

# Greeting and opening session

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\*This paper has been peer reviewed by the symposium scientific committee



## Welcoming address

### Wolfgang Schmitt

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Ladies and Gentlemen,  
Excellency,

on behalf of the GTZ, I would like to cordially welcome you all to this 2<sup>nd</sup> international symposium on ecological sanitation. We at the GTZ believe that this conference, and others like it, will make a major contribution to finding solutions for the water and sanitation crisis currently facing us all.

It gives me a great deal of pleasure to be addressing such a large and varied audience gathered upon the invitation of the GTZ and the International Water Association. It really is very encouraging to see so many people interested in sharing their experiences and learning more about innovative sanitation solutions.

My special thanks go to those who have spared no effort in travelling great distances to participate in the symposium. It is also extremely encouraging to see the range of nations represented here among the participants. It highlights that in this most urgent field of developing and implementing appropriate, sustainable sanitation alternatives, there already exists a vibrant dialogue, not just in the direction North-South, but equally South-South and North-North.

The GTZ is pleased to be able to contribute to the intensification of these exchanges and help address the pressing need for ecologically sound sanitation.

We are extremely interested to learn about the experience of experts and practitioners from all countries, from abroad and within Europe, concerning the latest developments and experience in the application of ecosan, that we understand as a holistic new approach to wastewater management and sanitation based on the systematic closure of local material-flow cycles in order to close-the-loop between sanitation and agriculture.

Why have we decided to hold the conference in Lübeck?

The aim of our ecosan-project is to contribute to the development and global dissemination and application of ecosan approaches and establish these internationally as state-of-the-art techniques – in both developing and in industrialised countries. In Lübeck we have an example of a closed-loop oriented urban eco-settlement, which has gained international recognition since the World Exposition EXPO 2000.

Also in Hamburg, and its neighbouring areas there are other such examples of closed-loop sanitation systems that will be visited in the course of the excursion planned for Wednesday. More such sites are to be found in Denmark and Sweden, the neighbouring countries. These will be visited during the post-conference study tour which will begin right here in Lübeck directly after the conference.

The existence of closed-loop oriented sanitation systems in industrialised nations should underline the fact that ecosan isn't an approach intended only for poorer countries, but that these concepts should be implemented in every nation.

In comparison with the first ecosan-symposium that we held in October 2000 in Bonn, the number of participants has doubled and we had to extend the conference to five days. I am very glad to see this huge increase in interest that ecosan is attracting, especially on the subject of sustainability in the field of water sciences, hygiene, energy and nutrition.

As the managing-director of the GTZ, I would like to give you a brief introduction of who we are, what we do and where we see the focal areas and our tasks for the future.

The Deutsche Gesellschaft für Technische Zusammenarbeit is a service enterprise for development cooperation with worldwide operations. Established in 1975, the GTZ is owned by the Federal Republic of Germany. Our organization operates as a non-profit private-sector enterprise with a development-policy mandate to improve and sustain the living conditions of people in partner countries and to conserve the natural resources on which life depends.

A major client of the GTZ is the Federal Ministry for Economic Cooperation and Development and I would like to extend my thanks to the BMZ for making this conference possible. The GTZ also supports development and reform processes on behalf of other German ministries and partner-country governments.

The cooperation with international organizations, such as the World Bank, European Union, United Nations Organisations and the African and Asian Development Bank is steadily increasing.

The private sector is also of growing importance to development cooperation. Public Private Partnership is the name given to cooperation between GTZ and the private companies in projects that combine beneficial development impacts with commercial gain for the enterprises involved.

Currently, the GTZ works in 131 partner countries and supports 2,703 development projects and programmes. All this is done with 10,977 staff members, 78% of them international employees.

One main focus of the German Technical Co-operation is the Water Sector. To date there has been much progress in the areas of fresh water supply, watershed and resource management, but unfortunately considerably less in the sound management of wastewater and excreta. It is therefore one of the factors that sets limits on human existence and development.

The supra-regional research and development project ecosan is financed by the Federal Ministry for Economic Co-operation and Development. The idea for the project arose 3 years ago out of other GTZ water-based programs and the recognised need to develop new economically feasible and ecologically sustainable sanitation solutions.

The great dynamics and diversity of our ecosan-project from the very beginning has contributed to a worldwide network of organisations and projects. Alone within the framework of German cooperation, ecosan-projects are currently being prepared or implemented in more than 20 countries. The Swedish International Development Cooperation Agency, which will be represented through several project representatives here in Lübeck, was the first actively promoting agency starting about ten years ago with ecological dry sanitation programmes.

We have learnt a great deal from them and our strategic partnership over the last few years has been very productive. Meanwhile we have integrated other household wastewater aspects into the ecosan-concept such as greywater treatment, biogas-technology and now, in China, for example, even waterborne ecosan-concepts will be integrated into new settlements in a Chinese-German eco-city-project.

The term "Ecological Sanitation" stands for ecologically and economically sustainable sanitation systems. It does not refer to a specific technology. We use it rather to describe a whole range of technologies and institutional arrangements, which address both the issue of water scarcity and better sanitation. "ecosan" covers closed-loop systems of wastewater management, which con-

concentrate on the principles of recycling water and nutrients as well as reducing the need for fresh water and is a holistic alternative to conventional sanitary systems.

The ecosan-concept fits perfectly into the Millennium Development Goals for 2015 set at the UN Summit of 2000. The goals most relevant to water are to stop the non-sustainable exploitation of water resources and to develop strategies, which enable an affordable and reliable water supply at a regional, national and local level.

At the Johannesburg World Summit on Sustainable Development in August/ September 2002 one declared goal was to guarantee the provision of clean drinking water and adequate sanitation, necessary to protect human health and the environment.

In this respect, a declaration was made agreeing to halve the proportion of people without access to safe and affordable drinking water (as outlined in the Millennium Declaration) and the proportion of people who do not have access to basic sanitation by 2015. This will require actions at all levels to:

- a) Develop and implement efficient household sanitation systems;
- b) Improve sanitation in public institutions, especially schools;
- c) Promote safe hygiene practices;
- d) Promote affordable and socially and culturally acceptable technologies and practices;
- e) Integrate sanitation into water resources management strategies.

At the World Water Forum in Kyoto two weeks ago ecosan emerged as a significant tool to help us meet the Millennium Development Goals. As a result, new partners have committed themselves to ecosan, while others have increased their resolve to ensuring an increased recognition for ecologically sound sanitation alternatives.

The number of international ecosan-partners is steadily increasing. The World Bank – Water & Sanitation Programme has decided to expand their group of experts significantly.

The United Nations Environment Programme will hold a meeting to elaborate strategies dealing with new ecosan approaches in October/ November of this year and we are pleased, that the Executive Director of UNEP has designated Mr. van de Guchte, to give a keynote speech on his behalf at this symposium.

I am also very glad to welcome Mrs. Maria Mutagamba, the Ugandan Minister of State for Water, who will give an opening speech to this symposium, as Uganda is one of the leading countries worldwide in the promotion of ecosan as a standard approach for sanitation.

I am also glad to welcome further high-ranking personalities from the United Nations Development Programme, the Centre for Science and Environment in India, the International Water Association, the Swedish Urban Water, the Stockholm Environment Institute the German Federal Ministry for Economic Cooperation and Development and last but not least, Kreditanstalt für Wiederaufbau, KfW, the German Development Bank, who will all be holding keynote addresses.

The coming five days will be filled with presentations from experts and practitioners with the focus on development work in both rural and urban areas. Social problems of participation and hygiene will be considered as well as the economic aspects.

Another goal of the symposium is to develop recommendations for action for the implementation of ecosan at a larger scale in rural and urban areas. These recommendations will be the subject of the side event on Tuesday evening and will be discussed and adopted in the panel discussion on Friday with the final recommendations then being made available for publication.

In closing I would like to take this opportunity to acknowledge the sterling work of our ecosan project team. In a relatively short period of time they have engaged in intensive international co-operations in a large number of countries, in many different fields of specialisation and are re-

ognised as enthusiastic members of the international ecosan network. They have achieved this thanks to their hard work, their enormous creativity and their 100% commitment to spread and introduce the concept of closed-loop sanitation around the world. We at the GTZ are proud of their achievements to date.

I would also like to take this opportunity to extend our most sincere thanks and appreciation to all our partners who have helped us organise this symposium. I would like to thank the BMZ for their constant support of the GTZ ecosan-project, and their particular input into the organisation of this conference.

I would also like to express our gratitude to the International Water Association, the Technical University Hamburg-Harburg, EcoSanRes, Urban Water, the Water Supply and Sanitation Collaborative Council, the Deutsche Vereinigung für Wasserwirtschaft, Abwasser und Abfall and UNESCO – an international array of partners, all of whom have willingly helped us in our organisational efforts for the symposium. I would like to say to you all that your close cooperation is greatly appreciated.

And finally let me thank both the ecosan “movement” that has proactively developed and spread an alternative water-wastewater concept worldwide, and all the participants that have gathered here. I wish you all success in all your efforts and hope we all have a very interesting, successful and productive symposium.

## Ecosan – what kind of advocacy is needed

**Maria Mutagamba**

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Thank you very much chairperson for this session, our hosts this morning, participants, ladies and gentleman.

I am more than honoured today to be here to give the Keynote Address at this ecosan conference, and especially at this time, immediately after the 3<sup>rd</sup> World Water Forum in Kyoto.

Let me introduce myself. I am Maria Mutagamba, Minister of Water in Uganda.

Before I continue, I am sure that each one of you is an expert on ecosan, so I will give you the theme of my speech. It is sanitation and hygiene, and how sanitation and hygiene are connected to my portfolio as Minister for Water.

The previous speaker said, we must look at sanitation as an aspect of water resource management. Sanitation is therefore of key importance to my sector.

Poor sanitation has been recognized as a global problem, and as such it is everybody's responsibility. The World Health Assessment Report of 2000, published by the World Health Organisation and UNICEF, clearly pointed out that over 300 million people in Africa (that is over 40% of the African population) are without access to adequate sanitation. For the case of Uganda, the story is not any better. 50% of the population are without adequate sanitation and hygiene facilities. That is half of the population of Uganda, so for every ten people you see, five of them do not have access to sanitary facilities.

With such a crisis, what measures can we take?

In Africa we mainly use an on-site (i.e. decentralised) form of sanitation, the pit latrine. It is the most widely used type of sanitary facility.

Other practices exist however. For example if one cannot go out at night, (and one must always go outside to use a pit latrine) it is common practice to defecate in a container which is then emptied somewhere outside in the morning.

Then there are those who use what we call "flying toilets", where one defecates in a plastic bag and then disposes of it, often into garbage bins or into running water, which is very dangerous.

Of course we have tried other improved methods, such as ventilated improved pit toilets, but these are not very common. We have tried to install them in urban centres, health centres and a few schools, however only a small section of the population is covered by these.

We also have septic tanks for water flush toilets. These are basically used by people who have the financial means to construct their own houses and are connected to a water supply allowing them to flush their toilets. So when they flush the water goes into the septic tank rather than into a central sewerage system. Sewerage systems only serve around 12 towns in Uganda, estimated at around 10% of the population.

Due to the low availability of water and the fact that they are a relatively new concept, we are faced with the problem of emptying the septic tanks wherever we develop towns. How and where do we empty them? In areas like Kampala where there is a treatment plant it is comparatively easy, as the tanker only has to travel a distance of 10 km or so to the plant. But how about those areas outside Kampala, a 100 miles or so away, where can they dispose of the contents of their septic tanks? That remains a problem. And it is a problem that our planners and you

people here are going to help us solve. Without a doubt it is a global concern.

We have the National Water and Sewage Corporation, I have my team here with me, they are the people that actually take care of the areas that are connected to the sewage system. And even there we still have a problem, as you know the sewage system dates from the 1960's and some parts are worn out and need replacement. Here we hope to learn and exchange ideas. We need to learn from those who have tried alternative solutions it and succeeded, we need to learn from your success stories in order to build ours. So for us it is a learning experience, especially in ecosan.

How are we going to translate what we hear and see here into an implementable and sustainable plan of action. Of course the current sanitary practices I have already mentioned are costly in terms of both their impact on health and the environment. They pollute and contaminate our water resources. In areas of high population density there is also a problem of space, as each family requires an area to dig their own pit latrine, and in areas with a high water table most of the faecal matter finds its way into the water resources. When that pit is full a new one is made, rather than emptying the old one, and then another and another. You need to have plenty of land for this. But what should communities do when they live in areas with sandy soil conditions where the pit caves in, or with hard, rocky soil conditions where you cannot easily dig a pit?

In order to overcome the problems caused by a high water table, people have learnt to build what we call "storage toilets". Instead of digging a pit and going downwards, they build upwards, constructing a vault to contain the excrement. That however also often proves to be unsuitable, as seepage tends to leak through the vault walls because the excrement is above ground. This happens because they fill up much faster, and the liquid tends to find a way out. What often happens then is that people just remove a brick or two and empty the contents onto the surface, causing an additional hazard.

Septic tanks are also not a good solution as they are not affordable to the majority of the people and are expensive to construct, maintain and empty. The sewage system does not cover the larger parts of the urban centres that have already been earmarked for development. It is expensive infrastructure but it must be done.

So what do we do with all these problems facing us?

This dilemma has led us to embrace ecosan and critically look at the various lessons learnt. Not with the aim of scrapping or doing away with what we already have in place but to somehow develop it further. So ecosan has come as a blessing and I think it can work.

However we have encountered some problems with it, the biggest being the attitude and behaviour of the people. In Uganda we have various communities and cultures. There are communities who have never believed in using a toilet. Especially the women who actually believe that if they use a toilet they may not be able to conceive. These communities need to be educated on these issues. During colonial times many toilets were built in these areas and the people misunderstood their purpose and did not accept them. We need to find a way of changing such attitudes and persuading them to use them.

It becomes even more difficult when you begin to tell the people that they must separate the liquid fraction from the solids, which they may not understand or accept. They believe what a person does in the toilet is their own private business and say that we are intruding a bit too far into their private lives, almost as if we are trying to supervise them there. The ecosan toilets we started off with in these areas had to eventually be locked up because they were being abused (or misused). The people just didn't know how to use them, and they became a problem in the area.

So how can we translate this information and get the message across?

We have to sensitise people and train them on what needs to be done. For us this is a new

concept, a new approach to sanitation, and there is a need for a great deal of work. Therefore, while the technical people are busy developing various technologies, the rest of us, especially we politicians need to carry out advocacy work. However we also need to be trained for that, we need information that will help us sensitise the masses out there.

For instance, I've been in politics since 1989 and I have never seen or heard any of my colleagues, or even myself, going up on a platform to seek a vote on an issue of sanitation. Never! I have talked about water, I have talked about schools but never about sanitation, because it is taken for granted, it is somewhere there in the background.

We have to make it a political issue. We have got to do political advocacy, starting with individual efforts. We in government ought to be able to develop policy.

I am active in central or national government level but it is at local government level where issues should be identified. For a long time we have been planning from the top down and making the people at local level unsure of their role and abilities. Because they do not understand what we are telling them it makes it difficult for them to sustain the projects. So we are appealing to local government to start to initiate programmes or identify issues on sanitation and draft proposals and policies, and then to forward them to the top to make them national policy coming originally from the local areas. This will let them see that it's their issue not just a central government issue.

Then at a national level we can be able to communicate to our colleagues in cabinet and in parliament ensuring that they do not marginalize issues of sanitation. I should add that a large number of them do not understand or have even heard of ecosan, and to be frank I only heard about it when I became a minister.

So for us policy makers who do not know much about ecosan, I hope the experts here can translate the information into political messages that we can take to our people.

And then having talked about political advocacy, there are still some other areas where we can advocate, for example in the private sector. A previous speaker from the GTZ spoke of PPP (Public Private Partnerships), and I'm pleased to say that in Uganda something is happening in this regard. Two or three companies that have championed the introduction of ecosan have been very generous even by donating some sets to schools for demonstrations. So here the private sector is able to participate and demonstrate the construction of ecosan toilets.

And of course the private sector would like to go into an area that is profitable so they are looking at the tariffs that are involved. At the moment sanitation as a service is not so lucrative. Very few companies are going into sanitation. In fact, an investor came to me proposing that I negotiate with the Minister of Finance for a concession on taxation for materials needed so that they can make the sets cheaper and more affordable. The private sector is willing to take the lead and we must be able to assist them with the concessions they require in order for them to offer a service that is affordable.

Other industries that can benefit from this are the fishing industry and the manufacturing industry. For example, the soap manufacturers from hygiene promotion, and the beverage industry because their products eventually end up in the system. They cannot only contribute to the problem but to the solution also.

Another aspect for advocacy is through education. In Uganda at the moment, four ministries, namely water, education, health and local government, are handling sanitation issues. It would be good if we could get ecosan principles to be taught in our schools because children are a good medium of transmission as an entry point. Then we can encourage the private sector to make these ecosan sets available to the schools because schools can monitor and supervise their utilization and people can learn through that.

Another area is the religious institutions because religious leaders already have a forum through their followers in churches or mosques. They can teach ecosan, and even better if a set is available. The message would be carried even faster as people would come initially out of curiosity and then eventually get to appreciate the concept and take something home with them. More people would be converted to our gospel of ecosan through the religious institutions.

And then there are the cultural leaders. I come from a country where people believe in their kings or cultural leaders. We can use them as mobilisers to convey the message to their subjects who believe whatever they say. They can advocate for ecosan and grey water reuse for agricultural purposes and so on. Sanitation has always been viewed as something dirty so the idea of using dirty water for growing vegetables will first be shunned by the people. We need widely accepted mobilisers who can convince them that the vegetables are not going to be dirty. After all, they have been eating vegetables grown from where there used to be toilets, utilising the same nutrients. That is the kind of message our cultural leaders should convey.

Having looked at national efforts we can look at global efforts. We have been at various international forums, such as the World Summit on Sustainable Development in Johannesburg, where we raised our voices for sanitation. We have to continue making our voices heard. There is the G8 summit taking place in June and we have got to be there to let everyone know that sanitation is the key to liberating our people, the 2,4 billion people who are not served. Sanitation is the key to liberating these people from the vicious cycle of disease, poverty and hunger.

In Africa the African ministers responsible for water and sanitation will be meeting in South Africa, five days from now, to follow up on the commitments made in Johannesburg and Kyoto. As a way forward I request that we each find a way of sending a message to the African leaders to solidify sanitation issues into the NEPAD and AU agendas in order to divert the crisis that seems to be looming.

It has been mentioned that 6000 children are dying everyday because of poor sanitation. That catastrophe is equivalent to 20 Boeings crashing everyday. If that happened none of us would have been able to travel to be here today, but it's happening with poor sanitation.

So with those few words, ladies and gentlemen, I want to emphasise that sanitation, especially ecosan, requires a great deal of advocacy and here we are to amplify the message.

Thank you very much.

## Why the flush toilet is ecologically mindless and why we need a paradigm shift in sewage technology

**Sunita Narain**

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*A few years ago, attending the Stockholm Water Symposium, we had an invitation to a banquet from the king of Sweden. But instead of dining in splendour, my colleague, Anil Agarwal and I were inspecting toilets in some remote parts of the city. I was not sufficiently convinced of our mission as we opened the hatch of these "alternative" toilets bins where the faecal matter was being stored before composting and were regaled with information about how urine could be separated in the toilet and used directly for agriculture. Our friend, Uno Winblad, toilet crazy like Anil then took us to supermarkets in Stockholm city where there were a range of toilets – from water saving, to electric and of course, urine separating toilets. Anil who hated shops, was delighted and I began to understand the links.*

*The flush toilet and the sewage system – which I always believed was the epitomy of personal hygiene and environmental cleanliness – were a part of the environmental problem and not the solution. I came to understand from our research, the technology is quite simply, ecologically mindless.*

### The crisis of sanitation

*"Sanitation is more importance than independence," said Mahatma Gandhi. It is clearly a critical issue, linked as it to human health and dignity. It is estimated that over 80 per cent in rural India and 50 per cent households in urban India have no access to sanitation.*

The health costs are enormous. Dirty water kills more babies than any other substance in the world. A World Bank study estimates that there were 2.06 million deaths of children in 1999 in India, of which 90 per cent were in poor rural households. If all households had clean fuel, private (clean) water, private toilet it would reduce infant child mortality by roughly 1 million -- half the deaths. The sanitation mission is clearly too small a price a pay for saving precious human lives.

But sanitation is a double-edged sword. It is a vital part of the solution of human well being but it is also a part of the problem of human health. This is because modern sanitation based on the excessive use of water as a carrier medium and for disposal, adds to the problems of water scarcity and water pollution.

### Growing water crisis

There are growing conflict over water in many parts of the world. There is also desperate scarcity of water, which is taking an enormous human toll. There is intense competition between competing needs of water in agriculture, industry, drinking and recreation. The conflicts between rural and urban settlements for water are real. Urban settlements are water guzzling and wasteful but powerful enough to source water from longer and longer distances. Water shortages now plague most large and small cities of India. Many cities get water for less than 20 minutes in a week. In rural India, the crisis is exacerbated by the fact that all traditional and community systems to manage local water resources have been lost over time.

But it is important to realise that water shortage is not about lack of water per se. A fascinating instance is Cherrapunji, located in the northeastern state of Meghalaya in India. This place could easily be known as the wettest place of earth, with rainfall levels of 14 meters annually – 14,000 mm. But it still suffers from acute shortages of drinking water because of lack of systems to hold and capture the rain that falls in the region. On the other hand, the desert city of Jaisalmer, which gets less than 100 mm of rainfall has been on major caravan routes for trade and has no recorded history of being evacuated for lack of water. Water scarcity is therefore, equally about the mindset of conservation and careful use. It is about the ability of humans to value each raindrop of rain.

It is important to note that to confront the water crisis of the world we need policies and practices that augment, minimise and recycle the resource. It is on this yardstick, when we measure the modern sewage system, we will find it is **ecologically mindless and inequitous**. This is because:

- **It is natural resource intensive:** It uses materials, energy and generates waste. It has high environmental and health costs.
- **It is highly capital intensive:** It divides the urban population into rich and poor, that is, between people who can afford the expensive urban services and those who cannot.

### Flush and forget mindset

Consider how first a large amount of clean water is used to carry away a small quantity of human excreta. In India, flushes are designed to be particularly water-wasteful so with each flush over 10 litres of clean water goes down the drain. We build huge dams, irrigation systems and what not to bring water to urban areas. Then this water which is flushed down the toilet goes into an equally expensive sewage system, all to end up polluting more water – invariably rivers and ponds. Most of our rivers are dead today because of the domestic sewage load from cities. We have turned our surface water systems into open sewage drains. This is **hydrocide** – deliberate murder of our water bodies.

This heavy use of surface water leads to growing conflicts between urban and rural users. It also leads to overexploitation of surface waters. But then the discharge of domestic sewage leads to heavy pollution of rivers and urban groundwater aquifers.

The solution is to invest in huge river clean up programmes -- the Ganga Action Plan or the Yamuna or the National River Action Plan -- to treat sewage, which incidentally is from the flush toilets of the rich and not the poor. The expensive river action programmes, are sanitary engineers dreams. The thrust of these programmes is to divert sewage, which earlier flowed directly into the river, to a treatment facility.

We need to understand this political economy of defecation. The more water you use, the more investment is needed in cleaning it up. In big cities of India, 22900 mld of wastewater is collected through sewers and of this only 5900 mld is treated in sewage plants. Rest of the human waste is disposed off untreated in water bodies. An estimated 26 per cent of large city waste treated. Waste of smaller settlements is not even collected, let alone treated. Less than 50 per cent of urban dwellers in large cities, less than 14 per cent in smaller cities have access to sewage systems.

The political economy of sewer systems is extremely atrocious in poor developing countries. Hardly any poor city is able to recover its investments in sewer systems. As a result the users of these sewer systems get a subsidy. But almost all users in poor cities are the rich. Thus, sewers only lead to a subsidy for the rich to excrete in convenience. The poor always remain the 'unserved' in this waste disposal paradigm. In addition, the government has to invest in sewage treatment plants whose costs are again rarely recovered from the rich users of flush toilets.

### Sewers cost us the earth

Worse, it is virtually impossible for governments to play catch with the targets of building and treating sewage plants. We chase targets hopelessly and remain miles behind the volume of sewage being generated. In a rapidly urbanising situation, the city would soon outgrow the sewage treatment capacity created at a high cost. Further investments will be needed all over again.

Take Delhi, as a typical instance. Yamuna is Delhi's main sewage drain. Yamuna enters Delhi at Wazirabad – where the city draws its water supply – and after this an estimated 1800 million litres per day (mld) of untreated sewage flows through 18 drains into the river. In the last four decades, the total sewage output has increased rapidly. Untreated sewage has grown even faster. In 1999, the Central Pollution Board estimated that Delhi produces over 2,547 mld of sewage of which only 885 mld is collected through the sewage network for treatment and the bulk – over 75 per cent flows into stormwater drains and then into the river. By late 2000, treated sewage had increased to 1333 mld as had the quantity of sewage. With this done, over 50 per cent of the city sewage was dumped into the river. By 2005, Delhi plans to triple its present sewage treatment capacity at a cost of Rs 750 crore. But even this, if built and operational, will be less than what is needed.

The even if Delhi builds all the sewage treatment plants, it will still not have the sewage to treat. Why? The city's sewage drains are choked and silted. The government admits that the present capacity of the sewage treatment plants is not being utilised and when it builds new treatment facilities, sewage never reaches these plants. On the other hand, sewage from these choked and broken lines is diverted to functioning lines and, as a result, the treatment plants at the end of these lines are overloaded leading to untreated sewage flowing into the river. Thus, there is an ironic situation. While some plants are overloaded, some are underutilised. The bill to refurbish the sewers is roughly Rs 500 crore, according to the government. Over and above this is the capital cost of the new sewage treatment plants.

Over and above this is the cost of maintaining and running sewage plants and ensuring that the released effluent meets quality standards. Even if the government were to bear the full capital costs of sewage treatment plants, few urban municipalities have the financial resources to bear the expensive operating costs. As a result, sewage treatment plants, even when built, often stand idle.

In urban areas, drinking water is a small component of the total water use. It is sewage and other waste disposal needs that require maximum water input. This huge demand for water for our cities comes at very high political cost as tensions between urban and rural users for water are reaching flashpoint.

### Paying “full costs”

Worse, the political economy of defecation is such that no democratic government will accept the hard fact that it cannot "afford" to invest in modern sewage systems for its citizens.

Instead it would continue to subsidise the users of these systems, in the name of the poor, who would not be able to afford the systems otherwise. The cost to build sewage treatment plants is externalised through these environmental programmes. The logical policy would be to accept the cost and then to impose differential pricing so that while the rich pay for the cost of the capital and resource intensive sewage and waste disposal technology, the poor pay for the cost of their disposal system, which is invariably unconnected to the sewerage system and hence low cost.

For the poor even today, there is no free lunch. They pay — through their labour or with cash — for the meagre stinking water they get. In truth, they pay for it through worsening health. The

relatively rich, in stark contrast, are grossly subsidised for the water they receive. Take Delhi. It costs the city public utility between Rs 9-10 per 1000 litres to treat and distribute water in the city. Its citizens pay 0.35 paise per 1000 litres — less than 4 per cent of the cost. Bangalore citizens pay the most: Rs 5 for 1000 litres. But their water cost is Rs 40 for the same quantity, so they pay 12 per cent of the cost. Compare this to bottled water, where we pay Rs 10 for each litre for the clean water.

But this we know is only half the story. The main cost is not in providing clean water, but in taking back the flushed dirty water in the sewage systems and treating it before discharging it into rivers. We know that sewage and drainage costs can be as high as 5-6 times more than the cost of water supply. And with increasing chemical pollution, water treatment costs are only going to increase.

The “socialist” framework in our countries forces political leaders to keep water and waste pricing affordable by large sections of urban populations. In this situation, private investment also looks for an easy way out. The answer is for them to invest in water services and to leave the costly business of cleaning up the waste to government agencies.

In the meantime, the use of sewer systems would have totally destroyed the aquatic ecosystems in the developing world, posing enormous threats both to public health and aquatic biodiversity. Literally, no small or medium river today is clean. Every river that passes through a city or a town becomes a stinking sewer.

All this makes water-borne sewerage a waste disposal paradigm that is extremely expensive because of its high economic, environmental and public health costs. And as a result it has very high political costs.

### Going against the laws of nature

Sewer systems totally destroy nature’s nutrient cycle in which nutrients collected from the land should be returned back to the land. With the use of sewers, this “waste” gets dumped into our aquatic systems. Therefore, while our nutrients in food come from agricultural lands, sewer systems dump the nutrients contained in human wastes into waterbodies. Over time, our agricultural lands get depleted of nutrients, which then need intensive artificial fertilization. The lack of these micronutrients not only becomes a limiting factor in plant productivity but the resulting lack of these nutrients in human food becomes a threat to human health.

#### A story of two cities: Roma and Edo

The water culture of people is an important indicator of their level of civilization. Take the two ancient cities, Rome and the town of Edo, which grew into the mega-metropolis of Tokyo. The people of Rome brought their drinking water with the help of long aqueducts, which today are regarded as architectural marvels of the bygone Roman civilisation. But the people of Rome lived on the banks of the river Tiber. They had no need to bring water from afar. Unfortunately, they did not know to dispose off their human wastes and like the modern Western civilisation they ended up polluting the river, thus forcing them to go far in search of clean water. This makes Roman aqueducts not a symbol of intelligence but one of great environmental stupidity.

On the other hand, Edo, which too was situated on several streams, ensured that all its human wastes were collected and returned to the farmlands. Its neighbouring rivers remained clean and it tapped its water from them through an extensive piped water supply.

But today we are all children of Rome and not Edo. We have turned our backs to our water bodies and if we don’t have money to clean our mess, then we will have nothing but polluted waters.

### Desperate for an alternative paradigm

Clearly we need to look for an alternative, cost-effective, non-sewage paradigm of human waste disposal. The capital-intensive, material-intensive urbanisation process of the West works only for rich countries, not poor countries.

But while our scientists think about going to the moon, the toilet is not in their vision at all. There is absolutely no thinking about the need to find environment friendly sewage systems in our countries. We need massive investments in R&D for non-sewage alternatives. While investments in sewer systems run into billions of dollars every year despite all the problems they create, research investments in non-sewage alternatives hardly exist.

But who will ask for an alternative paradigm? The entrenched interests and mindsets of our sanitary engineers being what they are, there is no demand for change from this community. But change, we must.

In this context we need to learn from what is happening across the world. There is a growing concern for ecological sanitation and this is giving rise to innovations from the concept of sewerless cities using new technological systems which use extremely low amounts of water or no water at all, and, in which all the wastewaters and the solid wastes are recycled.

These modern systems are built on the traditional science of recycling and composting human waste. But in a way that uses the best of modern science and technology to "sanitise" waste and match the convenience and public hygiene of the modern flush toilet.

Therefore, ecological sanitation is a paradigm that we must explore in all earnestness. But *we must make sure that the new technologies take into account cultural constraints* otherwise they are unlikely to succeed.

*The most important issue is that these "alternative" technologies must be for the rich and not just for the poor.* If ecosanitation technologies are "cost effective" technologies to serve the 'unserved' poor, these will only be an interim alternative, one to be discarded as soon as people become rich. We have to remember that it is the rich person's flush that is the biggest environmental culprit today.



## Challenges in the sanitation sector after Johannesburg

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Honourable Minister,

Dear colleagues, dear guests,

I would like to welcome you on behalf of the Federal Ministry for Economic Co-operation and Development, and in particular I warmly welcome all those, who have come from abroad to this beautiful city of Lübeck.

I would also like to welcome you on behalf of the Minister Heidemarie Wiecek-Zeul and the Deputy Minister Uschi Eid. I know both of them would have liked to be here today, but you will understand that very important political issues keep them fixed to our capital. These are of course very critical, very intense times, where also people and politicians involved in development issues are very much in demand and have very difficult decisions to confront. So please understand, that they can't be here, and I hope you will be satisfied with my presence, a simple bureaucrat from a Ministry. As you don't expect a very thoughtful lecture from a bureaucrat, let me just give you three points that have come across my mind, three thoughts:

Firstly: I think we have seen a political breakthrough in Johannesburg with the introduction of the Sanitation Target that the World Community, the United Nations, has now adopted to halve the proportion of people without access to basic sanitation by the year 2015. And I must say it was a breakthrough because of the special problems associated when we talk about sanitation.

Maria Mutagamba has been very explicit on this. It has not been easy to bring the sanitation issue to the top of the political agenda. It has in fact been very hard work and I must say that we have been quite successful. We as organizers of the Bonn International Conference on Fresh Water were proud that we managed to persuade the conference to put the Sanitation Target right on top of its agenda.

And I remember the evening when we actually reached an agreement in Johannesburg. It was a very difficult conference; we had to fight very hard. I have respect for those partners who resisted, because their hesitation to agree to global targets also had good reasons. But I think in the end they came around and agreed to have this as one of the leading targets of the developing community around the world, to bring sanitation to the poor in particular in the developing countries.

I think this was a breakthrough, and also in Kyoto we witnessed that this has really changed the minds at least in the developing community. People are now talking about sanitation just as they are talking about water supply. Let's remember that years ago this was not the case.

Secondly: I think that after Johannesburg, with the decision to have this new target, we started to think about what will it take to reach this target.

The development community has now started to work really hard on what it will take to implement the targets. The World Bank has just prepared what I think is one of the most important documents in a new report that will come out of the meeting of the Development Committee next weekend.

It is a progress report and a report on the critical next steps in scaling up for all the Millennium Development Goals: Education for all, Health, HIV/AIDS, Water and Sanitation.

We are being told in this document that in fact the Sanitation Target is the most ambitious target

of them all and that only 16% of the developing world is really on track to meet it. This is the lowest percentage for all of the Millennium Development targets.

For instance for the Water Supply Target, to halve the proportion of people without adequate access to water, the figure is 37%. It is still a quite low, but it is a much better figure when we compare it to the figure of the Sanitation Target.

Why is this a special challenge? Of course the focus in the past years has been on water supply. How does the water come into the household? And the focus has not been on the sanitation issue. I think this is not unusual. If we look at developments in Europe in the 19<sup>th</sup> century, it has not been different. But still it is a very critical issue because we have heard that sanitation is really the key to improve health and to improve general well being.

My third point refers to cultural dimension, and Maria Mutagamba has told us everything that we need to know about it. When we say that one of the obstacles in solving the sanitation problem is the cultural factor, we mean the need for people to change their habits. That makes it more difficult to make progress. If addressing the sanitation problem were simply about investment, we would know much better how to solve it, but it is also about changing peoples minds, and this is much more difficult.

It is very important that we have so many of you working on the ecosan approach. The ecosan approach is one of the keys to realistically achieving the sanitation target. I think Sunita Narain has already given all the figures that need to be known about this - that if we tried to provide everyone in the world with a flush toilet, we simply would not have enough water for it.

Another interesting cultural factor is that in Germany we faced real difficulties after Johannesburg in translating the sanitation target into German. It is about access to basic sanitation but how can you translate "access to basic sanitation"? It was very difficult because we don't have a word in German for sanitation. We have the word "Abwasser", but that means "waste water", so in German, "sanitation" and "waste water management" are almost identical in lingual terms. One newspaper proudly reported on the Sanitation Target by saying that: "*The United Nations decided that everyone should be connected to a sewage pipe!*"

That was the reference to the Basic Sanitation Target, but when you work in countries in Africa and Asia, you know that this has nothing to do with a sewage pipe. And a sewage pipe is a solution, which is very expensive and which is affordable only in countries in Europe or in North America.

So this tells you a little about the cultural difficulties in translating this approach and how the ecosan approach is really helping us, also in the North, to understand the cycle and the ecological implications. And I fully subscribe to what Sunita Narain said: "*It is not just a technology for the poorest of the poor, but it is also a technology for the richest of the rich.*"

In closing I would like to say that we are very proud to have such a dedicated team at the GTZ led by Christine Werner to work on the issue of ecological sanitation. We are committed to co-operation, to development co-operation in the water and sanitation sector. We have one of the largest development cooperation programs of all bilateral donors, and our government has committed itself to spend in the next years 350 million euros annually on water and sanitation.

Thank you for being here, and I hope you have a very good meeting.

## Ecosan – experiences and conclusions from the KfW's perspective

**Wolfgang Kroh**

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Dear Mr. Schmitt,

Dear Mrs. Narain and Mr. Konukiewitz, distinguished colleagues,

About two and a half years ago, in October 2000, I was holding an opening speech at the first International Symposium on Ecological Sanitation which took place in Bonn. At that time, I expressed my interest for this new approach on sanitation which was still new to me and my colleagues from KfW. Since then, we have witnessed various activities from different promoters on an international scale and we have become much more familiar with the concept of ecosan. The GTZ ecosan project has contributed largely to this. Therefore I would like to congratulate my colleagues from GTZ for their efforts undertaken so far.

This week, we are here in Lübeck to follow up on the progress made during the last years and to discuss the challenges lying ahead for a broader introduction of ecosan approaches. In my speech, I would like to give you first of all a general overview on KfW's activities in the water and, especially, sanitation sector. Secondly, I would like to present to you our point of view with regard to the experiences made so far with the ecosan concept. To finish my speech, I will draw a few conclusions from these experiences.

As a public-owned governmental development bank, KfW is committing each year funds of around 40 billion EUR to promote the German economy as well as the developing countries. In the framework of German Financial Co-operation, KfW is committing around 1.5 billion EUR of investment loans and grants per year. With some 260 million EUR dedicated per year towards water supply and sanitation projects and programmes, German Financial Cooperation is the world's second largest bilateral source of financing in this sector.

Currently, we are supporting over 25 countries in the water and sanitation sector. Our efforts focus on the Middle East and North Africa, various countries in sub-Saharan Africa, the Balkans and Caucasian region, but parts of India and China as well as countries like Peru and Bolivia are also covered by our activities.

The overall objective of our activities in the water and sanitation sector is to contribute to the realisation of the relevant International Development Goals including the Millennium Development Goals, i.e. to halve the proportion of people without access to safe drinking water as well as to basic sanitation. This can only be achieved if the access of the poor to water and basic sanitation is going to be improved dramatically. Taking into consideration the prevailing water shortage in many regions of the world on the one hand and the limited availability of the poor to pay for services on the other hand, it is needless to say that these goals are very demanding making new and innovative approaches necessary.

Presently, we are therefore focusing on the approach of integrated water resources management taking into consideration the whole water cycle – including wastewater treatment and reuse - on the one hand and the competition for water between human use, agriculture and industry on the other hand. We are following this approach not only through project and programme financing, but also through the sector dialogue with the governments and project sponsors of our partner countries. An appropriate design of sectoral framework conditions is obviously cru-

cial for the sustainability of investments.

Within the sanitation sub-sector, the spatial focus of our activities is on urban and semi-urban areas. We are aware that conventional, centralised wastewater treatment systems do not represent a universal solution for all situations and places. Conventional systems are usually cost-intensive and quite often, proper operation of the sanitation system poses problems due to capacity constraints of the operators. Therefore, we are actively promoting the introduction of new, alternative approaches to sanitation. Such projects include water and nutrient re-use schemes with different levels of decentralisation and technological standards.

Please let me give you a few examples:

- In our rural water supply and sanitation projects, predominantly in Africa, we promote traditional on-site sanitation systems using faeces in agriculture.
- A number of urban wastewater projects, which include the re-use of treated wastewater, are currently under preparation, amongst others in Tunisia, in Jordan and in Yemen.
- Concepts for using sewage sludge in agriculture have been successfully developed in Turkey. The implementation of these concepts has generated positive results.
- A plant for purifying pre-treated wastewater to produce drinking water went into operation in Namibia in 2001.

Details on these as well as other projects will be presented tomorrow by my colleagues, Uwe Stoll and Bernd Schönewald.

Dear colleagues, since the first ecosan symposium held in Bonn in October 2000 KfW is following with interest the activities of the GTZ-ecosan project as well as of other promoters of the ecosan approach. Furthermore, KfW is currently preparing ecosan related project components as part of German Financial Co-operation projects to assist in gaining experience with these concepts, often together with our colleagues from GTZ. Pilot projects for urban or semi-urban areas, which are most relevant for German Financial Co-operation, are being prepared for Yemen, Egypt and Zambia. In the case of Yemen, experts will study alternatives for solutions to realise the International Development Goals including ecosan approaches. This example will be presented to you on Thursday by Mr. Oldenburg from the consultancy firm Otterwasser GmbH.

Obviously, we cannot yet draw conclusions from these pilot projects since none of them is being implemented yet. However, taking into consideration ecosan projects promoted by other organisations in different parts of the world, we would like to highlight two aspects which will be crucial for the broad application of ecosan approaches and for which we do not yet see solutions: the integration of ecosan concepts in urban areas and the acceptance of ecosan systems by decision makers as well as customers. I will illustrate the latter aspect in more detail in a minute.

As you may know, German Financial Co-operation is following a comprehensive approach with regard to the sustainability of its project and programmes: apart from ecologic and social sustainability, financial and economic sustainability are essential for the success of projects and programmes. Thus, by identifying and designing projects and programmes, all of these aspects have to be taken into consideration. Of course this holds also true for any ecosan project or project component.

Ecosan oriented projects, by its definition, should be ecologically sustainable. Contrarily, as regards social and financial sustainability, we see challenges especially in the following:

- A low level of accepting ecosan approaches by the relevant decision makers. Existing standards in most countries presently do not allow the introduction of such approaches. Furthermore, in developing countries, decision makers strongly prefer standards and project concepts which are applied in the industrialised countries. Engineers often visited universities in these countries and thus are familiar with conventional techniques. They are reluctant

to accept new approaches.

- A low level of acceptance by the customers, since they would generally be faced with an elevated handling time and / or higher handling costs in comparison to conventional systems. This is due to the fact that ecosan systems are by its definition decentralised systems posing a higher burden on the end users.
- With regard to financial feasibility, systems already existing in a project area need to be taken into account for any new investment, may it be a replacement of or an extension to the existing system. Thus, it will usually not be financially feasible to replace an existing conventional system by an ecosan system in case the existing system has not yet been fully depreciated. Since most of the bigger cities do have existing conventional sanitation systems, also in the developing countries, these systems can only be gradually replaced.

Dear colleagues, please let me draw a few conclusions from what I have mentioned:

1. In order to have ecosan systems introduced on a large scale, their functioning and acceptance would still have to be proven. To achieve the latter, it is of utmost importance to successfully hold the dialogue with politicians and other decision makers. Therefore, I would like to recommend you to sacrifice some time during this symposium to discuss, how the political – as well as the legal – framework conditions could be improved in order to allow for a broader realisation of the ecosan approach.
2. We feel it to be unlikely that ecosan systems are going to be introduced in developing countries on a large scale as long as they have not been introduced and operated in the industrialised countries in a much wider scale, showing clearly the advantages to the existing conventional systems, especially in urban and semi-urban areas.
3. Even if all other challenges with regard to the implementation of ecosan approaches have been overcome, we are convinced that a comprehensive realisation of these approaches will still take at least some 30 to 50 years time. Until then, conventional systems and ecosan systems would exist in parallel, even within one city or community.

Notwithstanding the above said, it is clearly in our interest to promote the development and improvement of adapted and sustainable solutions with regard to sanitation problems. Therefore, KfW will continue to follow closely the further development of ecosan approaches. We will also continue to actively support the ecosan project of GTZ in implementing pilot projects. As soon as sufficiently tested solutions exist, we will be more than happy to study the possibilities for a broader introduction of ecosan concepts into Financial Co-operation projects.

Distinguished colleagues, please let me finish my short speech in wishing you interesting and fruitful discussions during this week and a successful Symposium. My colleagues and I are at your disposal for the ensuing discussion.

Thank you very much for your attention!



## Reasons for and principles of ecological sanitation \*

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### Keywords

Global water crisis, water supply and sanitation, Millennium Development Goals, closed loops, ecological sanitation, nutrient recycling, wastewater reuse

### Abstract

In order to achieve the Millennium Development Goals and the Johannesburg Plan of Implementation, new holistic sanitation concepts are needed, focussing on economically feasible closed-loop ecological systems rather than on expensive end-of-pipe technologies. Ecological sanitation systems are approaches that advance a new philosophy of dealing with what is presently regarded as waste and wastewater. They are based on the systematic implementation of the reuse and recycling of nutrients and water as a hygienically safe, closed-loop and holistic alternative to conventional solutions. Ecosan systems enable the recovery of nutrients from human faeces and urine for the benefit of agriculture, thus helping to preserve soil fertility, assure food security for future generations, minimize water pollution and recover bioenergy. They ensure that water is used economically and is recycled in a safe way to the greatest possible extent for purposes such as irrigation or groundwater recharge.

### World water crisis and millennium development goals (MDG)

Water problems with respect to increased scarcity and degraded quality are now present in various parts of the world and are becoming increasingly serious. All signs suggest, that it is getting worse and will continue to do so, with the most recent UN World Water Development Report talking about the serious world water crisis we are facing. The world economy has grown steadily in recent decades, bringing widespread prosperity and lifting many millions of people out of poverty, particularly in Asia. Nevertheless, there are still 1.1 billion people who lack access to a safe water supply, and 2.4 billion with no access to basic sanitation. In the next 25 years, the world's population is projected to grow by about another 2 billion people, most of whom will be born in developing and emerging market economies and will be living in urban areas. Without a concerted effort, many of these people will be doomed to poverty. The limited progress in reducing poverty has many causes. Some of the most dramatic ones are directly related to our present situation of wastewater management and sanitation, which consists of using surface and groundwater as a sink for human excreta and wastewater, resulting in increasing health hazards, environmental and water pollution, the steady degradation of natural resources and also the permanent loss of nutrients and organics from the soil sphere.

Water treatment and supply are often granted a much higher priority than wastewater collection and treatment, despite that fact that sanitation deserves a greater emphasis due to the impact that poor sanitation has on everyday lives, especially on those of the poor. It is the poor who suffer most from the decreasing quality and growing scarcity of water, and from the burden of

\*This paper has been peer reviewed by the symposium scientific committee

water related diseases and the degraded and dangerous environment.

Untreated excreta and wastewater contains organic matter, plant nutrients, trace elements and micronutrients as well as pathogenic bacteria, viruses, helminths, endocrine substances and medical residues. If they are badly managed they are a major source for the spread of diseases and environmental harm; yet if well-managed they can make a positive contribution to local resources.

Currently more than 90 % of wastewater and excreta worldwide is either only poorly treated or not treated at all at discharge. In addition to the problem of the pollution of water sources, such as rivers and aquifers, poor wastewater management also often leads to pools of stagnant water which may become breeding grounds for insects, with children playing on wet ground or near such pools being exposed to the dangers of infection. The pools may also become evil-smelling and unsightly. Badly designed or operated on-site sanitation is also contributing to groundwater pollution and contamination of the local environment. Sludge emptying is often ignored or the sludge is disposed of in the surrounding environment without precautions for the hygienic safety of the population.

In 2000, the estimated mortality rate due to hygiene related diarrhoea and other water and sanitation related diseases (schistosomiasis, intestinal helminth infections etc.) was about 2.2 million. Worldwide, over 2 billion people were infected with schistosomes and helminths, of whom 300 million suffered serious illness, most of them children under the age of 5.

A large amount of investment has been made in water supply and sanitation over the last two decades, however the resulting health benefits have been limited by an inadequate focus on hygiene and sanitation and have often even been counter-productive as the improvement in the water supply has resulted in larger wastewater flows.

In light of the fact that humanity and the global environment continue to suffer, different conferences and summits have been organized and resolutions adopted to explore and draw up solutions which may lead to sustainable development. Thirty years ago, in Stockholm, agreement was reached on the urgent need to respond to the problem of environmental deterioration. Ten years ago, at the United Nations Conference on Environment and Development, held in Rio de Janeiro, it was admitted that the protection of the environment, and social and economic development are fundamental to sustainable development, based on the Rio Principles (Agenda 21). To achieve such development, a new programme, the Plan of Implementation, including Millenium Development Goals (MDG), was adopted in Johannesburg in September 2002. According to this programme, poverty eradication, which is one of overarching objectives of, and essential requirements for, sustainable development, could be reached by rapidly increasing access to basic requirements such as clean water, sanitation, adequate shelter, energy, health care, food security and the protection of biodiversity.

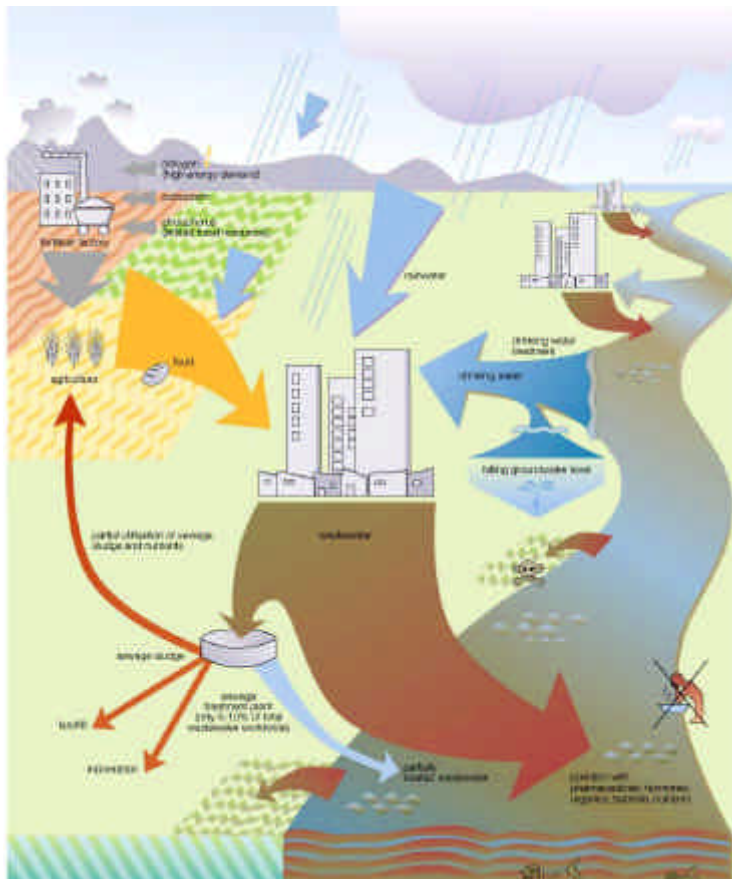
The set target for water and sanitation is to halve the number of people without access to safe drinking water and those without adequate sanitation. This new commitment to give sanitation the same priority as water supply is a very positive development. It is however, also a very big challenge, which for both economic and ecological reasons requires a revolution in our wastewater and excreta management strategies.

### **The problem with conventional wastewater management and sanitation**

Present conventional forms of wastewater management and sanitation fall either under the category of either waterborne systems or pit latrines. The design of these "flush and discharge" or "drop and store" technologies was based on the premise that excreta is a waste and that waste is only suitable for disposal. It also assumed that the environment could assimilate this waste. "Modern" water-carriage sewer systems are actually a relatively new technology, which

only began to spread in European cities from around the end of the 19<sup>th</sup> century, when piped water supply systems lead to an increased water consumption and subsequent wastewater production. Stagnant water pools and streams of wastewater in the streets of the cities lead to outbreaks of cholera and other diseases. Sewer systems were gradually introduced. Later, when this resulted in the heavy pollution of waterbodies, mechanical wastewater treatment plants, biological treatment and tertiary treatment for the removal of nutrients (which is now the present state-of-the-art in wastewater treatment), were added in order to reduce their eutrophication.

At first glance, conventional sanitation systems therefore seem to present advantages, as they allow, at least when functioning correctly, a relatively well assured hydraulic transport of excreta, used water and rainwater away from urban areas. Polluted surface waters in urban areas, which are a source of health and environmental problems, are also avoided. The hygienic situation of inhabitants in urban areas is thereby improved. This is however not correctly applied in many countries, especially where the urban populations are increasing rapidly, as these technologies are very expensive in investment, maintenance and operation. These are not problems limited only to developing countries, as the most recent UN-report revealed, with the water quality in Belgium being so poor that it is ranked last in the water quality assessment given in the WWDR. This is due to severe groundwater pollution, high industrial pollution and the fact that Belgium was cautioned by the European Court for directly discharging the wastewater of the more than 1 Mio inhabitants of Brussels directly into a small river.



- unsatisfactory purification or uncontrolled discharge of more than 90 % of wastewater worldwide
- pollution of waters by organics, nutrients, hazardous substances, pathogens, pharmaceutical residues, hormones etc,
- unbearable health risks and spread of disease
- severe environmental damage and eutrophication of the water cycle
- consumption of precious water for transport of waste (water carriage waste disposal systems)
- high investment, energy, operating and maintenance costs
- frequent subsidization of prosperous areas, neglect of poor settlements
- loss of valuable nutrients and trace elements contained in excrement due to discharge into waters
- impoverishment of agricultural soils, increased dependence on fertilizers
- combined central systems are predominant in organized wastewater disposal, resulting in problems with contaminated sewage sludge
- **linear end-of-pipe technology**

**Figure 1:** Shortcomings of conventional wastewater management systems

If considered more closely, conventional waterborne sanitation reveals shortcomings of even greater importance than their high costs. As water is used as a medium to transport the wastes, these systems are becoming increasingly more difficult to apply in regions of aggravating water

scarcity, in arid zones and in poor countries. The high water-consumption connected with our sanitary systems is incompatible with arid countries in the long term and is already leading to an irreversible exploitation of non-renewable water resources. Drinking water is therefore becoming an expensive property only available to the financially well off who are usually in good health. However, clean water is too precious to be flushed down the toilet and it is not the most pleasurable experience to operate a water flush toilet, when the water supply only operates a few hours per week. Additionally, even if these systems may contribute to a healthier environment in the cities located upstream, they do the contrary for those living downstream, as even the state of the art multistage wastewater treatment facilities do not eliminate the pathogens and many other substances contained in the effluent. If rain falls, in combined sewer systems the diluted wastewater is generally conveyed directly into the rivers as the treatment plant is designed only for a limited influent. In recent research there is an increasing awareness regarding the effects of endocrine substances contained in human excreta that can, for example, have an effect on altering the sex of male trout. The effects of pharmaceutical residues in the effluents and their impact on environment and humans living downstream and obtaining their drinking water from the same river are also being discussed.

The search for appropriate solutions has become a pressing problem, particularly for arid and semi-arid zones. With increasing population density and the resultant groundwater pollution, conventional decentralized disposal systems, such as latrines and seepage pits, are also not viable alternatives. In many densely populated areas, the contamination of groundwater by nitrates for example is several times greater than the maximum level recommended by the WHO for drinking water and represents a serious mortal danger to babies. Shallow groundwater is still a major source for local and reliable water supply, especially for the poor in rural and peri-urban areas. The design of the conventional "drop and store" pit-latrines (and of most other on-plot systems) however deliberately aims to retain only the solids and infiltrate as much of the liquids into the sub-soil as possible. As these liquids contain all the soluble elements of the excreta as well as the viruses and pathogens, this type of sanitation can be considered a highway to groundwater contamination.

In theory, these pits latrines should be emptied when they are full and the content should be treated before being put on the land. In practise however, old pits are often abandoned with people preferring to build completely new pit latrines, as emptying the pit is an extremely unpleasant job. However digging a new pit, and building a new superstructure each time the old pit is full is very expensive, and it is very difficult for the homeowners in densely populated areas, where plots are small and tend to be already crowded with many previously abandoned old pits. In addition, many conventional latrines smell and are a breeding place for flies and other insects and are inconvenient to use especially for children, girls and women, as they have to be built at a distance from the house.

The fundamental problem however, and probably the most important, is that conventional wastewater disposal systems directly impair soil fertility as the valuable nutrients and trace elements contained in human excrement are not usually rechanneled back into agriculture. Even where sewage sludge is put to agricultural use only a small fraction of the nutrients are reintroduced into the living soil layer. Most are either destroyed (e.g. by nitrogen elimination) or enter the water balance, where they pollute the environment. Frequently, the use of sewage sludge from central wastewater systems is also restricted as it contains too high a concentration of heavy metals and other hazardous substances, often as a result of intermixing household with industrial wastewater and with rainwater from contaminated streets.

In fact, our conventional wastewater systems are largely linear end-of-pipe systems where drinking water is misused to transport waste into the water cycle, causing environmental damage and hygienic hazards. If we continue to promote these technologies in order to meet the MDGs, the overall result would be worse than our present situation as the hygienic situation of

our waters would be further deteriorated and even more resources would be dissipated and introduced into water bodies.

### Advantages of ecological sanitation

An alternative approach to avoid the disadvantages of conventional wastewater systems is ecological sanitation, 'ecosan' for short. This is based on an overall view of material flows as part of an ecologically and economically sustainable wastewater management systems tailored to local needs. It does not favour a specific technology, but constitutes a new philosophy in handling substances that have so far been seen merely as wastewater and water-carried waste for disposal.



- improvement of health by minimizing the introduction of pathogens from human excrement into the water cycle
- promotion of recycling by safe, hygienic recovery and use of nutrients, trace elements, water and energy
- conservation of resources through lower water consumption, substitution of chemical fertilizers, minimization of water pollution
- preference for modular, decentralized partial-flow systems for more appropriate, cost-efficient solutions
- possibility to integrate on-plot sanitation into households, increasing user comfort and security for women and girls
- preservation of soil fertility
- improvement of agricultural productivity and hence contribution to food security
- promotion of a holistic, interdisciplinary approach (hygiene, water supply and sanitation, resource conservation, environmental protection, town planning, agriculture, irrigation, food security, small-business promotion etc.)
- **Material-flow cycle instead of disposal**

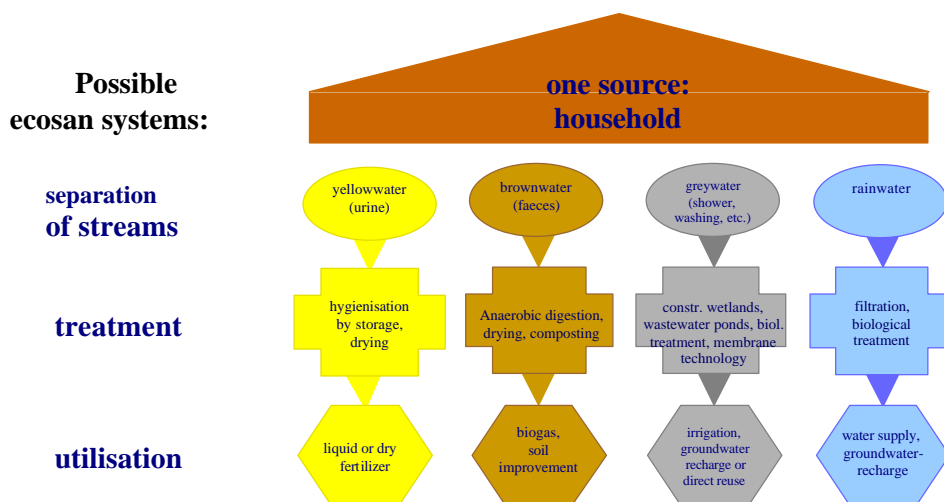
**Figure 2:** Advantages of ecological sanitation

Systems based on this approach are used for the systematic closure of local material flow cycles and thus ultimately enable recycling systems as are already in common use for solid waste. They also restore a remarkable natural balance, that is between the quantity of nutrients excreted by one person in one year and that needed to produce his food (7.5 kg nitrate, phosphorous and potassium for 250 kg grain). Ideally, ecosan systems enable an almost complete recovery of all nutrients and trace elements in household wastewater and their reuse in agriculture - after appropriate treatment. In this way, they help preserve soil fertility and safeguard long-term food security.

As an integral alternative, a hallmark of ecosan is its interdisciplinary approach that goes beyond the narrow domestic water supply and technological aspects to subsume agricultural use,

sociology, hygiene, health, town planning, economic/small-enterprise promotion, administration, etc. in system development.

In practice, the ecosan strategies of the separation and separate treatment of faeces, urine and greywater, for example, minimize the consumption of valuable drinking water and treats the separate wastewaters at low cost for subsequent use in soil amelioration, as fertilizer or as service or irrigation water. Rainwater harvesting and the treatment of organic domestic and garden wastes and of animal manure may also be integrated into ecosan-concepts.



**Figure 3:** Separation of substances and examples of possible ecosan elements

Of particular importance here are innovative logistics to return nutrients to farmland, marketing strategies for the recovered nutrients and directions for their safe application in agriculture. New ecosan schemes may also entail setting up service enterprises and hence implementing income-generating measures for the construction and easy and safe operation of the installations as well as the collection, treatment and marketing of recyclates.

Closing local nutrient cycles by retrieving and using nitrogen, phosphorus, potassium, trace elements and organic components contained in excrement are even more important considering some of the disadvantages of mineral fertilizers. They are too expensive in many parts of the world or are unavailable to local farmers, and their effects on soil and food quality are in dispute. Additionally, large amounts of energy and finite fossil resources are used to produce them. An example of this is phosphorus: It is currently estimated that reserves will be exhausted in about 60 years at the present rate of consumption. Also in this regard, ecosan is a decisive factor for environmental protection and resource conservation, sustainable food production and a stable future in food and health.

Individual, successful and promising examples of ecological disposal systems already exist in various countries, but a great deal of research and development work still needs to be done before ecosan is established internationally as a way of solving the many different problems. Also, applications to date have tended to concentrate on rural areas, with experience in urban and peri-urban areas still being quite limited. Faced with rapid world-wide urbanization there is a pressing need for solutions in conurbations.

Split-stream collection, treatment and reuse of the different partial flows of wastewater offer new possibilities for more specific and cost-efficient solutions. These partial flows can be characterised as blackwater (faeces and urine with or without flushing water), yellowwater (urine with or

without washing water), brownwater (blackwater without urine) and greywater (domestic water without faeces and urine).

fraction	characteristic
1. faeces	<ul style="list-style-type: none"> <li>• hygienically critical</li> <li>• consists of organics, nutrients and trace elements</li> <li>• improves soil quality and increases water retainability</li> </ul>
2. urine	<ul style="list-style-type: none"> <li>• less hygienically critical</li> <li>• contains the largest proportion of nutrients available to plants</li> <li>• may contain hormones or medical residues</li> </ul>
3. greywater	<ul style="list-style-type: none"> <li>• of no major hygienic concern</li> <li>• volumetrically the largest portion of wastewater</li> <li>• contains almost no nutrients (simplified treatment)</li> <li>• may contain spent washing powders etc.</li> </ul>

**Figure 4:** Characteristics of substances

The human faeces obtained after separation show valuable soil improvement qualities (an improved structure and an increase in the water retention capacity). They are treated, if necessary together with organic waste and according to local conditions (climate, power demand and sociocultural acceptance etc), using the processes of either dehydration, composting, stabilization, soilisation or fermentation. Thus, the organics and nutrients contained in faeces can be used in concentrated and hygienically safe form as a dry fertilizer, compost or fluid fertilizer. Dependent on the type of treatment, energy can be produced if necessary in the form of biogas after an aerobic digestion.

The urine, or yellow water, contains the highest proportion of natural nutrients (nitrogen, phosphorus and potassium), which are directly available to plants and equally effective as mineral fertilizers. Urine contains approx. 90% of the total nitrogen, 55% of the total phosphorus and a substantial portion of the potassium contained in human excrement. A partial flow separation and use of the urine is particularly advisable due to its low volume and the high concentration of nutrients it contains. In order to obtain the yellow water fraction devices such as urine separation toilets or waterless urinals can be used.

The greywater from washing, rinsing, showers etc., while representing the largest fraction of the total wastewater flow, has only a very low nutrient content. Therefore, it can be treated to a high quality using simple techniques such as unventilated gravel filters and biofilm procedures and is thereafter ready for reuse. This water can be put to particularly good use in agricultural irrigation (especially in water scarce regions), but may also be used for groundwater recharge or discharged into surrounding watercourses.

Thus, diverse technologies can be used in ecosan systems, from simple low-tech to sophisticated high-tech solutions. These currently range from compost toilets or urine-separating dry toilets, to water-saving vacuum sewage systems, possibly with separate collection and subsequent treatment of urine, faeces and greywater through to membrane technology for material separation and hygienization. Generally, precedence is given to appropriate modular and decentralized facilities, but in very densely populated areas centralized systems may still be needed. The essential advantage of the modular components is the optimal adaptation to the local social, economic, ecological and climatological conditions. As a result they represent a comparatively rapidly realizable alternative to conventional systems.

The implementation of sustainable sanitary approaches such as ecological sanitation "ecosan" systems is one of the most relevant solutions for sustainable development and goes towards

the Poverty Reduction Strategy (PRSP) initiated in 1999 and supported by the World Bank Group and the IMF. Ideally, ecosan systems enable the recovery of all nutrients which help to restore soil fertility and thus to assure food security and minimize water pollution, thereby improving the situation for farmers, and particularly for women, in at least two ways. The first is the improved yield of vegetables and other crops strengthening their income. The second is the possibility of building ecosan toilets indoors even in very poor areas, as these toilets, when well managed, have no flies and no odour. Thus, also very cheap ecosan toilets can function well indoors even in poor peri-urban areas. Indoor toilets improve the security situation, which is especially important for women and girls at night. Furthermore, they also save much time, as the women can help the children to the toilet with only a minimal delay in other activities.

The ecosan-approach is also in accord with the Bellagio Principles and the Household Centered Environmental Sanitation Approach (HCES), which has been developed by the environmental sanitation working group of the Water Supply and Sanitation Collaborative Council (WSSCC), and recommends that waste be considered as a resource that should be diluted as little as possible, and that sanitation problems should be solved on the minimum practicable size (household, community, town, catchment etc.).

## Conclusion

To realistically have a chance of meeting the Millennium Development Goals, we need a revolution in our way of thinking in order to see human excreta and domestic used water not as a waste but as an important natural resource.

The focus of the efforts for the next years should concentrate on developing and implementing new approaches on sustainable wastewater treatment and sanitation for a variety of suitable closed-loop systems in urban areas including the efficient agricultural reuse of organics, nutrients and water.

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## Current technical options for ecological sanitation

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Ladies and gentlemen,

let me welcome you on behalf of the International Water Association, IWA. It is new that the IWA is on board with ecological sanitation, and especially since the 3<sup>rd</sup> World Water Forum 2003 in Kyoto, ecosan has really become part of the key strategic issues of the organisation. We had our own IWA session on ecosan in Kyoto, even having the president of the IWA, Prof. Tambo with us. The director Paul Reiter and deputy director Marc Pascoe are supporting ecosan strongly. This is really good news that the major international organization of the water professionals is taking notice of this key issue. However, active promotion of ecosan it is certainly not done by all members yet.

To start with some of the current ecosan-options available I want to go briefly into the background of why we are doing this. For many conventional engineers this is very weird, so the first presentations I gave about ten years ago people were just incredulous of what I was talking about. And then a few years later they would first laugh and then discuss, but now it has become a key issue even internationally.

The basic thing is that we have to look at wastewater in a different way. I've put up a chart showing all the wastewater flows that are typically produced in houses. On one side, greywater being the largest amount but with a relatively small load of nutrients. It can be re-used in simple ways after appropriate treatment, including recharge of aquifers where appropriate. But this can only be done with affordable technology if it is not mixed with faecal matter. The mixing of faeces with the big amount of wastewater is the crime that has so often been committed and has and does result in the death of so many million people. It is done simply because we are used to it, having learnt it at home and at school so we think it's normal. But now is the time to re-learn, because faecal matter has got nothing to do with the water loop but it belongs to the nutrient loop. On the other side of the slide I show you that large amounts of water can be saved if we do not flush it down the toilet. It also shows that the amounts of urine and faecal matter are very small compared to the massive amounts of wastewater. The faecal matter is the smallest part and if kept separate and treated in the appropriate way, it is a simple material to handle and can even provide renewable energy and restore soil fertility. Throwing this into water creates a hazard, making it very difficult to treat the water at the other end of the pipe. The urine is the major nutrient resource, a natural fertilizer, in principle easy to collect and to use. Subsidies for commercial fertiliser are reduced around the world, many farmers now find it essential to be able to have cheap local fertiliser, and urine is the answer. We should get away from our understanding of what we still call wastewater to maybe blackwater, brownwater, greywater, yellow water, etc, the new colours of sanitation.

Now I want to go briefly through some technological applications, starting with some high-tech solutions. These include necessarily low-diluting toilets. The main thing is that we have toilets that minimize dilution in such a way that we can produce fertilizer and ensure sanitization.

I start with the vacuum toilets, which many of you know from aeroplanes, which have a high-tech appeal about them. Then there are the sorting toilets which have been re-invented in modern times. They were used in several places around about 100 years ago but did not get the attention at they deserve at that time. Finally there are the desiccation- and composting toilets.

Source control in urban and rural water management is first of all about finding ways of dealing with human excreta in a different way, and there are many ways. Ecosan specialists are working in different areas, from densely populated urban areas to sparsely populated rural areas. Of course we need very different approaches for these different situations. Ecosan is available for the rural and less densely populated peri-urban areas. We do have many choices and can make appropriate designs, at very low prices in many cases. Operation and interacted implementation in co-operation with users and operators are essential for success. There are many people living in metropolitan areas for who we need a lot more ecosan development. There are some promising approaches for those situations, but little experience so far. Some high-tech and some low-tech approaches, as demonstrated by the model of EcoSanRes from Sweden, showing how we can deal with black and brownwater in urban areas in relatively simple way.

Now I show you what the consultancy Otterwasser has built here in Lübeck, one of the reasons why we are holding the symposium here in this beautiful historic UNESCO world heritage city. It is a vacuum toilet system for urban areas that can be adapted even for high-rise buildings with its vacuum collection system, with urban production units for energy and fertilizer. The greywater is available for reuse, infiltration or discharge after appropriate treatment. This system can be used from around five hundred to maybe twenty thousand inhabitants in densely populated settlements, suitable for areas where a certain technological complexity can be handled. It is not, of course, a solution for all areas but a good model to illustrate the wide range of solutions that follow the ecosan principles. There are examples of similar developments in Berlin, Norway, Holland and China.

The same type of technology can be implemented in a more low-tech way with simple digesters especially in warm climate countries. It is far easier to install ecosan in new housing developments rather than retrofitting existing ones. There is a lot of construction done around the world, especially in south-east and east Asia. This type of technology can be incorporated into new construction projects to offer more cost effective solutions that have a number of advantages.

There are more toilet types based on the same principle where, even in urban areas, urine can be collected in tanks for agricultural purposes. But the amount collected in urban areas would be too much to be consumed in the neighbourhood. In my Institute at Technical University of Hamburg we are working on ways to make it more concentrated. This is mainly for transportation reasons and also because the agricultural industry would rather use it in dry form. The problems around micro-pollutants have to be addressed specially for pharma residues in urine, however this is also a major problem in conventional systems with their shortcut to the drinking water taps.

Composting toilets are probably the oldest form of ecological sanitation toilets in modern times. They are mainly found in central and northern Europe. I have to say that they still have too many failures and more developmental is needed, one of the major changes will be to divert the urine and install moisture control.

And then we have the composting tank system which is still in research and development phase. It is based on the principle of flushing with very little water and having a composting tank outside the house. The is a promising idea adopted from Australia to introduce some special type of worms in such a tank to help with the decomposition and sanitization process, preliminary experiments in Hamburg where very promising (see [www.ecosan.org](http://www.ecosan.org)). The greywater can be treated in different ways for re-use, especially for recharging aquifers with the additional treatment in soil passage. Membrane-biology systems can be used for densely populated city areas with very little space. The technology is available at reasonable prices now and the membrane prices are still dropping. If we want to turn the greywater into tap water (not drinking water) then we need one more step, preferably reverse osmosis. The combination of the two systems can be installed de-centrally, saving money by avoiding the often excessive costs of big central systems of supply and wastewater transport. This money can then be used for more intelligent technologies that are potentially cheaper and adaptable to local situations and water

scarcity.

We must not forget the rainwater, especially in urban areas. It is one of the tasks of the engineers to get rid of the stormwater run-off. But once again we need to get it to infiltrate and refill the aquifers so that decentral water supply systems can make use of this water. Of course we must make sure that we use enough of the infiltrated water in the region, otherwise we may flood these areas. Careful survey of the geological situation and the expected waterflows is of course necessary.

To say it once more: For most of the ecosan applications the key is to keep the faecal matter apart from the greywater. I also want to repeat that more than five million people, mostly babies and small children, a year are dying from polluted water, the main reason being that our profession is still mixing faecal matter into the waters.

There are many good ecological solutions of low-tech decentral ecosan which are working very well. The interesting thing is that on the one hand there can be local economic benefits generated from the manufacturing of these units by local companies while the money can circulate within the community and then not be drawn out. On the other hand there are low operation costs of the system, and the high-tech systems do not necessarily perform better than the simple ones. In fact all ecosan systems, if implemented correctly, perform better than the large-scale central wastewater treatment plants. They may look very shiny but they do not perform a very thorough recovery and cleaning job, compared to ecosan systems.

Finally I want to show the valuable resource of sunshine in warm climate areas. This unused resource can perform dehydration in sanitation systems very well if implemented correctly: Built above ground to avoid contact of water and faeces, two chambers alternating yearly, diverting the urine and making use of it. One sad thing I have seen with some ecosan projects is that often urine is simply infiltrated into the ground, and that will contribute to problems of nitrates in the groundwater. The re-use of urine in agriculture is the key to making the loop complete, one person produces fertiliser for around 100 to 400 m<sup>2</sup>.

So ecosan can be a dry or flush (little dilution) system. It can even be the conventional flush system upgraded by urine diversion and from an ecological point of view it is not a bad system at all. In the city of Hamburg the Hamburger Stadtentwässerung is looking at the possibility of converting the city, over 50 years, into a urine diversion system in partnership with the fertilizer industry. This would be a major step indeed.

Thank you very much for your attention. I am sure we will have a most interesting conference and hope you will discuss many creative solutions following the principles of ecosan.



## The role of ecosan in achieving sustainable nutrient cycle;

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### Keywords

Plant nutrient flow, fertilising effects, environmental effects, hormones, pharmaceutical residues

### Abstract

The present flush-and-discharge sewage system introduces a large one-way flow of excreta, containing organic matter, plant nutrients, hormones etc. from terrestrial to aquatic environments. This flow has proven to be a serious impediment to the development of a sustainable society.

End of pipe solutions (sewage treatment works) have so far not been able to make up for this impediment and will probably not be able to do so in the future either. This is shown by the continuously increasing number of problems observed due to this flow of excreta; eutrophication and algae blooms, depletion of arable fields, fish affected by endocrinal disruptions and water polluted by pharmaceutical residues.

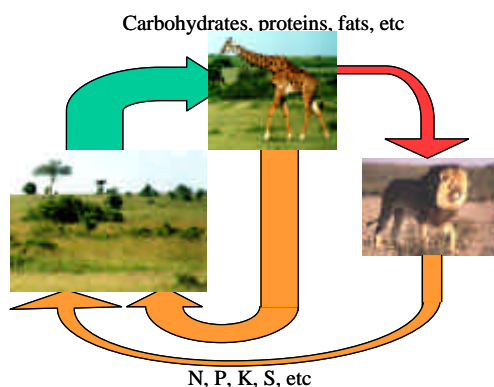
EcoSan systems direct the excreta flow in the correct direction, closing the nutrient loop and diverting the hormones to arable land, just as previously during evolution. Furthermore, practical and resource efficient sanitation methods can be employed, since the excreta are collected in a small volume. Therefore, the hygiene standard of EcoSan systems can be higher than that of the present flush-and-discharge system. Furthermore, EcoSan systems also increase the possibility of developing practicable treatments for inactivation of pharmaceutical residues, should this be prioritised by society.

### Introduction

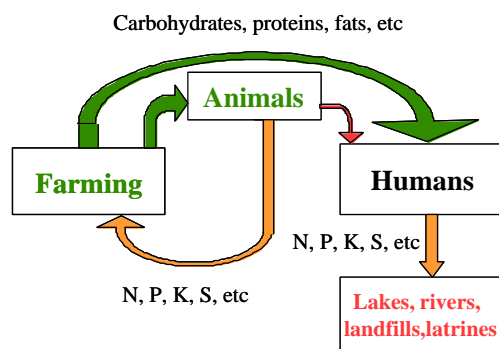
We have not inherited this globe from our ancestors, but borrowed it from our children. It is therefore our obligation to strive towards sustainable development. This implies that the use of our two most important sources of food, water and arable soil, must be sustainable. The plant nutrients of the food must be recycled to arable fields, from where they originate. The plant nutrients must flow in closed loops, in the way they have always flowed. With closed nutrient loops, plant production can be sustainable over a very long time perspective. This is illustrated by the African savannah, where plant production has been sustainable for such a long time that the giraffe has had time to evolve its long neck to graze from the trees (Figure 1). This is real sustainability!

This is far from the situation of the present society, where nutrient flows are linear and one-way. Plants take up nutrients from arable soil. We then consume the plant nutrients in the form of food and excrete them in the form of urine and faeces. However, the excreta nutrients are currently not recycled to the fields. If a flush-and-discharge sewage system is used, they are instead flushed away. In some places of the world, the phosphorous and nitrogen in sewage are efficiently reduced before the sewage is emitted to recipient waters. In such cases, most of the phosphorous usually ends up on a landfill (Figure 2). However, in most places, sewage receives

no, or very little, treatment before being emitted. The excreta nutrients fertilise algae instead crops. It is quite unavoidable that worldwide eutrophication is increasing.



**Figure 1:** The nutrient loops on a savannah.



**Figure 2:** The linear one-way nutrient flow from fields to lakes, rivers and landfills of current human society.

At the other end of the flow, arable fields are being depleted of their nutrients, with decreasing productivity as a result. To remedy this, the fields are supplemented with chemical fertilisers when these can be afforded. Chemical fertilisers are produced by the use of fossil resources, e.g. phosphates and potassium from mines and oil and natural gas to produce plant available nitrogen. In many countries agricultural fields are supplied with doses of plant nutrients that are far larger than any that plants have been exposed to before during their evolution. Naturally, this increases the leakage of nutrients from the fields.

The ample supply of chemical fertilisers also decreases the motivation to recycle excreta nutrients to arable land. This is one factor behind the rapid spread of the conventional water-borne flush-and-discharge sewage system, introduced in Western Europe during the late 19<sup>th</sup> Century. For city populations, the introduction of the water-borne system led to improvements in health, because it rapidly removed infectious wastes from densely populated areas and because it improved the drainage of the cities. However, excreta may contain pathogens in large concentrations and the flush-and-discharge sewage system normally does not destroy these. Instead the pathogens are partly accumulated in sludge or sediment and partly flushed out with the effluent.

Excreta contain not only plant nutrients and pathogens, but also organic macro and micro substances, e.g. hormones. The flush-and-discharge sewage system drastically increases the flow of excreta, and thus of a large number of different substances, from terrestrial to aquatic environments. This has led to serious eutrophication and oxygen deficiency in the recipient waters. To remedy these negative effects, advanced sewage treatment plants were developed, includ-

ing processes to remove biodegradable organic substances, nitrogen and phosphorous. However, new negative effects are continually being discovered. One example is the negative effect on aquatic wildlife caused by the female hormone oestrogen in the sewage effluent. Another example is pollution by pharmaceutical residues, which are being discovered in more and more places, even in groundwater resources used for production of drinking water.

The linear flow of excreta substances thus causes eutrophication, depletion of fields and problems with endocrine disruptors in the marine environment. Therefore, it becomes ever more evident that the linear substance flows introduced by the water-borne flush-and-discharge sewage system are major violations of ecology. The sustainable solution to this is not to improve the present end of pipe sewage treatment. It is instead to introduce a sanitation system that supports, instead of violates, the natural cyclic substance flows of nature. It is to introduce EcoSan.

### **EcoSan - substance flows and hygiene**

Ecological Sanitation, EcoSan, is designed to support the natural cycles of plant nutrients and other natural components of excreta, e.g. hormones. When fully implemented, all excreta are returned to arable land in a hygienically and chemically safe way. Thus, the cycles of the plant nutrients contained in food are closed and the other natural constituents of excreta, e.g. natural hormones, also flow to soil, just as previously during evolution.

There is a mass balance in the human body. Excreta contain approximately the same amount of heavy metals as food and therefore there is no risk of heavy metal accumulation in soil due to these fertilisers. They are chemically safe. Of course, this assumes that infrastructure systems are well designed and do not themselves contaminate the excreta.

Pharmaceutical residues are often cited as a new and additional risk when using excreta fertilisers, i.e. in EcoSan systems. This risk has not yet been verified, as far as I know, but risk assessments are underway. Meanwhile, before these studies are reported, my guess is that it actually is the other way around. The risks associated with pharmaceutical residues in EcoSan systems are probably smaller than in the conventional flush-and-discharge system. Downstream from the sewage effluent outlet of big cities, the concentration of many pharmaceutical substances is large enough to be detectable. In some places medical residues have even been detected in the groundwater. These findings are worrying as ground and surface waters are the sources of our drinking water.

Studies have also shown that pharmaceutical compounds degrade to varying degrees in sewage treatment plants and that this degradation increases with the retention time. Since arable soil contains the same types of microorganisms as treatment plants, it is reasonable to assume that the degradation will be high, or essentially total, since the retention time in the soil is very long. However, EcoSan also offers another unique possibility of eliminating the risk of pharmaceutical residues. This possibility is due to the small volumes of excreta collected, which increases the possibility of finding practicable and resource efficient treatments that eliminate or inactivate these substances. For example, incineration of dry faeces will not only sanitise them, but also eliminate pharmaceutical residues.

In EcoSan systems the excreta are source separated, i.e. they are collected and treated in a separate system from the greywater. Since the excreta are collected, stored, treated and transported before being reused as fertilisers, it is very important for practical reasons that they are collected in a minimal volume. The volumes of the excreta themselves are quite small, that of urine being only 1-1.5 litres per person and day and that of faeces only 0.1-0.3 litre. To keep the total volume down, no or very small amounts of flushwater are used in EcoSan systems for collection of excreta.

EcoSan strives towards a sustainable society. The recycling of excreta nutrients for sustainable production of food is a requirement for this society. However, this is not enough. To be sustain-

able the food produced must also be safe and of high quality. This implies that, while the plant nutrients should be recycled, pathogens should not. This is a very important requirement and at least two barriers against spreading pathogens should be implemented. Several barriers are possible. One is to sanitise the excreta well, another is to handle the excreta in such a way that they do not contaminate food consumed raw. Still another is not to harvest until a long time after fertilising with excreta.

Urine diversion is a component of many EcoSan systems, mainly because urine diversion simplifies the construction of hygienic, no odour, no fly and no water toilets. Therefore, urine diversion toilets with dry collection of faeces can be built inside the house.

Urine diversion also has the additional advantages of simplifying the sanitation of the excreta and of providing two fertilisers with different properties, instead of one, which makes it possible to address the specific nutrient requirements of different crops.

Urine diversion simplifies the sanitation of excreta. This is because the faeces accounts for only a small fraction of the volume but essentially the whole hygiene risk. The small volume of the dry faeces, i.e. without urine or flushwater, makes it easier to contain them and to sanitise them. They can be sanitised already in the toilet, for example by a combination of regular addition of ash or lime and dehydration, which also decreases the risk of flies and odour. The faeces can also be sanitised upon removal from the toilet by a secondary treatment, for example digestion, composting, incineration or by addition of urea or other chemicals. Further studies and developments are needed on these sanitation methods to minimise their need of resources for meeting a specified hygiene standard. Until such studies have been carried out and hygiene guidelines developed, it is important to apply the faeces before planting/sowing, to incorporate them well and not to use them for vegetables eaten raw.

The hygiene risk associated with urine is very small compared to that with faeces. Therefore, provided that the diversion of the urine functions well, the diversion itself can be seen as a hygiene barrier. Urine should also be incorporated well into the soil, to maximise its fertilising effect. In addition, as a hygiene safety measure, until hygiene guidelines have been developed, it is recommended that crops consumed raw are not fertilised with urine closer to harvest than one month (Schönning, 2003). This also ensures that the plant nutrients have time to be taken up and utilised by the crop.

The hygiene risk associated with latrine or blackwater (urine mixed with faeces and in the case of blackwater also with flushwater) is the same as that of faeces. It is therefore important that several hygiene barriers are enforced.

### Fertilising effects

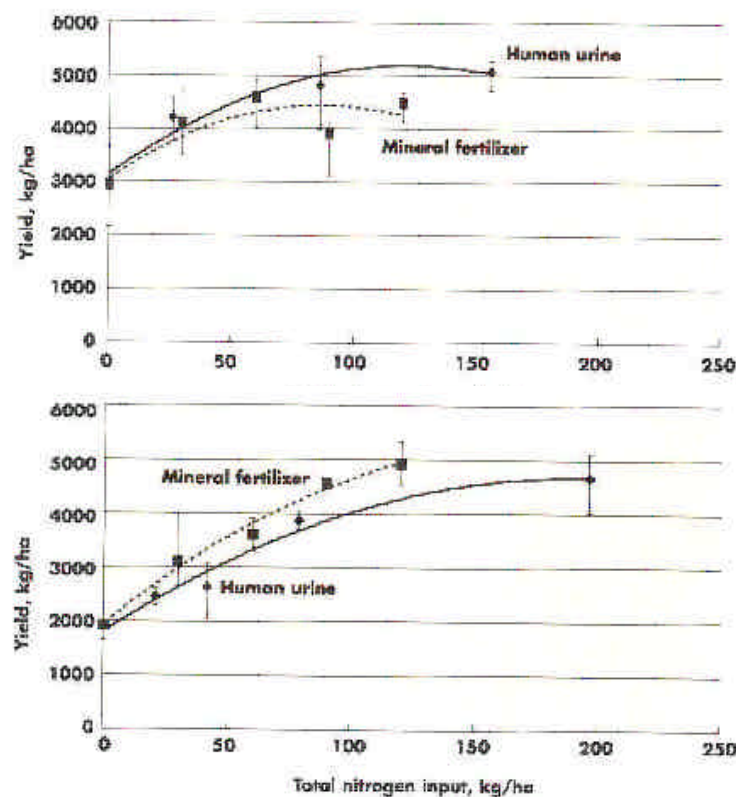
Urine is a complete fertiliser that is rich in nitrogen. It can be used in the same way as a nitrogen rich liquid chemical fertiliser. For biological fertilisers, the plant availability of the urine nutrients is uniquely high. In experiments, the phosphorous effect has been as good as that of chemical fertiliser (Kirchmann & Pettersson, 1995) and the nitrogen effect has varied from around 70% to more than 100%, compared to chemical fertiliser. On average the nitrogen effect has been around 90%, after deduction of the nitrogen lost as ammonia (Figure 3; Johansson et al., 2001). In Swedish experiments, the nitrogen loss in the form of ammonia has varied from less than 1% to more than 10%. On average it has been around 5%. To keep the ammonia loss low, it is important to mix the urine into the soil as quickly as possible. The best method is probably to apply it in furrows or holes, which are then covered over immediately after application.

Faecal matter is an organic fertiliser that is rich in phosphorous, potassium and organic matter. Faeces improve soil fertility and increase the buffering capacity of the soil, especially if they have also been mixed with ash or lime. The availability of the nutrients in faeces is slower than

of those in urine.

Thus, urine and faeces supplement each other well. Urine is well suited as a fertiliser for nitrogen demanding crops, like maize and spinach, while faeces are well suited as a fertiliser for crops without any large nitrogen demand, like legumes. So far, documented experiments are lacking concerning blackwater. However, since it is a mixture of urine and faeces, and urine contributes most of the nutrients, its fertilising effect should be fairly similar to that of diverted urine.

If plant nutrients are wisely used, introduction of EcoSan will lead to improved production of food. In deprived circumstances and, especially in subsistence farming, this factor can improve both health and economy. EcoSan fertilisers are well balanced complete fertilisers, as they contain the elements in the same ratios as the crops removed them from the fields. Therefore, the risk of unbalanced fertilisation is far less with EcoSan fertilisers than with chemical, which simplifies soil management and decreases the need for chemical soil analyses.



**Figure 3:** The effect of urine and mineral fertilizer on the yield of barley in an experiment in Sweden 1998 (upper diagram) and 1999 (lower diagram) (Johansson et al., 2001).

### Environmental assessments

It is obvious that EcoSan recycles far more nutrients to arable land and emits far less nutrients to water than a conventional flush-and-discharge system, even if the conventional system contains a very effective treatment. For blackwater systems this has also been shown in a number of environmental systems analyses (Bengtsson et al., 1997; Kärrman et al., 1999; Balmer et al., 2002). These studies also confirmed the low concentrations of heavy metals in excreta, and thus that it is a very pure and unpolluted fertiliser.

However, they also showed that the energy usage of existing blackwater systems is very high. This is due to the large energy usage both by the vacuum system used for collection and by the sanitation process, liquid composting or thermophilic digestion. One conclusion from these studies is that the development of resource efficient sanitation processes should be given the highest priority. Another conclusion is that further development of collection systems is needed, to increase their resource efficiency and decrease their use of water.

## Conclusions

The present flush-and-discharge sewage system introduces a large one-way flow of excreta, containing organic matter, plant nutrients, hormones etc., from terrestrial to aquatic environments. This flow is an obstacle to a sustainable environment. End of pipe solutions (sewage treatment plants) can probably never be a sustainable remedy to this imbalance. This is indicated by the continuously increasing number of problems observed, eutrophication, depletion of arable fields, fish affected by endocrinal disruptions, water polluted by pharmaceutical residues.

EcoSan systems make the excreta flow in the natural direction, closing the nutrient loop and directing the hormones to arable land, just as previously during evolution. Since the excreta are collected in a small volume, practicable and resource efficient sanitation methods can be developed. The hygiene standard of these systems can therefore be higher than that of the present flush-and-discharge system. Furthermore, these systems also increase the possibility of developing practicable treatments for the inactivation of pharmaceutical residues, should this be prioritised by society.

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## Addressing the environmental dimensions of sanitation

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Firstly, I would like to offer my compliments to the organisers of this symposium, especially to the GTZ, as well as to the governments of Sweden and Germany for their active involvement in this field and for making this symposium possible.

My first slide, a picture of a child standing inside a large wastewater discharge pipe, addresses the environmental dimensions of sanitation. It clearly shows that there is something wrong with both human and environmental health. The agreed target of Johannesburg, as mentioned earlier today, challenges the mandates of organisations, groups and professionals to put more energy into halving the proportion of people without access to sanitation by 2015, which is often seen as only being limited to household sanitation services but should be regarded in a holistic view to provide benefits for both humans and the environment.

Fortunately we do not have to act alone in this world, and many partnerships exist between different organisations. There are numerous groups operating in their own niches. Ecosan however is not simply a GTZ niche but represents more a collaboration with other partners to jointly address specific issues. I think it is the strengths of such partnerships that will make it possible to achieve the 2015 targets.

Although east and south Asia currently have the biggest problems of poor sanitation coverage we are aware that these problems are not only in Asia, but also on other continents such as Africa, South-Pacific, and South America including the Caribbean, which over the last decade were unable to keep up with their population growth. Here the numbers of the unserved population have increased over the last decade and we must pay attention to these regions. In addition to this, and often forgotten, are the problems that will be faced by the other half of the unserved population that do not receive the adequate sanitation aimed for in the Johannesburg targets. What will happen to them? And who is addressing the needs of the poorest of the poor? The poorest of the poor are quite often living in slums in poor countries with unstable economies. Poor countries where the international financing institutions tend to withdraw their support. It is one of the concerns of the United Nations Environmental Health Programme to address those issues of traditional financing mechanisms which lead to strained relations.

The rather traditional approach to sanitation; sewage treatment and discharge of wastewater requires that we look for innovative approaches to sanitation. Ecological sanitation is part of the toolbox containing these innovations. We therefore need to get the message across to the professionals and the financing institutions, and we need to strategise and professionalise the message for those we wish to reach.

It will be a time consuming process to shift from a use and discharge, to a use and re-use mindset. It will be a time consuming process to not only have household sanitation at the centre of achieving the targets of Johannesburg but also to include efforts considering the environmental dimensions of treatment and discharge of wastewater, and the re-use of nutrients as fertiliser rather than treating them as waste.

At UNEP we address issues of environmental protection, develop guidelines, key principles and knowledge bases in partnerships with other international organisations, and have a strong mandate concerning the environmental conventions currently being implemented. And I think that

within the framework of these environmental conventions UNEP strategies can help to implement ecosan as one of the solutions where governments have committed themselves to address environmental issues.

It is through setting targets, and outlining the necessary measures to implement them, that environmental conventions can assist parties involved, including NGO's, communities, governments and the financial sector. It is these types of statements that are being used at a political level to address environmental dimensions in step-wise approaches. For sanitation programmes these targets should be feasible and should encourage the joint development, in a professional way, of the guidelines to implement them.

I would like to use this opportunity to mention one of the ways in which we can further our debates, as ecosan is one of the tools in addressing the environmental dimensions of sanitation, and to promote the e-mail based conference due to take place at the end of April 2003. It addresses sanitation for the health of the environment. Another conference, planned for November, on sustainable environmental technologies, is being co-organised through our offices in Japan and the International Technology Centre of Japan.

Finally, to end my presentation I would like to repeat this statement „we need to professionalise the ecosan movement“. At this conference we have gathered as friends and colleagues sharing a vision, but I believe it is time to include those who do not share this vision in our discussions and work. I hope this symposium will succeed in producing such sound messages.

I wish you all a productive symposium over the coming days.

Thank you.

## The UNDP's approach and activities in ecological sanitation

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### Keywords

Ecological sanitation, UNDP, Millennium Development Goals

### Abstract

United Nations Development Programme is the United Nation's development agency. It works with global and national counterparts on solutions to achieve the overarching goal of cutting poverty in half by 2015, one of the Millennium Development Goals (MDGs) pledged to by world leaders. UNDP activities, covering 166 countries, help countries strengthen their capacity to achieve sustainable development, seeking out and sharing best practices and providing policy advice that help the poor build sustainable livelihoods. Access to safe water and sanitation services is essential to reach the targets of the MDGs, to reduce poverty and achieve sustainable development.

### Global UNDP concerns:

- Currently more than 1 billion people living in developing countries lack access to safe water supply and about 2.5 billion lack adequate sanitation.
- Modern waste management practices, such as water-based sewage where safe drinking water is used to flush away human excreta, are abusive to human well-being, economically unaffordable and environmentally unsustainable.
- Shallow ground water, which is the main source of accessible water for poor people, is increasingly becoming polluted and depleted.
- In the next two decades it is estimated that water use by humans will increase by 40% and that 17% more water will be needed to grow food for growing populations in developing countries.

### UNDP priorities:

- Improve national and local capacities to manage water resources, sanitation and water services including civil society, public and private sector,
- Support communities/households with small grants to improve water and sanitation - emphasis on ecological sanitation.
- Promote ecosystem based solutions to the management of excreta to prevent disease and protect the environment,
- Supporting and enhancing women's involvement in sanitation, water supply and water resources management.

UNDP's ecological sanitation activities are to a large extent funded by the Swedish Government and UNDP's projects are carried out in close collaboration with Sida. The basic strategy is to complement and add value to what is implemented under Swedish bilateral assistance which includes to introduce ecological sanitation to countries where Sida has no presence as well as to support the conceptual development e.g. for application in peri-urban areas.

In addition **UNDP's focus** is to:

- develop the concept and promote its application in activities of other agencies / sectors.
- explore linkages between ecological sanitation, urban agriculture, community composting etc.
- identify and address gaps in research and development (e.g. gender).
- identify opportunities, give advice, build capacity and provide funding for pilot studies and demonstration projects.
- disseminate information and knowledge - case studies, networking (Red Seco, Indian Lecture tour).

The geographic focus of UNDP's work on ecological sanitation is Latin America and Asia / Pacific. Countries benefiting from UNDP support include India, Sri Lanka, The Philippines, Vanuatu, Kyrgyzstan, Mexico, Peru, and Mozambique.

Focal point and consultant for Latin America is Ron Sawyer (<http://www.laneta.apc.org/sarar>),

Asia/Pacific Paul Calvert: (<http://www.eco-solutions.org/>).

Main UNDP publication: Closing the Loop – Ecological Sanitation and Food security, UNDP/Sida, 2001, available in English and Spanish on web site: <http://www.laneta.apc.org/sarar/>

More information about UNDP's work in sanitation and water: <http://www.undp.org/water/>

## Putting ecosan on the global agenda - results from the 3<sup>rd</sup> World Water Forum, Kyoto, March 16-23, 2003

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### Keywords

Ecosan, ecological sanitation, global, Millenium Development Goals, Kyoto

### Abstract

The Third World Water Forum provided a major opportunity to put ecological sanitation onto the global agenda. A series of key workshop and lecture sessions were organised in collaboration with the IWA, City of Kyoto, Japan Toilets Association and the EcoSanRes Programme. A resolution on ecosan was written and agreed to by a number of organisations including multi-lateral, bi-lateral, finance institutions, national governments, etc. This represents a paradigm shift in the making where sanitation is no longer a practice of disposing human excreta in deep pits and water courses but one centred around the all-so-important relationship between humans and soil systems. The 3<sup>rd</sup> WWF Ministerial Declaration and Commitments from UN agencies also referred to new opportunities where positioning of ecological sanitation will be possible. The linkage to the Millennium Development Goals was also made and details describing the roadmap ahead for the Water and Sanitation goals are described.

### Ecosan at the Third World Water Forum

The Third World Water Forum was a large meeting involving many parallel sessions, plenaries and a Ministerial meeting covering virtually all aspects of water concerns from all over the planet. This is not meant as a summary or review of the 3<sup>rd</sup> WWF but merely a bridging introduction to help kick off the 2<sup>nd</sup> International Symposium on Ecological Sanitation held in Lübeck on April 7 to 11, 2003. The 3<sup>rd</sup> WWF contained some 351 sessions covering 33 themes and 5 regions of the world. One of the main themes of the Forum was sanitation and ecological sanitation was given a large opportunity to show its presence. This is the main message of this paper – that ecosan was put on the global agenda at the 3<sup>rd</sup> WWF.

In collaboration with IWA, Japan Toilet Association, City of Kyoto and the EcoSanRes Programme, the following sessions dealing with ecosan were organized:

- Ecological Sanitation – Progress Being Made Around the World: What is Ecosan and what is Being Done Generally? (Uganda Ministry present)
- Ecological Sanitation – Closing the Nutrient Loop Through Ecosan in Rural and Urban Areas (Swedish Minister present)
- Affordable & Ecologically Sound Community Sanitation – New Solutions to Old Problems (IWA Head present)
- Proper Toilets for Everyone All Over the World

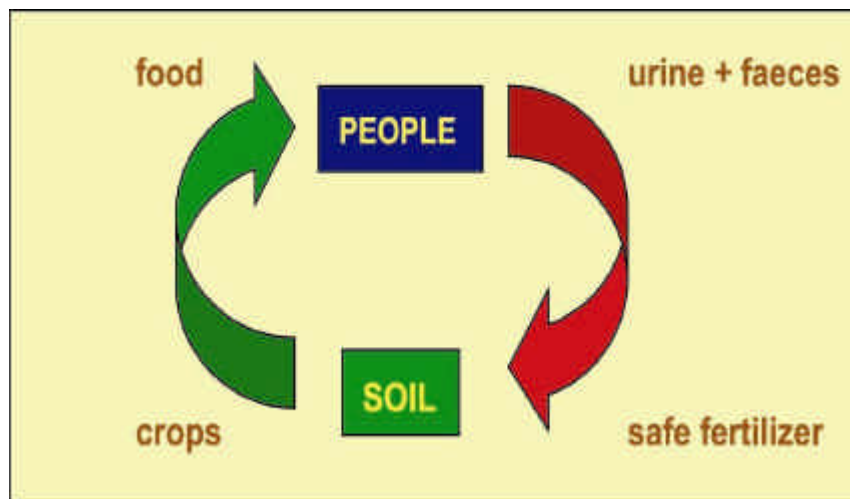
These were well-attended attracting practitioners and policy-makers and provided new insights into latest developments and the progress made thus far within the field of ecological sanitation.

## The Kyoto Resolution on Ecosan

A resolution was generated and consensus achieved along the following lines:

- Ecological sanitation (ecosan) is an environment-friendly and safe approach to sanitation.
- Ecosan is holistic in that it saves water, prevents water pollution, sanitizes and recycles the nutrients and organics to restore soil and soil fertility.
- Ecosan includes low- as well as high-cost solutions for rural and urban settings. Ecosan can be more cost-effective than conventional sanitation and thereby offering a greater chance of meeting the Millennium Development Goals and the Johannesburg Commitments on Sanitation.
- Ecosan is applicable to a wide array of local physical, cultural and economic conditions providing permanent installations.
- Ecosan concepts and techniques can also be used to upgrade conventional pit latrines and flush systems.
- Ecosan is being applied successfully in many locations in Africa, Asia, Europe, the Americas, and Oceania.
- At the Kyoto 3rd WWF, ecosan emerged as a significant option in meeting the Millennium Development Goals and the Johannesburg Commitments on Sanitation and is supported *inter alia* by UNDP, UNEP, UNICEF, Water and Sanitation Programme (World Bank), EU, Government of Uganda, GTZ (Germany), Sida (Sweden), Austrian Aid, SDC (Switzerland), IWA, CREPA (West Africa), Mvula Trust (South Africa), the City of Kyoto and the Japan Toilets Association.

A new paradigm is thus in the making, whereby sanitation should be based on the relationship and dependency that people have on soil systems and should not continue the common practice of disposing of human excreta in deep pits (ground water) or water courses. This shift in thinking is depicted by the following diagram:



## Ministerial Declaration

The Ministerial Declaration arising from the 3<sup>rd</sup> WWF included several statements referring to topics related to ecosan. Under the heading Safe Drinking Water and Sanitation the following was resolved:

- §16. Achieving the target established in the MDGs to halve the proportion of people without access to safe drinking water by 2015 and that established in the Plan of Implementation of the WSSD to halve the proportion of people without access to basic sanitation by 2015 requires an enormous amount of investment in water supply and sanitation. We call on each country to develop strategies to achieve these objectives. We will redouble our collective efforts to mobilize financial and technical resources, both public and private.
- §17. We will address water supply and sanitation in urban and rural areas in ways suitable for the respective local conditions and management capacities, with a view to achieving short-term improvement of water and sanitation services as well as cost-effective infrastructure investments and sound management and maintenance over time. In so doing, we will enhance poor people's access to safe drinking water and sanitation.
- §18. While basic hygiene practices starting from hand washing at the household level should be encouraged, intensified efforts should also be launched to promote technical breakthroughs, especially the development and practical applications of efficient and low-cost technologies tailored to daily life for the provision of safe drinking water and basic sanitation. We encourage studies for innovative technologies to be locally owned.

### Kyoto Commitments

Several organizations announced new commitments at the 3<sup>rd</sup> WWF. The following four samples are relevant to ecosan and should be seen as opportunities:

- The **Water and Sanitation Program** (World Bank) commits itself to funding national capacity building projects for MDG monitoring. Candidate countries are welcomed to apply.
- The **WSSCC** is committed to publishing every three years a 'People's Report' that will present progress towards hygiene, sanitation and water for all. The first one is due in December 2003, and thereafter at each WASH Global Forum.
- The **United Nations Development Programme (UNDP)** commits to a Community Water Initiative, aimed at building on the power of the local community to solve water and sanitation challenges. Its aim is to provide innovative communities with small grants to expand and improve their solutions to the water and sanitation crisis. The Community Water Initiative has an estimated target budget of \$50 million for 2003-2008.
- **UN-HABITAT** signed a memorandum of understanding with the Asian Development Bank (ADB) to create a programme to build the capacity of Asian cities to secure and manage pro-poor investments and to help the region meet the Millennium Development Goals (MDG) of halving, by 2015, the proportion of people without safe drinking water and basic sanitation. The programme will cover a pipeline of US\$10 million in grants from ADB and UN-HABITAT for the first two phases and US\$500 million in ADB loans for water and sanitation projects in cities across Asia over the next five years. Additional funding for Water for Asian Cities has also been made available to UN-HABITAT by the Government of Netherlands.

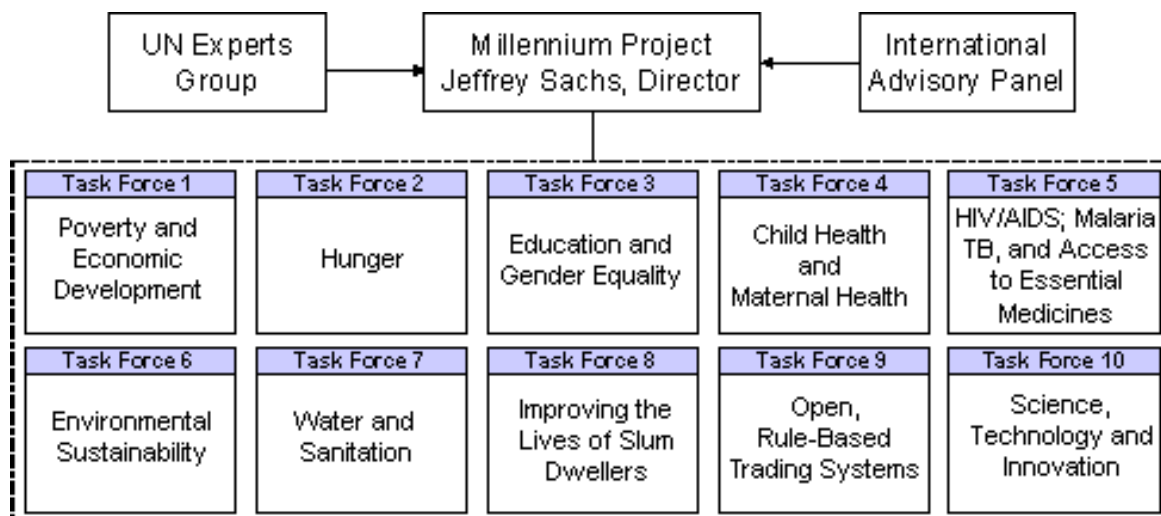
### The UN Strategy for the Millennium Development Goals

The UN MDG strategy is also relevant in providing opportunities for ecosan development. The following are the four main features of the MDG process:

- The Millennium Project, which analyses policy options and will develop a plan of implementation for achieving the Millennium Development Goals. Headed by Jeffrey Sachs, Columbia University.

- The Millennium Campaign, which mobilizes political support for the Millennium Declaration among developed and developing countries. This is led by Evelyn Herfkens, the Secretary-General's Executive Coordinator for the MDG Campaign.
- Country-level monitoring of progress towards achieving the Millennium Development Goals, led by the UN Development Group.
- Operational country-level activities, coordinated across agencies through the UN Development Group, which help individual countries implement policies necessary for achieving the Millennium Development Goals.

A battery of Task Forces have been set up one of which deals with the issues of water and sanitation:



The MDG timeline is as follows:

- **Late-2002.** Completion of background papers, which map out the planned research work of each Task Force.
- **Mid-2003.** Publication of the Human Development Report 2003, which will focus on the Millennium Development Goals and draw upon research contributed by the Millennium Project Task Forces.
- **Mid-2004.** Presentation of the Millennium Project Interim Report to the UN Secretary-General and the UNDP Administrator.
- **June 30, 2005.** Presentation of final recommendations by the Millennium Project to the UN Secretary-General.

The Water and Sanitation Task Force includes the following representatives:

- *Coordinators:* Roberto Lenton (Columbia University and GWP) and Albert Wright (Africa Water Task Force, GWP, World Bank)
- Ingvar Andersson Senior Water Advisor, (UNDP)
- Michel Camdessus, Chair, Panel on Water Infrastructure Financing
- Margaret Catley-Carlson, Chair, Global Water Partnership
- Ivan Cheret, Suez Lyonnaise des Eaux

- Kamla Chowdry, Vikram Sarabhai Foundation (VSF), India
- William Cosgrove, Vice President, World Water Council
- Manuel Dengo, Chief, Natural Resources, United Nations Department of Economic and Social Affairs (DESA)
- Halifa Drammeh, Deputy Director, Division for Policy Development and Law, United Nations Environment Programme (UNEP)
- Gourisankar Ghosh, Executive Director, WSSCC
- Richard Jolly, Emeritus Fellow, Institute of Development Studies, University of Sussex
- Torkil Jonch-Clausen, Chairman, GWP-TAC
- Mike Muller, Director General, South Africa Department of Water Affairs
- Kalyan Ray, Chief, Water, Sanitation and Infrastructure Branch, United Nations Human Settlements Programme (UN-Habitat)
- Frank Rijsberman, Director General, International Water Management Institute
- Jamal Saghir, Director, Energy and Water, The World Bank
- David Seckler, Former Director General, International Irrigation Management Institute
- Andras Sollosi-Nagy, Deputy, Assistant Director-General, Science Sector Director, Division of Water Sciences, (UNESCO)
- Vanessa Tobin, Chief, Water, Environment and Sanitation, United Nations Children's Fund (UNICEF)
- Gordon Young, Coordinator, World Water Assessment Program

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Website for the EcoSanRes Programme: <http://www.ecosanres.org/>

