sustainable sanitation alliance

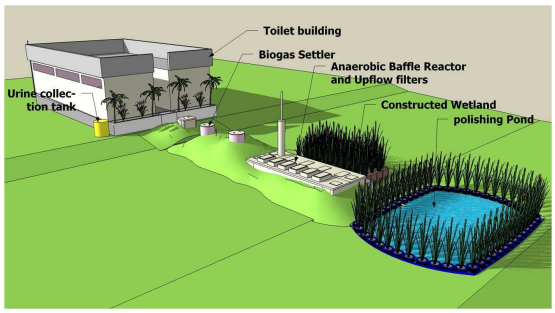
SuSanA – Thematic paper

sustainable sanitation for cities

version 1.2 (October 2008)

key take-aways

- The nature of impending urban environmental change is unprecedented, and the impacts of this trend will be critical to the sustainability of urban sanitary systems. This is not simply a technical challenge, but an issue which is complicated by politics, legislation, technical norms & standards, economics and socio-cultural factors.
- The limitations of conventional, top-down, supply driven approaches to urban sanitation are well known and documented; this paper argues a rationale for more sustainable forms of urban sanitation provision. The impacts of this approach, and the trade-offs that this decision brings to planners and sanitation professionals alike are outlined.
- A clearly defined set of objectives for sustainable urban sanitation is presented, based on both general and specific criteria of sustainability. Moreover, the document makes a strong case and argument for a systems based approach to sanitation and planning, shifting the emphasis away from isolated technological inputs to a series of processes that operate from cradle to grave.
- In order to make sanitation systems more sustainable, good planning is important. Systems should be (i) comprehensive: all waste streams and stormwater should be considered; (ii) re-use oriented: waste has to be looked at as a resource and whenever possible be used beneficially; (iii) appropriate: a comprehensive suite of technology options has to be examined to determine the most sustainable, rather than the most typical, solution. A range of innovative planning appraches addresses this in a comprehensive manner.
- The paper presents a typology of 'typical' urban settlement types, which though site specific, offers planners and technicians a greater understanding of the conditions (physical, socio-cultural, institutional) in which more sustainable options for sanitation can be planned, consulted on, operated and maintained.
- Whilst the paper outlines much of the complexity of planning urban sanitation systems, action can always be taken. This document highlights three needs: to be opportunistic in working with existing alliances and opportunities, wherever they may develop; to be comprehensive in consultation, demand assessment and use of diagnostic tools to create local interest in sanitation; and thirdly, to take action to address structural constraints such as institutional fragmentation, regulatory environments which impact on sanitation programming and to reorientate our training institutions to ensure our professionals are more adept at coping with change in the future.



▶ figure 1: In Badlapur (agglomeration of Mumbai, India) an innovative sanitation concept has been implemented at a college for 1600 students. One measure is that the effluent from pour-flush squatting toilets is used for biogas production by passing it through an Upflow Anaerobic Sludge Blanket reactor. The treated blackwater is then purified in a constructed wetland and used for irrigation. (Source: ESF)

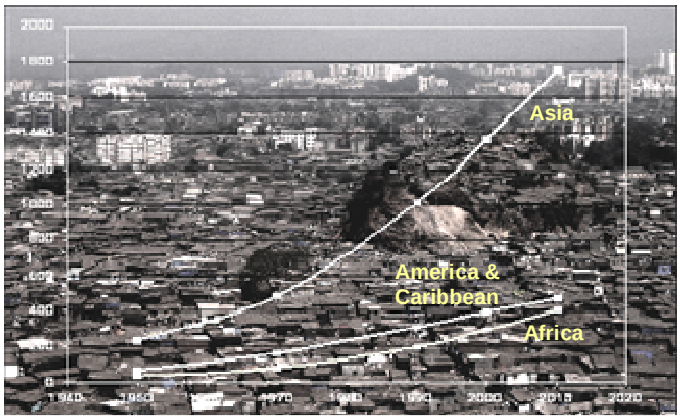
▶ figure 2: The combination of income generating measures (biogas production, user fees) is used to increase ownership and economic sustainability in several public toilet projects in Asia and Africa. The picture shows a sanitation project which is currently implemented in the Kibera slum in Nairobi, Kenya. (Source: C. Rieck)

▶ figure 3: Water saving devices, greywater reuse and urine diverting dry toilets with off site composting of faeces and organic kitchen waste have been implemented in multi-storeyed buildings in Dongsehng, China. These new residential buildings for 3000 people have been designed in response to extreme water scarcity and to contribute to sustainability. (Source: SEI)

nature of the urban sanitation problem

increased urbanization is linked to sanitation

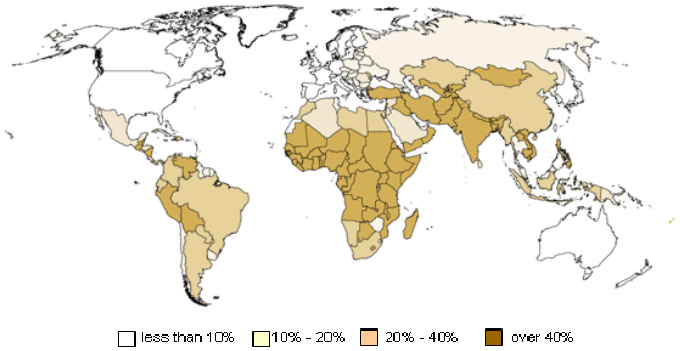
Current urbanization processes are driven by three global trends: (i) the continued growth of megacities in the developing world, (ii) most population growth occurring in intermediate and small cities for another few decades, and (iii) 95% of the urban growth taking place in the developing world over the next two decades and by 2030 80% of the world's urban population will be located there.[1] Many of the world's cities experience population growth that far exceeds their absorptive capacity in terms of shelter, water, sanitation infrastructure, public health services, employment, education, food supplies and environmental protection. Global poverty will increasingly be found in cities, unless key issues are addressed now.



▶ figure 4: people (millons) living in cities 1950-2000, with projections for 2010 (source: UN-Habitat 2006)

The great majority of the population growth in the urban centres of Africa, Asia and Latin America is in the unplanned and underserved informal settlements commonly known as slums. More than one quarter of the urban residents in the developing world - more than half a billion people - lack safe drinking water and basic sanitation. The group worst affected is small children. The impact on the age-group under-five therefore includes 1.6 million deaths due to diarrhoea each year in addition to morbidity and mortality from other causes and diseases.

Urban vulnerabilities in the face of population dynamics and climate change are felt both in the North and the South. However, they manifest themselves in fundamentally different ways depending on the context. In developing countries, the benefits of modern globalization are not evenly spread. In countries like China and India with tremendous economic growth it means that millions are moving into cities in search of new opportunities offering a chance to move out of poverty. In sub-Saharan Africa, continued urbanization takes place in the context of economic stagnation due to the inability of governments to provide services to any significant degree.



▶ figure 5: share of urban population living in slums [in percent] (source: UN-Habitat 2006)

According to UN-Habitat almost one billion people or one in six people live in informal settlements. This is expected to increase to 1.4 billion by 2020, with the biggest growth taking place in Africa and South Asia (Source: UN-Habitat, 2006). Many governments are reluctant to accept the extent of urbanisation and fail to acknowledge how many of their citizens lack access to water, sanitation, habitable dwellings and secure land tenure. The politicians responsible are reluctant to legalise informal settlements or provide them with infrastructure and services. Without radical changes in policy and implementation approaches to sanitation provision, the needs of urban dwellers in informal settlements will remain unmet.

scale of the urban sanitation problem

it is more than toilets

The scale of the urban sanitation problem is not limited to the numbers of toilets alone or necessarily limited to low and middle income countries. Toilets, the user interface with sanitation systems, constructed in isolation, will not lead to sustainable sanitation outcomes. The reasons for this include:

- Much of the wastewater produced in the urban environment is not, or insufficiently, treated.
- For existing on-site systems, faecal sludge management is generally missing.
- Urban slum dwellers often depend on shallow ground water, which may be endangered by leaking sewers, "flying toilets" or pit-latrines, with effluents infiltrating the soil and leaching into groundwater lenses.
- The demand for water and nutrients leads to the uncontrolled reuse of sewage by millions of farmers.
- The unsustainable consumption of scarce or non-renewable resources (such as scarce water, phosphorous, and energy) is a typical result of disposal-oriented transportation and treatment of human excreta.

[1] State of the World's Cities 2006/7, (2006) UN-Habitat Nairobi

▶ figure 6: drinking water wells and open drains often lay next to each other leading to frequent cross-contamination (source: GTZ)

complexity of the urban setting

recognizing the importance of local conditions

The challenges and issues outlined above are further complicated by the characteristics and conditions which are common in the urban setting itself. These conditions bring with them demands relating to integrated developmental approaches which apply not only to water supply and sanitation provision, but also to related disciplines such as agriculture, urban planning, public health, solid waste management, environmental protection, resources management, economics, marketing, capacity development, gender issues and sustainability assessment. Conditions in the urban context are significantly different from the rural environment, leading to substantive and particular implications for implementation and management of urban service provision. This is illustrated in the following examples:

- Planning related issues: these are characterised by lack of legality of tenure, absentee landlords, the challenge of servicing marginal land (space and vulnerable physical environments), and inappropriate or unsuitable technical norms and standards
- Institutional issues: including the fragmentation of responsibility / accountability for sanitation between different stakeholders; and the potential for political conflict between national, regional and municipal levels of government
- The political economy: a nexus between local politicians, local administration, and land brokers steers urban development. The need to provide services in exchange for votes often takes precedence over existing master plans and/or more rational planning processes.
- Economics and finance: the urban setting is highly monetised; yet opportunities to support service provision both, through public funds, or private initiatives (e.g. through micro-financing or commercialisation) are limited or small scale. Rapidly increasing land prices lead to higher population densities and reduce the availability of space for alternative treatment systems such as artificial wetlands.
- Capacity: personnel responsible for service provision in the urban setting frequently need diverse skill sets and capacities, not least an ability to understand different programming approaches and to make assessments of a highly diverse set of risks (e.g. inter-sectoral nature of the urban setting). Ironically, forms of training and curricula development for sector professionals are typically outdated, or inappropriate for this setting (both in terms of engineering standards and methodological approaches).
- Socio-cultural issues: urban socio-cultural complexity may be greater than in rural areas due to the diversity of ethnicity and religious affiliation, the general lack of community homogeneity, and transient and unstable populations.
- Waste management: Urban waste management streams tend to be highly mixed and this impacts upon their respective treatment processes, which, in addition to organic and household wastes, typically includes wastes from cottage, small trade and large scale industries

▶ figure 7: During flooding proper waste and excreta management is an impossible task (source: GTZ)

- Measuring the right outcomes: International and national statistics consistently underestimate the proportion of urban households living in poverty without basic services like safe water and adequate provision for sanitation. This is due to the fact that government defined 'poverty lines' do not reflect the high cost of meeting basic needs in a monetized urban economy. This is reflected in the great discrepancy between monitoring results and the reality on the ground.[2]

If we look at the urbanisation trends described above, the scale and nature of the problem ahead and the need for pro-poor sustainable sanitation solutions – especially for cities – the challenge becomes even more obvious.

[2] The WHO/UNICEF JMP together with other development partners are currently addressing these caveats and discussing 'next-generation' monitoring systems which incorporate more sensitive monitoring to include issues of management and sustainability and not just counting existing facilities (SIWI, BMZ, JMP. 2008).

the need for sustainable urban sanitation

challenges to find locally adapted solutions

The impacts of inadequate sanitation in terms of human suffering and financial loss are enormous. The present lack of adequate sanitation systems also impacts the future for millions of people. It is a fact that in many cities centralised infrastructure networks cannot be constructed quickly enough to keep up with the growing urban populations. It is also a fact that present urban solutions are usually disposal oriented and completely neglect to consider the reuse potential of different "waste" streams. This calls for innovative solutions, since "business as usual" does not provide sufficient focus on ecological, economical and socio-cultural sustainability, and will continue to lead to people living without adequate sanitation and clean drinking water in urban areas. It will also cause more unemployment and poverty due to the health effects of poor or absent sanitation, widening the gap between the urban rich and the urban poor, e.g. lower attendance rates in schools, especially for girls, are linked to the lack of proper toilets that do not provide adequate privacy. Women may drop out of the urban workforce for the same reason. Issues of personal safety may mean that many people, particularly women and girls, cannot leave their houses at night to go to the toilet. As a result, they may be forced to simply throw excreta into the dirty and poorly drained streets outside their homes (so called flying toilets), which seriously impacts both hygienic and environmental conditions.

Today, more than two billion urban dwellers in developing countries use on-site sanitation facilities such as pit latrines, septic tanks and aqua privies for excreta and wastewater disposal. However, all urban sanitation systems, irrespective of system type, will only bring about positive health impacts if behavioural change happens in the full community, if the systems are properly used and well managed, if behavioural patterns lead to sound hygienic practices and if they seek to minimize contamination of the wider environment.

The concentration of waste resulting from dense populations is a serious health burden. This is particularly true concerning human excreta. The growing quantities of excreta must be dealt with in more sustainable ways in the future. The diseases, which result from a lack of sanitation systems or the improper management of existing systems, are among the main constraints to the economic development of many developing countries.

The basic concept of collecting domestic liquid waste in waterborne sewer system, treating the wastewater in centralised treatment plants and discharging the effluent to surface water bodies became the accepted approach to sanitation in urban areas in industrialised countries in the last century. Although these conventional sewer and treatment systems have significantly improved the public health situation in those countries that can afford to install and operate them properly, it is not the only available solution and often not the most appropriate one. Due to water scarcity, unreliable water supply services, lack of skilled labour for operation and qualified management and for financial-economic reasons, this area-wide sewered sanitation may not be suitable in many areas.

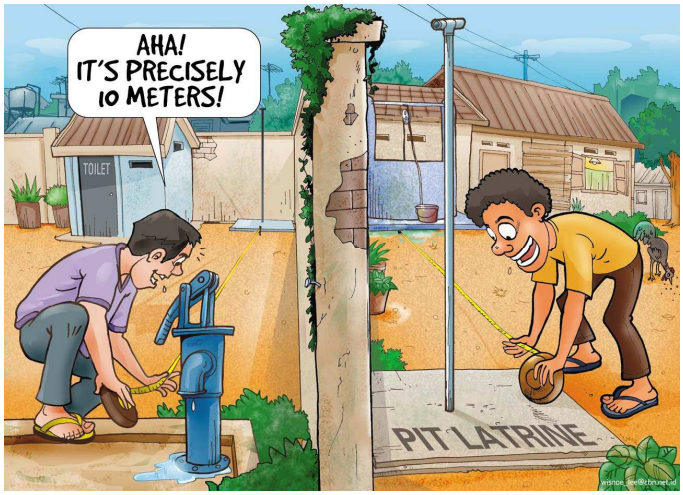
If the staggering amount of people that live without sanitation is to be significantly reduced, innovative systems that fulfil their intended function in the local environment need to be implemented.

▶ figure 8: In most developing countries like here in Dar Es Salaam, Tanzania, pit latrines are emptied manually, a dirty and dangerous job. (source: S. Sugden)

Regardless of the technology used, a trade off must be struck between needing to reduce environmental and ecological degradation that the discharge of untreated wastes causes to surface and ground water and the immediate health risks from faecal contamination of households and communities. This relative risk assessment leads to a balancing act – polluting water sources versus increased local morbidity and mortality rates. Recognizing that this represents a 'least worst' case scenario, policy makers may favour reducing the burden of disease in the short term through on-site sanitation programmes, and focusing on the achievement of environmental integrity over the medium and longer terms.

However, in order to protect water supply sources (mainly groundwater) from pathogenic pollution, uncontrolled discharge needs to be replaced by safe containment options which prevent high pathogenic loads from entering water sources. In parallel, treatment needs to take place to diminish the

microbiological load of the excreta. This can be achieved even with incremental improvements, e.g. regularly emptied pits and well-functioning septic tanks, and later on be extended and upgraded. Aiming at an improvement of environmental degradation and long-term water supply source protection, further treatment steps (such as making nutrients available for reuse or eliminating carbon, nitrate and phosphate) have to be implemented, most likely raising costs but however ensuring sustainable protection of water resources.



▶ figure 9: Comic of the World Bank – Water and Sanitation Programme showing the necessity of integrated planning in the urban context. (source: WSP)

The discharged nutrients that cause eutrophication of surface water and drinking water sources are at the same time a valuable resource if they are used in a proper way (WHO 2006). Discharge or disposal without first considering the potential for reuse is a waste of natural resources – and may be a missed opportunity to increase ownership for and economical viability of sanitation systems. For instance, biogas production for cooking gas or electricity; increased soil fertility through added soil-conditioner from sludge drying beds; or increased crop production in peri-urban agriculture through nutrient rich irrigation water from a constructed wetland could all be used to the benefit of society.

criteria for sustainable sanitation systems

no sustainable development without sustainable sanitation

The most widely used definition of "sustainable development" is given in the Brundtland Report "Our Common Future" (WCED 1987). It is defined as *"development that meets the needs of the present without compromising the ability of future generations to meet their own needs"*. This definition makes clear that the modern concept of sustainable development is a concept dealing on a global level with the justice of development options between different generations (inter-generational justice). This definition takes credit for promoting a comprehensive view, encompassing the three dimensions of sustainability: "economic development", "social justice" and "ecological responsibility". It has to be emphasized that there are close interrelationships between these dimensions frequently characterised by tensions and trade-offs which require an integrated view on the different aspects of sustainability.

In addition, considering the needs of future generations vis-à-vis the practices of today's generation, the need for intra-generational justice between members and stakeholders of the same generation such as neighbours, upstream or downstream riparian owners, commercial partners etc. has to be taken into account. Broken down to the level of urban sanitation, sustainable sanitation means to meet the basic sanitation needs of all population segments of the present generation within a city (principle of equity) without compromising the needs of the present and future generations living inside and outside of the city.

objectives of sustainable sanitation systems

sustainable development and sanitation in cities

The main objective of a sanitation system is to protect and promote human health by providing a clean environment and breaking the cycle of disease. In order to be sustainable, however, a sanitation system should also be economically viable, socially acceptable, technically and institutionally appropriate, and protect the environment and natural resources (SuSanA 2007 -short statement).

Reflecting the earlier mentioned classical sustainability dimensions (ecology, economy, socio-cultural dimension) sustainable sanitation systems should achieve the following **specific objectives**:

- protect the health of the entire population
- protect the environment within and outside the city
- avoid negative impacts upstream or downstream of the city
- optimise the entire system (socially, technically, legally) taking into consideration necessary trade-offs
- make the system economically viable (for the users and the society)
- guarantee flexibility concerning future demands

According to regional circumstances additional **site-specific objectives** could be formulated, such as:

- recycling and reuse of nutrients
- water saving in regions with water scarcity
- improved urban drainage
- minimising energy consumption and gaining renewable energy through wastewater and excreta treatment
- storage of storm water within the settlement for improving microclimate or for pleasure and recreation.

According to the Joint Monitoring Programme (JMP) 2004 estimates, 80% of the urban population have access to

improved sanitation (JMP 2006). The JMP is not a specific survey but utilises existing household survey data that is collected through MICs/DHS, census and other approved nationally representative household surveys. As these surveys in some cases do not count slums in cities as urban, but as rural, they could lead to the impression, that little funding is needed for sanitation in the urban context.

Furthermore it has to be recognised that the coverage data from JMP does not refer to "sustainable sanitation" (according to SuSanA 2007) but to "improved sanitation" coverage (according to JMP-criteria, e.g. JMP 2006). Therefore the coverage with "sustainable sanitation" as described in the SuSanA short statement is lower than the JMP-figures.

Further refining the existing international monitoring tools, so that they can better include sustainability aspects is important and should begin now, to have them tested and ready when for example in 2015 a next generation of indicators for global monitoring is to be applied (SIWI, BMZ, JMP. 2008).

translating sustainability to the urban context

basic criteria for urban sanitation

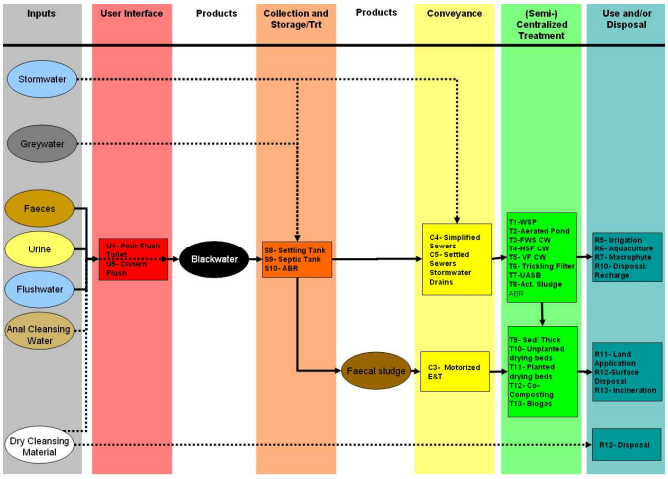
As a consequence of different regional or local environmental, economic and socio-cultural conditions, sustainable urban sanitation systems can only be realized in a context-specific way. Due to this, no single sanitation system can be considered universally sustainable. Generalised **basic criteria** for sustainable sanitation systems based on proposals of (Kvarnström et al. 2004, Lennartsson et al. 2006 and Lehn 2004) will be presented in a separate SuSanA thematic paper (SuSanA 2008b) for a context-specific discussion on factors that could help to distinguish between more and less sustainable features of sanitation systems worldwide. Sustainability **indicators** derived from these criteria are tools to formulate a threshold for sustainability for such a feature, if deemed suitable as a sustainability indicator in the actual context, and to measure progress in sustainable development. It is strongly recommended to select the sustainability criteria and derive corresponding indicators in a participatory manner on a regional or local level.

sanitation systems from cradle to grave

analyzing urban sanitation systems

Usually, when talking about 'sanitation' one speaks *not* of sanitation, but rather of a single technology, or an instrument, that is designed to handle excreta and wastewater. Septic tanks, pit latrines, and composting toilets, among others, are often referred to as sanitation systems. In fact, these are technological components. They may, when linked to a range of other components, designed appropriately and possibly after up-grading form a robust, sustainable sanitation system.

Too often, such a part of the sanitation system (under the guise of being a sanitation solution) is implemented, only to realize later that other components are missing, e.g. there has been no provision made for the treated effluent (which is soon diverted into open drains), the faecal sludge (which, in the absence of a collection site, is soon dumped in open fields), or for other side-streams that may be generated (e.g. greywater from sinks and showers). Therefore, while the technological component itself may work, the system as a whole might not be sustainable.



System: Onsite collection and storage with settled sewerage with (semi-) centralized treatment

▶ figure 10: Sanitation systems should reach beyond providing toilets only and consider sustainability of the system from cradle to grave (source: Eawag/Sandec)

A sustainable sanitation system includes all the components (physical parts and actions) required for the adequate management of human waste. By considering 'sanitation' as a multi-step process and not a single point, waste products are accounted for from the point of generation to the point of ultimate destination: the **'cradle to grave'** concept. This concept describes life cycle of wastes which are generated at the household (the cradle), which are then processed (e.g. stored, transformed and/or transported) until they reach a final point of destination (grave). Ideally, resources contained in "wastes" would be used beneficially, which could be referred to as **'cradle to cradle'** or **'closing the loop'**. Nutrients, biogas, soil-conditioner, irrigation water recovered from wastes and wastewater would be used to benefit the society in a cycle (e.g. biogas production for cooking gas or electricity; increased soil fertility through added soil-conditioner from sludge drying beds; or increased crop production in peri-urban agriculture through nutrient rich irrigation water from a constructed wetland).

The planning and design of a sustainable sanitation system requires a holistic view and a bottom-up approach. The re-use of waste for urban agriculture or energy production may lead to additional incentives but add to additional managerial and institutional complexity. However, most importantly sustainable sanitation systems require strong partnerships between different institutions and stakeholders as no single stakeholder will be able to cover the entire chain. The main issues to be considered in the planning process for a sustainable sanitation

system are discussed in a separate fact sheet. (SuSanA (2008)). In the design process, the different components have to be identified that in conjunction with existing or innovative new technologies improve coverage and service, while minimising the negative impact on the environment. The frameworks for such a systems approach are suggested in NETSSAF (2006), Eawag-WSSCC (2008) and IWA (2005).

As this thematic paper is not a technical reference document, specific system components will not be described in detail, but rather the underlying issues are emphasised, as being

- **comprehensive:** all waste streams are considered (especially those that are by-products of processing steps, e.g. faecal sludge or nutrient rich water)
- **re-use oriented:** that whenever possible the wastestream is used beneficially, otherwise it is disposed of in an appropriate way
- **appropriate:** a comprehensive suite of technology options is examined to determine the most appropriate, site specific solution, rather than the most typical.

In the following section we provide examples of "business as usual" in different urban contexts, how they are typically addressed, and what are the options that may come into the picture if a more holistic analysis – namely the "systems approach" - is applied.

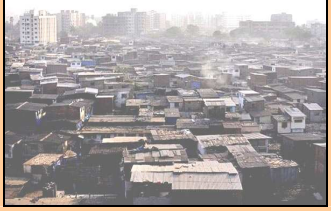
examining typical urban settings

from business as usual to sustainable solutions

This section highlights the physical, demographic and socio-economic factors that need to be considered for sustainable sanitation interventions in cities of the developing world. Although each context is site-specific, there are nevertheless "typical situations" which are found in most developing cities. In the following, typical urban settings & structures and their characteristics are presented, which house and serve the majority of the urban population in the developing world. These are: (i) Non-tenured low-income settlements (slums), (ii) Tenured (or non- tenured) peri-urban settlements, (iii) Planned urban development areas (low, middle and high income); (iv) Inner city middle and high income settlements with potential for upgrading (v) Non-residential buildings. Sustainable sanitation options for these different settings will vary, depending on the different regional or local environmental, economic and socio-cultural conditions. The sustainable options outlined for each of the urban settings are therefore only indicative.

I Non-tenured low-income settlements (inner-city slums)

Dharavi, Mumbai, India



Population density	300 - 2000 persons per hectare
Average household size	5 - 6 persons
Water consumption	20 - 40 litres per capita per day
Sources of wastewater	Kitchen, laundry, showers, sanitation blocks, pit latrines, informal business and cottage industries

Context

Typical inner-city slums are overcrowded informal settlements with maximum population densities reaching up to 2000p/ha (e.g. Dharavi, India or Kibera, Kenya). Most are non-tenured and they are often considered 'illegal' settlements by local and central governments. The majority of residents live on less than 1$ a day. People must fight for sufficient space for sanitation, drainage, urban agriculture, economic activities (e.g. food vending), since urban space is ever-decreasing.

Business as usual

In most slums there is sparse, if any, formalized form of sanitation. Self-dug shallow pit latrines, flying toilets (plastic bags with excreta) and open defecation are common. Even if the owner could afford an emptying service for his pit latrine (which is rare) there is little chance of having it emptied, either because of access (large trucks in dense slums), safety (unsafe pits prone to collapse), or institutional support (e.g. licensing). More often, pits are emptied by hand, drained into the local water body or simply covered and left: none of which are healthy, sustainable options.

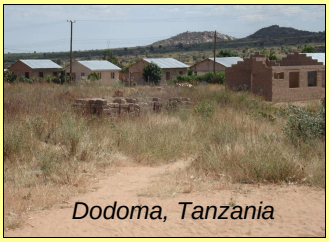
Incremental improvements typically suggested

- Small, mobile pit-emptying units owned and operated locally to empty pits in tandem with the availability of tools and supplies for building and maintaining safe pits (e.g. slabs)
- Community or public-run sanitation blocks, buying and selling water and connected to a nearby sewer

More sustainable approaches may include:

- Collective treatment and reuse systems (e.g. Community Based Organisation (CBO)-managed solutions; small-scale independent service providers; community sanitation blocks connected with an on-site bio-digester to produce energy; treated grey-water for local use; reuse of sanitized sludge in urban agriculture

II Tenured or non-tenured peri-urban interface[3]



Dodoma, Tanzania

Population density	100 - 300 persons per hectare
Average household size	~5 persons
Water consumption	40 - 60 litres per capita per day (depending on available water connection)
Sources of wastewater	Kitchen, laundry, showers, sanitation Facilities, informal businesses and cottage industries

Context

Settlements in the peri-urban interface are less crowded than inner-city slums and allow for more space for individual or community sanitation. There is generally a high prevalence of peri-urban agriculture. Often recent or new settlements have a low awareness about the consequences of unsanitary conditions and practices (rural migrants).

Business as usual

Typical conditions may include human waste disposal (simple pits). Pits may be covered, left and re-dug in a new location because of the increased space, or pits may be emptied more easily given the increased access. Still, independent service providers (latrine builders, pump-truck operators, etc.) are usually rare, sanitation is still a low priority, and consequently usually a problem remains for the community.

Incremental improvements typically suggested

- Double pit VIP latrines that are emptied manually
- Pour-flush toilets, septic tanks and leach fields

More sustainable approaches may include:

- Decentralized reuse oriented or semi-centralised systems (e.g. semi-centralised biogas solutions, Urine Diversion Dehydration Toilets (UDDTs), grey-water gardens, etc.) or on-site systems (e.g. Arborloo)

III Planned urban development areas (low middle or high income)

Pikine, Senegal

Population density	depends on type of development (high, middle or low income)
Household size	4-5 persons
Water consumption	depends on income strata and water availability
Sources of wastewater facilities	Kitchen, laundry, showers, sanitatio

Context

These are planned and tenured settlement areas with formal title deeds or simplified property "right-to-use" titles. As these are tenured areas, key target groups are typically from high-end to lower-middle-class. These planned urban areas offer a great potential for sustainable urban development, especially innovative sanitation solutions (integration of rainwater harvesting, greywater separation and re-use, organic solid waste management, irrigation of public space and recreational areas, incorporation of urban agriculture, biogas harvesting, etc.).

Business as usual

Depending on the type of development (high- to low-income) and other context parameters (e.g. precipitation, water table, soil conditions) typically applied systems may range from sewers to septic tanks or pit latrines. Interest of investors and local regulations may play a significant role in the choice of sanitation systems and does not always meet environmental concerns and user priorities. Sewers may be drastically over-designed (and therefore expensive), management and maintenance for septic tanks and pit-latrines is often missing.

Incremental improvements typically suggested

- Septic tanks with connections for small-bore sewers to facilitate the potential installation of communal sewer system (Latin America)
- for low-income settlements: lined pit latrines or VIPs

More sustainable approaches may include

- Community-level, semi-centralized treatment and reuse options (shallow sewers, grey-water gardens, allotment gardens, productive constructed wetlands, biogas-systems, UDDTs, vacuum systems).

[3] „The peri-urban interface is characterized by strong urban influences, easy access to markets, services and other inputs, ready supplies of labour, but relative shortages of land and risks from pollution and urban growth"
(Phillips et al, 1999 - Literature Review on Peri-urban Natural Resource Conceptualisation" NRSP-DFID).

IV Non-residential buildings(social infrastructure and tourism facilities)


Public Toilet, Kumasi, Ghana

Type of structures	Schools, health clinics, hospitals, public markets, communal facilities, tourism facilities, office buildings
Number of users	Depends on facility; public toilets can serve up to 5000 visitors daily
Water consumption	depends on facility

Context

Public buildings in low income areas or city centres are crucial for providing affordable services to low-income residents. Schools, especially, play an important role in promoting health, hygiene and behaviour change. Sanitation facilities in public buildings are complex because of the variety and number of users, each of whom may have different habits, requirements and approaches to sanitation. What is obvious to some groups of users (i.e. to squat over a pan) may not be obvious to others. Similarly, the fact that people use the facility without owning it means that the level of care and ownership may be low which consequently leaves the facilities in a poor state of maintenance. Missing hygienic conditions are the main reason for low user acceptance of sanitation facilities in public spaces.

Business as usual

Typically, a few pit latrines are provided at schools, while an unmaintained pour flush toilet may be provided at a market or hospital. Since the crucial element of a public facility is the management structure, operation and maintenance must be carefully planned in terms of human, material and financial resources.

Incremental improvements typically suggested

- Communal urinals and/or pour flush toilets connected to a sewer main. Maintenance and operation are paid for with user fees and the block is run by CBO or NGO

More sustainable approaches may include

- Solutions depend on type of structure and use. The following wide range of technologies may be appropriate, e.g. vacuum systems, membrane technology, biogas digesters, community sanitation blocks, UDDTs, greywater gardens, constructed wetlands, etc.)

V Inner-city middle and high income settlements with potential for upgrading

Population density	between 50 and 200 persons / hec.
Type of structures	middle- and high income housing areas, shops, small-scale businesses, office buildings
Average household size	~3 (China) – 6 (Algeria) persons
Water consumption	100 -400 litres per capita per day
Sources of wastewater	Kitchen, laundry, washing facilities, flush toilets, small businesses

Context

The typical middle and high income settlements in inner cities have modern apartments in multi-storey and high-rise buildings. These residential buildings are complemented by small-scale businesses, shops, restaurants, office buildings, etc. Water consumption is generally high, high population density, higher living space per inhabitant compared to low income areas, as well as green areas / parks for recreation.

Business as usual

Inner-city middle and high income settlements usually have (combined) sewer systems which collect domestic wastewater and rainwater via gravity sewers. The combined sewage is either transported to a centralised wastewater treatment plant where it is (partly) treated and directed to the receiving waters or discharged directly to a water body. Most often the wastewater is not reused. On-site sanitation systems are not the norm for this type of settlement.

Incremental improvements typically suggested

- Existing wastewater treatment plants should be optimised for treatment efficiency and energy consumption e.g. by anaerobic digestion of sewage sludge to produce biogas and by using the treated effluent for irrigation in agriculture thus saving energy needed for nutrient removal.
- Where wastewater treatment does not exist, the first step is to construct a treatment facility which should consider economic, ecologic and cultural sustainability aspects.

More sustainable approaches may include:

To further increase the sustainability of inner-city sanitation systems:

- separation of stormwater and wastewater streams
- decentralised and semi-centralised reuse oriented systems (e.g. biogas solutions, no-mix systems, grey-water gardens, rainwater harvesting systems, etc.)
- water saving devices
- Increased re-use of water e.g. through rainwater harvesting systems

the way forward – be opportunistic

identify and work with key opportunities

As outlined earlier, urban complexity is part of the reason why sanitation today still belongs to the world's most imminent, least well resourced problem. In a holistic approach towards sustainable sanitation, the complexity of the urban context provides not only problems, but opportunities. The chances of successful sanitation provision lie in exploring linkages to more sectors than only to the water supply and sanitation sector. The following section proposes some possible opportunities for the way forward.

In most urban contexts there are different actors who do recognize the importance of sanitation. These can include, for instance, an environmental NGO or a business service provider. Wherever such opportunities can be found, they can be supported - they may provide a starting point for sanitation or an anchoring point for improvement of an existing system and can help to put sanitation on the map particularly where visible success can be demonstrated.

Economic and business opportunities

There is important evidence to suggest that sanitation brings a higher rate of return than initial investment, and not only in terms of health impact (Haller et al 2007). Urban sanitation systems comprise a range of processes that represent potential business opportunities. These may include small-scale service provision for construction of appropriate system components, collection, transport, storage and processing/recovery of products from sanitation systems (e.g. biogas, fertiliser, soil conditioner or irrigation water).

▶ figure 11: Energy provision with biogas in combined systems can be provided by semi-centralised biogas plants (source: J. Heeb)

Other opportunities exist in:

- Environmental protection (e.g. to urge industries to treat and manage their own wastewater)
- Urban agriculture (using nutrients generated in the city to increase productivity of urban and peri-urban food production)
- Solid waste management (e.g. co-digestion of organic waste with wastewater in an anaerobic reactor)
- Energy generation/provision (connect sanitation with biogas and biomass producing initiatives)

the way forward – be comprehensive

... but stay realistic!

Interventions must be based on developing a common understanding of the situation on the ground. This needs to cover the demand side (demand of households for toilets, demand of other stakeholders for resources generated by productive sanitation systems, e.g. biogas, irrigation water, fertiliser), as well as the supply side (small scale and institutional providers) and the policy environment. One needs to be comprehensive in order to find a suitable entry-point for the introduction of more sustainable sanitation systems in the specific local setting, but also be realistic in order to see what works and what doesn't. A way of doing so is to put systems into practice to accelerate information, education and communication on innovation in sanitation, and then to further adapt and to up-grade them.

There is clearly an opportunity to re-invent the role of sanitary engineers in sustainable sanitation development – e.g. by creating a fruitful dialogue with urban planners, developers and policy makers to integrate sanitation infrastructure in the urban planning and development agenda.

Make use of holistic urban planning

To allow for a more comprehensive consideration of appropriate sanitation solutions, a number of new sanitation planning tools are available or under development (e.g. Eawag, 2005, SEI, 2005, IWA, 2005). They show the types of required changes in current urban planning practice, e.g. a move towards sustainability assessments of individual urban neighbourhoods, a thorough assessment of socio-economic, cultural, physical and environmental conditions and the consideration of smaller, semi-centralized and decentralized approaches. (See: SuSanA 2008a)

Other ways to find an entry point into better sanitation provision include:

- Resources management (deal with resources that are scarce in the local context and evaluate how a sanitation system can reduce resource pressure)
- Surveys, analyses, impact evaluation (e.g. market surveys, institutional analysis, impact evaluation of previous sanitation strategies, sustainability assessment)

the way forward – be effective

… the 3-legged stool

The promotion, development, and implementation of sustainable sanitation systems in an urban context needs to be based on three pillars: (a) local demand, (b) appropriate local supply, and (c) an enabling environment (policy, regulation, legislation, etc). Addressing these pillars increases effectiveness as shown in the following.

Create local demand

Merely supply driven sanitation programmes have not proven effective - often the supplied facilities are not accepted and deteriorate quickly. Creating ownership, by contrast, proves to be a major success factor. Thus, sanitation provision must be more demand oriented. Tools for creating local demand include:

- community led behavioural change campaigns (e.g. CLTS in India)
- social marketing approaches
- awareness raising campaigns
- hygiene promotion

▶ figure 12: Workshops, e.g. for awareness raising and hygiene promotion are an important tool for establishing sustainable sanitation systems (source: GTZ-Philippines)

In the process of demand creation, no special sanitation option should be imposed onto users. However, only if sufficient information on sustainable sanitation options is available for a given context can a truly informed choice be made. Demonstration projects may play an important role here, as they allow comparing and experiencing different options.

While in a rural context individual households may choose their technology of choice independently, in an urban context, a multitude of stakeholders are involved in this decision making process and many decisions can not be taken on an individual household basis. Accompanying measures including educational and empowerment approaches are therefore necessary to provide information on innovative options to improve sanitation provision and the health situation, and to influence hygiene behaviour.

Ensure appropriate local supply of hardware, labour and software skills

Following on from the Bellagio Principles (WSSCC/Sandec, 2000), sanitation problems should be solved on the lowest appropriate level. This can be achieved by developing responsive supply chains of goods and services. Wherever possible these should draw on local experience with good practice examples, e.g. small scale hardware producing and service providing companies, capacity building for community sanitation workers, well-managed community toilets, successful combinations of sanitation provision and urban agriculture or biogas production and the like.

Understand and work towards an enabling environment

Local authorities and governmental institutions are responsible for establishing the framework conditions for the implementation of sustainable sanitation systems. They can, however, also be more directly involved by initiating local, regional or national sanitation programmes promoting or even requiring sustainable approaches (e.g. Case study on Cagayan de Oro, Philippines, SuSanA 2008b).

Governments are also responsible for ensuring the creation of a legislative enabling environment making it possible to implement and use sustainable sanitation systems to their full potential. A primary goal is to bring on board local administration and decision makers as local champions for better sanitation solutions.

The development of an enabling environment for sanitation includes:

- awareness raising campaigns and lobbying,
- targeted workshops,
- advocacy material for decision makers,
- “learning alliances”, (IRC, http://www.irc.nl/page/14957) etc.

In turn, these will create local demand for sustainable sanitation options.

the way forward

taking action, making a difference

With the 2015 MDG end target date now in sight, programmes at a national, regional and local level must gain traction. There will be no quick fix to these problems; no blue-print solutions and no substitute for long term policy and practice commitments to get sanitation back on track. By learning from the experience explained in this briefing, and adapting this to local conditions, practitioners and policy makers have an opportunity to make an impact on the lives of millions of urban settlers.

To do so requires courage and conviction:

- To develop coherent institutions, with consistent operational responsibilities and accountabilities;
- To foster innovation, technical and non-technical in nature, through legal and regulatory adaptation;
- To encourage stronger and more deeply rooted peer-to-peer learning amongst key stakeholders (utilities, government, public/private sector providers) in order to help address common problems in common operational situations;
- To support and lobby at training institutions, universities, research institutes and donors to ensure that more and better quality technical capacity is developed, and we become capable of coping with the pressures and challenges of modern day water and sanitation service provision.

Sanitation has been a taboo subject for too long. The UN International Year of Sanitation 2008 has kick-started the process to change this. It has raised consciousness on sanitation and impacted operational change that will affect future generations. The time to act is now.

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sustainable sanitation alliance