PATHFINDER PAPER

Sanitation Markets

Using economics to improve the delivery of services along the sanitation value chain

Sophie Trémolet

December 2012

LONDON SCHOOL of HYGIENE &TROPICAL MEDICINE
icddr,b
iied
SHACK / SLUM DWELLERS INTERNATIONAL (SDI)
WaterAid
share
Sanitation and Hygiene Applied Research for Equity

Table of Contents

Executive Summary

Using economics to evaluate sanitation markets

The ‘‘sanitation economics’’ approach used throughout the paper consists of applying economic principles, approaches and tools to evaluate a number of ‘‘sanitation markets’’ alongside the sanitation value chain. Each segment of the sanitation value chain can be conceived as a separate ‘‘sanitation market’’, with different actors demanding and providing sanitation services.

In most developing countries, sanitation markets are not organised in a way that provides sanitation goods and services in sufficient quantity or quality. In economic terms, this incapacity of sanitation markets to deliver services in sufficient quantity can be attributed to a number of market failures resulting from external effects, imperfect information, abuses of monopoly power or destructive competition.

As a result of these market failures, economic actors in charge of investment or spending decisions would typically demand or provide less sanitation services than would be optimal for society.

The types of ‘public responses’ that can be adopted by domestic governments or donors to correct these market failures include:

- Providing subsidies in order to influence investment decisions by economic actors or finance activities that benefit the community as a whole (such as wastewater treatment);
- Defining and enforcing regulations and standards. This can include economic, environmental and public health regulation;
- Supporting ‘‘market-based’’ solutions by facilitating access to finance, disseminating information or supporting the provision of business support services.

Using economics to assess overall resource allocation

Economic analysis has been used in a number of instances to assess the economic case for investing in sanitation overall, i.e. considering ‘sanitation’ as a single market. These estimates of the benefits of investing in sanitation are frequently used to support the allocation of additional public resources to the sector in the form of subsidies.

Despite accumulating evidence on the benefits of investing in sanitation, the sector does not attract sufficient resources. Funding for both water and sanitation comes from ‘tariffs, taxes and transfers’ or the ‘3Ts’. Whereas the provision of taxes and transfers can be influenced by arguments based on economic benefits, private investments are usually driven by financial returns or perceptions of economic benefits. This is an issue for the sector as a whole because the largest investors in sanitation are households themselves.

There is limited evidence at present to show whether economic arguments influence investment in sanitation or have an impact on public sector policy-making. The sector should seek to mobilise additional financial resources from all potential sources, including direct investments (e.g. household investment in on-site sanitation) or tariffs (for sewerage services or via cross-subsidies from the water tariffs), domestic public sector, Official Development Assistance (ODA) and private foundations.

Going forward, existing resources and new investments should be better targeted, so as to focus on areas that generate most benefits and to rely on the most cost-effective measures.

Multiple drivers could convince governments and private sector entities and philanthropists to invest in sanitation. Further research is needed in the following areas:

- Estimates of the benefits or cost-benefits of sanitation interventions that can provide reference points for other studies or evaluations;
- Differentiating between types of interventions so as to isolate the benefits from sanitation from the benefits of other interventions such as water, hygiene promotion or health improvements;
- Additional evidence and analysis of the value of 'non-quantifiable' or difficult to quantify benefits of sanitation, such as improvements in dignity, status, security or providing the ability to study for a longer period (particularly for girls).

There is evidence that current methods for mobilising financial resources for sanitation are inadequate. For example, the 'Polluter-Pays Principle' may not be suited to some or most sanitation markets. As an alternative, the beneficiaries from improved sanitation may need to be asked to pay and to cover the costs of others who are not able to invest in sanitation by themselves. The limited understanding about how sanitation markets work and where, if at all, governments should seek to intervene to make these markets work more efficiently results in a lack of clarity about how additional resources can best be channelled to the sector and how these funds should best be used.

Using economics to analyse market failures and identify potential interventions

Markets for providing access to sanitation

Providing access to sanitation can be done in two main ways: either by collecting the waste through connecting to piped systems or through on-site sanitation solutions such as latrine pits and septic tanks which are the most ubiquitous sanitation solutions in developing countries. In the case of on-site sanitation, households would either build latrines themselves or hire latrine artisans. For sewerage connections, the utility or government agency would build sewerage networks and either charge users for the sewerage connection or incorporate its costs into the relevant utility bill.

The delivery of sanitation access services remains limited in many countries, with 2.5 billion people living without basic sanitation facilities. This under-provision can be attributed to a number of market failures, both on the demand and on the supply side. Public interventions to address sanitation market failures typically include:

- Sanitation demand promotion and campaigns such as CLTS;
- Supply side interventions, such as sanitation marketing;
- Provision of either software or hardware;
- Facilitated access to finance, both on the demand and the supply side.

Given the importance of demand as a trigger for sanitation adoption, public funders of sanitation would do well to finance location-specific demand studies prior to designing an intervention, so as to better understand what encourages or discourages households to invest.

A better understanding of demand triggers and existing barriers to adoption can help improve the design of public support schemes to encourage adoption of sanitation at household level. A basic principle for this would be to adopt financing schemes with high leverage ratios (i.e. ratio of privately invested funds versus public funds) so as to allocate scarce public resources to well-targeted interventions for the poorest. A direct result of this recommendation would be to minimise hardware subsidies for sanitation, except when they

are very specifically targeted onto poor or disadvantaged households that are likely to require ongoing subsidies for sanitation.

The effectiveness of existing approaches (and particularly subsidy approaches) can be evaluated in order to potentially redesign such subsidies to increase their effectiveness, improve their targeting and make them more results-oriented. More support, including financing, should be provided for demand promotion activities. The implementation of packages of activities, including demand-side, supply-side and facilitated access to finance and incentive payments should be encouraged as they have been shown to be most effective in terms of sustainable change behaviour. Emphasis should be placed on identifying where the gaps are and providing supplementary support to fill in those gaps.

However, there are lingering uncertainties about basic parameters of the access equation with respect to the costs of alternative solutions, particularly software approaches. In addition, some existing popular approaches to promoting demand for sanitation such as CLTS need to be further developed so that robust institutional models for scaling-up are designed and tested. Similarly, even though microfinance appears to be a promising approach to enable households to invest in their sanitation facilities, its impact remains to be tested at scale.

Markets for transport and treatment

The vast majority of the developing world is served by on-site sanitation facilities. For these systems to function properly, households are required to regularly maintain them by hiring manual or mechanical pit-emptying service providers. The markets for transport and treatment have remained so far very embryonic in places like Sub-Saharan Africa or South Asia. A number of market failures typically affect the sanitation transport and treatment markets in those regions.

In order to address these market failures going forward, it is important to engage decision makers and encourage the use of innovative and more appropriate solutions. Small-scale decentralised solutions should be encouraged over conventional centralised large-scale solutions wherever possible, to keep costs down and support the current realities of the market. It is also necessary to provide more support to small-scale independent providers (SSIPs) of emptying and transport services and utilities in the form of ‘smart subsidies’ to help them get formally established, build their business skills, help them set up providers associations and facilitate access to credit to purchase equipment. However, as there are at present only a limited number of schemes that have successfully supported the development of SSIPs, we still do not know enough about how best to support these types of service providers. One potential means of support is output-based aid (OBA): to encourage pit latrine emptiers to bring the pit content to designated points, it could be considered to pay them per volume and/or load of sludge brought to the safe disposal point rather than charging them to do so.

External Support Agencies (ESAs) can foster increased access to finance for SSIPs. Donors can use a combination of financing instruments and channels to transfer finance to small-scale actors (including SSIPs and households) in order to address the various market failures identified, including grants, concessionary loans, guarantees and equity investments.

A number of other more technical initiatives can be taken by public funders in order to reduce the costs of emptiers, with the view that this would allow reducing charges to households for such services. For example, in order to shorten the distance required to transport the waste as well as to facilitate bulk transfer, some studies have suggested the use of transfer stations.

There are various regulatory measures that can be taken to mitigate market failures, including regulation of competition between pit latrine emptiers (mostly SSIPs), the combination sanitation and water service payments into instalment payments to reduce unregulated activity and increase willingness to pay, the introduction of public health and environmental standard, the formation of emptiers associations and support to SSIPs to diversify their work. In all cases, regulation should be 'light-touch' with emphasis on improved information and better quality regulation rather than price regulation.

There are still substantial knowledge gaps regarding how best to improve transport and treatment. Because of the focus on large-scale wastewater conveyance and treatment until relatively recently, our understanding of informal sanitation emptying services is limited. Investigation is still required to better understand the cost structures of SSIPs in order to design more effective support strategies, including subsidies and payments based on performance, the provision of business and technical skills and evaluation of the viability of certain models such as franchising.

On the basis of this information, it would be possible to draw some guidance regarding the characteristics of the most efficient market structures, i.e. its concentration, product differentiation, entry and exit conditions and the degree of vertical integration. In this case, it would involve identifying what the role of the utility could be vis-à-vis the SSIPs or what the potential for franchising might be. There is no 'one-size-fits-all' in this kind of market and each solution would need to be tailored to local circumstances. However, it would be possible to identify drivers and factors that need to be taken into consideration when designing the most appropriate market structure.

In order to design better actions, the level of knowledge on what needs to be financed to improve these activities and how must be improved. For example, it would be important to identify the specific needs for mesofinance coming out of entrepreneurs, as this tends to be less documented than microfinance. Some financing instruments, such as leasing, have found marginal use in the WATSAN sector although their potential appears to be large. It would also be crucial to more systematically monitor the microfinance market for water and sanitation and its impact on beneficiaries.

To formulate recommendations on different types of regulation and their effectiveness, the applicability and effectiveness of results-based financing for sanitation needs to be evaluated further as well as the impacts of different types of financial and non-financial regulation of sanitation markets.

Markets for re-use and safe disposal

The residual waste following transport and treatment ultimately needs to be either disposed of or reused. Large-scale disposal of wastewater and/or sludge may occur in an unregulated manner. To discourage unsafe disposal, a value needs to be found in the by-products so as to be able to reuse them productively. Overall, reuse activities are still rather limited compared to their potential to generate additional revenues for the sector and for the economy as a whole. Although the benefit cost ratio of some of these reuse schemes can be high, most of these markets have so far failed to scale up. Based on what we currently know, a number of initiatives could be taken to develop reuse.

Scale-up existing initiatives. Many re-use projects which have yielded positive results at pilot stage could be scaled-up. Reuse based on wastewater treatment would require treatment facilities to increase their capacities in order to treat a greater volume of wastewater and ideally construction of additional wastewater treatment capacities would undertaken with a view to maximising the reuse potential. In rural areas and small towns, reuse could be scaled up by disseminating information on safe handling of human waste

and available technologies such as the types of toilet facilities that allow reuse, and. The strength of valorisation and reuse of treatment by-products lies in the ability of the service provider to understand, access and integrate with markets external to sanitation in order to be able to market their products to them, such as aquaculture, artisans, agriculture, urban landscaping and household energy.

Encourage regulation. Some countries have limited existing reuse practices due to health concerns. However, existing initiatives demonstrate that sanitation by-products can be reused for agriculture provided appropriate treatment and monitoring is in place. Regulating sanitation reuse could be encouraged by implementing new regulations based on the results of latest research into safe handling of sanitation by-products (e.g. WHO 2006) or revising existing strict regulations. Such regulations would need to extend to the full range of sectors where reuse can be considered, including water markets where the value of treated wastewater for agriculture for example would very much depend on the value of alternative supply sources. Other regulatory instruments could be considered, such as the introduction of an environmental tax on non-reclaimed wastewater for example.

Mobilise financing for investments alongside the sanitation value chain to encourage reuse. Maximising reuse often requires a series of up-front investments alongside the sanitation value chain. For example, at the level of collection, this may require households investing in sanitation facilities that allow re-use such as UDDTs to separate faeces from urine or other types of composting toilets, or septic tanks to allow partial on-site treatment for direct re-use in nearby fields. At the level of transport and treatment of by-product from on-site facilities, this would call for investments in transportation of sludge to treatment facilities, which themselves need to be developed and maintained effectively. Similarly, for sewage transport and treatment, investments are called for in systems that do not flush sanitation by-products with freshwater but rather allow maintaining and isolating either their nutrient content or calorific content.

The users of sanitation by-products may themselves need to invest in order to be able to use those products. All these up-front investments need to be pre-financed in some way and it is only after they are built that they can generate returns on the initial investment. There is a clear case for public investment or investment by potential users of the by-products, since they would later benefit from re-use.

Going forward, research needs to be directed at analysing how best to increase demand for reuse in order to make the system economically and financially viable for the actors concerned. At present, there is little evidence of how far the sale of treatment by-products would be able to subsidise sufficient service delivery further up the value chain.

One of the key influencing factors is safety, thus treatment processes need to be improved and better promoted in order to ensure safe reuse and gain the trust of end-users. Additional research is also needed in order to develop new types of reuse and determining their economic value.

Overall, a stronger focus on maximising reuse could deliver efficiency gains alongside the entire sanitation value chain, as the by-product would become a valuable resource instead of a cost that needs to be minimised or avoided. Research and analysis on maximising the re-use potential can thereby encompass all actions that seek to improve the functioning and efficiency of the sanitation value chain as a whole. For example, if compost is to be sold, then the treatment method used should aim to conserve nutrients, treatment location should be appropriate for potential clients, faecal sludge should be collected along with organic solid waste, the type of toilets used should be either Ecosan, urine diverting, or safe bucket latrines (, and households should use degradable anal cleansing methods. Therefore,

Conclusions

In summary, a number of actions could be undertaken based on these findings:

- Make the case for investment in sanitation;
- Channel financing more effectively and increase the effectiveness of public funding;
- Foster demand for sanitation at all levels of the value chain;
- Influence the restructuring of the provision of transport services for on-site sanitation, particularly by formalising small-scale private providers, Estimate the value of the various sanitation by-products and identify ways of monetizing such value in a sustainable manner through reuse.

In order to support future actions, key areas of research should be explored, including:

- Improve the estimates of the benefits of investing in sanitation and compare the benefits with the costs of sanitation in a broader range of countries and local contexts, as well as evaluate the cost-effectiveness of alternative investments;
- Identify the most effective financing mechanisms, including ways of attracting new resources into the sector (e.g. from beneficiaries) and via re-use and overcoming the affordability constraint;
- Identify ways of stimulating demand and overcome information asymmetry for households, entrepreneurs or even the government;
- Identify ways of organising service provision and scaling-up of small-scale entrepreneurs.

Sanitation economics research has a critical role to play and should be fostered. On this basis, budding and ineffective sanitation markets can be transformed into thriving markets where the full value of sanitation by-products is fully realised and reinvested into the system so as to foster increased investments and generate efficiency gains.

Abstract

This Pathfinder Paper has been commissioned by the SHARE Research Consortium to provide a basis for future research with respect to sanitation economics, defined as the application of economic concepts, approaches and tools to the sanitation sector.

The objectives of this paper are to identify how market failures affect the ability to extend appropriate and sustainable sanitation services alongside the entire sanitation value chain. We examine how economic analysis has mostly been used so far to assess the economic case for investing in sanitation overall, i.e. where 'sanitation' is considered as a single market. We argue that, although this type of analysis can be useful to shift mind-sets and public attitudes, its usefulness is limited by a number of uncertainties affecting such economic valuation and by a fundamental difference between the evaluation of economic costs and benefits and the financial incentives that drive actual investment decisions (from both public and private actors) across the entire spectrum of sanitation markets along the value chain. Based on this finding, we investigate how economic analysis can help identify market failures in sanitation markets and potential interventions to make these sanitation markets work better. The paper examines in turn three main market segments alongside the sanitation value chain, starting with markets for providing 'access' to sanitation (collection services), markets for transport and treatment activities and finally, markets for reuse services.

The paper concludes with recommendations to policy-makers on what to do based on what we know and to researchers on areas for future research in the developing area of 'sanitation economics'.

Acknowledgements

This paper has been prepared by Sophie Trémolet, with additional research support from Georges Mikhael and Aarti Daryanani. Thanks go to Goufrane Mansour for her assistance with the bibliography and finalising the paper and to Andreia Santos for her helpful comments on earlier drafts. Many thanks go to Sandy Cairncross (SHARE Research Director) and Oliver Cumming (SHARE Policy and Research Manager) of the London School of Hygiene and Tropical Medicine for their indefatigable support and encouragement. Finally, we are very grateful to Rick Rheingans, Sue Cavill, Oliver Cumming and Georges Mikhael for their comments on the final draft. Special thanks go to Isabelle Pugh for editing the final version of the paper.

Ideas for the paper were initially presented at a SHARE internal meeting in London in September 2010 and at a Sanitation Community of Practice meeting in London in November 2010. I am grateful for comments formulated by all present which helped give shape to the analysis. The paper was then developed based on ongoing research on sanitation economics and financing, a field that has been rapidly expanding over the last few years, with SHARE support as well as in the context of other initiatives.

This material has been funded by UK aid from the Department for International Development (DFID). However, the views expressed do not necessarily reflect the Department's official policies.

Abbreviations and acronyms

BCC	Behaviour Change Campaigns
BCR	Benefit Cost Ratio
BMGF	Bill and Melinda Gates Foundation
CATS	Community Approaches to Sanitation
CBO	Community Based Organisation
CLTS	Community-Led Total Sanitation
CSO2	Country Status Overviews (second round)
EC	European Commission
IBRD	International Bank for Reconstruction and Development (World Bank)
IDA	International Development Association
IFI	International Financing Institution
IRC	International Water and Sanitation Centre
JMP	WHO/UNICEF Joint Monitoring Programme for Water Supply and Sanitation
MDGs	Millennium Development Goals
NGO	Non-government organization
NGOs	Non-governmental Organisations
O&M	Operation and Maintenance
ODA	Official Development Assistance
ODF	Open Defecation Free
SSIP	Small scale independent provider
SANIMART	Sanitation Market
SLTS	School-Led Total Sanitation
SWAp	Sector-wide approach
TSSM	Total Sanitation and Sanitation Marketing
UDDT	Urine Diverting Dry Toilet
UNICEF	United Nations Children's Fund
USAID	United States Agency for International Development
USD	United States Dollars
VIP	Ventilated Improved Pit
WASH	Water, Sanitation and Hygiene
WATSAN	Water Supply and Sanitation
WB	World Bank
WHO	World Health Organisation
WSSCC	Water Supply and Sanitation Collaborative Council

1 Introduction

Paper objectives

The objectives of this paper are to assess how sanitation markets currently work, to identify how potential market failures may affect the ability to extend appropriate and sustainable sanitation services, especially to the poor and to recommend potential interventions to address such market failures. To this end, the paper examines how economic and financial analysis approaches have been applied to assess the economic case for investing in sanitation overall, to understand how sanitation markets work (or fail), and to identify interventions that could make sanitation markets work better.

This paper can help with understanding issues such as the fact that most sanitation service producers in developing countries tend to be small-scale, with limited potential for economies of scale or identifying financial mechanisms that could stimulate the production of sanitation services without introducing undesirable market distortions.

Target audience

This Pathfinder Paper has been commissioned by the SHARE Research Consortium, based on a review of recent literature and in order to provide a basis for future research in this area. There are a number of key audiences for this paper:

- Policy-makers, who want to know what more can be done in the sanitation sector based on the application of economic and financial analysis;
- Sanitation sector specialists, who may be interested in using economic analysis tools to support their work on a range of sanitation issues or develop their research agenda;
- Economists and financial specialists, who may not be familiar with the sector but are looking to apply economic methodologies and tools to a field that is critical for human development and yet remains relatively under-researched.

Structure overview

Section 2 sets out the approach which consists of applying economic principles, approaches and tools to evaluate a number of 'sanitation markets' alongside the sanitation value chain.

Section 3 examines how economic analysis has mostly been used so far to assess the economic case for investing in sanitation overall, i.e. where 'sanitation' is considered as a single market. This section argues that, although this type of analysis can be useful to shift mind-sets and public attitudes, its usefulness is limited by a number of uncertainties affecting such economic valuation and by a fundamental difference between the evaluation of economic costs and benefits and the financial incentives that drive actual investment decisions (from both public and private actors) across the entire spectrum of sanitation markets along the value chain.

Based on this finding, ***Section 4*** investigates how economic analysis can help identify market failures in sanitation markets and potential interventions to make these sanitation markets work better. To do so, this section examines in turn three main market segments alongside the sanitation value chain, starting with markets for providing 'access' to sanitation (collection services), markets for transport and treatment activities and finally, markets for reuse services.

Section 5 summarises key findings and recommendations stemming out from the analysis.

2 Approach: using economics to evaluate sanitation markets

This section sets out the approach that is used throughout the paper, which consists of applying economic principles, approaches and tools to evaluate a number of 'sanitation markets' alongside the sanitation value chain. Although the sanitation sector has attracted limited interest from economic researchers up to relatively recently, a number of papers and articles have been published over the last five to ten years showing increasing interest in applying economics to better understand sanitation: this is what we refer to as 'sanitation economics' (see definitions in Box 1 below).

Box 1 – Basic definitions

- **Sanitation** is defined as the methods for the safe and sustainable management of human excreta, through the delivery of a number of sanitation services including collection, storage, treatment and disposal/reuse of faeces and urine.
- **Sanitation economics** is defined as the analysis of the production, distribution, and consumption of sanitation services.
- **Sanitation markets** are defined as the markets on which sanitation and services are produced, distributed and consumed.

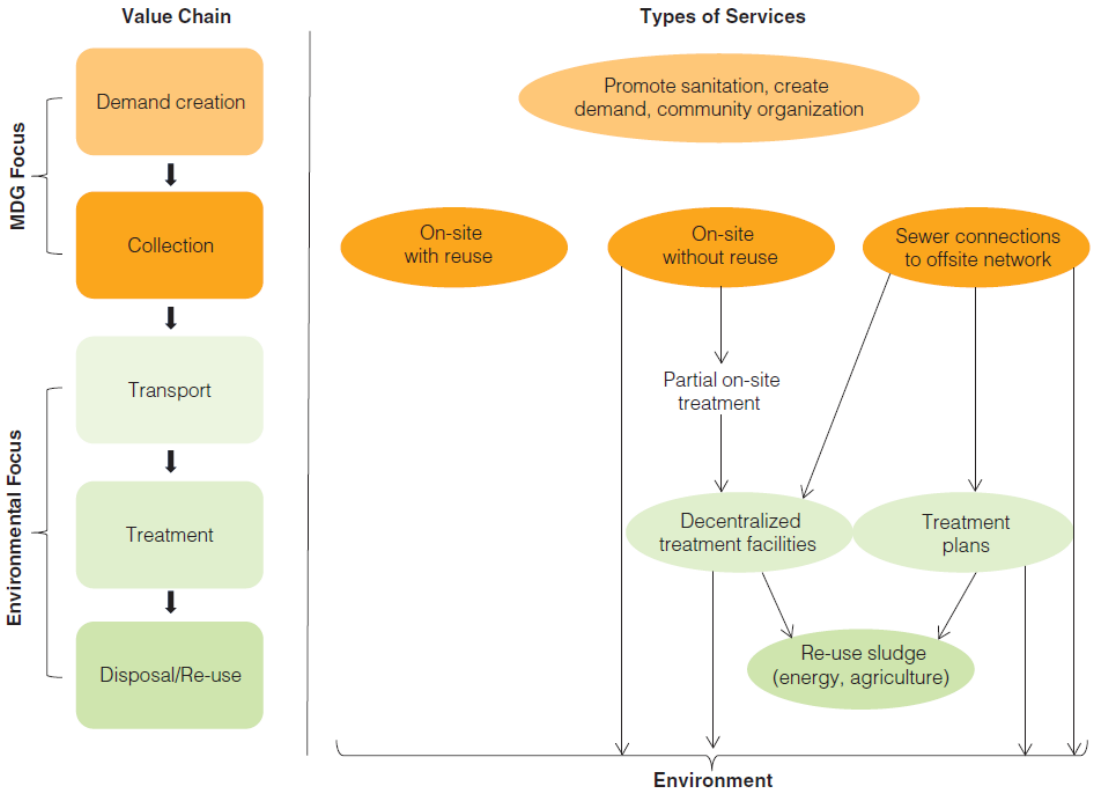
2.1. Introducing the sanitation value chain

Even though the provision of sustainable sanitation has benefits for the community as a whole, it cannot be considered as a purely public good, i.e. a good that is both non-excludable (i.e. individuals cannot be effectively excluded from use) and non-rivalrous (i.e. where use by one individual does not reduce availability to others). By contrast, households need to be connected to a system that handles their excreta in a sustainable and affordable manner.

As a result, it is useful to think of sanitation in market terms, with different actors demanding and providing services along what is now commonly referred to as the 'sanitation value chain'. Figure 1 below shows that the sanitation value chain can be broken down into a series of services (also referred to as 'segments'), which include the collection, transport, treatment, safe disposal and reuse of faeces and urine. In addition, given the importance of generating demand for sanitation, services relating to the promotion of demand for sanitation can also be included as the first step of the value chain.

The different services provided along the sanitation value chain are described below.

Figure 1 – The sustainable sanitation services value chain



Source: (Trémolet S. , 2011).

Demand promotion. Demand for sanitation is often low: as a result, fostering demand can be seen as the first step of the chain of sanitation services. Interventions to increase household and community demand for sanitation typically include promotion of sanitation in general, marketing of specific sanitation products, hygiene promotion, social development and mobilization (often linked to the formation of village committees or community groups in urban areas) and community triggering. Approaches that emphasize demand creation and let households carry out infrastructure investments (such as the Community Led Total Sanitation approach) can be particularly effective, by leveraging private household financing with a limited but well-targeted use of public funds. Experience to date has been largely confined to rural areas, however.

Collection / access. Human waste needs to be collected and separated from human contact. In the context of the Millennium Development Goals, this is commonly referred to as providing 'access' to sanitation.[1] Collecting the waste can be done either through on-site sanitation solutions (whereby excreta are collected, stored and sometimes treated close to the toilet) and off-site (or networked) systems, where excreta are removed from the plot, most commonly via waterborne sewerage. In general, as density increases, networked systems are increasingly cost-effective compared to on-site sanitation solutions. Specific services need to be provided to collect the wastes not only from people's homes but also from public spaces, work places and schools.

Transport. When latrines fill up they need to be moved or emptied while latrines connected to sewers will fail if the sewers themselves fail. If pits are not emptied and cannot be moved

[1] Target 3 of the Millennium Development Goals 7 is: 'To halve, by 2015, the proportion of the population without sustainable access to safe drinking water and basic sanitation'. See: http://www.un.org/millenniumgoals/environ.shtml

they cannot be used and households will revert to open defecation. This is a particular challenge in urban areas where density of housing increases the negative health implications of both open defecation and unregulated emptying of pits. In most rapidly-growing cities, emptying is poorly organized and regulated. Householders either empty pits and tanks themselves or pay private operators to do so.

Treatment. Treatment may take place either on-site (some on-site systems allow this, such as septic tanks) or off-site (when the wastes have been collected via sewer networks or pit latrine emptiers and transported to a sewage treatment plant). Onsite systems may also require this kind of downstream treatment in urban settings where onsite treatment is inadequate. Treatment of these waste flows is often (although not always) critical to protect downstream water resources, public health and the environment.

Disposal. Ultimately, the residual waste is for the most part disposed of in the environment. Disposal can be safe or unsafe, depending on the level of treatment that occurs previously. Pit and tank waste is heavy and costly to transport, and operators often incur additional costs because they have to pay to dump the waste at the official site. The result is that little on-site waste reaches the treatment plant and most ends up in nearby watercourses, waste ground or unofficial landfill sites. In the case of wastewater, treated wastewater is disposed of in nearby water courses whereas the residual product (also referred to as 'biosolids') needs to be disposed of somewhere, either in a landfill or on fields in the case of reuse.

Reuse. Suitable treatment can result in waste streams being converted into a valuable resource for reuse. Reuse of treated excreta offers significant benefits both in terms of reducing the need to find safe disposal sites for wastes and because the 'waste' itself contains nutrients which are an important resource for agriculture or energy generation, either at a large scale (wastewater treatment plants with co-generation) or at the domestic/ community level through biogas plants or burning as fuel for industrial processes.

2.2. Examining the demand and supply side of sanitation markets

Each segment of the sanitation value chain can be conceived as a separate 'sanitation market', with different actors demanding and providing sanitation services. Typical actors and decision-makers that are demanding and supplying services at each step of the sanitation value chain are set out in Table 1 below. Those actors would vary depending on factors such as the type of services that are provided (on-site vs. network sanitation) and the government's policy with respect to sanitation. For example, collection (i.e. building latrines) used to be a highly subsidized activity (with limited impact) whereas households are now seen as the primary investors in on-site sanitation.

Table 1 - Actors and decision-makers at each step of the sanitation value chain

	Demand for the service	Supply of the service
Demand creation	• Government entities (national and local governments) • NGOs and charitable foundations • Communities	• Government entities (national and local governments) • NGOs and charitable foundations • Community leaders
Collection	• Primarily households (in non-subsidised models) • Government entities or NGOs and charitable foundations (in subsidised models)	• On-site sanitation: masons, latrine builders • Network sanitation: utilities or government entities
Transport	• Households: payment	• On-site sanitation: latrine emptiers • Network sanitation: utilities or government entities
Treatment	• Government entities (in application of environmental regulation)	• Utilities or government entities
Reuse	• Users of downstream products, such as farmers, energy producers	• Utilities or government entities

Source: authors.

These different actors will only spend on 'sanitation' (i.e. by investing or purchasing a service) if they have an incentive to do so, i.e. if they perceive the financial and economic benefits to be higher than the costs. At present, in most developing countries, sanitation markets are not organised in a way that provides sanitation goods and services in sufficient quantity or quality, however.

This situation is due to a variety of factors. In economic terms, this incapacity of sanitation markets to deliver services in sufficient quantity can be attributed to a number of market failures, resulting from external effects, imperfect information, abuses of monopoly power or destructive competition between a multitude of actors, as defined in Box 2.

Box 2 – Potential market failures affecting sanitation markets

A market failure is the failure of a free market to achieve an efficient allocation of resources, i.e. one that is optimal from society's point of view. Common market failures in sanitation markets are defined below:

- **An externality (or external effect)** refers to the effect of the action of an economic agent on another that is not mediated via the market. The externality is said to be positive when the effect leads to an improvement in the well-being of the other agent and negative when it sees its well-being deteriorate. An example in the sanitation sector would be when unimproved traditional latrines contaminate groundwater supplies and affect the ability of economic agents to extract groundwater resources for drinking.
- **Imperfect information** occurs when economic agents have incomplete information when making a decision to buy or sell a given product or service. This may result in an inadequate amount of such product or service being traded on the market. Households often have imperfect information about the health benefits from improved sanitation, which may result in them under-investing in sanitation (alongside other factors that affect demand for sanitation). There is an 'information asymmetry' when all market participants do not have access to the same level of information, which may distort decisions.
- **Imperfect competition** occurs when a market is not working efficiently due to the number and behaviour of buyers and sellers. In the case of a single provider of the service (a monopoly), a single buyer (a monopsony), these agents may affect the delivery of services in order to increase their revenues (i.e. a rent) or have no incentive to improve service quality. Another type of imperfect competition could be 'destructive competition', when there are so many producers of a product that prices are driven down to the point where no one makes a profit. This may occur in sanitation markets with many small-scale operators competing for business, which results in none of them being sustainable or able to achieve scale.

2.3. Identifying potential types of public interventions

As a result of these market failures, economic actors in charge of investment or spending decisions (both on the demand and on the supply side) would typically demand or provide less sanitation services than would be optimal from society's point of view. A typical example of this would occur when households are responsible for investing in on-site sanitation: given that they would not capture all the benefits from improved sanitation if they are the only ones to invest (and other households do not invest), their incentive to invest would be limited unless they do so in the framework of collective action.

Identifying market failures is therefore essential to define potential interventions to correct them, either through improvements in the way sanitation markets are organised or via targeted public sector intervention. The types of 'public responses' that could be adopted by domestic governments or donors include:

- Providing subsidies in order to influence investment decisions by economic actors or finance activities that benefit the community as a whole (such as wastewater treatment);
- Defining and enforcing regulations and standards. This can include economic regulation (relative to the definition of tariffs and charges) as well as environmental and public health regulation, particularly if there are environmental externalities that are not appropriately captured by the market;
- Supporting 'market-based' solutions, by facilitating access to finance, disseminating information or supporting the provision of business support services for example.

The following sections examine how public interventions can be supported by an analysis of sanitation market failures. Section 3 reviews how economics has been used at a 'macro-level' to evaluate the need to allocate resources (and in particular, public resources) to the sanitation sector as a whole and identifies the limits of such macro approaches. Instead, we suggest that analysis of market failures needs to be done for each sanitation segment in turn, due to the diversity of services provided and multiplicity of actors involved alongside the sanitation value chain: Section 4 provides a framework to conduct this type of 'micro-level' analysis.

3 Using economics to assess overall resource allocation

Economic analysis has been used in a number of instances to assess the economic case for investing in sanitation overall, i.e. considering sanitation as a single market.

This section argues that, although this type of analysis can be useful to shift mind-sets and public attitudes, its usefulness is limited by a number of uncertainties affecting the underlying assumptions for the economic valuation and by a fundamental difference between the evaluation of economic costs (and benefits) and the financial drivers and incentives that drive actual investment decisions (from both public and private actors) across the entire spectrum of sanitation markets along the value chain. As a result, we argue that 'macro-level' analysis is likely to be insufficient to identify areas where interventions are required so as to increase resource allocation into the sanitation sector. For that reason, Section 4 adopts a segment-by-segment view of the sanitation markets.

3.1 Assess the benefits from sanitation at a macro level

3.1.1. What do we know on the economic benefits from investing in sanitation?

Numerous studies have been undertaken over the last ten years to better understand the economic impact of poor sanitation. This research has been conducted by academics including from the London School of Hygiene and Tropical Medicine and the World Health Organisation (WHO). For example, WHO (Hutton & Haller, 2004) sought to estimate the global costs and benefits of reaching the Millennium Development Goals for water and sanitation.

These studies have concluded that there is potentially a strong economic case for investing in sanitation, lending more weight to previous empirical observations on the impact of sanitation. For example, a survey of medical professionals carried out by the Lancet found consensus amongst the British Medical Journal readers that "sanitation was the most important medical advance since 1840". In addition, historical evidence has been used to demonstrate the positive impact of sanitation investments. For example, in Marseille (France), water supply was a significant constraint on the city's growth during the early nineteenth century. A catastrophic drought in 1834 meant that water availability dropped from 75 litres per capita per day to 1 litre per capita per day and triggered a cholera epidemic. This in turn led to the construction of a canal to bring water, which allowed augmenting water supply to 370 litres a day after its completion in 1848. Increased water availability helped bring down mortality significantly, although it remained at much higher levels than in other French cities at the time (28 deaths / 1000 inhabitants as opposed to 9/1000 in Paris at the same time). Indeed, more generous water supply also meant more dirty water lying about: it is not until ambitious sewerage works were completed and households got connected to the sewers that mortality rates dropped significantly (OECD, 2011).

One key innovation from (Hutton & Haller, 2004) is that they sought to estimate the total benefits of meeting the water and sanitation MDGs. Their estimates included the economic and financial costs relating to medical treatment, lost time from foregone productive activities, the economic value of premature death and time savings. They estimated such benefits at USD 84 billion a year, of which direct health benefits made up only 8% of the total, whereas three quarters of the benefits were estimated to be generated from time gains, from not having to walk or to queue at the water point or not having to find a secluded place to defecate. Other literature regarding the costs and benefits of sanitation also highlighted that the benefits from providing basic water supply and sanitation services would greatly outweigh the costs. For example, according to (Hutton, Haller, & Bartram, 2007a), investment in sanitation in MDG off-track counties was estimated to result in a benefit/cost ratio of USD 9:1. However, a recent revision of (Hutton & Haller, 2004) work estimated a lower benefit/cost ratio (at 4.3 at a global level), with time savings accounting for 70% of potential gains across all regions (Hutton G. , 2012).

According to the literature, the greatest benefits from access to adequate water and sanitation facilities are likely to be linked to time gains and health improvements. The first is relative to the time gained by not having to travel long distances in search of appropriate facilities and queue at water points or to find an area suitable enough to practice open defecation. According to Hutton and Haller (2004), access to adequate sanitation facilities was estimated to save up to 30 min per person per day, freeing up to 1000 hours a year per household which could be used to work, study, take care of children, engage in collective community efforts as well as take rest. They estimated a saving of more than USD 100 billion a year from these time savings, accounting for 90% of all benefits estimated. However, one potential concern with such estimates, particularly with respect to sanitation, is

that there is little evidence on the time that can be saved from more convenient sanitation solutions and on estimating the opportunity cost of such time. This means that the majority of the estimated benefits hinges on assumptions that have yet to be validated through empirical studies. Households would often value convenience and mention it as a driver for them to invest in sanitation (particularly for women) but they would not necessarily place a direct value on respective time gains. In particular, individuals with a lower opportunity cost of their time (because they are unemployed or under-employed) would not necessarily attach a high value to such time gains.

The second main benefit of investing in sanitation is linked to the reduction in waterborne diseases. In 2002, WHO published the first scientifically substantiated estimate of the global burden of disease related to WASH (Water, Sanitation and Hygiene) as a risk factor (Prüss, Kay, Fewtrell, & Bartram, 2002). These estimates were revised in 2008, when WHO stated that 9% of the global burden of disease worldwide could be prevented through improvements related to WASH (WHO, 2008).

Adequate access to sanitation has been observed to reduce cases of diarrhoea between 22-37% (Esrey, 1996); (Prüss, Kay, Fewtrell, & Bartram, 2002); (Fewtrell, Kaufmann, Kay, Enanoria, Haller, & Colford Jr, 2005); (Waddington, Snilstveit, White, & Fewtrell, 2009). With children under the age of 5 accounting for 30% of total diarrhoeal deaths (WaterAid, 2009) this disease is a major cause of premature deaths for young children. Separating out the benefits from improved sanitation from those stemming from other interventions (such as water supply or hygiene education) remains difficult, however. Similarly, reduced diarrhoea amongst labourers has been observed to have a positive impact on productivity. Ill health and/or taking care of a sick child significantly affect a worker's productivity. As a result, it is estimated that investment in water and sanitation has the potential to add more than 3 billion work days a year (Prüss-Üstün, Bos, Gore, & Bartram, 2008). Lastly, it has been estimated that a general decline in waterborne diseases could save health care costs in the range of USD 10-23 per case of diarrhoea treated, as well as transport costs to health facilities and opportunity costs (between USD 0.5-2 per patient visit) (Hutton & Haller, 2004). Additional evidence on this point would be warranted however to strengthen such estimates.

Other potential benefits have also been included in such global estimates but are harder to quantify. For example, (Hutton, Haller, & Bartram, 2007a) estimated that investment in sanitation would add more than 200 million days of school attendance per year, with the potential to increase literacy levels, especially amongst females. A study carried out by UNICEF identified a 0.3% increase in economic growth for every 1% increase of females in secondary schools (Bartram, 2008). When separate toilet facilities are provided in schools for boys and girls, this has been found to boost female attendance, which otherwise have the tendency to drop out of school following the onset of their menstrual cycle. There is emerging evidence to support such findings but it remains weak and would merit being strengthened through additional research.

Other benefits that are potentially significant but hard to quantify would include benefits for the tourism sector, revenues drawn from reuse or the benefits from improved water quality. For example, revenue from tourism can sometimes be an important source of income for developing countries. In some countries, poor sanitation reduces the country's attractiveness to foreign tourists, thereby reducing the potential contribution of tourism to the economy. As a result, it can be inferred that lack of adequate sanitation generates potential economic losses for a country.

The Economics of Sanitation Initiative led by the Water and Sanitation Programme (WSP), was the first attempt at evaluating the costs of inadequate sanitation at a country level in a systematic manner taking account of all of these potential benefits in a coordinated manner, as described in Box 3.

Box 3. The Economics of Sanitation Initiative (ESI): evaluating the impact of poor sanitation

Phase 1 of the ESI study consisted of evaluating the impacts of inadequate sanitation on the economy of five countries in Southeast Asia, including Cambodia, Indonesia, Lao PDR, the Philippines and Vietnam. The stated goal of the study was to provide decision-makers at country and regional levels with better evidence on the negative economic impact of poor sanitation, and to provide estimates of those negative impacts that can be mitigated by investing in improved sanitation. The study showed that, due to poor sanitation, these countries (except Lao, which was not included in the total estimate) lose an aggregated USD 2 billion a year in financial costs (equivalent to 0.44% of their GDP) and USD 9 billion a year in economic losses (equivalent to 2% of their combined GDP). This was equivalent to annual financial losses of USD 5 per capita and USD 22 per capita of economic losses at current exchange rates, although these values could reach close to 200 international dollars (i.e. expressed on a PPP basis) on a purchasing-power parity basis in the case of Cambodia.

The study also sought to estimate the economic gains that could be achieved from adopting improved sanitation, which are summarised below for the four countries combined. Given the difficulties of attributing health impacts to sanitation, it was estimated that only 45% of the health losses could be reverted through improved sanitation, which means that the total benefits from improvement are lower than the estimated losses. This estimation shows that the protection of water resources (through preventing leakage of contaminated wastewater into surface and groundwater resources) is the most significant component of total benefits.

Economic benefits from improved sanitation	**Estimated total (billion USD)**	**% of total gains**
Time gained from latrine access	1.4	21%
Health gains from latrine access and hygiene	2.2	33%
Water resource protection (reduced contamination)	2.3	35%
Increase in tourism activity	0.4	6%
Benefits from waste re-use (Ecosan)	0.271	4%
Estimated total economic benefits	**6.571**	**100%**

In Phase 2 of the study, which began in 2008, cost-benefit analysis studies of a range of sanitation options were conducted for both rural and urban areas in the East Asia Pacific region as well as the Yunnan Province in the South of China. In all study sites, the study found that benefit-cost ratios for investments in various sanitation options (including both on-site and off-site) were all above one, reaching as high as 10. The economic rate of return on initial investment ranged from 30% to 200% per year and was highest in rural areas.

Results showed that the economic loss of inadequate sanitation facilities ranges from an equivalent of 2.3% - 7.2% of the study country's GDP from 2005- 2007. Clear differences were observed between sanitation interventions in rural and urban areas, with pit-latrines rendering economic returns in the range of 5-7 times the cost of investment in Vietnam, Indonesia, Philippines, and China. Urban areas highlighted the use of off-site treatment, which was evidenced to have an economic return of between 2-4 times the cost in Vietnam, China, Indonesia and the Philippines. In addition to this, inadequate sanitation was observed to have a substantial impact on the tourism sector. This was particularly evident in Cambodia, Lao, Vietnam, Indonesia and the Philippines, where the lack of appropriate sanitation infrastructure accounted for 5-10% of tourism losses.

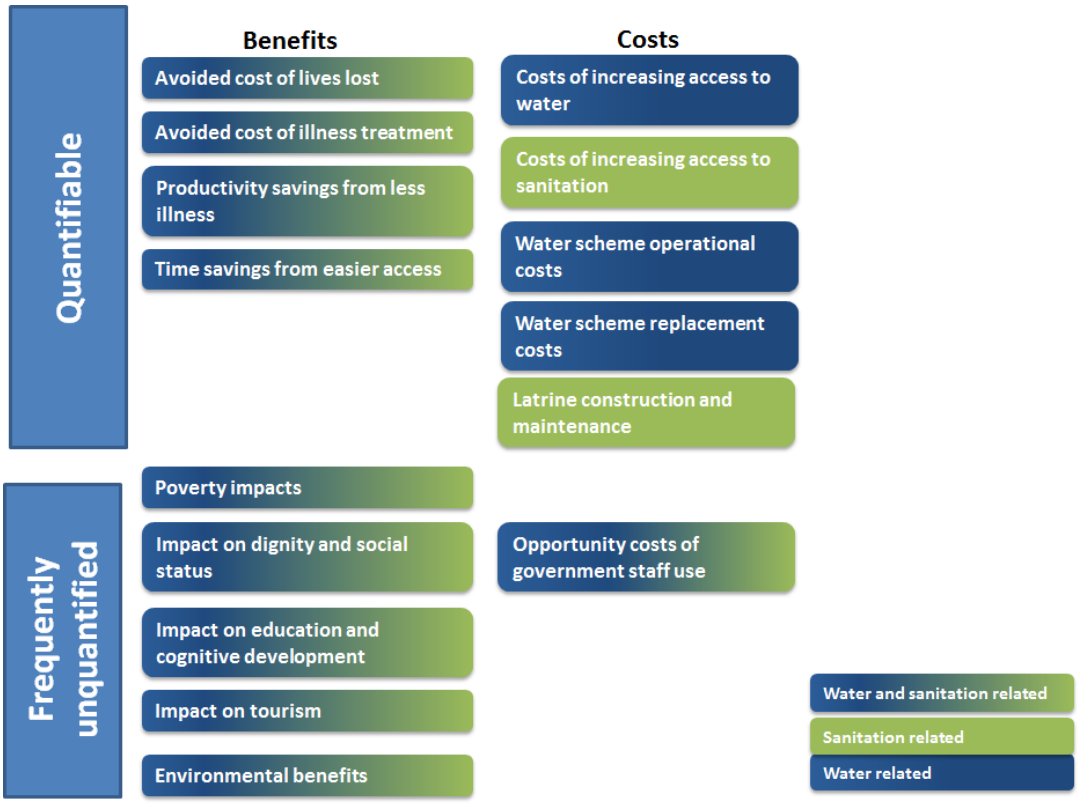
In parallel, the WSP undertook a desk-based study based on the ESI methodology in Sub Saharan Africa. Using data from Demographic Health Surveys (DHS), Multiple Indicator Cluster Surveys (MIC) and the JMP, the total costs of poor sanitation were estimated in Kenya, Mozambique, Nigeria, Rwanda and Ghana. These costs were estimated to be equivalent to 0.9%, 1.2%, 1.3%, 0.9% and 1.6% of the national GDP of these countries respectively.

(Hutton G. , Rodriguez, Napitupulu, Thang, & Kov, 2007b) *and* (OECD, 2011). *A WSP website gathers all documents relative to the Economics of Sanitation Initiative across 3 continents: http://www.wsp.org/wsp/content/economic-impacts-sanitation#top.*

An additional complication when conducting economic evaluation of water and sanitation programmes, is that it is often difficult to isolate the relative impact of sanitation (vs. water) because some of the benefits are shared between these two interventions (particularly when they are introduced jointly) and other types of benefits (and some costs) might be quite high to quantify.

A rapid summary of the benefits from water and sanitation investments that are quantifiable (based on assumptions) and those that are harder to quantify is presented in Figure 3 below.

Figure 3 – Quantifiable and ''harder to quantify'' benefits from water and sanitation



Source: authors.

3.1.2. What do we know on overall resource allocation to sanitation?

Despite accumulating evidence on the benefits of investing in sanitation, the sector does not attract sufficient resources, which means that the sanitation MDGs are unlikely to be met in a number of countries. The 2012 report from the WHO-UNICEF Joint Monitoring Programme (JMP) states that, at the current rate of progress, it is unlikely that the world will meet the 2015 sanitation target. The report stated: "Unless the pace of change in the sanitation sector can be accelerated, the MDG target may not be reached until 2026. Open defecation is still practiced by more than half the population in 19 countries, and by 15% of the global population, a staggering 1.1 billion people". Although there are many potential factors for such slow progress, it appears that resources allocated to the sector are insufficient (including financial and human resources, as well as overall governmental support). The fact that the sanitation sector is under-resourced does not reflect the potentially high benefits that can be generated by sanitation investments.

Estimates of the benefits of investing in sanitation are frequently used to support the allocation of additional public resources to the sector in the form of subsidies.

However, funding for (water and) sanitation comes from three main sources, which are commonly referred to as tariffs, taxes and transfers or the '3Ts' (OECD, 2010) as set out in Box 4.

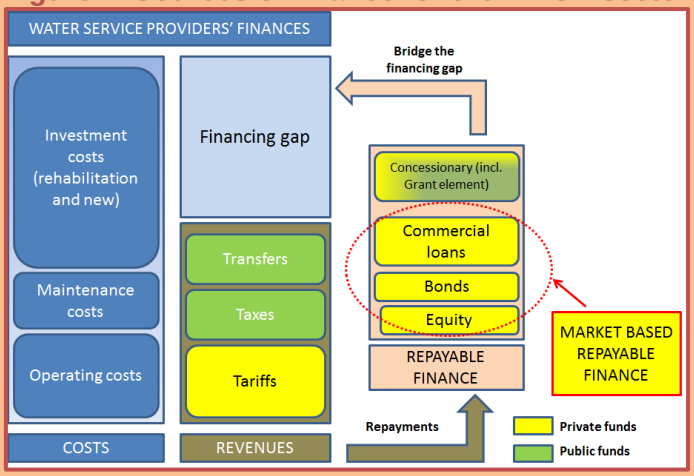
Box 4 – Common sources of WASH financing

Financing for the water, sanitation and hygiene (WASH) sector can come from three main sources, which are commonly referred to as tariffs, taxes and transfers or the '3Ts' (OECD, 2010).These three sources of funding can be summarised as follows:

- Tariffs are funds contributed directly by users of WASH services for obtaining the services. When the service is self-provided (for example, when a household builds and operates their household latrine), the equity invested by the household (in form of cash, material or time) would also fall under tariffs.
- Taxes refer to funds originating from domestic taxes which are channelled to the sector via transfers from all levels of government, including national, regional or local. Such funds would typically be provided as subsidies, for capital investment or operations. 'Hidden' forms of subsidies may include tax rebates, soft loans (i.e. at a subsidised interest rate) or subsidised services (such as subsidised electricity).
- Transfers refer to funds from international donors and charitable foundations (including NGOs, decentralized cooperation or local civil society organizations) that typically come from other countries. These funds can be contributed either in the form of grants, concessionary loans or guarantees.

The way in which these financing sources can be combined is shown on Figure 4.

Figure 4. Sources of finance for the WASH sector



Source: Adapted from OECD (2010)

Due to the lumpy nature of WASH sector investments (relatively large investments with a long asset-life), it is seldom possible to finance all necessary investments up-front. If additional financing cannot be raised, either by reducing costs or by increasing the 3Ts, the remaining financing gap needs to be bridged via a mix of repayable financing sources. At the most basic level, this financing would include loans (on either commercial or concessionary terms) and equity investments from private investors. If repayable financing is not available (either because the cost of borrowing is too high or expected revenue streams are not sufficient to repay), the financing gap would result in an investment gap, which means that necessary investments are not carried out for lack of finance.

Whereas the provision of taxes and transfers can be influenced by arguments based on economic benefits, private investments (by households or service providers) would usually be driven by financial returns or by their own perception of economic benefits.

This can be an issue for the sector as a whole because the largest investors in sanitation at present are, by and large, households themselves (given that they are the main investors in on-site sanitation systems). In practice, household's ability to invest in improved sanitation is often constrained by a number of factors, including limited access to finance or the fact that many of the benefits do not accrue directly to them (as set out in more detail in Section 4.1). As most countries have been moving away from a hardware subsidy policy, most of them are now relying on households to cover the financing gap for achieving the Millennium Development Goals. In Ghana, for example, the Country Status Overview led by the Water and Sanitation Programme (WSP, 2012) estimated that the total capital expenditure requirements to meet the MDG target stand at USD 402 million per year. With the adoption of Community-Led Total Sanitation (CLTS) as the Government's main policy direction for sanitation, households are expected to meet the full costs of sanitation hardware.

Substantial household investments are already taking place. According to (Banerjee & Morella, 2011) in the water and sanitation-specific report of the Africa Infrastructure Country Diagnostic (AICD) published by the World Bank and a wide number of development institutions, households in Sub-Saharan Africa are the biggest group of investors in the sector, thanks to their investments in household latrines. This report estimated that households contributed 0.3% of GDP through investment in on-site sanitation whereas donors and domestic governments each contributed 0.2% of GDP respectively. However, as stated in the AICD report, traditional latrines are built instead of improved ones. This shows that households, if left to their own devices, do not necessarily invest in sanitation solutions that are optimal from society's point of view.

Investments by private sector providers also remain limited, despite a growing number of small-scale independent providers (SSIPs) becoming active in the market. This is particularly the case in developing cities, which are increasingly being serviced by individuals or micro-enterprises that offer valuable pit latrine emptying services. In the city of Bamako, for example, mechanical pit-latrine emptiers ('camion spiros') carry out approximately 70% of pit latrine emptying, whilst the remainder is done by manual emptiers or households themselves (and a non-measured proportion of latrines is never emptied). A recent study (unpublished) carried out for the Agence Française de Développement in 2011 in the context of the preparation of a sanitation investment programme found that there were 88 'camion spiros' (trucks) in operation in the Bamako District, 79 of which were private and 9 belonging to the central government or local governments. The average purchase price of one such truck (usually a second-hand one) is FCFA 15 to 22 million (equivalent to GBP 18,000 to 26,500 as of June 2012). Owners do not have access to credit for this type of investment, which do not tend to be recognised by banks as a business. This may be due to the fact that they are informal or unregistered and do not keep records of their financial transactions.

Investment in sanitation by the public sector (from domestic taxes and via subsidies) has increased in some countries but remains very limited, although it is impossible at present to track it with any level of accuracy. Domestic governments have been committing for some time now to increase financial allocations to the sector. Some governments, such as the Indian government for example, have made significant financial efforts in the last decade. By 2010, the total commitment to the Total Sanitation Campaign (TSC) was approximately USD 3888 million (WSP, 2010a), of which the Below Poverty Line households had committed USD 488 million or 11.4%, the remainder being commitments from the Federal government and from the State governments. This means that the TSC is undeniably a very significant financial commitment for the Government of India.

By contrast, other governments have committed to increase financial resource allocations but have not made significant progress so far. For example, at the AfricaSan conference

held in South Africa in February 2008, country representatives from 32 African countries came together to sign the eThekwini declaration committing to "establish specific public sector budget allocations of at least 0.5% of GDP for sanitation and hygiene programs". This included drawing up national plans, local investment plans, ensuring that sufficient funds are leveraged for implementing WASH programs as well as keeping a tighter control over accountability measures. However, such commitments are difficult to track and are not always followed through. The summary statement of the High Level Meeting that took place in Washington in April 2012 referred to a recent survey of 18 African countries that had committed to allocate 0.5% of GDP to sanitation, which found that none had reached the target (the average was 0.1%) (Sanitation and Water for All, 2012). Based on these findings, WHO has recently launched an initiative on behalf of UN-Water GLAAS to track financing to WASH on a more consistent and comparable basis (Trémolet S. , 2012).

In addition, there is some evidence that existing public sector investment (from both domestic and international sources) is allocated to investments that do not necessarily generate the highest benefits and in some cases, not effectively spent. For example, in urban areas, a very large component of public spending is allocated to large systems rather than to lower-cost investments, such as on-site sanitation. This is often based on an 'incidence of benefit' argument, which states that the party that benefits most from the service should be paying for it. With that logic, some would argue that householders should pay for a household connection, the local government should pay for the sewage collection network and the national government should pay for treatment. This is because users are assumed to be willing to pay for those benefits that they perceive and are able to internalize them, whereas they may be unwilling or unable to pay for the full costs of the system, including trunk sewers and wastewater treatment. However, in countries or cities where the wastewater systems are very under-developed, this often results in those systems benefiting only a small percentage of the population. For example, research for WaterAid on the effectiveness of public spending on sanitation (Trémolet & Binder, unpublished) found that, in Dar es Salaam, 99% of public spending went to wastewater systems when only 10% of the city's population was connected to the sewerage systems. As a result, households have to invest in on-site sanitation systems, at a cost which is about three times higher than if they were to pay only for a household connection to the sewerage system.

The international community has been placing increased emphasis on the sector as a result of sanitation being one of the most off-track MDGs but issues remain with respect to how this aid is distributed. For example, aid to water and sanitation has been rising steadily since 2001, increasing from USD 7.4 billion to USD 8.1 billion over the 2007-2008 to 2008-2009 period. Nevertheless, substantial levels of aid are delivered to middle income countries where access to basic services is less of a problem than other countries which receive comparatively little aid despite a greater proportion of un-served people (OECD, 2011) According to the 2012 GLAAS report (WHO, 2012), the sanitation sector only receives 27% of total public spending on water and sanitation (based on a sample of 12 countries), and hygiene receives only 2% of total spending.

3.1.2. What do we know on the use of economic evidence to drive resource allocation?

There is limited evidence at present to show whether economic arguments do influence investors in sanitation to allocate more resources to the sector or not. With respect to the main investors (households), there is mounting evidence that some types of behaviour change campaigns (such as those using Community Led Total Sanitation techniques) can be comparatively more efficient than others in triggering investment decisions (see Section 4.1 for more detail on supporting demand for sanitation). However, such approaches do not place emphasis on the economic impacts of the lack of sanitation but rather rely on triggers such as shame or disgust. Economic arguments could have an

impact, nevertheless, when households are faced with the decision of taking a microfinance loan or not to acquire a sanitation facility. In this case, the financial and economic benefits of investing in a toilet (through reduced medical expenses and increased productivity) can be estimated by households themselves (with support from external agents) to far outweigh the costs of the loan.

With respect to public sector decision-makers, there is limited evidence that economic arguments do have an impact on policy-making. A study on the political economy of sanitation conducted by WSP (Garbarino, Holland, Brook, Caplan, & Shankland, 2011) has made a first attempt at filling in that gap. The study sought to analyse the political economy of pro-poor sanitation investments and service provision in Brazil, India, Indonesia and Senegal. A qualitative analysis was undertaken in order to identify how political actors, institutions and economic processes influence each other in these countries. Amongst all, Indonesia was highlighted as a country that has used data on economic benefits of investment in sanitation as a tool when making political decisions. In the case of Indonesia, "external agency influence has clearly been important. The Government interest has been stimulated through, among other factors, a WSP comparative study on the economic impacts of sanitation, a WSP/US Agency for International Development regional workshop in the Philippines, and the Indonesia Sanitation Sector Development Project (ISSDP) implemented by the Government of Indonesia together with the Water and Sanitation Program–East Asia and the Pacific (WSP-EAP)" (Garbarino, Holland, Brook, Caplan, & Shankland, 2011). This apparently marked a turning point in the country's sanitation investment strategy. As a consequence, 2010 saw a rise in the national budget allocation for sanitation to local governments, which equalled that allocated for water. This rise represented a fourfold increase from the previous year's budget, reflecting an increased understanding of the economic repercussions of underinvestment in sanitation.

Although a solid economic evidence basis is crucial, the study on the political economy of sanitation also showed that the point in time at which this information is disseminated has a significant impact on whether it can or cannot influence political decisions regarding investments in sanitation. In the case of Brazil, data on the economic benefits of sanitation in Bahia Azul was released in a transition period between two political administrations. The information was thus not received and used in the most effective manner and its role in influencing the debate regarding the value of sanitation was not maximised.

In addition, it is important to recognise that political decisions regarding investments in the sanitation sector are not merely influenced by the economic benefits that such investments bring about. This same study by WSP argued that political opportunism, whereby leaders act according to self-interest, is in itself a big contributing factor. For example, in Maharashtra, during the mid-2000s, policymakers believed that a poverty targeted sanitation programme may actually lose them votes, and thus sanitation was not felt as a priority or a need among rural communities. A further example, from Senegal, reflects how investment in large, highly visible infrastructure seems to have won votes for powerful leaders amongst the population, even though they may not have been the type of investments that would generate the highest economic benefits. Thus, although useful, economic benefits cannot be recognised as the sole determinants of political decisions regarding investments in the sanitation sector.

3.2. Using available evidence to drive resource allocation

Based on the finding that sanitation and hygiene are cost-effective ways to improve health and the economy, the sector should seek to mobilise additional financial resources from all potential sources, including household investment via direct investments (e.g. investment in on-site sanitation) or tariffs (for sewerage services or via

cross-subsidies from the water tariffs), domestic public sector, Official Development Assistance (ODA) and private foundations. Other types of more innovative financing could include 'social finance' from social entrepreneurs or social investment funds (as advocated by the World Sanitation Financing Facility) or from decentralised solidarity mechanisms, as advocated by the 6th World Water Forum Finance Working Group in (Trémolet S. , 2012).

Substantial economic benefits can be associated with investment in sanitation. These benefits are not limited to one component of the sanitation value chain, i.e. either collection or wastewater treatment. In fact, each type of service can generate specific benefits as discussed in detail in an OECD publication on the benefits of investing in water and sanitation (OECD, 2011). The sequencing of investments matters, because some investments may have a negative impact if conducted in isolation. For example, investments in sewerage systems when water supply is low or intermittent would limit the ability of such sewerage pipes to function effectively. Household investments in on-site sanitation systems when downstream services are not available could result in worse health impacts (as it did in 19th century London whichled to the spread of cholera). Consideration must therefore be given to the most effective investment options and to their sequencing across the entire value chain in order to avoid excessive costs, now and in the future. When making the case for more investment in sanitation, it should be noted that investments made are not necessarily the most effective in the long term.

Going forward, it will be necessary to target existing resources and new investments better, so as to focus on areas that generate most benefits and to rely on the most cost-effective measures (or use the most cost-effective service levels). Too many resources have been allocated in the past to large systems, i.e. wastewater networks and wastewater treatment plants that do not get used to their full potential. Governments and donors alike are already shifting their priorities by reallocating funding to basic sanitation programmes in rural areas. In future, funding from international donors will be tracked with more accuracy since the OECD/DAC database now allows to distinguish between water and sanitation and to distinguish (as was done before) between large and small systems.

Most importantly, it would be necessary to understand the multiple drivers that could convince governments and private sector entities to invest in sanitation. A key issue is the fact that some economic benefits do not actually materialise in terms of investment because there is a key distinction between potential economic benefits and financial returns / incentives to invest for those who actually take investment decisions. Research has shown that if presented with evidence, policy-makers can be encouraged to take appropriate action in delivering water supply and sanitation services. Donors and international institutions play an important role in this equation since they can help generate the necessary evidence, particularly if partnered with local entities.

Finally, it might be necessary to formulate messages in slightly different ways so that these messages can reach other stakeholders that may act as providers of finance, such as global philanthropists or the corporate social responsibility departments of certain industries (such as international hotel chains or other actors of the tourism industry, that stand to benefit hugely from improvements in sanitation status in the developing world).

3.3 Identifying the need for further research

The costs of inadequate sanitation are not adequately measured and reflected in decision-making. It would be necessary to conduct more analysis such as the ESI study, in a wider set of countries and regions. WSP has established a robust methodology which it is rolling out to a number of countries, including in Central Asia and Africa. This type of research could be carried out in more countries, in order to motivate a greater number of

countries to allocate more resources to sanitation. At the same time, the methodology would need to be improved on an ongoing basis so as to reflect new evidence, particularly on issues such as the quantification of time gains which is a significant driver of overall estimated benefits. Further methodological development would be needed in the following areas:

- Differentiating between different types of interventions so as to isolate the benefits from sanitation from the benefits of other interventions (such as from water investments, hygiene promotion or health improvements). Most studies that provide reference points in terms of benefits have looked at the combined impacts of providing access to water and sanitation. It would be important to conduct further studies that seek to isolate the impact of sanitation investment and the impact of hygiene improvements (such as hand washing with soap);
- Sanitation generates a long list of non-quantifiable, or at least difficult to quantify benefits, such as improvements in dignity, status, security or providing the ability to study for a longer period (particularly for girls). Additional evidence and analysis is required to attach a more precise value to such benefits;
- There are overall few estimates of the cost-benefits of sanitation interventions (or even of benefits, which have been estimated only in a few countries) that can provide reference points for other studies or evaluations (where the financial means to conduct evaluations may be limited). Additional studies would be needed to expand the set;
- There is limited attempt to track how these benefits can be monetized, i.e. how they translate into revenues for governments or for households themselves. It would be important to try and follow the logical links of benefit monetization so as to strengthen the case for investing in sanitation.

There is evidence that current methods for mobilising financial resources for sanitation are inadequate. For example, the presumption that 'sanitation should pay for sanitation' and that polluters should be asked to pay for the cost of their pollution (i.e. the 'Polluter-Pays Principle') may not be suited to some or most sanitation markets. As an alternative, the beneficiaries from improved sanitation may need to be asked to pay (e.g. tourism facilities) and to cover the costs of others who are not able to invest in sanitation by themselves (e.g. poor households). Also, it may be preferable to pay sanitation service providers to pay for delivering certain services (such as disposal to safe sites) rather than charge them for it, as it is currently practiced.

More broadly, there is a lack of clarity about how additional resources can be channelled to the sector and how these funds should best be used. This is because there is limited understanding about how sanitation markets work and where, if at all, governments should seek to intervene to make these markets work more efficiently. This is what we examine in the next section.

4 Using economics to analyse market failures and identify potential interventions

This section investigates how economic analysis can help identify market failures in sanitation markets and potential interventions to make these sanitation markets work better. To do so, this section examines in turn three main market segments alongside the sanitation value chain, as follows:

- ***Section 4.1. analyses markets for providing access to sanitation***. We seek to understand what market failures have meant that demand for sanitation services remains

low, despite various public sector-led attempts at triggering a demand-side response. This section presents a number of potential interventions to boost sanitation access, particularly with respect to innovative sanitation financing mechanisms. This section is particularly relevant for rural sanitation, given that in rural areas, households usually build and service their own sanitation solutions and can only rely on few external sanitation service providers.

- ***Section 4.2. examines markets for transport and treatment services.*** We examine why transport and treatment services are currently inadequately provided and what could be done to boost the delivery of such services. This section is particularly relevant for urban sanitation, where population density and the complexity of urban life makes it essential for transport and treatment services to be provided by dedicated service providers;

- ***Finally, Section 4.3. considers the market for disposal and re-use,*** i.e. for by-products of the sanitation value chain such as raw urine, faeces and treated wastewater on its own. This section is potentially relevant for both urban and rural sanitation provision.

Each sub-section is structured in the same way: it starts with examining how each market segment tends to function in a developing country context and identifying the type of market failures that typically occurs in this market segment. It then examines the types of public (and private) actions that could be adopted in order to correct some of these market failures where they are observed (in response to the question: what can we do given what we know?) and identifies additional research needs (in response to the question: what do we need to know in order to do better?).

4.1. Markets for providing ‘‘access to sanitation’’

4.1.1. What do we know: how do markets for ‘access to sanitation’ function?

As mentioned in Section 2, providing access to sanitation can be done in two main ways: either by collecting the waste through on-site sanitation solutions (whereby excreta are collected, stored and sometimes treated close to the toilet) or connecting to piped systems that take the excreta off-site, most commonly via waterborne sewerage. In the case of on-site sanitation, households would either build latrines themselves or hire latrine artisans to do it for them. For sewerage connections, the utility or government agency (such as a municipality) would build sewerage networks and either charge users for the sewerage connection or incorporate its costs into the overall water and sewerage bills (when water and sewerage are provided jointly) or the sewerage bill (when provided stand-alone).

In general, the most ubiquitous sanitation solutions in developing countries are small-scale on-site systems such as latrine pits and septic tanks, as shown on Table 2 below. Of the sanitation systems used in sub-Saharan Africa, on-site sanitation (OSS) accounts for nearly 80% in the urban centres and up to 100% in rural areas (Sandec, 2006). In Asia, there are reports of up to 75% to 90% OSS coverage in places such as Vietnam and Sri Lanka (AECOM and Sandec, 2010).

Table 2 - Sewerage connection rates and percentage of population using on-site solutions

Country	City	Percentage of Population Connected to Sewerage Network	Percentage of Population Using On-Site Sanitation Solutions	Source
Ivory Coast	Abidjan	25 - 30 %		(Collignon & Vézina, 2000) (Norman, 2009)
Kenya	Nairobi	20 %		(Collignon & Vézina, 2000)
Senegal	Dakar	15 -25 %		(Collignon & Vézina, 2000) (Norman, 2009)
Uganda	Kampala	6 %		(Collignon & Vézina, 2000)
Tanzania	Dar es Salaam	3 - 10%	>85%	(World Bank, 2003)
Guinea	Conakry	10 - 15%		(Collignon & Vézina, 2000) (Norman, 2009)
Mauritania	Nouakchott	4 %		(Collignon & Vézina, 2000)
Benin	Cotonou	1 %		(Collignon & Vézina, 2000)
Burkina Faso	Ouagadougou	0 %		(Collignon & Vézina, 2000)
Mali	Bamako	2 %	98%	(Collignon & Vézina, 2000)
Sierra Leone	Freetown	1 - 2 %		(Mikhael, 2011) (Atkins, 2008)
Nigeria	Abuja	15%		(Norman, 2009)
India	All Urban	40%*		(AECOM and Sandec, 2010)
Ghana			85%	
Sri Lanka	All Urban	4%	89% (septage)	(AECOM and Sandec, 2010)
Indonesia	All Urban	2.3 %	62% (septage)	(AECOM and Sandec, 2010)
Malaysia	All Urban	73%	27% (septage)	(AECOM and Sandec, 2010)
Thailand	Bangkok		65%	
Philippines	All Urban	7%	40% (septage) Manila (78%) Towns (98%)	(AECOM and Sandec, 2010)
Vietnam	All Urban	NA	77%	(AECOM and Sandec, 2010)
** Projection in order to meet MDGs*				

Based on this reality, the rest of this section examines in more detail the market for access via on-site sanitation solutions, as these types of facilities serve the vast majority of the population in the countries and regions targeted by the SHARE Research Consortium. Aspects related to sewerage services are dealt with in more detail in the next section which deals with the markets for transport and treatment services, as sewerage combines collection and transport in a single service (as opposed to on-site sanitation where those two services are usually provided separately).

4.1.2. What types of market failures typically account for this lack of market response and what interventions can be adopted to correct these market failures?

The delivery of sanitation access services remains limited in many countries, however, as evidenced by the sector's predicted failure to reach the sanitation Millennium Development Goal. This under-provision is due to a number of market failures, both on the demand and on the supply side. In addition, a number of interventions have been tried to address these market failures but so far, with limited success.[2] In this section, we therefore review identified market failures and what is currently known on the effectiveness of existing interventions to correct failures, as summarised in Table 3.

[2] See Section 2.3. for examples of public sector interventions.

Table 3 - Providing access to sanitation: potential market failures and public interventions

	Potential market failures	Potential public interventions
Demand-side	• Households lack information on the benefits of sanitation. • Taboo element means that they are not receptive or not willing to change.	• Conduct sanitation promotion and behaviour change campaigns
	• Limited access to finance: households are supposed to invest in on-site sanitation but high cost is a hurdle • People benefiting from investments (e.g. tenants) are different from those taking investment decisions (e.g. landlords)	• Facilitate access to finance, by encouraging microfinance institutions to lend for sanitation for example • Impose on landlords to provide sanitation facilities in all rented facilities (regulation)
	• Externalities: households do not capture all benefits from their own investment (especially if investment is not part of an overall community response)	• Provide subsidies to households to cover the difference between public and private benefits
Supply-side	• Inadequate market structure: service providers (latrine builders) are inadequately trained, operate illegally or at a small-scale, thereby foregoing benefits from economies of scale	• Provide training to service providers, regularise their situation, introduce a 'light-touch' regulation regime, facilitate access to finance
	• Utilities hold a monopoly over service provision in a given service area but may be reluctant to serve poor customers in 'harder to reach' areas.	• Remove monopoly or exclusivity rights • Introduce obligations (or incentives) for utilities to serve poor customers in their service area

Source: authors.

A number of market failures are at play both on the demand side and the supply side of the market for providing access to sanitation, which may account for this lack of market response.

On the demand side, the main market failures that may occur (depending on the local circumstances) are as follows:

- Imperfect information: households may be insufficiently informed and are not always aware of the benefits of sanitation. Sanitation often remains a taboo: awareness is often too low to get people to change their entrenched behaviour and resistance to change is often strong. Addressing this type of market failure can be done by conducting promotion and behaviour change campaigns.
- Externalities: on-site sanitation is usually treated as a private investment (based on the 'incidence of benefits' theory) when, in fact, investment in household sanitation can generate significant public benefits. One key finding of the literature is that, like for immunization, sanitation has benefits beyond the immediate household which acquires the service. Safe collection of excreta has the effect of reducing the number of faecal-pathogens in the environment, which in turn reduces people's exposure to those pathogens. A significant number of people need to change their behaviours for this effect to occur.
- Misaligned incentives: people responsible for taking investment decisions are not necessarily the ones that stand to benefit from the investments (particularly in slums, where many households are tenants and cannot apply pressure on absentee landlords to build a toilet that would infringe on the amount of space available for rental), which can create a further distortion. By contrast, people standing to benefit from investments are not taking decision, which might lead to improper use.

On the supply side, classic market failures would include the following:

- The number of trained service providers (such as masons and latrine artisans) is insufficient. They may have insufficient training (particularly in business skills, to market

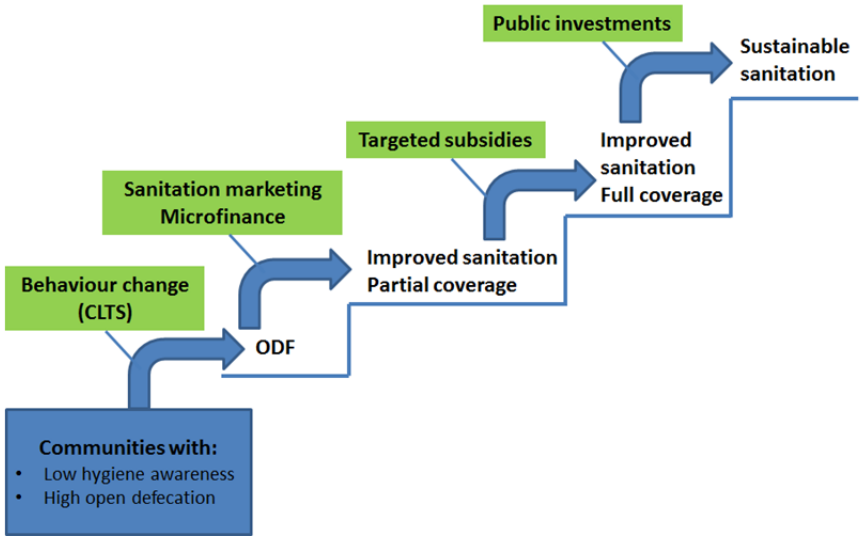
their services) or not have sufficient equipment. Another issue may be that small-scale independent providers have no clear legal status and therefore operate in illegality, which constrains their ability to invest and to plan;
- Utilities have monopoly rights for service provision over a given territory and do not allow additional providers to supply services on that territory. Although this type of market failure would more often materialize in the water sector, it might also be observed for sanitation.

Public interventions to address these types of market failures on the market for access to sanitation would typically include the following:

- Sanitation demand promotion and campaigns (including CLTS);
- Supply side interventions, such as sanitation marketing;
- Provision of subsidies, which can either be software or hardware subsidies;
- Facilitated access to finance, both on the demand and the supply side.

These interventions can be combined depending on the circumstances that lead to insufficient demand for access to sanitation services, as shown on Figure 4 below. In communities where lack of demand is the main issue, conducting behaviour change campaigns may be the main point of entry. But as communities' sanitation conditions improve, additional interventions may be required, such as sanitation marketing (to address supply-side market failures) or facilitated access to finance (both on the demand and on the supply side). Once the majority of a community has gained access to sanitation, there might still be a role for hardware subsidies, especially if they are targeted onto the poorest and output-based. We review these types of interventions in turn in the paragraphs below.

Figure 4 - Sequencing of public interventions to increase access to sanitation



Source: authors.

Conducting behaviour change campaigns (including CLTS) can be a way of addressing information asymmetries and external effects, particularly when households are not aware of the negative impacts from the lack of sanitation.

Such campaigns are particularly effective as a public intervention in areas with high open defecation so as to get communities onto the sanitation ladder and eliminate open defecation. The way in which these behaviour change campaigns have been conducted has evolved overtime, with some approaches being more successful than others, which is why it is important to understand better what works and what does not work in terms of changing behaviour and triggering demand.

Until relatively recently, water and sanitation projects relied on hardware subsidies as a means to build capital infrastructure, including on-site sanitation facilities. It was repeatedly observed, however, that when latrines were built by the public sector 'for' the recipients, those facilities were neither used nor maintained adequately. Based on these observations, there was a growing realisation of the need to motivate people to change their sanitation behaviour, in addition to (or instead of) providing them with sanitation facilities, and to get them to invest in their own latrines, which would be built by local service providers (Jackson, 2004). This lead to a shift away from the provision of hardware subsidies to conducting behaviour change campaigns in order to get households to invest themselves in sanitation (and thereby have a higher chance that they would actually use the facilities).

A key motivating factor to convince households to build sanitation facilities was first believed to be arguments around the health benefits of sanitation. However, evidence presented by (Jenkins & Sugden, 2006) has shown that households are not primarily motivated by engaging in sanitation only to avoid excreta-related diseases. Even if changes in behaviour are experienced, these are only sustained over the short-term. Instead, factors such as dignity, comfort and privacy appear to hold greater value for individuals. If they are taken into consideration to motivate demand, behaviour change is more likely to be sustainable.

When trying to communicate this to individuals, numerous difficulties are encountered. In many societies, sanitation is considered a taboo subject. When people are faced with inexistent or inadequate facilities, they may experience feelings such as embarrassment and indignity. People who do not have any other alternatives but to practice open defecation seek secluded areas, with women particularly waiting till night falls to avoid being spotted. The actions and feelings attached to these practices are often considered too private and thus are seldom discussed openly. For this reason, issues remain hidden and thus seldom make it to the political agenda (Frias & Mukherjee, 2005).

The lack of information is also present at the level of communities, since they are often unaware of details regarding sanitation infrastructure and/or the range of alternatives, both of which have been observed to influence sanitation demand. Research on the situation in Kenya, carried out by (Jackson, 2004) reflects that, in some instances, only those who are literate have access to information, leaving a large part of the population unaware of the value of sanitation and hygiene. This lack of knowledge has an important impact on the decision-making ability of numerous people.

In some cases, costs are often misjudged to be high, acting as a further barrier for adoption of sanitation facilities. This was evidenced in a few studies carried out in rural Benin (Jenkins M. , 1999) (Jenkins & Curtis, 2005) and rural Vietnam (Frias & Mukherjee, 2005). The study from Benin, however, highlighted that out of those households which did not use a latrine, only 11% stated that the actual cost of a latrine was too high (Jenkins M. , 1999); (Jenkins M. , 2004). This relatively low percentage confirms the misconception often held by households on the actual costs of sanitation infrastructure. In other settings, such as rural Ghana, respondents to a survey conducted in the context of the design of a water and sanitation programme (feasibility study for the SAWISTRA programme, unpublished) indicated that limited access to finance was a key barrier preventing them from investing in sanitation, however. It is therefore important to conduct specific assessments on a case-by-case basis to evaluate the impact of costs on household investments, to evaluate whether it acts as a barrier. Specific interventions to address high costs (such as facilitated access to finance for example) are reviewed further down in this section.

A number of so-called software approaches have been developed to generate demand for sanitation and it is important to assess the differences and relative merits of those approaches. These approaches have been comprehensively reviewed in a report published

by WSSCC (Peal, Evans, & Voorden, 2010), which described the various hygiene and sanitation 'software' approaches that have been deployed over the last 40 years by NGOs, development agencies, national and local governments in all types of settings – urban, informal-urban and rural (Frias & Mukherjee, 2005; TARU, 2008). The authors noted: "there are many different software approaches and there is often confusion over for example, what a particular approach is designed to achieve, what it comprises, when and where it should be used, how it should be implemented or how much it costs. There is currently no reference material that explains the different approaches available or helps practitioners decide which one would be best to use for a particular situation. Moreover, the many 'acronyms' and 'brand names' in use frequently mean different things to different people. Therefore, the purposes of this document are to clarify some of the confusion in the sector about the terminology and language used and to provide a 'ready reference' or introduction to some of the more commonly-used approaches". Box 5 provides more information on the content of their analysis.

Box 5 – Promoting demand for access to sanitation: understanding alternative approaches

(Peal, Evans, & Voorden, 2010) presents software approaches on a comparable and neutral basis, grouping them in categories such as: participatory planning tools (e.g. Participatory Rural Appraisal or PRA), hygiene promotion (e.g. Participatory Hygiene and Sanitation Transformation or PHAST), sanitation promotion (e.g. Community-Led Total Sanitation or CLTS) and programming frameworks (e.g. Sanitation 21 developed by the International Water Association). These ultimately seek to empower, create demand, facilitate the establishment of supply chains or improve sanitation and hygiene projects for individuals, schools and/or entire communities. This publication did not seek to recommend any of these approaches specifically but rather highlighted the pros and cons of each approach and the need to tailor their use to the specific circumstances. What they found is that demand for sanitation has more chances of being increased succeeding when software components are introduced. Despite the wide range of activities which could be undertaken, evidence has shown that rather than design broad hygiene programs, demand generation and consequent behaviour change is likely to come about if focus is put on a small number of promotional activities. Thus prioritisation of practices that lead to a reduction in the greatest health risk is crucial.

Source: (Peal, Evans, & Voorden, 2010)

There are some indications that triggering demand at a collective level in a homogenous community can work better than acting at the level of individuals. For this reason, over recent years, Community Led Total Sanitation (CLTS) has been promoted by a number of donor organisations and governments as a very effective method for generating demand for sanitation at community level (Mehta, 2011). This method relies on community-level triggering, using levers such as shame and disgust instilled at the level of a whole community through group work, including methods such as the 'walk of shame'(whereby villagers tour the open defecation sites) or 'calculations of shit' and medical expenses.

It must however be recognised that there is a lack of systematic studies regarding the impact of CLTS triggering, making it difficult to undertake a complete evaluation of this approach. Despite the considerable enthusiasm generated by CLTS, the actual impact of CLTS has not been systematically studied. Its impact has been evaluated in certain regions, such as in Sub-Saharan Africa by UNICEF (Ecopsis, 2011), which evaluated the implementation of CLTS in 18 countries in the region. The evaluation found that about 25% of the communities that had been triggered had become and sustained their status as ODF (Open Defecation Free), which is relatively low compared to earlier claims of success. The report concluded that the effectiveness of CLTS approaches can be increased when there are repeated visits by CLTS facilitators over a relatively long period of time (one or two years post-triggering). In

India, WSP conducted a review of the effectiveness of the Total Sanitation Campaign introduced by the Government of India, as summarised in Box 6 below.

Box 6 – Review of alternative approaches to stimulate demand for sanitation in India

WSP's assessment on India's TSC reviewed numerous different approaches undertaken by districts across the country to stimulate demand for sanitation, including CLTS and other approaches in the context of the Total Sanitation Campaign being rolled out with support from the Federal government of India but with differences in approaches from State to State. An example from the Sisra district, in the state of Haryana, showed particularly good results. The responsibility to move towards open defecation amongst the villages in the district fell upon a team of motivators who helped communities undertake a self-analysis of their sanitation situation back in 2007. The principal motivator of behaviour change in the Sisra district related to disgust and shame, i.e. when communities started realising that open defecation led them to consume each other's faecal matters. Further formation of Sanitation Committees and Information, Information Education and Communication (IEC) techniques led to 277 out of 333 Gram Panchayats (GP) winning the Nirmal Gram Puraskar (NGP) prize at the time of the WSP study in 2010. This incentive program introduced by the Government of India (GoI) awards cash prizes to local governments that achieve community-wide total sanitation. With the remaining GP's in Sirsa applying for this award, the district was the first to achieve complete ODF status in the whole country (WSP, 2010a). Under the TSC, the state of Maharashtra also opted to support a community-based approach. In that State, coverage increased from 18% in March 2003 to 53.4% in February 2008 and was projected to rise further to 82.2% in March 2012, at least demonstrating remarkable impact on the ground.

Source: (WSP, 2010a)

Household demand is often constrained by the inability to access sanitation services when these services are insufficiently developed, due to failures on the supply side of the market. To address these, supply-side interventions need to be considered, which are usually referred to as 'sanitation marketing'.

Supply-side limitations can be observed in a number of settings. For example, in rural Benin, people were recorded to experience difficulties in accessing materials, expertise/advice, skilled labour and special tools. This acted as a significant barrier to the adoption of improved sanitation facilities for numerous households in the region. Technical complexities involved with infrastructure construction were also observed in Ghana (Jenkins & Scott, 2005) where there was no help to be found in order to build latrines and thus responsibilities laid on households themselves. Similarly, in rural Vietnam, a lack of technical services and credible suppliers was found to constrain demand for sanitation services (Frias & Mukherjee, 2005).

For example, the TSSM (Total Sanitation and Sanitation Marketing) schemes developed by the Water Sanitation Program in Indonesia, Tanzania and India with funding from the Gates Foundation have sought to combine demand-side and supply-side interventions in order to boost access to sanitation in the regions where they operate.[3] They found that sanitation marketing could speed up the scaling up process and contribute to the sustainability of the behaviour change campaigns. However, an analysis of the management models in these three countries showed that local governments had made a lot more progress in their role in supporting CLTS than in sanitation marketing. According to WSP, one of the reasons why sanitation marketing has not fully developed is because local governments had not clearly defined their role as yet with regards to sanitation marketing. Thus, a gap existed for the provision of continued training and guidance to institutions on how to engage with and

[3] These combined approaches are sometimes referred to as 'CLTS +' by certain agencies or as CATS (Community Approaches to Sanitation) by UNICEF.

develop local private sector providers. In support of this, WSP decided to increase the capacity of local governments by supplying training to CLTS facilitators in sanitation technologies in order to enhance sanitation marketing communication. WSP also developed documentation, including a toolkit, on sanitation marketing techniques in order to provide support to governments as well as NGOs or other international donors on developing this type of programmes.[4] They argued that further help could be geared towards the financing of mason training to reduce the responsibility of households where construction and maintenance is concerned, creating demand for services offered by the private sector and developing business skills of private providers.

The way in which financing to promote household sanitation is delivered was also found to have a significant impact on the effectiveness of public spending.

As mentioned above, a key barrier limiting access to sanitation can be that the investments costs involved in building a latrine can represent a significant hurdle for households. For example, limited access to finance by households has been found to be a key constraint on investment in rural Ghana during a detailed assessment to support the preparation of a rural water and sanitation programme to be funded by the European Investment Bank, the Agence Française de Développement, the European Union and the Bill and Melinda Gates Foundation. To address this, public funds can be used to provide subsidies to households so as to help them invest. The way in which these subsidies are defined and channelled can have a significant impact on their effectiveness, however. Recent analysis has found that using public funds to support access to finance or via targeted and output-based subsidies can be much more effective than blanket hardware subsidies. In the following paragraphs, we present different types of subsidies in existence and analysis with respect to the relative effectiveness of such subsidies.

WSSCC, in their primer on public funding for sanitation (Evans, Colin, Jones, & and Robinson, 2009), set out the range of subsidies that can be provided to support access to sanitation. This document explains that subsidies for software activities can be directed to capacity building and training, development of promotional material and campaigns, market research and the development of sanitation marketing activities. Hardware subsidies on the other hand can be of various types including direct subsidies (which are paid to the recipient and can be spent to access a range of services) and infrastructure subsidies (where public money is spent specifically to construct new infrastructure, noting that this is the most common). In addition to this, connection subsidies can be used to connect households to networked sewerage and operational subsidies can be offered to a service provider in order to offset some of the costs of supplying a service.

Research conducted for WSP examined the effectiveness of alternative approaches to using public funding to support access to sanitation. The study showed that different financing strategies adopted had a profound influence, for better or for worse, on equity, scale, sustainability, levels of service, and costs (see Box 7 for more detail on these findings).

[4] See: http://www.wsp.org/wsp/toolkit/toolkit-home.

Box 7 – Evaluating alternative approaches to using public funds to support access to sanitation

A WSP study conducted in 2009 presented evidence on alternative financing approaches for on-site household sanitation from six case studies in Bangladesh, Ecuador, India, Mozambique, Senegal and Vietnam. The study systematically compared alternative financing approaches based on a set of common indicators, including efficiency and the cost-effectiveness of public funds. The case studies revealed a wide spectrum of options: from a minimal investment in start-up of a revolving fund (in Vietnam), to significant community mobilization and demand stimulation (e.g. in Maharashtra), all the way to hardware subsidies of up to 75 per cent of capital costs in addition to community mobilization (in Senegal). The study showed that the choice is thus not 'Subsidy or no subsidy?' but rather, 'What form and level of public funding makes sense in a specific context?' No single case study represented a 'silver bullet' approach that could be replicated globally, but different models will be more appropriate with differing project objectives. There was an indication nevertheless that there has approaches based on software support can be more effective than those relying on substantial hardware subsidies. This was specially the case in the state of Maharashtra in India and in Bangladesh where alongside hardware subsidies for the poor, investment was also geared towards software subsides. Similarly in Mozambique it was seen that sanitation projects were most successful when government financed animators to generate demand and declined when this software support was withdrawn.

One of the key indicators used for comparison was the 'increased access / public funding ratio': it was revealing to find that in rural Bangladesh, US$1,000 of public finance yielded sanitation for 135 households, while in urban Senegal the same public funding could only serve 1.6 households. The case with one of the highest leverage ratio was that of a Sanitation Revolving Fund in Vietnam seeded by the World Bank and Nordic donors. In this case, poor households made substantial sanitation investments (up to 25 or 30 per cent of their annual income) thanks to gaining access to credit via the revolving fund. As a result, the household contribution to sanitation was 20 times greater than the public investment and this showed that limited access to credit could be a more severe problem than basic affordability for many, if not for all.

Source: (Trémolet, Perez, & Kolsky, 2010)

Hardware subsidies should not be dismissed off-hand as they can have a critical role to play to overcome affordability constraints for the poorest household, as shown on Figure 4 above. Ways of improving the efficiency in the use of hardware subsidies may be to make them performance-based and better targeted. This means that these subsidies are disbursed ex-post against a service delivered to poor people rather than ex-ante based on inputs. Box 8 below reviews the ways in which output-based approaches have been used to support sanitation service providers so as to boost access to sanitation (noting that OBA subsidies could be used at other points of the sanitation value chain).[5]

[5] The ways in which OBA and results based financing at large can be used further down the value chain is discussed in subsequent sections.

Box 8 – Using Output-Based aid for sanitation

Even though output-based aid (OBA) has gradually emerged as an important way to finance access to basic services, experience with OBA-type financing approaches in the sanitation sector has remained limited so far and has had mixed results. Based on a limited number of examples from the sector as well as other sectors, (Trémolet & Evans, 2010) concluded that OBA could potentially improve the targeting and efficiency of subsidy delivery and help develop and strengthen sanitation providers along the entire 'sanitation value chain,' from demand promotion to collection/access, transport, treatment, and disposal/ re-use. One of their key recommendations was indeed to broaden the scope of output-based subsidies in sanitation, as they have traditionally been focused on subsidising hardware for collection (via latrines and sewer connections). They recommended including ex-post subsidies for a range of sanitation services, including demand promotion (such as CLTS triggering) or pit-latrine emptying.

A switch to an output-based aid approach had a positive impact in the context of the Total Sanitation Campaign (TSC) in India, for example. The TSC is a nation-wide program to boost rural sanitation coverage which combined support to demand promotion activities and community mobilization, together with supply-side activities (support to rural sanitary marts) and hardware subsidies to households building latrines. Since 2004, these payments are paid to poor households (Below-Poverty Line households) once they have built a latrine and the village has reached Open Defecation Free status. Such payments can be considered as OBA payments to the extent that households are seen as providers of sanitation. In addition, villages that achieve Open Defecation Free (ODF) status can apply for a monetary award (the Nirmal Gram Puraskar, NGP) in recognition of their achievement. Such award goes to the community as a whole, and can be used either for any type of community investment or for sanitation.

Another example where an output-based approach was used to support access to sanitation is in Morocco, with support from the Global Partnership for Output Based Aid (GPOBA).[6] Funds from GPOBA supported an OBA project which worked with several water service operators in three cities (two private concessionaires, Amendis in Tangiers and LYDEC in Casablanca and one municipal utility, RADEM, in Meknès) to extend water and sewerage services into unplanned urban settlements that were formerly excluded from regular service provision. The project was embedded within the National Initiative for Human Development (INDH) which focuses on the extension of basic services to the poor, particularly in settlements which were previously considered illegal and ineligible to receive public services. Launched in 2007, the project aimed to connect 11,300 households to piped water and sewerage through a US$ 7 million grant from GPOBA. Details of the schemes and the costs of the subsidy varied by operator but in each case the output was a simultaneous connection to piped water and sewerage for individual poor households. The subsidy was paid in two instalments: 60% on completion of the connection and 40% upon verification of at least 6 months of sustained service. Verification was carried out by an independent third party. Unit subsidies for sewerage connections varied from US$421 in Casablanca to US$913 in Meknès. This variation was due both to differing unit costs and differing ability to pay on the part of households in different cities. Initial progress under the scheme was slow, with only 2,000 eligible connections completed in the first year. This slow pace was largely due to a lack of familiarity with Bank procurement processes, investment delays upstream and lack of clarity over land tenure. The pace of investment then picked up in subsequent years and the project was completed on target.

Sources: (Trémolet & Evans, 2010)

(Trémolet S. , 2011) expanded the scope of this investigation in the potential for output-based subsidies to all forms of results-based financing, on the demand side as well as on the supply side (and even considering results-based financing for government agents. Results-Based Financing (RBF) refers to a broad family of financial instruments whereby

[6] The Global Partnership for Output Based Aid (GPOBA) is a multi-donor trust fund managed by the World Bank which was established precisely with the objective of promoting output-based subsidy approaches in a range of sectors.

public funding is provided only if pre-specified results have been achieved. Their use in the sanitation sector has so far remained limited, as opposed to in other sectors such as health or education. Results-based financing (RBF) could potentially be provided in several ways to encourage sanitation adoption, as shown on Table 4 below.

Table 4 – Potential results-based financing (RBF) instruments for sanitation

Level	Potential Results-Based Financing (RBF) Instruments
Supply-side	Output-based aid: Support for incumbent operator or small-scale providers Advanced market commitments (AMC) for research and innovation
Demand-side	Conditional cash transfers to households Targeted subsidies, voucher schemes Individual rewards
Research and support	Results-based research grants Awards and international competitions
Macro level	National level: Cash on delivery (COD) aid Local level: Rewards to communities or local governments, performance-based interfiscal transfers

Source: (Trémolet S. , 2011)

Another potential avenue is to facilitate access to finance to the households or to the service providers themselves through microfinance or mesofinance. This type of public intervention could therefore apply on both the demand and supply side of the market.

Stretching the cost of the investment over a longer period through a loan may allow overcoming the affordability constraints, although this may not be applicable for the poorest of the poor. (Trémolet, Perez, & Kolsky, 2010) found that a scheme that relies on providing access to finance via microfinance, as done in the Vietnam Sanitation Revolving Fund, had been very effective at extending access and had achieved a high leverage ratio (defined as the ratio between private and public funds invested).

According to a report co-published by SHARE and the European Union Water Initiative Finance Working Group (Trémolet S. , 2012), micro-finance and mesofinance could be used to provide access to finance for sanitation investments to those who would otherwise be excluded, such as households, SSIPs, community based organisations (CBOs) and non-governmental organisations (NGOs) when they do not have the ability to invest up-front. Even though micro-finance as a financing model is now well-established with a solid track record, its applications to the financing of water and sanitation services has remained somewhat limited and MFIs rarely offer tailored products for that sector. In some countries, such as Kenya, India or Vietnam, the markets for micro and mesofinance for water and sanitation are growing, with the development of lending products such as ‘toilet loans’ or ‘water tank loans’.

Some countries have defined sanitation microfinance as a key pillar of their strategy for reducing the sanitation access deficit, such as Vietnam (which has mandated the Vietnam Bank for Social Policy to offer water and sanitation specific loan products) or Ghana (which has a stated policy to roll out sanitation revolving funds, although not yet implemented). Based on these experiences, it appears that both microfinance and mesofinance present market potential to provide services to the poor. Sanitation (as compared to water) is potentially the sub-sector where needs are greatest and holds great potential for the application of microfinance. Even though a ‘toilet loan’ would not usually be income-generating, it can be clearly income-enhancing as it improves health and well-being and saves time for revenue earning activities.

The opinions on the role that microfinance can play to improve access to sanitation are usually divided, however, as summarised in Table 5, and strong evidence is still lacking in

order to identify clearly the contribution that facilitated access to finance can make in this area.

Table 5 - Microcredit for water and sanitation: the case for and against

Potential advantages	Potential constraints
For households (HH)	
• Enables HH to spread the cost of their investment, thereby alleviating capacity-to-pay-constraints • Income-enhancing: generates benefits for HH from accessing water and sanitation, some of which can be monetised, such as time savings, reduction in waterborne diseases, increased labour productivity, increased school enrolment, increase in housing value	• Water and sanitation investments do not directly generate income that can be monetized: HH may not be willing to borrow
For microfinance providers	
• Could prove a substantial market, given high needs and donors' support, which could then help them reach additional clients • Aligns well with social mission of microfinance	• There is not necessarily a direct revenue stream to guarantee repayment, which means higher risks • MF providers may not be aware of the needs of the water and sanitation market and unwilling to lend as they perceive it too risky
For governments and external support agencies	
• Efficient use of funds and high leverage ratios: this may help free up scarce public resources to target the poorest	• MF (micro-credit) may not lift affordability constraints for the poorest: it may only be applicable to a segment of the population

Source: (Trémolet S. , 2012).

4.1.3. What can we do to improve access to sanitation given what we know?

Given the importance of demand as a trigger for sanitation adoption, public funders of sanitation would be well-inspired to finance location-specific demand studies prior to designing an intervention, so as to better understand what encourages (or discourages) households to invest in those specific circumstances. Existing studies exist but they are very location-specific. To the extent possible and if budgets allow, it can be a good investment to dig deeper at the local level to understand demand, for example, to conduct an analysis by poverty quintile.

A better understanding of demand triggers and existing barriers to adoption can help improve the design of public support schemes to encourage adoption of sanitation at household level. A basic principle for this would be to adopt financing schemes with high leverage ratios (i.e. ratio of privately invested funds versus public funds) so as to allocate scarce public resources to well-targeted interventions for the poorest. A direct result of this recommendation would be to minimise hardware subsidies for sanitation, except when they are very specifically targeted onto poor or disadvantaged households that are likely to require subsidies for sanitation for times to come. This is the policy that was adopted by the Global Sanitation Fund (a vertical fund set up in 2006 to focus on sanitation and hygiene funding as part of the Water Supply and Sanitation Collaborative Council in Geneva), which has indicated that it would not provide hardware subsidies unless it can be demonstrated that they are well-targeted and provided where affordability remains a key hindrance to sanitation adoption.

The effectiveness of existing approaches (and particularly subsidy approaches) can be evaluated in order to potentially redesign such subsidies to increase their effectiveness, improve their targeting and make them more results-based. For example, (Robinson, 2012) on behalf of WSP, reviewed the effectiveness of existing sanitation subsidies in Cambodia and recommended that alternative approaches be explored, including the provision of Conditional Cash Transfers for sanitation, what they refer to as a 'grow-up with a toilet plan', as detailed in Box 9 below. The advantage of this type of scheme is that it aligns the time horizon over which households would perceive from their investment with the timeline over which they can receive financial support for this investment.

Box 9 – Proposals for a 'Grow-up with a toilet plan' in rural Cambodia

(Robinson, 2012) proposed a plan to ensure that every child in Cambodia 'grows up with a toilet' through the provision of sanitation finance to poor households during the first five years after the first child is born. The intention is that the development of improved sanitation facilities and the establishment of good sanitation practices among both parents and the first-born will ensure that the rest of the family grows up using a hygienic latrine and observing good sanitation and hygiene practices. The five-year plan would be targeted at poor mothers on the birth of their first child, on the basis that poor children under five are the highest risk group for diarrhoea, malnutrition and worms. Assistance would be provided to the mother of the household to improve household sanitation throughout the five-year period, with both connection subsidies (incentives for the construction of facilities) and outcome-based sustainability incentives (to encourage long-term improved sanitation practices).

- Year 0 (birth of first child): US$15 toilet voucher (redeemable by local producers) plus a US$5 voucher for a rebate on construction of second latrine pit;
- Year 1-5 (annual reward): up to US$10 each year based on following criteria:
  - Toilet usage (verified)
  - Village toilet coverage (verified)
  - Completion of hygiene course
  - Presence of hand washing facility

The plan would be supported by demand creation programs (CLTS, mass media), sanitation marketing programs to increase and improve the supply of low-cost sanitation goods and services, and micro-finance programs to enable poor households lying just above the 'extreme poverty' line to develop improved sanitation facilities. The intention of the plan is three-fold: 1) to focus attention on the need to target sanitation finance toward improved sanitation among under-five children; 2) to recognize that sanitation finance should promote a process of sanitation development over a period of several years (providing incentives for the upgrading of facilities and the adoption of improved behaviours); and 3) to encourage more efficient demand-side financing through vouchers and cash transfers in place of existing mechanisms for the supply of in-kind materials and services.

Source: (Robinson, 2012)

More support (including financing) should be provided for demand promotion activities. In many cases, these activities are neither sufficiently nor adequately conducted. They are often limited and not scaled-up because this requires adequate training for the personnel in charge of these demand promotion activities, as many officials have more of a technical background that does not necessarily prepare them for conducting this type of activities. For demand promotion activities to be effective, numerous factors have to be taken into consideration. Good policies and planning are crucial to steer the organization of these activities and adequate financing is required to cover all costs. Attention should be paid to the training of personnel in charge of these demand promotion activities since the success of any organized campaign to generate demand lies on the quality of the facilitation. Their transport costs need to be adequately funded: this would typically be one of the largest

cost item, given the needs to visit a large number of often spread out communities, particularly in rural areas and the need to make repeated visits in order to achieve sustained behaviour change. The existence or creation of supportive organisations (both public and/or private) should be encouraged in order to facilitate programme monitoring as well as to scale-up these activities. These factors simply provide a structure: demand promotion activities must be adapted to the local context where these are being carried ensuring that they are targeted at all sectors of the population.

The implementation of packages of activities, including demand-side activities, but also supply-side support, facilitated access to finance and incentive payments, should be encouraged as they have been shown to be most effective at sustainably change behaviour. These approaches may also include hardware subsidies, either for the poorest households or for crucial investments that are 'public' in nature. For example, building latrines in schools, health centres or public spaces (such as market places) can be an effective way of moving a community towards total sanitation. School-led sanitation in particular has been shown to be a very important complement to community-led sanitation given the important role of school children as agents of change. In dense peri-urban or urban communities, public investment in transfer stations, disposal sites or even small-bore sewers can be critical in order to ensure that the entire sanitation value chain is working properly. However, implementing such multi-pronged approaches can be complex and requires adequate planning and institutional support.

For example, the introduction of support for microfinance activities needs to be carefully planned, since funding may need to be channelled through different types of institutions, such as a local microfinance institution, an apex institution (an institutional mechanism operating within a single country or integrated market to channel funds, with or without technical assistance or other supporting services, to a significant number of retail MFIs that, in turn, disburse loans to low income people) or a micro-investment vehicle (a private entity which acts as intermediaries between investors and microfinance institutions). A recent report provides guidance with respect to identifying which types of actors would need to have access to financing and what role external support agencies can play in increasing such access to finance (Trémolet S. , 2012).

Sources of support for access to household sanitation do not necessarily need to be external subsidies but may also include cross-subsidies between sectors (as in the sanitation tax in Burkina Faso). Where both water and sanitation services are provided jointly, cross-subsidies from customers already connected to water supply can prove to be a good source of finance for the sector and more importantly allows for the extension of facilities to the poorer/disadvantaged sector of the population. Burkina Faso presents a successful example where a cross-subsidy between existing water and sanitation customers allows new customers to access on-site sanitation facilities. In Zambia, Lusaka Water Supply Company (LWSC) has developed an interesting 'sanitation levy' in order to raise revenues for supporting sanitation investments in peri-urban areas. This is paid by existing customers in addition to the standard sewerage charge (for access to sewerage services). According to (Daryanani, Peal, & Norman, 2012), although this type of charge could be an attractive way to generate additional revenues for the sector, it is seldom used in African cities and there are still a number of difficulties with its implementation.

A shift to a more results-oriented approach to funding is also encouraged by a number of public agencies and donors. For example, the Bill and Melinda Gates Foundation (BMGF) has recently switched its approach to one of 'outcome-based investing', in which they would link most grant payments to the delivery of specific outcomes. Such an emphasis on results is also encouraged by GPOBA, the EIB or the Global Sanitation Fund (GSF).

Emphasis within these multi-pronged approaches should be placed on identifying where the gaps are and providing supplementary support to fill in those gaps. Analysis based on the identification of market failures can help with identifying those gaps and supporting the design of public interventions, particularly when the latter seek to kick-start a market (for example, for the construction of latrines that are affordable and desired by the vast majority of the population) and reduce the need for public support further down the road.

4.1.4. What do we need to know about sanitation access services to do better?

There are lingering uncertainties about basic parameters of the access equation, such as with respect to the costs of alternative solutions, particularly with respect to software approaches. A number of studies have sought to identify the costs of sanitation promotion in more detail. For example, (Robinson, 2005) evaluated the costs of delivering alternative approaches to sanitation in South Asia, mostly based on alternative approaches to implementing community led or total sanitation approaches. Building upon this work, (Trémolet, Perez, & Kolsky, 2010) estimated the costs of sanitation provision in the case of six externally funded projects or programmes, in each case evaluating the initial investment costs (distinguishing between the hardware costs and the software costs or premium per sanitation solution built, through apportioning the total costs of programme design, management and monitoring and evaluation) and the ongoing annual operating costs. This type of cost information can be useful in order to, for example, derive global estimates of the costs and benefits of reaching the Millennium Development Goals (Hutton G. , 2012).

However, it is important to bear in mind that the specific data points relative to costs are highly location specific and likely to change over time, due to general inflation and factor-specific inflation (such as fuel prices, as impacted by global trends, or cement prices, which can be impacted by a local construction boom for example) or exchange rate fluctuations (for example, costs are generally found to be higher in West Africa where the local regional currency, the FCFA, is pegged to the Euro and is deemed to be over-valued). Therefore, specific cost analysis are likely to be required in each location, but should preferably be based on commonly agreed methodologies as developed by the research initiatives mentioned above. This should be combined with comprehensive reviews of existing costs of alternative measures in the country of intervention, based on a precise definition of such measures.

One area where additional work is needed, including in methodological terms, is in developing a better understanding of software costs for sanitation. Many agencies that are funding sanitation through software support are not keeping transparent records of how much they are spending and are not trying to track the link between such expenses and delivered outcomes. As a result, in a number of countries, the costs of software measures are difficult to budget for as there are few reliable comparable estimates. The ongoing WASHCost project, led by IRC and funded by the Bill and Melinda Gates Foundation, has sought to evaluate the lifecycle costs of different water and sanitation solutions in the countries where it is operating and defining a methodology that could be applied in other countries. It has applied its methodology to the analysis of software costs for water and sanitation (Smits, Verhoeven, Moriarty, Fonseca, & Lockwood, 2011). Further evaluation of the range and magnitude of costs associated with a wide range of software approaches would need to be conducted in order to better understand what drives such costs (to facilitate planning and budgeting).

Another area which requires further investigation is to assess the cost-effectiveness of a range of alternative approaches to supporting access for sanitation. To do so, it would be necessary to run randomised-controlled trials that would enable to compare the effectiveness of alternative public support approaches. For example, this could be done to

evaluate the relative impact of different payments for results (ranging from purely symbolic awards to some cash payments, for example for communities that achieve open-defecation free status) or different ways to facilitate access to finance (i.e. through an approach purely based on lending or a mix of savings and loans, or through partial subsidisation of the capital investment costs combined with micro-lending for the remaining portion).

Some existing and popular approaches to promoting demand for sanitation (such as CLTS) would need to be further developed so that robust institutional models for scaling-up are designed and tested. These approaches have been found to have good results on a small to medium scale but are highly dependent on the quality of facilitation and on the organisational approach to scale-up. Models based on some degree of private sector participation (such as franchising) could be compared to some more community-based models (relying on village leaders) or reliant on existing government structures (such as going through environmental health officers).

Similarly, even though microfinance appears to be a promising approach to enable households to invest in their sanitation facilities, its impact remains to be tested at scale. Some donors are currently leading programmes that are seeking to do this, such as the FINISH programme financed by the Dutch Government. According to (Trémolet S. , 2012), FINISH (Financial Inclusion Improves Sanitation and Health) was set up as a 5-year programme in 2008. Its main objective is to expand sanitation infrastructure to rural India to cover 1 million households by 2013. They intend to do this not just through the building of toilets, but by promoting an overall 'sanitation system' that takes a holistic look at the process, from a strong emphasis on hygiene promotion and awareness-raising through to safe excreta treatment and disposal. As of July 2011, FINISH had contributed to the extension of 132,000 'toilet loans' throughout seven Indian states, with the highest number being provided by BISWA (Bharat Integrated Social Welfare Agency), an Indian NGO in Orissa. Getting more information on the results of such a programme and its modus-operandi (particularly, giving incentives to microfinance institutions that enter the sanitation microfinance business) would be particularly interesting.

Finally, other related points that could influence demand for sanitation from an economics perspective would be worth exploring further. For example, we have some understanding of the fact that investing in sanitation facilities at household level can increase the value of the house but this has yet to be borne out by detailed studies into this impact. The relationship would in any case not be a linear one, as many factors can influence whether or not such an investment is directly reflected in the house value, such as the land legal status, whether or not the property is fully owned or rented and whether or not there is a threat of removal. Similarly, the impact of sanitation access on household revenues could be traced in more specific terms, so as to provide arguments in favour of alternative financing models, including savings or savings and loan models.

4.2. Markets for transport and treatment

In this section, we give a brief overview of how markets for transport and treatment currently operate in developing country contexts and we examine the potential market failures affecting those market segments and how such market failures could be corrected.

4.2.1. What do we know: how do markets for transport and treatment function?

The type of transport service that is applicable would partly depend on the type of sanitation products that needs to be transported, as briefly set out in Box 10 below.

Box 10 – Defining sanitation products

- **Faecal Sludge (FS)** is the general term for the raw (or partially digested) slurry or solid that results from the storage of blackwater or excreta. The composition of faecal sludge varies significantly depending on the location, the water content, and the storage. FS usually needs to be removed from pit latrines.
- **Septage or Blackwater** is the substance held in septic tanks or cesspits, usually a combination of human excreta and greywater. Septage has higher water content than faecal sludge, but lower water content than wastewater.
- **Sewage Sludge:** A viscous residual of wastewater treatment processes.
- **Sludge:** In this document, sludge refers to both faecal sludge and septage, as previously defined.
- **Sullage or Greywater:** Waste liquid that does not contain faecal matter but is produced from such things as washing one's clothes, person, etc.
- **Sewage**: discharge from water-based sanitation sewerage systems.
- **Wastewater**: this is a generic term for liquid waste that is unfit for disposal into the environment prior to treatment. This could include sewage, sullage, stormwater drainage, or a combination of the previous.

Source: adapted from (Tilley, Lüthi, Morel, Zurbrüg, & Schertenleib, 2008)

A variety of actors are involved in the provision of these services including the households themselves, small-scale independent providers (SSIPs), national or international manufacturers, utilities and local governments. The provision of transport services for human waste can usually take two main forms, either via on-site sanitation systems where on-site sanitation facilities exist, or via sewerage network where households are connected to such a system.

In developed countries and some developing countries, at-scale conveyance of human waste is performed by a network of sewerage pipes carrying wastewater away from households. In most cases, sewerage networks are major investments that are driven by and require the support of international donors or lenders, national governments and multinational corporations. Public or private utilities are then assigned the task of operating the service and collecting tariffs. According to the 2000 Joint Monitoring Programme (JMP), Latin America and the Caribbean had the highest sewerage connection rate amongst developing countries, with 49% of the population connected to sewerage systems, while Asia and Africa lagged far behind at 18% and 13% respectively (Joint Monitoring Program, 2000).[7]

Over the last few decades, alternative types of sewerage systems have emerged to address the high costs that are typical of conventional sewerage. Simplified sewerage (using smaller pipes buried at shallower depths) has been successfully employed in Brazil for many years as the standard design. Small-bore sewers, which only carry liquid waste from septic tanks, are also substantially cheaper to build and operate than conventional sewers. Cities and towns in Brazil, India, Pakistan and South Africa have invested in simplified, small-bore and low-cost combined sewerage with reported savings of up to 50% (Foster, 2001) (Melo, 2005) (Mara, 2009). Some of these systems, referred to as condominial sewerage, included the participation of communities in the planning, implementing, and operating phases (Nance & Ortolano, 2007). In general, however, and similar to conventional sewerage, public or private utilities were given overall responsibility for operation and maintenance of those systems (Melo, 2005).

[7] Obtaining more recent data on sewerage coverage rates on a comparable basis across countries is not possible given that JMP reports beyond 2000 are focused on measuring access to improved sanitation, not sewerage. There is therefore no consolidated data source on access to sewerage around the world at present.

In addition, in an informal but widespread and generally accepted manner, household connections to canals or stormwater drains play a significant role in the transport of sewage in many cities in countries such as Thailand. To address this issue, it has become common in Thai cities to collect and treat canal effluents. This alteration in infrastructure functionality results in unsafe and unpleasant transport of sewage and reduced wastewater treatment plant efficiency.

The vast majority of the developing world is served by on-site sanitation facilities, however (see Section 4.1.). For these systems to function properly, households are required to regularly maintain them by hiring manual or mechanical pit-emptying service providers. These would typically charge a fee to the households for their services, which would vary greatly depending on the town, the emptying method, the distance of the household to the nearest disposal point and the relationships between the household and the emptier. In general, emptiers are then charged for disposing of the faecal sludge or septage at authorised dumping points (which may or may not involve treatment). Dumping in unauthorised disposal points is usually prohibited but whether it happens or not would typically depend on the resources available for enforcement, the distance between collection points and the nearest disposal site, the size of the tipping fees (and their relative weight against transport costs or penalties and fines) and other operational factors such as opening hours of the disposal point.

In nearly all cases of on-site sanitation systems, manual pit emptying services are offered by small-scale independent providers (SSIPs). Using buckets to empty the contents of an OSS system, the SSIPs would then either bury the content on-site or dump it into a nearby stream or drain (Mikhael, 2011) (Bongi & Morel, 2005). In places such as Kibera, Kenya, or in Dakar, Senegal, the sludge is dumped into sewer lines (Eales, 2005). Manual emptying is widely practiced in sub-Saharan Africa and Asia, particularly in areas inaccessible to large vacuum tankers (BPD, 2008) (WUP Africa, 2003) (AECOM and Sandec, 2010). It can be carried out by hired manual emptiers who do this activity (amongst others) for a living or sometimes by family members themselves. The practice of manual emptying is physically unsafe and degrading for those providing the service. Additionally, the practice is either illegal in many cities (e.g. Dhaka), perceived to be illegal, or in most cases informally conducted (e.g. Dar es Salaam and Freetown) (Parkinson, 2005) (BPD, 2008) (Mikhael, 2011). Rarely is manual emptying adopted by local governments as a strategy for the delivery of sanitation transport services.

The alternative to manual emptying is mechanical emptying, usually through trucks equipped with suction pumps. In some cities such as in Indonesia, mechanical emptying is more common than its manual counterpart (AECOM and Sandec, 2010). The mechanical emptying service, provided either by local government, utilities or SSIPs, requires relatively expensive vacuum tankers or pumping trucks to remove septage from OSS systems and dispose of them either at a treatment facility or at a designated disposal point (sewerage point, open land, water body), or in an unregulated manner on open land or water. In many cities, the private sector dominates this market, especially in areas where public provision is lacking. In a study of six African cities, for example, it was estimated that between 40 and 100% of mechanical operators were private businesses (pS-Eau & MDP, 2003). A recent study conducted for the Agence Française de Développement in Bamako (see Section 0 above) found that almost 90% of the 'camion spiros' (sucking trucks) that were in operation in the Bamako District were privately-owned (Estienne, Kébé, Rama, & Trémolet, 2011).

Several attempts have been made by NGOs, educational institutions and agencies to fill the wide technological gap between the emptying methods of the bucket and the vacuum tanker. This includes innovations such as the sludge gulper by the London School of Hygiene and Tropical Medicine (LSHTM), the Manual Pit Emptying Technology (MAPET)

by the Dutch NGO WASTE, and the Vacutug by UN-HABITAT and Manus Coffey Associates. While some of these technologies are still in service, all have yet to operate at scale at the local level, let alone on the global market. The potential causes of this failure to scale-up are numerous, including a lack of institutional support, lack of local market supply for foreign parts, insufficient dissemination of information, or simply inappropriate technical designs (BPD, 2008).

The treatment of wastewater or sludge is generally required prior to disposal to avoid threatening public health and the environment. In most cases, public or private utilities operating sewerage networks also operate the corresponding wastewater treatment plants (WWTPs). By contrast, septage or faecal sludge treatment plants (STP or FSTP) are managed by a more diverse category of operators including utilities, local government, solid waste service providers, or small-scale independent providers (SSIPs). In reality, however, sufficient treatment capacity is rarely available. Of the 32 African countries studied in the latest Country Status Overview of the African region, only 3 were assessed to have sufficient operators to handle the demand for treatment and disposal activities (AMCOW/WSP, 2011). Medium and large cities in India only treat 9% of the wastewater they produce, and worse yet, none of their septage (Ministry of Urban Development, 2008).

Similarly in Thailand, 58% of LGAs had no septage treatment facilities at all, and of those that did, 22% of treatment plants were out of operation. It must also be noted that among the surveyed group, the facilities present only treat 30% of the collected septage disposing the remaining 70% in sanitary landfills and agricultural lands where this untreated septage is used as fertilizer (AECOM and Sandec, 2010), as shown in Table 6 below. In general, this highlights the low priority given by governments for investing in treatment activities and the lack of incentives for the private sector to enter the market.

Table 6 - Sewage and septage treatment capacities, various cities

	Sewage Treatment Capacity	Septage Treatment Capacity
Thailand (major local governments surveyed)	14%	30%
Vietnam		4%
Indonesia (urban)		4%
India (medium and large)	9%	0%
Malaysia		100%
Philippines (Metro Manila)		5%
Dar Es Salaam (Tanzania)	3%	<1%
Senegal (Dakar)	14%	<10%

Source for all information (unless otherwise indicated) is (AECOM and Sandec, 2010). *For Dakar, the source is* (Hoang-Gia & al., 2004) *and recent estimates. For Dar Es Salaam, Trémolet and Binder (unpublished).*

Off-site treatment technologies adopted by operators can range from the low-tech biological treatment mechanisms requiring large areas of land to the high-tech and energy intensive mechanical mechanisms. With regards to wastewater, examples of treatment technologies include low-tech waste stabilisation ponds or the more high-tech upflow anaerobic sludge blanket reactors. The technology used for septage or sludge treatment also varies between the low-tech drying beds and the more high-tech mechanical dewatering systems. In addition, on-site systems can provide full or partial treatment before its contents are emptied. Partial treatment can take place in septic tanks or pits, while full treatment could be done in the compost chambers of urine diversion toilets.

4.2.2. What types of market failures typically account for a lack of market response in the transport and treatment segment and how can the public sector intervene?

A number of market failures may affect the sanitation transport and treatment markets. Below, we identify typical market failures as well as potential interventions to address them.

Table 7 - Transport and treatment: potential market failures and public interventions

	Potential market failures	Potential public interventions
Demand-side	• Households are not willing to pay for a service from which they do not capture all benefits. They may seek to pay lower fees, but frequently this is for an inferior service • Those who might benefit from the services do not necessarily have a clear mechanism or vehicle for 'purchasing' waste reduction	• Provide an incentive or subsidy to households that empty their pit regularly
Supply-side	• Governments invest in expensive solutions for a variety of reasons (including lack of awareness of cheaper solutions, rigidity of existing standards, engineering training, etc)	• Circulate information about alternatives to conventional sewerage and ways to make on-site sanitation or simplified sewerage attractive
	• SSIPs (e.g. pit latrine emptiers) are not aware of potential reuse possibilities, thereby foregoing potential revenues	• Regulation of SSIP markets (including licensing of operators, setting tariffs, setting treatment and effluent standards – however, inadequate regulation can itself be 'destructive'
	• Service providers are inadequately trained and badly organized and do not market their services, resulting in insufficient competition	• Provide an incentive to SSIPs for disposal in designated areas (rather than charging them for doing so). This could be done as an OBA.
	• Low returns limit potential for scaling-up – profitability affected by rising fuel costs and tipping charges (for disposal)	• Invest in technologies to reduce emptying costs.
	• Limited access to finance	• Facilitate access to 'mesofinance'

Source: authors.

The markets for transport and treatment have remained so far very embryonic in places like Sub-Saharan Africa or South Asia. This is often due to a combination of factors. Where there has been public investment, those investments are in some cases misallocated (as they are focused on sewerage and sewage treatment, which benefit only a small percentage of the population) and / or are inadequately maintained. The profitability of utilities and small-scale operators can be very low, which combined with other factors detailed below, limits their ability to scale-up and extend their services. On the other hand, governments have often been unable to organise the markets and regulate them adequately. Below, we review these different factors in turn.

Governments, service providers and households sometimes lack access to information that would otherwise have assisted them in making informed decisions. As mentioned in Section 3, many governments are unaware of the level of economic impact that sanitation has on the health, water, environment and tourism sectors. Similarly, decision-makers are usually unaware of the relative cost profiles and benefits of alternative transport technologies: for example, many would be totally unaware of simplified sewerage as a cost-effective alternative and would therefore not take this into account when selecting systems. Similarly, operators providing transport or treatment services are also frequently unaware of the opportunities they may have, such as to access credit or to monetise the economic value of the wastewater or sludge they transport for reuse. As a result, service providers in charge of transport and disposal do not capture the full value of the product they transport, and treat this as a cost rather than as a potential source of revenue. While in part, this may be due to a non-existent, weak or unorganised reuse market (see Section 4.3 for

more detail), this is also due to a lack of capacity and business skills on their part. Finally, many households are not aware of the range of emptying services that they can access: for example, in Dhaka, many residents and even local authorities are unaware of the emptying services provided by the NGO DSK.

Public investment resources are commonly mis-allocated, with technical solutions that fail to address existing realities often receiving the bulk of the funding. The most common misallocation of resources takes place when governments – supported by funders and their consultants –invest the vast majority of their funds in centralised, large-scale sewerage and wastewater treatment systems while ignoring the weak transport and treatment markets serving ubiquitous on-site sanitation (OSS) systems. It is common for large treatment facilities to be built costing millions of dollars and ending up either non-operational after a few years or not fully used because they have not been connected to sewers or there are no transport operators to collect faecal sludge from latrines. In addition, these wastewater treatment facilities often treat wastewater in ways that are not optimal, by taking out nutrients which could generate value if reused for agriculture for example. The city of Medan, Indonesia lends itself as an example. With a population of 2 million, Medan has invested in a sewerage network and accompanying treatment plant for 2% of the population, while failing to provide an operational septage treatment facility for the majority who rely on OSS (AECOM and Sandec, 2010). Such cases come about in part due to a tendency of decision makers to perceive OSS as a temporary solution and consequently overlook the potential to build upon existing opportunities. The lack of appropriate funding for the transport and treatment markets is not limited to investments in infrastructure, but also in research, planning, policy and enforcement.

In some rare cases, where the political will for sanitation investments exists and is acted upon, the investments made can at times be higher than what is required to adequately deliver a service. For example, high-cost conventional sewerage systems are installed in places where lower-cost sewerage or sludge management arrangements would have sufficed. A long-term supporter of simplified sewerage, Professor Duncan Mara suggests that despite the many successes of simplified sewerage in several cities in Latin America, Africa and Asia, the bias by the major stakeholders for conventional sewerage has been difficult to overcome.[8] Treatment of either wastewater or sludge is no different. This means that expensive, high-tech and energy intensive treatment technologies are sometimes installed in circumstances where more economic and low-tech technologies would have proven to be just as effective.

The improper nature of these public investments is further exasperated during their operation in the form of elevated annual operational costs and a limited technical capacity to maintain the installations. (Koné, 2010) suggests that these issues are commonplace for treatment systems in both Asia and Africa. As a result of poor maintenance due to lack of training or inadequate access to spare parts, many of these facilities are found to be inoperative several years down the line. For example, a World Bank financed faecal sludge treatment plant in Dakar (the largest in the city) was found to be in complete state of disrepair less than 6 years after being built.

By contrast, the public sector has only occasionally invested in or supported transport services for on-site sanitation systems, which is largely dominated by the private sector. In these markets, limited returns can have a significant impact on a service provider's ability to invest and scale-up, which in some cases can lead to failure. The reasons behind a provider's limited returns vary greatly and are intertwined with other market failures discussed in this report. Some include low willingness to pay by the

[8] See: http://duncanmarasanitation.blogspot.co.uk/.

customer and low willingness to charge (particularly by public providers) for transport and treatment services (see also Section 4.1), destructive competition, inability to collect revenue, high operational expenses and lack of demand. The poor in particular are often unable to pay for safe emptying of faecal sludge, which is why they would frequently call on SSIPs that may provide an inadequate service for example, by simply burying the waste in the environment by digging a hole nearby. Alternatively, they may also call on emptiers too infrequently (to save money), which means that in-house sanitation would become unavailable during the intermediary period. In some cases, such as in Dakar, frequent emptying (which is costly at around USD 50 per visit) is required in the rainy season because the septic tanks have been badly designed and constructed, allowing groundwater infiltration. Investments in improving the septic tanks would be financially attractive and environmentally beneficial (because at present septic tanks are contaminating groundwater resources) but households either do not have the knowledge that better designed septic tanks should be built (or that improvements can be made to the existing systems) and are unable to source the required up-front capital in order to do so.

Public service providers are typically prone to low willingness to charge, most commonly due to interference and influence by the political class (commonly sanctioned through a regulator). Examples of the political classes' low willingness to charge are typically found in India, where operational, maintenance and capital costs are rarely covered from user charges (World Bank, 2006). This has resulted in a lower level of service and a deterioration of assets, whilst the willingness to pay higher fees for a better service exists (ibid.). In Dhaka, Bangladesh, the NGO operator of the Vacutug DSK (*Dushtha Shasthya Kendra*) faced a combination of a low willingness to charge due mainly to low demand and high competition by manual emptiers (Parkinson, 2005). Inevitably, since the start of the service and up to the latest available data (2009), revenues from DSK's operations have never been able to cover the true cost of the service (ibid. and correspondence with DSK).

Low financial returns can impact small service providers, such as the manual emptying operators of Kibera, Kenya. In that case, their high operational expenses leave them with very little profit (Eales, 2005). Such expenses included renting equipment, acquiring permits, paying dumping fees, and being charged higher than market value for showers (ibid.). In Dakar, Sénégal, low profitability affected the manual emptiers and the mechanical emptiers that have only one truck according to (Mbéguéré, Gning, Dodane, & Koné, 2010) and a recent update conducted as part of a landscaping study for the Bill and Melinda Gates Foundation. Such low profitability, largely due to high fuel consumption, makes it difficult for them to grow. In addition to this, it was found that maintenance and repair of equipment although to a lesser extent, plays a significant role in the profitability of these services. In that case, however, it was shown that established formal companies that operate with several trucks and are able to diversify their business (i.e. delivering other types of services than latrine emptying or managing government contracts) are usually profitable, as opposed to smaller businesses. Such variations also occur in other towns.

For example, a case study from Freetown sought to evaluate operations of 10 faecal sludge emptying operators between June and July 2010. These manual operators worked in informal groups composed of an average of 5 people. It was observed that despite the lack of financial management amongst all groups, they got a high return on investment (between 110 and 359%), as well as a high revenue collection in short periods of time. This reflected that businesses are relatively stable (Mikhael, 2011). This was in contrast with the situation of mechanical emptiers, which were fairly limited in numbers in Freetown and with much lower profitability. Mechanical operators are all small-scale with only one or two vehicles. They are unable to diversify their operations, have high fuel costs due to considerable traffic, high maintenance costs due to poor road infrastructure, and inability to charge more due to destructive competition by local government's subsidised emptying services.

Overall, the profitability of emptying companies tends to be largely dependent on fuel consumption and tipping charges. Given the low returns highlighted above, the majority of emptying businesses has only a very limited ability to invest in new equipment. In Dakar, Senegal, for example, many of the trucks are second-hand trucks imported from Europe which have gone far beyond their design life: as a result, they break down more often and exhibit high fuel consumption, thereby reducing profit margins further (Mbéguéré, Gning, Dodane, & Koné, 2010).

There are also a number of general challenges that affect the profitability of the emptying business. For example, demand for pit latrine emptying tends to be seasonal, with the dry season seeing a significant reduction in demand for OSS emptying services (Boot, 2007) (Mikhael, 2011). While predictable, this seasonal change creates a difficult operational environment for SSIPs that have not diversified their services. This is even more challenging for mechanical operators with high running costs (equipment and salaries). Climate change is likely to make rainfall patterns increasingly unpredictable with extreme weather events that could further complicate the task of emptying businesses. In addition, working in the informal sector does not provide SSIPs with the level of security required: as a result, they are not allowed to bid for more profitable government contracts which could enable them to diversify their sources of revenues. They also suffer from general challenges affecting their business, such as poor transport infrastructure, inadequate security and poor construction standards. Finally, they would often tend to be reluctant or have failed to form associations, thereby precluding the exchange of ideas and denying the strength to negotiate with the public sector or with providers of finance (be they public or private).

Sanitation services – similar to any other service – cannot exist in absentia of a supporting market environment. Failures in service delivery have regularly arisen from the lack of local spare parts suppliers and technical and business management expertise. Vacuum tanker operators are particularly vulnerable to this, due to the long down times and high maintenance costs they have to face. Other casualties to this weakness are the operators of the manual pit emptying technology (MAPET) – an intermediate technology introduced by WASTE in Tanzania. Only 15 years after its launch, none of the MAPET service providers were found to have been capable of sustaining their services (BPD, 2008).

The organisation of the transport and treatment markets has often been decided based on factors that are completely external to the sanitation services sector. For example, decisions taken at general government level (such as decentralisation) or linked to the organisation of water services often drive the way in which the delivery of sanitation services with respect to transport and treatment in particular. From the sanitation service delivery perspective, this is less than optimal and is in fact a hindrance for the sector's ability to realise all potential economies of scale and scope. Additionally, from a regulatory perspective, this type of externally-driven restructuring may lead to one of two undesirable outcomes: overlapping or gapping responsibilities.

For example, in Thailand legal and institutional barriers have been put in place dividing the regulation and funding of sewerage and septage between two Ministries, the Ministry of Natural Resources and Environment and the Ministry of Public Health respectively. This division - not uncommon in other countries - in an otherwise connected system has led to impediments in evaluating sector costs as well as in sharing resources and technical knowledge (AECOM and Sandec, 2010). Similarly in Dar es Salaam, Tanzania, the sewerage utility is responsible for the management of wastewater services, whereas households utilising OSS are left to their own devices and are compelled to hire SSIPs to service their sanitation systems (BPD, 2008). Mechanical emptiers would nevertheless be allowed to bring the sludge to the stabilisation ponds run by the utility but are charged for disposal.

Competition between local government, utilities, and SSIPs can in some cases be destructive. For example, in Freetown, the local government has undercut mechanical emptying SSIPs by providing emptying services at a subsidised fee (Mikhael, 2011). In Durban, according to (Eales, 2005), no private service providers exist due to the highly subsidised emptying fee (which is only 15% of the real average cost). In addition, there might be unfair competition between informal and formal emptiers. For example, in Accra, informal operators commonly emptied into transfer stations and did not have to pay for emptying it when full. This gives then a financial advantage over registered formal businesses. More generally, competition in the sector has typically been insufficient and has not yet led to the development of sustainable business models based on technological innovation, as most technologies remain very basic and the few operators of these technological innovations have struggled to become commercially viable (such as operators of the gulper or vacutug).

A number of governments are seeking to regulate the transport and treatment sectors, which is particularly challenging in the case of transport activities from on-site sanitation facilities. There are several ways in which such regulatory regimes can be organized, including:

- Outlawing or regulating manual emptying (as in Vietnam or South Africa);
- Licensing operators (as in Ghana);
- Regulating emptying of on-site systems (Vietnam);
- Allocating disposal points (Accra, Freetown, Dhaka);
- Setting treatment and effluent standards (as in Vietnam and many other countries);
- Tariff setting (as in Indonesia or Thailand).

A weak or absent regulatory framework can lead to vulnerable transport and treatment markets. In only a few countries, there is no regulation at all. Some countries would typically regulate wastewater management but not sludge management. For example, in part due to the lack of any septage management programmes, India has no septage treatment facilities (Ministry of Urban Development, 2008). Vietnam does not have any national laws that regulate septage collection, transport, or treatment (AECOM and Sandec, 2010). Instead, the national government has chosen to focus on regulating wastewater treatment (ibid.). The failure of a septage collection and treatment project in the city of Da Nang was reportedly due to the lack of its integration into local policies. Even when regulations are put in place by local government, as is the case in Ho Chi Minh City, enforcement is difficult due to limited capacity of local governments.

When regulation does exist, in some cases it is found to be harmful rather than beneficial to the establishment of sustainable markets for sanitation transport and treatment activities. For example, in Thailand, the national public health act sets tariffs for public and private operators at US$7 for the first cubic meter and US$4 for each subsequent cubic meter. As a result, some private operators do not register with the local government agencies to avoid such restrictions (and are known to charge as much as US$100 per cubic meter), as well as to avoid other taxes and dumping fees. This puts local governments and registered private operators at a net disadvantage vs. illegal operators.

In other cases, the failure to enforce existing regulations (or to define meaningful regulations) is what is stopping the sector to deliver its full benefits. Existing fines and other methods of enforcement may not be high or strong enough to dissuade local emptiers from engaging into illegal dumping, as this was the case in Hanoi for example. In Indonesia, according to (AECOM and Sandec, 2010), the private sector is not interested in wastewater treatment service provision, in part because local governments typically set tariffs too low to achieve cost recovery.

4.2.3. What can we do given what we know to improve transport and treatment services?

Target dissemination of information to decision makers so as to provide them with the tools required to make informed decisions. In the area of technology, this would entail encouraging the use of innovative and more appropriate solutions. Conventional, centralised, large-scale solutions should not be the ultimate goal: instead, condominial/simplified/small-bore sewerage, faecal sludge management strategies, decentralised solutions (such as decentralised treatment options as suggested by (AECOM and Sandec, 2010) for Asia) should be considered and encouraged wherever possible, to keep costs down but to also support the current realities of the market.

Provide more support to SSIPs that provide emptying and transport services and utilities. Whereas the construction and operation of large-scale facilities such as sewers and treatment plants is likely to require public subsidies for a long-time to come, private emptying businesses do not necessarily need subsidies but rather training, access to finance and a supportive business and regulatory environment. Even though they have in some cases 'flourished' (i.e. filled a gap in the market left glaringly open by failing public enterprises), they still face numerous constraints. Which means that 'smart subsidies' to help them get formally established, build their business skills, help them set up providers associations, facilitate access to credit to purchase equipment (in the form of credit guarantees for example) would in most cases be needed. However, there are at present only a limited number of schemes that have successfully supported the development of SSIPs. Some externally-funded schemes have sought to do so (such as the gulper businesses, promoted by WaterAid in Dar Es Salaam) but have not been particularly successful at scaling it up in Tanzania (although there have been some successful experiences in other countries, such as Kenya or Zambia). This means that we still do not know very much about how best to support these types of service providers.

One potential way that appears to hold promises is to support SSIPs providing transport and treatment services through output-based aid (OBA). At present, financial incentives for operators to organise collection are in place, since they can charge households for those services, and especially given that those charges are rarely regulated. By contrast, there are few financial incentives for them to dispose of the waste appropriately, let alone to treat it. (Trémolet & Evans, 2010) suggested several ways in which financial incentives to dispose appropriately or to build appropriate treatment facilities could be introduced (the latter with reference to the PRODES programme in Brazil, which has enabled the construction of wastewater treatment plants with targeted ex-post subsidies). To encourage pit latrine emptiers to bring the pit content to designated points, it could be considered to pay them per volume (and load) of sludge brought to the safe disposal (or treatment) point rather than charging them for doing so.

With respect to facilitating access to finance, (Trémolet S. , 2012) formulated a number of recommendations as to how External Support Agencies (ESAs) could foster an increase in access to finance for this kind of entrepreneurs. For example, the report mentioned that donors can use a variety of financing instruments and channels to transfer finance to SSF recipients. These instruments may include grants (in various forms), concessionary loans, guarantees and equity investments. Overall, no single financial instrument can be used in order to trigger a market response from private finance providers to get them to start offering SSF services for WATSAN. A combination of such instruments would need to be used, in order to address the various market failures identified, although it would be necessary to keep the overall financing structure as simple as possible. Some financing institutions may be more willing to take one type of instrument vs. another (for example, NGOs can accept grants but seldom can they accept equity investments). Identifying a financing channel (such as a local MFI or NGO) would also be critical. On the

supply side, some donors (such as philanthropic organisations or social investors) may be more willing to take risks than traditional donors. Blending funds from various donors may therefore be the way to develop a financing package with optimal risk profile.

A number of other, more technical, initiatives can be taken by public funders in order to reduce the costs of emptiers, with the view that this would allow reducing charges to households for such services. For example, in order to shorten the distance required to transport the waste as well as to facilitate bulk transfer, some studies (Strauss, et al., 2003) have suggested the use of transfer stations. This provides manual emptiers with both a financially and physically viable position to dispose of waste (Boot, 2007). The BMGF is currently investigating the development of a new truck technology, the 'omni-ingesters', which could partially treat and dry faecal sludge in-situ, thereby enabling the trucks to empty several facilities before having to make the trip to the faecal sludge treatment plant or nearest disposal site. They are planning to pilot this technology in Dakar and roll-it out if successful. This would need to be combined with appropriate training to be successful.

On the regulatory side, many improvements can be introduced in order to better supervise the organisation of pit latrine emptiers (mostly SSIPs) and thereby correct market failures linked to destructive competition between these providers. On the tariff regulation side, one way of improving both the demand for these services and their financial viability according to (Sandec & Aecom, 2010) would be to "combine billing and collection for septage management with that of water services, in order to break customer payments into instalments, reduce unregulated private desludging activity, and increase willingness to pay." In addition, on the quality regulation side, it would be necessary to regulate markets in a way that encourages their growth and their compliance with standards appropriate for public health and the environment (e.g. regulating periodic emptying). This could also entail support for the formation of emptiers associations that can defend their joint interests or signing collective agreements with the banking sector for facilitated access to finance. SSIPs should also be allowed to diversify their activities as this has proven to be a useful way of smoothing out revenues and allowing them to overcome low season factors during the rainy season. In all cases, it would be preferable to rely on light-touch regulation, in order to rely on improved information and better quality regulation, but in most cases steering clear from price regulation.

One potential way of supporting SSIPs in the sanitation sector and helping them reach an efficient scale of operation could be via franchising (van Ginneken, Tyler, & Tagg, 2004)***.*** Van Ginneken et al. suggest that in addition to technical assistance, the franchisee could realise long-term financial benefits from such an arrangement in the form of higher liquidity, smaller revenue gaps, and an increased attraction of financial resources. This conceptual proposition is confirmed by the early signs of success of the South African sanitation franchise *Impilo Yabantu* (Bhagwan, Wall, & Ive, 2010). While the development costs of the franchise were supported by donors, franchisors of *Impilo Yabantu* were able to extend their assistance to franchisees in several ways, including for example negotiating affordable loans for equipment. However, although the concept of franchising has been around in the water and sanitation sector for many years now, it has yet to be applied at a large scale. Other solutions might be to encourage a consolidation of existing SSIPs, or even the transfer of some of their functions to the utility (which in theory should be able to deliver those services more efficiently). The form and the sector coverage of the utility may in itself have to be revised, to ensure that adequate financing flows to sludge and septage management, particularly where this reaches the majority of the population in a given city.

4.2.4. What do we need to know to do better to improve transport and treatment?

There are still substantial areas where we would need to know more in order to do better in the area of transport and treatment. Because of the focus on large-scale

wastewater conveyance and treatment (until relatively recently), our understanding of informal sanitation emptying services is somewhat limited. Investigation still remains necessary to better understand the cost structures of SSIPs (such as pit latrine emptiers, both manual and mechanical), evaluate their returns and incentive structures. This would be necessary in order to design more effective support strategies, which could include subsidies and payments based on performance, the provision of business and technical skills and to evaluate the applicability of certain models (such as franchising). With this in mind, the BMGF has funded a study of faecal sludge management activities in ten countries, focusing on obtaining financial information on vacuum tanker operators in three towns of various sizes in each of these ten countries. It would also be useful to identify the obstacles that have so far prevented the scale up of low-cost sewerage systems.

On the basis of this information, it would be possible to draw some guidance about what the most efficient market structures might be, i.e. how the characteristics of the market are, including its concentration (the number, size and distribution of firms), the extent of product differentiation, entry and exit conditions (including entry barriers) and the degree of vertical integration. In this case, it would involve identifying what the role of the utility could be vis-à-vis the SSIPs (i.e. for example, to provide supervision, or to focus on building a network of designated disposal points) or what the potential for franchising might be. The latter (franchising) has been discussed and referred to in the sector for quite some time now (admittedly more for sanitation than for water) and has yet to be implemented and tested on a large scale.

There is no 'one-size-fits-all' in this kind of market and each solution would need to be tailored to local circumstances. However, it would be possible to identify drivers and factors that need to be taken into consideration when designing the most appropriate market structure. The European Investment Bank is currently leading a multi-agency study to address such issues, so as to produce recommendations by type of city to identify what the optimal sanitation service market structure might be and to identify how public financing could best be channelled (and to what) in order to encourage a move towards this optimal or efficient market structure. This will entail examining what role utilities should play (if any) in organising on-site sanitation transport and treatment services, including roles of supervision, monitoring, support or fostering.

In order to design better actions, it would be important to start by improving the level of knowledge on what needs to be financed to improve these activities and how. For example, it would be important to identify the specific needs for mesofinance coming out of entrepreneurs, as this tends to be less documented than microfinance. Some financing instruments, such as leasing, have found marginal use in the WATSAN sector although their potential appears to be large. It would also be crucial to more systematically monitor the microfinance market for water and sanitation and its impact on beneficiaries. Existing resources on micro and mesofinance for water and sanitation could be pulled together on a web platform (on a similar model to that for rural finance) to increase their accessibility. The ultimate objective would be to stimulate interest from funders to provide more micro and mesofinance for WATSAN and for sanitation in particular.

The applicability and effectiveness of results-based financing for sanitation would need to be evaluated further. In a similar vein, the impacts of different types of financial (and non-financial) regulation of sanitation markets would need to be evaluated, so as to be able to formulate recommendations on different types of regulation and their effectiveness. The way in which reuse can influence actors at the bottom of the sanitation chain to demand better transport and treatment services could be analysed in more detail, as also discussed in the next section.

4.3. Markets for safe disposal and reuse

4.3.1. What do we know: how do the markets for safe disposal and reuse usually function?

The residual waste following transport (and treatment in some cases) ultimately needs to be either disposed of or reused. The disposal of waste either before or after treatment can take place in landfills, trenches as well as in the open environment. Large-scale disposal of wastewater and/or sludge may occur in an unregulated manner where waste is directly discharged into water bodies such as the sea or oceans. This is often the case in South East Asian countries where the lack of available treatment facilities means that a significant proportion of human excreta is often flushed directly into water bodies (Cambodia 84%, Indonesia 28%, Philippines 70%, Vietnam 100%) (Hutton G. , 2008). In Thailand, in addition to dumping waste into water ways, collection operators often dispose of their septage in landfills, fields and drains. Examples of this can also be observed in the African continent, specifically in Bamako and Ougadougou (Collignon & Vézina, 2000).

There are also cases in Dakar, Kampala, Abidjan and Freetown where the disposal of sludge takes place in designated dump sites. Although this waste is generally not treated, the designation and use of disposal sites facilitates future provision of treatment services. In Dakar for instance, of all the wastewater disposed into the sea, only 14% is treated. In order to help solve this problem, the EU is currently funding a US$ 10million project to provide a long sea outfall in Dakar (Norman, 2009). On the contrary, manually emptied sludge is rarely disposed of in a designated disposal site. Instead, due to a number of factors including high transportation costs, lack of household demand, lack of regulation or enforcement, lack of available nearby disposal sites and a general lack of knowledge, disposal tends to take place wherever land is available close to the waste source and sludge from manually emptied pits is either buried or simply dumped into the open environment.

Nearly all cultures in the past have found financial and economic value in reusing excreta. Whereas some of these practices are very ancient, others are simply at piloting and testing stage According to (Murray, 2011), agricultural irrigation is the oldest form of wastewater reuse, as its history dates back 5000 years to the Minoan Civilization in ancient Greece, and it remains ubiquitous in developing and developed countries. Some countries have a long tradition of re-use, particularly for agriculture, whilst others do not.

To discourage unsafe disposal, it is possible to find a value in the by-products so as to be able to reuse them for a productive use. This not only creates a more hygienic environment by stopping unsanitary disposal of excreta but can also generate economic and environmental gains. Faeces and urine can be used in a variety of ways to generate economic value. (Murray, 2011) identified several potential ways of reusing sanitation by-products, as summarised in Table 8.

Table 8 - Resources in human waste

Waste medium	Productive use
Urine	Fertilizer
Raw faecal sludge	• Fertilizer and soil conditioner • Household biogas • Community biogas • Feedstock for biodiesel
Dewatered faecal sludge	• Growth medium for black soldier fly larvae • Soil conditioner • Solid fuel
Co-composted faecal sludge	Soil conditioner
Untreated wastewater	Irrigation
Wastewater partially treated	Aquaculture

Source: adapted from (Murray, 2011)*. Note that some of these uses may be considered as unsafe, although they could also be safe depending on handling practices.*

Throughout history, many have pinned great hopes on the potential for sanitation to 'finance itself' through use of the by-product of the sanitation value chain, i.e. faeces and urine, to generate income. For example, engineer Henry Austin, who was tasked in 1849 to design a system to remove sewage from the centre of London even before Sir Joseph Bazalguette was eventually asked to do the job, presented a design for a 'converging system', in which sewage would be conducted to four reservoirs converging on a pumping station in Belgravia from which the sewage would be pumped for use in agricultural areas. Austin claimed that the system could be built 'at a cost fully 30% below that of the most improved and economical arrangements under the present system because the cost of engine power and of the suction and distributing pipes, together with the annual expense of working, would not be a charge upon the public, as it would be borne by the parties to whom the application of the refuse to agriculture would be entrusted' (Halliday, 1999).

There exist numerous applications for reused wastewater, most of which have been identified by (Asano, 2002)***.*** The largest current use of reclaimed water throughout the world is agricultural irrigation, followed closely by landscape irrigation which is the second largest use of wastewater in industrialized countries. Industrial activities come next, where reclaimed water is used for cooling equipment and other process needs. Artificial groundwater recharge and recreational and environmental use are the fourth and fifth largest uses of wastewater. However with the advent of 'end of pipe' treatment solutions, excreta have become diluted with tonnes of clean water. As a result, it has become expensive to extract its nutrients, which are often mixed with industrial wastewater containing harmful chemicals (such as heavy metals or hydrocarbons).

Due to the existence of high concentrations of pathogens in wastewater, there are often concerns regarding the safety of disposing of it in nature or reusing it and consequent implications on health, especially in less developed countries where wastewater treatment facilities are not always available and thus waste is often dumped untreated into the open environment. Those facilities that actually allow for re-use have a reputation for being costly pilot projects that are difficult to scale up simply because when those facilities are located away from agricultural/industrial uses, transport and distribution costs of reclaimed water increase costs.

Similar to wastewater, faecal sludge can be applied on land as well and used for

agricultural purposes. Where it is spread over edible crops, strict environmental and health standards would need to be applied. Faecal sludge reuse can also result in the production of biogas. This recovery process is achieved through anaerobic digestion which seeks to stabilize the sludge and generate biogas. The latter contains methane, a gas that is commonly used for heating and cooking, as well as converted to electricity or bottled for use as fuel for transport. In developing countries, biogas digesters are most commonly used in rural households making use of animal and human waste. Lastly with the use black soldier larvae, livestock manure can be degraded, and these larvae can then be harvested as feed for poultry, pigs and fish (Diener, Zurbr, & Tockner, 2009).

A case study from Tamale (Ghana) regarding the disposal of faecal sludge from on-site sanitation systems showed that the net revenue of farmers using faecal sludge was three-folds greater than those not using it. This increase in revenue was due to increased yields and cost savings on fertilizers. (Murray, 2011). A project involving community-scale waste stabilization ponds was piloted in Ghana by a private company under the name of Waste Enterprisers. The aim was to enable household wastewater to flow through a series of 4 ponds, each providing a biochemical and/or physical treatment process. The system was set up so as to achieve a water quality which allowed for the raise of catfish which are harvested every six months for commercial use. Health implications for workers as well as consumers must be taken into consideration using guidelines such as that prepared by the World Health Organization regarding both pathogen and heavy metal levels in wastewater-fed aquaculture systems.

When purified and compressed under high-pressure conditions, biogas can also replace Compressed Natural Gas (CNG) in vehicles. This low-cost system was developed by the Centre for Rural Development and Technology at the Indian Institute of Technology (New Delhi). Based on research it was observed that these systems are cost effective in India where production exceeds 400m^3. This however is dependent on the local costs of CNG, the costs of operating facilities and labour and utility costs (Murray, 2011).

Another market that has failed to grow significantly is that for biosolids reuse. Biosolids are the solid by-product of wastewater or sludge treatment that can be used as soil conditioner or fertiliser. (Strauss, et al., 2003) suggested that markets in Vietnam, Mali and Ghana lack strategy, are insecure and require considerable investment to induce demand. The WHO 2006 guidelines on safe use of wastewater, excreta and greywater suggested that commercial use of biosolids was not common but rather mostly used on a household level for subsistence farming. A stronger, larger and better structured biosolids market could have provided supplemental income and an added incentive for service providers to safely transporting and treating wastewater and sludge. Overall, wastewater/ sludge reuse by farmers of for biogas for energy has reached a significant scale but other components, such as the reuse of faecal sludge or the introduction of composting toilets or UDDT toilets (urine-diverting in order to allow reuse of urine and faeces separately) has remained very limited.

Overall, reuse activities are still rather limited at present, however, compared to their potential to generate additional revenues for the sector and for the economies as a whole. The extent to which sanitation by-products are reused productively very much depends on local culture and regulations (for example, in some countries, there might be limits on 'grey water' use for agriculture or aquaculture). For example, in Zambia, a major reason why faecal sludge reuse is not common in rural areas is because chemical fertilizers are subsidised to become so cheap that faecal sludge cannot possibly compete with them. In addition, chemical fertilisers tend to have lower transport and application costs than faecal sludge-based fertilisers. Facilities that allow re-use have a reputation for being costly and for involving pilot projects that are difficult to scale-up. Yet, some of these schemes have achieved high benefit cost ratios. In addition, the value of reuse is likely to rise with a global

increase in chemical-based fertilizer prices (due to an increase in the cost of commodities and rarefaction of global resources) and a drive towards renewable energies, as described below.

There have been some limited attempts at valuing the economic value of reuse, for example in the context of a study examining the costs and benefits of Ecological Sanitation (EcoSan). According to (WSP, 2009), reuse of excreta can be an income-generating activity for households with Ecosan toilets. It can increase crop production and generate additional income for the household. In this study carried out by the WSP, Ecosan was identified to have a greater economic potential than conventional on site sanitation given the right environmental conditions. UDDTs in particular are an attractive technological option, especially where desludging and off-site disposal of conventional on site sanitation is not viable.

The capital costs required to set up Ecosan play a larger role than operational and maintenance costs in determining the benefits of excreta reuse in terms of NPV. This is specially the case when project costs do not consider subsidies. It was noted that although the benefits from crop production can offset the higher capital and operational costs, these may not be sufficient to cover any additional costs required for implementing Ecosan (WSP, 2009).

Another study carried out by Winrock International sought to undertake a benefit-cost ratio (BCR) analysis of an integrated household-level biogas, latrine and hygiene program in sub-Saharan Africa (SSA). The programme enabled the establishment and support of small business which aimed to sell biogas plants to poor African households essentially used for cooking and lighting. These plants could be connected to latrines allowing for human waste to be fed directly into the plant. Results showed a BCR ranging from 1.22 to 1.35 and financial internal rates of return (FIRRs) from 7.5 – 10.3%. Similar to the above study, it was seen that if capital costs of the biogas plant, latrine and fuel expenditure were reduced, these savings could have a positive impact on the financial performance of this integrated system. In economic terms, it was calculated that every dollar invested in the biogas, latrine and sanitation program results in US$4.50 of economic benefit in terms of improved health, availability of high-quality fertilizer, time savings regarding fuel collection and associated environmental benefits. (Winrock, 2007). However, for households, although investing in such programme may make a lot of sense when all potential economic benefits are taken into account, the case for investment may be less clear cut when simply considering the financial returns from such an investment.

4.3.2. What types of market failures typically account for this lack of market response in terms of reuse and what interventions may be warranted?

Although the benefit cost ratio of some of these reuse schemes can be high, most of these markets have so far failed to scale up. There are several reasons that might explain this failure to scale up, as summarised in Table 9.

Table 9 - Safe disposal and reuse: potential market failures and public interventions

	Potential market failures	Potential public interventions
Demand-side	• Lack of information on value of reuse products	• Disseminate information on the value of reuse and ways to make it safe
	• Inadequate information on potential health risks, taboo element with respect to reuse products	• Strengthen or define regulation with respect to safe reuse
Supply-side	• High transport costs mean that reuse may not be financially attractive	• Facilitate access to finance
	• Financial value of reuse products driven by external factors, which are difficult to control (such as water scarcity, prices of alternative energy sources, etc.)	•
	• Limited financial value of reuse result in very small, inefficient markets	• Inject funding at the bottom of the sanitation value chain to encourage higher volumes of reuse product and kick-start market response

Source: authors.

One key market failure at present is that many of the economic actors who are handling sanitation products and those who would potentially purchase these products are currently unaware of their potential financial value. This can be due to a lack of evidence and research on the actual value of that waste. For example, researchers found that whereas the calorific value of activated sludge (the by-product of wastewater treatment) is well known, resulting in extensive use of this product for bio-gas production including in developed countries, little research has examined the calorific value of dried faecal sludge. This has resulted in very limited use of this by-product for that specific purpose. In other cases, the information is simply not disseminated, either due to lack of interest or the taboo element associated with handling human excreta. Ways to address such market failures include marketing initiatives, for example to present compost based on human waste as a safe and valuable resource as opposed to other types of composts and addressing regulatory barriers.

Some of the technologies that exist in order to allow reuse may not be easily adopted by the population and require education. For example, urine-diverting dry toilets, to allow reuse of urine and faecal sludge separately for agricultural purposes) increase the ability to recover nutrients from both streams but requires education and acceptance to be used correctly. If they are not used adequately, they are prone to clogging with faeces and misuse. In addition, special child seats have to be provided to keep their urine and faeces separate.

High transport costs are a major hurdle for making the reuse of sanitation by-products economically viable, particularly in congested cities and given high fuel prices. Water reclamation and reuse is commonly considered a low-cost new water supply. However this is only the case when wastewater treatment facilities are located near large agricultural or industrial users and no additional transport is required. This is because transport costs for reclaimed water represent the principal costs of most water reuse projects (Aquarec, 2006). With respect to faecal sludge, such transport costs would affect the transport segment (i.e. latrine emptiers who need to transport the faecal sludge to the treatment plant) but also further downstream, since the treated faecal sludge then needs to be transported to the location where it is going to be reused (such as a factory if dried faecal sludge is used for energy production or fields). As a result, the economic value of faecal sludge may be greater (or more easily extracted) in rural environments, used for domestic biogas production or agriculture (the latter only if the pit is designed to allow partial on-site treatment, such as functioning septic tanks or EcoSan latrines, so as to eliminate or significantly reduce the risk of spreading pathogens). One key issue in rural environments,

however, is that the quantity produced may not be sufficient. As a result, it is generally recommended to put animal manure into the biogas digesters along with human faecal sludge to increase volumes.

Putting transport aside, in spite of benefits of land application of sludge, there are serious public health constraints which must be taken into consideration. Facilities often treat a minimal proportion of collected septage. Such is the case in Thailand where only 30% of the septage which is collected in sent for treatment, the remaining 70% is disposed of half in unsanitary landfills and half onto agricultural land where farmers use this untreated septage as fertilizer. Taking into consideration that the amount of faecal sludge applied to land is usually restricted, in order to protect the health and safety of people and the environment, this unregulated use can be detrimental. Due to this, (WHO, 2006) has issued guidelines for composting human excreta into reusable fertilizer in a safe manner. These can be used by health authorities at national level to develop national regulations.

In addition to the health impacts, numerous wastewater treatment facilities reduce the nutrient value of the treated effluent. This is the case in Vietnam where settling tanks and constructed reed beds are used to treat wastewater. Although operation and maintenance costs are kept low, the effluent is stripped off its nutrients, thereby influencing its performance. In Thailand, on the other hand, a combination of wastewater treatment technologies are used: 86% of the facilities that exist use anaerobic digestion tanks with sludge drying beds and oxidation ponds, 12% treat septage at combined septage and sewerage treatment plants, and 2% use constructed wetlands. Each process produces an effluent of a particular quality which must be suited to its final end-use.

The value of end uses is highly dependent on context, including demand and alternative sources of supply. In the case of wastewater, (Hernández, et al., 2006) observed that demand depends on potential customers as well as whether or not alternative water resources exist. Thus, where there is an available cheap water supply, the latter acts as the greatest competitor for reclaimed wastewater. By contrast, in the Middle East, the extent of water stress is so large that the entire area relies on large-scale wastewater reuse. In a country like Jordan, which is amongst the most water-scarce country in the world, the reuse of treated wastewater constitutes a very significant source of water for agriculture. This is facilitated by the fact that the largest wastewater treatment plant (As-Samra), serving the capital city (Amman) is located fairly close to areas with intensive agriculture.

Similarly, reuse of biosolids or dried faecal sludge for energy production is determined by the price of alternative energy sources. When alternative domestic fuels are wood and charcoal, biogas from dried faecal sludge can be a reasonable alternative (Renwick, Subedi, & Hutton, 2007). The use of treated wastewater for biogas production has also developed rapidly thanks to high fuel prices. Using dried faecal sludge as a combustible fuel and alternative to heavy fuel oil or coal in industrial processes could potentially be supported by rising fossil fuel prices. However, ongoing research conducted in the framework of the EU-funded SPLASH research project finds that unless dried faecal sludge can be produced in large quantities, it might be difficult to use it in energy-hungry industrial processes such as cement production.[9] This finding emerged when examining the potential economic value of the dried faecal sludge for use as combustible in cement production in Dakar, which exposed a series of inefficiencies alongside the value chain resulting in low and unreliable production volumes. This is largely due to the fact that, at present, significant quantities of faecal sludge are 'unaccounted for' and disposed of directly into the environment, the sewerage system or the sea.

[9] See: http://www.splash-era.net/ for more information.

4.3.3. What can we do given what we know to support the re-use market segment?

Despite its huge potential, sanitation re-use remains in a state of relative infancy in most developing countries. Based on what we currently know, a number of initiatives could be taken to develop reuse.

Scale-up existing pilot projects and disseminate the findings. Taking into consideration that numerous re-use projects have only been undertaken at a pilot stage, those which have manifested positive results could be scaled-up. In the case of reuse based on wastewater treatment, this would require treatment facilities to increase their capacities in order to treat a greater volume of wastewater. To the extent possible, construction of additional wastewater treatment capacities would need to be done by paying attention to maximising the reuse potential. In rural areas and small towns, reuse could be scaled up by disseminating information on available technologies (notably on the types of toilet facilities that allow reuse) and safe handling of human waste. For example, Waste Enterprisers has been reusing faecal sludge in Ghana for aquaculture, breeding fish in wastewater stabilisation ponds and thereby demonstrated that such re-use can be done safely provided all safety measures are adequately followed. This private company based in Ghana (http://www.waste-enterprisers.com/) has positioned itself as a strong advocate of reuse for a wide range of purposes, such as aquaculture, but also agricultural use and energy production and is conducting research on how to develop the market. The strength of valorisation and reuse of treatment by-products lies in the ability of the service provider to understand, access and integrate with markets external to sanitation (such as aquaculture, agriculture, urban landscaping, household energy (e.g. biogas for cooking), kilns (e.g. cement, ceramics or glass). Without a thorough understanding of the needs of these potential clients and the structure of the markets, sanitations service providers would be unable to market their products to them.

Define appropriate regulation for sanitation reuse and for water markets. Some countries have limited existing reuse practices due to health concerns. However, existing initiatives have shown that it is possible to safely reuse sanitation by-products for agriculture, provided appropriate treatment and monitoring is in place. Regulating sanitation reuse thereby in some cases might start with removing unnecessarily strict regulations to replace them by regulations based on the results of latest research into safe handling of sanitation by-products. In other cases, regulations are currently not in place and would need to be developed. For example, in Thailand, there are no standards for discharge of effluent, discharge of solid waste, and waste re-use in agriculture, and there is no clear attribution of responsibilities with respect to who would monitor water and fertiliser quality. Regulations could be developed based on WHO (2006), which states guideline values for the verification monitoring in large-scale treatment systems of greywater, excreta and faecal sludge for use in agriculture.

Such regulations would need to extend to the full range of sectors where reuse can be considered. Initiatives on the regulatory side would also need to consider the regulation of water markets, since the value of treated wastewater for agriculture for example would very much depend on the value of alternative supply sources. For example, if adequate regulation of groundwater abstractions were put in place (with abstraction limits and fees), this would in many countries increase the case for relying on treated wastewater for agricultural production. Other regulatory instruments could be considered, such as the introduction of an environmental tax on non-reclaimed wastewater for example.

Mobilise financing for investments alongside the sanitation value chain to encourage reuse. Maximising reuse often requires a series of up-front investments alongside the sanitation value chain. For example, at the level of collection, this may require households investing in sanitation facilities that allow re-use (such as Urine Diverting Dry Toilets or

UDDTs that separate faeces from urine or other types of composting toilets, or septic tanks to allow partial on-site treatment for direct re-use in nearby fields). At the level of transport and treatment of by-product from on-site facilities, this would call for investments in vehicles (trucks, vans or mopeds) that allow transporting the sludge to treatment facilities, which themselves need to be developed and maintained effectively. Similarly, for sewage transport and treatment, investments are called for in systems that do not flush sanitation by-products with freshwater but rather allow maintaining and isolating either their nutrient content or calorific content.

The users of sanitation by-products may themselves need to invest in order to be able to use those products (for example, a cement factory would need to adjust its systems in order to be able to deal with an alternative form of fuel, such as dried faecal sludge). All these up-front investments need to be pre-financed in some way and it is only after they are built (and maintained and operated adequately) that they can generate the value that can justify the initial investment. There would be a clear case for public investment to be allocated to kick-start or cover the full costs of these investments. Alternatively, it could be possible to ask potential users of the by-products to participate to fund these initial investment costs, since they would later benefit from re-use. For example, (WHO, 2006) suggested that 'farmers intent on using excreta and greywater in their agricultural production system may be willing to share in the investment in treatment works that are a prerequisite to obtaining use permits. Their contribution may be in cash or in the form of land for treatment and storage facilities'.

4.3.4 What do we need to know to do better to support re-use?

Research needs to be directed at analysing how best to increase demand for reuse in order to make the system economically and financially viable for the actors concerned. At present, there are very few financial analyses of how much the sale of treatment by-products would be able to subsidise sufficient service delivery further up the value chain.

One of the key influencing factors is safety, thus treatment processes need to be improved and better promoted in order to ensure safe reuse and gain the trust of end-users. Additional research is also needed in order to develop new types of reuse and valuing the economic value of such reuse methods, so that they can be taken into account by economic actors considering sludge as a potential input in their production.

Overall, a stronger focus on maximising reuse could deliver efficiency gains alongside the entire sanitation value chain, as the by-product would be seen as a resource with an economic value rather than a cost that needs to be minimised or even avoided (in the case of illegal disposal). The analysis of reuse opportunities would also help formulate decisions alongside the entire sanitation value chain. For example, if compost is to be sold, then the treatment method used should aim to conserve nutrients, treatment location should be appropriate for potential clients (nearby and accessible), faecal sludge should be collected along with organic solid waste, the type of toilets used should be either Ecosan, urine diverting, or safe bucket latrines (such as uniloo), and households should use degradable anal cleansing methods. Therefore, research and analysis on maximising the re-use potential can thereby encompass all actions that seek to improve the functioning and efficiency of the sanitation value chain as a whole.

5 Conclusions

This paper has reviewed a number of areas where the application of economics concepts, tools and approaches could improve our understanding of how sanitation markets currently work and how their functioning could be improved. This paper argues that economics can help us make the case for additional investments in sanitation (showing that sanitation is 'a good buy', with strongly positive economic returns) and that it can help us identify what works and what does not work at various steps of the sanitation value chain.

As a conclusion, we present below some of the key recommendations with respect to what we can do given what we know and what else we would need to know.

5.1. What can we do given what we know?

- Make the case for investment in sanitation: this can be achieved based on evaluating the magnitude of the benefits that can be extracted from investments in sanitation (which can also be estimated based on the costs of non-investment) as well as the benefit/cost ratios from investment and the relative cost-effectiveness of alternative investments;
- Channel financing more effectively and increase the effectiveness of public funding (in order to achieve maximum leveraging of funding from private investors, such as households or entrepreneurs);
- Foster demand for sanitation at all levels of the value chain (economy-wide and at the level of households in particular, who are key investors in on-site sanitation in particular);
- Influence the restructuring of the provision of transport services for on-site sanitation, particularly by formalising small-scale private providers, enabling them to grow and organising relationships with the main utility;
- Estimate the value of the various sanitation by-products (faecal sludge in particular, as this is the main by-product coming out of the sanitation value chain in the majority of developing countries) and identify ways of monetizing such value in a sustainable manner through reuse.

5.2. What do we need to know in order to do better?

- Improve the estimates of the benefits of investing in sanitation and compare the benefits with the costs of sanitation in a broader range of countries and local contexts, as well as evaluate the cost-effectiveness of alternative investments;
- Identify the most effective financing mechanisms, including ways of attracting new resources into the sector (e.g. from beneficiaries) and via re-use and overcoming the affordability constraint;
- Identify ways of stimulating demand and overcome information asymmetry for households, entrepreneurs or even the government;
- Identify ways of organising service provision and scaling-up of small-scale entrepreneurs.

More generally, this paper has identified a number of areas that show that 'sanitation economics' can be considered as a field of knowledge on its own, which shares some commonalities with 'water economics' but also presents some important differences. Water economics mostly concerns itself with pricing and valuing water either as a resource or as a service, because water, on the whole, tends to be provided by large scale utilities. Demand for water does not need to be fostered in quite the same way as for sanitation. With regards to sanitation, although pricing is important, fostering efficient markets might be even more important, so that all information gets revealed (on the costs of the lack of sanitation but also on the potential financial returns and economic benefits) and can be acted upon by

stakeholders. Sanitation economics research has a critical role to play in this regard and should be fostered so that budding and ineffective sanitation markets can be transformed into thriving markets where the full value of sanitation by-products is fully realised and reinvested into the system so as to foster increased investments and generate efficiency gains.

References

AECOM and Sandec. (2010). *A Rapid Assessment of Septage Management in Asia.* Bangkok: United States Agency for International Development.

AMCOW/WSP. (2011). *Pathways to Progress - Transitioning to Country-Led Service Delivery Pathways to Meet Africa's Water Supply and Sanitation Targets. .*

Aquarec. (2006). *Integrated Concepts for Reuse of Upgraded Wastewater.* Luxembourg: European Commission.

Asano, T. (2002). Water from (waste)water – the dependable water resource. *Water Science and Technology*, 23-33.

Atkins. (2008). *Strategic Water Supply and Sanitation Framework: Sanitation Improvement Plan .* Freetown: Atkins.

Banerjee, S., & Morella, E. (2011). *Africa's water and sanitation infrastructure: access, affordability, and alternatives.* Washington D.C.: The World Bank.

Bartram, J. (2008). *Sanitation is an investment with high economic returns.* Geneva: WHO.

Bhagwan, J., Wall, K., & Ive, O. (2010). *Using franchising principles to improve water services reliability.* Pretoria, South Africa: IRC.

Bongi, S., & Morel, A. (2005). *Understanding Small Scale Providers of Sanitation Services: A Case Study of Kibera.* Nairobi: Water and Sanitation Program at the World Bank.

Boot, N. (2007). *Talking Crap: Faecal Sludge Management in Accra, Ghana.* Loughborough: WEDC.

BPD. (2008). *Sanitation Partnerships: Dar es Salaam Case Study.* London: Building Partnerships for Development.

Chaggu, E., Mashauri, D., van Buuren, J., Sanders, W., & Lettinga, G. (2002). Excreta Disposal in Dar-es-Salaam. *30*(5), 609 - 620.

Collignon, B., & Vézina, M. (2000). *Independent Water and Sanitation Providers in African Cities.* Washington: Water and Sanitation Program.

Collignon, B., & Vézina, M. (2000). *Independent Water and Sanitation Providers in African Cities.* Washington: Water and Sanitation Program.

Daryanani, A., Peal, A., & Norman, G. (2012). *Sanitation surcharges collected through water bills: a way forward for financing slum sanitation?* London: WSUP.

Diener, S., Zurbr, C., & Tockner, K. (2009). *Conversion of organic material by black solider fly larvae establishing optimal feeding rates.*

Eales, K. (2005). *Bringing pit emptying out of the darkness: A comparison of approaches in Durban, South Africa, and Kibera, Kenya.* London?: BPD.

Ecopsis. (2011). *Roll-Out Evaluation of 'Community Led Total Sanita-tion' in West and Central Africa.* UNICEF WCARO.

EPA. (1999). *Biosolids generation, use and disposal in the United States.*

Esrey, S. (1996). Water, waste, and well-being: a multicountry study. *American Journal of Epidemiology, 143(6)*, 608–623.

Estienne, C., Kébé, G., Rama, M., & Trémolet, S. (2011). *Bamako: organiser et financer l'assainissement non-collectif.* Paris: Agence Française de Développement.

Evans, B., Colin, J., Jones, H., & and Robinson, A. (2009). *Sustainability and Equity Aspects of Total Sanitation Programmes, A study of recent WaterAid-supported programmes on three countries, Global synthesis report.* WaterAid.

Fewtrell, L., Kaufmann, R., Kay, D., Enanoria, W., Haller, L., & Colford Jr, J. (2005 йил January). 'Water, sanitation, and hygiene interventions to reduce diarrhoea in less developed countries: a systematic review and meta-analysis'. *Lancet Infect Dis, 5*, 42-52.

Foster, V. (2001). *Condominial Water and Sewerage Systems - Economic and Financial Evaluation - El Alt, Bolivia / Pilot Project.* Lima, Peru: World Bank.

Frias, J., & Mukherjee, N. (2005). *Private Sector Sanitation Delivery in Vietnam: Harnessing Market Power for Rural Sanitation.* World Bank. Jakarta: WSP.

Garbarino, S., Holland, J., Brook, S., Caplan, K., & Shankland, A. (2011). *The Political Economy of Sanitation: How can we increase the investment and improve service for the poor?* Washington, D.C.: Water and Sanitation Program (WSP).

Halliday, S. (1999). *The Great Stink of London: Sir Joseph Bazalgette and the Cleansing of the Victorian Metropolis.* Stroud: The History Press.

Hernández, F., Urkiaga, A., De las Fuentes, L., Bis, B., Chiru, E., Balazs, B., et al. (2006). Feasibility studies for water reuse projects: an economical approach. *Desalination*, 253–261.

Hoang-Gia, L., & al. (2004). *Alimentation en eau potable et assainissement. Elaboration d'un document de stratégie pour la réalisation à l'horizon 2015 des objectifs du millénaire pour le développement. Volume 1: Etat des lieux.* Sénégal: Projet Eau à Long Terme.

Hutton, G. (2008). *Economic Impacts of Sanitation in Southeast Asia.* Jakarta: Water and Sanitation Program.

Hutton, G. (2012). *Global costs and benefits of drinking-water supply and sanitation interventions to reach the MDG target and universal coverage.* Geneva: World Health Organisation.

Hutton, G., & Haller, L. (2004). *Evaluation of the Costs and Benefits of Water and Sanitation Improvements at the Global level.* Geneva: WHO.

Hutton, G., Haller, L., & Bartram, J. (2007a). *Economic and Health Effects of Increasing Coverage of Low Cost Household Drinking Water Supply and Sanitation Intervetions, Background document to te 'Human development Report 2006' UNDP 2007.* Geneva: WHO.

Hutton, G., Rodriguez, Napitupulu, Thang, & Kov. (2007b). *Economic Impacts of Sanitation in Southeast Asia, A Four-Country Study Conducted in Cambodia, Indonesia, the Philippines and Vietnam under the Economics of Sanitation Initiative.* Jakarta: Water and Sanitation Program.

Hutton, G., Rodriguez, U., Napitupulu, L., Thang, P., & Kov, P. (2009). *Economic Impacts of Sanitation in Lao PDR: A five-coutry study conducted in Cambodia, indonesia, Lao PDR, the Philippines, and Vietnam, under the Economics of Sanitation Initiative (ESI).* Jakarta: WSP.

Jackson, B. (2004). *Sanitation and Hygiene in Kenya: Lessons on What Drives Demand for Improved Sanitation.* The World Bank. Nairobi: WSP.

Jenkins, M. (1999). Sanitation Promotion in Developing Countries : Why the Latrines in Benin are Few and Far Between. PhD Dissertation, Dept. of Civil & Environmental Engineering, University of California, Davis. 433.

Jenkins, M. (2004). *Who buys latrines, Where and Why, Sanitatio and Hygiene Series Field Note.* WSP. Nairobi: The World Bank.

Jenkins, M., & Curtis, V. (2005). Achieving a 'good life': Why some peope want latrines in rural Benin. *Social Science and Medicine, 61*, 2446-2459.

Jenkins, M., & Scott, B. (2005). *Assessing Sanitation Demand in Ghana: A Behavioral Approach for Designing Sanitation Programs.* Draft Manuscript.
Jenkins, M., & Sugden, S. (2006). Rethinking Sanitation: Lessons and Innovation for Sustainability and Success in the New Millennium. In *Human Development Report Office - Occasional Paper .* New York: UNDP.
Joint Monitoring Program. (2000). *Global Water Supply and Sanitation Assessment.* Geneva: World Health Organization and United Nations Children's Fund (WHO/UNICEF).
Joint Monitoring Program. (2012). *Progress on Drinking Water and Sanitation.* Geneva: World Health Organization and United Nations Children's Fund (WHO/UNICEF.
Knapp, A., Schuen, R., & Parkinson, J. (2009). *Study for Financial and Economic Analysis of Ecological Sanitation in Sub-Saharan Africa.* Nairobi: Water and Sanitation Program (WSP).
Koné, D. (2010). Making urban excreta and wastewater management contribute to cities' economic development: a paradigm shift. *Water Policy*(12), 602 - 610.
Mara, D. (2009). Sanitation Options for Low Income Urban Areas: Technical Options and Financial Arrangements. In D. Kohn, & V. Dr. Pfeiffer (Ed.), *KfW Water Symposium 2009 - Financing Sanitation.* Frankfurt: IWA Publishing.
Mbéguéré, M., Gning, J., Dodane, P., & Koné, D. (2010). Socio-economic profile and profitability of faecal sludge emptying companies. *Resources, Conservation and Recycling*, 1288–1295.
Mehta, L. a. (2011). *Shit Matters: the potential of community-led total sanitation .* Rugby: Practical Action Publishing .
Melo, J. C. (2005). *The Experience of Condominial Water and Sewerage Systems in Brazil: Case Studies from Brasilia, Salvador and Parauapebas.* Lima: World Bank.
Mikhael, G. (2011). *Assessment of Faecal Sludge Emptying Services in Freetown, Sierra Leone.* Freetown: GOAL.
Mikhael, G. (2011). *Demand Assessment for Sanitary Facilities in Freetown.* Freetown: GOAL.
Ministry of Urban Development. (2008). *National Urban Sanitation Policy.* New Delhi: Government of India.
Murray, A. (2011). *Human-waste reuse: global overview of options and background market analysis of waste-based business opportunities in Nairobi, Kenya.*
Nance, E., & Ortolano, L. (2007). Community Participation in Urban Sanitation: Experiences in Northeastern Brazil. *Journal of Planning Education and Research*(26), 284 - 300.
Norman, G. (2009). Can sewerage be pro-poor? Lessons from Dakar. *West Africa Regional Sanitation and Hygiene Symposium.* Accra, Ghana: IRC International Water and Sanitation Centre.
OECD. (2010). *Innovative Financing Mechanisms for the Water Sector.* Paris: OECD Publishing.
OECD. (2011). *Benefits of Investing in Water and Sanitation: An OECD Perspective, OECD Studies on Water.* OECD Publishing.
Parkinson, J. (2005). *Decentralised domestic wastewater and faecal sludge management in Bangladesh.* Dhaka: GHK Consulting Ltd.
Peal, A., Evans, B., & Voorden, C. v. (2010). *Hygiene and sanitation software. An overview of approaches.* Geneva: Water Supply and Sanitation Collaborative Council.

Prüss, A., Kay, D., Fewtrell, L., & Bartram, J. (2002 йил May). ‘Estimating the Burden of Disease from Water, Sanitation, and Hygiene at a Global Level’. *Environmental Health Perspectives, 110*(5).

Prüss-Üstün, A., Bos, R., Gore, F., & Bartram, J. (2008). *Safer Water, Better Heath: Costs, benefits and sustainability of interventions to protect and promote health.* WHO.

pS-Eau & MDP. (2003). *Enterprises providing mechanical emptying of on-site sanitation systems in major African cities.* Chateauneuf de Gadagne, France: Programme Solidarité Eau and Municipal Development Partnership.

Renwick, M., Subedi, P. S., & Hutton, G. (2007). *A Cost-Benefit Analysis of National and Regional Integrated Biogas and Sanitation Programs in Sub-Saharan Afirca.* Little Rock, Arkansas: Winrock International.

Robinson, A. (2005). *Scaling-up Rural Sanitation in South Asia. Lessons learned from Bangladesh, India and Pakistan.* New Delhi: Water and Sanitation Program.

Robinson, A. (2012). *Sanitation Finance in Rural Cambodia.* Washington D.C.: Water and Sanitation Programme, Guidance Note.

Sandec. (2006). Urban Excreta Management - Situation, Challenges and Promising Solutions. In M. Strauss, D. Koné, H. Koanda, & M. Steiner (Ed.), *1st International Faecal Sludge Management Policy Symposium and Workshop.* Dakar: Sandec.

Sanitation and Water for All. (2012). ‘Second Global High Level Meeting, April 20th 2012 - Summary of Proceedings’.

Smits, S., Verhoeven, J., Moriarty, P., Fonseca, C., & Lockwood, H. (2011). *Arrangements and cost of providing support to rural water service providers - WASHCost Working Paper 5.* The Hague: IRC International Water and Sanitation Centre.

Strauss, M., Barreiro, W., Steiner, M., Mensah, A., Jeuland, M., Bolomey, S., et al. (2003). Urban Excreta Management - Sitation, Challenges and Promising Solutions. *IWA Asia-Pacific Regional Conference.* Bangkok, Thailand: SANDEC.

TARU. (2008). *Impact Assessment of Nirmal Gram Puraskar Awarded Panchayats.* The Action Research Unit, New Delhi.

Tilley, E., Lüthi, C., Morel, A., Zurbrüg, C., & Schertenleib, R. (2008). *Compendium of Sanitation Systems and Technologies.* Dübendorf, Switzerland: Swiss Federal Institute of Aquatic Science and Technology (Eawag).

Trémolet, S. (2011). *Identifying the Potential for Results-Based Financing for Sanitation.* Washington D.C.: Water and Sanitation Program.

Trémolet, S. (2012). Sixth World Water Forum - background paper. *Condition for Success 2: Financing Water for All.* Marseille: World Water Council.

Trémolet, S. (2012). *Small-scale finance for water and sanitation.* Stockholm: European Union Water Initiative and SHARE.

Trémolet, S. (2012). *Tracking national financial flows into sanitation, hygiene and drinking water.* Geneva: World Health Organization .

Trémolet, S., & Binder. (unpublished). *Research for WaterAid on the effectiveness of public funding for sanitation.* unpublished.

Trémolet, S., & Evans, B. (2010). *OBA Working Paper Series (Paper No. 10): Output-Based Aid for Sustainable Sanitation.* Washington, DC: The Global Partnership on Output-Based Aid.

Trémolet, S., Perez, E., & Kolsky, P. (2010). *Financing On-Site Sanitation for the Poor. A six country comparative review and analysis.* Washington D.C.: Water and Sanitation Program.

van Ginneken, M., Tyler, R., & Tagg, D. (2004). *Can the Principles of Franchising be used to Improve Water Supply and Sanitation Services? – A Preliminary Analysis.* Washington, D.C.: World Bank.

Waddington, H., Snilstveit, B., White, H., & Fewtrell, L. (2009). *Water, Sanitation and Hygiene Intervention to Combat Childhood Diarrhea in Developing Countries.* International Initiative for Impact Evaluation.

Wandera, B. (1999). *Small Scale Independent Providers of Water and Sanitation to the Urban Poor - A Case of Kampala, Uganda.* Kampala: WSP, IRC.

WaterAid. (2009). *Fatal Neglect: How Health Systems are Failing to Comprehensively Address Child Mortality.* WaterAid.

WHO. (2006). *WHO guidelines for the safe use of wastewater, excreta and greywater - Volume IV - Excreta and greywater use in agriculture.* Geneva: World Health Organization.

WHO. (2008). *The Global Burden of Disease: 2004 update.* Geneva: World Health Organzation .

WHO. (2012). *Global analysis and assessment of sanitation and drinking-water (GLAAS), The challenge of extending and sustaining services.* WHO.

Winrock. (2007). *A cost-benefit analysis of national and regional integrated biogas and sanitation programs in sun-saharan africa.*

World Bank. (2003). *Project Appraisal Document on Proposed Credit for the Dar es Salaam Water Supply and Sanitation Project.* Dar es Salaam: World Bank.

World Bank. (2006). *India - Bridging The Gap Between Infrastructure and Service - Urban Water Supply and Sanitation.* New Delhi: World Bank.

WSP. (2007). *Economics of Sanitation Initiative - Poor sanitation cost indonesia over Rp 58trillion/year.*

WSP. (2009). *Study for financial and economic analysis of ecological sanitation in sub-saharan africa.*

WSP. (2010). *Country Status Overviews on Water Supply and Sanitation - Regional Synthesis Report.* n.a.: AMCOW (African Ministers' Council on Water) and Water and Sanitation Program (WSP).

WSP. (2010a). *A Decade of the Total Sanitation Campaign, Rapid Assessment of Processes and Outcomes.* WSP.

WSP. (2012). *Water Supply and Sanitation in Ghana, Turning Finance into Services for 2015 and Beyond.*

WUP Africa. (2003). *Better Water and Sanitation for the Urban Poor: Good Practice from sub-Saharan Africa.* Kenya: European Commission (EC) and Water and Sanitation Programme (WSP).