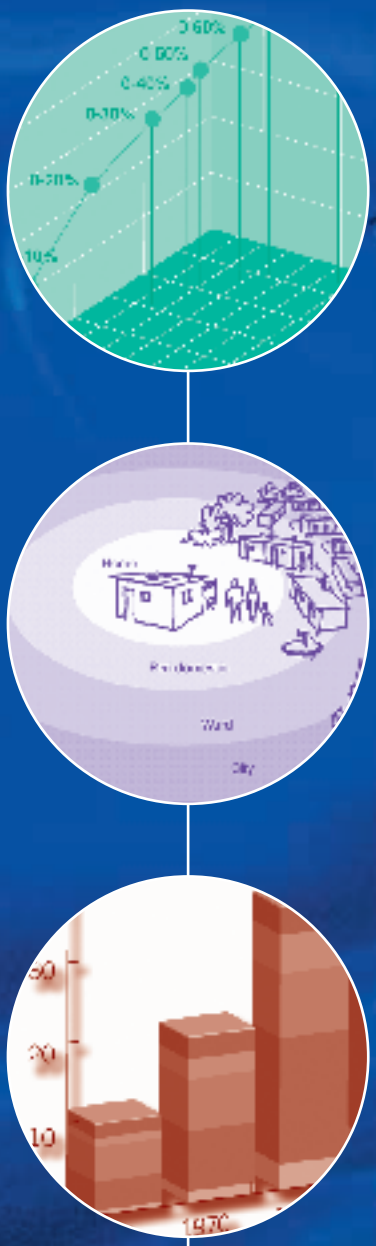
International Water Association



# Sanitation 21

## Simple Approaches to Complex Sanitation

## A Draft Framework for Analysis

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# PREFACE

IWA represents a key group of actors in the compelling development drama of sanitation; namely the engineers, water scientists and technicians who often carry much of the responsibility for decisions about sanitation investments. Over the years a number of IWA Specialist Groups have grown up to address particular elements of the technical challenge associated with sanitation. However, until now there has been no Specialist Group dedicated to examining the overall challenges of sanitation planning and design and able to provide support and guidance to members to improve the quality-at-entry of sanitation investments, particularly in low-income areas in and countries with low GDP. In recognition of this, IWA has instituted a Task Force to consider this challenge (see Annex 1 for the terms of reference). The members of the Task Force are listed below. This paper represents a summary of the key ideas developed by the Core Group of the Task Force to date and is currently subject to review by the Advisory Group and also through an open process of discussion at the IWA Congress in Beijing.

The paper is intended to help IWA members and interested professionals think about how excreta management could be better planned so that investments are more likely to generate the needed health and environmental benefits. It focuses on a particular topic and context which is of relevance and interest to IWA members and which is not specifically covered by an existing IWA specialist group:

**Topic:** management of human excreta[1]

## The Task Force

| Core Group Members | Advisory Group Members |
|---|---|
| Andrew Cotton | Mogens Henze |
| Barbara Evans (Core Group Leader) | Goen Ho |
| Andreas Knapp | Zaini Jang |
| Tove Larsen | Peter Kolsky |
| Darren Saywell (Secretary) | Saburo Matsui |
| Rebecca Scott | Ralf Otterpohl |
| László Somlyody (Chair) | Roland Schertenleib |
| Markus Starkl | Peter Wilderer |
| Steven Sugden | Christian Zurbrugg |

*Additional contributions of Brian Reed are gratefully acknowledged.*

**Context:** dense settlements with multi- layered sanitation needs (i.e. urban utility settings, towns and small urban settlements, rather than rural communities).

The paper is intended to be used as a starting point for discussion and debate amongst sanitation professionals, it does not offer a 'solution' but rather, in recognising the complexity of the challenge, it offers a framework which can be used to develop appropriate, sustainable and effective solutions tailored to a specific time and place.

1 While excreta management is impacted by other environmental services including water supply, stormwater drainage, solid waste management and sullage management, this wider arena of environmental sanitation is beyond the remit of the existing working group.

# FOREWORD

The debate around the Millennium Development Goals (MDGs) has thrown into sharp relief the enormous development task which faces the world in reducing poverty. In the run up to the World Summit on Sustainable Development intense lobbying from sector professionals resulted in the inclusion in 2002 of sanitation as a specific MDG target alongside water. This decision reflects the crucial importance of sanitation both in its own right (conferring as it does dignity, privacy, safety and convenience) and its central role in achieving other goals (health, education and poverty reduction in particular).

However the sanitation challenge remains enormous for a number of reasons not least because:

(1) Coverage of sanitation in urban areas in general is low and even where reported coverage is high the quality of service is often very poor;
(2) the challenge of serving urban populations is growing both because of urbanisation and the increasing degree to which cities and towns are characterised by unplanned and informal settlements (in other words, the real challenges lie in the slums, illegal settlements, unplanned areas and growing peripheries of cities where 'conventional' approaches to sanitation have demonstrated extremely limited impact); and
(3) The challenge of serving both rural and urban populations is concentrated in the poorest countries that lack the institutions, and particularly the financial means to support either massive public or widespread private/ household investment.

Frustratingly much of the investment which is made may be wasted either because sanitation systems fail to reach a significant percentage of people living in the areas they are expected to serve or because management requirements of the installed systems do not match the capacity and resources of the actors expected to manage them and they rapidly fall into disrepair.

During 2006 an IWA-constituted Task Force has been grappling with this challenge. The Task Force has begun to develop an analysis of what is going wrong and how better approaches to sanitation planning could improve the 'quality at entry' of sanitation investments. The Task Force worked through real-life case studies and built on the work of existing groups to identify a framework which could be used to both to analyse a citywide system and also to assess elements within that system; importantly the framework can also be used to identify a development path over time.

The framework addresses some key failings in current approaches which result in a mismatch between the stated objectives of investments and the outcomes. It puts the focus on results – effective and workable sanitation systems which are properly used - based on the real situation on the ground rather than the imposition of pre-selected technologies. It also enables the interests of people engaged in sanitation from the household down to the city and beyond to be reviewed and balanced.

The work of the Task Force is of course only a first step in this process but we hope that the membership of IWA will respond to the challenges which the task force has identified and commit to working towards improved quality of planning and design in urban sanitation systems so that the commitments made at the Millennium Summit can be met.

**László Somlyódy**
**IWA President**

# EXECUTIVE SUMMARY

Conventional approaches to sanitation planning and design seem to fail with depressing regularity. In developing utility situations where coverage is low, the norms and approaches that are being applied in general seem to result in too frequent failures which either sees the perpetuation of low access to services, or short term failures in operation and maintenance.

Current technical planning and design practices, based as they are on logical normative technical planning approaches, seem to be failing because:

- the objectives upon which decision are based are distorted by special interests, or by a poor understanding of the real needs of the population,
- they result in plans which do not respond to the rapidly changing urban context and diverse conditions which pertain in modern urban spaces;
- they fail to make a realistic assessment of short term inertia which impedes capital investment; and
- They result in systems which place an unrealistic management burden on all levels of the city.

In this document we argue that improving the quality and effectiveness of sanitation investments is not particularly about technologies (although the appropriate application of technology is important) rather it is about developing an explicit understanding of what the objectives of a system are and then designing a system which meets those objectives. We should not be surprised that *significant investments in wastewater treatment plants* often do not result in *significant improvements in access to sanitation services.* Likewise we cannot expect *subsidies which help poor families to construct on-site latrines* to result in *better overall sludge management in the city*.

The Sanitation 21 Task Force argues that technical planners and designers have to get smarter at planning systems which respond to the needs of the modern city. This requires a sea-change in the way technical decisions are taken, so that they can respond better to the human and political context in which they are made. Yet, paradoxically, what we are proposing is not rocket science; it's not very new at all. It draws on well-established principles of good planning and design practice from within the technical world and also from much thinking in the development world[1] All we are really saying is 'let's do planning and design better.'

We lay out an approach which:

- promotes an analysis of the objectives of a sanitation system across all domains of the city, *including the household* (other domains include the neighbourhood, city and beyond the city)
- promotes an analysis of the external drivers and contexts which impact on behaviour in each domain
- analyses technical options in terms which relate elements of the system to these domains
- encourages a realistic assessment of the management requirements in each domain; and then
- Prompts the planner/ designer to ask, will it work? Are the management requirements matched by management capacity throughout the system? Is what we are proposing *fit for the purpose?*

We hope this publication will form the basis for a real discussion amongst practitioners, designers and planners, so that sanitation investments in this century can be effective at meeting the needs of those who are currently unserved.

1 In particular for example Albert Wright, SSP, Roland Schertenleib/ John Kalbermatten, HCES, Steven Esrey Closing the Loop etc.

# SANITATION 21

## 1 BACKGROUND

### 1.1 The Scale of the Problem

The scale of the problem is enormous. This is because urban populations are growing, urban areas are becoming increasingly informal and coverage (our starting point) is extremely low, with the main challenges focused in the poorest countries.

**Urbanisation:** There is no doubt that one of the defining characteristics of the late 20th and early 21st centuries has been the rapid rate of urbanisation. During the 20th century, the world's urban population increased more than tenfold. Today, nearly half the world's population lives in urban centres, compared to less than 15 percent in 1900 (see **Table 1** and **Figure 1**)[1]).

**Growth of slums:** Within cities themselves exclusion and marginalization of the poorest appears not only to be deepening (the gaps between rich and poor widening) but also spreading, so that an increasing percentage of the urban population is living "outside" the systems of formal service provision. UN-HABITAT estimates

**% of total population which is urban**

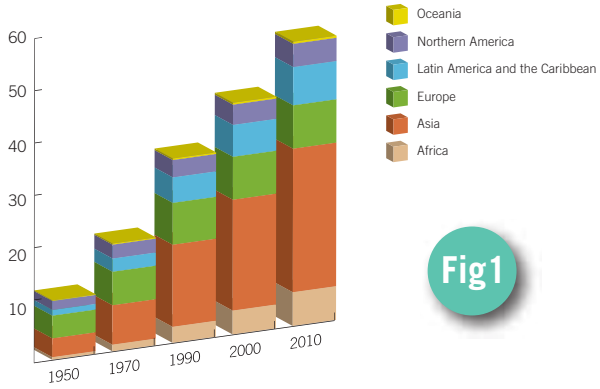



Fig1

Table1

**Urban population (millions of inhabitants)**

| Region | 1950 | 1970 | 1990 | 2000 | 2010 |
|---|---|---|---|---|---|
| Africa | 33 | 83 | 199 | 295 | 417 |
| Asia | 232 | 486 | 1012 | 1367 | 1770 |
| Europe | 280 | 413 | 516 | 529 | 534 |
| Latin America and the Caribbean | 70 | 163 | 314 | 393 | 472 |
| Northern America | 110 | 171 | 214 | 250 | 286 |
| Oceania | 8 | 14 | 19 | 23 | 26 |
| World | 733 | 1330 | 2273 | 2857 | 3505 |

indicate that in 2001, 924 million people, or 31.6% of the world's urban population, lived in slums. In developing regions, slum dwellers account for 43% of the urban population. If current growth rates are maintained, **by 2030, half of humanity will be slum dwellers.**

**Low Coverage:** The percentage of this urban population which is served with improved sanitation is difficult to determine. Official data are analysed and presented by the 'Joint Monitoring Program' (JMP) of UNICEF and WHO[2]. A summary of the latest data for urban sanitation coverage is shown in **Table 2** and illustrates the magnitude of the challenge; in 2002 **more than a quarter** of the urban population in **developing countries** was recorded as **not** having access to improved sanitation, **fewer than 40% had a house connection.**

**Low Coverage correlates with poverty:** **Table 2** also shows us that the situation is even more complicated for the **least developed countries.** Most observers suggest that the situation may in fact be much worse, since coverage of urban areas is often counted in terms of whether a settlement has a system in place sometimes with little attention to the status of the system, rather than by assessing household access to services. The correlation shows even more clearly in **Figure 2** which relates sanitation coverage against GDP and population. The figure indicates the general correlation between low coverage and low GDP per capita. More specifically:

1 Data in Table 1 and Figure 1 are derived from United Nations 2004 and cited in World Water Development Report 2005 Chapter on Water and Human Settlements (forthcoming). Figures for rural and urban populations for 1900 are drawn from Graumann, John V. (1977), "Orders of magnitude of the world's urban and rural population in history", United Nations Population Bulletin 8, United Nations, New York, pp. 16-33. Data for 2000 are aggregate national statistics, many of which draw on national censuses held in 1999, 2000 or 2001 – but some are based on estimates or projections from statistics drawn from censuses held around 1990. There is also a group of countries (mostly in Africa) for which there are no census data since the 1970s or early 1980s so all figures for their urban (and rural) populations are based on estimates and projections.

2 **http://www.wssinfo.org/en/welcome.html** The quality and reliability of the data in the JMP data set is subject to much debate and there is no doubt that the real picture may be slightly different; but in one essential aspect JMP tells the right story; the challenge is enormous and, at least in Africa, still growing.

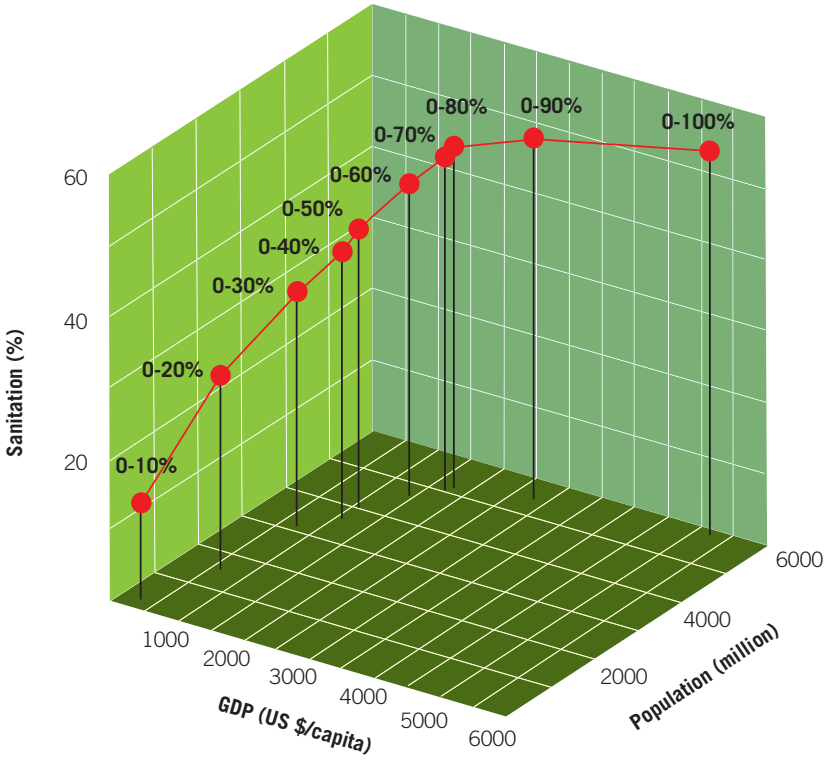



Fig2

**Sanitation Coverage and Wealth: All countries grouped by cumulative wealth decile showing % sanitation coverage, average GDP per capita and cumulative population.**

- About one-fifth of the world's population, living on approximately US$500 capita/pa, have just above 20% access.
- This figure rises to approximately 4 billion people (two thirds of humanity) living on approximately US$1000 capita/pa, with only 50% access to sanitation.
- The figure points to the redundancy of high technology, high cost solutions for the majority of the world's poorly served inhabitants

Moreover, these figures tend to mask the fact that (a) the quality of the coverage, the extent to which the sanitation systems which count towards coverage may be inadequate or sub-standard, and that (b) there is divergence between the relative rate of coverage and the rate of urban population growth (that is the rate of growth outstrips the rate of supply).

## Box 1

**A sanitation system:**
- **Collects** excreta
- **Transports** it to a suitable location and/or stores it for treatment
- **Treats** it
- **Reuses** it and/or **discharges** it to the environment

A *good* sanitation system also minimizes or removes health risks and negative impacts on the environment.

### 1.2 Benchmarking a 'Good' Sanitation System

In this paper we are going to discuss the many things that a 'good' sanitation system needs to achieve. To start at a simple level however, we can consider this definition (see **Box 1**) taken from a popular document widely used in the sanitation sector in developing countries[1]:

### 1.3 Areas of Controversy

This simple description however conceals a wide range of differing interests and incentives. In recent years the immense complexity of this discussion has occasionally been stereotyped into a conflict between those who promote 'conventional' networked sewerage and waste water treatment and those who promote 'closed loop' systems which in various ways seek to reuse the nutrients in human wastes as close to their origin as possible (see **Box 2**). But this stereotyping does

1 *Sanitation and Hygiene Promotion - Programming Guidance (2005)* Authors: USAID, WSSCC, UNICEF, WHO/PAHO, WEDC, the Water and Sanitation Program (WSP) and the London School of Tropical Medicine and Hygiene

2 JMP Data. There has been much discussion about the definition of access to 'improved sanitation' systems, For the purposes of JMP reporting an 'Improved Sanitation facility' may be connection to the public sewer, connection to a septic system, pour-flush latrine, simple pit latrine or ventilated improved pit latrine. JMP describes public or shared latrines, open pit latrines and bucket latrines as 'Unimproved sanitation facilities'._

Table2

| Summary of Coverage Data – URBAN Sanitation[4] | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Year | 1990 | | | | 2002 | | | |
| Population | Total | Served | % served | %. with house connections | Total | Served | % served | % with house connections |
| Global | 2,273,241 | 1,804,813 | 79% | 57% | 2,980,995 | 2,413,465 | 81% | 55% |
| All Developing Countries | 1,415,957 | 960,270 | 68% | 35% | 2,056,759 | 1,502,751 | 73% | 39% |
| Least Developed Countries | 190,043 | 55,612 | 51% | 6% | 184,990 | 105,444 | 57% | 7% |

a disservice to the main protagonists in the discussion who understand that urban sanitation systems are immensely complex.

Just how important is the environment and how do decision makers value its protection when assessing a range of sanitation options? When, if ever, is it justified to expend energy created by the burning of fossil fuels on cleaning wastewater? Is it fair to charge very poor people for the costs of wastewater treatment from which they experience no immediate private benefit? If this is not fair, how can utilities operate and who should pay them for the costs of running a system? How much can utilities be expected to promote environmentally optimum solutions if this results in no revenue for them? Can people who have no previous experience of recycling human wastes be persuaded to adopt such practices and who pays for the promotion of the approach?

These questions are just a few of those which should be addressed by system planners when initiating or managing urban sanitation systems. Often they are not because the decision making process is dominated by one particular type of decision maker – perhaps an engineer with highly technical knowledge, or perhaps someone from a development agency with a strong social agenda or a strong home-industry export agenda, or again it may be the environment agency or a donor with a strong commitment to environmental protection. But in all these cases opportunities for exploring the whole range of potential solutions may be lost and the agenda may be 'hijacked' by one particular interest group. This document seeks to provide a framework by which any decision maker can at least check what it is they are trying to achieve before committing to a particular technical solution.

# 2 WHY DO 'WELL-DESIGNED' URBAN SANITATION SYSTEMS FAIL?

## 2.1 Introducing a Problem

In some parts of the world there are sewerage networks which were constructed in the 19th century ; the brick arch main sewers are a wonder of 19th century engineering and are still in almost immaculate condition but many such sewers are still running at t fraction of their capacity more than 100 years after they were completed. In the City of Brussels, at the heart of Europe where environmental legislation is made for the countries of the EU, construction of the city's first wastewater treatment plant began only recently. South to the Governorate of Gharbeya in Lower Egypt; here the water and wastewater company runs some 16 wastewater treatment plants. Eight of these mostly new plants are running at less than 30% capacity while most of the population in the command area struggles with high water tables and overflowing septic tanks.

## Box 2: Technology blues?

**A debate in the pages of Water 21 from April 2005 illustrates well the problem of 'technology supremacists' in the sanitation sub-sector; a tendency towards professionals who advocate their own preferred system to the exclusion of all others. The polarisation of opinion that this leads to, and the energy expended in defending/fighting other systems is, at best flawed, and at worst an expensive distraction from the wider task at hand.**

**The debate was sparked by a commentary and analysis of the initial cost of Ecosan systems and the value of nutrients to be saved and used for food production when the systems are adopted. In turn, Ecosan system advocates responded in kind, focusing on and detailing the deficiencies and technical limitations of VIP and simplified sewerage systems.**

**The outcome from such a debate was a continued tendency towards entrenched positions, rather than a more mature analysis of boundary conditions and contexts in which individual systems perform well or poorly. Ironically, one of the points of convergence in the debate was an acceptance that more research was needed to support analysis. A little knowledge is a dangerous thing!**

**What is going wrong?**

All three systems rely on proven conventional sewerage. We know it can work. Surely then the conclusion has to be that these systems are either inherently inappropriate to the cities they are meant to serve, badly planned, badly implemented, or poorly managed. The exception is Brussels which perhaps illustrates a realistic approach to incremental development. Meanwhile many cities which have adopted alternative approaches to sanitation provision have seen an increase in illegal dumping of sludge. To help understand what might be going wrong below we take a look at three significant challenges relating to urban sanitation:

- The gap which exists between the interests of households and the incentives facing utilities/ cities;
- The lack of capacity and sense of ir prevails in many utilities/ cities; and
- The dynamics of urban developmer

In short we need to explore the reaso for poor decision making.

### 2.2 The gap between households and urban systems

#### 2.2.1 The Household Focus on Health

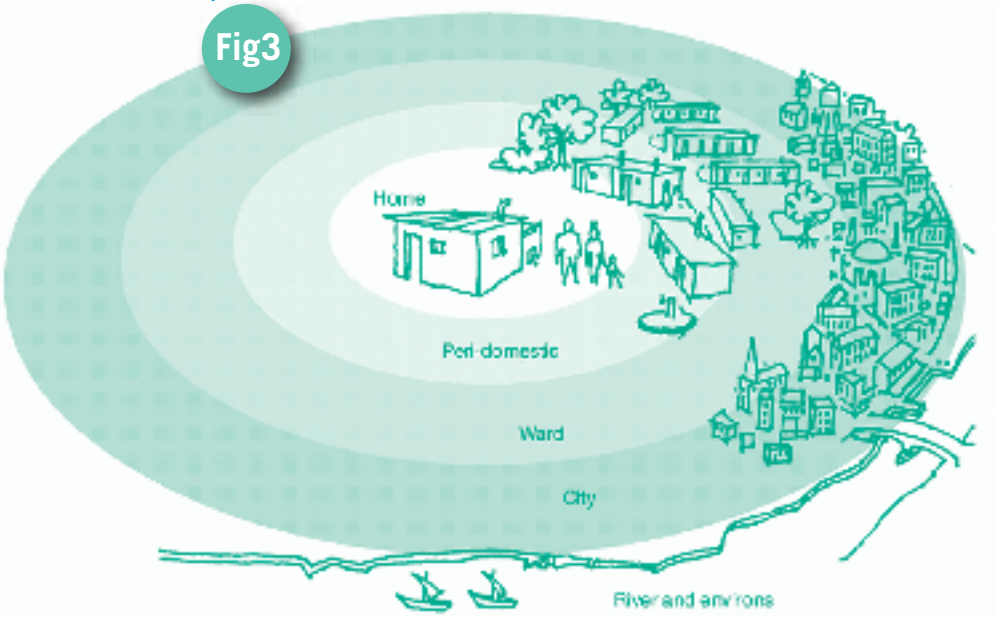
Sanitation investments are usually jus by concerns about environmental hea

Environmental health gains from such investments are driven to a very large extent by the impact that they have at the household level that is *in and around the home*.

This is where most people (especially children) spend most time, and are most vulnerable to contamination. In denser urban and peripheral urban areas the environmental priorities of most households mirror this focus – the first priority for most families is a clean and pleasant household followed by a better environment in the street and community.

**The household perspective on sanitation**

Fig3



There is rarely much concern for the wider environment of the city or downstream areas. Where competent utilities are operating and there is a history of environmental management, this simply translates into household willingness to pay (usually through a sewerage 'cess' – a tax or fee) for the utility to 'take care' of downstream issues. Where there is no 'trusted' or competent utility provider this translates into households or neighbourhoods discharging wastes downstream to contaminate the next quarter of the city or town (see **Figure 3** on previous page)[1].

### 2.2.2 The Utility manager's focus on the external environment and finance

By contrast service providers, often utilities, may have a focus on *water management* rather than *sanitation provision*, resulting in a particular focus on networked solutions. Even where utilities or service providers focus on alternative sanitation options external drivers such as environmental legislation, regulation or technical norms and standards may result in decisions which do not take household interests fully into account. Financial structures which steer investments from national to local governments may also have a bigger impact on investment decisions than household needs. Furthermore technicians may sometimes concentrate on designing the most efficient and technically elegant solution. These *institutional* constraints are significant and seem disproportionately to result in a decision to build a wastewater treatment plant. This, in turn determines the selection of the collection system (usually a sewerage network), the layout for trunk sewers and hence local technical choices for collection further upstream. Finally, at the household domain, options have been narrowed to the use of a water closet and a sewer connection, with all their associated financial implications. Many poorer households or those without water connections are automatically excluded. In informal settlements where the utility cannot or will not construct sewers the result is no connection and no service. Thus it happens that the utility/ city may have met a set of reasonable criteria and connected hardly anyone.

### 2.2.3 The Resulting Gap

Thus investments made at one 'end' of the system may have neutral or even negative impacts at the other end. Left without access to sewerage, households or communities may invest in local solutions (onsite pit latrines, local informal sewerage etc) which, since they are not officially recognised as part of the system, are at best unregulated with pit wastes and effluents for example being 'dumped' on downstream areas. Meanwhile utilities who invest heavily in expensive reticulated sewerage and costly wastewater treatment systems may seek to raise tariffs to offset these investments, or may charge high connection fees, or may exclude households who live in informal unplanned settlements from connecting – thus creating multiple barriers to households accessing an 'improved service.

Alternatively utility managers may decide to encourage and support the development of on-site systems but fail to put in place sludge management strategies.

1 This diagram is taken from the DFID Guidance Manual on Water Supply and Sanitation Programmes LSHTM/WEDC 1998. Section 2 of the guide provides and excellent summary of the health-analysis which drives much sanitation decision making and has contributed to the thinking about this framework.

## Box 3: Kibera – People in the Way

**In Kibera, Nairobi almost a million people reside in an unplanned and technically illegal settlement, many households have constructed rudimentary pits and many people make a living emptying them. Furthermore Kibera residents have consistently resisted removal and redevelopment efforts and represent a potent political force in the city. Nonetheless the city master plan depends on a network of trunk sewers, some passing through an area of well-planned housing right where Kibera lies today. Since these trunk sewers are a key element of the Nairobi sanitation system Kibera effectively prevents the development of the 'ideal' solution. As a result utility investments in sanitation for Kibera are more or less stalled despite goodwill on all sides to improve the situation.**

## Box 4: Development of Reticulated Sewerage in Western Europe and America

**The most widely used sanitation system in the developed world consists of toilet, sewerage, wastewater treatment and sludge management. Its development has a long history. The epoch-making innovation of the flushing toilet dates back to the end of the 16th century (though in a primitive form it was already used in the Royal Court of Minos, 3700 years ago). Its widespread use is the consequence of dramatic epidemics in the 19th century: the solution to this problem was by the combined application of toilets with a collection network which efficiently and safely removed pollutants and pathogens from homes. The system clearly depends on the use of large amounts of water as a transport media which obviously becomes contaminated.**

**Increased organic loads in rivers (such as the Thames, Ohio etc.) and their severe impacts (oxygen depletion, fish kills, unbearable smell etc.) led to the first introduction of wastewater treatment after the turn of the century. Activated sludge processes were discovered at the beginning of the 20th century, but the widespread application only took place during the 1960's and '70's. For instance, the first, relatively small municipal wastewater treatment plants in Vienna and Budapest started to operate in the 1960's when the core of the sewerage network was already nearly hundred years old. The large central plant in Vienna started to operate at the early 1980's, while an extended, advanced version came into production in 2005. Due to political and economic reasons, the development in Budapest was much slower: the treatment ratio remained 30 % for a long time; at present it is close to 60 % and will reach 95 % in about five years time when the new central plant in the South of the city will be completed.**

**Conventional sanitation is probably the only system which is widely and reliably used. It is "hidden", safe and an obvious part of our comfort with negligible or modest environmental impacts. Thus, seemingly it is the "perfect" solution. But is this really true in practice? The answer is "no" and reasons are manifold: (i) water consumption is high, (ii) the sewer network is expensive, (iii) maintenance is often neglected leading to in- and ex-filtration, and related problems, (iv) rehabilitation of ageing infrastructure requires tremendous investments - a serious issue of today in many parts of the world, (v) the ideal implementation model is missing nearly all the time: partial, often distorted infrastructure can cause severe pollution and other problems, and (vi) the system is not flexible and can not be adjusted to conditions changing over its long economic life. This is manifested in the developing world through frequent overloads, while in the Central and Eastern European countries; the huge reduction in wastewater generation due to proper water price setting after political change is the problem. Changing concepts - sustainability - and new technological options which would call for and allow closed water and material cycles on the household level also belong to this category. We need to cope with conventional sanitation where it exists, but would we design new systems on the basis of the same principles from the 19th century? And which concept would we follow for large scale and long term future rehabilitation?**

Either way the end result is a system with a 'gap' – a failure to connect target households to city-wide systems. The gap is critical; it prevents households from realising the health benefits they desire, and it prevents cities from realising the environmental benefits they have planned. It results in enormous wasted investment and may even result in a worsening of both the health and environmental conditions in a city[1].

### 2.3 Lack of Flexibility

The interests and incentives of households and utilities are not fixed. Over time the urban system is dynamic. Population growth, new settlements, formalisation of slums, redevelopment of inner-city areas, economic growth, commercial development and changing policy priorities will all change the way households and cities relate to sanitation. For many technicians used to working with well established mature utilities this dynamism comes as a surprise. Typically master plans propose an idealised end-point (almost invariably sewerage and centralised wastewater treatment) and a sequence of development steps to reach that end point, without taking into account the future growth and changing aspirations of the city. This idea of 'staged development' simply as steps towards a fixed end point fails to recognise two crucial facts. First that everyone, from the household to the city level, may change their interests over time and secondly that there is rarely a 'greenfield' sanitation site to start with. In most areas people have invested in some sort of sanitation even if it is only of the most basic kind (see **Box 3**)

Lessons from history should teach us that the development of 'conventional' sanitation in many western cities was itself the product of a dynamic and practical approach. Given more than a

1 No-one knows the full extend of this 'failed' investment, but many sector practitioners recognise that it is very large indeed and may dwarf the effective investments which have been made over the past 25 years.

## Box 5: Are we dealing with Single Sanitation Systems?

**The answer is no: due to reasons of historical development, variable population density within a city/settlement and many other reasons, mixed schemes exist most of the time. By way of example, we can use the case of Hungary where the last two decades have brought tremendous developments. Sanitation is based on conventional systems approach. The overall setting is probably typical for Central Europe and a large part of the old continent. What can we see in the summary table below?**

**Ratio of population connected to the collection network in Hungary, depending on settlement sizes**

| Settlement size | No. of settlements | Sewerage % |
|---|---|---|
| Budapest | 1 | 95 |
| > 100 000 | 8 | 82 |
| 25 000 – 100 000 | 39 | 73 |
| 10 000 – 25 000 | 93 | 63 |
| 5 000 – 10 000 | 141 | 44 |
| 2 000 – 5 000 | 500 | 39 |

**We note that with decreasing settlement size, connection to the sewerage system is decreasing while sanitation is solved one way or another nearly everywhere. Thus in the > 2 000 population range, 5 % to 60% of the population relies upon a system other than conventional. It is a septic tank combined with wastewater transportation to treatment plants which is accepted by legislation in many countries in Europe or on-site treatment depending on groundwater vulnerability. On average in towns above 100 000 inhabitants, about 20 % of the population use local solutions, but this ratio for individual cases may reach 40 %. In the course of the coming decade sewerage and wastewater treatment will be further developed (the present country wide connection level is close to 65 %), but the presence of mixed systems will remain for economic and other reasons. In reality, we have mixed solutions operating nearly all the time.**

100 years of reliance on networked sanitation however, this understanding appears to have faded from the collective professional consciousness (see **Box 4**). Furthermore the idea that a single unified technological approach is necessarily appropriate for the entire urban space has clearly been demonstrated to be faulty (see **Box 5**) but still apparently features in many discussions and sanitation master plans.

### 2.4 Inertia and Capacity

In addition to this 'mismatch' between the objectives of different domains of the city, there is also the problem of inertia. Since household demand for sanitation is often suppressed, there may be little upward pressure on city governments and utilities to ensure that sanitation investments are made and made effectively. Furthermore, as attested by the proceedings of almost every urban sanitation workshop held in the last 20 years, roles and responsibilities for sanitation in urban areas are often poorly articulated, conflicting and mismatched with staff and financial capacities to fulfil them. The result, in the absence of a clear budget line in a competent agency, is inaction and worse, a resistance to action, since everyone's responsibility becomes no-one's responsibility.

When action is taken, poor planning and lack of focus on long-term operation and maintenance requirements may often result in the construction of sanitation systems whose requirements far outstrip the capacity of the relevant agency. This is the underlying reason why we often find sewage pumping stations operating with the wet-well in flooded condition, and the upstream sewers surcharged; to reduce the electricity bill of the utility's district office. This is also why trunk sewer networks may lack branches and branches may lack connections; because there are no staff and no funds to extend the service up to the household. This is why on-site sanitation systems may fill up and pits remain full, or sludge may be removed by households and dumped into the storm drains; simply because there is no budget and no staff for downstream sludge management.

While the international conferences call for better coordination, it may be more pertinent to call for greater accountability to deliver a project with well

articulated objectives, a clear budget line for capital and operational expenses and more realism when assessing the management requirements of new-build sanitation systems.

### 2.5 In Summary: Matching Supply and Demand

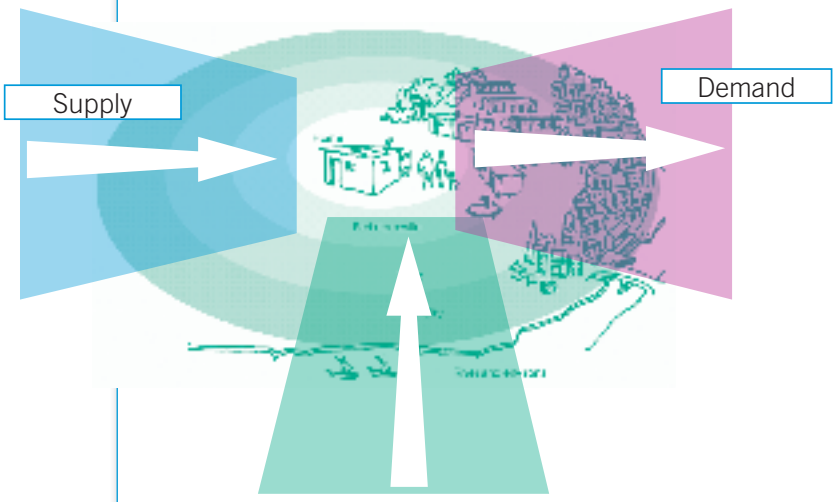
In summary current practice, based as it is on logical normative technical planning approaches, may often fail to because:

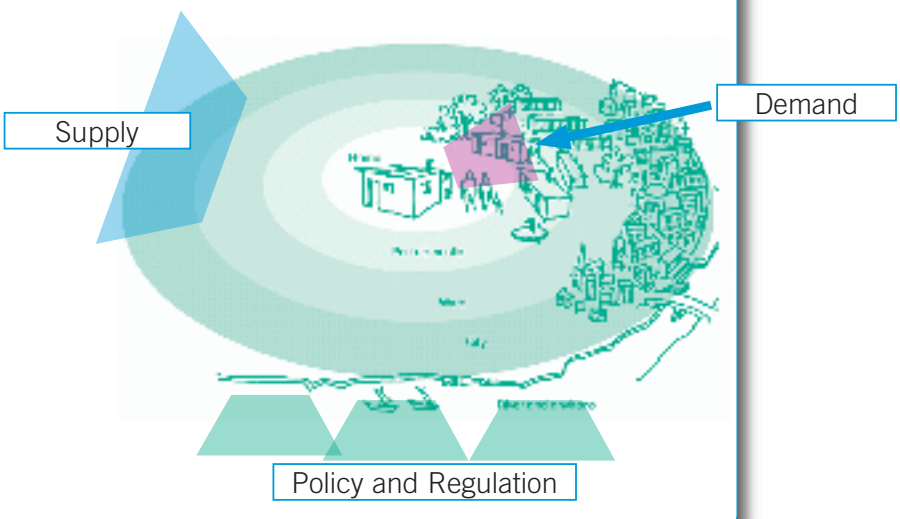
- they do not take into account the mismatch between the objectives which drive investment decisions across the domains of the city, allowing one set of objectives to outweigh another;
- they cannot respond to the rapidly changing urban context and diverse conditions which pertain in modern urban spaces;
- they fail to make realistic assessment of short term inertia which impedes capital investment; and
- they result in systems which place an unrealistic management burden on all levels of the city.

In short, looking back at **Figure 3,** what we commonly find are systems which across all domains of the city fail to match the supply of an appropriate service to the demands and capacities of the actors in that domain. Understanding this dynamic better is essential if the quality and effectiveness of sanitation investments is to improve and if objectives are to be widely met (see **Box 6**)

## Box 6: Matching supply and demand

A recent analysis of sanitation in Dar Es Salaam showed that far from the supply of services reaching households (see left) there was a total mismatch between the limited supply of networked sanitation and the strong demand for services from households (see below). The weak regulatory and policy environment did little to change the status quo. (For more information see **section 4.3** below).



# 3 The Framework

In this section of the document we have drawn on the arguments in Section 2 above to develop an approach which could improve the quality-at-entry or planning of urban sanitation systems. It is simple, and based on principles of good planning, but clearly the gaps we have identified suggest that good planning must sometimes be missing in reality. In the following three sections we will see how to analyse context across the domains of the city; how to develop or evaluate a range of technical options and then use a simple framework to show that optimum solutions are those where the latter satisfies the former across all domains of the city.

# PART ONE: The Context

## 3.1 Decision Making Domains

To help understand how interests and incentives play out across the city, we have used a simplified version of **Figure 3** where the city is divided into five domains. In reality the domains of a city vary enormously with social and political norms and structures, so this approach can be applied flexibly to the situation that the reader is actually considering. IN general however in the sections below the following generalised terminology is used to describe the domains of the city:

- **Household** to describe the personal sphere within which households (families, individuals, small units etc) take investment and behavioural decisions;
- **Neighbourhood/ ward/ district** to describe a continuum of 'areas' within the city at which level households either act jointly, are jointly represented by the political process or can be organised for planning purposes;
- **The City** to describe the level at which services are centrally planned and organised, and financial decisions are taken; and
- **Beyond the city** to describe the sphere in which policy and practice is set which impacts onto decisions made at the city level.

## 3.2 Objectives and Interests

### 3.2.1 Developing a checklist

As we already saw in **Section 2** there are a wide range of interests and objectives which may come into play when an urban sanitation system is being planned. These variable interests arise partly because there are usually a number of 'stakeholders' or interested parties each of whom has a different perspective on the problem. For example, while the elected government of the municipality may have an over-riding interest in cleaning up the city and preventing outbreaks of disease, the river basin authority may be more interested in preventing pollutants from entering the basin system[1]. Beyond **health** and the **environmental protection**, other interests for different stakeholders may include:

- Economic development
- Improved water resources management
- Poverty reduction
- Improved urban planning or
- Reducing operational costs

The way different interests play out depends to a large extent on power relations and incentives between actors in different domains. The interest of a design consultant to minimise reputational risk by recommending a 'conventional' solution involving networked sewerage with limited technical innovation may, for example, outweigh the interests of poor households whose interests are to gain privacy and dignity while minimising upfront costs. Thus poor households may remain excluded because connection fees to the network are prohibitively high.

**Annexe One** contains a summary of our preliminary analysis and discussion about how different interests/ objectives are likely to impact on system decisions in each domain of the city. The analysis is discussed briefly in the sections below and summarised in **Table 3**.

1 The analysis will also vary enormously in different contexts which have differing institutional arrangements.

**Checklist of Contextual Factors** Table3

| DOMAIN | Context | | |
|---|---|---|---|
| | **INTERESTS/ OBJECTIVES** | **External influencing FACTORS** | **CAPACITY**<br>**Actors**<br>**Mandate**<br>**Human Resources**<br>**Budget** |
| Household | **Primary**<br>• Status<br>• Cleanliness<br>• Convenience<br>**Secondary**<br>• Health (secondary) | • Levels of poverty<br>• Access to service providers<br>• Influence on downstream systems<br>• Land Tenure | Gender relations, decision making within the household, household finances.<br><br>Interests likely to be highly dynamic over time. |
| Neighbourhood | **Primary**<br>• Status<br>• Cleanliness<br>• Community services<br>**Secondary**<br>• Health | • Levels of poverty<br>• Access to service providers<br>• Influence on downstream systems | Community cohesion is important. |
| Ward/ District | **Primary**<br>• Status<br>• Cleanliness<br>• Health<br>**Secondary**<br>• Environmental protection<br>• Economic development | • Relations with the city (political and social)<br>• Financial structures | Role of wards in local political processes<br><br>Local budgets/ links to community/ ability to raise funds locally<br><br>This level of analysis may not always be relevant |
| City | **Primary**<br>• Environmental protection<br>• Economic development<br>• Formalisation of the city<br>• Health<br>• Utility cash flow<br>**Secondary**<br>• Achieving water security/ food security<br>• Promoting urban and rural development | • Decentralisation<br>• Economic priorities/ profile<br>• Strength of external policy drivers<br><br>NOTE also the importance of seemingly insignificant policies which often drive technical decisions. | City institutions may themselves be disparate and even in conflict. May include elected body, administrative body, utility etc. |
| Beyond the city | **Primary**<br>• Environmental protection<br>• Economic development<br>• Achieving water security/ food security<br>**Secondary**<br>• Achieving equity and increasing access<br>• Meeting the MDGs | • Economic priorities/ profile<br>• International/ regional water sharing issues<br>• Political priorities | River basin management is usually weak, particularly institutions. Basic environmental legislation may over-ride holistic planning. Also consider power relations between the city (both institutions and individuals) and external/ national institutions |

### 3.2.2 At the Household Level

Householders usually change their attitude to sanitation over time so understanding household interests is not a static one-off exercise. Commonly households are interested in improvements to their immediate environment, including improving privacy and safety for family members as we discussed above. Marketing experts understand that the level of household interest (demand) will be dynamic and depends on:

- **Awareness** - household knowing that sanitation goods/services exist and have benefits which could satisfy their interests (usually **status**,

**cleanliness** and **convenience/ privacy/safety,** occasionally **health**).

- **Priority** – household having sufficient cash and interest to steer expenditure towards sanitation (i.e. deciding to build a latrine rather than buy a sewing machine or an extra TV)
- **Access** – households being able to get the service (households may place a priority on sanitation but they will not make an investment if they cannot find a mason to build a toilet or if they do not meet legal requirements for a formal connection to the sewerage network for example
- **Influence** – households may often hesitate in making an investment in sanitation if they are unsure about the 'downstream' system. For example where utilities have a poor reputation for operating and maintaining collector sewers households may not want to invest in a connection if they feel they are powerless to influence the utility's performance in their area. Such hesitations are often overcome for example through the intermediation of a local councillor who can act as an intermediary for a poor community with the utility company. Utilities which develop a track record of good performance may find it increasingly easy to encourage households to connect to their networks.

Households who have no prior experience of a working sanitation system thus move gradually towards being willing to invest in household level infrastructure and services. Their attitude at any time is impacted both by internal factors (household knowledge, wealth, priorities) and external factors (performance of the city/ utility, availability of artisans etc)[1].

### 3.2.3 At the neighbourhood and ward/ district level

The interests of the neighbourhood are still likely to be heavily focused on cleanliness and status and some urban communities also see collective service delivery as a means to general stronger social cohesion; part of the development process itself. However, the ability of communities to express ideas and act may be severely constrained. Many have other priorities and in many cases there is in fact no 'community' at all – simply people living in the same area in an atmosphere of extreme stress.

Like households though, community attitudes and interests change over time and are strongly affected by external factors such as levels of poverty and the nature of city authorities and utility service providers. Community capacities and cohesion may grow with other development activities.

The importance of the *political* ward/district will vary in different institutional contexts. In many cases the boundaries between the 'community' and the ward are blurred, particularly where local elected councillors are active. Interests at this level are still likely to focus on cleanliness and status but may also include health, particularly where responsibilities for health services are devolved to this level.

In reality there may be one or more than one domain at this level – each case needs to be assessed individually depending on the dynamics of communities and the realities of political organisation in any given city.

### 3.2.4 The city

The objectives of city authorities are strongly impacted by (a) who those authorities are and (b) the external incentives they face through higher levels of government (incentives which may be created by financial flows, penalties, electoral relationships and law). Generally at the city level the focus shifts markedly away from convenience, status and access, towards protecting the economy and environment of the city, and meeting externally-established targets. Health also becomes more prominent here, as major outbreaks of disease impact directly on the political credibility and economic attractiveness of the city. Where financially independent utilities exist, financial considerations will also come into play at this level.

### 3.2.5 Beyond the City

Finally beyond the city, considerations around the management of water resources, food resources,

1 While it may seem strange for professionals working in areas with well established sanitation systems that households may be unwilling or unable to make investments in sanitation, it is important to recall that for most cities it is less than a 150 years since the existence of networked sanitation began to become a norm, and in many cases less than 75 years since internal plumbing became standard for new-built dwellings.

the protection of the environment and macro development considerations (usually focused on economic development) come into play. At this level primary objectives are rarely to do with household access and are concerned with the impact exerted by the city on wider society. Heath and access will remain secondary concerns of course; most national governments are strongly committed, at least on paper, to a general improvement in health status and in meeting the MDGs. Relationships with water users downstream (which may be international users) may also impact at this level.

### 3.3 External Influencing factors

From the above sections we can also see that in addition to internal objectives, for actors at each level there are external factors which tend to influence decision making. Many of these create incentives for actors to make particular decisions. For example poverty, tenure security or insecurity and the relationship with service providers will all influence how households act even if their objectives are clear. Further 'downstream' external policy drivers become more important so that wards may be influenced by city politics and cities by national policies, financial structures and economic priorities. Interestingly it is probably only at the 'beyond city' domain that international commitments to targets such as the MDGs become relevant.

A key group of external influencing factors can be categorised as technical norms and standards – either those practices which have become standard through widespread application, or those which are enshrined in technical standards, design manuals, standard bills of quantities and sometimes even in law. Technical norms and standards can influence both the types and levels of service which are put in place and which 'count' towards national or local targets, and can also influence the cost of delivering certain types of service, thus influencing investment decisions. While written norms are difficult to deal with, unwritten ones may be harder still (see **Box 7**)

A checklist of indicative external influencing factors is shown on **Table 3.**

## Box 7: Standards and Regulations – checks and balances or barriers to innovation?

**In El Alto, Bolivia, a partnership between the water operator, the regulator and civil society groups, with support from external support agencies, was required to introduce and normalise the use of condominial sewers to serve an area of the city which had very low coverage. The local population were unwilling to adopt any form of on-site sanitation due to their cultural beliefs, but there was initial reluctance on the part of the water company to provide conventional sewerage which, due the demanding technical standards in place, had a very high investment cost. Furthermore, very low water consumption cast doubt on the viability of conventional sewers. By creating political 'space' for innovation, the external support agencies were able to facilitate a change in approach which has ultimately resulted in a change in Bolivia's national standards to allow some forms of shallow and condominial sewers.**

**By contrast in Linz, Vienna, an innovative attempt to equip a new area of housing with ecological toilets employing urine separation has fallen foul of external concerns about the safety of reusing human excreta in agriculture. A lack of formal consultation early in the process may have resulted in construction of a system which, while viable, cannot be used effectively.**

**For more information see TF case studies summarised in Section 4.3**

### 3.4 Actors, Mandates, Manpower and Budgets

The final group of crucial contextual factors relates to the capacity of actors in each domain. Capacity can be analysed using full-blown institutional analysis but this sometimes generates such a wealth of information that key issues get lost. The key question is; at this level, who are the actors

who have an interest in promoting or hindering progress on sanitation and what are their capacities in terms of mandate, staff power and skills and crucially funds.

### 3.5 The Context Checklist

Based on our interpretation of the order of importance of interests, external factors and capacity considerations we have developed the following generic checklist (**Table 3**). **Table 3** can be used as a starting point for assessing the context within which sanitation systems are operating. Clearly the details of the analysis will vary between different towns and cities. The broad outline however holds good for a wide range of cases and is worth examining in detail. A range of tools are available for assessing the drivers/objectives in detail at each level. These are summarised in **Annexe 2**.

# PART TWO: Technical Options

### 3.6 The components of the system

In systems-terms sanitation consists of some combination of:

- A toilet
- Collection mechanism
- Transportation mechanism
- Treatment process
- Disposal/ re-use mechanism/ process.

Engineers or technicians generally consider themselves familiar with the full range of technical options for each of these components. However, in many cases, they exhibit biases which may exclude some options from consideration altogether. To illustrate, a list of technologies taken from a recent publication on 'Smart Sanitation Solutions'[1] is shown in the first column of **Table 4**. Alternative options, taken from a more 'conventional' source with a focus on networked sanitation are included in the second column of the table. Both lists have merit in their own right – for the situations for which they were developed. But it only when they are taken together that the two columns begin to show a more comprehensive listing of technical options; and even then the list is probably not complete. Taken alone neither column presents the full picture.

This table also illustrates an interesting effect of making the fundamental assumption that networked conventional sanitation is to be used; options for wastewater treatment proliferate, but options further upstream are extremely constrained. For example water borne sewerage requires water flushed toilets and its use precludes most other toilet options. By contrast non-networked and dry systems present more choices and options at the toilet/ collection end of the system while also offering some additional treatment/disposal/ re-use options.

### 3.7 The system as a whole

Of course, technical choices made for each component of a system are highly interdependent (no engineer would suggest the need for a cartage approach if water closets are in use). But if technical assumptions are fixed and not challenged some of the objectives of the sanitation system we discussed earlier may not be achievable. To expand on the example given above, if only water flushed toilets can be used because networked sewerage has already been selected, then only people with house connections to the water system are likely to be connected to sanitation. If the utility only serves 40% of the population, then the remaining 60% are by definition not going to benefit from investments made in sanitation. Similarly, if water flushed toilets are the norm and a networked sewerage system exists, but there is neither land nor operating budget available to run a wastewater treatment plant, then downstream waterbodies are going to receive large volumes of untreated effluent and environmental objectives may not be achievable.

The challenge for the planners, designers and managers of the system is, while understanding all the drivers and options, to balance the objectives

1 *Smart Sanitation Smart Sanitation Solutions - Examples of innovative, low-cost technologies for toilets, collection, transportation, treatment and use of sanitation products (2006) Netherlands*
Water Partnership, WASTE, PRACTICA, IRC and SIMAVI. This publication as its title suggests is an excellent introduction and practical guide for use of more innovative and less 'conventional' technologies which can have many advantages in the right circumstances. The authors are clearly aware of a much wider range of options but have chosen to focus attention on non-networked solutions because of the relative lack of attention they usually attract.

Table4

| Some technical options for components of the sanitation system | | |
|---|---|---|
| | **Non-networked and non-conventional networked** | **Networked** |
| Toilets | • Dry toilets<br>• Dry urine diversion toilets<br>• Pour flush slabs<br>• Waterless urinals | • Water closet (various types) |
| Collection | • Fossa Alterna<br>• Oil drums and containers<br>• Vaults and Chambers | • Collectors/ secondary sewers |
| Transportation | • Cartage systems<br>• MAPET and Vacutug systems<br>• Settled sewerage (small diameter) | • Main sewers<br>• Sewerage pumping stations |
| Treatment/ re-uses | • Co-composting<br>• Dehydration<br>• Planted soil filter<br>• Anaerobic digestion | • Baffled reactor<br>• Upflow anaerobic filter<br>• Upward flow anaerobic sludge blanket reactor<br>• Facultative and maturation waste stabilisation ponds<br>• Constructed wetlands<br>• Duckweed ponds and other aquatic plant systems* |
| Disposal/ re-use | • re-use of wastes in gardens, urban agriculture or sale to agricultural market | • Disposal to downstream areas<br>• Some reuse of sludge |

* These last two are not strictly 'conventional' but are definitely only appropriate for use with networked systems

and identify the optimal solution for a given situation at a given time.

Further challenges and constraints arise from what might be considered more 'conventional' technical considerations – including ground and groundwater conditions, availability of water, social practices, and the need to handle grey water and stormwater.

## 3.8 Making use of some Generic systems

To avoid the need to consider every permutation of technical components even where these are not realistic, various publications and organisations have developed generic urban sanitation system 'types' which can be used to simplify the planning process. To assist with the discussion here we are adopting this approach and have identified eight generalised system types. These are summarised below and in **Table 5**.

### ON-SITE DRY SYSTEMS

Dry systems are appropriate where water is not required for anal cleansing. A simple or double pit latrine is used, with urine infiltrating away through the bottom and sides of the pit. Excreta are stored for a period during which treatment occurs and the material can subsequently be re-used as a soil conditioner. The level of treatment will vary and some latrines use composting technology including the addition of materials such as ash or organic matter which improve the quality of the end product. Particularly in urban areas, wastes from simple latrines may be collected (using hand carts or similar) and transported to a location in the neighbourhood or ward for decentralised treatment, often using composting technologies.

An advanced form of dry sanitation uses a specially designed latrine pan to separate urine and faeces. Urine is then available for use as a fertiliser, whiles

Table5

**Sanitation Systems Typology**

| SYSTEM | General Description | Technical options | | |
|---|---|---|---|---|
| | | Toilet | Grey water | Stormwater |
| 1A<br>On-site dry | Dry latrines hygienisation and re-use of excreta in gardens. | Twin pits or , composting toilet | Infiltration, onsite reuse or discharge into drains | Onsite reuse, infiltration or discharge into drains |
| 1B<br>On site dry with (semi-) centralised treatment | Dry latrines, collection & treatment of faecal sludge at neighbourhood or city level before reuse in agriculture | Simple pit latrines | Infiltration or discharge into drains | Infiltration or discharge into drains |
| 1C<br>On site dry with urine diversion | HH latrine with urine separation. On-site reuse of urine in garden. Faeces dehydrated on-site. Possible reuse onsite or further downstream | Urine separating latrines, co-composting toilets, twin pits | Treatment and reuse at household level (eg constructed wetland) | Infiltration or discharge into drains |
| 2A<br>On site semi wet (pour-flush) | Latrine system at hh level with infiltration of liquid wastes, emptying of faecal sludge when full (additional hygienisation?) and reuse in garden or disposal | Twin pit pour flush or similar | Infiltration, onsite reuse or discharge into drains | Infiltration, onsite reuse or discharge into drains |
| 2B<br>On site wet with (semi) centralised treatment | As 2A with faecal sludge evacuation system, transport and treatment on neighbourhood or centralised level before reuse in agriculture | Twin pit pour flush or similar may have septic tank or ABR | Mixed with blackwater and treated on hh or neighbourhood level, infiltrated or reused in garden and agriculture | On-site use or infiltration as in 1A; discharge into drains, possible reuse in agriculture |
| 3A<br>Waterborne with (pre) treatment and (semi) centralized treatment | Toilet with on-site pre-treatment linked to small bore sewerage system. | Pour flush or flush toilet with septic tank/ vault or similar | Mixed with blackwater and transported for treatment | Discharge into drainage. |
| 3B<br>Waterborne with (semi) centralized treatment | Same as 3A however without pretreatment on hh level and uses simplified sewers | Pour flush or flush toilet | On-site use or infiltration as in 1A; or else discharge into drains for evacuation and discharge in surface water or reuse in agriculture | On-site use or infiltration as in 1A; or else discharge into drains for evacuation and discharge in surface water or reuse in agriculture |
| 3C<br>Waterborne with centralized treatment | Flush toilets and conventional combined sewers | Flush toilet | Mixed with black water in the sewer | Mixed with blackwater – possibility of storm-overflow and discharge to water bodies. |

Table6

| Sanitation system options and Management Requirements | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| DOMAIN | 1A Onsite Dry | | 1B Onsite Dry with semi centralised treatment | | 1C Onsite Dry with urine diversion | | 2A Onsite semi wet (pour flush) | |
| | Sanitation Elements | Management | Sanitation Elements | Management | Sanitation Elements | Management | Sanitation Elements | Management |
| House-Hold | Toilet Collection Treatment Disposal | MEDIUM: Management and reuse of pit wastes | Toilet Collection | MEDIUM: Responsible use of the toilet | Option 1 Toilet Collection Treatment Re-use | HIGH: Household use of urin divering toilet and management ov urine and feaces re-use | Option 1 Toilet Collection Treatment Re-use | HIGH (1) MEDIUM (2): Responsible use of the toilet, management ot twin pits, re-use of treated wastes |
| Neighbour-hood | | | Option 1 Transport Treatment Disposal or Re-use | HIGH: Responsibility for management of pit emptying and treatment facilities (could be community/ district govt or small scale private operation) | Option 2 Transport Re-use | MEDIUM: Where households have no demand for re-use oncsider if there are options for re-use further downstream. If so what are the management and regulation requirements? (could be community/ district govt or small scale private operation) | Option 2 Transport Re-use | MEDIUM: Where households have no demand for re-use oncsider if there are options for re-use further downstream. If so what are the management and regulation requirements? (could be community/ district govt or small scale private operation) |
| Ward/ District | | | | | | | | |
| City | | | Option 2 Transport Treatment Disposal or Re-use | HIGH: City responsibility for treatment (with local community or private sector) collection, or possible private operation of treatment | | | | |
| Beyond the city | | | Sub-Option 3 Transport Re-use | HIGH: Base decision on whether there are acceptable disposal/ re-use options? | Sub Option 3 Re-use | HIGH: Is there a market for re-use of materials? | Sub Option 3 Re-use | HIGH: Is there a market for re-use of materials? |

**Sanitation system options and Management Requirements (cont.)** Table6

| DOMAIN | 2B Onsite wet with (semi) centralised treatment | | 3A Waterbourne with pre treatment and (semi) centralised treatment | | 3B Water bourne with (semi) centralised treatment | | 3C Waterbourne with centralised treatment | |
|---|---|---|---|---|---|---|---|---|
| | Sanitation Elements | Management | Sanitation Elements | Management | Sanitation Elements | Management | Sanitation Elements | Management |
| House-Hold | Toilet Collection | MEDIUM: Responsible use of the toilet – requires adequate water | Toilet Pre-treatment | MEDIUM/HIGH: Household responsibility for pre-treatment – consider availability of small operators to empty silt traps etc. | Toilet | LOW | Toilet | LOW |
| Neighbour-hood<br>Ward/ District | Option 1 Transport Treatment Re-use | HIGH (1) LOW (2): Where households have no demand for re-use oncsider if there are options for re-use further downstream. If so what are the management and regulation requirements? (could be community/ district govt or small scale private operation) | Option 1 Transport Treatment Disposal | HIGH (1) Low (2): Management options: could be community/ district govt or small scale private operation | Option 1 Transport Treatment Disposal | HIGH (1) LOW (2): Management options: could be community/ district govt or small scale private operation | Transport | LOW |
| City | Option 2 Transport Treatment Disposal or Re-use | MEDIUM(1) HIGH (2): At city level treatment options include combination with conventional wastewater treatment | Option 2 Transport Treatment Disposal or Re-use | MEDIUM (1)HIGH(2): City responsibility for public or possible private operation of treatment. Re-use has high management requirements | Option 2 Treatment Disposal | MEDIUM (1) HIGH (2): City responsibility for public or possible private operation of treatment. Re-use has high management requirements | Option 1 Treatment Disposal | HIGH: City responsibility for treatment public or possible private operation of treatment. Re-use has high mgt. requirements |
| Beyond the city | Sub-Option 3 Transport Disposal or Re-use | HIGH: Base decision on whether there are acceptable disposal/ re-use options? How will this be financed? | Sub-Option 3 Transport Disposal or Re-use | HIGH: Base decision on whether there are acceptable disposal/ re-use options. High management requirements | Sub Option 3 Re-use | HIGH: Is there a market for re-use of waste – this has high operational costs. | Sub Option 2 Re-use | HIGH: Is there a market for re-use of waste – this has high operational costs. |

faeces is treated in the pit and re-used.

Grey water and stowmwater are either handled separately through the drainage network or can separately or jointly be disposed of through infiltration depending on local climate and ground conditions.

**Semi wet systems**

Where water is used for anal cleansing on-site systems must handle additional water. This can be done by infiltration, with semi solid wastes being treated onsite in latrine pits, composting pits or similar in which case the most common latrine technology is the twin-pit pour-flush latrine. Alternatively or wastes can be collected onsite and removed for further centralised or decentralised treatment. In this case, pre-treatment in a septic tank is an option. The nature and cost of collection and treatment is determined in part by whether grey water is separated and dealt with separately (through infiltration, drainage, or re-use) or mixed with black water.

**Waterborne systems**

Water borne systems can be clustered into three groups. The first group uses pre-treatment of some kind (septic tank, ABR or a settling chamber) and only black and grey water are transported using small-bore sewers for decentralised or centralised treatment. The second group dispenses with pre-treatment but, keeping grey and stormwater separate is able to make use of simplified sewers to transport excreta for treatment. Finally in a conventional system, black, grey and storm water is handled together in combined sewers or through conventional separate sewers.

In the case of waterborne sewerage the opportunities for re-use of treated wastes are fewer than for the other system types, and re-use tends to move progressively downstream. In the case of conventional sewered sanitation, re-use of faecal sludge wastes is only rarely an option, tends to have high costs associated, and is dependent on moving wastes well away from the urban area.

### 3.9 Management Requirements

In addition to technical considerations, we argue here that the management implications of sanitation system choice have a major impact on the outcome in terms of long term sustainable operation. The evidence of failed systems (see **section 1** above) suggests that sufficient attention is not being paid to the nuances of management requirements of sanitation systems. This may be because management responsibility is not analysed across all the domains of the city and all the elements of the sanitation system selected; thus attention may be paid to capital costs for on-site sanitation systems but long-term sludge management questions remain unanswered, or by contrast in a conventional system finances for operation of the wastewater treatment plant are analysed in detail but the costs of purchasing in-house plumbing and the additional costs of water usage to households are not factored in.

In **Table 6** we show how the choice of technical system can impact management requirements.

## PART THREE: Fit for Purpose?

### 3.10 Does It Meet Objectives?

The key step in the framework comes when assessing how well a proposed (or existing) sanitation system fits with the context. The first question (although rarely asked) should be whether it is likely to meet objectives. For example in a situation of constrained finances, a decision may be taken that the system will not include secondary wastewater treatment. An early question should then be whether this will impact on the city's and wider environs' objectives. If yes, then this flags a potential challenge which requires either (a) a change in the design or (b) a process whereby downstream expectations can be managed in the short term and longer term plans for enhanced wastewater treatment set in place. By contrast, an investment which focuses on providing water closets may not meet the objectives of poor households if they do not have a water connection or cannot afford the internal plumbing required to connect to the system. Changing objectives over time can also be considered – in terms of whether what is proposed is likely to meet objectives in 5 or 10 years time for example, and if not, whether the system has flexibility built in to enable it to

be brought up to another level at a later date if appropriate.

### 3.11 Do the Management Requirements Match?

Having assessed whether the objectives are met, systems can also be assessed in terms of their management requirements. Here the process of analysis which divides the city into domains assists because it enables a disaggregated assessment of whether sufficient skills and finances exist in each domain to effectively operate the system. Where management requirements do not match with existing capacity adjustments to the design are possible which either shift responsibilities up or down the system or alter the management requirements at a given level. Thus for example if the costs of pumping are excessively high throughout the network this may point to the need to consider shallow sewers with significantly lower pumping costs. This in turn may shift some management responsibilities upstream to neighborhoods and households which in turn can be assessed against available capacity.

A key point here is to anticipate potential cuts, particularly in funding and manpower, which may possibly arise in the future and consider how vulnerable a system may be to such, often political, decisions.

### 3.12 Does it/ Will it work?

Finally, it should be possible to ask and answer the question "will it work?" or for existing systems "does it work, and if not, why not?" **A useful test at this point in the analysis is to ask the open question "what could go wrong?"** Using the framework, potential challenges can be identified from the upstream to the downstream end of the system. Once again, the framework is not a scientific tool for this purpose but rather a way of thinking that helps to ensure that elements and potential problems are not overlooked.

# 4 Using the Framework

### 4.1 Simple depiction of a complex problem

This framework of course does not really capture the enormous complexity of the challenge of urban sanitation. In reality urban sanitation planners and designers need to take into account a wide range of additional factors. What it does do however is serve as a useful preliminary tool to outline the options and to open a debate about the real *objectives* of a given sanitation investment; to raise the right questions systematically. It enables stakeholders to evaluate their interests alongside some of the technical drivers which might otherwise be used in isolation to develop technically 'orthodox' solutions.

In time, what is really needed is a new paradigm for urban sanitation planning which links the human challenge of excreta management with the organisational challenges of modern city life. What we argue here is that this paradigm needs to move beyond the normative approach presented in conventional texts towards a more realistic assessment of how proposed technical solutions meet the objectives *in each domain of the city*. In this way, well-designed systems can be tailored so that they really link the household with its local interests in cleanliness and convenience to the city and the wider world with its policy imperatives to protect the environment and deliver national development goals.

### 4.2 Steps in an Approach

So our framework is really an embryonic approach which seeks to enhance conventional urban sanitation planning. It draws on huge cannon of existing literature both from the "development" world and the "technical" world. It suggests that a sanitation system which works will probably comprise a range of elements and a range of technologies performing various functions in different quarters and domains of the city and selected with both institutional and technical considerations in mind. While some people may make use of reticulated sewerage others may make use of a well-functioning on-site management system, and, in an ideal world, they will enjoy the same level of service within the household. Thus the framework can be used not only to help

Table7a

**Using the Framework – describing the CONTEXT**

| Step | CONTEXT | | | SANITATION SYSTEM/ OPTIONS | | FIT FOR PURPOSE? | | |
|---|---|---|---|---|---|---|---|---|
| **Factor** | Interests/ objectives | External Factors | Capacity | Sanitation Elements | Management | Does it meet Objectives? | Do Management requirements match? | Will it/ does it work? |
| **Household** | | | | | | | | |
| **Neighbour-hood** | | | | | | | | |
| **Ward/ District** | | | | | | | | |
| **City** | | | | | | | | |
| **Beyond the city** | | | | | | | | |

**Step One**
**Identify who are the key actors in each domain of the city. Assess carefully the range of interest groups and ensure that all the key actors are identified (for example at household level, consider decision making within the home and variations between different communities)**

**Step Two**
**Identify the interests of the key groups identified in step one (shat do they want from a sanitation system?), Use this analysis to generalise groups if their interests converge**

**Step Three**
**Understand what external factors drive decisions at this level (ranging from poverty/land tenure for households to institutional realities, regulation and technical norms at the city level). Consider who many of these could or should be addressed/ changed and how many are fixed**

**Step Four**
**Identify the capacities which exist in each domain for implementation and long term management of any system. Capacities include interests, but also skills, numbers of people, resources (especially money) and time**

analyse a citywide system but also elements within that system, and can also be used to identify a development path over time.

What the framework offers is a way of ensuring that the institutional realities of the whole city (all domains) are matched to the technical options under consideration or in operation. Unfortunately a simple two-dimensional representation of the framework does little to convey the complexity of urban sanitation or the mental athletics required to identify systems which can work in the long term. The representations in **Table 7 (a-c)** should therefore not be taken too literally but used rather as a tool to remind practitioners how institutional analysis can be matched with technical decision making.

In a general sense then the framework can be used to help the designer or planner consider:

### 1. The Context (see Table 7(a))

By first understanding the dynamics of the city the planner can identify groups whose interests are likely to diverge. By formalising this through a simple process of 'institutional mapping' the planner can disaggregate between the interests of different groups across all domains of the city. Developing some kind of understanding of interests in each domain the planner rapidly develops a

Table7b

**Using the Framework – describing SANITATION SYSTEM/ OPTIONS**

| Step | CONTEXT | | | SANITATION SYSTEM/ OPTIONS | | FIT FOR PURPOSE? | | |
|---|---|---|---|---|---|---|---|---|
| **Factor** | Interests/ objectives | External Factors | Capacity | Sanitation Elements | Management | Does it meet Objectives? | Do Management requirements match? | Will it/ does it work? |
| **Household** | | | | | | | | |
| **Neighbour-hood** | | | | | | | | |
| **Ward/ District** | | | | | | | | |
| **City** | | | | | | | | |
| **Beyond the city** | | | | | | | | |

**Step Five**

**(a) Analysis of existing systems**
**Where there is an existing system, 'map' this against the domains identified. Disaggregate the system so it is clear what elements exist and/or function in each domain. In this way for example the existence of a wastewater treatment plant can be separated from the households, and the existence of put latrines can be separated from the downstream areas.**

**(b) New systems/ development of systems over time**
**Where new systems are being proposed, the various options can be mapped in turn against the domains identified.**

**Step Six (existing and new systems)**
**Identify IN DETAIL the management requirements for the systems disaggregated across each domain. These requirements include skills, manpower, time, money, tools, etc.**

checklist against which later proposals can be measured. Some assessment of the external factors which drive decisions and priorities at each level will also help at the later stages of planning. Finally, having separated out various interest groups and disaggregated these across domains the planner can make a realistic assessment of capacities at each level – thus preparing the ground for sensible decision making about short term implementation and long term management of sanitation systems.

At this stage the planner can also review how interests, external factors and capacities are likely to change over time

## 2. Sanitation Systems/ Options (see Table 7(b))

Having put in place a relatively sophisticated institutional framework, sanitation systems (either existing or proposed) can be 'mapped' against it. This means that each element of the system (collection, transport, treatment, disposal, re-use etc) can be accurately located in the relevant domain of the city and assessed against the prevailing and likely future context *within that domain*. This approach forces the planner to consider the implications of technical decisions against the full range of interests, external drivers and capacities in the city – allowing a more realistic

Table7a

**Using the Framework – is the existing/ proposed system FIT FOR PURPOSE?**

| Step | CONTEXT | | | SANITATION SYSTEM/ OPTIONS | | FIT FOR PURPOSE? | | |
|---|---|---|---|---|---|---|---|---|
| Factor | Interests/ objectives | External Factors | Capacity | Sanitation Elements | Management | Does it meet Objectives? | Do Management requirements match? | Will it/ does it work? |
| Household | | | | | | | | |
| Neighbour-hood | | | | | | | | |
| Ward/ District | | | | | | | | |
| City | | | | | | | | |
| Beyond the city | | | | | | | | |

**Step Seven**

**Assess whether the proposed/ existing system meets the objectives in each domain. Does it provide the sort of service and outcomes that households expect? Will it address environmental concerns at the city level? Once this question has been asked across each domain it may be necessary to consider some pay-offs between interests at each level (typically in a resource-scarce world pay-offs between different interest groups are inevitable). The advantage here is that the payoffs can be assessed explicitly – with a clear weight being placed on interests right across all domains of the city.**

**Step Eight**

**Equally importantly assess whether the system can be managed in the way it needs to be managed in each domain. If not are there alternative arrangements or minor adjustments in the system (either institutionally or technically) which would make it more likely that management can be carried out in the long term?**

**Step Nine**

**Finally ask the question 'will it (or does it) work? Taking all the previous steps and technical considerations into account. If a number of workable options are thus identified these (and only these) may be suitable for an economic and financial assessment to identify the least-cost solution.**

assessment of the pay-offs inherent in selecting one system over another. Thus it becomes possible for example to understand what are the implications *at the household level* of decisions about wastewater treatment options taken on the periphery of the city. Similarly it is possible to ask how decisions taken by households to adopt certain technologies (ecological toilets say or pit latrines) will impact on the wider city.

### 3. Fit for Purpose? (See Table 7(c))

Finally the likelihood of success can be assessed. The beauty of the domains approach is that it enables an assessment of the proposed or existing system across all the domains of the city – thus revealing why a system which appears to meet the city's objectives may not result in better services for households, or why a system selected by households may have resulted in a worsening situation in 'downstream' domains. Key questions are to be asked in each domain by comparing what elements of the sanitation system will exist there against the context. Three simple questions can help to identify potential problems. These are:

- Does it meet objectives (will people/ institutions in that domain get what they expect?)

- Do management requirements match? (Are there institutions – people, skills, money – available to do what is needed to keep the system working in each domain?)
- Will it/ does it work?

This final question is one which is asked less often than it should be.

The process is shown graphically in **Table 7** (a)-(c) which shows a blank notional framework. We would however like to emphasise again that the process itself may be complex and varied and the reality is by no means captured on a table printed on a single A4 sheet. A more comfortable way to illustrate the framework is through the use of case studies and it is to these that we turn in the next section.

## 4.3 Case Study Examples

*The Task Force are developing a series of case studies to demonstrate the usefulness of the framework developed here. Until these are completed the following sections provide some brief examples of how the framework has been used, utilising some sample cases. .*

**Post Conflict Kabul**

One of the worse-case scenarios of sanitation planning arises in situations where existing infrastructure and institutions are badly damaged and the urban situation is in a state of insecurity and flux. An example in recent years is post-conflict Kabul where, in 2002, there was little or no sanitation provision but an urgent need to provide access to basic services. The existing piped sewerage network had been severely damaged and in any case served a very small portion of the city. Meanwhile many of the traditional dry toilets had fallen out of use because of disruption to the traditional agricultural market for solid wastes. This disruption arose because of both insecurity and also because introduction of cheap chemical fertilisers had severely depressed demand. Furthermore in-migration to the city was happening at a rapid rate but the urban authorities were barely in existence and struggling to manage even basic day to day urban service delivery.

In such cases it is not untypical to find 'conventional' systems being promoted or selected for rehabilitation simply because there is no capacity to analyse and understand an older existing or traditional system and certainly no capacity to deal with the rapid changes in conditions. In Kabul this was indeed the case, with consultants recommending rehabilitation of the sewerage network serving an estimated 5% of the population but unable to propose any effective means of delivering services to the peripheral urban areas, low income settlements, high density housing or hilly locations. The consultants and their clients exhibited an unwillingness or inability to analyse how interventions in the agricultural market and attention to people's own cultural preferences could lead to an alternative, more flexible and disaggregated solution. A focus on conventional technologies appeared to compromise the consultants' ability to make more radical suggestions while pressures both from administrators and technicians biased the initial analysis in favour of investments in wastewater treatment and trunk sewerage.

In such a case use of the framework could have shown how local solutions could work in substantial areas of the city; subsequent work supported by the World Bank and reinforcing excellent work already undertaken by ICRC amongst many others has resulted in the proposition of more effective options for various areas of the city; it remains to be seen whether these meet the 'objectives' of the city administrators and the international donors who will be providing financial support.

**Small Town realities in Bharatpur, India**

In the late 1990s the Water and Sanitation Program (WSP) worked with the municipal government of Bharatpur, a 'small' Indian town with a population of around 200,000 people, to develop a 'Strategic Sanitation Plan'. Bharatpur is a site of interest to tourists due to a large and unique bird reserve on its outskirts and a number of historic buildings in the city itself. However the sanitation situation of the city was extremely poor, with many families relying on badly-maintained septic tanks and pour-flush latrines and widespread incidence of open defecation. Furthermore the city was subject to periodic severe flooding, particularly in the area around a central 'fort' and its moat, the Sujjan Ganga.

A recent report summarised some of the interests

Table8

**Range of sanitation options proposed for Greater Kampala, Uganda**

| Density | Average income | Within sewerage areas | Outside sewerage areas |
|---|---|---|---|
| Low density | High income | Predominately sewerage | Septic tanks |
| | Medium income | Predominately sewerage | Septic tanks |
| | Low income | Household non-water borne sanitation | Household non-water borne sanitation |
| Medium density | Medium income | Predominately sewerage | Septic tanks, but perhaps upgrade to sewerage on environmental grounds |
| | Low income | Household non-water borne sanitation | Household non-water borne sanitation |
| High density | Medium income | Predominately sewerage | Septic tanks, but perhaps upgrade to sewerage on environmental grounds |
| | Low income | Sewered public toilets and household non-water borne sanitation | Public toilets and household non-water borne sanitation |
| Informal | Low income | Sewered public toilets and household non-water borne sanitation | Public toilets and household non-water borne sanitation |

Source: Sanitation strategy and Master Plan for Kampala City. Better Consult, Mott MacDonald and M&E Associates

as follows:
'The Municipality was primarily concerned at the effect of the polluted moat (Sujan Ganga) on tourism and therefore economic growth in Bharatpur. The Water and Sanitation Program, South Asia (WSP-SA), greatly concerned at the highly subsidized nature of existing services, sought a solution in which users would contribute towards sanitation services. Households and NGO representatives were seeking environmental improvements (frequent flooding caused by blocked drains was damaging the homes of poorer residents living in the flood-prone areas), but with a focus on bettering their immediate environment and increasing convenience from improved household-level services.' (Tayler, K (2003).

However, all of these concerns were overshadowed by the very limited institutional capacity of the municipality and in particular their almost-total reliance on funding from state and national programs to cover both capital and operational costs. For example the Government of India's LCS programme promoted only one type of latrine – a twin-pit pour-flush latrine. While the supply-driven approach resulted in the construction of over 4,000 latrines in Bharatpur, it did not include health and hygiene promotion, or educating households in how to correctly operate and maintain their latrines. Incorrect use and maintenance eventually led to overflowing pits and localized flooding with highly polluted wastewater. (Colin and Brocklehurst (2000)). Despite the fact that the municipality developed a workable long term investment plan for sanitation, involving the gradual improvement of the system and adoption of a range of technologies to address various sanitation needs, the implementation of the plan stalled in the absence of external support. The interests and criteria of state and national programs and agencies continued to dominate whatever small piece meal investments could subsequently be made.

The problem in Bharatpur could be summarised as a dominance of the interests of state and national agencies over the interests and needs of households, neighbourhoods and even the city itself.

**What are the engineering options? – A More Positive Story from Kampala**

The National Water and Sewerage Corporation of Uganda commissioned a study to develop a strategy and master plan for the city. The current estimate of service provision is shown in **Figure 4.**

The possibility of providing a sewerage connection for all inhabitants in the medium term was remote, for technical, economic and social reasons. In

order to plan for the general improvement of sanitation for all parts of the city and society, a range of options was proposed, based on the existing physical and financial constraints (**Table 8**). Using this strategic approach, it could be seen that sewerage coverage was only likely to increase marginally in the near future, as existing catchment sewers were in-filled to make a denser pipe network. Extensions outside the existing catchments are unlikely for 20 years.

**Solar City, City of Linz, Austria**

The city of Linz is the capital of the province of Upper Austria, has about 200.000 inhabitants and is situated around the river Danube. In the second half of the 1990s the city council decided to build a new ecological housing area (low energy type, solar energy) in the South of the city comprised of about 1400 flats and a school. The construction started in 1999 and the first flats were ready for housing in 2003. Whereas about 90% of this housing area was connected to the nearby sanitation system (a sewer connecting to a recently renovated central wastewater treatment plant for the City of Linz), there was a wish to furnish a small part of this new housing area (about 100 flats) with additional ecological features. After some discussion the decision was taken that innovative options for its wastewater management should be considered.

**Considered options and assessment**

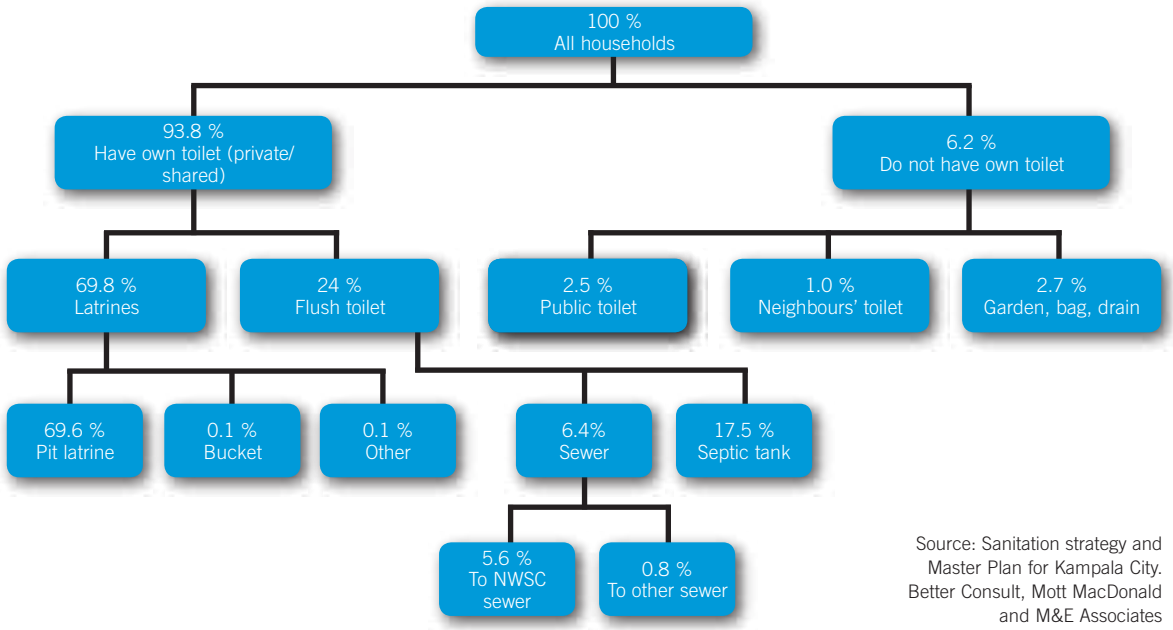
Originally it was planned to furnish the entire new housing area with a non-conventional wastewater management system. About 14 different alternatives, including both conventional and non-conventional ones, were studied. However, the cost assessment has shown that the cheapest option would be to connect the housing area to the existing centralised treatment plant (as an existing sewer passes by close to the new housing area) and therefore it was economically not justifiable to construct an alterative system. However, for various reasons it was decided that a smaller area (only 88 flats and a school) would comprise the pilot project for a urine separating system.

**Decision making process**

For the pilot area it was decided to implement an option which was comprised of the separation of the wastewater in its constituent's parts, urine, brownwater and greywater, and to furnish around 100 flats with urine sorting toilets of the company 'Roediger'. The main reason for this decision was firstly the possibility to close the nutrient cycle and secondly the possibility to treat only urine, if micro-pollutants will get more attention in the future (i.e. it is assumed that reduction of micro-pollutants from

Fig4

**Breakdown of existing sanitation coverage in Greater Kampala, Uganda**




Source: Sanitation strategy and Master Plan for Kampala City. Better Consult, Mott MacDonald and M&E Associates

urine is more efficient than to reduce it from the entire wastewater stream in view of eventual stricter regulations in future).

This decision was driven by the board of directors of Linz AG. Furthermore, a discussion with the director of the Board on 30.09.2003 showed that Linz AG, as a public company, is not only looking at maximising its profits, but also to provide contributions to society. Therefore, implementing an innovative wastewater system perceived to be ecologically superior to other options was considered an opportunity to position Linz AG in this field as an innovative service provider. Moreover, this option was considered to be viable in particular for rural areas, to which Linz AG also provides its services.

**Conclusions and lessons learned**

The analysis has shown that some technical assumptions did not occur. For instance, it was assumed that no urine fall out would occur, but did. Social analysis highlighted that user's would be willing to accept some reduction of comfort in the new system if there is a positive contribution to environmental protection.

This prompted a second question to be addressed by the project: how relevant is the contribution of such systems to solving nutrient cycles in agriculture? This question was analysed from the perspective that agriculture should not be 'misused' for disposal of any substrates. And in order to reach a real level of 'recycling' two aspects need to be ensured: first, the substrate should have a benefit for agriculture and at the same time cause no harm to it.

This study indicated that even large scale implementation of urine sorting systems would only provide marginal quantities of nutrients compared to the used commercial fertilizer; and secondly, that many areas in Austria have even too many nutrients available; third, that the benefits of urine would be marginal (around 5EUR commercial value of 1m$^3$ of urine based on its nutrient composition). However, by contrast, there would be no problem to apply the urine in agriculture (if appropriate measures for risk management are taken and it would be legally possible) as the quantities are very low.

In the planning and design of the system, future users' needs could not be included. Even if then they had the choice, they may not have been fully informed about the implications of the new system. This resulted in the end to the lack of acceptance outlined above. However, this case highlights the potential for innovation if a multi-utility company is willing to demonstrate and experiment with alternative solutions. In this context the Solar City is also mainly perceived as a demonstration project to look at if and how such a system can work in practice, and to provide lessons learned.

**Dar es Salaam – absence of decision making**

In practice, the existing situation in Dar es Salaam regarding excreta management in the city's unplanned areas can be characterised as follows:

- The supply chain for sanitation is reaching the richer, sewer based wards within the city, but failing to reach excreta disposal needs of the 2 million population dependent on on-site sanitation.
- Policy and regulation is fragmented at the national level and failing to have any impact other than with city based sewerage systems.
- Although demand for sustainable latrines in the unplanned area is high, it is being expressed beyond the boundary of the household.

This raises the interesting question of why the excreta management of nearly million people has been allowed to develop into such a dangerous and neglected situation? There is no one ministry, department or person in Dar es Salaam who has intentionally and deliberately set out to ensure the people living in the unplanned areas have to resort to open defection and flying toilets. If this was the case Dar es Salaam would be the exception rather than the rule, and unfortunately similar situations can be found in Kampala, Addis Abba, Nairobi, and the majority of Africa's rapidly growing cities. Although it may be a simplification, the root of the problem can be attributed to a lack of flexibility regarding solutions and an inertia in decision making.

**Lack of flexibility regarding solutions**

Although pit latrines serve the vast majority of the population, they are regarded as an inferior technology by many engineers to the more expensive water borne sewered system. This technology no doubt has its place in the arsenal of possible solutions and in some contexts it will be. In Dar es

Salaam and many other African cities is one context where the narrow winding nature of the streets, the poverty of the occupants and the topography of the area, make the laying and maintenance of a financially viability sewer system extremely unlikely; a pipe dream. When challenged with the difficulties of serving the poor area with sewers, planners and designers respond along the lines of "Not yet , but in 20 years when the rest of the system is working, we plan to connect all the areas". In the mean time residents of the unplanned area have to wait amongst the growing pile of their own excrement. There are other options. From a public health perspective, as long as humans are separated and remain separated from their excrement, health benefits will follow.

**Inertia in decision making**

The unplanned areas do not appear overnight; they grow and their housing density gradually increases over time. Nobody chooses to live in a slum area and the people who live there do so because they lack other housing options. The unplanned areas are now officially recognised, but for a long time they were considered illegal settlements. Moving the residents and bulldozing their houses is not a politically acceptable option so the next, easiest and risk adverse solution is to pretend they did not exist. In the meantime the environmental conditions in the unplanned areas are left to fate and the individual actions of the residents. If the planers at an early stage only insisted and enforced minimum plot sizes and the layout of the area in a grid, then many of the problems the resident now face would become manageable.

Similar consequences occur with the inability to decide which ministry or department is responsible and accountable for excreta disposal in the unplanned areas, about the inability to agree, develop and enforce a coordinated approach, with the lack of clear subsidy policy, and with the inability to improve an inappropriate and outdated legislation. This results in one of the most important and fundamental aspects of public health being left directionless and leaderless. This, coupled with unwillingness amongst the politicians and professionals to tackle a problem that has little kudos, has developed into a downward spiral of passive inactivity. In medical terms, the problem is degenerating from acute to chronic.

# 5 Conclusions

## 5.1 It all adds up to good planning

At the outset we asked the question "what is going wrong"? In this paper we argue that the problem and challenge in urban sanitation lies principally not in debates about technologies but in questions about how these can best be applied to solve important development questions. Planners need to plan in the real world where things change and things go wrong. The conventional approach to sanitation planning creates an artificial barrier between technical decision making and institutional analysis in its broadest sense. This results in technically 'appropriate' systems which don't work, or which don't achieve the objectives that some people value highly. Crucial to changing this paradigm is to acknowledge in a more effective way that many of the 'objectives' of urban sanitation systems may actually be in conflict; a real discussion about the payoffs is needed. The first step is to learn to understand what these objectives are and what external factors drive decision making *across all the domains of the city.* The second step is to build in flexibility and begin to anticipate how these objectives and the urban context itself *may change over time*. It is nothing more than good planning, and has been described in many publications but for some reason it is not happening. Acknowledging and facing up to the open and hidden drivers of sanitation planning will be an important first step in improving the quality-at-entry of many sanitation investments.

## 5.2 Thinking ahead

IWA members have a crucial role to play in improving the effectiveness of urban sanitation investments. IWA members constitute a large proportion of the technicians, engineers, water scientists and planners who are involved in the process of urban sanitation planning, design, implementation and management. As such the experience of the membership could be brought to bear to improve the quality of planning and design and to bringing reality into the process. This document represents a potential first step in this vital process.

# Annex One:

## Summary Terms of Reference for the Task Force

The Sanitation 21 task force will consist of a Core group supported by an Advisory group of senior experts in the field. The Core Group's objective is to contribute to thinking about sanitation in urban areas in a way which will address the challenges of increasing sustained access to services of an acceptable standard. The Task Force will achieve its objectives in the following ways:

- Identify and convene a cross-section of leading thinkers from different backgrounds working on all aspects of sanitation (hardware, software, planning, etc);
- Involve task force members in development of key outputs, namely:
  - > Classification and review of a range of sanitation technology options (including *inter alia* technical, social, financial, institutional, etc, issues), focusing primarily on existing technologies, with a review of innovative options at the 2006 IWA World Congress;
  - > Identification of a framework for evaluation of these technology options;
  - > Review of selected case studies where such evaluation criteria can be applied;
  - > Identification of a longer-term process as to how the issue of sanitation should be handled in the future;
- Publish, communicate and disseminate the results from task force activities to policy makers and practitioners alike.

# Annex Two:

## Preliminary Analysis of Drivers at each Level in the Sanitation System[1]

| Driver | Impacts |
|---|---|
| **Home (personal/ family concerns)** | |
| Status | At the household level the interplay of these drivers with the conditions of awareness, priority, access and influence will determine how ready households are to make investments. The relative weight of different drivers, the state of the local market and cultural factors will determine what types of toilets are in demand. The nature of demand at this level is dynamic and will usually grow over time, Note that the environment beyond the peri-domestic arena rarely drives decisions at this level |
| Cleanliness | |
| Convenience | |
| Safety and security | |
| Income / employment generation | |
| Food/ water security | |
| Tenure status/ legislation | |
| | |
| Health, environment | These are usually unlikely to drive decisions at this level. |
| **Peri domestic (community concerns / social pressures)** | |
| Income/ employment generation | May promote collective demand for household facilities (ie for home-based workers) and for ecological toilets if urban agriculture is feasible and practiced. |
| Status/ land values | Will impact if communities are relatively homogeneous or where landlords predict an increase in rental or land values,. Note where tenancy is high this may have a negative impact on the status of many tenant families who face higher rents if household investments are made. May tend to encourage public investment in household facilities if % of landlords is high. |
| Cleanliness | May impact and encourage communities to take joint action if relatively homogeneous (ie investing in small local sewer networks, shared septic tanks, pit emptying services) but usually a rather weak driver. |
| Water security | May have significant impact on household willingness to pay and participate in community sanitation programmes if shallow water tables are threatened. |
| Health, environment | These are usually unlikely to drive decisions at this level. |
| **Ward/ district (community/ local government/ political concerns)** | |
| Status/ land values | May encourage local politicians/ leaders to promote household or city investments – may impact negatively on tenants (as above). Will not tend to drive one particular technology over another. |
| Cleanliness | Often a strong driver for high visibility, possibly low- sustainability interventions by local politicians (ie one-off clean up campaigns, public toilets but without attention to long term management etc ). |
| Water security | Again unlikely to result in significant sustained investments except where problems are acute and gains are likely to be highly visible (ie where shallow groundwater is so severely contaminated as to be unusable) |
| Service delivery/ patronage | Often a strong driver for investments (commonly for public and community toilets, but could also be for local collection system, small sewer networks or public financing of household latrines etc). Sometimes a good driver to help households access maintenance services, pit emptying etc but only on a sporadic basis. |

continued >>>

1 Note this is a VERY preliminary first cut based on the brainstorming at Budapest #1 and on various documents provided by the core group.

# Annex Two (continued)

| Driver | Impacts |
|---|---|
| Health | May be a strong driver for local politicians to use own funds or lobby for funds if major health impacts are visible (cholera outbreaks etc). Rarely a good driver for ongoing a responsible operation and maintenance. |
| Environment | May be a driver for collective investments or for politicians to use own funds, where communities are mixed and there are sufficient numbers of middle-income households. |
| **City (city government/ utility/ political/ wider societal concerns** | |
| Equity/ access/ MDGs | Should be a driver for pro-poor service delivery and attention to access to usable toilets but may not be where urban coverage is counted in terms of areas served by sewers in which case, will have little impact on household access. |
| Economic development | Often drives investments in the CBD, and may also promote high-cost investments (ie in downstream services such as WWTP). Should be a strong driver for appropriate household sanitation but only where cities perceive unserved populations in terms of their contribution to the economy of the city. |
| Reducing costs | Relevant in mature utilities – should drive adoption of efficient new technologies and also encourage promotion of low-water use toilets etc. In immature utilities, should encourage wholistic response and balanced approach to household access and downstream services but this is rarely the case. In some cases may encourage unregulated dumping of untreated wastes. |
| Increasing revenue | May tend to encourage utilities to think in terms of sewerage connections. Should encourage attention to well-managed pit-emptying services managed on a commercial basis. |
| Health | Should encourage a focus on increasing access and promoting the use of household facilities. |
| Environmental protection | Tends to have little impact on household access and the adoption of the best possible local solutions (including ecological toilets, decentralised collection and treatment etc). Often results in costly investments in under-utilised downstream services trunk sewers and (WWTPs) |
| Water resources management | Should encourage low-water use technologies, maximising re-use and recycling and minimising pollution of water courses but more commonly results in attention to downstream treatment. |
| **Wider environs (national/ international concerns)** | |
| Water security/ food security | Should encourage low-water use technologies, maximising re-use and recycling and minimising pollution of water courses. |
| Equity/ access/ MDGs | Should be a driver for pro-poor service delivery and attention to access to usable toilets but may not be where urban coverage is counted in terms of areas served by sewers in which case, will have little impact on household access. May steer investments away from urban sanitation if rural poverty is perceived to be a greater priority. |
| Economic development | May counteract effect of above by steering national funds towards urban administrations, but this may result in high- cost investments and a focus on industrial areas and the CBD. Historically (ie the UK) an understanding of the negative impacts of sanitation-related ill health on the workforce eventually resulted in serious household/ peri-domestic and ward investments in sanitation. |

continued >>>

# Annex Two (continued)

| Driver | Impacts |
|---|---|
| Health | Should result in attention to household access and peri-domestic services (possibly through financing of national sanitation promotion programmes, hygiene promotion programmes and financing for local investments) but there is little evidence that this actually happens. More commonly results in ad hoc responses to crises rather than serious planning. |
| Urban and rural development | May result in national funds being made available to local administrations for urban, peri-urban and rural sanitation investments, but this may not occur in practice. |
| Environmental protection | May result in heavy environmental legislation which requires large investments in WWTP or which means local administrations (and donors) are unwilling to invest in sanitation because of the onerous requirements of environmental protection. Should however have the opposite effect; of encouraging a shift away from open defecation and promoting local solutions where possible including ecological toilets if appropriate and decentralized collection and treatment. |
| Water resources management | Should encourage low-water use technologies, maximising re-use and recycling and minimising pollution of water courses. Where countries put in place robust mechanisms for IWRM within river basins this might happen, but only if there are sector specialists with the skills to present the importance of such interventions, more commonly results in punative legislation relating to wastewater discharges and the may steer attention and investments towards downstream treatment. |

# Annex 3:

## Analytical Tools to Use at Each Level

Clearly the design of a sanitation system has to consider the status and drivers which are operating at each level, to prioritise these. Various tools are available which can be used at each level (Table A2):

**Table A2: Analytical tools for assessing the sanitation system**

| | Home | Peri-domestic | Ward/district | City | River/ environs |
|---|---|---|---|---|---|
| Tools | • Situational analysis<br>• KAP studies<br>• Household demand surveys (including WTP)<br>• Communication studies<br>• Consumer research | • Social/ institutional mapping<br>• Participatory poverty assessments | • supply side market surveys (latrine providers, masons etc)<br>• community management options study<br>• environmental impact assessment<br>• product identification, development and testing | • supply side market surveys (latrine providers, masons etc)<br>• institutions study – utility/ LG finance review<br>• policy/ regulatory environment review | • policy/ regulatory environment review<br>• environmental impact assessment |

# – notes –

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