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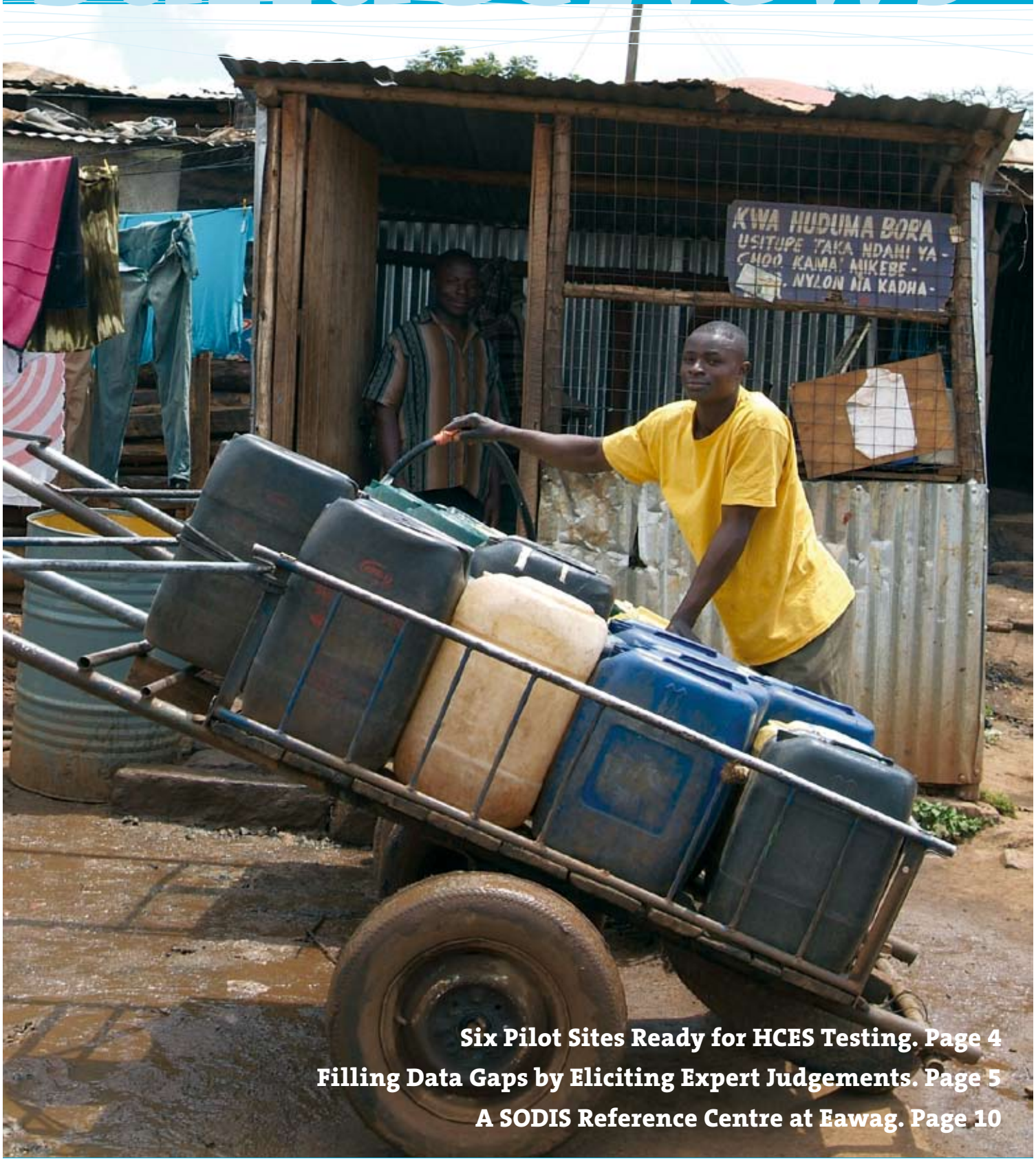
Sandec News



The Urban Tomorrow

> **“The future will be predominantly urban and water supply and environmental sanitation concerns will also be urban-oriented”**

2007 is the year the world’s urban populace will exceed the rural population. Most of the world’s urban growth (95 %) will be absorbed by cities of the developing world – the least equipped to deal with rapid urbanisation.

In developing countries, urban population increase is significantly higher than the average national population growth. Migration towards cities both small and large and the high internal growth rates of urban areas are undeniable. The widespread belief that rural development can prevent urbanisation and its associated problems must be abandoned in favour of addressing the main urban challenges, for example, with strategic planning of infrastructure and services, and due consideration to the related environmental issues. However, it is not only the large urban centres on which we need to focus our attention. Both the number of towns and small cities as well as the number of people living in towns and small cities in Africa, Asia and Latin America are expected to double within fifteen years, and redouble within only three decades. Furthermore, some 43 % of the urban population of all developing regions already live in slums where vulnerability is highest and health and wellbeing severely threatened by a lack of safe drinking water, adequate sanitation, solid waste infrastructure and services.

Improving urban water supply and environmental sanitation are decisive elements toward achieving the targets set by the UN Millennium Development Goals. One challenge lies in the way we view the problem and the alternative water and sanitation solutions adopted. Household access to a latrine or connection to a septic tank does not necessarily indicate adequate sanitation if faecal sludge management is not ensured or if the liquid effluent flows untreated into open drains, into the adjacent surface water or groundwater. A system approach to environmental sanitation, starting from generation to disposal/discharge or reuse – from cradle to grave – is urgently needed both on project and policy level. Unfortunately, the lack of a well-articulated portfolio of sanitation alternatives – set in a system context – deprives both communities and planners the choice and access to viable options. Finding feasible decentralised solutions tackling the problem as close to the source of waste generation as possible – on household or neighbourhood level – remains one of Sandec’s key research activities. Not only in the field of excreta or wastewater, but also of greywater, solid waste and safe drinking water treatment.

Sandec’s research in strategic environmental sanitation planning has pushed forward with various pilot projects, such as the Household-Centred Environmental Sanitation (HCES) planning approach, currently being tested. Developing a portfolio of sanitation alternatives – as one step in the HCES process – is being further pursued in the Coordination Action EU Project on Sustainable Sanitation Systems for West Africa (NETSSAF). Moreover, use of the material flux analysis (MFA) method, allowing system description and analysis of environmental impact, has been developed further in the sanitation context by Agnes Montangero’s PhD thesis and by projects of the solid waste group. In close collaboration with the Swiss Tropical Institute (STI) in Basel, this methodology is now being complemented by tools and methods assessing health risks of water, sanitation and waste reuse to humans to improve determination of strategic sanitation alternatives.

Building upon the successful activities with solar water disinfection (SODIS), Sandec is establishing a SODIS Reference Centre at Eawag and will be strengthening regional SODIS reference centres worldwide. We are glad that Regula Meierhofer, with her extensive experience on SODIS activities, has agreed to lead this centre for the next few years.

Sandec can look back to a hectic and successful 2006. Much of the ongoing research has been capitalised and many new projects have been launched. This newsletter gives a glimpse of past, current and future activities. If the short articles whet your appetite, do not hesitate to contact the authors by email. We would be more than pleased to provide additional information or discuss opportunities for research collaboration.

Chris Zurbrügg
Director Sandec

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Water and Sanitation in Developing Countries

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Six Pilot Sites Ready for HCES Testing

Following our call for collaboration to test the Household-Centred Environmental Sanitation (HCES) approach, 20 partners responded and submitted their proposals. Six sites were selected in the following countries: Two sites were identified in Costa Rica (Central America), one site in Burkino Faso (West Africa), two sites in Kenya and Tanzania (East Africa), and finally one site in Laos (South-East Asia). Christoph Lüthi, Roland Schertenleib, Antoine Morel

In the selection of pilot sites, we joined forces with locally anchored institutions, i.e. the Latin American Faculties of Social Sciences (FLACSO) in Costa Rica, the research institution CREPA in West Africa and "Maji na Ufanisi" (Water and Development), a growing NGO in Kenya. In the last few months, Memoranda of Understanding were signed with most partners and the ten-step HCES process launched.

Initiating the HCES process

So far, HCES launching workshops (step 2 of the actual planning process) were held in Costa Rica, Kenya and Burkina Faso, and their results in terms of stakeholder participation and content surpassed our expectations. Participation, reflected by the lively debate and concrete results of the community at large and key stakeholders at national and municipal level, was achieved in all workshops. The following factors largely contributed to the success of the launching workshops:

- A good mix of stakeholders.
- A gender balance in community representation.
- Allowing space for the community to speak out and voice its concerns.
- Careful preparation and detailed organisation of the launching event.

So far, experience suggests that best results are obtained if the launching event is divided in two parts: (i) a community planning workshop, where the community feels uninhibited in communicating and speaking freely without dominant external stakeholders; (ii) a formal launching event, where authorities and decision-makers are appointed by the community and where the framework of the HCES planning process can be negotiated. The outcome of the workshops has laid the foundation for future planning processes, i.e. creation of a multi-stakeholder task force or working committee and an action plan detailing further steps of the household-centred approach.

The main challenge of step 3 in the HCES process is the assessment of the current status of environmental sanitation services at local, municipal and city level despite data scarcity. Is collection of reliable planning data possible from an informal and unmapped settlement in Nairobi, which is practically devoid of municipal services and totally devoid of public schools or health clinics etc (Photo 1)? A mix of quantitative surveys, collection of qualitative information and interviews with key resource persons certainly forms part of the solution to this problem. A further challenge is the integrated, cross-sectoral nature of the information required, covering sanitation, solid waste, water supply, and drainage issues.

Steps ahead

Key steps in the future planning process comprise open discussions on the outcome of the assessment of the current status, user priorities and different environmental sanitation options, including organisational, financial and technological options (steps 4 and 5). In Costa Rica's Curridabat neighbourhood, an information workshop on the outcome of the assessment of the current status (i.e. neighbourhood diagnosis) was already held with those concerned (Photo 2). The community is now ready to find options and solutions for its neighbourhood. The "options workshops", to be organised for each individual block, will group about 25 households and will be held in the living room of a community member to ensure the highest possible community participation.

The future planning steps 6–8 will comprise the evaluation of feasible service combinations as well as the drafting and finalisation of the consolidated strategic sanitation plan. These plans are likely to take several months to complete prior to initiating the actual implementation step. In many cases, especially if new and innovative solutions are suggested, implementation will start on a limited scale (carefully monitored and evaluated in step 9) before large-scale implementation can take place in step 10.

To support the HCES planning process, especially steps 5 and 6, SANDEC is currently compiling a Compendium/Sourcebook to facilitate identification of the favoured system from a list of possible options. Its main objective is to present a wider range of conventional and innovative options, including on-site technologies. The material is intended for sector experts and decision-makers, but can also be used for presentations during community consultations such as the ones mentioned.

For further information on the household-centred approach, visit our website or download the HCES Guidelines now also available in French and Spanish.

Photo 1: HCES seeks to provide solutions to environmental sanitation problems encountered, for example in a Nairobi informal settlement.

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Photo 2: The HCES approach begins by launching a workshop for key stakeholders. The photo shows the Curridabat workshop in 2006.

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Filling Data Gaps by Eliciting Expert Judgements

Interviewing experts is a promising method to assess data required to conduct a material flow analysis that is otherwise unavailable from existing data sources. Agnès Montangero

If reliable data is unavailable and time too short or laboratory equipment inadequate to conduct measurement campaigns, quantitative information, as a basis for decision-making, may only be obtained by asking best expert judgement. We have therefore elicited expert judgement [1, 2] to fill specific data gaps in material flows for developing a model on water and nutrient flows in the environmental sanitation system of Hanoi, Vietnam.

Transfer coefficient of phosphorus (P) in septic tank sludge, i. e. ratio between accumulated P in a septic tank and total P input, was one of the model parameters that could not be quantified on the basis of available data. This example [3] illustrates the expert elicitation method used here:

Expert elicitation method

Background. A literature search was conducted to determine the range of available scientific knowledge.

Identification and recruitment of experts. Three experts were selected on the basis of their theoretical knowledge on wastewater treatment techniques and research experience related to septic tanks. The experts selected were expected to provide estimates covering the entire range of realistic values.

Introduction to probability assessment. Scientists often prefer to rely on measurements rather than on subjective judgement. Since they may hesitate to express their opinions, it is important to gain the experts' confidence and stimulate their enthusiasm for the project. Experts were thus first introduced to the project and to the principles of subjective probability assessment. They examined the results of the literature review on septic tanks and were given the opportunity to correct or add information.

I am indebted to Dr Mark Borsuk for introducing me to the method of expert assessment and to the septic tank experts for their excellent collaboration. This project is supported by the **Swiss Nat. Centre of Competence in Research (NCCR) North–South.**

Qualitative model. Experts were then asked to generally describe qualitatively the mechanisms in a septic tank and, specifically, the ones influencing nutrient separation in the output material, i. e. faecal sludge, effluent and gas.

Probability elicitation and verification. Points on the cumulative distribution function were assessed by assigning a transfer coefficient value to a given cumulative probability. To avoid anchoring, extreme points, i. e. transfer coefficient values corresponding to cumulative probabilities of 0.95 and 0.05 were first assessed. Anchoring occurs when an individual fails to adjust sufficiently from his/her first impression. After assessing the highest and lowest values, intermediate cumulative probabilities and their corresponding transfer coefficients were determined (Fig. 1). Experts had to explain the rationale for their assessment. The cumulative distribution functions were then fitted through the points (non-linear regression) and converted to probability density functions (derivation). Experts were finally invited to review their results. The resulting probability density functions obtained were averaged by attributing the same importance to the results of each expert.

Phosphorus retention in sludge

The P transfer coefficient in sludge from septic tanks ranges between 0.10 and 0.45, with an 0.22 mean value. Despite the wide coefficient range, the values served as a preliminary approximation for the water and nutrient flow model in Hanoi to assess the impact of different sanitation systems on nutrient recovery and discharge into the environment.

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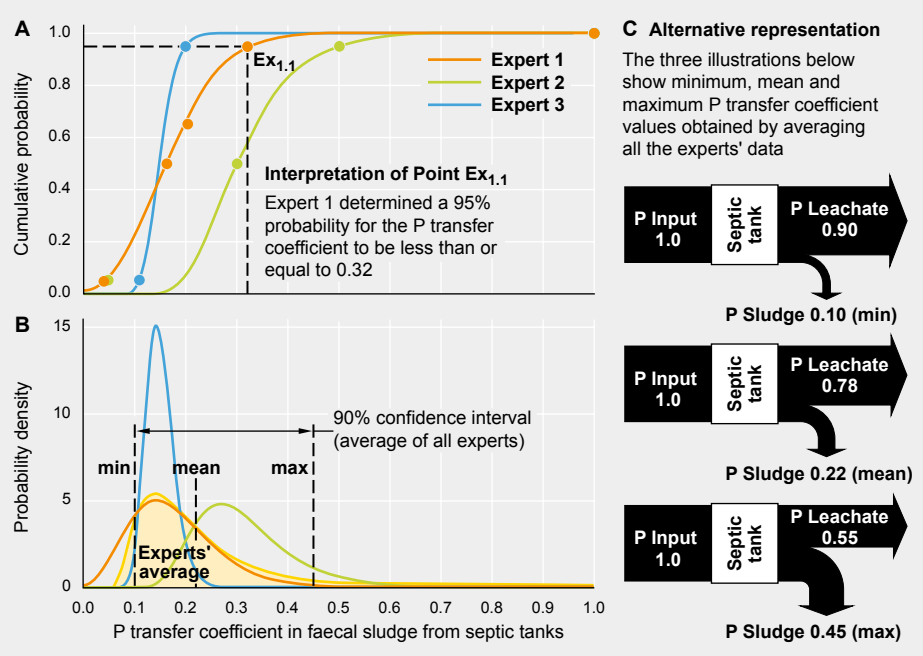
[3] Montangero, A., Belevi, H. (2007): Assessing nutrient flows in septic tanks by eliciting expert judgement: A promising method in the context of developing countries. Water Research 41 (2007):1052–1064, http://dx.doi.org/10.1016/j.watres.2006.10.036

Figure 1: Assessment of P transfer coefficient in sludge from septic tanks by eliciting expert judgement.



Material Flow Analysis in the Tha Chin River Basin, Thailand: A Tool for River Water Pollution Control

The Material Flow Analysis (MFA) model provides an overview of the main nutrient flows in the Tha Chin River Basin, Central Thailand. Instead of extensive measuring campaigns, local data is integrated into the model to quantify these flows and find suitable remediation measures.

Monika Schaffner, Ruth Scheidegger

Tha Chin River Basin

The Tha Chin River Basin is an intensively used watershed in the Central Delta of Thailand, a 12000-km^2 flat and fertile area west of Bangkok (Photo 1). During the last decade, the river water quality experienced serious deterioration [1]. Today, oxygen levels are below Thai standards for most of the river course, and ammonia as well as phosphorus concentrations are elevated, especially in the many side canals [1], [2]. This is partly attributed to the high nutrient discharge into the river system. Agriculture (rice, sugarcane, fruit and vegetable production), livestock production (pig and poultry), aquaculture, industries, and urban settlements are the main sources of nutrient discharge into the aquatic system. The flat river basin with its intricate network of irrigation canals is best compared to a large bathtub: Long water retention times, stagnant flows and changing flow directions characterise the hydrology of the basin [3]. Therefore, once nutrients are discharged into the water, they are not easily transported out and their degradation is slow.

The approach chosen by the Thai government to address this nutrient overload is based on conventional river water quality models (e.g. [4]). Such models focus on the points where pollution is discharged into the main river. However, they do not include an investigation into the actual pollution origins. Thus, these models produce broad and generalised mitigation scenarios, leading to strategy plans that lack prioritisation of concrete and effective mitigation measures.

Method

An MFA model allows to assess the entire path of pollution generation, i.e. from its origin through its different transformations and diversions to its final discharge into the river [5]. Thus, the key pollution sources and main parameters influencing these sources can be identified. Mitigation measures have to target these main parameters in order to achieve an effective impact.

The MFA model for the Tha Chin River Basin simplifies the complexity of the river basin system with its manifold land and water uses. The key activities with their main input and output flows as well as their interactions are identified. The parameters describing these flows are determined by an acquired understanding of the system and based on a nutrient balance concept. Data for these parameters is obtained from available (if possible local) sources, such as statistics, local and international research reports and scientific literature, and complemented by expert opinions and approximations.

The model simulations allow to quantify the nutrient flows and to identify their corresponding key parameters. The results are illustrated in a flow diagram that enables to directly and visually determine the key nutrient flows in the system (Fig. 1). The effect of possible mitigation measures can then be calculated and discussed by adjusting the respective parameters (scenario analysis). These scenario calculations reveal the effectiveness of different measures in lowering the nutrient input into the Tha Chin River.

To derive concrete measures tailored to the local context, the local stakeholders have to be involved and the measures adapted to their needs, plans and aims. For the Tha Chin River Basin study, interviews

Photo 1: Tha Chin River in Central Thailand.

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Our research partners: **Asian Institute of Technology, Bangkok** (Dr Thammarat Koottatep); **Hydrology Group of the University of Bern** (Prof. Rolf Weingartner); **Systems Analysis, Integrated Assessment and Modeling** (Siam) **Department of Eawag** (Dr Hans-Peter Bader).
This project is supported by the Swiss National Centre of Competence in Research (NCCR) North-South: Research Partnerships for Mitigating Syndromes of Global Change, co-funded by the Swiss National Science Foundation (SNF) and the Swiss Agency for Development and Cooperation (SDC).

have been carried out with selected stakeholder representatives of different levels and occupational fields to identify and understand their requirements.

Results

The subsystem of poultry farms was selected to illustrate the aforementioned approach (Fig. 1). This subsystem comprises the sum of the main poultry farming types in the Tha Chin River Basin. Poultry farming activities in this area include large-scale commercial farms, small and medium-scale private enterprises (Photo 2), integrated poul-try-fish farming (Photo 3) as well as free-range husbandry at household level. The flows considered are feed and water inputs, yield outputs (eggs and meat) and flows within the system, such as reuse of manure as a fertiliser in other activities.

Figure 1 presents the simulation results for the status quo of phosphorus flows in the poultry subsystems of the Tha Chin River Basin. The diagram shows that poultry annually receives a total of 3800 tonnes of phosphorus in feed. Of which 1800 tonnes are converted into yield (eggs and meat) and the remaining 2000 tonnes are excreted. 1700 tonnes of this total annual phosphorus excretion are reused as fertiliser in fruit and vegetable production and in fish ponds. This represents a total reuse rate of more than 80 %, whereas only 20 % of the manure (or 300 tonnes of phosphorus per year) are discharged into the Tha Chin River and its canals.

The results of the subsystem clearly reveal that poultry production in the Tha Chin River Basin is a positive example of turning waste into a valuable resource.

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Photo 2: Poultry farm with laying hens. Manure is collected and sold as organic fertiliser.

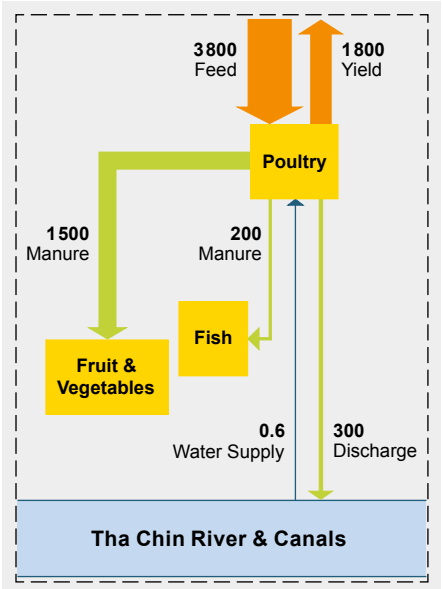

Figure 1: Status quo of phosphorus flows (t/yr) in poultry farming systems of the Tha Chin River Basin. The boxes represent activities and the arrows the phosphorus flows. The width of the arrows is proportional to their value. The dashed line is the system border, i. e. the basin boundary.

Indeed, since poultry manure is highly appreciated for its fertilising value, it can be easily sold as organic fertiliser for fruit and vegetable production or even for household gardens. Its reuse as fertiliser in fish farms is also widespread, however, this practice may raise new problems, as indicated in a detailed MFA study on fish farming in the area [6].

Conclusions and outlook

This MFA model allows to simplify the complexity of the river basin system and to provide an overview of the dimensions and interactions of the nutrient flows. The ability of MFA to draw from available data and system knowledge is an important advantage, compared to conventional river water quality management approaches, which build on extensive measuring campaigns. This MFA characteristic is of significant benefit, especially in developing and emerging countries with limited technical and financial resources.

A Material Flow Analysis model is an ideal technical basis for planning and informed decision-making in the field of water quality remediation of river basins. With its transparent character and rapid simulation runtimes, proposed measures can be directly modelled and results illustrated in flowdiagrams. Different remediation measures can thus be directly compared and evaluated for best ecological impact.

Photo 3: Medium-scale integrated poultry-fish farm. Poultry manure drops through cage to the fishpond.

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Excreta and Wastewater Management Contributing to Cities' Economic Development – A Paradigm Shift

On-site sanitation installations will serve the growing urban populations in developing countries for decades to come. Creating an enabling framework for sustainable service provision to users of on-site sanitation facilities is key to attaining the MDG in sanitation. Doulaye Koné

Growing cities – a challenge for sanitation

Cities, as engines of economic growth and social development, require large quantities of natural resources to meet the inhabitants' economic and social needs. Good infrastructure and reliable service provision are important to sustain urban development. In this regard, they enhance investment opportunities and service access to low-income populations. To respond to the lack of sanitation infrastructure, many governments, development agencies and NGOs generally set up latrine programmes for poor and disadvantaged populations. These programmes often do not link infrastructure provision and its necessary management requirements. As a result, most "latrine-based", unsewered cities cannot reliably handle emptying (when latrines are full), transport and treatment of urban excreta and wastewater. Furthermore, planning of conventional water and sanitation infrastructure does not account for local business opportunities involving resources such as water, nitrogen or biosolids. In many cases, these failures place huge financial burdens on municipalities, which have to permanently rely on subsidies to operate and maintain existing infrastructures. The recent WHO guidelines on safe use of wastewater, excreta and greywater pave the way to reuse opportunities other than urban irrigation, thus leading to a new paradigm.

One decade remains to meet the Millennium Development Goals (MDGs) established by the international community in 2000. Yet many countries, particularly in Africa and South Asia, are off track. Examples abound of slow or failing efforts, i. e. inadequate resources and weak governance contribute to over 10 million children dying annually of readily preventable diseases; only three-fifth of the urban and one-quarter of rural low-income households in developing countries have access to improved sanitation facilities [1]. Since the world population is migrating towards cities, the share of the urban population is rapidly increasing and expected to reach 55 % by 2015.

Cities are engines of economic growth and social development fuelled by human activities and requiring large quantities of natural resources to meet the inhabitants' economic and social needs. For city managers, industrial or traditional activities taking place in the urban area are potential sources of revenue from taxes, rents and fees. In some countries, large cities contribute significantly to the GDP [2]. Hence, urban infrastructure planning in the fields of water, electricity or transport is a key element to sustain economic growth. According to the World Bank, infrastructure enhances investment opportunities and growth, which in turn increases productivity, bridges market gaps and facilitates trade. Households also benefit as they are supplied with basic needs necessary to guarantee quality of life, such as access to safe water and improved sanitation [3].

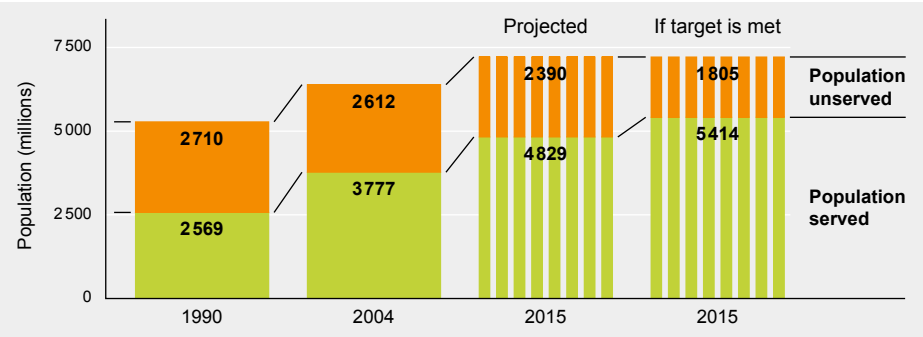
Although the Millennium Development Goals have mobilised the international community, the report published in 2006 [4] shows that half of the developing countries still lack improved sanitation and are far off track to meet the water and sanitation target aiming at reducing by half the number of people without sustainable access to safe drinking water and basic sanitation by 2015 (Fig.1).

In urban areas of developing countries, on-site sanitation systems predominate over water-borne, sewered sanitation [8]. In sub-Saharan Africa, 60–80 % of the houses in large cities and up to 100 % in secondary towns are served by on-site sanitation facilities [9]. Citywide, sewered sanitation is not a viable option although small-bore or low-cost satellite sewer systems may prove feasible in a few selected urban areas. Thus, on-site sanitation installations will serve the growing urban populations in developing countries for decades to come. Upgrading existing systems in "latrine-based cities" is an urgent priority in terms of reducing excreta-related diseases and protecting mankind and the natural environment. It is unrealistic to believe that existing on-site technologies (latrines, septic tanks, small-bore sewers) can simply be phased out given the current lack of resources to service the unserved with networked sanitation infrastructure.

A paradigm shift is needed

To date, global water and sanitation experts agree that it will need a dramatic change to meet the established target

Figure 1: World population with and without access to improved sanitation. (Source: WHO and UNICEF, 2006).



and go beyond "business as usual" [5]. In the past (Water Decade 1980–1990), inappropriate planning and a lack of users' involvement have led to dramatic failures in the massive provision of water and sanitation infrastructure [6]. For instance, many wastewater treatment works built in Africa since the 1980s have become dysfunctional after a few years of operation due to scarce financial and human resources for proper operation and maintenance [7]. When it became apparent that sewer systems were inappropriate in most urban contexts of developing countries, investments in sanitation infrastructure shifted to latrine provision programmes, but omitted to include other components of the sanitation system such as latrine emptying, excreta and faecal sludge management as well as the principles of closed loop recycling.

In its latest guidelines on safe use of wastewater, excreta and greywater [10], WHO introduced a new paradigm for dealing with sanitation in developing countries. Conventional thinking provided sanitary engineers with three (3) intervention tools (sanitation infrastructure, water infrastructure and hygiene education) used individually or in combination for interventions targeting public health improvements. The new guidelines, based on the quantitative microbial risk assessment approach (QMRA), allow to identify a series of barriers and measures to reduce or hinder contamination. Hence, countries are left to define their own health target, depending on the type of wastewater, excreta or greywater use and exposed risk. It links sanitation to agricultural productivity and business and provides, for the first time, realistic wastewater, excreta or greywater reuse alternatives. Implementation of the guidelines is supported by a number of chapters covering non-technical aspects of sanitation and health management. These include: institutional arrangements, socio-cultural aspects, capacity development, private service provision, regulation, and policy. This sanitation intervention concept constitutes a paradigm shift. Indeed, application of the WHO guidelines will require the involvement of the following key national ministries: Health, Water and Sanitation, Agriculture, Environment, Finance, Planning, Justice etc. Therefore, the current WHO guidelines encourage sanitary engineers to open their own network to others.

Ngoutane Pare MM, Cameroon, 2005

Photo 1: Demand for urban and peri-urban dairy products is increasing worldwide. Natural pasture is limited and decreasing steadily due to climate change. Forage plants and cash crops can be grown on excreta and wastewater treatment works to contribute to livestock production and urban food security.

Research opportunity: Linking sanitation to business opportunities

Sandec's research programme Excreta and Wastewater Management (EWM) is placing focus on creating an enabling framework for sustainable service provision to users of on-site sanitation facilities. Our programme develops research-based policy and technological options that contribute to sustainable strategic planning, as well as financial, economic and institutional measures. These enhance resource and nutrient reuse, equity and effectiveness in service delivery and create new business opportunities for sanitation entrepreneurs.

To link treatment units with urban economic development agendas, our research on macrophyte-based excreta and wastewater treatment systems will centre on cultivating plants for use as forage crops to support urban and peri-urban dairy systems (Photo 1). The research and investigation will focus on maximising the nutritive value of forage grown on treatment units, nitrogen uptake efficiency and on minimising health risks for humans and animals. Use of downstream excreta and wastewater irrigation as polishing or final treatment step will be tested on non-water-based forage crops (legumes, grass). The expected income derived from the sale of forage is likely to contribute to maintaining treatment works operational and to cover maintenance costs. Such infrastructure has a far greater urban economic development potential.

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Establishing a SODIS Reference Centre at Eawag

Sandec will continue to strengthen SODIS as an internationally recognised drinking water treatment method for household application. One of the key strategies will be to establish Regional Reference Centres in Latin America, Asia and Africa. Regula Meierhofer, Martin Wegelin

Research on Solar Water Disinfection was initiated at Eawag in 1991 to evaluate the efficiency of the method in the laboratory and in the field in different regions of developing countries. Pilot projects were formulated to assess user's handling and acceptance. In collaboration with local institutions, Sandec has been supporting global dissemination of SODIS for more than six years. Promotion and training projects successfully introduced the method in over 20 countries. Currently, more than two million people use SODIS to treat their drinking water. Multilateral development organisations, private foundations, international and local NGOs as well as government institutions show increased interest in SODIS.

Sandec's project evaluations and health impact assessments, conducted in collaboration with the Swiss Tropical Institute and Instituto Nacional de Salud Pública, Mexico, revealed that diarrhoea rates among users were reduced by 40–50 %. Research on best SODIS dissemination strategies is ongoing at Eawag's Department of System Analysis, Integrated Assessment and Modelling (Siam). Eawag's Department of Environmental Microbiology (Umik) is currently investigating inactivation mechanisms at cellular level through SODIS.

While SODIS is quite well established in different countries, its dissemination process has just begun in many others. Additional inputs are necessary to establish SODIS as a recognised drinking water treatment method at household level. In October 2006, Eawag's Directorate therefore decided to create a SODIS Reference Centre at Eawag with the aim to pursue the SODIS promotion and dissemination process until 2010 (Fig. 1).

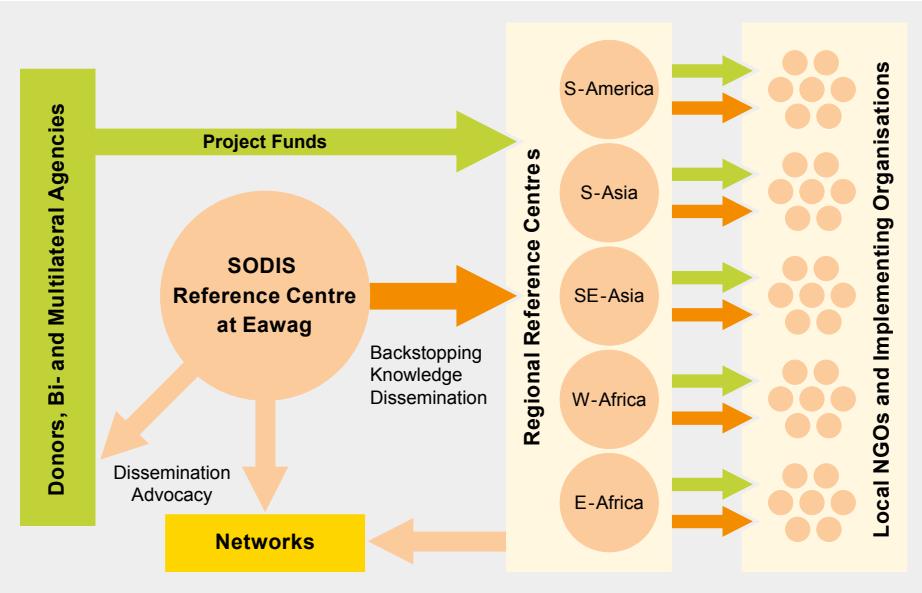
Key strategy of the SODIS Reference Centre at Eawag is to establish in Latin America, Asia and Africa Regional Reference Centres capable of acting as self-sustained knowledge and reference centres for "Household Water Treatment and Safe Storage" as well as Hygiene. Until these centres are fully established, the SODIS Reference Centre, hosted by Eawag/Sandec, will be responsible for:

- Maintaining and ensuring continuity in the transfer of knowledge and provision of assistance to SODIS projects worldwide. This includes collection of information on SODIS projects and research worldwide, as well as documentation on SODIS know-how and knowledge sharing initiatives (e. g. disseminating scientific information or best SODIS implementation practices).
- Providing technical advice (backstopping) on promoting and disseminating the SODIS method to local partners in Asia, Latin America and Africa, and participating in fund-raising activities. Yet, the long-term objective is to strengthen direct collaboration and contact between donors and Regional Reference Centres.
- Maintaining close ties to international networks (e. g. the Household Water Treatment and Safe Storage (HWTS) Network, established by WHO http://www.who.int/household_water), as well as to bi- and multilateral development agencies, and assuming a proactive role in advocacy at international level. SODIS RC at Eawag will support participation and involvement of the SODIS Regional Reference Centres (RRC) in international water treatment and hygiene networks.

Sandec

SODIS contributes markedly to reducing diarrhoea incidence in the Kisoro region of Uganda..

Figure 1: Role and functions of the SODIS Reference Centre at Eawag.



Analysis of SODIS Promotion Strategies in Bolivia

Every innovation requires promotion activities to get disseminated, even in the case of SODIS, this simple and efficient Solar Water Disinfection method. Social science research is necessary to develop the most effective and locally adapted strategies. Hans-Joachim Mosler

How do you promote SODIS? What are the strategies used so far? How do "consumers" of target populations perceive and assess these promotion strategies and by what criteria? A socio-scientific study provides some key answers on SODIS promotion strategies in Bolivia [1].

Solar water disinfection is a simple and efficient method to obtain microbiologically clean drinking water: plastic bottles are filled with water and exposed to the sun for six hours (or two days in cloudy weather). Despite its simplicity, the method is not necessarily self-promoting. To promote its widespread distribution, dissemination strategies have to be developed. What are the criteria for the most effective dissemination strategies? To determine the most appropriate dissemination policy, 644 households in eight study areas in Bolivia were interviewed on the promotion efforts undertaken so far. The strategies were also rated according to different criteria listed in Table 1.

The results reveal that the "health fair" – an event held on a central square with exhibit stalls addressing different health topics – ranks first among all promotion strategies. The main advantages of a stall at a fair are the pleasant atmosphere with a pro-SODIS majority and the possibility to discuss and debate with the promoters on various aspects. Persuasiveness of the arguments and like-minded participants were also rated above average. Use of this SODIS dissemination strategy also presents a drawback since health fairs are not frequently held.

Promotion of SODIS by skilled staff of local authorities ranked second among the strategies. It achieved a high ranking, especially as regards similarity with those interviewed, thereby allowing a high level of identification. Argumentation quality and quantity as well as friendliness also ranked above average. Promotion by staff of local NGOs received a similar ranking (3rd place), with the only drawback that their intervention is less frequent than that of local authorities. Dissemination activities in schools and by local residents acting as promoters, were also rated quite positively, however, they reveal the same weakness of limited frequency. Furthermore, dissemination by local promoters was characterised by a rather formal atmosphere. Use of TV, women's groups, staff of the national SODIS organisation and mother centres as promoting tools take up middle position. Though viewers are well reached by TV programmes with a sufficient number of arguments, they clearly do not offer the target audience the possibility to debate on the subject nor provide a relaxed and friendly atmosphere. The groups in mid position unfortunately score only in certain areas.

Hans-Joachim Mosler

SODIS users in Oruro, Bolivia.

The radio and, surprisingly, also community meetings were awarded last position. They obtained the worst ranking (– –) in all criteria, except for frequency. In the case of the radio, the results thus show that the programmes must be entirely revised and updated. As regards community meetings, the unsatisfactory achievement can be mainly attributed to the low priority given to SODIS activities during the meetings compared to other topics.

This analysis provides an overview of the strengths and weaknesses of different SODIS promotion strategies and clearly reveals where improvement is required. Given the limited funds and human resources for promotion and dissemination, the knowledge thus gained allows to streamline activities and focus on the most efficient and effective strategies to adopt.

Key: ++ best, + above average, – below average, – – worst rating in the category of the respective criterion; empty fields reveal inapplicability of the criterion for a particular strategy.

	Argument quality	Argument quantity	Atmosphere	Friendliness	Similarity	Pro-SODIS majority	Participation frequency	
Health fair	+	+ +	+ +	+	+	+ +	– –	1
Local authorities	+	+	+	+	+ +		+	2
NGO staff	+ +	+	+	+ +	+		–	3
Schools	+	+	+	+	+	+	–	4
Local promoters	+	+	–	+	+		–	5
TV	–	+	–	–	+		+ +	6
Women's group	–	–	–	–	–	+	+	7
Staff of national SODIS organisation	+	+	–	+	–		–	8
Mother centres	–	–	+	–	+	+	–	9
Radio	– –	– –	– –	– –	– –		+	10
Community meeting	–	–	–	–	–	– –	–	11
	1	2	3	4	5	6	7	Rank

[1] Moser, S., Heri, S., Mosler, H.J. (2005): Determinants of the diffusion of SODIS. A quantitative field study in Bolivia. Summary Report. Eawag, Dübendorf, http://www.sodis.ch/Text2002/T-Papers.htm

Health Impact of SODIS and Hand Washing Promotion in Latin America

Does SODIS application actually reduce diarrhoea rates among its users? Since health impact studies of SODIS and hand washing promotion campaigns on waterborne diseases among children under the age of five are scarce, this article presents some results of an investigation conducted in Ecuador and Nicaragua. Enrique Cifuentes[1], Martin Wegelin[2], Matthias Saladin[3]

A health study was conducted in Ecuador and Nicaragua to measure the impact of SODIS and hand washing promotion campaigns on waterborne diseases among children under the age of five. Communities were randomly assigned to one of the three intervention groups, each with at least 120 children: In one group, a Solar Water Disinfection (SODIS) promotion campaign was carried out, in the second group, a hand washing promotion campaign and in the third group, a combined promotion campaign of SODIS and hand washing. During the 52-week follow-up phase, diarrhoea rates of the target children were registered bi-weekly, and at least four stool samples were taken from each target child along with water samples from the target households.

Results from Ecuador and Nicaragua clearly reveal a sustained effect of both the SODIS and hand washing promotion campaigns on diarrhoea rates among the target children, and a stronger effect of the combined campaign compared to the two isolated interventions.

SODIS simple but also effective

The SODIS method has been widely investigated and published also by Eawag [1]. This simple method, requiring only plastic bottles and sunlight, is capable of inactivating a wide range of pathogens, from viruses to bacteria and protozoa. However, as the link between drinking water quality and health status is not always directly apparent, it is also important to prove that SODIS application actually reduces diarrhoea rates (and other waterborne diseases) among its users. To date, only a few studies have been conducted in this field, and none in Latin America. Therefore, a study of the impact of SODIS and hand washing promotion campaigns on waterborne diseases among children under the age of five was realised in Ecuador, Nicaragua and Guatemala (Photo 1).

Planning the survey

After completing the initial study phase in 2005, communities were randomly assigned to one of the three intervention groups:

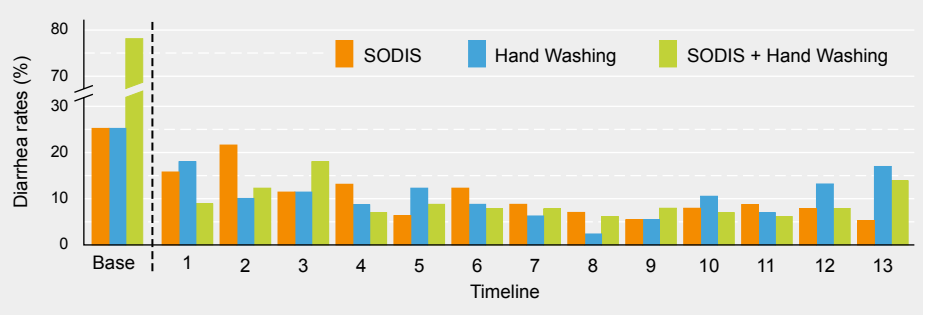
- SODIS promotion
- Hand washing promotion
- SODIS + hand washing promotion

For ethical reasons, control groups were not considered. In each country, at least 360 children formed part of the study (120 per intervention group). The assessment surveys were coordinated by the National Institute of Pubic Health in Mexico, while the interventions were guided by the SODIS Foundation in Bolivia. In each country, two independent institutions were involved, one for investigating the health impact and the other for conducting the promotion campaign. The institutions in charge of promoting the different methods (SODIS and hand washing) used local health promoters. In each intervention group, a promotion campaign was launched through group meetings and household visits. During the follow-up phase (52 weeks), the persons in charge of the children involved in the study were interviewed every two weeks and diarrhoea episodes registered for every child. At least four times a year (twice in the dry season and twice in the wet season), water samples were taken from storage vessels of the target households and stool samples from the children. Unfortunately the study in Guatemala had to be abandoned in October 2005 after hurricane Stan had devastated the project area and many families had moved away.

Lessons learned

The data from Ecuador reveals very high levels of diarrhoea (between 25 % and 77 %) among children under five at the beginning of the study. These rates dropped drastically within the first two weeks of intervention and continued to

Figure 1: Bi-weekly diarrhoea rates (% of studied children with diarrhoea within the last two weeks) among children under the age of five in the three study groups in Manabi, Ecuador, August 2005 to February 2006. The first group of three bars on the left of the figure shows the data of the baseline study (before the interventions started), the other bars correspond to the follow-up data samples.



[1] Chief Investigator, Instituto Nacional de Salud Pública, Mexico
[2] Eawag/Sandec
[3] Eawag/Sandec/Fundación SODIS
The current investigation was made possible by a donation of the **VELUX Foundation**. Sandec would also like to thank the following collaborating institutions: **INSP México, INHMT Ecuador, PLAN Ecuador, CIES Nicaragua, Red Cross Nicaragua, CRS Guatemala, ERIS Guatemala, and the SODIS Foundation in Bolivia**.
Contact: msaladin@fundacionsodis.org

decline within the following five months, after which a slight increase was measured (Fig. 1). This general trend indicates a clear health improvement attributed to the three interventions as well as a lowering compliance rate towards the end of the study. Children from the SODIS group experienced the expected and quite significant reduction in prevalence of diarrhoea from 25 % to 5.3 %. The children from the hand-washing group only revealed an 8.3 % reduction in diarrhoea throughout the study – a far lower rate than reported in other studies (up to 47 %) [2]. This result is likely to be attributed to a low compliance towards hand washing, commonly encountered in community hygiene interventions. The combined group (SODIS + hand washing promotion) revealed a 64 % reduction in diarrhoea from the initial study phase till the end of the intervention phase. Assuming a combined effect of the two promoted measures, this decline lies within the expected range (62–65 % reduction) [3].

Initial levels of intestinal infection by *Giardia lamblia* of the target children were extremely high (50–70 %) but declined steadily during the study in all three intervention groups. The communities, where SODIS was introduced together with a hand washing campaign, revealed the highest diarrhoea rates at the onset of the study and a significant health improvement (nearly 25 % reduction in infection rate) in the course of the intervention. This supports the assumption that combined interventions targeting water quality as well as hygiene behaviour are more effective when combined. The reduction of infection rates in the hand-washing group was substantial but smaller than in the combined group – a factor likely to reflect low compliance levels in hand washing promotion activities among children under five who are mainly dependent on their mothers or other persons in charge of personal hygiene.

The study also showed that water quality improved significantly in all study groups within the first few months of the intervention. Thereafter, it remained constant or deteriorated slightly (data not shown). The number of water samples contaminated with faecal coliforms was reduced by 60 % in the SODIS group, by 17 % in the hand washing group and by 64 % in the SODIS + hand washing group, thereby revealing a strong impact caused by SODIS and to a lesser degree by hygiene measures. The increase towards the end of the intervention may be attributed to a drop in compliance towards the promoted methods.

Fundación SODIS

Photo 1: A young woman from Guatemala is exposing SODIS bottles to the sun.

In Nicaragua, the children from all three intervention groups experienced a strong reduction in enteric disease episodes throughout the study. Reduction in diarrhoea rates was most significant among the SODIS + hand-washing group, however, it was of the same order as in the other two study groups. The combined group (SODIS + hand washing) also indicates a reduced risk of infection by *Giardia lamblia* compared to the other two groups.

Conclusions

Data from diarrhoea observations as well as from stool and water analyses in Ecuador indicates that combined SODIS and hand washing activities significantly increase the effect of the intervention compared to individual SODIS or hand washing campaigns. The same conclusions can be drawn from the investigations in Nicaragua, even though the patterns are not as clear and consistent as in the study in Ecuador.

Though not concurrent with other published evidence [4], the main results of the studies clearly indicate the positive effect of combined health interventions. Further investigations are necessary to improve our understanding of the effect of promotion campaigns on behaviour and health status of target groups. Future studies are recommended to focus on applied field research and to take advantage of planned interventions, such as the SODIS programme in Latin America.

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[2] Curtis, V and Cairncross, S. (2003): Effect of washing hands with soap on diarrhoea risk in the community: a systematic review. The Lancet infectious diseases, 3, 275–281.

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Cash Flow in Solid Waste Management

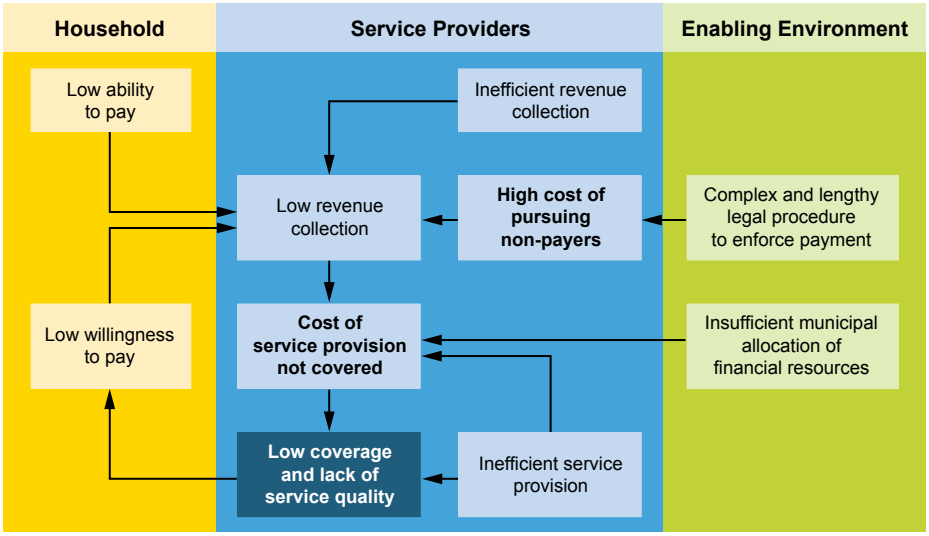
Operational costs to assure daily solid waste service provision and maintenance of equipment are substantial and may range from 20–50 % of the total municipal expenditure. Service levels can be sustained by improving the services and cash flow efficiency. Willingness to pay rises with the provision of better services, thereby contributing to enhance cost recovery. Experience recommends decentralised financial authorities at local government level. Chris Zurbrügg, Birgit Becker, Yvonne Vögeli

Inadequate solid waste management leads to negative environmental impact as well as health and safety problems. Pollution of air, soil and water by indiscriminate waste burning and dumping, as well as the spread of diseases by insects and rodents attracted by garbage heaps, threaten the health and wellbeing of all citizens. Municipal authorities, responsible for the provision of municipal solid waste management services, find it increasingly difficult to fulfil their mandate, which several municipal officers attribute to inadequate funds. A lack of budget may be partly an obstacle for some municipalities, however, the manner in which these funds are spent often have a more significant influence on service quality. Many cities in developing countries spend 20–50 % of their municipal budgets on street sweeping and waste collection, and allot scarcely any funds to waste treatment or disposal. Despite these high expenditures, collection coverage remains low. Often less than 60 % of the generated waste is collected, and the poor areas of difficult access and low political priority are generally underserved. Cost efficiency is often not an objective pursued by the municipal authorities. This is especially true when politicians allocate budgets to the solid waste department. By proving that little can be achieved with the funds available may actually solicit more money from the central government. Introducing user charges is seen as an option to improve cash flow and to enhance accountability for service performance. However, unsatisfactory service provision or even a lack of trust in service quality directly affects residents' willingness to pay and again threatens cash flow. Furthermore, inefficient or ineffective revenue collection systems may also hinder appropriate cash flow and cost recovery (Fig 1).

Solid waste management - A merit good

Solid waste management is a commodity, i. e. a service benefiting the individual household with a positive impact on public health and the environment. Service contributing to private and public benefits has inherent characteristics of a private and public good. Waste collection at household level (door-to-door or curbside collection) provides a certain degree of convenience to the resident and lies in the interest of the household. Non-payers can be excluded from such a service if alternatives are available (such as provision of a collection point). Thus, primary collection has inherent characteristics of a private commodity. However, it is of public interest that residents make use of some form of waste collection service, since littering and indiscriminate dumping endanger the health and environment of all concerned. No one should be excluded from such services, as everyone benefits from the various individual activities of appropriate waste management. In contrast to individual waste collection, public cleanliness and sanitary waste management, to protect the environmental resources (water, soil and air), are thus a public commodity. Solid waste services can thus also be considered and defined as a merit, valuable and under-consumed commodity (or service) if ruled by market mechanisms. In economic terms, the positive externalities of the asset are not internalised by consumers. Aside from solid waste management, typical examples of merit goods are health services, education or public libraries. Households are often only willing to pay for solid waste services from which they can draw individual benefits, such as primary collection. However, they seldom consider the benefits to public wellbeing, like secondary transport, treatment or sanitary landfilling. The attitude "out of sight, out of mind" by residents and authorities severely hinder the meeting of solid waste management objectives to provide a hygienic environment for all to lead a healthy and productive life and protect and improve the natural environment.

Figure 1: Various factors involving different stakeholders may affect cash flow of solid waste management systems [1].



Cost recovery and willingness to pay

Only few cities attempt to achieve full cost recovery of all waste management processes. The principle of cost recovery aims at raising the necessary financial funds to cover all investments and recurring costs of solid waste provision. Capital costs for investments are generally ob-

tained through national or international loans or grants. However, the choice of technologies influences the recurring costs, for which no municipal loans or grants are usually available. Revenues in solid waste management are most often obtained through taxes (e.g. property tax). Access to tax money – if not specifically earmarked for solid waste management – is subject to continuous negotiation with the municipality and, thus, not an assured source of income. Besides, substantial tax recovery is not an easy task given the inadequate property cadastre systems in rapidly urbanising cities with their large and continuously expanding informal settlements, which are unaccounted for and not recognised by local officials. Service provision to such areas is only possible if cash flow can be guaranteed by other means than taxes, for instance by user charges. Introducing user charges is, however, not easy either, though surveys have shown that residents are willing to pay for services if they see improvements and if the tariff is affordable. Difficulties arise when residents historically perceive waste management as a free basic service which "must" be provided by the municipality. Revenue collection rates are often also low where municipalities have implemented service charges. Municipal staff remunerated by a centrally managed budget often shows little incentive to deploy the necessary tenacity in collecting the service charges. In a franchising or open competitive system using private sector or community-based participation, service providers collect their revenues directly from the residents. They are accountable to them and rely on these service charges to cover their costs. This model can enhance motivation to provide quality service and establish efficient revenue collection. Nevertheless, an efficient enforcement system to penalise non-payers is also necessary as service is non-excluding (to guarantee public interest in hygiene and avoid environmental degradation).

		Low-income country	Middle-income country	High-income country
Average waste generation	(t/capita, year)	0.2	0.3	0.6
Average income from GNP	($/capita, year)	370	2400	22000
Collection cost	($/t)	10 - 30	30 - 70	70 - 120
Transfer cost	($/t)	3 - 8	5 - 15	15 - 20
Sanitary landfill cost	($/t)	3 - 10	8 - 15	15 - 50
Total cost	($/t)	16 - 48	43 - 100	105 - 190
Total cost per capita	($/capita, year)	3 - 10	12 - 30	60 - 114
Cost as % of income	**(%)**	**0.7 - 2.6**	**0.5 - 1.3**	**0.2 - 0.5**

Table 1: Cost of municipal solid waste processes (S. Cointreau, cited in [2]).

Photo 1: The choice of technology affects recurring costs. A new collection fleet in Kathmandu.

Sandec

Breakdown of costs by process cost accounting

What are the feasible cost recovery models and tariffs required? These and other strategic decisions call for a transparent and well-structured cost analysis of the existing situation. They are essential when benchmarking service components and planning recycling, collection, transport or treatment. However, specific cost data (based on process steps in the waste management stream) is still scarce.

Sandec's solid waste management group has conducted studies on economic valuation of strategic alternatives in organic waste management and has developed a new approach combining the methods of material flow analysis and cost accounting. The approach provides information on waste flows, process costs and overall cost type structures of current and future SWM systems. Due to the growing trend towards user charges, tariff setting has become a key issue for municipalities to tackle. Commonly, provision of solid waste services for the poor costs more than for the rich, as costs are dependent on waste quantities in containers (little waste in many containers are more costly to collect) and on access possibilities by cost-effective vehicles. To avoid such effects, special attention must be given to financial issues to sustain equitable service provision and avoid financial burden for the poor. Municipalities may develop a cross-subsidising tariff model, where the more affluent pay more than the poor. Such tariff models might use the size of property and type of habitat as a proxy-indicator or link the waste service tariff to the water or electricity consumption (as the wealthier tend to consume more of this utility).

Outlook

With increasing private sector participation in service delivery, the importance of establishing equitable tariff models is greater than ever. Experience with community-based organisation of primary collection in Pakistan has shown that decentralised approaches foster participatory processes, and social cohesion may allow tariff setting by taking into account the financial hardship of residents (e.g. widows) and exempting them from waste service charges.

Public authorities can choose to outsource the service to private providers, but positive externalities from service provision justify public interventions to guarantee all households access to adequate service with equitable tariffs and policy goals to be defined. Knowledge of municipal solid waste costs allows authorities to make informed decisions about programmes as well as service improvements and future planning. Sandec is pursuing research opportunities on appropriate and equitable financing mechanisms for recurring cost recovery and methods of full cost accounting, tariff setting and benchmarking efficiency.

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Using Bacteria to Quantify Arsenic Contamination in Potable Water

Daily measurements of drinking water quality generally rely on advanced chemical methods. This is no trivial matter for arsenic, a toxic heavy metal contaminating potable water in millions of family-based groundwater wells in Asia. Michael Berg[1], Pham Thi Kim Trang[2], Jan Roelof van der Meer[3]

Expensive instrumental methods, such as atomic absorption spectroscopy (AAS) or inductively coupled plasma-mass spectrometry (ICP-MS), are necessary to measure arsenic accurately. Such equipment is mainly absent in low-income regions. Though chemical field test kits can be used as an alternative, they are often unreliable at low arsenic concentrations. Accurate quantification of arsenic even at low concentrations is important to avoid chronic and toxic exposure and to meet the current WHO guideline for arsenic in drinking water (10 µg/L). Trang et al. [1] have recently reported on the successful validation of a completely different analytical method based on light emission from engineered bacterial cells (Fig. 1).

From the laboratory …

How can bacterial cells detect arsenic and emit light? In order to do so, Stocker et al. [2] equipped Escherichia coli bacteria with the ArsR protein, a naturally occurring arsenite sensing protein in the bacterial arsenic detoxification system. By genetic engineering techniques they then created a circuit in which ArsR controls expression of a reporter protein, such as the enzyme luciferase. As soon as the cells encounter arsenite, luciferase is synthesised and the cells start to emit light, which can be easily measured. Within a certain range, the light emission is proportional to the arsenite exposure (Photo 1).

… to the field

A set of simple bioassays was designed on this principle, thereby allowing accurate detection of arsenic in aqueous samples of very different chemical composition within 30 min to 2 h. To validate the bioassay performance in determining arsenic in real groundwaters, we recently applied the light-emitting biosensors to a region in Vietnam where Berg et al. [3] had reported serious arsenic contamination. A total of 194 groundwater samples from the Red River and Mekong River Delta were analysed both by AAS and the arsenic bioassay method. Compared to AAS, the bacterial assays falsely predicted in 8 % of the samples less than 10 µg of arsenic per litre and more in 2.4 % of all cases. Since this is a far better performance compared to that of chemical field test kits, the bioassay method has a great potential for use in drinking water analysis in developing countries (Photo 2).

Jan R. van der Meer

Photo 1: Colourimetric arsenic bioassay. Cells produce beta-galactosidase in response to the presence of arsenite in the medium. Image shows different cell lines (in rows) with varying response kinetics. Arsenite concentrations (left to right): 0, 0.1, 0.2, 0.5, 1.0 and 2.0 µM. Incubation time: 3 h at 35 °C.

Jan R. van der Meer

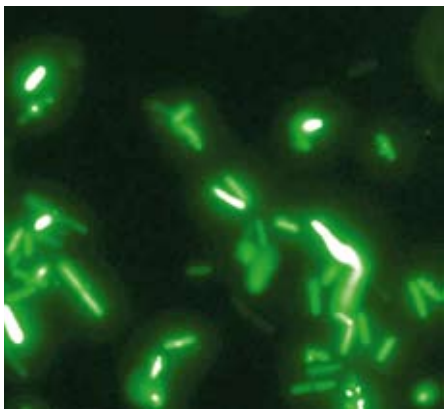
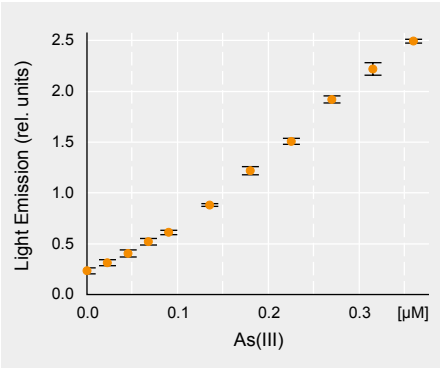


Photo 2: Escherichia coli bacteria producing the green fluorescent protein (GFP) in response to the presence of arsenite in the medium. The GFP signal can be quantified by epifluorescence microscopy, but more easily in steady state fluorimetry. Incubation time: 2.5 h at 30 °C with 0.5 µM As(III).

Figure 1: Calibration curve with the bioluminescent arsenic biosensor. Incubation time: 1.5 h at 30 °C. Measurement: Luminometer plate reader.



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[2] Centre for Environmental Technology and Sustainable Development (CETASD), Hanoi University of Science, Vietnam.
[3] University of Lausanne, Department of Fundamental Microbiology, Bâtiment de Biologie, 1015 Lausanne, Switzerland.

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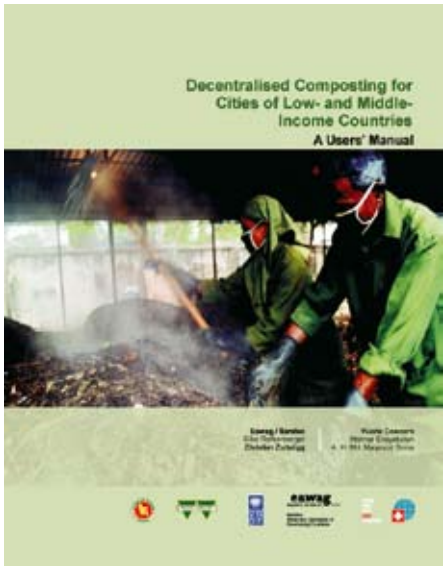
New Publications on Composting and Compost Marketing

Decentralised composting turns professional

Sandec has been conducting research on decentralised organic waste treatment for the last seven years and it is time to wrap up all this experience and knowledge. This User's Manual leads step-by-step through planning and implementation of a decentralised composting site.

The manual is the product of more than six years partnership between the Bangladesh-based NGO Waste Concern and Sandec. It combines the hands-on experience of Waste Concern in initiating and running decentralised composting sites in Bangladesh and Sandec's conceptional knowledge and practical experience with compositing in developing countries. Both partners agree that decentralised composting can significantly contribute to improving integrated solid waste management in cities if planned carefully with all the relevant stakeholders.

This book provides systematic assistance in setting up decentralised composting schemes. It addresses prevailing challenges posed by decentralised composting projects and recommends measures to avoid problems through improved strategic planning, organisational, institutional and operational procedures. It mainly centres on neighbourhood-based systems, thus covering not only composting plants with daily capacities of up to five tonnes, but also offering information on primary waste collection systems. Several case studies and exercises assist in transferring the concept to the prevailing individual situation. The Annex provides various useful sheets with technical drawings, monitoring forms, draft contracts or quality standards. The handbook addresses individuals, community-based organisations, NGOs, municipal authorities as well as staff of donor organisations, and facilitates the dissemination of decentralised composting schemes worldwide.



The composting publication can be downloaded from http://www.sandec.ch

Decentralised Composting in Low and Middle-Income Countries – A User's Manual
by Silke Rothenberger, Chris Zurbrügg, Iftekhar Enayetullah, and A.H.Md. Maqsood Sinha

Available online www.sandec.ch
or order free copy from info@eawag.ch
ISBN 978-3-906484-36-5

Customer Satisfaction is Key to Successful Composting

The latest Sandec publication on composting introduces the principles of marketing compost in low and middle-income countries. There is no magic solution to compost marketing; yet applying marketing principles may increase the chances of success.

Experience reveals that many composting schemes – both large and small – face marketing problems, as they neglect market assessment and appropriate sales strategies during initial project setup. Composting can be viewed in two ways:

- The solid waste management approach: Composting is a way of treating organic waste within the solid waste management system.
- The marketing approach: Composting is a way of producing a valuable and marketable product.

Applying the marketing approach not only meets the objectives of the solid waste management approach, but also focuses on producing a high-quality marketable product. In other words, it is driven more by customer demand than material supply.

This handbook provides information and guidance on improving your composting business through use of marketing techniques. It introduces both the basic and key principles as well as composting techniques. These include understanding the 'marketing environment', identifying appropriate target customer groups, product development and pricing, as well as developing and promoting products to suit the market. This handbook is relevant for private entrepreneurs, investors, staff of development agencies and municipal authorities wanting to use composting as a sustainable waste management option. This guide is an important supplement to the manual on decentralised composting, where marketing is just one side aspect of successful composting. The composting principles are currently tested in Nepal and Palestine to ensure their applicability. The handbook will be available online or as hardcopy in October 2007.

Marketing Compost - A Guide for Compost Producers in Low and Middle-Income Countries
by Jonathan Rouse, Silke Rothenberger and Chris Zurbrügg

Available online www.sandec.ch
or order free copy from info@eawag.ch

Sandec

New publication on Greywater Management in Low and Middle-Income Countries

This Sandec report compiles international experience in greywater management on household and neighbourhood level in low and middle-income countries. Though greywater is generally less polluted than other wastewater sources, its contribution to the total pollution load originating from households is significant (40–50 % of the total organic load, 25 % of the total suspended solids load and 50–60 % of the total phosphorous load). Greywater treatment is thus essential to avoid detrimental impacts on the environment and health. The report is not a plea for standalone greywater management systems for all situations and at all costs, but aims at providing a comprehensive description of the main components for successful greywater management. Recommendations are formulated for control measures at the source, design of primary and secondary treatment systems as well as for safe reuse and disposal of treated greywater. The documented systems – varying significantly in terms of complexity, performance and costs – range from simple systems for single-house applications (e. g. local infiltration or garden irrigation) to rather complex treatment trains for neighbourhoods (e. g. series of vertical and horizontal-flow planted soil filters).

Greywater recycling has a great potential to enhance recovery and reuse of nutrients and water. However, suitable measures to minimise its negative impact on health and the environment should be investigated. One Sandec project was launched in Thailand to develop concepts and technologies for improved greywater management. Different interventions to maximise resource recovery and reduce health and environmental risks will be investigated.

Feedback and suggestions are most welcome:
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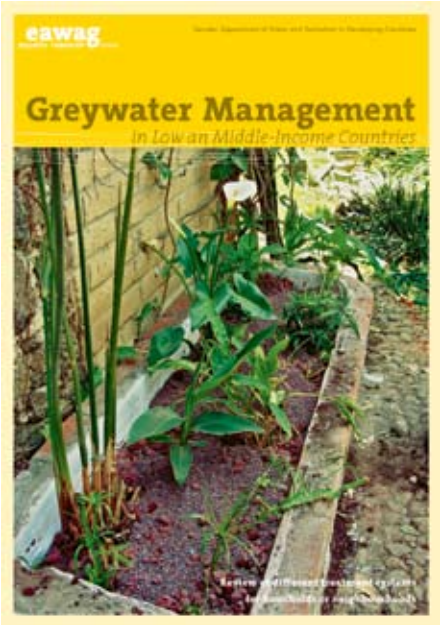

The Greywater Management handbook for Low and Middle-Income Countries is downloadable from http://www.sandec.ch

Sandec Moves into a New Building with NoMix Toilets

In the summer of 2006, Sandec moved into Forum Chriesbach, Eawag's new headquarters. The building complies with strict sustainability requirements: (i) all resources (energy, water, material, land, and finances) are handled sparingly, (ii) energy requirements for the operation of the building are minimised and covered as much as possible by renewable sources and (iii) urine separation and rainwater use form an integral part of the water management system.

In Switzerland, about one third of the total energy demand is consumed in the "living and working" environment, which shows how important it is to create energy-efficient buildings. By applying an innovative architectural and technical concept, it was possible to achieve a "Zero Energy House", i. e. minimal use of heating and cooling energy. The building requires basically no conventional heating. With a 45-centimetre-thick outer wall and high-quality windows, it is so well insulated that heat losses are minimal. All sources of heat inside the house (e. g. computers, lighting, employees' body heat) are utilised. In winter, incoming air is preheated in underground pipes and warmed further in a heat exchanger, using heat from exhaust air and server room. Additional heat can be supplied by the hot water storage system, which is heated by solar collectors on the roof of the building and by exhaust heat from refrigeration units in the kitchen. In summer, the entire building is cooled overnight through automatically opened office windows and skylights in the roof. Heat escapes via the atrium as if through a chimney and cool night air enters the offices. In addition, silkscreen-printed glass fins along each facade are adjusted according to the position of the sun: in winter, the amount of sunlight reaching the building is maximised and in summer, exposure to the sun's rays is minimised to prevent the interior from heating up. Even during the hot July of 2006, when the outdoor temperature reached 36 °C, the ambient temperature inside Forum Chriesbach remained below 26 °C without energy-intensive air-conditioning.

Particular importance is attached to the management of water and wastewater. Roof water is stored in an external reservoir and used for toilet flushing. The entire building is equipped with waterless urinals and NoMix toilets, which collect the urine separately from other wastewater. Eawag is focusing some of its research on the potential and limitations of integrating separate collection and treatment of urine in urban water management systems. Removing urine from sewage streams significantly reduces the urine load in wastewater treatment plants and facilitates treatment. A further advantage is the fact that urine contains valuable nutrients with a high fertilising potential. Eawag uses Forum Chriesbach as a research project to optimise urine-handling technologies for widespread use. To study the differences in urine composition, men's and women's urine is collected separately. Eawag's research on the NoMix technology can be downloaded from www.novaquatis.ch

New Faces

Valérie Cavin, agronomist, was appointed SODIS Project Officer at Sandec in April 2007. She will be mainly responsible for developing further SODIS projects in West Africa and will act as liaison between the SODIS team and all French-speaking SODIS partners.

Dr Mbaye Mbéguéré, Senegalese citizen, was appointed Project Officer for Faecal Sludge Management in December 2006. He is stationed in Dakar, where he is coordinating and pushing forward the collaborative programme between the Senegalese Sanitation Utility (ONAS) and Eawag/Sandec. With ten years experience in sanitation as consultant, researcher and lecturer in Senegal and Mauritania, he will be working together with a team of researchers towards developing faecal sludge treatment technologies. His tasks will also comprise teaching, training and education to reinforce capacities in African sanitation utilities.

Yvonne Vögeli, geographer, joined Sandec in January 2007. After working for several years at the Swiss Federal Office for the Environment in the field of waste management, her activities at Sandec will centre on organic waste management strategies in low and middle-income countries, with special focus on anaerobic digestion of organic household waste and financial mechanisms related to waste management.

Pierre-Henri Dodane, French Civil Engineer, was appointed Project Officer on low-cost options for excreta and wastewater treatment in developing countries at Sandec in March 2007. He will be mainly working together with a team of five specialists on developing O&M and design criteria for treatment technologies to enhance resource and nutrient reuse in Africa and Asia.

Elizabeth Tilley, Canadian citizen, completed her Masters in Environmental Engineering in Canada before coming to Eawag as a research intern in the Engineering Department working on nutrient recovery from urine. She began her work at Sandec in April 2007 as a sanitation specialist in the Strategic Environmental Sanitation Planning group. Her activities will focus on further developing the Household-Centred Environmental Sanitation (HCES) planning approach by providing sanitation expertise to the collaborating partners in Africa, Asia and Latin America. She will continue developing the HCES Compendium for use as an overview and selection tool for Urban Environmental Sanitation Services. Additionally, she will assist in coordinating the NCCR North-South research projects conducted at Eawag.

The Sandec Team

Sandec

The Sandec team from left to right: Back:
Caterina Dalla Torre, Mbaye Mbéguéré,
Kim Müller, Regula Meierhofer, Dionys Forster,
Agnès Montangero, Antoine Morel, Stefan Diener,
Roland Schertenleib, Chris Zurbrügg,
Doulaye Koné, Christoph Lüthi
Front: Yvonne Vögeli, Pierre-Henri Dodane,
Martin Wegelin, Marc Authenried, Prem Gurung
Missing on photo: Sylvie Peter, Karin Güdel,
Daya Moser, Christian Müller, Monika Schaffner,
Elizabeth Tilley, Lukas Vonwiller, Valérie Cavin

On the Bookshelf

Apart from the publications cited in the previous articles, we recommend the following new books and key readings in the water and sanitation, solid waste management and urban agriculture sectors.

Water and Sanitation

Creating Space for Innovation: Understanding Enablers for Multi-Sector Partnerships in the Water and Sanitation Sector
Through this guidance piece, Building Partnerships for Development in Water and Sanitation (BPD) seeks to advise practitioners on the likely external obstacles that can block partnership progress. Anticipating these policy, procurement, legal or other obstacles will assist the partners in designing refined strategies for a more effective partnership arrangement.
This research has resulted in a 4-page practitioner note and a 32-page full report. The full report includes a discussion of common "enablers and disablers" for multi-sector partnerships; including issues around organisational cohesion, relationships between partners and the scope of the partnership. There is also a dialogue tool for practitioners and partnership brokers to explore strategies for overcoming disabling factors within multi-sector partnerships.
By Newborne P. and Caplan K., June 2006, ISBN 0-9551073-1-8. Available from http://www.bpdws.org/

Shadow Cities – A Billion Squatters, A New Urban World
This 335-page book, written in a deft, accessible style by an investigative reporter, gives a deeply humanistic accounting of his lived experience of squatters and their struggles on four continents. It describes today's transnational cities and their squatters who are at the forefront of the worldwide movement to develop new visions of what constitutes property and community.
By Neuwirth R., ISBN 0-415-93319-6 (hardback edition 2005) or ISBN 0-415-95361-8 (paperback edition 2006). Available from http://www.taylorandfrancis.com

WHO Guidelines for the Safe Use of Wastewater, Excreta and Greywater
Volume I: Policy and Regulatory Aspects
Volume 1 of the Guidelines presents policy issues and regulatory measures distilled from the technical detail found in volumes 2, 3 and 4. Those faced with the need to expedite the development of policies, procedures and regulatory frameworks, at national and local government levels, will find the essential information in this volume. It also includes summaries of the other volumes in the series.
Volume II: Wastewater Use in Agriculture
Volume 2 of the Guidelines explains requirements to promote safe use concepts and practices, including health-based targets and minimum procedures. It also covers a substantive revision of approaches to ensuring the microbial safety of wastewater used in agriculture. It introduces health impact assessment of new wastewater projects.
Volume III: Wastewater and Excreta in Aquaculture
This volume informs readers on the assessment of microbial hazards and toxic chemicals and the management of the associated risks when using wastewater and excreta in aquaculture. It explains requirements to promote safe use practices, including minimum procedures and specific health-based targets.
Volume IV: Excreta and Greywater Use in Agriculture
This volume provides information on the assessment and management of risks associated with microbial hazards. It explains requirements to promote the safe use of excreta and greywater in agriculture, including minimum procedures and specific health-based targets, and how those requirements are intended to be used. It also describes the approaches used in deriving the guidelines, including health-based targets and a substantive revision of approaches to ensuring microbial safety.
By WHO/UNEP, 2006. Available from http://www.who.int/water_sanitation_health.html

Engineering and Costs of Dual Water Supply Systems
The purpose of this book is to discuss the engineering and cost aspects of dual water supply systems drawing on the authors' experience obtained in Hong Kong, where dual water supply systems have been used for fifty years.
The book is suitable for use as a textbook or reference book at undergraduate and postgraduate levels. University undergraduate students and postgraduate students in water science, civil engineering, environmental engineering and environmental science or management will be the principal audiences. Practicing engineers, managers and other practitioners in these fields will also find this an invaluable reference source.
By Tang S.L., Yue Derek P.T., Ku Damien C.C., 2007, 90 pages, ISBN 1-84339-132-5, hardback. Available from http://www.iwapublishing.com

Environmental History of Water – Global views on community water supply and sanitation
Altogether 34 authors have written 30 chapters for this multidisciplinary book, which divides into four chronological parts, from ancient cultures to the challenges of the 21st century, each with its introduction and conclusions written by the editors. The authors represent such disciplines as history of technology, history of public health, public policy, development studies, sociology, engineering and management sciences.
Lessons learned from earlier societies help us to understand the present crisis and challenges. This new book provides this analysis by studying these lessons.
By Juuti P.S., Katko T.S., Vuorinen H.S., 2007, 629 pages, ISBN 1-84339-110-4, hardback. Available from http://www.iwapublishing.com

Water Resources in the Middle East: Israel-Palestinian Water Issues – From Conflict to Cooperation, Vol. 2
Leading Palestinian, Israeli and international water experts document the importance of mutual understanding, respect and amity among peoples during a difficult period of stress. The present water crisis facing the Middle East will become even more severe over the next twenty years, unless dealt with energetically and in good time. This book provides valuable source material for water scientists, engineers, political scientists, specialists in conflict resolution, environmentalists, economists, lawyers, administrators, managers, and policy makers interested in understanding, developing, managing, and protecting the scarce shared water resources of the Middle East and for the promotion of "Water for Life" for the benefit of all the nations of the region.
This book contains papers from an international conference on water issues in the Middle East organised by the Israel Palestine Center for Research and Information (IPCRI).
By Shuval H., (Israel); Dweik H., (Palestine) (Eds.), 2007, ISBN 978-3-540-69508-0, Springer Verlag. Available from http://www.ipcri.org/

Solid Waste Management

Principles of Solid Waste Management, Vol. I & II
This publication looks at the use of environmentally sound technologies for managing municipal solid waste in developing countries. It is designed as a sourcebook on solid waste management, covering a multitude of topics, including the principles of solid waste management, processing and treatment as well as final disposal. It also covers key non-technical aspects, and offers regional overviews and information sources on SWM.
This publication has been prepared primarily for: 1) decision-makers and policy-makers, and 2) professionals involved in the management of solid waste. The information is also useful to students in environmental engineering. The material is presented in such a way that most chapters need not be read in any particular sequence.
By UNEP International Environmental Technology Centre (IETC), 2005, ISBN 92-807-2676-5. Available from http://www.unep.or.jp

Urban Agriculture

Cities Farming for the Future – Urban Agriculture for Green and Productive Cities
Five years after the publication of "Growing Cities, Growing Food; Urban Agriculture at the Policy Agenda" (DSE 2000, edited by ETC-RUAF), this new book by RUAF looks at the situation of urban agriculture as it is today.
"Cities Farming for the Future" integrates results of recent research on the potentials, risks and dynamics of urban agriculture and presents early experiences with the development of policies and action programmes on urban agriculture. It provides new insights and interesting examples for senior and mid-level officers in municipal departments, governmental organisations, NGOs, farmer and community-based organisations and is of high value for those influencing policies and programme development.
By Veenhuizen R. van (Ed.), 2006, 459 pages, ISBN 1-930261-14-4, Published by ETC - Urban Agriculture. Available from http://www.idrc.ca/en/