda*			Ghana
Small group meetings	*Ghana* *Sri Lanka*	Ghana		Ghana		Sri Lanka		Ghana
Home visits	*Ghana* *India*	Ghana	India (women)	Ghana	India (women)			
Classes (training)	*India*		India (women)		India (women)		India	

* In 2 out of 3 districts

In Burkina Faso[5] a large proportion of women were able to remember radio advertisements (59%), whereas few women could recall either street theatre performances that had been presented repeatedly in their neighbourhood or advice on hygiene offered at health centres (19% and 18%, respectively).

In the FC project in Rajasthan, India (Annex 8), women were specifically involved in deciding the locations for showers and latrines, and they were also the official recipients of the funds

[4] http://www.worldwaterweek.org/Downloads/2008/presentations/thursday/K16_17/Nandita_singh_Sanitation_Pres.pdf
[5] http://www.hygienecentral.org.uk/pdf/SaniyaBullWHO.pdf

for construction. Health camps organised in cooperation with the Health Ministry offered women not only hygiene instruction but also gynaecological examination and treatment. At the women's request, schools offered hygiene instruction and sex education for girls.

The IRC study (see Annex 2) indicates that it is preferable if the provision of information on hygiene topics lasts for longer than one year. Indeed, FC projects altering successfully hygiene behaviour (Rajasthan and Malawi) provided hygiene sensitisation over a period of several years in the different project areas.

2.4 Organisation of the content of educational programmes

When the content of an educational programme is being determined, it is generally recommended that the focus should be on a few easily understood issues relevant to the individual target group. The various studies consider the following areas of hygiene behaviour to be of particular importance:

- Washing hands before eating, after using the toilet and after contact with the faeces of babies and small children; keeping water and soap readily available for washing hands;
- Using latrines; maintaining and cleaning latrines; disposing of the faeces of babies and small children in latrines;
- Menstrual hygiene for women and girls;
- Secure storage of water and food;
- A clean housing environment.

2.5 Costs

Hygiene education can change the behaviour of a target group to only a certain extent. The goals of some projects are relatively "low cost" changes in behaviour (especially hand washing); other projects, in addition to promoting behavioural changes, also aim to create a demand for better sanitary facilities at the level of the individual household.

Table 2: Costs of hygiene awareness-raising
(measured as costs per individual "adopter")

Project / length	**Target group**	**Activities**	**Key indicator for change % adopters**	**Costs per adopter in EUR (in % of per capita GNP)**
FC Water and sanitation Rajasthan 10 years	1.05 million	Raising awareness of key decision-makers; combination of awareness raising with health care for women in the form of health camps; health competitions in schools; health and sex education for girls	Latrine building Project +18% other adopters +28% (total +46%) Baby faeces in latrine +10%	Project EUR 3.34 (0.7%) all adopters EUR 1.27 (0.3%)
UNICEF Bobo Dioulasso 3 years	37,319 mothers	Neighbourhood hygiene committees with home visits; discussion groups in health centres and neighbourhoods; street theatre; local radio; primary school curriculum	Hand-washing after contact with baby faeces +18.5%	Per mother EUR 48 per family member EUR 6.55 (2.3%); *without start-up costs EUR 5.03 (1.7%)*
FC Water provision / sanitation Malawi 3-5 years	308,000	Videos, street theatre, flip charts and brochures on hand-washing, covering over water and keeping latrines clean	Safer latrines project +49% Hand-washing project +14%, water covering project +19%	EUR 7 / person (4.4%)

The table above shows which approaches and activities led to measurable changes in behaviour. In addition, the costs per inhabitant with changed hygiene behaviour (= "adopter") are presented at 2007 prices.

In very poor countries, even regular hand-washing with soap represents a heavy financial burden. A detailed examination of changed hygiene behaviour in Burkina Faso[6] estimated the costs of hand-washing with soap at around USD 1 per person per year in 1999. At the time, this represented about 0.4% of the average per capita GNP and, therefore, clearly a noticeable cost for poor households. In this specific case the cost was made up equally of water (0.3 litres / hand wash) and soap. It is thus not surprising that other case studies report households hiding the soap from children or locking it away.

2.6 Effects and indicators of altered hygiene behaviour

It is not possible to measure reliably the health impact of small projects, but it is possible to assess the impact of longer lasting large regional or national programmes. However, obtaining meaningful data on hygiene behaviour is costly and time-consuming. Only within few FC projects, studies compare hygiene behaviour before, during and after intervention (for a positive example from Malawi see Annex 15).

The study coordinated by IRC (see Annex 2) gives good pointers on how to plan studies of hygiene behaviour. Since socially accepted answers tend to be given in surveys, this study recommends participatory observation or pocket voting to complement enquiries.

2.7 Risks

If there is no analysis of hygiene behaviour and the concept for raising awareness on hygiene is not drawn up prior to the start of a project, the desired changes may either not take place or may be unclear. This will make an ex-post evaluation difficult.

In some of the FC projects, hygiene education measures were run in a *too fragmentary way or for too short a time*. In such cases the "message" fails to get through.

In water supply projects with hand pumps or standpipes, hygiene education is often confined to maintaining the drinking water quality (i.e. keeping the standpipe environment clean, washing out the containers, methods of transport and of storage). *This frequently ignores other important transmission routes for waterborne diseases* (hand-washing, practices for dealing with small children's faeces, cleanliness of latrines, food storage).

3 Success factors for affordable infrastructure and services

When are improved hygiene practices, better domestic facilities or better public wastewater management affordable in the long term? Firstly, the costs must be in reasonable proportion to the benefits to both the national economy and the individual. However, society, politicians and individual households must also recognise the benefits as such. Only then will politicians and individual households commit part of their limited resources to maintain sanitation achievements.

Moreover, it must be possible to fund operation and maintenance costs and the replacement investments locally, at regional level or at least with national subsidies.

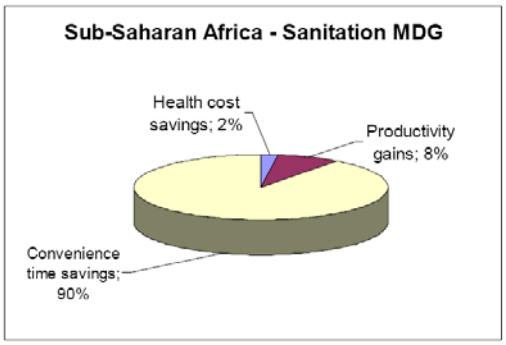
3.1 Significance / awareness of the benefit

WHO did a macroeconomic cost-benefit analysis of the achievement of the Millennium Development Goals in the area of drinking water and sanitation (first version 2004[7], revised

[6] Evidence of behaviour change following a hygiene promotion programme in Burkina Faso; author Curtis et al.; WHO 2001
[7] Evaluation of the Costs and Benefits of Water and Sanitation Improvements at the Global Level; Guy Hutton and Laurence Haller; WHO Geneva; 2004

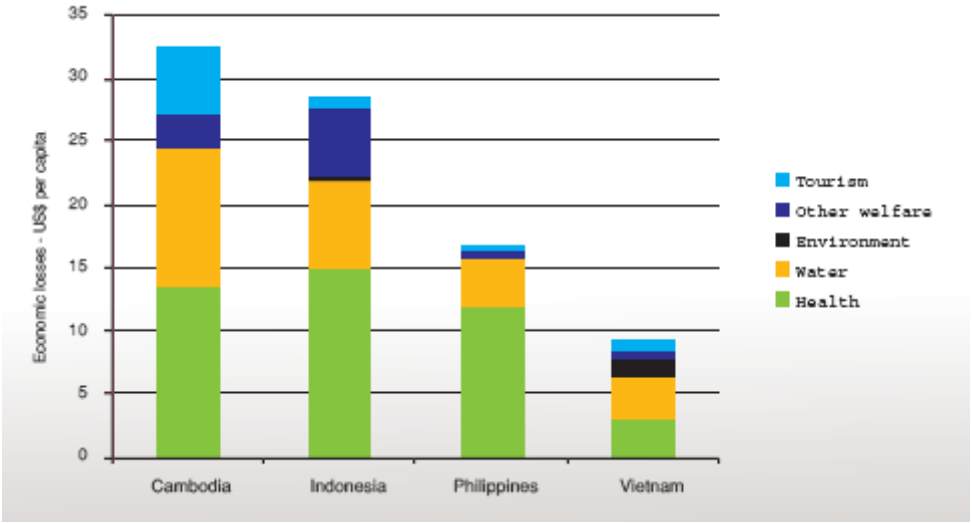
version with figures 2007[8]). The analysis shows a nine-fold national economic benefit (Sub-Saharan Africa 6.5-fold) from the funds invested in the area of basic sanitation and wastewater management. However, the study assumes that, worldwide, the access to improved sanitation produces a daily economy of time of 30 minutes for each user. This assumption without empirical evidence explains 90% of the benefit (see Figure 1). This limits the significance of the study.

Figure 1: Benefits of improved sanitary facilities[9]



More realistic are the findings of four country studies on WSP in Asia (see Annex 1). They evaluate the costs of inadequate sanitation on micro and macro level. In particular they assess health impact (morbidity and mortality), additional costs of obtaining or treating drinking water, economic effects (for example tourism) and broader environmental impacts (for example on fishing). The overall damage caused by inadequate wastewater management is estimated at 1.3% of GNP in Vietnam, 1.5% in the Philippines, 2.3% in Indonesia and 7.2% in Cambodia. Premature death due to waterborne diseases constitutes the highest external cost; additional costs for drinking water supply coming in second place (see Figure 2). At individual level, the assessment covers the costs of water treatment (boiling), medical treatment or reduced ability to work. However, the micro-economic costs are limited. In Vietnam, the Philippines and Indonesia they are approximately 0.5% of GNP or 0.8% of household income. Only in Cambodia are these costs higher, totalling 2.6% of GNP (approximately 3.2% of household income) due to the high costs of water treatment.

Figure 2: Annual losses per capita and per sector in USD[10]



[8] Economic and health effects of increasing coverage of low cost household drinking-water supply and sanitation interventions to countries off-track to meet MDG target 10; Hutton, Haller, Bartram; WHP Geneva; 2007
[9] Hutton et al. 2007, page 23
[10] WSP 02/2008

A number of studies show that households value above all the comfort, convenience and status value of improved sanitary facilities. Included in these advantages in part is also the time-saving factor (e.g. Ghana: no queuing for public toilets). In many cases, however, the time factor is not decisive.

Politicians become aware of water pollution in places where pollution already poses a serious problem for drinking water supply, irrigation or tourism. In the Middle East, North Africa and Asia, the reduction of health risks also plays a role in political attention. Tunisia, for instance, is trying to enforce irrigation standards to reduce the risks of infection from food.

Urine separation toilets were originally developed in Asia in order to simplify treatment of human faeces for reuse in agriculture and thus reduce rates of worm infection. Urine separation toilets have been quite successful in some rural areas in China, where they are also very economical (see Annex 6 and Table 3). Apart from the comfort factor (tiled toilets inside the house), people appreciate the advantage that the tanks are above ground, so that there is no risk during floods. Ecosan pilot projects in other regions have so far not yet yielded in such large scale positive results (see Table 3).

3.2 Reasonable total costs as success factor

Evaluation of successful FC projects has shown that, as a rule, the annual full costs per inhabitant are around or below 1% of per capita GNP.

Table 3: Annual costs of various projects

Project and type of solution	**Population reached**	**Per capita annual costs in % of GNP**
Rajasthan, India; pour-flush latrines, showers, grey water infiltration (Annex 8)	1.05 million (rural)	0.5%
Bahia, Brazil; small decentralised systems and on-site solutions (Annex 9)	34,000 (rural)	0.6%
Haikou, China; central sewerage system and wastewater purification with sludge digestion (Annex 10)	850,000 (urban)	0.7%
Fethiye, Turkey; central sewerage system, mech.-biol. purification, nutrient limits, disinfection (Annex 11)	65,000 (urban + tourists)	0.7%
Ghana; VIP latrines (Annex 13)	25,500 (planned)	0.8%
Malawi; Sanplats (Annex 15)	196,000 (rural)	0.9%
Al Bireh, Palestinian Territories; central sewerage system, mech.-biol. purification (Annex 12)	50,000 (urban)	3.5%
Kabale, Uganda; sewerage network in city centre; pond type wastewater treatment plant (Annex 14)	3,300 (actual figure for 2008 urban) 8,000 inhabitants + IE (plan 2015)	14%
Ecosan examples: Mexico (GTZ) Mozambique (GTZ) Ecuador (GTZ) China (China Plan; Annex 6)	150 1,200 (private toilets) 46 196,000	2% 1.5% 1% 0.1%

Projects with low maintenance and operating costs are less fragile than projects with relatively high operating costs. In Al Bireh, Palestinian Territories, operating costs total around 40% of total costs due to high energy prices. At present these costs cannot be covered by user fees because incomes have declined. In Kabale, Uganda, operating costs are relatively low at around 10% of total costs and are presently covered through user fees. In contrast,

high total costs mean that in Kabale, replacement investments can hardly be funded without external support.

The ex-post evaluation of FC sanitation projects shows that on average 68% of projects manage to cover operation and maintenance costs. In these projects the operation and maintenance costs are covered to 136% on average. Only in two out of eight projects (for which there was data available) user fees cover full costs. .

3.3 Households can (and want to) bear one-off and running costs

High access costs are a problem if households have to bear a significant proportion of the investment costs. This is frequently the case for on-site systems, but also for central sewer systems with high connection fees or high costs for on-site plumbing. Poorer households in Rajasthan paid up to 20% of their annual income as own share for the construction of a latrine and a shower. In very poor countries households are not getting connected to available sewerage systems because they can neither afford a flush toilet nor the wastewater fees (Kabale, Uganda) or they are unable to pay for the house connection (El Doret, Kenya).

In India, Sulabh[11], one of the largest suppliers of latrines, offers a range of models costing from EUR 25 for the most basic model, through EUR 160 for a model with solid walls and a wooden door, up to a tiled bathroom for EUR 900. The average income of the poorest 40% in India is currently approximately EUR 250 per person per year. Sulabh Toilets can thus already be built for 10% of a household's annual income.

In Vietnam (see Annex 3), the approach supported by WSP enables local masons to offer a range of technical options. These options are designed in such a way that they can be implemented in stages. Besides raising the awareness of households, the programme trains masons to become market-orientated entrepreneurs. Households decide on the solutions that address their needs. On average they spent 11% of their annual income on the investment (15% in the case of the poorer households). Poorer households also took advantage of payment facilities offered by the masons allowing for deferred payment of 50-70% over a period of up to 6 months.

The ex-post evaluation of FC projects revealed an average collection efficiency of 88%. In FC projects with central sewer systems, households often pay around 1% of average household income for wastewater fees. Only in rare cases, user fees are significantly higher. In Kabale, Uganda, the wastewater fee (EUR 0.45/m³ fresh water) roughly corresponds to 7-10% of an average household income. But only 8% of the households are connected and these are probably higher income households.

3.4 Subsidy mechanisms for the poorest households

Progressive block tariffs can function as cross-subsidy mechanism in central sewer systems (for example in Morocco). For on-site systems, there are some experiences with a local decision process for allocating subsidies to the poor. This has worked in some cases, for instance in the FC projects in Rajasthan (higher subsidies for the poorest people). In Indonesia, a large sector project (WSLIC 2) financed by the World Bank offered a sanitation revolving fund to local communities. The basic idea was that the communities themselves could decide on loan conditions and then use the repayments to provide subsidies to the poorest households. In practice, however, this approach failed in Indonesia. The first loans were granted to better-off households; repayment morale was low, so there were no funds left to subsidise the poor. Therefore, the follow-up programme focuses rather on CLTS and marketing.

[11] http://www.sulabhinternational.org/st/differentdesigns_sulabh_shauchalayas_costs.php

3.5 Success factors for community and public toilets

In very densely populated slums public toilets or community-managed sanitation blocks are frequently seen as the only way of ensuring well-managed sanitation. However, adapted sewer systems do appear to be feasible in slums, if the residents have actual ownership or similar land use rights, as was the case in a series of slum rehabilitation projects in India[12].

Due to the costs of efficient management, public toilets are usually only viable in central locations (railway stations, markets, etc.). In New Delhi, the city authority involved private entrepreneurs via build, operate, and transfer contracts (see Annex 4). At city-centre locations, the contractors earn up to 95% of their income from advertisements on the toilet walls and charge INR 2 per visit for the use of the toilets. Even this modest charge corresponds to annual costs of EUR 23 per person, assuming the toilet is used twice a day. It is therefore not a "cheap" solution for the poorest people.

WaterAid Bangladesh has provided financial and technical support for the construction of community toilet facilities for 1,800 residents (2 facilities, each with 8 toilet bowls, 2 urinals, and 2 showers for women) in a slum in Dhaka (see Annex 5). Homeowners make up 20% of households while the rest are tenants. The households are very reliable in paying the relatively limited operating costs (0.2% of household income). The investment costs are being paid back by the few owner households. In general, though, this example illustrates the limited level of comfort offered by an affordable community solution (around 113 residents per toilet; around 125 women per shower).

3.6 Risks / failures

A major risk of sanitation projects is that the *targeted health impact is not achieved*. This can be the case if the toilets are without water for hand washing, if toilets are dirty, if sewer networks are not operational, if wastewater treatment plants are not run effectively, or if the sludge is not disposed of properly.

The causes sometimes lie in *planning errors*. These include an inadequate baseline analysis, leading to unrealistic future assumptions (for example El Doret, Kenya). In other cases, *operating costs are high and there is a lack of political will to impose cost covering user fees*. Only few countries provide public funds reliably to offset such operational losses. The wastewater utilities usually have to make cutbacks. This leads to operational shortfalls and inadequate maintenance.

Some projects *do not serve very poor households* because of the way they are conceived or due to unintended barriers to access. The sanitation project in Kabale, Uganda, for example, failed to recognise that most households cannot afford flushing toilets.

4 Success factors for effective institutions

4.1 Participation on the ground, local operational responsibility, centralised services

In a participatory process, state governments in Brazil (see Annex 12) transferred part of the operational responsibility to local user groups, while central tasks are assumed by a special joint service council. User fees are allocated to both levels. This arrangement works quite well in Brazil.

4.2 The right to have a say / possibility for customers to express their views

In some FC projects there are user representatives on the supervisory board of the utility. There is not enough information to judge the impact of this approach. A transparent system

[12] With "Slum Networking" in Indore, Baroda, Ahmedabad and Bhopal, an Indian planning office was one of three winners of the "Changemaker" competition; see http://www.changemakers.net/en-us/competition/waterandsanitation

for complaints management and customer satisfaction surveys generally help to improve the quality of service of utilities. Countries with a regulatory authority usually follow up on such indicators.

4.3 Suitable basic conditions and performance incentives for service providers

Tunisia, with support from Germany, has created an exemplary legal framework and also covers the deficit of the national sanitation company, as long as the company complies with the legally required treatment standards. Much poorer countries such as Uganda and Burkina Faso have also succeeded in creating legal framework conditions and incentives for their water and sanitation utilities, resulting in good collection efficiency and good coverage of recurrent costs. A regulatory authority is one possible option, but service agreements between client (municipality, joint service council or state) and utilities can also be effective.

The ex-post evaluation of the FC projects shows that projects with private sector elements were more successful than purely state-run structures. The 5 projects with public funding and private management mechanisms[13] scored an average of 2.4 (with 1 being the highest mark and 6 the lowest), the only project with a private operator scored a mark of 2, while 17 state-run projects without such management mechanisms scored an average mark of 3.2.

4.4 Risks / failures

In many countries employees of utilities fall under public sector regulations and the payment is not attractive. Such utilities tend to loose their qualified staff, who have often been specifically trained under development projects. Furthermore, decisions regarding staffing are frequently subject to political influence. This threatens the professionalism of institutions and also often brings with it a risk of overstaffing.

In hardly any country user fees cover the full costs of good wastewater management. In development countries, transfers from general tax revenues (e.g. investment grants) are generally insufficient to ensure sustainable systems. In some cases the design is so expensive that national funding of future costs is unrealistic (Kabale, Uganda or El Doret, Kenya).

5 Success factors for ecological sustainability

5.1 Water pollution and water wastage are recognised as problems

Truly sustainable changes require full awareness of problems at political level. In Tunisia and Turkey, water scarcity and the importance of bathing water quality for tourism have contributed to this awareness. In China it is above all the rising treatment costs of water supply and the damage to agriculture and fish farming that have contributed to wastewater treatment now being taken very seriously. Where there are sensitive ecosystems but relatively weak government and institutions (for example Lake Victoria, Uganda / Tanzania), political awareness alone is often not enough to guarantee a sustainable wastewater management. The cross-border protection of Lake Ohrid (Albania and Macedonia) shows that setting up efficient water utilities is a good basis for obtaining broad political support for better wastewater management, including the necessary decisions on required user fees.

5.2 Reuse of human faeces is socially accepted

In some countries it is traditionally acceptable to reuse human faeces. In such cases sanitation projects try above all to reduce health risks. In countries without such a tradition, or with taboos against such reuse, objections can be fairly easily overcome in the case of reforestation or public green spaces. In contrast, farmers have to be convinced of the quality of the

[13] For example water and sanitation companies managed according to commercial law but with public stakeholders and monitoring of customers' interests by an effective regulatory authority

product before they reuse faecal products as fertilizer (for example sewage sludge or urine and faeces from ecosan toilets).

5.3 The benefit for water, nutrient or energy use is greater than the costs

Water reuse becomes more and more common in the arid countries of the Middle East and North Africa (Morocco, Tunisia, Yemen and Jordan).

In landlocked countries with high transport costs (such as in parts of Africa), the nutrient value can play a role if it is not yet a tradition for human faeces to be recycled. In rural areas nutrients are sometimes used on farmland close to the homestead. In the urban context nutrient reuse involves e.g. fertiliser produced from the sludge of wastewater treatment (China), or the use of sludge for reforestation and covering landfills (planned for Turkey).

Energy use can play a considerable role in decentralised biogas production (e.g. Nepal) or sludge digestion in large wastewater treatment plants. This energy use also contributes to climate protection, because it avoids the release of methane to the atmosphere.

For larger wastewater treatment plants, the process of sludge digestion and the use of methane are interesting in countries without subsidised electricity prices and with sufficiently qualified operating staff. As CO_2 and methane emissions are avoided, CDM certificates can also be used to some extent (planned: Tunisia). As a rule, however, the energy produced does not exceed the amount of energy needed for the wastewater treatment process.

Small-scale biogas facilities for individual households require sufficient biomass. Depending on the climate and cooking practices, only 10-30% of the energy needed for cooking can be covered by using human faeces. Small rural biogas facilities are very successful in Nepal, as many farmers there have at least a few animals whose dung they can use. Increasingly, latrines are also connected to these small biogas plants.

5.4 Risks / failures

In the matter of the energy optimisation of small biogas facilities, the sanitisation of human faeces is often insufficient. The sludge often does not stay long enough in the biogas fermenter to be hygienically safe.

Social taboos and risks connected to handling human faeces are underestimated. As a result, sewage sludge is often not reused in agriculture as planned, latrines are not emptied or urine from urine separation toilets is merely channelled away or allowed to seep into the soil. In some cases this underestimation of social taboos leads to new risks, for instance if the sludge is not disposed of properly or if latrines overflow.

Although the ex-post evaluation showed that usually FC wastewater projects have a sludge management plan (only 2 out of 17 projects did not have such a plan), the planned disposal or reuse is often not implemented in a sustainable manner.

Appendix

Annex 1	Economic Impacts of Sanitation in South East Asia: WSP studies Cambodia, Vietnam, Indonesia, the Philippines, Vietnam (overview)
Annex 2	Sustainable changes in hygiene behaviour – comparative studies in Ghana, India, Kenya, Nepal, Uganda, Sri Lanka (overview)
Annex 3	WSP – Mobilising market mechanisms – private sector sanitation delivery in rural Vietnam
Annex 4	WSP – public toilets in India
Annex 5	WaterAid – Management of slum neighbourhood sanitation services in Dhaka, Bangladesh
Annex 6	Plan – Community-led Water and Ecosan Programme Shaanxi Province, China
Annex 7	FC project wastewater management as a contribution to integrated water resource management in the Medjerda Valley, Tunisia
Annex 8	FC project rural water provision and sanitary facilities Rajasthan, India
Annex 9	FC project rural water provision and sanitary facilities Bahia, Ceara, Piaui, Brazil (sanitary components as case studies)
Annex 10	FC project urban wastewater management Haikou, China
Annex 11	FC project urban wastewater management Fethiye, Turkey
Annex 12	FC project urban wastewater management Al Bireh, Palestinian Territories
Annex 13	FC project rural water provision and sanitary components Ashanti region, Ghana
Annex 14	FC project water provision and wastewater management Kabale, Uganda
Annex 15	FC project rural water provision and sanitary components Balaka and Mangochi, Malawi

Economic Impacts of Sanitation in Southeast Asia; A four-country study conducted in Cambodia, Indonesia, the Philippines and Vietnam under the Economics of Sanitation Initiative (ESI); wsp; February 2008

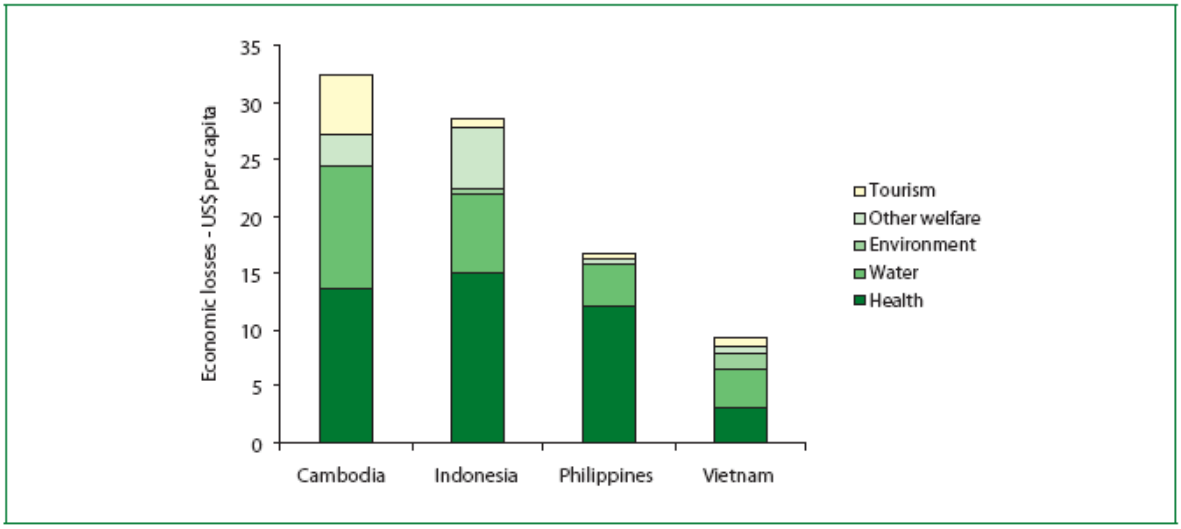
Executive Summary

Sanitation is a neglected aspect of development in countries where spending is limited, and where many other priorities crowd the agenda. Improved sanitation coverage has increased gradually as economic growth has spread to Asia's poorer countries. However, latest estimates put improved sanitation coverage at 28% in Cambodia, 57% in Indonesia, 76% in the Philippines and 69% in Vietnam, far below the universal sanitation coverage achieved in other Southeast Asian countries such as Thailand and Singapore. Subsequently, hundreds of millions of people in the region still lack access to improved sanitation, which is seen more as a result, rather than a cause, of economic growth. Few governments and households identify poor sanitation as an impediment to economic growth. This study examines the major health, water, environmental, tourism and other welfare impacts associated with poor sanitation in Cambodia, Indonesia, the Philippines and Vietnam.

The study is based on evidence from other investigations, surveys and databases. The impact measurement reported in the study focuses mainly on a narrow definition of sanitation − human excreta management and related hygiene practices. The measurement of water resource impact also includes grey water, and the measurement of environmental impact includes solid waste management. By examining the economic impacts of poor sanitation, and the potential gains from improved sanitation, this study provides important evidence to support further investment in sanitation. The goal of this report is to show decision-makers at the country and regional levels how the negative impacts of poor sanitation can be mitigated by investing in improved sanitation.

Cambodia, Indonesia, the Philippines and Vietnam lose an estimated US$9 billion a year because of poor sanitation (based on 2005 prices). That is approximately 2% of their combined Gross Domestic Product, varying from 1.3% in Vietnam, 1.5% in the Philippines, 2.3% in Indonesia and 7.2% in Cambodia. The annual economic impact is approximately US$6.3 billion in Indonesia, US$1.4 billion in the Philippines, US$780 million in Vietnam and US$450 million in Cambodia. With the universal implementation of improved sanitation and hygiene, it is assumed that all the attributed impacts would be mitigated, except for health, for which 45% of the losses would be mitigated. This would lead to an annual gain of US$6.3 billion in the four countries, as shown in the figure below. The implementation of ecological sanitation approaches (fertilizer and biogas) would be worth an estimated US$270 million annually.

Annual per capita losses, by impact (US$)



The four countries in this study contain a total of 400 million people. Health and water resources contribute most to the overall economic losses estimated in the study. Poor sanitation, including hygiene, causes at least 180 million disease episodes and 100,000 premature deaths annually. The resulting economic impact is more than US$4.8 billion a year, divided between US$3.3 billion in Indonesia, US$1 billion in the Philippines, US$260 million in Vietnam and US$190 million in Cambodia. Poor sanitation also contributes significantly to water pollution – adding to the cost of safe

water for households, and reducing the production of fish in rivers and lakes. The associated economic costs of polluted water attributed to poor sanitation exceed US$2.3 billion per year, divided between US$1.5 billion in Indonesia, US$320 million in the Philippines, US$290 million in Vietnam and US$150 million in Cambodia. Poor sanitation also contributes up to US$220 million in environmental losses (loss of productive land) in Indonesia and Vietnam, US$1.3 billion in other welfare losses (time to access unimproved sanitation), and US$350 million in tourism losses.

This is the first regional study to compile economic evidence on a range of impacts of poor sanitation. The results are a wake-up call to governments and the development community. Poor sanitation affects everyone, but especially the poor and vulnerable (children, women, disabled and senior people). The considerable socio-economic importance of sanitation shown in this study, and the key links improved sanitation has with other development goals (poverty and hunger reduction, gender equality, child health, access to safe drinking water, and the quality of life of slum-dwellers), demonstrates that sanitation should receive far greater attention from governments and other development partners of the countries of East and Southeast Asia that are interested in equitable and sustainable socio-economic development. Decision-makers should act now and in a concerted way to increase access to improved sanitation and hygiene practices.

Sustainability of hygiene behaviour and the effectiveness of change interventions: A six-country study conducted in Ghana, India, Kenya, Nepal, Sri Lanka and Uganda under the direction of the International Water and Sanitation Centre (IRC); 2004

Executive Summary

Diarrhoea, worm infestation and eye and skin infections are diseases related to water and sanitation. The most vulnerable are children under five years - about three million children die from diarrhoea each year. Each of the three common worms (roundworm, whipworm and hookworms) is estimated to infect more than 500 million people. Roughly 6 million people have become blind from trachoma, an eye disease. Good hygiene can help prevent illness and saving lives. For example, it is estimated that washing hands with soap can reduce the risk of diarrhoea by more than 40%. Programmes to promote handwashing might save a million lives each year.
Simple hygiene behaviours are key to improve health. Hygiene promotion is therefore recognised nowadays as an essential part of water and sanitation programmes if the maximum health benefits are to be gained from provision of improved facilities.
The challenge within programmes is to ensure that the necessary new, improved hygienic behaviours are developed and sustained. Do people retain newly acquired behaviour or do they slide back into 'old habits' when they are no longer in contact with or supported by programme staff?

The study was undertaken to help fill this knowledge gap. The findings can be interpreted to inform best practice in hygiene promotion and education.
In this study, information was collected in communities in Africa and Asia where the project had ended two or more years earlier. The hygiene behaviours of people and households were compared, that had or had not participated in certain hygiene promotion and education activities during the project.
The focus of the research was on three groups of key behaviour:

- Handwashing knowledge, skills and practice;
- Use and maintenance of latrines;
- Household hygiene related to safe water storage, covering food and environmental cleanliness.

These are the behaviours indicated by the World Health Organization as having the largest impact on people's health and these are generally promoted in water, sanitation and hygiene programmes. Nevertheless, it is important to consider that questionnaires are not necessarily the right tool to get information. In particular for getting information about practice, observation checklists or demonstration protocols are more likely to provide reliable information and that the questionnaires were guided by social desirability of their answers.

To study the impact of programme interventions on hygiene practices there were examined four ways:

- Comparing results of intervention and control groups,
- Showing changes overtime, using baseline information,
- Finding evidence for direct links between inputs during the project period in terms of hygiene activities and outputs after the project had ended in terms of hygiene practices,
- Examining some standard external variables such as improved access to drinking water, education and socio-economic levels.

The research data demonstrated that hygiene behaviours are sustained beyond the end of intervention.
Testing statistically the sustainability gives us the result that only 3 of 46 comparisons suggested a significant decrease in hygiene indicators.
Furthermore, the results of this study imply that merely providing convenient sources of water is not sufficient to induce good hygiene but therefore all the more educational level.
Hygiene promotion is usually carried out through some combination of actions such as mass activities, group activities and through personal communication. In these studies, home visiting was the major form of personal communication. However, the data also indicates that no single approach is likely to be sufficient.

The study shows that the local bodies implementing hygiene promotion in developing countries can carry out simple but rigorous studies of the impact of their own interventions. Measuring behaviour change is possible and it is very useful for project evaluation.
In addition, the results can help justify investments in hygiene promotion to funding bodies. It can be used to advocate for hygiene promotion. This can be very useful if a programme tends to focus too much on construction and not enough on what people actually do, that is, their behaviours.

Case studies of sustainable sanitation projects: Private Sector Sanitation Delivery in Vietnam; wsp; February 2005

Executive Summary

In 2003 the international NGO International Development Enterprises (IDE) launched a project to stimulate the acquisition and use of hygienic sanitation in village in two provinces in Vietnam. IDE developed a range of options that were affordable and appealing to potential customers. IDE then developed, through capacity building, business development support, and credentialing, a local network of masons to deliver these options. To better understand the drivers of sanitation, IDE and the masons assessed the consumers' willingness to pay and perceived benefits and availability of the sanitation options through appropriate media channels and tailored messages. Within a year of the project, there was a 100 percent increase in sanitation access compared to the pre-project access rate. Unlike traditional sanitation projects, no capital cost subsidies were employed to stimulate demand. Households of all income levels accessed sanitation, which was greatly facilitated by the masons offering flexible household financing terms. The project highlights the importance of never underestimating a population's willingness to pay for sanitation, provided that quality products and services are offered and effectively communicated.

Conventional Approaches are characterized by (1) heavy subsidies for capital costs, (2) standardization of models, (3) decision making by external agencies, (4) a focus on infrastructure targets and (5) a focus on centralized service provision.
However, Market Approaches have (1) subsidies for market development and full cost recovery from users, (2) a range of affordable options, (3) the users decide what and how to buy, (4) a focus on behavioural targets and (5) a focus on diversified local service provision.
Subsidy-based, supply driven interventions have been painfully slow bringing sustainable sanitation in developing countries, especially among the rural poor. The use of external subsidies for business development and promotion is often more sustainable than subsidizing sanitation hardware, because once the demand is stimulated and the market is established, suppliers take over promotion even if external funds are gone.

The project chose to develop the sanitation market in the project areas through three main strategies and associated activities:
(1) Promotion the availability of a range of desirable and affordable sanitation improvements of dependable quality through:

- Identifying and standardizing a range of options
- Increasing the availability of competent service providers
- Building the capacity of service providers
- Endorsing service providers

(2) Stimulating the demand for sanitation improvements and adoption of related hygiene practices through:

- Gaining an understanding of customer behaviour and drivers of consumer demand
- Developing, testing, and delivering the marketing campaign
- Mobilizing the community for behaviour change

(3) Facilitating linkages between demand and supply through:

- Linking market players
- Monitoring the quality and cost through competition

IDE helped small-scale operators to understand the market size and adjust their enterprise accordingly. Linkages among players in the supply chain have improved the flow of market information, which is bringing in increasingly more benefits to all stakeholders. Furthermore, the project found that the status and convenience benefits associated with having a latrine held a far stronger appeal for customers than did disease-prevention (upon which programs have traditionally based their promotional efforts).

Table 2: Investment in sanitation in relation to annual household spending

Population Category	Per Capita Annual Income (US$)	Household Annual Income (US$)	Average Household Investment in Sanitation (US$)	Investment as % of Annual Household Spending
All Latrine Buyers	126	592	66	11.1
Poor Latrine Buyers	77	362	55	15.2

Table 3: Technology choices made by the total market compared with choices by the poor

Technology Options	Cost of Latrines at Market Value (in US$)			% of All Latrine Buyers Choosing This Option	% of Poor Latrine Buyers Choosing This Option
	Labor Cost	Material Cost	Total Cost		
Double Vault	15	43	58	17	39
Pour Flush	16	49	65	5	8
Septic Tank	24	73	97	18	5
Semi-septic Tank	16	55	71	48	28
Other (1)	10	22	32	-	1
Upgrades (2)	4	6	10	12	19
All				100	100

(1) "Other" refers to any facility that did not fall into the other technology categories, for example, an improved pit latrine.
(2) Investment to transform an unhygienic latrine into a safe system.

Implementation experience and a recently completed project evaluation suggest that a market-based model was an appropriate strategy for bringing about rapid increases in rural household access to safer latrines and improved hygiene practices in the selected provinces in Vietnam.

- IDE's project successfully stimulated both the consumers' demand for improved sanitation and the capacity of the local market to supply services in response. Within a year of project implementation, rural entrepreneurs were able to recognized the potential of the market and expand. The private sector providers can now continue to serve rural communities beyond the project duration. The masons shown that they can now supply spare parts and provide post-sale service to existing customers, cater to the demand of the new customers, and even expand their customer base and business through innovative local promotional strategies.
- The project's experience shows that simply assuming, without carrying out proper consumer research, that the poor cannot afford improved sanitation may lead to inappropriate program strategies, such as subsidizing relatively high-cost latrines. Household priorities greatly influence demand for sanitation. Though rural households in Vietnam often lack a hygienic latrine facility, they may still be able to afford a TV set or a karaoke player. Both the poor and the more affluent can experience constraints in accessing sanitation that are varied due to individual motivations and priorities, which, as this project experience shows, are fundamentally influenced by the extent to which the local sanitation market is developed. The challenge for sanitation programs is to offer both the poor and the non-poor a range a desirable and affordable options while persuading customer's to reorient their priorities, if necessary, so that improved sanitation becomes an attractive "must-have" for every household.
- Many poor countries now rely on foreign assistance for scaling up access to sanitation to meet the Millennium Development Goals (MDGs). Full capital cost recovery under the marked-based approach addresses the gap in sanitation financing by drawing in resources from the private sector and consumers. The market-based approach may represent the only viable solution for developing countries to move beyond the stalemate of poor sanitation access and reach the MDG targets.
- Full cost recovery also offers better hope for sustainability of sanitation investments. When customers consciously choose to purchase a facility representing more than 10 percent of their household annual budget, the likelihood that the properly use and maintain the facility is high. It is not surprising that post-sale services have now emerged in the local market in the project areas. Consumers making such an important investment tend to demand increased accountability from the service providers. Full capital cost recovery may thus finally and the embarrassing legacy of dysfunctional and abandoned latrines that top-down conventional approaches had delivered free cost or at subsidized costs.

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Case studies of sustainable sanitation projects: Doing Business Differently – Public Toilets in India; wsp; December 2007

Executive Summary

Delhi has witnessed a new initiative that involves private entrepreneurs via Build, Operate, and transfer contracts. This field note looks at both the achievements and challenges in the use of these contracts for public toilets. It presents some significant lessons for meeting the sanitation needs of the city as a whole.

In Delhi, the idea of private sector development of public toilets via Build, Operate, and Transfer (BOT) contracts first emerged in 1998. It offered two benefits: private financing of public infrastructure and an incentive for maintenance.

India faces a daunting urban sanitation challenge. Over one-fourth of urban households lack a private toilet and there is an evident lack of hygiene facilities in public places. Communal facilities may be essential not simply as a convenience to travellers and shoppers, but as the only possible means of providing access to sanitation in crowded slums that are characterized by small plots and little space.

Historically, municipalities were the main providers of public toilets, but these facilities suffered from poor maintenance and cleanliness and were largely avoided by the public.

Today, pay-and-use toilets have become well established across India, most of them funded by municipalities and a large proportion by nongovernmental organizations (NOGs) or small contractors. These are often better maintained than standard municipal toilets and are consequently more popular with the public.

While NGO- and Community-Based Organization (CBO)-run toilet complexes are not quite common, much less has been done to develop the role of the private sector in financing, developing, and maintaining public toilet complexes. Recently, however, the city of Delhi has witnessed a new initiative that involves private entrepreneurs via BOT contracts.

Box 1: Management Models for Public Toilet Facilities in India

Communal toilet facilities fall into two broad categories: *community toilets*, which are provided to meet the basic needs of poor residential areas; and *public toilets*, which serve mobile populations in public places such as shopping centers, as well as bus and train stations. This field note is concerned with the latter. The three most common management models for public toilets are shown below, though there are numerous variations on these themes.

Public sector management	Toilet blocks owned and maintained by municipal agencies. Usually, no charge is levied on users. These are becoming rarer as cleanliness and maintenance are generally poor, there being no real obligation or incentive for caretakers to maintain a good service.
Private leasing	Toilet blocks built using municipal funds but operated by NGOs, private contractors or individuals who are responsible for routine maintenance and charge user fees. The municipality may provide water and power supplies free of charge, and/or retain responsibility for structural repairs. The nongovernmental organization Sulabh International operates a huge number of pay-and-use toilets on this basis, many of them in public places but some serving poor residential areas.
Private sector development	Toilet blocks funded, constructed, operated, and maintained by the private sector, usually on land provided by the municipality. User fees apply. Under Build, Operate, and Transfer contracts, ownership of the premises transfers to the municipality when the lease period expires, typically after five or seven years.

Some 60 public toilet blocks have been developed, and a novel feature of the contract is that the operators are allowed to use the external walls of the premises as advertising space. This enables them to generate substantial revenues.

Box 2: Financing Public Facilities through Advertising

JCDecaux makes a wide range of street furniture from billboards to automatic public conveniences, and has very efficient systems for their installation and maintenance. The company operates in over 800 cities in 40 countries and in 2005 generated revenues of US$2.5 million.

For decades, bus shelters in the Netherlands were subject to graffiti and vandalism. In the 1990s, JCDecaux offered to finance and build new shelters in a number of cities, and thereafter to maintain them, with an obligation to repair damage within 24 hours of it being reported. In exchange, it acquired the right to display advertisements in bus shelter windows. The company now owns most of the bus shelters in the Netherlands and the results have been impressive.

The approach is based on three principles:

- Offer the best, receive the best.
- Don't compromise on maintenance.
- Don't sub-contract operation and maintenance.

Recently, JCDecaux won its first contract in India, for 192 bus stops in New Delhi.

Box 3: Key Content of the Delhi Build, Operate, and Transfer Contracts

- The contract is for five to seven years, after which ownership transfers to the municipality.
- The municipality provides land free of cost but retains the title; it provides power, water, and other facilities on payment.
- The contractor must build sound and aesthetically appealing facilities, at his own cost, and may plant flowers and shrubs around each convenience.
- The contractor must maintain the complex, keep it clean (internally and externally), and provide continuous clean water, exhaust fans, hand dryers, tissues, soap, towels, and so on.
- User charges are limited to Rs. 2 (US$0.05) per head for a compartment, Re. 1 (US$0.02) for a urinal.
- The contractor may use road-facing walls for advertising, paying a licence fee and tax.
- The municipality may terminate the contract if conditions are breached.

The results of this innovation have been mixed, but some contractors have provided an excellent service. The Delhi BOT initiative has been very successful in attracting private sector investment in public toilets. However, the model has been less successful in securing the delivery of high quality services where the contracts were not well managed and where the selection of sites vis-à-vis sanitation demand was skewed. It has not found universal solution to the sanitation needs of public spaces – especially those in poor areas – but it nevertheless provides valuable insights into both the opportunities and challenges presented by BOT contracts. Finding private sector incentives to deliver high quality, affordable sanitation services remains a challenge but in this case the outcomes could be improved and enforcement of contract conditions. This confirms that, whether services are delivered in-house or contracted out, the role of the municipality remains paramount.

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Case studies of sustainable sanitation projects: CBO – Management of Slum Neighbourhood Sanitation Services in Aynal's Bastee, Dhaka, Bangladesh.
A PSCT- WaterAid - IRC Study; December 2004

Executive Summary
Population Service & Training Centre (PSTC), an on-governmental organization in Dhaka, Bangladesh, has been implementing a **community based water supply, sanitation and hygiene promotion (WATSAN)** project since October 1998 in the poor urban slums of Dhaka city. To date the project covers 22 slums of the city with the financial and technical support from WaterAid Bangladesh (WAB).

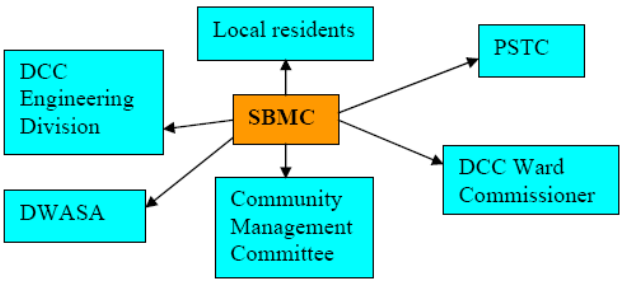
The aim of the programme is to develop a replicable model for water supply and sanitation services to the urban poor, based on devolution of management to the communities themselves. The specific objectives are to:

- Provide water and sanitation services in the slum neighbourhoods of Dhaka city
- Improve environmental sanitation and hygiene in the same community
- Create access to the Government of Bangladesh (GoB) water sector agency by the urban poor through advocacy and intermediation
- Encourage change in the local institutional environment to facilitate the supply of water to the urban poor
- Help build capacity in the communities to operate, maintain and manage water supply and sanitation facilities
- Provide technical assistance to communities and the water utility agency to establish and maintain water connections and ancillary facilities

5.5 millions of the urban population live below the poverty line. Most of the urban poor live in slums and squatter settlements. The neighbourhood of Aynal's Bastee consists of a total of 350 households, with a population of 2000 residents. It was established in 1989 on the land of Dhaka city Corporation (DCC).
The houses of the slum were built by the DCC, no provision for sanitation facilities ware made. Dwellers use hanging latrines which were poorly maintained. (A hanging latrine is made of two planks laid over a hole, usually behind the house, that is the used a designed spot for open defection). Some of them did not have any fence to shield the user from public view while some other were weakly grounded. Some did not have a roof while other were slightly leaned over. Women residents in particular faced many problems. They could not use the latrines as male dwellers could clearly watch them while using the mostly shack latrines. Especially old- age women and children were also afraid of using the hanging latrines, because very often the bamboo pillars of the latrines broke as they got older. No sewerage existed in the slum.
In 1998, the PSTC initiated its WatSan programme activities in Aynal's Bastee by following a new community-based approach that encouraged people's participation. The people of Bastee were approached by PSTC field staff members to build rapport, initiate dialogue and hold meetings focusing on WSS issues. The entire process of community's involvement was done following the 5R approach of PSTC:

- R – Relation with the community
- R – Root level organization development
- R – Resource person development
- R – Resource centre development
- R – Right based communication With GO and NGOs

Once the sanitation issue had emerged as the top priority, PSTC facilitated the dwellers to hold meetings and form a Community Management Committee (CMC) to lead the overall development of the neighbourhoods including water, sanitation and environmental hygiene.
In Aynal's Bastee, two Sanitation Block Management Commitees (SBMCs) were formed to lead the establishment of two Sbs and manage their day- to- day operations. Each of the SBMCs was formed with 9 local members democratically nominated by the neighbourhood residents and regarding this, they also maintained the norms of gender sensitivity i.e. nominated 5 male and 4 female.
The number of stakeholders that a SBMC members needed to interact with while establishing the sanitation Blocks and management them sustainable:



Dhaka Water Supply and Sewerage Authority is the statutory body responsible for water supply, water borne sewerage and sub-surface drainage in Dhaka city.

PSTC's experience shows that community based management system can be a highly effective strategy to help urban slum neighbourhoods gain access to water and sanitation and improve their hygienic practices. The project has brought about significant changes in power relationships between slum dwellers, landlords, the water utility and city authorities.

This case study documents the process through which PSTC facilitated a CBO managed sanitation programme in one of the slum neighbourhoods of Dhaka City i.e. Aynal's Bastee.

sustainable sanitation alliance

Case study of sustainable sanitation projects

Community-led Water and Ecosan Programme Shaanxi Province, China

Figure 1: Project location

Figure 2: Applied sanitation components in this project

1 General data

Type of project:

Large-scale community-led water and environmental sanitation improvement in rural area.

Project period:

Start of planning: Jan. 2005

Start of construction: July 2005

Start of operation: Jan. 2006

End of Project: June 2009

Project scale:

196,000 beneficiaries up to June 2007 (mid term of the project) based on base line survey for WES program of Plan China.

Total investment: € 1.8 million up to June 2007

Address of project location:

Villages in Pucheng, Chunhua, Xixiang, Chenggu, Jia Xian and Yulin Counties of Shaanxi province, China

Planning institution:

Plan China

Executing institution:

Respective Village Development Committees facilitated by Plan China Program Units

Supporting agency:

Government Township Project Offices

2 Objectives and motivation of the project

- Deliver sustainable health and hygiene benefits to the children and their families through improvement in water supply and environmental sanitation.
- Promote eco-sanitation methods to reduce water consumption and recycle nutrients and organics.
- Improve household income through time savings and income earning opportunities particularly for women.
- Support processes that can nurture self-empowerment of individuals or groups. The ultimate aim is the empowerment of the community, giving it the decision-making power and access to resources.
- Promotion of ecological sanitation option integrated with health and hygiene education.

3 Location and conditions

Despite China's remarkable growth and development, significant pockets of poverty remain in many regions. The development of poor communities is constrained by lack of access to services, unsustainable use of natural resources and unhygienic environmental conditions (e.g. fixed point open defecation, no garbage disposal, unmanaged domestic wastewater disposal, low water quality, mosquitoes breeding, unplanned disposal of animal excreta).

Rural and western China is particularly affected by this inequality. In rural China, only 68% of the population has access to safe drinking water and 29% to adequate sanitation (UNDP data from 2006; although JMP figures are higher). The absence of safe water supply systems and adequate sanitation is one of the most important problems for people in western China.

In the project area, in Shaanxi Province (in the North-West of China), lack of safe water supply and basic sanitation is closely associated with livelihood and other social issues. Poor economic conditions and lack of participation has hampered the initiation of developmental work. Due to a "top

Community-led Water and Ecosan Programme Shaanxi Province, China

down approach" for community development projects, there is little or no participation from the community.

Annual income per capita is in the range of € 100-150. Farming and fruit orchards are the primary source of income in the programme area. Human excreta are used as fertilizer for crops and vegetables. This is an old practice in China. In many houses toilets are made in such a way that the excreta of all members of the family are collected in buckets, which are taken to the fields periodically and are diluted with water and applied raw on the crops. When one bucket is filled up another one is placed in its place. Furthermore, water is not used for anal cleaning as the habit is wiping. The availability of water resources per capita in Shaanxi province is only half of the country's average. Droughts and low rainfall level, 400 – 600 mm per year, are faced by all rural communities in Shaanxi.

Shaanxi province is among the most under-developed regions in China and a survey conducted by Plan China in 2004 highlights this disparity. 25% of children under three years old suffer regularly from diarrhoea, due to poor access to water supply and sanitation (based on a single survey done by Plan China - a final survey will be conducted after completion of the entire project in 2009 to assess the changes due to project implementation).

A second Plan China baseline survey reveals that only 2% of families have access to potable water and 8% of families dispose excreta in a sanitary manner.

Communities in the programme area are affected by a very high incidence of water borne diseases, particularly diarrhoea and viral hepatitis. After conducting initial health and hygiene awareness raising activities in Shaanxi province and through participatory planning and discussion sessions with the target communities, the inhabitants identified three main needs:

1. The lack of safe drinking water forces families to use contaminated water sources that expose them to a range of water borne pathogens. These water sources are often located far from homes leaving women and children with the duty of collecting water.

2. The lack of access to basic sanitation increases the contamination of local water sources, degrades the local environment and promotes the spread of disease.

3. The lack of knowledge about the relationship between hygiene, water quality and good health increases the vulnerability of families, especially young children, to water-borne diseases.

The project area is most suitable for the promotion of ecological sanitation (in the form of urine-diversion dehydration toilets) based on the following:

- This sanitation practice is not new in China. Chinese people have a long history of using this type of sanitation in which urine is diverted from faeces.
- The same is true for the reuse concept. Since ancient times, Chinese are using human excreta as fertilizer in agriculture, thus the attitude is positive.
- Cleaning habit in China is wiping thus facilitating the dry separation of urine and faeces.
- The shortage of water calls for a solution which does not require water for flushing.

The project has targeted children, their families and the community. The target area covers 247 communities in the counties of Chunhua, Xixiang, Chenggu, Pucheng, Jia Xian and Yulin of Shaanxi province in North-West China.

4 Project history

The WES (Water and Environment Sanitation) programme of Plan China started in 2005 to cover 500 communities and 200 schools in Shaanxi province with a grant from Plan Netherland and supported with a matching amount from child sponsorship which is collected by Plan worldwide. Prior to this, the WES programme was implemented with sponsorship money and the project interventions were limited. The WES programme integrates the water supply, sanitation with hygiene promotion and education with further linkage to health and livelihood.

The first urine diverting toilets of the project were piloted and demonstrated in Sanyong village in Pucheng County during May/June 2005 and later it was piloted in other programme counties. After the successful pilot of urine diverting toilets in all counties, the construction of these systems in larger numbers began in July 2005. The number of toilets constructed in 2006 was impressive, confirming that the community accepted this new technology in large numbers.

The main reasons of the acceptance of this technology by the community are:

- The effective promotion by Plan programme units,
- Low price in comparison to other toilets (eg. biogas, flush latrines and twin pit series latrines),
- Simplicity of usage and maintenance and
- The individual household subsidy provided by Plan China.

The respective government departments (Water Bureau, Health Bureau, Poverty Alleviation and Township Offices) also accepted the fact that this type of toilets can be promoted on a large scale in rural areas since they are hygienic and present a compelling alternative for use by rural households. Subsequently ecosan UDD toilets have been included as the standard type of systems promoted by the Chinese government for on-site treatment, disposal or reuse of human excreta. These standard types are:

- Three compartment latrines
- Twin pit series latrines
- Biogas toilets
- Urine diversion dehydration toilets (UDDTs)
- Elevated dry compost latrine

In this respect the work done by Jiu San Society, a leading social organization, for promoting ecosan in China and also for advocating at national level is laudable. Ecological sanitation is high on the agenda of the Jiu San Society national action plan.

5 Technologies applied

Three types of latrines have been presented to the community to choose from in the programme area:

a) Urine diverting dehydration toilets

Community-led Water and Ecosan Programme Shaanxi Province, China

b) Biogas toilets

c) Twin pit series latrines (double urn toilets)

The communities were informed about the benefits and cost of all three types of latrines as well as the financial support available from Plan China.

a) Urine diverting dehydration toilets (UDDTs). The major difference between urine diverting toilets and other sanitation systems is that the toilet has two outlets and two collection systems. One is used for urine and one for the faeces, in order to keep these excreta fractions separate (Figure 3). There is a cover for the faeces compartments to protect the latrine from flies and other insects as well as to reduce potential bad odour. The latrine used in the programme area is based on the Vietnamese double vault latrines to enhance the dehydration of faeces and allow the use of urine as fertilizer.

The urine collection pipe is normally a plastic pliable pipe with the diameter of 40 mm. It connects the urine hole in the front of the squatting pan and the urine storage tank. The length of pipe should have sufficient reserve to facilitate the chamber change by turning the squatting slab by 180°. In colder climates, however, the pipe should not be too long to avoid freezing and blockage. The urine storage tank can be bought locally, and comes in various forms, such as barrel, bucket, kettle etc. with lids.

Figure 3: Household urine diverting dehydration toilet in Shaanxi Province (source: Plan China)

The faeces vault is normally built above ground. A faeces vault with a volume of 0.30 m³ can meet the requirement of a family of 5 to achieve a storage time of one year. There are normally two vaults to be used alternatively. The dimensions of the opening for emptying are about 25 cm × 25 cm. It can be sealed with a wooden board, metal board or bricks because the emptying takes place only once per year. The best way to seal the opening is with a black metal board which can effectively absorb solar energy to dry the waste faster (if the toilet is exposed to the sun).

When the first vault is full, the squatting pan is turned 180° and the other vault comes into use. The full vault is sealed for a minimum of 6-8 months for drying and hygienisation. The retention time and the elevated pH level results in die-off of pathogens and allows safe handling for use as fertilizer.

When the second vault is full, the first vault is emptied from the opening provided in the structure, and it then comes into use. The operation and maintenance is explained in Section 10.

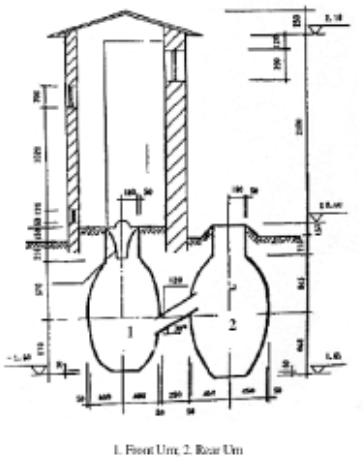
b) Biogas toilet. This kind of toilet consists of a squatting pan, faeces inlet, faeces pipe, biogas reactor (including fermentation chamber and biogas tank) and faeces storage chamber. In order to avoid the escape of biogas, sealing of the innner layer of the fermentation chamber should be done carefully. A squatting pan is normally installed, needing 2.5 to 3 litres for flushing the faeces by pouring water from a bucket.

Under the toilet the faeces pipe is connected. The faeces pipe can be bifurcated to have another inlet which is used for adding animal excreta based on the users' demand and availability of livestock.

c) Double pit series latrine (double urn toilet). This toilet has two urns built underground, which are constructed of brick or pottery. There is a concrete squatting slab with an inlet hole for the excreta and with foot rests and a super-structure for privacy and protection from the weather (Figure 4). The squatting pan is fitted on top of the pit without water seal and little water is required for flushing.

The two urn storage tanks are named according to their shape. The front urn is smaller and is normally constructed under the ground. It is mainly used to receive and store faeces. The retention time is generally over 40 days. The excreta can be completely digested to eliminate pathogens such as bacteria and parasite eggs (40 days retention period in first urn and after that carried to second urn through connection pipe to further eliminate the pathogens).

After the digestion in the front urn, effluent of this urn flows into the rear urn via a connection pipe. The rear urn is mainly used for storage of the effluent. A concrete slab is used to cover the outlet of the rear urn which prevents odour from escaping and rainwater from flowing into the urn.



1. Front Urn; 2. Rear Urn

Figure 4: Side view of a double urn toilet (source: Plan China)

65% of the constructed systems in the project area up to June 2008 are urine diverting dehydration toilets (UDDTs), as can be seen in Table 1. The promotion of UDDTs is quite successful in the Plan China programme area particularly in the central plain and south. There is still an operational problem in the North where harsh winter conditions cause frequent freezing of urine pipes.

Table 1: Number of toilets constructed in Shaanxi Provence under the Plan China WES programme

Period	UDDTs	Biogas	Double urn
July 2005-June 2006	8,457	1,214	1,650
July 2006-June 2007	6,410	1,369	3,072
July 2007-June 2008	3,189	1,020	1,500
Total	18,056	3,603	6,222

6 Design information

The design information in this section is only for the UDDTs since they are the most used option in the programme area. Expected average quantity (from Swedish literature) of faeces and urine per adult is:

- 400 - 500 litres urine per year i.e. 1.10 -1.36 litres per day.
- 50 kg wet faeces per year

Whilst these figures were derived for Swedish diets, they seem to also work for the Chinese UDD toilets built with these design parameters.

In the UDD toilets promoted in the Plan China programme area, the urine is collected in a separate container which is often placed under the stairs for safety and efficient space utilization. The construction of these types of toilets is quite simple and there is no risk of leaking from the vault - hence, water proofing of the vaults is not required. The flood risk in the Plan China program area is minimal. However in flood prone areas, water proofing is must.

The toilet can be constructed entirely above ground. Due to separation of urine and no flush water, the volume of potentially hazardous materials becomes smaller and the toilet requires less space for construction.

- For a household of 5 persons the unit should consist of two processing chambers, each of a volume of 0.25 m^3 (50 kg per person per year x 5 (No. of adults) x 1 year = 250 kg ≈ 0.25 m^3).
- The entire construction is above ground and the vaults are placed on a solid floor. The size of a vault may be 0.9 m x 0.7 m x 0.4 m (depth) = 0.25 m^3. 0.2 m of free space is provided, i.e. total depth = 0.4 + 0.2 = 0.6 m. Thus, final vault size is 0.9 m x 0.7 m x 0.6 m. For a smaller household the size may be reduced.
- Two openings of size 0.25 m x 0.25 m are provided in each vault for the removal of dried faeces.
- One vent pipe (diameter 10 or 15 cm) extents from the vault to above the roof for ventilation and is equipped with lids to stop rain water. Vent pipes should be as straight as possible as bends reduce air flow, and should be minimum 50 cm above the roof. If necessary the vent pipe can be fitted with a small electric fan (price: € 3).

Setting/location of UDDTs:

- Location of a UDDT can be done in several different ways depending on the availability of space, its location inside or outside the house, convenient position/space for openings for the removal of dehydrated material and urine collection (the location is selected in consultation with the households).
- The vent pipe should be provided in the middle. Where it is not possible to provide a pipe in the middle then two vent pipes, one in each vault, should be provided at the edges especially in warmer/humid areas. Generally in the toilets constructed inside the house, it is not possible to provide vent pipes in the middle as this would encroache on leg space. If the vent pipe is provided in the middle without bend then due to optimal size of surface area of squatting it will cause inconvenience in squatting and getting up.
- Where the plinth level of the house (in dry areas) is substantially higher than ground level (around 1-1.5 m higher than ground level), and the location selected for the latrine has access to an external wall in which an opening for collecting dehydrated material can be provided, the UDDT can be constructed partially/fully underground (the vault opening would be above ground from the outside and can be emptied easily). In this case the urine container can also be placed outside the house. This arrangement will save space needed for stairs but extra precaution should be made to avoid dampness. Excessive dampness will negatively affect the dehydration of faeces.
- The steps of the stairs can be 200 mm or 150 mm. For children and elderlies the steps should be ideally 150 mm. Number of steps should not be more than 3 in case of 200 mm and 4 in case of 150 mm thus limiting the depth to 0.60 m. Higher depths require more space for stairs and are not safe for children and elderly.
- The stairs can be constructed in the middle or in the sides depending on the availability of space. Stairs should be by the side of toilet if it is constructed together with the bathroom otherwise it will obstruct the bathroom use.
- In extremely cold conditions, insulate the urine pipe so that it will not freeze. Urine pipes should be attached to the container in such a way that all urine passes to the container and that it is free of any residues (stagnant urine) after use (Figure 5). This will help the urine pipe not to freeze in extremely cold conditions.

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Figure 5: Open hatch shows access to the urine pipe and urine storage tank of the UDD squatting toilet (source: Plan China)

- For toilets constructed outside the house, again there can be a number of different ways to place the opening for taking out the dehydrated faeces. It can be placed on the rear wall, on any side walls or even in the front. The most optimal setting of an outside toilet is to provide openings in the rear wall and stairs in the front (middle of the vault). The other option is to provide openings in the sides and stairs in front of one vault.
- The thickness of the vault partition wall should not be more than 60 mm. Since it is a non-load bearing wall and the squatting slab rests on the peripheral wall (120 mm thick) the thickness can be reduced further by using other materials like thick dark hard glass, stone slate slab and wood with aluminium wrap. If the thickness of the partition wall exceeds 100 mm there is a chance that faeces will stick to it.
- For lighting and ventilation adequate openings in the walls of an outside toilet should be provided.

7 Type of reuse

Since ancient times human excreta has been used in China for crop fertilization. However, the safety aspects have often been overlooked and mostly fresh excreta have been taken to the fields while neglecting the health risks.

By promotion of ecosan systems the hygienic concerns are being addressed, and excreta can be safely utilised for crop fertilization. Note that if households open the faeces vault prematurely (less than one year) and use the dried faeces for fertiliser too early, this is not a safe practice.

The dried faeces are removed from the vault once or twice a year depending upon the filling rate. They are applied to the field before plantation or sometimes in between two planting periods. However the amount produced from one household is relatively small compared to the fertilizer need of the household, as they produce crop not only for their own consumption but also for sale. The average fertilizer need for these households of five members is 150 kg per year and the use of composted faeces and urine from UDDT fulfills around 15% of total need of the family.

Urine is applied by the households once or twice a week mostly to nearby fields. Often it is applied with a dilution of 1:2 with water but sometimes also raw followed by watering.

The toilet users are generally small farmers owning on average an area of 0.2 - 0.33 ha. Most of the farmers have some land near their household used mostly for vegetable farming and some fruit orchards (apples, dates, pears, plum, apricot etc.). The land further away from the house is generally used for grain farming such as rice, wheat and maize.

8 Further project components

This programme aims for comprehensive development in the field of water and sanitation in the respective communities. The sanitation programme is integrated with hygiene promotion and education activities in the communities to raise the residents' awareness about the linkage between health, sanitation and livelihood. The project focuses on behaviour change through communication. The approach of this program is "software precedes hardware", "demand based, child centred development and gender awareness", and "sanitation precedes water supply and other infrastructure".

"Sanitation precedes water supply" was the main approach with full participation from community. The sanitation intervention starts from the planning phase itself and continues in post implementation as well. The water supply component was taken up only after the overall improvement in sanitation and acts as an incentive to the community. The other project components include water supply, solid waste management, greywater management, rainwater harvesting and water source protection.

Mid-term evaluation of the programme was carried out in September 2007. The evaluation showed the improved usage of toilets (data on health improvements is planned to be collected in 2009). However it has been recommended to extend post implementation support for minimum one year to ensure the sustainability of system. The project is regularly monitored at three levels - community, programme units and country office(s). The country offices are planning to conduct research on community participation, use of urine and faeces in agriculture and the programme's impacts on community and children health in coming years.

Similar programmes are being implemented outside of Shaanxi province and also in other counties in Shaanxi in association with government departments on the initiative of Plan China.

Urine separating systems have also been introduced at schools in Plan China program area of Shaanxi province (Chunhua, Puchenmg and Xixiang county) and the initial results are encouraging (the demo toilets are being used by children and teachers). In the future more schools will be covered under this programme for constructing urine diverting toilets - in consultation with school authorities and the education bureau of the province.

Plan China is lending support to other organizations such as local NGOs, Water Bureau, Poverty Alleviation Office and Health Bureau for promotion of UDD toilets in their respective

areas (reuse is the old Chinese tradition so this type of toilet promotes safe use)

Specific activities for childern should be planned in the preparation phase. Women should be encouraged to participate in regular meetings of VDC (Village Development Committees) as well as in community-wide meetings. Some activities should be planned for more active women involvement to improve overall health and hygiene of a family. Consult women for site selection of household latrine and water tap connection: For long-term and consistent use of sanitation facilities by the entire household, female members of the houses should actively participate from planning to implementation and operation and maintenance.

Post implementation support is required for permanent behaviour change, consistent use of toilets and safe use of faeces as fertilizer.

9 Costs and economics

The standard urine diverting toilet (complete in all respects) in the project in 2007 costs 750 RMB (€ 80). However, due to the use of local materials for superstructure, such as the use of thick plastics or asbestos sheet for roofing, the cost has come down to 500 RMB (€ 54). In cases where it has been constructed inside the house, the cost of the superstructure was saved and normally it costs 300 RMB (€ 32). Table 2 shows the cost breakdown of a standard UDDT.

The rates of materials in Table 2 are for bulk procurement by the community inclusive of transportation. The rates would be higher if procurement of material would be done individually due to higher transportation and retail cost.

Plan China has a policy of individual household subsidy for the UDDTs (50% subsidy per toilet in 2006, down to 44% in 2008). However gradually this subsidy is being reduced and will be phased out in the next 2-3 years. In the future the focus will shift more towards intensive software with complete discontinuation of hardware subsidy.

Table 2: Cost breakdown of a standard UDDT (outside, with superstructure including labour) in Plan China project area in 2007 (1 RMB = 0.107 € in Aug. 2008). For comparison: Double urn toilet costs 1000 RMB and the cost of biogas toilet was 2500 RMB.

Item	Quantity	Costs in RMB	Costs in EUR
Urine diverting squatting plastic pan (produced by Jiu San Society)	1 unit	61	6.5
Concrete squatting slab	1 unit	29	3.1
110 mm PVC ventilation pipe	6 m	24	2.6
PVC bend 110 mm plus adhesive	1 unit	3	0.3
Cement	3 bags	33	3.5
Sand	1 m^3	35	3.7
Glazed tiles (20 x 0.3 x 0.3 =1.8 m^2)	1.8 m^2	36	3.9
40 mm plastic urine pipe	1.2 m	3	0.3
Urine container	2 unit	5	0.5
Ash Container	1 unit	4	0.4
Toilet paper basket	1 unit	2	0.2
Spade for ash	1 unit	5	0.5
Mason (1 for 3 days)	3	120	12.8
Labour (2 x 3 days)	6	168	18.0
Bricks	700 pieces	112	12.0
Galvanized corrugated iron (GCI) sheet for roof	3 pieces	24	2.6
Wooden beam to support roof	1 unit	6	0.6
Door	1 unit	60	6.4
Ventilation	1 unit	20	2.1
Total		**750**	**80**

10 Operation and maintenance

The operation and maintenance of urine diverting dehydration toilets (UDDTs) is very simple. The most important do's for UDDTs are:

- Before the first use, cover the vault floor with a 3 cm thick layer of dry powdered earth to absorb moisture from the faeces and to prevent faeces from sticking to the floor.
- Always keep two containers on the latrine platform, one full with ash and a shovel or a small bowl, and the other for storing used toilet paper after anal cleaning with a small stick to compress it in the container (toilet paper may retard the drying process of the faeces by covering them).
- After each use (for defecation), sprinkle two bowls or shovels of ash over the faeces and return the cover attached to the pan. The ash absorbs moisture, controls bad smell, prevents fly breeding and makes faeces less unsightly to the next user.
- Paper used for anal cleaning stored in a container should be burnt regularly outside the house.
- Keep a brush or small piece of cloth for cleaning the pan at regular intervals.
- Wash hands with soap after defecation, handling urine container and cleaning the squatting pan. Always wear gloves during emptying the faeces vault and wash hands with soap afterwards.
- Always keep two small urine containers and two big urine containers. The big urine containers with tight lids should be placed in the courtyard in a shed for storing the urine from the small container. Two small containers (with a small inlet for inserting urine pipe) should be used alternatively to collect urine by placing it next to the latrine. Urine containers should be closed at all the time to prevent odour and losses of ammonia into the air. - For households who have their field away from their houses, it is not practical to take urine frequently, but for those households who have their kitchen garden and nearby fields, they can use small urine containers alternatively.

- When the first big urine container is full then seal it properly for use as a liquid fertilizer (undiluted) after 30 days and use the second container.
- In kitchen gardens, urine may be applied directly but the time gap between urine applications and harvesting should be at least one month. Urine contains salt so plain watering would be beneficial after urine application for better plant growth.
- Apply undiluted urine to open soil. For growing plants urine can be used diluted or undiluted. If urine is diluted then use one part urine with three parts of water. It may be applied in one large dose or several small doses. Apply urine in smaller doses for crops with smaller roots. For fertilizing 1 mu (0.067 ha) land, approximately 850 litres of urine would be required i.e. approx. the total urine discharge of two adults in a year.
- The first vault can be used for about 6-7 months by a household of 5 persons. Additives are also added after defecation and soil is placed on the bottom and also on top for sealing when the vault is full. Therefore the effective depth would be 0.6 m - 0.03 m (soil on floor) - 0.05 m (top soil for sealing) - 0.20 m (free space) = 0.32 m. When the vault is full up to 35 cm, level the content by a stick and then fill the vault to the brim with dried powdered earth and seal it for processing for six months. The second vault now comes into use. When the second vault is nearly full, empty the first vault.
- The timing for using compost should be planned in advance (400 - 500 kg humus per family per year can be formed).
- Wash the urine pipe at regular intervals by passing small quantities of water through it from the squatting pan, where it is attached.

11 Practical experiences and lessons learnt

A community, if properly mobilized and trained, is capable of identifying sanitary problems and their solutions, and is also ready to plan, design and execute the system which is useful for them. Children and women have eagerness to learn, analyze and solve their problems and manage their time in a most useful manner. One should design hygiene promotion messages with women and children in mind. Hygiene activities should suit to the women in the family and their domestic responsibility. The focus in this case study is on ecosan but this project is part of the comprehensive WES program of Plan China.

Demonstration and cross visits are important tools for community capacity building. Urine diverting toilets proved to be a community-friendly technology in rural China. Promotion of new technologies should always be supported by demonstration and cross visits. The community is able to accept the new technology for betterment of their lives and changing their unhygienic behaviours by health and hygiene information conveyed by the ecosan promotion programme. Simple, low cost technology allows independent local level construction.

More community mobilization activities should be planned. Community mobilization and gender awareness is a continuous process and cannot be achieved by a single training period.

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

	Collection and transport			Treatment			Transport and reuse		
Sustainability criteria (aspects)	+	o	-	+	o	-	+	o	-
• Health and hygiene	X			Not appropriate as there is no external treatment (other than the storage of urine)			Not appropriate as reuse is by the toilet users themselves		
• Environmental and natural resources	X								
• Technology and operation	X								
• Finance and economics		X							
• Sociocultural and institutional		X							

With regards to long-term impacts of the project, the main expected impact of the project is improved public health (e.g. reduced rate of diarrhoea incidences in children). It is planned to assess this at the end of the project in late 2009.

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Wastewater management as a contribution to integrated water resource management in Tunisia; KfW; 2008

Water is Precious

Today Tunisia uses more than 90% of its renewable water resources and suffers from acute water stress, as do the other countries of North Africa. In some regions the groundwater level is falling steadily as a result of overexploitation. Agriculture consumes 80%, the biggest share, followed by drinking water supply, which accounts for 12%. Thus water is a precious commodity, which Tunisia needs to manage with increasing care to preserve its development opportunities.

In the past, great efforts were made to develop the country's accessible water resources. Tunisia now has 26 dams and a vast number of groundwater wells for irrigation and drinking water supply. However, these water sources are often too salty, particularly in the south of the country. At the same time, wastewater from human settlements and industry has increasingly polluted surface waters and groundwater reserves. Seepage water from uncontrolled rubbish tips poses an additional threat.

Integrated Water Resource Management (IWRM)

In recent years, a new mindset has emerged. Tunisia no longer focuses on exploiting more and more the available water resources but on establishing a demand-oriented, integrated water resource management (IWRM). To implement this strategy, the Tunisian Government has adopted a water sector investment programme whose specific objectives consist in managing the resource of water in an integrated and efficient way and preserving it in a sustainable way. The IWRM is based on a planning process in which decision-makers, researchers and users together devise a concept for sustainable water use in the different water catchments - even across national boundaries. Today the water supply in rural regions of Tunisia is being managed by around 2,000 drinking water user associations which operate the water supply systems for some 1.5 million inhabitants with substantial technical and financial autonomy.

Wastewater is to be treated in order to protect surface water and groundwater from pollution. Tunisia has undertaken great efforts in wastewater and solid waste management. However, the water resources are still at risk of contamination from industrial wastewater and solid waste. The sparing use of water is intended to preserve and increase the agricultural potential. Water consumption per hectare of irrigated farmland has already been reduced and is set to decrease further in the coming years through the use of more efficient irrigation techniques. At the same time, in the tourism sector Tunisia has been quite successful in its efforts to reduce water consumption per hotel bed.

KfW Entwicklungsbank supports Tunisia in conserving and managing its water resources under a number of different schemes:

- Drinking water supply for poor, rural groups of the population that have had no access to water or to water of only poor quality, and promotion of user associations;
- Improving the drinking water supply for small towns in the south of Tunisia through decentralised groundwater desalination plants (reverse osmosis);
- Promotion of efficient irrigation techniques (sprinkler irrigation, drip irrigation);
- Treatment of municipal wastewater, including recycling effluents for use in irrigated farming;
- Safe disposal of municipal waste in sanitary landfills;
- Improvement of industrial wastewater and solid waste management.

Recycling of treated effluent and reuse of sewage sludge

The recycling of treated wastewater is playing an increasingly important role in Tunisia. Some 30% of effluent of wastewater treatment plants is already being reused for the irrigation of more than 8,000 hectares of farmland (such as peach or olive plantations), but also for public green spaces (420 hectares) or golf courses (a good 1,000 hectares).

Sewage sludge was initially re-utilised in agriculture. Because of hygiene problems, however, Tunisia stopped this practice in 1998. KfW has subsequently promoted a debate after which the use of sewage sludge was readmitted in agriculture in 2007 provided it met certain standards. In addition, KfW is also supporting concepts for alternative sludge treatment and disposal for ten large wastewater treatment plants.

Anaerobic digestion of sewage sludge becomes an interesting alternative due to higher energy prices and climate protection. Sludge digestion is to be introduced for some large sewage treatment plants (for more than 100,000 inhabitants). Methane, a biogas released in the process, is burned and used for electricity generation. The electricity gained in this way can cover a large portion of the energy requirement of the sewage treatment plant itself. Besides, this climate-friendly method of electricity generation is rewarded with emissions certificates (CDM). They represent an additional source of income.

Developing the institutional framework further

The Office National de l'Assainissement (ONAS) as a state institution is responsible for the operation of most of the sewer networks and wastewater treatment plants (currently around 98). Tunisia is working to further improve the efficiency of ONAS through a multi-year service agreement (Contrat Programme 2007 – 2011). One of the approaches being pursued is the privatisation of the operation of sewer networks and wastewater treatment plants. Around 12% of the systems are currently being operated by private enterprises.

In Tunisia, the wastewater fees are included in the fresh water price and are collected by the state water utility SONEDE. The wastewater fees cover the operating costs of the sewage systems but not the full costs. In the past the Government has reliably supported ONAS with subsidies within the framework of service agreements so that the costs were covered overall and sustainable operation was ensured. The strong increases in energy costs, however, pose an additional challenge which ONAS also wants to meet by further improving energy efficiency.

While 87% of the households in the municipalities serviced by ONAS are already connected to a sewer system and almost all the sewage collected (96%) is also being treated, many industrial enterprises are still dumping their wastewater into the rivers without any treatment. With the support of KfW Entwicklungsbank, Tunisia has therefore established an environmental fund that is designed to support these industrial enterprises in financing environmental measures such as the necessary investments in wastewater avoidance or wastewater treatment. KfW has financed a complementary study that analyses what changes in the institutional framework are necessary in order to better enforce environmental standards in industrial enterprises over the long term.

The Medjerda Valley - an example

The Medjerda River plays a very important role in supplying Tunisia with water. Its source is in north-eastern Algeria and it is not only Tunisia's mightiest river but the only one that flows perennially.

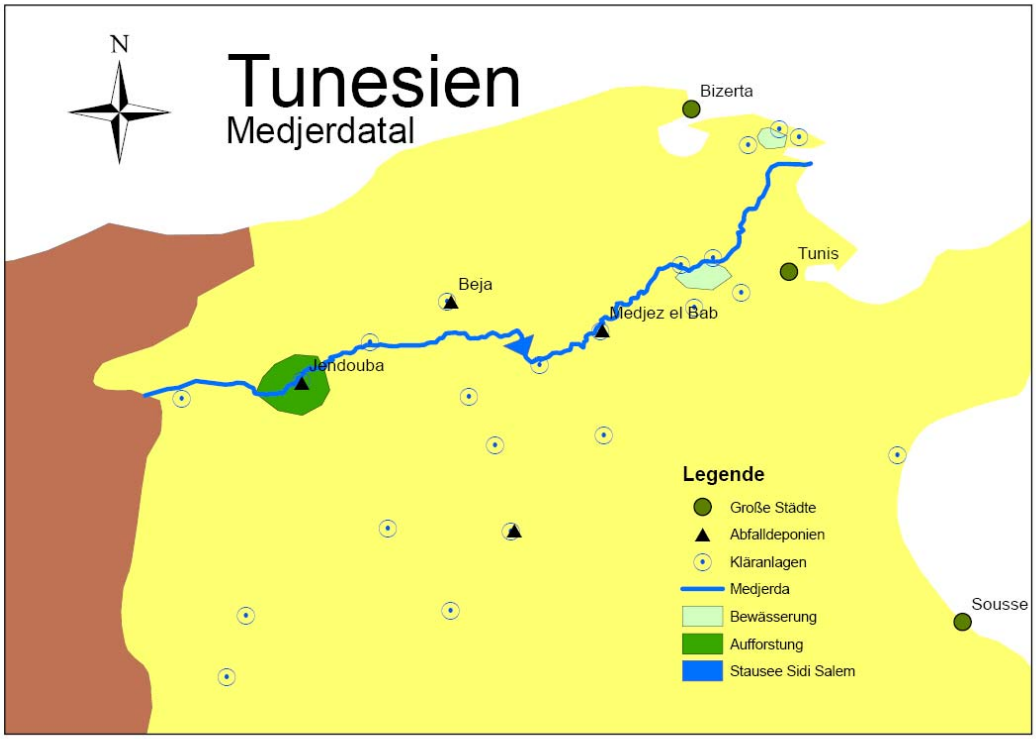


Illustration: KfW projects in the Medjerda Valley

In the catchment of the Medjerda River, KfW Entwicklungsbank has financed rural drinking water supply, more efficient irrigation systems and the establishment of safe sanitary landfills. The wastewater management in a total of 11 towns with some 375,000 inhabitants was supported under several programme phases.

These wastewater programmes contributed to collect and treat almost all residential wastewater in the Medjerda Valley. They include mixed sewer systems and in some cases also separate collection of stormwater and wastewater. The wastewater is treated mechanically and biologically. The effluent is increasingly being used for irrigation, for instance in the region around the town of Beja. In the upper reaches of the Sidi Salem Dam the effluent is treated further to eliminate nutrients in order to prevent eutrophication of the reservoir. The dam was built in the 1970s and partly financed by Germany. With a maximum volume of 1 billion cubic meters the reservoir is one of the world's large reservoirs. In addition to renewable electricity generation, the reservoir also supplies water for irrigation and drinking water for half of Tunisia's population, including the people living in the large coastal cities of Tunis, Sousse and Sfax. Against this background it is very important to preserve the water quality.

Conclusion

The long-term engagement of German Development Cooperation with Tunisia shows how improved wastewater management can support a partner country's integrated water resource management. In the Medjerda Valley the broad support that has been provided in the areas of drinking water, irrigation, wastewater and solid waste management has already made a significant contribution towards achieving a lasting improvement in river water and groundwater quality. Nevertheless, achieving a greater reduction of industrial water pollution continues to pose a major challenge for Tunisia.

Rural Water Supply in Rajasthan, India -Sanitation Component

1 Objective

The overall project aimed to reduce the risks of water-induced diseases. The project covered water supply, health education and sanitation. The main focus of this document is on the health education and sanitation aspects.

2 Context

BMZ ID: 1995 65 420
Planning started in 1994; implementation from 1995 – 2007, latest report 02/2008

	Project area	India
Target group / population	1.05 million	1,148 million (2008)*
Under 5 mortality rate (per 1,000)	67 (Rajasthan 2004) ***	32 (2008) *
Population below poverty line	n.a.	25%*
Population growth p.a.	2.2% (Rajasthan 2005) ****	1.6% (2008) *
GDP per capita at official exchange rate	EUR 400 (Rajasthan 2004)**	EUR 575 (2004)** EUR 711 (2007)*
Local per capita household income	EUR 63 (2005)	
N° of on-site systems realised	28,266	n.a.
N° of sewer connections realised	0	n.a.
% improved sanitation in the project area	9% (before project) 55% (2008)	n.a.
% sewage treated	0%	n.a.

* CIA The World Fact Book, July 2008; 973 USD per capita (base 1,130 million) in 2007
** Ministry of Statistics and Programme Implementation, 2004
http://en.wikipedia.org/wiki/States_of_India_by_size_of_economy
*** http://sje.rajasthan.gov.in
****http://www.investrajasthan.com/kommon/bin/sr.php?kall=showfile&code=020070020

The project area is a rural area located in the State of Rajasthan (North-West of India). Little rainfall (400 mm per year) and high temperature variation (0.5° - 48° C) characterise this semi-desert region. Drought and excessive use of ground water for irrigation raised the salt content of the ground water. Population density in this rural area is high (165 inh./km²) in relation to scarce water resources, but lower than Indian average (386 inh./km²).

Prior to the project, drinking water supply was insufficient and Fluor content constituted an additional health hazard. Sanitation conditions were very poor. Only 9% of households had access to basic sanitation. More than 80% of the rural population used open fields for defecation. For women this situation was especially discriminatory, since they are subject to strict social conventions. Thus they were forced to find sheltered places or to go out at night time. Knowledge of the linkage between hygiene and health was limited, especially among poor people.

3 Project approach

Investment/Technology:

The project financed a water supply system providing villages with water from the Indira Ghandi canal. The sanitation component supported investment in private and public facilities. For private latrines, several different models were suggested. In a participatory and demand-driven approach, women have been systematically included in the decision process, in particular regarding the location of the sanitation facilities within the compound. People mainly opted for a pour-flush toilet combined with a bathroom. They generally preferred a deep pit for the toilet, which requires no emptying over long time. The grey water from the bathroom infiltrates the sandy soil through a separate soak pit. All construction materials and know-how are locally available. Altogether the project supported the construction of 28,266 private sanitation units to serve about 180,000 people as well as 95 school sanitation facilities. The sanitation coverage in the project area increased from 9% to 55% in 2007. A

part of the increased coverage is the result of investments without project support (mainly better-off households).

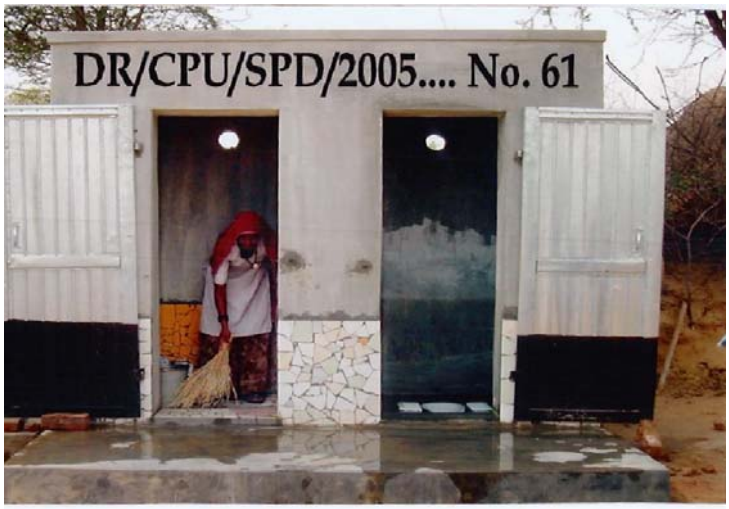
School sanitation facility

Institutional concept / support activities:

The Public Health Engineering Department (PHED) of Rajasthan is responsible for water supply and sanitation. Before the start of the project, PHED had no particular focus on wastewater management and hygiene. Local authorities also did not consider this an important issue. Only some NGOs promoted sanitation and hygiene campaigns.

The project therefore initiated the creation of a Community Participation Unit (CPU) staffed permanently from a consortium of five NGOs. The “Indian Institute for Health Management Research” is the lead NGO. The CPU supported user participation in planning and implementation of the entire project. A Water and Health Committee (WHC) was established in each of the 360 villages - it is responsible for maintenance and fee collection for the water supply system.

The CPU organised a campaigns on hygiene and health addressing women groups, self-help groups and school children in particular. Special efforts were undertaken to empower women and strengthen their social status by stressing their responsibility for water in the families. This contributed to raising demand for the basic sanitation facilities supported by the project. The applications for sanitation facilities were filed in the name of women. The local WHCs were responsible for the selection of beneficiaries, giving priority to poor families and families with handicapped members or households headed by women. The CPU procured building materials, advised local user groups and trained local masons in technical and health aspects of sanitation. The CPU certified the masons who entered into an agreement with CPU to construct sanitation units for the project. The villagers could then employ these trained masons. Thus know-how remains in the project region.



Standard sanitation unit with latrine and bathroom

India has adopted a “total sanitation” approach and the Indian President is rewarding each village that achieves 100% sanitation coverage. This is a strong motivating factor and villages strive to obtain this reward. By the end of 2007 twenty-three project villages out of 360 had achieved 100% sanitation coverage, and 70 to 80 more villages will probably achieve it in 2008.

Operation and maintenance concept

The individual households are responsible for cleaning and maintaining their toilets and bathrooms. With six to seven users, the deep pits generally require emptying only after 10 to 15 years. Due to the dry climate and the very limited amount of water used for flushing, the deep pits will contain a solid product which can be used as fertiliser on nearby fields. The users can do the emptying themselves; but service providers for the job are also available.

4 Cost and financing

	Project (sanitation component)	**per capita**
Infrastructure investment	EUR 4,857,658	EUR 26
Hygiene awareness, staff, consultant	EUR 613,735	EUR 3
Subsidy (for beneficiaries)	EUR 2,751,842	EUR 15
Loan	n.a.	n.a.
Investment contribution from beneficiaries	EUR 2,719,551	EUR 15
Investment contrib. as % of regional GDP (2005)		3.7%
Investment contrib. as % of HH income (2005)		23%
LRMC* per capita and year (2007 prices)	n.a.	EUR 1.87
LRMC as % of regional per capita GDP (2005)	n.a.	0.5%

* LRMC = long run marginal cost = full costs of the programme; useful lifetime 25 years; discount rate 5%

The overall cost of the sanitation component (including school sanitation) was EUR 5.4 million, financed 50% by beneficiaries and 50% by the German grant. Average investment costs for a toilet with bathroom serving on average 6 to 7 persons was EUR 135 (in 2007 prices). Eighty percent of the costs are construction materials, the rest is labour costs. The overhead costs for awareness campaign and project implementation were around EUR 21 per sanitation unit. The own labour for regular cleaning of the facilities has not been valued.

The resulting full costs of the programme over the lifetime of the investments are EUR 1.87 per capita and year. The costs are only 0.5 % of the per capita GDP in Rajasthan. Beneficiaries received a 50% subsidy on average through the project. However, their contribution to the investment was still quite a burden for the poorest households. A household income survey of the project in 2005 classified 58% of households in the lowest income bracket and indicated an average annual per capita household income of around EUR 63. Compared with this income, the contribution to the investment is around 23% of the annual income. Only part of the contribution can be provided in kind (labour, stones), another part has to be provided in cash.

5 Experiences / lesson learnt / critical aspects

The PHED considers that the institutional approach with a CPU including NGO experience was crucial for the success of the sanitation component.

A project survey exploring the motivation of people to improve their sanitation facilities, led to very interesting findings. Neither the protection of natural resources nor the aspect of health or hygiene was the most important. The main factors were “convenience” (74%) and “dignity, self-respect” (8%). A high percentage of beneficiaries were not motivated by the toilet but by the prospect of having an own

bathroom. Despite this fact, a survey showed that several years after investment, 90% of toilets and 95% of bathrooms were well maintained and in use.

Even though the water supply is not yet entirely cost-covering and operation problems still occur, the time required for fetching water has been reduced considerably and there is now more water available for personal hygiene. Thus the linkage of sanitation to better water supply has been important.

Another lesson learned from this project applies to the time schedule. Large-scale behavioural changes take time. The initial time schedule of 5.5 years was stretched to an implementation time of 12 years. Sanitation coverage in past years has speeded up, showing that there has been a real change in attitude towards sanitation.

While different technical options were suggested, people generally opted for deep pits for the toilets. The risk for the ground water from the soak pits is limited as the ground water is very deep and not used for drinking purposes because of the poor quality. Technical solutions ensuring better ground water protection will probably be successful only if they are as convenient and economical as the present design.

Basic Rural Sanitation in Bahia, Brazil

1 Objective

The overall objective of the project was to reduce the risks of water-induced diseases for a population of 34,000 in 11 municipalities with a total of 45 rural villages. The approach includes improved drinking water supply and improved sanitation.

2 Context

BMZ ID: 1995 65185
Planning and implementation 1997 – 2003; construction 1998 – 2002, start of operation 1998 – 2002, sensitisation, training 1998 – 2004; final evaluation 2006

	Project area	Brazil
Target group / population	34,000 (rural; 2002)	192 million (2008)
Under 5 mortality rate (per 1,000)	38 (Bahia, 2002)*	27 (2008)**
Population below poverty line		31% (2005)**
Population growth p.a.		1% (2008)**
GDP per capita at official exchange rate	EUR 2,712 (2002)***	EUR 5,007 (2007)***
N° of on-site systems implemented	1,035	
N° of sewer connections implemented	7,819	
% improved sanitation	3% (before project) 100% (after project)	
% sewage treated	100% (after project)	

* UNICEF: Situação da Infância Brasileira 2006, http://www.unicef.org/brazil/pt/resources_10167.htm
*** CIA The World Fact Book, July 2008
*** World Bank

Prior to the project, institutions in the sanitation sector were rather weak. Cost recovery for water supply and sanitation was largely insufficient. Sanitation services were more or less inexistent in the region. The risk of failure was estimated to be high at the start of the project.

3 Project approach

Investments / technology

All houses in the 45 villages have been connected to water supply and have been provided with sewage disposal. Depending on local conditions (housing density, topography and soil conditions), the approach included central or on-site wastewater management concepts. Sewers were constructed as condominial systems (smaller pipe diameters, fewer manholes, low depth, backyard connection). The options for wastewater treatment were ponds where sufficient space was available. In case of limited space, anaerobic Imhoff tanks were followed by gravel-sand filters.

The on-site sanitation facilities are septic tanks with a sludge settling chamber and infiltration pits of the treated sewage. In some cases, a multi-chamber septic tank serves several households jointly. The initial project design included latrines, but this feature was generally rejected by users.

In the different systems, the residual pollution of the treated effluent is below 100 mg BSB_5/l.

Institutional concept / support activities

As a special-purpose company the Companhia de Engenharia Rural da Bahia (CERB) executes drinking water programmes in the Federal State of Bahia. CERB was responsible for the implementation of the entire programme including the sanitation component.

A core feature of the project was the establishment of user groups on the community level and a joint service council CENTRAL on the regional level. CENTRAL is an association of several municipalities

and their user groups created for the technical and administrative management of water supply and sanitation facilities. The overall sector regulation is the task of the government of Bahia.

As an accompanying measure, the project supported sensitisation campaigns for hygiene and the correct utilisation of the sanitation facilities. Condominials have smaller diameters (equal or less 100 mm) and the gradient is not very high. This increases the risk of blockages and it is very important that people do not flush solid waste or other objects in their toilets. Therefore the accompanying measure is very important to make people aware about these issues.

Training session

Operation and maintenance concept

The user groups take charge of the everyday operation and service of the facilities. They maintain the facilities, do small repairs, build new connections and collect the fees. Wastewater fees are collected together with the drinking water fees.

The regional joint service council CENTRAL is responsible for greater repairs, emptying collective septic tanks, the treatment ponds and Imhoff tanks. They have the overall responsibility for financial management and accounting.

4 Cost and financing

The specific investment amount varied according to local conditions. Average per capita investment for on-site systems was EUR 130 (with infiltration) and around EUR 30 (without infiltration). The total investment for condominial systems varied between EUR 100 and EUR 190 per capita. Major variations were related to the size of the village, local conditions and length of network (3 to 7 meters per inhabitant served). The investment cost of the treatment facilities was around EUR 24 per capita for ponds and EUR 17 for Imhoff tanks.

The project executing agency received a 100% grant for the project from the Federal State of Bahia. German Financial Cooperation (through KfW) contributed with a EUR 0.75 million grant and a EUR 2.26 million loan at preferential interest rate to the State of Bahia for sanitation purposes.

The waste water tariff structure of CENTRAL is a progressive block tariff system based on drinking water consumption. The lowest block is a fixed block of 10m³, which is charged to all customers. Most residential customers do not consume water beyond the first block, the average water consumption being 48 l/pcd. The tariff progression for residential customers is limited (25% progression for 20m³ and 40% progression for 25m³ per month). The structure furthermore provides for a cross-subsidy from other customers, such as commercial, public and industrial customers. However, the number of other customers is very limited in this rural area. The main revenues of CENTRAL come from private households.

	Project (sanitation component)	per capita
Infrastructure investment	EUR 4.6 million	EUR 145
Hygiene awareness, training of operation staff	EUR 1.3 million	EUR 39
Subsidy (for beneficiaries)	EUR 5.9 million of which EUR 0.8 million German FC	EUR 184
Investment contribution of beneficiaries	None	None
Operation cost p.a. (2002 prices)	EUR 0.147 million	EUR 4.33
LRMC p.a. (2002 prices)		EUR 16*
LRMC as % of local per capita GDP		0.6%
Annual HH user fees for CENTRAL services		EUR 1.50
Collection efficiency	90%	
Coverage of operation cost	95% (2005)	
Annual HH user fees for local services		0 – 2 EUR
Operation cost borne by municipalities	In some cases	2 EUR
Annual HH user fees for CENTRAL and local services (combined) as % of local GDP		0.1 – 0.2%

* Population growth estimate 1.5% p.a.; weighted average of useful lifetime 25 years; discount rate 5%

In most villages the users also pay the costs for local technicians and energy. In some villages, the community covers the local operation costs out of the general community budget. At the time of final project evaluation (2006), very poor households had to use up to 3% of their income for the combined water and wastewater fees, which can be seen as an affordable charge.

5 Experiences / lessons learnt / critical aspects

For CENTRAL it is important to generate sufficient income to cover operation and maintenance cost. As long as the service quality is good (especially for water supply), people are willing to pay for the services. Blockage of the sewer systems occurs quite often because people dump solid waste into the toilet. Blockages and other problems are generally repaired quickly. Two villages with technical problems showed low collection efficiency (40%) compared with an average of 90% for the other villages. At the time of final evaluation (2006) the project implementing agency CERB was working on these technical problems and expected to solve them.

In the first years of operation it has not yet been necessary to remove sludge from ponds or Imhoff tanks, but CENTRAL has adequate equipment for the sludge removal. The sludge will be used in agriculture. For septic tanks, the users remove the sludge and use it directly in agriculture. This is already common practice.

Meanwhile, two municipalities left the joint service council CENTRAL. In one case the water is supplied by another provider (EMBASA) from a reservoir. EMBASA operates the systems properly. In the other municipality water supply was discontinuous and pumping costs were high. Prior to a local election the future mayor promised to take over the water supply system and to reduce fees. Now the municipality runs the system with untreated water from a nearby lake. This poses high health risks for the inhabitants because of upstream chrome mining.

The States of Bahia, Piauí and Ceará have extended the joint service council approach to other areas. The concept is generally very successful and has received further support from other donors (e.g. World Bank).

Water supply and Sanitation in Haikou, China – Sanitation component

1 Objective

The overall objective of the project was to improve and assure the (ground-) water and environmental protection in Haikou, a coastal city in China with a population of 850,000. The project included improved drinking water supply and improved wastewater management.

2 Context

BMZ-Nr.: 1994 65 956
Support to project planning and implementation 1995 – 1999; construction 1997 – 1999, training of staff 1997 – 1999; start operation treatment plant 1999 (start sludge digestion and biogas production 2005); final evaluation 2007

	Project area	China
Target group / population	850,000 (urban)	1.3 billion (2007)
Under 5 mortality rate (per 1,000)		21 (2006)*
Population below poverty line		8% (2006)*
Population growth p.a.		0.6% (2008)*
GDP per capita at official exchange rate	2,226 EUR (2007)***	1,723: EUR (2007)**
Per capita HH income	1,400 EUR (2006 est.)	1,284 EUR**** (2006)
% connection to sewer system	70% (after project)	
% sewage treated	none (before project) 100% (after project)	
% of agricultural reuse of sludge	100% (after project)	
Energy generation from biogas	Yes (after project)	

* CIA The World Fact Book, July 2008
** http://siteresources.worldbank.org/DATASTATISTICS/Resources/GNIPC.pdf; 2,360 USD; exchange rate 1.37
*** http://en.wikipedia.org/wiki/Haikou 3,049 USD; exchange rate EUR 1.37
**** http://english.mofcom.gov.cn/aarticle/subject/davos/lanmuaa/200708/20070805037588.html

Water pollution is one of the big environmental problems of China. This was also the case in Haikou, the capital of Hainan Island province. Before the project, the wastewater polluted the sea and endangered the entire ecosystem of the Haikou Bay, the city's main tourist attraction. Furthermore, the increase in water consumption had lowered the groundwater level and increased the risk of saltwater infiltration to the groundwater.

3 Project approach

Investment/Technology:

The project included a drinking water component providing treated surface water, thus ending the overexploitation of ground water sources. The sanitation component supported the extension of the sewer system (120 km new sewer lines, 4 pumping stations) and the construction of a mechanical-biological wastewater treatment plant with sludge digestion and a 1.4 km marine outfall to discharge the treated water into the sea. The present document deals in the following only with the sanitation component.

The capacity of the treatment plant is 300,000 m^3 per day. The treatment plant serves more than 70% of the urban population of Haikou and the local industries. Industries account for roughly 30% of water sales in 2005 (down from 65% of water sales in 1994). Presently, the treatment plant operates almost at full capacity and the upgrading to a capacity of 400,000 m^3 per day is ongoing.

Institutional concept / support activities:

The project executing agency is Haikou Water Service Group Ltd (HWSG). HWSG is responsible for the operation of the water supply system and the wastewater treatment plant. This group is a fusion of

the former Haikou Water Supply Company and Haikou Sewage Treatment Company. This fusion was a great step towards an integrated management of water supply and wastewater. Only the operation of the sewer network remained with the Haikou Sewage Company. HWSG is a commercial semi-autonomous enterprise. In 2007, a 49% share has been sold to Veolia (France) for over 90 million EUR, thus attracting private capital for the further investment. The municipality still has to approve tariffs and investments.

Wastewater treatment plant Haikou

Operation and maintenance concept

Since the start of operation the effluent quality has been very good. The average concentration of BOD_5 is 15 mg/l, nitrogen 5 mg/l and phosphorus 1 mg/l. The Environmental Protection Bureau controls regularly the water quality close to the outfall. The sludge is stabilised in a digestion tower, where biogas is produced. The generated electrical energy covers 20-30% of the energy consumption of the wastewater treatment plant and the pumping stations. A local fertilizer plant buys the digested and dewatered sludge (40 t per day) for its fertilizer production.

The wastewater treatment plant is operated efficiently with 107 staff members. They follow maintenance routines including regular replacements. During implementation a special training program was carried out including several block seminars and visits to Germany and other Chinese treatment plants.

4 Cost and financing

Roughly half of the infrastructure investment was for the upgraded and additional sewer lines, the other half for the wastewater treatment plant and four pumping stations. The costs per inhabitant equivalent (126 EUR in 2006 prices) are rather low for the high treatment standard reached.

The project was financed by the Chinese Government, the City of Haikou, an infrastructure fund and a loan of KfW Entwicklungsbank, subsidised by the German Development Cooperation. The Chinese Government covers the debt service of the loan. Thus HWSG is only in charge of depreciation (replacement).

The wastewater tariff is 0.06 EUR/m³ for households and 0.08 EUR/m³ for industrial clients. This is sufficient to fully cover the operation cost. For water supply, the household tariff is 0.16 EUR/m³, commercial and industrial clients pay 0.26 EUR/m^3. The water tariff fully covers operation and capital costs of the water supply. The collection efficiency of water and wastewater fees is over 90%.

Based on the average per capita water consumption (170 l per day) the annual wastewater fee is around 4.20 EUR per person. This corresponds to 0.3% of the average income (1.400 EUR in 2006). The combined water and wastewater fees are around 1.4% of the average income. The project is economically and ecologically sustainable. Further tariff increases to fully cover capital cost of the

wastewater component might further reduce the water consumption and thus reduce pressure on water resources.

	Project (sanitation component)	per inhab. equiv. (30% industry)
Infrastructure investment	105 million EUR	123 EUR
Training of operation staff, consultant	2.3 million EUR	3 EUR
KfW loan (to Central Government of China)	15.3 million EUR	
KfW grant (0.3m EUR) + subsidy value of loan	approx. 3.6 million EUR	
Investment contributions Central Government of China and City of Haikou	total investment cost	126 EUR
Investment contribution of beneficiaries	none	
Operation cost p.a. (2006 prices)	3.6 million EUR	
LRMC p.a. (2006 prices)		16 EUR
LRMC as % of local per capita GDP		0,7%
Annual HH user fees for sewer services		4.20 EUR
Annual HH user fees as % of HH income		0.3%
Collection efficiency	90%	
Coverage of operation cost	> 100%	

* Population growth estimate 0.9% p.a.; useful lifetime in average 30 years; discount rate 5%; 70% of population connected; 30% of water sales to industrial clients

5 Experiences / lessons learnt /critical aspects

Due to the reasonable treated waste water quality at the sea outfall, water quality measurements of the Environmental Protection Bureau in the bay of Haikou revealed a significant improvement, gives a positive momentum for the tourism along the coast.

The sludge has good quality (very low contamination with heavy metals) and can therefore be used in agriculture. Haikou is one of the first wastewater treatment plants in China, where sludge is used in agriculture and has become a model for environmental sustainability.

Digestion tank

Wastewater management in Fethiye, Turkey

1 Objective

The objective of the project was to protect the environment against pollution by waste water and to improve the sanitation standard of the population in Fethiye.

2 Context

BMZ-Nr.: 1999 66 326
Construction 2002 – 2004; start of operation 2004; training of staff 2001 – 2005

	Project area	Turkey
Population of Fethiye	45,000 (2005)	72 million (2008)**
Population of Fethiye + tourists	65,000 (2005)	n.a.
Under 5 mortality rate (per 1,000)	n.a.	25.1 (2006)*
Population growth p.a.	3.3% (urban Turkey)*	1.2% (2006)*
GDP per capita at official exchange rate	n.a.	EUR 4,365 (2006)*
N° of households connected to sewers	2,700	n.a.
Sewer connection rate	50% (before project) 65% (after project in 2005)	66% (2004)*
% sewage treated	0% (before project) approx. 70% (2005)	n.a.

*Turkish Statistical Institute Prime Ministry Republic of Turkey (TURKSTAT), http://nkg.die.gov.tr/
**CIA World Factbook, July 2008

The city of Fethiye is located on the Mediterranean coast in the South-West of Turkey. The bay of Fethiye is a protected nature reserve and harbours one of the last hatcheries of the loggerhead turtle. It is also a popular tourist destination.

Prior to the project, nearly all inhabitants of Fethiye had house connections for water, but only half of the households were connected to the old and totally overloaded sewer system. The other households discharged their wastewater into cesspits, which pollute the groundwater, or to septic tanks, which were often not emptied or maintained. The wastewater collected in the sewer system was discharged into the Mediterranean Sea without any treatment. Thus the coastal waters showed high pollution with coliform bacteria, nitrogen and phosphorus. This threatened the nature reserve and the attractiveness of the location for tourists.

3 Project approach

Investments / technology

The project included the rehabilitation and extension of the sewer network and the construction of a waste water treatment plant. By 2005, 2,700 households were newly connected to the sewer. With an additional loan, the city of Fethiye expects to connect all households by 2009. In 2013 an expansion of the treatment plant will be necessary. For the households not yet connected the project financed a sludge suction vehicle and an acceptance point for this sludge at the entrance of the wastewater treatment plant.

The wastewater treatment plant is one of Turkey's most advanced facilities. The treatment process is mechanical-biological with nutrient removal. To further ensure high water quality in the bay, the process also includes UV disinfection, being Turkey's first.

Wastewater treatment plant

Institutional concept / support activities

The project executing organisation is the municipal water and sewage department FESKI which was transformed into a semi-autonomous water and sewage utility with own accounts and management responsibility. The municipal council has to approve the water and wastewater tariffs. Initially, it was considered a potential risk that the municipality would not raise tariffs for political reasons. But in 2004 the tariffs were increased sufficiently (approx. 30%) to cover the costs.

The project supported the training of FESKI staff in financial management, sludge management and environmental monitoring. FESKI monitors the water quality at 14 measuring points in the bay of Fethiye. Shortly after starting the wastewater treatment, the water quality improved significantly.

Operation and maintenance concept

The functional tender for the treatment plant included a period of 42 months of operation. So far, the operation has shown no problems and the quality of effluent has always complied with the legal requirements. The sludge is mechanically dewatered and deposited on a substandard landfill, 15 km outside the city. In the future, it is planned to use the sludge as fertiliser in agriculture. Since 2007, FESKI has contracted a private service provider for the operation of the treatment plant.

4 Cost and financing

The net cost for investment and training was 16.8 million EUR (2004 prices). However, FESKI also had to pay EUR 3 million of national value added tax (VAT). German Development Cooperation financed the training component with a grant and the main share of investment (EUR 13.45 million) with a subsidised loan (2% interest) through KfW Entwicklungsbank. In addition, FESKI had access to national loans (Iller Bank) and funding from the municipality. The financing structure included the first 42 months of operation of the wastewater treatment plant. This permitted a gradual increase of user fees. The grant and the subsidy value of the KfW Entwicklungsbank loan are only slightly higher than the national tax (VAT) born by FESKI, so user fees have to cover almost the entire net investment cost.

The annual operating costs of the network are approximately EUR 0.6 million and the operating costs of the treatment plant are around EUR 0.5 million (2004 prices). The calculation of the total cost (as long-run marginal cost LRMC) further includes the value of the existing sewer network before the start of the project at an estimated replacement value of EUR 5.5 million. The total cost per inhabitant and year served (including approximately 30% seasonal tourists) is EUR 32. In relation to Turkey's per capita GDP in 2006, the LRMC corresponds to 0.7% of GDP.

	Project	per capita (30% tourists)
Infrastructure investment (2004 prices)*	EUR 15.5 million	EUR 313
Consultant services and training (2004 prices)	EUR 1.3 million	EUR 23
KfW loan (2% interest; 30 years)	EUR 13.45 million	
Other loans / municipality of Fethiye		
KfW grant of EUR 1.02 million and net present subsidy value of KfW loan EUR 3.0 million	EUR 4.0 million	
Operation cost p.a. (2004 prices)	EUR 1.1 million	EUR 23
LRMC p.a. (2004 prices) over 30 years		EUR 32
LRMC as % of Turkey's per capita GDP (2006)		0.7%
Costs borne by users as % of per capita GDP		0.7%

* Also considering estimated replacement cost of assets existing prior to the project: EUR 5.5 million; useful lifetime pipes and civil works 40 years, equipment 15, power-supply 30, vehicles 8 years

The resulting tariffs are affordable and collection efficiency is acceptable (around 90%). The tariffs for commercial clients and industry are progressive for large consumers (>1,500 m³/month) and they provide a certain cross-subsidy for residential customers. The envisaged extension of the network and the treatment plant might require a further increase in tariffs.

5 Experiences / lessons learnt / critical aspects

The old parts of the sewer system drain a considerable amount of ground water, especially in winter time. As a consequence, the treatment plant already works almost at full hydraulic capacity. Nevertheless, the energy efficiency of the entire system is good and treatment results are very good. The first years of operation of the wastewater treatment have been successful. The quality of the effluent and the improved sea water quality have already earned two national environmental awards.

National environmental award for treatment plant in Fethiye

A critical point is the sludge disposal as long as it is not reused in agriculture. The actual landfill has no base seal or other technical means to protect the groundwater. A new sanitary landfill is planned but not yet realised.

The operation cost of the treatment plant in the first years was part of the financing arrangement for the overall investment. This facilitated a gradual increase of tariffs and thus made political acceptance easier. Furthermore, the operation is state of the art and FESKI could outsource this task. Thus FESKI has presently less staff than initially planned.

1 Objective

The objective of the project was to improve and assure the wastewater management in Al Bireh, which has an estimated population of 47,000 (2007) including refugee camps.

2 Context

BMZ no: 1995 67 058
Construction: 1998-2000; start of operation of treatment plant 2000; training of staff 1993 – 2003; final evaluation 2008

	Project area	West Bank
Target group / population	47,000 (2007)	2.46 million (2009)**
Under 5 mortality rate (per 1,000)	n.a.	24 (2005)*
Population growth p.a.	n.a.	2.2% (2009)**
GDP per capita at official exchange rate	n.a.	EUR 1,227 (2008)**(i)
Per capita HH income	n.a.	
% connection to sewer system	75-80% (after project)	
% sewage treated	0% (before project) 75-80% (after project)	0%
% of agricultural reuse of sludge	0%	0%

* http://unstats.un.org/unsd/cdb/cdb_country_prof_results.asp?crID=275&cpID=15
** CIA The World Fact Book, May 2009
***http://www.pcbs.gov.ps/
(i) =includes the Gaza Strip: USD 6.641 billion; population West Bank + Gaza 2.46 million +1.55 million = 4.01 million; EUR 1 = USD 1.35

The project was designed in 2000, before the start of the second Intifada. Al Bireh in the West Bank is located in proximity to Ramallah and Jerusalem and has suffered less from blockages than other Palestinian cities. However, the conflict has reduced overall economic activity and household income. It has also contributed to a 1.5-year delay in project implementation mainly due to difficulties local construction companies experienced in securing supplies. Despite the conflict, the wastewater treatment plant has been operating continuously up to now.

3 Project approach

Investment / technology:

The project comprised minor extension of the sewerage network (1 km; 1 pumping station). The main component was the construction of a wastewater treatment plant with a capacity of 5,750 m³/d (50,000 population equivalents). The design provides for a possible extension to 11,500 m³/d (100,000 population equivalents). The selected treatment technology is an oxidation ditch with simultaneous sludge stabilisation. This is a very robust but energy-consuming technology. It is the first mechanical-biological treatment plant in the West Bank.

Institutional concept / support activities:

The municipality of Al Bireh is responsible for the operation of the sewerage network and the wastewater treatment plant. The city has an independent wastewater section under the City Engineering Department. This section, headed by a wastewater engineer, operates the wastewater services with 12 staff members, including 5 engineers. GTZ provided management support and staff training. This is quite lean staffing for 5,890 house connections (year 2004).

Al Bireh wastewater treatment plant (photo KfW)

Operation and maintenance concept

Until 2006, the operation of the wastewater treatment plant showed excellent results with BOD_5 removal of 97% on average. Regular monitoring of the effluent confirms that the required BOD_5 level of 20 mg/l has been observed ever since. After mechanical dewatering, the sludge was initially deposited on the urban landfill of Al Bireh. However, Israeli Authorities revoked the permission in 2002. An intermediate storage place in the vicinity of the treatment plant was used until the dewatering equipment showed some problems, and recently some raw sludge has been released directly into the Wadi. It is planned that the mechanical dewatering will be replaced by drying beds and in the future the dried sludge will be deposited on a new district sanitary landfill to be constructed under German DC.

4 Cost and financing

	Project (sanitation component)	**Per capita**
Wastewater treatment plant and main collector	EUR 8.9 million	EUR 190
Training of operation staff, consultant	EUR 1.1 million	EUR 23
German FC contribution	EUR 9.4 million	EUR 200
Investment contribution PNA	EUR 0.55 million	EUR 12
Investment contribution of beneficiaries	0	0
Operation cost p.a. (2006 prices)	EUR 0.61 million	EUR 12.9
LRMC p.a. (2006 prices)		EUR 33
LRMC (2006) as % of per capita GDP (2008)		2.7%
Average annual household user fee		EUR 8.76
Collection efficiency	60%	
Operation cost coverage	50%	
Costs borne by users as % of per capita GDP		0.6%*

LRMC = long run marginal cost; discount rate 5%

* at the present collection efficiency of 60%. At 100% collection efficiency, this would correspond to 1% of GDP.

Since March 2000 the municipality Al Bireh has been charging a waste water tariff of EUR 0.24 /m^3. It currently covers only 80% of the cost of operation. Necessary tariff adjustments were not made after

the start of the second Intifada. The political and economic instability also reduced the ability and willingness of users to pay for water and sanitation services. Today collection efficiency is only 60%. As a consequence, fees cover only half of the cost of operation. Earlier, the Al Bireh municipality could afford and did cover operating cost deficits, but seems to have had more problems recently.

The annual full cost of the management of the wastewater treatment system is EUR 33 per capita and year. This is relatively high compared with present per capita GDP. The average water consumption in Al Bireh is about 100 l/cd. The water tariff is progressive. For average consumption, the water tariff is 0.91 EUR/m3. Including the fixed service fee of EUR 19 per connection and year, the average water and wastewater fee per inhabitant and year is EUR 44, which is close to 5% of average net household income. This partly explains the difficulties in fee collection.

5 Experiences / lessons learnt / critical aspects

Al Bireh is the first mechanical-biological wastewater treatment plant in the West Bank and is a model for environmental protection. The good motivation of the personnel has helped to secure fairly good operation under difficult conditions. The treatment technology has the advantage of affording high stability but the great disadvantage of high energy consumption. Therefore, the Palestinian Authority is exploring other treatment options for further treatment plants. At the time of planning, operating costs seemed affordable. But with the increase in energy prices and falling household incomes, this is not the case anymore. The mechanical sludge dewatering also was not stable enough as a process and is to be replaced by drying beds. The initially planned reuse of effluent was not realistic under local conditions. The effluent is now discharged into the Wadi and helps to recharge the groundwater.

Rural Water Supply and Sanitation in the Ashanti Region, Ghana

1 Objective

The overall objective of the programme is to reduce the risks of water-induced diseases. The fourth phase of the programme covers water supply and sanitation in 15 districts in the Ashanti Region. This phase also finances the construction of latrines as part of the sanitation component. This case study mainly covers the sanitation aspect.

2 Context

BMZ ID: 2001 66 066
Planning and implementation 2005-2007; construction 2006–01/2010 (planned); latest report 02/2008

	Project area	Ghana
Target group / population	25,500	23.38 million (2008)*
Under-5 mortality rate (per 1,000)	115 (Ashanti 2004) **	112 (2004) **
Population below poverty line		29% (2007)*
Population growth p.a.		1.9% (2008)*
GDP per capita at official exchange rate		EUR 470 (2007)*
N° of HH on-site systems planned	3,400	
N° of inst. on-site systems planned	200	
% improved sanitation	39% (before programme)	57%***

*CIA The World Fact Book, July 2008; USD 636 per capita (Ghana USD 14.86 billion) in 2007
** WHO: http://www.who.int/whosis/mort/profiles/mort_afro_gha_ghana.pdf
***Worldbank:http://ddpext.worldbank.org/ext/ddpreports/ViewSharedReport?&CF=1&REPORT_ID=1336&REQUEST_TYPE=VIEWADVANCED&HF=N/IDGProfile.asp
http://www.ghanadistricts.com/districts/?_=51&r=2&sa=4609

The Ashanti region in the centre of Ghana is not a particularly poor region of Ghana, but rural income is much lower than in the regional capital Kumasi. In the first three phases, the programme had already provided more than one million inhabitants in rural districts of the Ashanti Region with improved water supply. In phase four of the programme, the target population for improved water supply is 300,000 inhabitants. In addition, the project provides subsidies to ventilated improved pit latrines (VIPs) constructed at a household level. It also finances the construction of 200 double vault Kumasi ventilated pit latrines (KVIP) for schools and hospitals. The estimated 3,400 private VIP latrines will serve approximately 25,500 inhabitants. By February 2008, 963 VIP latrines and 102 KVIPs for institutions were completed.

3 Project approach

Investment / technology:
The approach includes a hygiene awareness campaign that communicates basic links between sanitation and water-induced diseases. It is planned to increase the demand for private latrines, which has been low so far. The programme offers a standard design for VIPs and trains latrine artisans in latrine construction. The standard design comprises a dug pit (no reinforced walls), a ring beam supporting the concrete slabs and the stonewalled superstructure completed with metal roofing sheets and a vent pipe with screen. These latrines are relatively cheap (EUR 169 per unit in 2007 prices), easy to build and rely on regionally available material. The ventilation considerably reduces odours and accelerates the composting of faeces in the pit, while urine can drain away into the soil. The fly screen on top of the vent pipe prevents flies and other insects from entering and transmitting diseases. If constructed and maintained properly, the latrines can be used for around 9 years and serve 5-10 people. In rural Ashanti there is a tendency not to empty the VIPs but to abandon them after they fill up.

Ventilated improved pit latrine in Ashanti Region

Institutional concept / support activities:

The project executing agency is the CWSA (Community Water and Sanitation Agency). CWSA is responsible for the implementation of the health and hygiene campaigns. Households apply for VIP subsidies to CWSA. CWSA approves applications and executes on-site quality checks. Subsidies are only disbursed after completion of the construction. Local craftsmen build the latrines and washrooms.

Operation and maintenance concept

Individual households are responsible for cleaning and maintaining their latrines. Since latrines are built with a major commitment from households, it is expected that they will be maintained. The programme documents do not further elaborate on the operation and maintenance concept of school and hospital KVIPs.

4 Costs and financing

	Household sanitation component	Per capita
Infrastructure investment	EUR 573,810	EUR 22.5
Hygiene awareness, staff, consultant	EUR 146,455	EUR 5.74
Investment cost borne by beneficiaries	EUR 286,905	EUR 11.3
Investment contrib. as % of Ghana p/c GDP (2007)		2.4%
Investment contrib. as % of HH income		
LRMC* per capita and year (2007 prices)		EUR 3.97
LRMC as % of Ghana per capita GDP (2005)		0.8%

* Useful lifetime 9 years; discount rate 5%;

The overall cost of the entire sanitation component is EUR 1.5 million. The bulk of the cost is the investment in 200 KVIP latrines for schools and hospitals. The total cost of VIP latrines at the household level and the overhead costs amount to EUR 720,265. The resulting total cost of the programme is EUR 3.97 per inhabitant served and year. This is rather low compared with the per capita GDP of Ghana (0.8%). The German contribution fully finances the hygiene awareness campaign and consultant costs as well as 50% of the investment. Households have to finance the remaining 50% of the estimated EUR 169 cost of one VIP (of which EUR 90 for stones, sand, pit digging and other labour). This investment contribution is equivalent to 2.4% of Ghana's per capita GDP. In the rural area, the contribution might constitute 5 – 10% of household income. This might limit the demand from poorer households.

5 Experiences / lesson learnt / critical aspects

In Ghana it is common to hold the government responsible for access to sanitation. Therefore, it takes time to trigger demand for household latrines. The envisaged number of 3400 VIPs will probably not be reached. District Assemblies disbursing the subsidies have set up complicated procedures and delayed payments. Communities pre-financing the construction therefore had to delay constructions.

Communities often do not have the capacities to effectively control construction quality.

Furthermore, having sanitation programmes that subsidise latrine construction while other programmes in the same country (e.g. the neighbouring district) do not draws criticism. Subsidies might not accelerate but slow down the process towards improved sanitation. Instead, it has been suggested that opinion leaders in the community (chiefs etc.) can play an important role in promoting latrine construction. VIPs are often regarded as status symbols.

Institutional KVIPs are actually built for schools, considering the number of pupils there. However, the local population regards institutional KVIPs as being for the public. This results in an overuse of the KVIPs. It is expected that the pits will fill up much sooner than estimated. The time span will be too short for complete decomposition of the excrements.

So far, sanitation in Ghana represents only a minor component of water supply programmes. Execution should be more successful if programmes were set up with sanitation as the main objective.

1 Objective

The objective of the project was to provide safe drinking water and improved sanitation for the inhabitants of Kabale in order to reduce health risks. This document focuses on the sanitation component.

2 Context

BMZ no: 1994 66 061
Planning 1996-2000; construction 2001-2002; start of operation 2003

	Project area	Uganda
Population	35,000 (2004)**	31.4 million (2008)**
Under-5 mortality rate (per 1,000)		134 (2006)*
Population below poverty line	50%**	31% (2006)*
Population growth p.a.		3.6% (2008)**
GDP per capita at official exchange rate		EUR 274 (2007)*
Inhabitants connected to sewer system	1,280 (before project) 3,312 (2008) 8,000 (projected for 2015)***	
% of sewage treated	100%***	
% of agricultural reuse of sludge	planned, not yet started***	

* http://web.worldbank.org (USD 370 per capita; USD 1.35 = EUR 1)
**https://www.cia.gov/library/publications/the-world-factbook/geos/ug.html
*** KfW reports

Kabale is a town of 35,000 inhabitants (2004) in the far south-west of Uganda, on the border with Rwanda. In former times it was an important trading post and transport hub, but it declined in importance due to wars and insecurity. Before the project started, people used not only central water supply but various other sources as well. Three quarters of the population had traditional pit latrines, but they were often in poor condition. Only 8% used ventilated improved pit latrines and 1% owned flush toilets with septic tanks. Before the project, the hospital and the main commercial centre with approx. 4% of the population were connected to an old sewer system, which was more or less out of operation.

3 Project approach

Investment / technology:
The project measures include a water treatment plant with a distribution network as well as the rehabilitation and extension of the sewer system and a waste water treatment plant. The old sewer system (2 km) was rehabilitated and extended (6 km), and a pumping station was added. The project further financed approx. 18 km of household sewer connections. The sewage is treated in a stabilisation pond. The capacity of the pond was initially designed for 15 m^3/h or 12,500 population equivalents, later reports refer to 8,000 population equivalents. In 2008, only 3,312 people were living in households with a sewer connection. In addition, the project financed two sludge trucks for emptying septic tanks. This service has been extended to fewer than 300 inhabitants.

Institutional concept / support activities:
The project is embedded into the nationwide sector reform process. The GTZ project RUWAS (Reform of the Urban Water Sector) supports the project executing agency NWSC (National Water and Sewerage Corporation) to become an efficient service provider. Before the start of the project, the municipality was responsible for the sewerage and waste water treatment of Kabale. During the project the responsibility was handed over to NWSC, which operates various similar sewerage systems in Uganda. NWSC does not depend on the state budget and covers its costs from fees collected for fresh water. It presently operates water supply and waste water disposal facilities in nine cities in Uganda. Its operating surplus enables NWSC to cover some new investments.

The consultant provided the staff of NWSC with a training course in the operation of the facilities. Local workers have basic skills to run the system, but lack a full understanding of electric and hydraulic processes.

Routine works on the waste water treatment plant in Kabale

The project also included an information campaign designed to sensitise inhabitants to hygiene and to create demand for household connections.

Operation and maintenance concept

The waste water treatment plant is operating well and the water quality of the river has improved. The plant removes 99% of pathogens from the waste water. The sludge will be treated and used as fertiliser in agriculture. Because of the low rate of connection to the sewer system, no sludge had to be removed from the ponds so far. However, the training of the local operating staff has been limited and they have not yet developed a good understanding of the treatment processes.

The maintenance of the sewer system is difficult. Manhole covers are stolen and manholes are destroyed. People dump solid waste into the open manholes and so many blockages occur in the sewer system. NWSC has acquired a high pressure jetting machine to remove the blockages in the sewer.

4 Costs and financing

	Project (sanitation component)	**Per inhabitant**
Infrastructure investment	EUR 2,410,000	EUR 728 (3,312 inhabitants 2008) EUR 301 (8,000 inhabitants 2015)
Training of operating staff, consultant	EUR 383,940	
KfW grant	EUR 2,793,940	
Investment contributions by the central government of Uganda	Allocation of land (not quantified)	
Investment contribution of beneficiaries	none	None
Cost of operation p.a. (2007 prices)	EUR 10,536 (without network maintenance)	
LRMC p.a. (2001 prices)		EUR 37
LRMC as % of national per capita GDP		14%
Annual user fees for sewer services		EUR 13
Annual user fees as % of per capita GDP		5%
Collection efficiency	95%	

*useful lifetime in average 33 years; discount rate 5%;

The German government financed the entire investment. The Ugandan government provided the land for the treatment plant and the sewer lines.

The waste water tariff in 2007 was EUR 0.45 /m3 for households, EUR 0.94 /m3 for commercial clients and EUR 0.75 /m3 for governmental and public institutions. With an average consumption of 80 l/cap per day, the annual user fee for sewerage is EUR 13. The collection efficiency is 95%. The revenue from tariffs (EUR 80,000 in 2007) is sufficient to cover the operating costs for energy and staff as well as general maintenance and minor replacements. Tariff increases are not planned.

5 Experiences / lessons learnt / critical aspects

The project fulfils the purpose of improved sewer collection and wastewater treatment for the city centre. The combined effects of improved water supply and sanitation have reduced health risks. The process of households connecting to the sewer system is slow. It will probably take a long time for the treatment plant to operate at full capacity, originally expected for the year 2015. The effluent of the waste water treatment plant is of very good quality, partly due to the low connection rate. Thus the water quality of the river has improved, which reduces health risks to inhabitants downstream.

The user fees cover more than the cost of operation and collection efficiency is good. Still, the per capita cost for having a household connected to the sewer system is very high in relation to local income (5% of national per capita GDP might correspond to 10% of local household income). Thus only well-off households can afford a sewer connection. The demand for new house connections has been far lower than expected. The number of households with cess-pits to be emptied has not increased either (22 cesspits emptied in 2007). As a consequence, the per capita investment costs are very high. This is due to the overestimation of potential clients for sewer services. Very long house connections (over 30 m on average) indicate that the network was extended to areas with low housing density. Even if the planned target population of 8,000 will have a sewer connection in 2015, the full costs of the system per inhabitant served and per year will be very high (14% of per capita GDP). It is unlikely that Uganda will be able to renew or extend this system without further external support.

Rural Water Supply and Sanitation in Balaga and Mongochi, Malawi

1 Objective

The overall objective of the two programmes was to reduce the risks of water-induced diseases in the Balaka and Mangochi districts in Malawi. The focus of this document is the sanitation component of the programmes.

2 Context

Balaka: BMZ ID: 1988 65 891
Planning 1994-1995; construction 1995-1997; start of operation 1997
Mangochi Phase I: BMZ ID: 1998 65 171
Planning 1999; construction 1999-2001; start of operation 2001
Mangochi Phase II: BMZ ID: 2001 65 175
Planning 2002; construction 2002-2006; start of operation 2006

	Project area	Malawi
Target group / population	308,000 (2001)**	11.6 million (2000)*
Under-5 mortality rate (per 1,000)		84 (2000)*
Population below poverty line		63% (2001)**
Population growth p.a.		2.9% (2000)*
GDP per capita at official exchange rate		EUR 150 (2000)*
N° of on-site systems realised Population served	44,800** 196,000	
% improved sanitation in the project area	< 5% before programme 64% after programme **	< 10%**

* http://data.un.org/CountryProfile.aspx?crName=Malawi
** KfW reports

The area of both programmes is in the south of Malawi. With 105 inhabitants per square kilometre (2001), Malawi has one of the highest population densities in Africa. Prior to the programmes, 50% of the population in the project area had an own latrine, but most facilities were in poor condition. 60% of them were not clean and often the simple cover panel had collapsed. In Malawi, less than 10% of the population had access to improved sanitation, and less than 5% in rural areas. Hygiene awareness and behaviour were poorly developed.

In ex-ante and ex-post surveys, pupils were asked if they had diarrhoea in the last 2 weeks. Before the programme started 41% gave a positive answer compared with only 15% after completion.

3 Project approach

Investment / technology:
The two programmes covered water supply and sanitation measures in the areas of the traditional authorities Kalembo, Liwonde in Balaka District and Jalasi, Katuli, Mbwana Nyambi, Chowe in Mangochi District. In Balaka District, the programme financed 320 new boreholes with hand pumps, rehabilitated 60 boreholes and provided 10,000 sanplats (cover panels for latrines). In Mangochi District, the two programme phases financed 730 new boreholes, rehabilitated 120 boreholes and provided 34,800 sanplats. The programmes provided intensive hygiene and health education.

Originally, only hygiene education was planned, but people also asked for hardware. Many people already had traditional latrines, but the simple cover panel structure often collapsed. Inhabitants raised the idea of concrete cover to be provided to improve the simple pit latrines. The programmes commissioned several local manufacturers to produce the concrete sanplats. The programmes provided the sanplats for free, but inhabitants had to dig the pit and provide a superstructure. Users generally opted for a simple superstructure with mud bricks or thatched walls. Programme staff supervised latrine construction. Now 196,000 beneficiaries have access to improved sanitation facilities.

Installed sanplat

Institutional concept / support activities:
An intensive hygiene and health campaign included video presentations, street theatres, flipcharts, brochures etc. The campaigns focused on messages regarding hand washing, food and water storage and the importance of well maintained latrines. The approach took into account that most people in the programme area cannot read or write.

Hygiene and health campaign

Operation and maintenance concept
Users are responsible for keeping their latrines clean and maintaining the superstructure. The hygiene and health campaign placed specific emphasis on this aspect. There are no provisions for emptying the pits. It is assumed that once a pit has filled up, households have enough space to dig a new pit and move the latrine.

4 Costs and financing

	Project (sanitation component)	**per capita**
Infrastructure investment	EUR 257,600	EUR 1.31
Hygiene awareness, staff, consultant	EUR 1,209,600	EUR 6.17
Subsidy (for beneficiaries)	EUR 1,467,200	EUR 7.49
Investment contributions Government of Ghana	-	-
Investment contribution of beneficiaries	Labour, superstructure	
LRMC* per capita and year (2007 prices)		EUR 1.29
LRMC as % of regional per capita GDP (2005)		0.9%

* Useful lifetime 7 years; discount rate 5%

The sanitation component of the programme financed the distribution of concrete sanplats (EUR 5.75 per sanplat), the hygiene campaign, training and supervision. The contribution of the beneficiaries (pit digging and superstructure) was quite significant but difficult to quantify. The hygiene campaign, training and supervision of construction were much more important than the subsidised physical investment.

5 Experiences / lessons learnt / critical aspects

The programmes have been successful. The overall monitoring was extensive and allows programme results to be evaluated. The use of latrines increased from 70% to 82%. The share of households with improved latrines rose from 5% to 54%. After a few years of operation, 98% of the newly built latrines were still clean, functional and in use. Most of the latrines (82%) are equipped with hand washing facilities. Also, changes in hygiene behaviour are considerable: 82% practice hand washing (compared with 68% before the programme); 93% of water containers are covered (compared with 74% before the programme).

The programme area is relatively poor compared with other Sub-Saharan African countries. So water supply, hygiene campaign and the provision of simple sanplats had a big impact. This may not be the case in wealthier regions, where people expect higher sanitation standards. The programmes confirm the importance of combining water and sanitation investment with intensive hygiene and health education. In group discussions during the evaluation process, people stated that only the provision of safe drinking water and sanplats is not sufficient; there has to be an educational campaign, too.

A critical aspect is that local manufacturers did not take up the provision of sanplats after programme completion. Concrete sanplats are too heavy to be transported on a bicycle and there is no other regular transport to remote rural areas. At final appraisal, there was still an unsatisfied demand for improved sanitation.