

35th WEDC International Conference, Loughborough, UK, 2011

**THE FUTURE OF WATER, SANITATION AND HYGIENE:
INNOVATION, ADAPTATION AND ENGAGEMENT IN A CHANGING WORLD**

**Alternative solutions for challenging environments:
a look at UNICEF-assisted ecosan projects worldwide**

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REFEREED PAPER 1220

This paper summarises information from 20 UNICEF-assisted ecological sanitation projects in 12 countries. The projects varied widely in size from 95 users for a project with household urine diversion dehydration toilets (UDDTs) in Bangladesh up to 23,000 users under emergency conditions in Zimbabwe. They share characteristics of purpose, scope, challenges, opportunities and sanitation technologies, which were mainly UDDTs and composting toilets. Specific insights are given for the projects in Bangladesh and Rwanda where large-scale ecological sanitation 'ecosan' programs are currently underway. We discuss the potential to scale-up initiatives by providing increased technical back-up support to users, greater linkages with community-led total sanitation and with income generation initiatives via higher agricultural yields. In the context of growing urbanisation and hydro-geological challenges, this paper highlights that "ecosan technologies" (such as UDDTs) can be a suitable technical solution where pit-based toilets are impossible to be implemented sustainably.

Introduction

Ecological sanitation (ecosan) is a paradigm in sanitation that recognises human excreta and household wastewater as resources that can be recovered, treated where necessary and safely reused to generate additional incomes (von Muench and Winker, 2009). Ecosan systems can help to ensure food security by improving soil fertility through safe excreta and urine reuse in agriculture (Richert et al., 2010). The GTZ program "Sustainable sanitation – ecosan" which is funded by the German Federal Ministry of Economic Cooperation and Development (BMZ) is providing technical support to programs both within GTZ and externally. A key outcome is the establishment of a global database with currently 313 ecosan projects, covering an estimated 4.8 million users worldwide (GTZ n.d.). This database serves as a reference for practitioners and the general public on information for ecosan projects.

It was noted that several UNICEF-assisted ecosan projects were missing from the database. UNICEF's water, sanitation and hygiene (WASH) strategy focuses on demand creation, service provision and supporting an enabling policy environment, as well as technological innovations e.g. for disabled persons. One recent publication called 'Soap, Toilets and Taps (2009)' notes in regards to ecosan and UNICEF's association with the Sustainable Sanitation Alliance (SuSanA): "UNICEF has supported small-scale pilot work on ecosan in several countries and continues to work with members of the alliance [SuSanA] to find ways in which the approach can be used on a larger scale in a cost-effective and culturally acceptable manner." (UNICEF 2009: 27).

UNICEF operates in about 190 countries worldwide and many UNICEF country officers and UNICEF partners are supporting ecosan approaches in challenging physical and hydro-geological environments. These ecosan projects are the focus of this paper, with a particular emphasis on the situation in Bangladesh and Rwanda.

Methodology

Data was collected following a two-pronged approach using e-mail contacts, and online document searches. In the first approach, we contacted two regional UNICEF advisors for sanitation in Africa who are in charge

of programs in East and Southern Africa (ESARO), and West and Central Africa (WACRO). Both officers provided contacts of country level officers or forwarded our request for information to UNICEF country offices. The project officers provided answers to the following questions:

1. What are the target areas, i.e. districts and villages; rural or urban
2. Which partners does UNICEF work with (government and NGO partners)?
3. What is the project period (pilot or second phase/continuation)?
4. What is the size and scope of the project? Number of facilities constructed and number of users
5. What are the conditions of the target area? Hilly, desert, coastal etc.
6. Who executed the project?
7. Who funded it: UNICEF or other donors?
8. What technology was applied -and promoted?
9. What are lessons learned?
10. Are there plans to continue this project/approach if you had more funding or any constraints?

The majority of UNICEF officers provided an overview of the project and then referred to their NGO “counterpart” for further details. Other UNICEF officers provided contact details of partners or reports from which the answers to the questions could be derived.

Another search method was an online search to scan all documents on the UNICEF website for citations of ‘ecosan’. Country offices were contacted through their head of programs for verification that ecosan projects existed. Those offices which responded positively were forwarded the same set of questions as listed above. In the case where government partners were implementing ecosan projects, UNICEF WASH specialists answered the questions on behalf of the project. The work to collect and verify information took place from February until July 2010. The exception to this methodology was the ecosan project in Malawi, where the primary author worked for six years. In this case, UNICEF project officers and the international NGO Canadian Physicians for Aid and Relief (CPAR), who co-funded the project, were contacted directly.

Owing to the nature of methodology and professional contacts, the primary author contacted mostly specialists in Africa and Asia. Bolivia was added from a referral in Africa, who had previously worked there.

Results

Basic project statistics

Of the approximately 40 UNICEF country offices contacted, 14 replied back with positive confirmations eventually leading to the documentation of 36 ecosan projects in 13 countries supported by UNICEF together with other partners. The fourteenth country office which responded was UNICEF China, but since they focus primarily on policy support to government, and not ecosan construction projects *per se*, they are not included in the numerical analysis presented below. Furthermore, the Burkina Faso case is not included in this overview as the ecosan projects were funded by the NGO CREPA (Centre Régional pour l'Eau Potable et l'Assainissement).

For this paper, 20 projects in 12 countries are detailed as they were funded partially or wholly by UNICEF. The 12 countries were: Bangladesh, Bhutan, Bolivia, Congo Brazzaville, Guinea Conakry, India, Malawi, Nigeria, People Democratic Republic of Korea (PDRK), Rwanda, Togo and Zimbabwe. Some projects were funded in cooperation with other donors, as in the case of Bolivia, with Canadian International Development Agency (CIDA) and Swedish Environment Institute (SEI). The 20 projects were mostly funded by UNICEF with support from the governments of Netherlands (DGIS), Japan (JICA), Australia (AusAid), Canada (CIDA) and Sweden SIDA (Swedish International Development Agency).

Eight projects were from Bangladesh, owing to a large-scale program known as the SHEWAB project for “The Sanitation, Hygiene Education and Water Supply in Bangladesh”. UK’s Department of International Development (DFID), Australian High Commission, CordAid (Dutch), Government of Netherlands (DGIS), and JICA are also supporting the ecosan projects along with UNICEF. The SHEWAB project is implemented through a consortium of NGO and government partners. It is important to mention here that while UNICEF assists financially, many governments are funding ecosan projects through available sources, as in the case of Rwanda, since 2000.

The names and locations of the 20 ecosan projects are given below. Note that for the eight projects in Bangladesh only the SHEWAB project is funded by UNICEF; the other seven are in partnership with UNICEF but are not funded by UNICEF. All project details can be found in the global database (also called worldwide project list) available from the GTZ website (see link in Introduction Section).

1.-8. Ecosan projects in Bangladesh:

- SHEWAB project:
 - Action research on ecological alternatives and construction of 100 UDDTs (urine diversion dehydration toilet) and urine diversion toilets in sanitation difficult areas of Gaibandha, Rangpur, CNgonj, Narsindhi, Moulovibazar, Sunamgonj, Bandarban
 - Compost toilets within solid waste compost plants in six municipalities (Rangpur, Maulvibazar, Homna, Sirajgani, Sibjani, Mherpur of Bangladesh)
 - UDDTs in five schools in Gazipur Municipality
 - UDDTs with 19 households in Pazulia and Fawcal villages Gazipur district under Gazipur Municipality
 - Sanitation block with biogas plant at G.K. Model High School in Dhirassharm under Gazipur Municipality
 - Construction and promotion of concrete Urine Diversion Pan through piloting community-based urine diversion toilet (UDT) in Wrishipara Polli of Gazipur Municipality
 - UDDTs constructed in eight schools in Gazipur City
 - Construction of 200 UDDTs in rural communities of Gazipur, Tangail, Mymensingh Municipalities
 - Double Vault Composting and Urine Diversion Toilets and action research in difficult rural areas in Bandarban, Gaibandha, Chapainawabgonj Districts.
9. UDDTs at Goenpasingma Lower Secondary School and village, Zobel Geog Pemagatshel, Bhutan.
 10. UDDTs in the Departments of Cochabamba, Chuquisaca, Pando, Beni and Potosi, Bolivia.
 11. UDDTs in Ganga Edouard Primary School, Congo Brazzaville.
 12. UDDTs in schools in Ansoumaniya, Dubréka and Kissidougou, Conakry, Kindia, Guinea Conakry.
 13. UDDTs for rural farming households in hilly village of Talavadi village, Tamil Nadu, India.
 14. Promotion of UDDTs in rural households in Dindigul District, Tamil Nadu, India.
 15. Double Vault Composting Toilets in schools in Chintech, Malawi.
 16. Promotion of UDDTs in Six Riverine Communities in Cross River State of Nigeria.
 17. Decentralised Wastewater Treatment System in Yonton Country, PDRK (North Korea).
 18. UDDTs in rural communities and schools of Burera, Musanze, Nyabihu, Rubavu, Nyamasheke and Rusizi Districts, Rwanda.
 19. UDDTs in 75 schools and 60 communities of Maritime (Lome), Kara and Savanna Regions of Togo.
 20. Composting toilets under emergency situations in settlements in Hopley, Hatcliffe and Victoria Falls, Zimbabwe.

Just over 50% of the projects were implemented by NGOs, followed by governmental departments (see Figure 1). This is significant because one would have expected that ecosan being considered an *alternative* solution, it would have been the almost the sole domain for NGOs and research institutes. In fact only one of the project implementers was a research institute.

Key NGOs in the UNICEF-assisted projects were CREPA (Centre Régional pour l'Eau Potable et l'Assainissement) for the French-speaking African countries of Burkina Faso, Congo Brazzaville, Guinea Conakry and Togo; as well as SPACE (Society for People's Actions in Change and Equity) and Practical Action for the ecosan projects in Bangladesh.

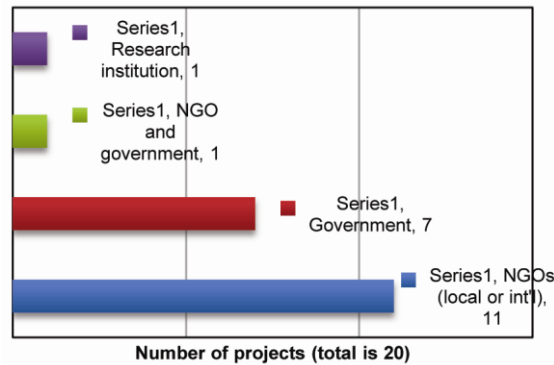


Figure 1. Implementation partners for UNICEF-assisted ecosan projects

While most projects were described as ‘pilot’, the numbers of actual users varied from very small, one school or few households to large catchment areas targeting tens of thousands as in Bangladesh. Most projects fall between two categories: quite small (under 1,000 users) or quite large (over 10,000 users), see Figure 2 below.

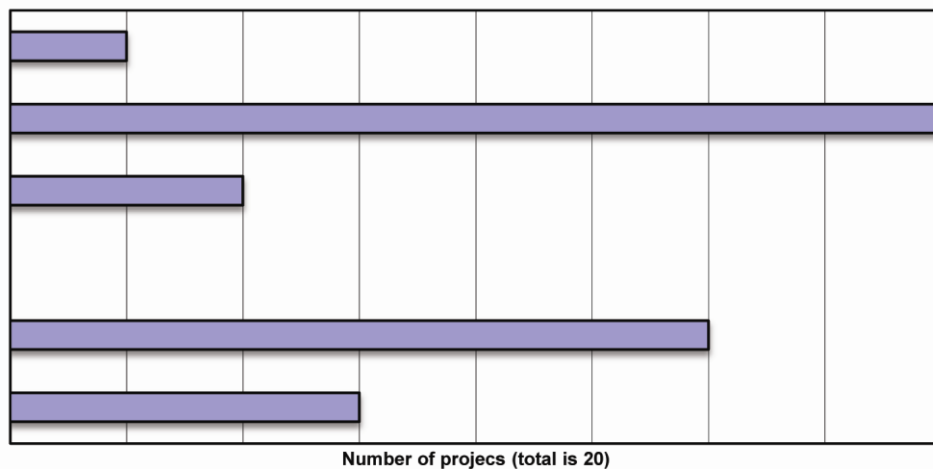


Figure 2. Number of users in 20 UNICEF-assisted ecosan projects worldwide

The majority of the projects target rural areas (60% of projects) and households (55% of projects). Fewer projects targeted schools (35% of the projects) and peri-urban/urban areas (30% of the projects), whilst only two projects targeted schools and households together.

The decision of where projects are located is a result of joint situational analysis with national governments. UNICEF advocates for supporting the most marginalized areas where development indicators for children and women are the lowest. The procedure is systematic, and therefore the same in Asia, Africa and Latin America.

Technologies used and types of environment

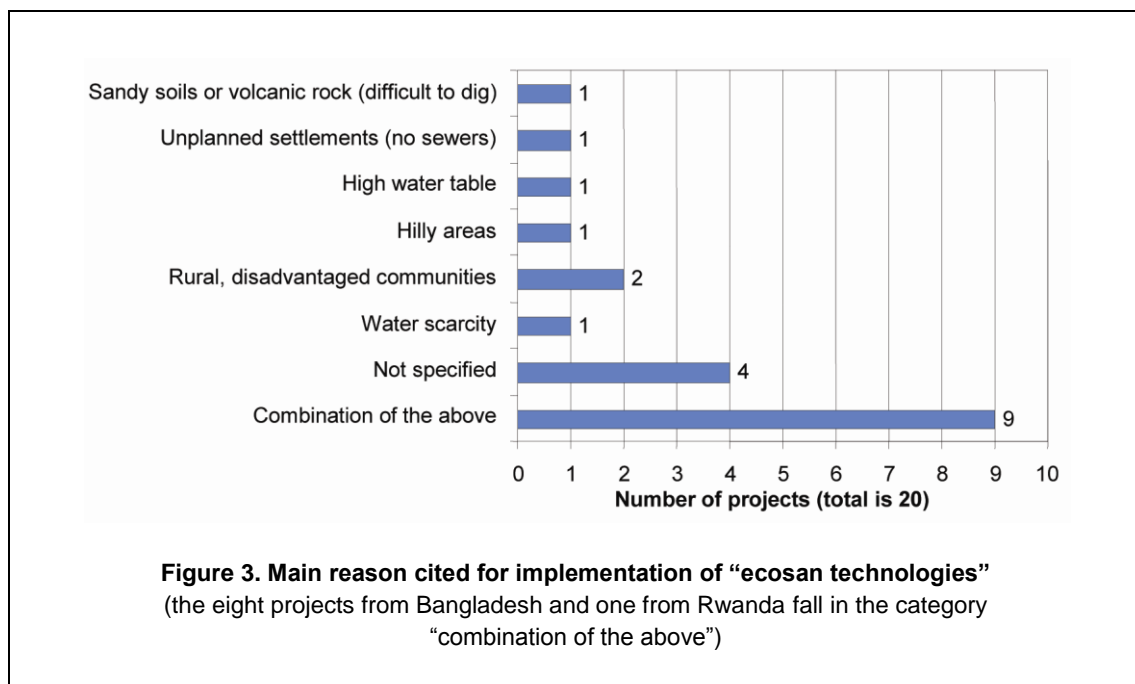
The vast majority of ecosan projects used urine diversion dehydration toilets (UDDTs), namely in 14 out of 20 projects; followed by four projects using either single or double vault composting toilets (Bangladesh Malawi and Zimbabwe). One project used DEWATS technology (in North Korea) and one project used

biogas sanitation (in Bangladesh). The UDDTs and composting toilets are in line with UNICEF's support to low-cost community managed and affordable facilities.

However, the project in North Korea (PDRK) was an exception to the low-cost focus, where wastewater treatment decentralised plants were built based on the DEWATS design by BORDA. It was noted that the costs were too high for replication at community level. The plan is now to scale down the current size and develop a small scale DEWATS for facilities like hospitals and education institutions.

The main reasons for implementing “ecosan technologies” were that the target areas were in one way or another difficult or challenging geologically (Figure 3) – where the conventional pit latrines would fail to deliver satisfactory solutions. For example, in the case of Bangladesh, ecosan is introduced in areas characterised by landslides and flash floods in hilly areas; uneven land and clay soils in the so-called *Barind* regions; flood prone areas with loamy soils; insufficient land areas in urban slums; and heavily water logged areas (5-6 months of the year) in the low lying so-called *Haor* areas. For the latter areas, the challenge is that they are important areas for agricultural activities such as rice cultivation and fishing, yet are home to very poor people with scarce land available for infrastructure. Under these conditions, conventional pit latrines become inappropriate because of the risk for groundwater contamination, the need for frequent latrine replacement (or pit emptying), associated recurrent costs, the unavailability of land for construction and land tenure issues, in the case of urban areas (see also Morshed and Sobhan (2010)).

Staff from UNICEF Nigeria stated that in riverine communities of the Cross River State, the high water tables and water logged soils made pit latrines impossible, and UDDTs were being researched for their potential as a solution. Similarly, Rwanda's challenging environment of hilly volcanic rock and high water table in many places led to a high uptake of UDDTs because of their above ground design and added bonus of reuse of treated excreta as fertiliser.



The majority of projects were being implemented in difficult geological or geographical conditions. As such the majority focussed on some sort of action research, either as a stand alone project or a component of an overall national sanitation program by the government and UNICEF. The majority of projects (65%) had a focus on “action research” testing the conditions under which ecosan could be implemented, 30% of the projects were normal development projects with a pilot component (non-emergency response) and one project – the one in Zimbabwe – was an emergency intervention. From the 20 projects analysed, 60% were designed to test ecosan technology *vis a vis* the geographical conditions (such as rocky soils or water logged situations), 30% were designed to test the technology appropriateness and/or social acceptance and two projects were neither of the two categories (Zimbabwe and Malawi projects).

A closer look at the study countries, examples from Rwanda and Bangladesh

The consortium model in Bangladesh

The Bangladesh project (SHEWAB) is an action research project on ecosan. It is linked to community demand approaches, as trained community facilitators under a government extension program work with communities using a triple ‘A’ approach. That is, assess their condition, analyse the situation and make a committed action through action plans. Eleven different “ecosan toilet” options (mostly UDDTs) have been developed and tested with modifications addressing anal cleansing, menstrual hygiene, improved access for the disabled, elderly or pregnant women, better ventilation and light, and inclusion of a moveable “compost drum” (for storage and drying) when space is a problem (Practical Action, 2010). Demonstration sites are established so people have first-hand experience to see a facility and ask questions. More details about ecosan initiatives in Bangladesh in general are provided by Alam (2010).

The project has established cost sharing schemes and is not fully subsidized. Households must contribute between 15-40% of total costs. In most cases, the above-ground substructure (vaults to collect faeces) is covered by the project but the toilet superstructure for privacy is the responsibility of households. The capital costs of the consortium’s UDDT models range from USD 70 to 243, which is cheaper than many “conventional UDDT” designs. Cost savings were made through primarily adjustments in size, materials used for construction, and the number of standard features. Efforts continue to bring down the cost of a unit. The consortium has a number of organisations which provide technical backstopping. It also has good support from the government of Bangladesh as ecosan is built into the national sanitation strategy to meet the MDGs. The government plays an important role in monitoring, approving facilities and providing extension staff to support households. As it is action research, there is built-in monitoring and evaluation of activities, giving opportunities for reiterative planning and changes as required.

Reuse of treated urine and faeces still remains a challenge and the consortium has developed a package of awareness activities to address this as well as other challenges. It includes exchange visits, court yard meetings, popular theatre, child to child and school ecosan projects. One example being a local folk song adapted to address the shame felt by many people when using urine, dried faeces or excreta-derived compost as fertiliser. People are first encouraged to use urine and dried faeces for fertilising fruit trees. The consortium tries to link up urban dwellers with farmers to use the fertiliser in order to provide a market for the excreta-based fertiliser. They are also exploring vermicomposting for landless and poor households, where space is an issue. Moreover, movable drums and urine diversion options seem to be effective for urban slums setting.

Implementation challenges and opportunities in Rwanda

The raised and permanent structures of the UDDT toilets along with the prospect of increasing their revenue with the use of excreta-based fertiliser for crops are reasons for many families to embrace this technology in Rwanda. However, the uptake remains quite limited and low when compared to the uptake of VIP latrines (ventilated improved pit latrines) after demonstrations. The first reason for this is the relatively high capital costs to build UDDTs (although the Bangladesh case has shown that low-cost UDDTs are possible). Secondly, the health risks due to handling of raw excreta (after less than six months of drying), is another deterrent for UDDT selection: The UNICEF program promoted the cheaper single vault design instead of a double vault design. These vaults filled quickly and required households to empty the vaults before the 6-12 month sanitisation period, putting household members at risk to contact pathogens. Where double vault designs were promoted by some NGOs, the issues of handling raw excreta during vault emptying were addressed, as a second vault could be used in the interim.

Thirdly, without operation and maintenance arrangements, several of these UDDTs, especially the public ones, remained closed and unused till today. The common arrangement for operation and maintenance is to have a third party to handle the urine and dried faeces, usually in a nearby cultivation plot. Common problems are the lack of a cultivation plot near the households in which the fertiliser can be applied, as in the case of urban areas. Schools are fortunate as they often have a garden and their maintenance staff to look after the excreta and fertiliser. In general, handling of excreta is seen as a menial task, which is a factor working against the adoption of this technology.

Opportunities to link ecosan with other nation-wide programs exist for the generation of energy and heat for lighting and cooking, respectively. For example, the human and animal waste generated from households that keep livestock could be sufficient to operate a bio-digester and produce biogas. In 2008 the Rwandan government instituted the “One Cow per Poor Household Program”, which aims to give 257,000 of the

poorest households in the country training and support to raise cows and produce milk for home consumption. The Rwandan government is firmly supporting UDDTs as an option that provides sanitation in difficult geological conditions and with possible income and energy generation for poor households (the energy generation via biogas sanitation is generally only viable for the combination of human and animal waste or for large institutions such as schools and prisons).

Discussion

Wider community-led approaches and schools

The focus of UNICEF and its partners continues to be on rural households with increasing recognition of the importance of schools and peri-urban/urban areas. There is increasing urbanization in most countries resulting in slums, scarce land availability and the risk of disease outbreaks from congested living quarters without adequate sanitation. Ecosan in urban areas has its challenges as high population density leaves little physical room for the immediate use of treated excreta as fertiliser. Therefore reuse is less likely in peri-urban and urban areas, as in the case of Rwanda unless challenges are addressed.

Schools are viewed as centres of learning and development and can provide a good model to the wider community (CARE et al., 2010; Fogde et al., 2010). However, isolated school ecosan projects make replication to households difficult if they do not address the issues of cost, technical support and reuse of treated excreta as fertiliser in the absence of nearby gardens or farms.

Clearly there are opportunities to link ecosan to the overall strategy of community-led total sanitation, potentially expanding uptake of sanitation, especially in areas where conventional technologies (toilets with pits) are difficult to implement. This is especially true if links are made with development initiatives related to agriculture, health, and education. Hence ecosan projects are viewed as a larger strategy to improve child nutrition, health and economic development. Moreover, once demand is created for sanitation, people will need support in finding sustainable solutions for their situation. If conventional technologies such as dry pit latrines, pour flush toilets or water closets and septic tanks are implemented but are not suitable nor sustainable in the longer term, people may revert back to open defecation if they have no knowledge of alternative options.

Opportunities for information-sharing and technical back-up

As lack of available technical support is cited as a constraint by many UNICEF country programs, a positive model for information sharing is the initiative in Bangladesh where implementation takes place in a consortium, managed by one NGO with technical knowledge of ecosan. This ensures information is exchanged, documented and disseminated to the wider sector. Furthermore, online networks with an extensive internet presence, like the Sustainable Sanitation Alliance (www.susana.org), and regional NGOs like CREPA can be a source for technical backstopping by linking projects to local individuals or organisations with expertise in ecosan. These networks can also support dissemination of project results and impacts. Already many countries and regions have dynamic networks for ecosan such as in the Philippines, India, and Kenya. Further, considerations could be made to expand network coverage through the use of radio, newsprint and mobile telephones, as these have been shown to have wide audiences. There is a gap between the extensive information available and the people who need this information and support.

An important selling factor for ecosan, as demonstrated in Rwanda, can be the potential economic benefit of selling excreta-based fertiliser or applying fertiliser for improved crop production. A comment from staff of UNICEF Cameroon, which is in the process of embarking on ecosan initiatives, noted the need for additional technical support to ensure that such fertiliser is being safely and consistently applied to agriculture. This in turn would promote the regular use of the toilet facilities and increase the likelihood of uptake by other communities and schools.

Conclusions

This paper highlights that ecosan is being adopted in response to the challenging hydro-geological conditions which make conventional technologies (particularly pit latrines) difficult to implement sustainably. The reasons given for choosing the ecosan approach were very different from those normally used to promote the ecosan approach (namely improved agricultural yields with cheap fertilizer and the protection of natural resources such as groundwater). This paper shows that ecosan is being chosen because it offers, through primarily its above-ground substructure design, advantages in terms of managing and

dealing with human excreta in difficult geological conditions and congested areas. In light of urbanization and growing demand for sanitation, ecosan has the potential to provide access to sanitation to those who would otherwise not have access.

Barriers exist for up-scaling of ecosan, as highlighted in the paper, in terms of relatively high initial costs compared to pit latrines, having adequate technical back-up support and opportunities for reuse of treated urine and faeces as fertiliser particularly in terms of hygienic handling and given the absence of supply chains. The Bangladesh model using a consortium approach offers a potential solution to deal with these issues, while simultaneously sharing and disseminating experiences. Other opportunities, as demonstrated in Rwanda, may be realized when ecosan projects are linked to poverty alleviation strategies. Information on ecosan exists in many networks (such as SuSanA), and regional NGOs such as CREPA. The challenge remains on how to innovate, adapt and disseminate this information so that people who need it the most can benefit in terms of improved health, hygiene and dignity.

Acknowledgements

The authors would like to extend thanks to all those who responded with information: Astrid van Agthoven, (UNICEF Bangladesh), Hans Spruijt (UNICEF Bangladesh), S. A. Abdullah Al Mamun (Practical Action), A. K. M. Shirajul Islam (Bangladesh Association for Social Advancement, BASA), Md. Azahar Ali Pramanik (SPACE), Franck Bouvet (UNICEF Bolivia), Kencho Namgyal (UNICEF Bhutan), Gilles Djagoun (CREPA Burkina Faso), Abel Ndembe Nimi (UNICEF Brazzaville), Madina Bah (UNICEF Conakry), Prakash Kumar (UNICEF/SEI Consultant, India), Bisi Agberemi (UNICEF Nigeria), Ramesh Bhusal (UNICEF DPR of Korea), Fataou Salami (UNICEF Togo), Maxwell Jonga (UNICEF Zimbabwe), Suzanne Gbaguidi (UNICEF Cameroon), Phocus Ntayombya (UNICEF Rwanda), Onana Salomé (CREPA), Jane Bevan (UNICEF WCARO), Sophie Hickling (UNICEF ESARO), Therese Dooley (UNICEF NY).

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