FOR PARTICIPANTS ONLY

31 March 2015

ENGLISH ONLY

ECONOMIC AND SOCIAL COMMISSION FOR ASIA AND THE PACIFIC
In collaboration with
UNITED NATIONS HUMAN SETTLEMENT PROGRAMME

Regional Policy Workshop
on Wastewater Management and Sanitation in South-East Asia
2 and 3 April 2015, UNCC, Bangkok, Thailand

Market Opportunities for Decentralized Wastewater Treatment Systems in South-East Asia

(Final version of 31 March 2015)

The views and opinions expressed in this report are those of the authors and do not necessary reflect official views of the ESCAP Secretariat

This is final version of the Study has been issued after proof reading and without a formal editing

Table of Contents

Acronyms

ADB	Asian Development Bank
ASEAN	Association of South-East Asia Nations
BCR	Benefit-Cost Ratio
BORDA	Bremen Overseas Research & Development Association
CBA	Cost-Benefit Analysis
DEWATS	Decentralized Wastewater Treatment Systems
GDP	Gross Domestic Product
MDG	Millennium Development Goals
LDC	Least Developed Countries
JMP	Joint Monitoring Programme (WHO, UNICEF)
OECD	Organisation for Economic Co-operation and Development
PPP	Public-Private Partnerships
ROI	Return on investment
SEA	Southeast Asia
SME	Small and medium-sized enterprises
UDDT	Urine-diverting Dry Toilet
WHO	World Health Organization
WSP	Water and Sanitation Program

Glossary

System - a system is a set of elements that interact to achieve some purpose. System is a group of interacting, interrelated, or interdependent elements forming a complex whole. A system is almost always defined with respect to a specific purpose within a larger system.

Systemic - means affecting most or all of a system rather than a small portion of the system and affecting the general behavior of the entire system.

Systems Thinking - focuses on recognizing the interconnections between the parts of a system and synthesizing them into a unified view of the whole. This is a way of understanding reality that emphasizes the relationships among a system's parts, rather than the parts themselves.

Open System - a system which is open to its environment such that there are recognisable inputs to the system and outputs to the environment

Climate Change – Climate change refers to a statistically significant variation in either the mean state of the climate or in variability, persisting for an extended period. Climate change may be due to natural internal processes or external forces such as solar variance, or to persistent anthropogenic changes in the composition of the atmosphere or in land use.

Climate System – The climate system is the highly complex system consisting of five major components: the atmosphere, the hydrosphere, the cryosphere, the land surface and the biosphere, and the interactions between them.

Acknowledgements

The report on Market Opportunities for Decentralised Wastewater Treatment Systems (DEWATS) in South-East Asia (SEA) is prepared within the frame of the joint project of ESCAP and UN-Habitat on "Strengthening capacity of policymakers in SEA to promote policies and developing plans for improved wastewater treatment and reuse in urban and peri-urban areas", to address the fast-growing problem of untreated wastewater through promotion of the Decentralized Wastewater Treatment Systems (DEWATS) in 2013-2015 (ref: DA 8th Tranche).

Energy Security and Water Resources Section of Environment and Development Division of Economic and Social Commission for Asia and the Pacific (ESWRS/EDD/ESCAP) and UN-Habitat as a project team acknowledge the research and analytical contribution of Mr. Christoffer Larsson, project consultant, as well as the valuable inputs from participants of the national workshops on DEWATS in Lao PDR and Cambodia of 6-7 October and 27-28 October, 2014, respectively. Proof reading was done by Mr. Robert Steele, **Syst**ainability Asia, Thailand

The project team is grateful for the contribution of participants from two meetings, namely: Regional Workshop on "Dissemination Experiences of the Pilot on DEWATS project, Study Tour at Attapeu Province, Lao PDR" Lao PDR, 11 December, 2014, as well as the National Workshop on DEWATS, Hanoi, Viet Nam, 22 December, 2014 , which were taken into consideration in the new draft and would be to further present findings of the report at the Regional Policy Workshop on DEWATS, scheduled on 2-3 April 2015 at UNCC, Thailand.

Special thanks to Ms. Kris Schneider for her suggestions from the business perspectives and case studies on the subject and to Mr. Christoph Bernleitner, intern of ESCAP, for the support on research and the graphic design throughout the report.

Executive Summary

This overview of the market opportunities on decentralized wastewater management of South-East Asia (SEA) highlights some findings that can assist policy makers of targeted countries to make advancement towards improving sanitation services in their countries and the region as a whole, and to follow renewed commitment towards ensuring safe water and sanitation services, such as:

Most of financing of wastewater treatment come from donors and households themselves:

> Appropriate policies and strategic government investments could spark the private sector as strong financial contributor through the Inclusive bill for water supply & wastewater treatment

DEWATS are affordable and add the great value to conventional centralized treatment systems:

> Furthermore, DEWATS benefits through a flattened long-term investment in construction, where expansion possibilities respond to actual timely and on site demand. Old systems characterize through the need of high investments for construction, while means of expansion remain very rigid, which poses great challenges for communities.

DEWATS provide potential investment and market opportunities:

> These lie in the different segments of the DEWAT value chain - demand stimulation, construction of DEWATS, collection & transport of waste, and treatment & reuse. Value can be generated by focusing on strategies to enhance demand from households and businesses, sustainable (micro-) financing schemes for households, incentives for proper conduct of waste collection, and regulations & standards for waste treatment and resource recovery technologies (in DEWAT construction and service provision).

DEWATS has a big potential to profit from a wide range of financing opportunities:

> DEWATS's high connectivity and its dispersed value chain increases the number of stakeholders involved as well as the potential of market opportunities, thus generating the possibility to diversify funds to gain financial sustainability. Financing mechanisms can range from trust funds, private investments, industry taxes, generated household revenues, reuse and recovery of resources, bonded water provision and water treatment bills to indirect benefits to BDP from health and environmental improvement, social impact bonds, etc.

Investment in DEWATS improves the Benefit-Cost Ratio of socio-economic terms:

> Policy-makers can bring health benefits be ensuring the discharge of treated water to the ecosystems (rivers, canals, lakes), therefore brings water resources benefits and contributes to the well-being to their people (communities, households) by regulating sanitation market.

Financial models and sustainable financing schemes:

> could be adapted depending the level of pollution, ability or willingness to pay, and the regarding payment method to recover costs (tariffs, taxes, etc.) by actors. Identifying Industry, SMEs and households as the main players on the wastewater treatment market. A sustainable financial framework provides that industry is regulated with environmental and green taxes to compensate for costs of pollution and negative effects on third parties, while household demand has to be reinforced by guaranteeing supply and quality, financial incentives, marketing of DEWATS.

1. Introduction

Conventional practices of wastewater management and sanitation services are primarily financed through public funding (i.e. taxes) and supported by government regulations, while investments to wastewater treatment do not provide an immediate return on investment (ROI) in monetary terms.

No country has managed to finance its wastewater treatment practices from investments from the private sector or through tariffs. An Asian Development Bank (ADB) survey covering 27 countries revealed that only 24 percent of O&M costs for water and sanitation are met from tariffs (ADB, 2009).

There are, however, successful examples of investments from the private sector, within the middle-income countries, where the perceived risks of doing business are lower than in the least developed countries. For example, the reuse of wastewater has a high potential to recover parts of the investment costs, However, due to the high costs of the transportation services, most of the successful examples have been located in the areas with a close proximity to the industrial zones and large farms, where the large scale and volume of waste is an advantage. There is a need for more research in this area, particularly looking at the differences in investment costs between different countries and the potential market opportunities that exist linked to policy stimulus.

In this regard, the DEWATS can be seen to provide good market opportunities for households and small industries in urban and peri-urban areas where there is no access to centralized sanitation services, especially in climate risk zones. The market includes the different segments of the value chain, starting from the stimulation of demand and proceeding to the supply of hardware facilities (e.g. latrines and septic tanks), and the collection and transport of waste. It also includes opportunities to recover costs from reuse of wastewater.

The Cost-Benefit Analysis (CBA) can help policy makers to better target new investments and to focus on areas that generate the highest benefits, while maintaining cost-effectiveness. To add weight to this claim, the CBA from the World Bank studies shows the return on investments of different sanitation solutions for three selected countries, compared to other countries. The studies indicate that the return on investments can be as high as 10 USD per 1 USD of investment, but also as low as 10 US cents. This analysis can help policy makers to more effectively target new investments and to focus on areas that generate the most benefits and rely on the most cost-effective measures. The CBA and case studies/best practices on DEWATS documented in the WB report are collected from the worldwide practices and prepared based on the discussions from three national workshops on DEWATS conducted in Lao PDR (6-7 October 2014), Cambodia (27-28 October) and Viet Nam (22 December), as well as the regional workshop on dissemination of results of two pilots on DEWATS in peri-urban areas, delivered in Attapue Province, Lao PDR on 11 December 2014.

Based on the findings of this study, several policy recommendations are proposed for governments of SEA in the following areas:

- Carry out demand studies prior to designing an intervention;
- Solutions must be replicable and scalable;
- Encourage behavior change to increase demand;
- Design legislation that can be followed and enforced.

The purpose of this report is to assist policy-makers in decision making of SEA by providing:

- a better understanding of the market opportunities for Decentralised Wastewater Treatment Systems (DEWATS[1]), with related enabling operational and political system market

[1] Please see ESCAP, UN-Habitat, AIT. (2015). Policy Guidance Manual on Wastewater Management and Sanitation, with a Special Emphasis on Decentralised Wastewater Treatment Systems in South-East Asia, for a definition of DEWATS

segmentation within the value chain; and benefits, analysis of the services costs and financing sources for sustainable sanitation services in the South-East Asian region;

- to provide policy advice on financial schemes that can enable DEWATS that are linked to a systems based approach in policy, planning and implementation of DEWATS which can contribute to designing cost effective and sustainable solutions that will eventually lead to universal access to safe water and sanitation;
- Ensure a step by step approach in enabling and implementing the Pro-Poor Public Private Partnership Approach for Sustainable Sanitation Services

2. Estimates of Wastewater Treatment and Sanitation Costs in the Region

There are several estimates regarding the global financing that is required to achieve universal access to sanitation. The World Health Organization (WHO) estimated the capital cost requirements to achieve universal access of sanitation to approximately USD 66 billion per year from 2011 to 2015 in non OECD countries (ESCAP, 2012). According to Camdessus (2003), the annual estimate for municipal wastewater treatment is USD 56 billion for the period of 2002 to 2025.

Other studies have arrived at similar estimates. Media Analytics estimated the total capital expenditure requirements universal access to sanitation at USD 83.5 billion per year in 2009 (OECD, 2010). As the current spending is approximately USD 30 billion annually, only about one third of the sanitation and wastewater management costs are currently being met (ESCAP, 2013).

For Asia, WHO estimates capital cost requirements of USD 12 billion per year from 2011 to 2015 to achieve the sanitation Millennium Development Goals (MDG) target and an additional USD 25 billion per year to achieve universal access of sanitation (ESCAP, 2012). Hence, the total is calculated at USD 37 billion per year, of which USD 23 billion is for urban areas and USD 14 billion is for rural areas. Table 1 below presents the capital cost requirements for some selected countries in Southeast Asia[2].

Table 1: The costs of achieving the MDG sanitation target and universal sanitation access in the South-East Asia[3]

Country	Capital Cost to reach MDG (in million USD)			Additional Capital Cost to reach Universal Coverage (in million USD)		
	Rural	Urban	Total	Rural	Urban	Total
Viet Nam	0	0	**0**	1,103	803	**1,993**
Lao PDR	55	0	**55**	306	56	**362**
Cambodia	710	4	**714**	1,023	196	**1,219**
Thailand	0	85	**85**	0	655	**655**
Indonesia	1,372	961	**2,333**	2,097	2,585	**4,682**
Philippines	17	239	**256**	431	1,489	**1,920**
Myanmar	0	0	**0**	453	302	**755**

[2] For the full list see Annex III in Development Financing – The Case of Sanitation in Asia, ESCAP, 2013
[3] Note: Data presented are generated from WHO and UNICEF(2012) and ESCAP (2012)

In summary, we can see that Viet Nam, Lao PDR, and Cambodia are all on track for reaching the MDG for sanitation in urban areas and would need to make more efforts to ensure universal coverage. For rural areas only Viet Nam has reached the MDG goal for sanitation, but to achieve universal coverage both Viet Nam and Cambodia needs to invest an additional USD 1 billion, respectively.

Based on these observations, to reach the target of universal coverage, governments should increase investments on wastewater treatment, especially in financing decentralised wastewater treatment systems (DEWATS). At present, governments have mostly invested into centralised treatment facilities, while investments of decentralised systems have largely been financed by donors and households. Figure 1 presents the sources of current financing in Viet Nam, Lao PDR and Cambodia.

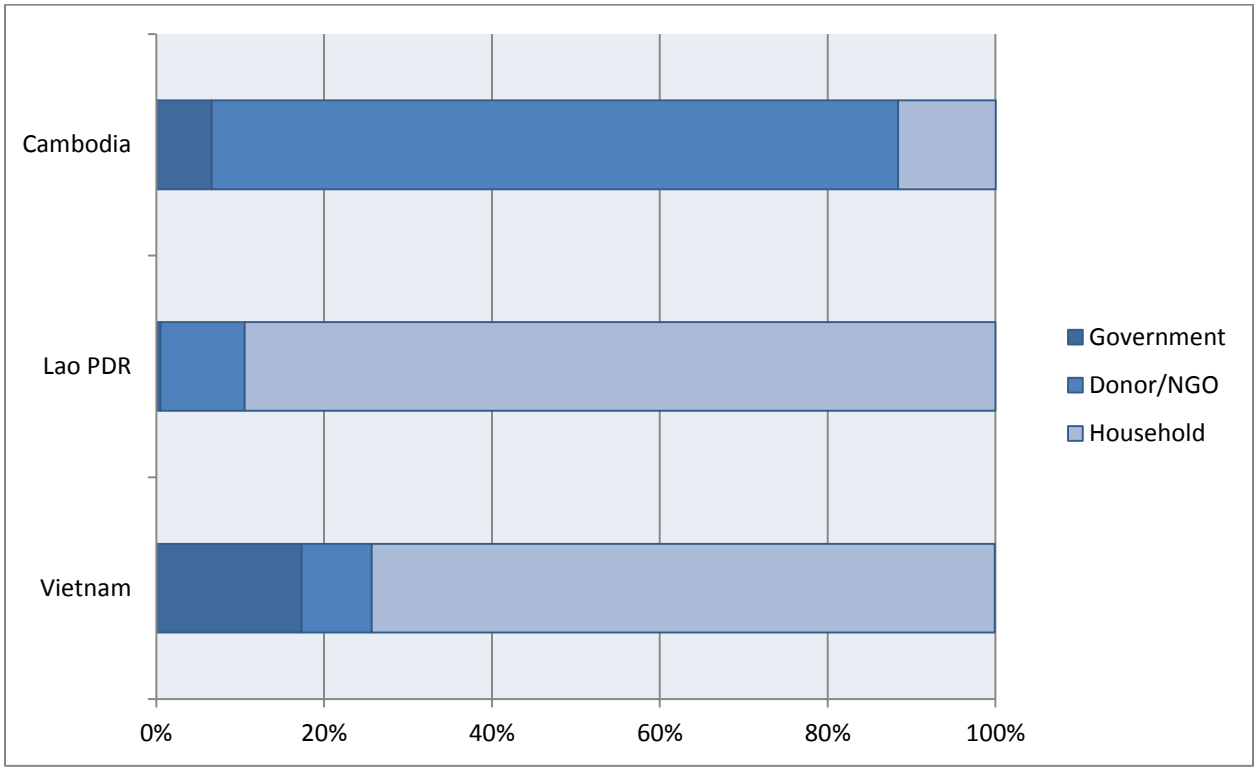

Figure 1: Sources of financing for sanitation and wastewater treatment[4]

More investments into wastewater treatment would also be welcomed from the private sector[5]. Most private sector investments for wastewater treatment are currently found in middle-income countries where risks are perceived to be lower than in the least developed countries (WPP, 2012). This poses a big challenge for developing economies such as in Lao PDR and Cambodia. Governments are committed to formulating the regulatory frameworks along with the respective legal enforcement so as to enable the strengthening of private sector actors to further raise confidence for private investments, including small and medium-sized enterprises (SMEs). However, an issue that currently exist in relation to this is the shortage of private firms able to step in, which is something that needs to be nurtured, and it takes time.

A successful example of how financing can be raised from the private sector can be found in China, where 10 – 20 percent of investments in wastewater treatment services are originated from the private sector. There is more information about this in Chapter 4.5, 5.1.

[4] The share of each source is based on the average funding of studied sanitation projects by WSP (published 2012 – 1013)
[5] Inputs from National Workshop in Viet Nam

While investments from the private sector are difficult to mobilize in the least developed countries, the opportunities to secure support from donor funding are greater. According to WaterAid, Viet Nam received an annual average of USD 522 million between 2008 -2010 in the Water, Sanitation and Hygiene WASH sector. As presented in Figure 1 more than 80 percent of funding into sanitation and wastewater treatment comes from donors in Cambodia. It's important to note that most funding from donors is reserved for poverty alleviation with a focus in rural areas. This means urban areas are often excluded from these interventions.

2.1 Investment costs of centralised wastewater treatment facilities are higher than for decentralized wastewater treatment facilities

A major issue with centralised systems for developing countries is that the investment size required to cover entire cities is very large and it is not financially viable to raise enough capital in the short- and medium term. For example, Bangkok has seven central plants with a total capacity of 992,000 cubic meters of treated water per day (Chokewinyoo and Khanayai, 2012). Still, they only cover 54 percent of the city's treatment needs (ADB, 2010), and much of the remaining wastewater is disposed untreated directly into the Chao Phraya River and its subsidiary canals. To be able to close this gap, solutions that are less capital-intensive need to be adopted in parallel with an expansion of centralized plants. Hence, there is a strong case for the integration of decentralised wastewater treatment systems to supplement centralised systems, thus making wastewater management more available in urban areas.

Another argument for decentralised plants is that trends for private investments are increasingly in favor of smaller size treatment plants. In 1997, the median capacity of a new treatment plant with private investment was 300 cubic meter per day. By 2010 this had dropped to 40 cubic meters per day (Perard, 2012).

At the same time, investments from governments are larger for centralised systems than for decentralised systems. For example, in Viet Nam, the total contribution from the government for centralised wastewater management projects was 77 percent, compared to 23 percent for decentralised systems (WSP ESI Viet Nam, 2012).

2.2 Cost Comparison between Centralised and Decentralised Systems

Comparing the cost between centralised and decentralised wastewater treatment is not easy, as it depends on a number of factors, such as location, water pollution levels, length of piping required, etc.

Using data from the study in Viet Nam carried out by the World Bank, the investment cost for centralised wastewater treatment facilities per household was approximately USD 600 and the annual O&M cost was USD 60. In contrast, the investment cost of an urban septic tank is USD 300 million, and the annual O&M cost USD 20 -25. However, the life span of a centralised facility is estimated to be around 20 years, compared to 10 years for a septic tank.

Taking this into consideration, the difference in investment size and needs for O&M per household is rather small. The great difference lies with the fact that a decentralised treatment facility can be built piece by piece and does not require multi-million dollar investments that can be difficult to raise in countries with limited public funds.

As mentioned previously, the costs of centralised and decentralised treatment facilities will be different for different countries, but the example described from Viet Nam gives an indication that differences in costs per households are not that large. For further information, the six country study carried out by the World Bank in SEA provides Cost-Benefit Analysis (CBA) of both centralised and decentralised treatment systems, which can be compared. For Viet Nam, Cambodia and Lao PDR, details of these comparisons are presented in Chapter Four herewith.

3. Demand Stimulation for Wastewater Treatment Services requires a Systemic Approach

The market opportunities for sanitation and wastewater treatment can be divided into segments within the sanitation value chain (ref Policy Guidance Manual on DEWATS for South-East Asia, ESCAP 2015), whereby different actors are providing and demanding services. The main segments in the value chain include: 1) Construction of hardware, such as toilets and septic tanks; 2) Collection and transport of waste 3) Treatment and potential reuse of the waste. An illustration of the value chain is presented below in Figure 2.

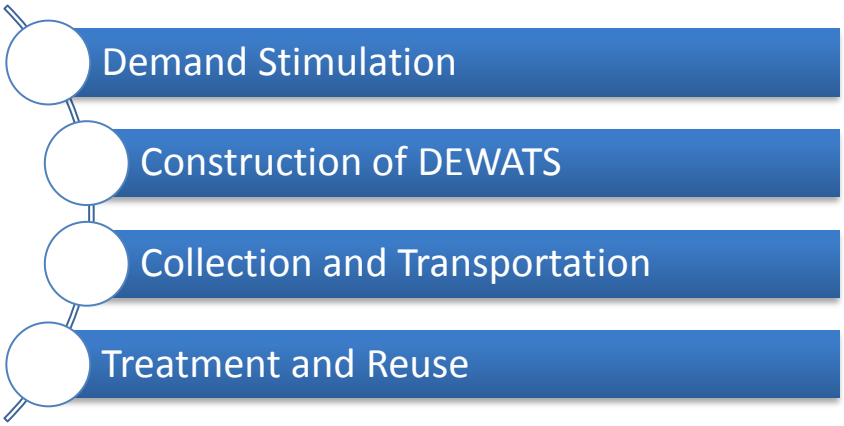

Figure 2: Value Chain of Sanitation Services

It is also considerably beneficial to dedicate resources to a more market wide inter-sectorial and cross-industry approach. In this case, the different businesses' DEWATS value chains and sanitation services may benefit from shared resource productivity, inter- linking synergies between supply chains and consumption nodes, while tapping into unused local resources. This then allows them to realise compounding effects through synergistic linkages and material-symbiosis through the principle of circular economy in order to reap multiplier effects.

There is a range of auxiliary sectors and service systems that can be generated alongside the sanitation value chain (i.e. bio energy, biofuel, fertilizer, heat…etc.) while bringing in eco-profit potential through synergistic cross-industry collaboration & symbiotic material exchange between industries; i.e. collect sanitation waste from hospital while supply hospitals with heat and hot water generated from waste. The same principle works in other fields through innovative business collaboration.

3.1 The demand for DEWATS and sanitation services can be stimulated through more awareness of enabling markets, micro-financing schemes

The government has the key role in setting policy that stimulates private sector participation. This can be done through political prioritization, functioning legal frameworks, transparency in the award of contracts, fairness in tariff setting, and avoiding unnecessary political interference. Weak institutional frameworks and financing policies may result in the ineffective and inefficient use of existing resources within the sanitation market.[6]

While money for sanitation programs exists, there is a growing need to ensure quality and sustained sanitation service delivery. Therefore, governments have to acknowledge and give sanitation adequate attention and promote sanitation as a core national issue. In Asia, the

[6] Source: UNESCAP 2013: Development Financing for Tangible Results: A Paradigm Shift to Impact Investing and Outcome Models - The Case of Sanitation in Asia

following policy areas of water and sanitation should be improved, including annual sector reviews, monitoring and evaluation, civil society participation, investment planning, sector absorption of government and donor budgets, use of equity criteria in budget allocations, and capacity building of human resources (World Health Organization 2012).

When the demand for wastewater treatment is low, it is difficult to recover costs from the public budget and even more challenging to attract the private investments from the private sector. This is especially true in developing countries where people are often concerned with more pressing issues, and priorities, such as access to food, access to water and access to the roads.

However, it is paramount that the poor are recognised as central agents in the development partnership process, and as key stakeholders in planning and implementing their own development (Binswanger 2004:2). Ways in which they can participate in these partnerships may involve co-creating the soft infrastructure (service systems) networks to sustain adaptive capacity, such as resource efficiency, subsistence farming and agricultural productivity, micro-business innovation, supply-chain and service life extension, technology diffusion, local resource utilization and revolving micro-credit financing. In poverty alleviation, the major emphasis of development criteria emphasize local knowledge, local context and co-creation processes with the poor that eventually move up through the community to enable 'self-help' capabilities to develop alongside exogenous market mechanisms, technical aides and policy supports.

Demand can be stimulated by conducting sanitation promotion and behavior change campaigns, and is one of the most effective interventions governments can use to empower communities and households to cover more of the costs for sanitation hardware and reduce the share of government expenditures.

Given the importance of such PR campaigns location-specific demand studies should be conducted by the public sector (government, academia, ngos, etc.) prior to designing an intervention, so as to better understand what encourages or discourages households to invest in sanitation (Trémolet S., 2012).

Without stimulation coming from the public sector, households may often underestimate the values and tangible benefits of practicing hygienic behaviour, and thus, do not demand the government to ensure the basic human right in access to sustainable sanitation services for each household, such as health benefits and benefits from clean ecosystems (rivers and lakes) within urban and peri-urban areas.

Although this may be the case, experiences suggest that focusing on intangibles can be effective in stimulating demand, though it is more effective coupled with suggestion of policy tools and technological options that could be accessible through the market. Evidence presented by (Jenkins & Sugden, 2006) has shown that even if changes in behavior are experienced, when focusing on health benefits, these new behaviors are only sustained over the short-term. Instead, factors such as dignity, comfort and privacy appear to be more important factors for households to change their behaviour in the long-term (i.e. sustainably).

Another proven effective strategy to change behavior is to focus sanitation interventions in public areas, such as in schools, hotels, resorts and hospitals. Most changes in behavior do not actually occur through individuals, but through introducing the new habits to the next generation. Therefore, building toilets in schools can be an effective way of moving a community towards total sanitation services, whereby students take on the role of an change agent (Trémolet S., 2012). Another example of including next generations as agents of change can be by mobilizing youth and tapping into their social resources and networks, and engaging them in awareness raising, advocacy, public relations campaigns and youth-led research projects for sanitation and health (for more information see http://www.assistasia.org/youth4asia/GMS.html).

Another tool to stimulate demand is to target affordability through financing schemes, such as micro credits. A toilet with a septic tank is a long-term investment, and if households are given

the opportunity to repay it through microcredits and loans they are more likely to invest in this technology.

Loans can use targeted subsidies for poor households in order to reach as large a portion of the population as possible.

The current situation of sanitation in emerging markets requires a systemic approach which undergoes evaluative and planning activities, conducting whole system need analysis, to a self-supporting business development that meets immediate demand / short term interest, with an objective of a business ecosystem.

Also applying comprehensive approaches for optimizing total life cycle business models for the benefit of owners, users, the environment and the society secures demand for wastewater treatment and sanitation products and services. A whole system design with total life cycle approach would produce appropriate business models, financing, technology, tools, procurement process and contractual frameworks that supports innovation and innovative value sharing schemes.

3.2 Regulate construction of DEWATS facility through an adequate supply in sanitation hardware, as a technical module

Supply of hardware module includes construction of latrines, flush toilets, septic tanks, and on-site treatment and other sewage facilities. The construction of this hardware is typically carried out in the region by private firms.

For many developing countries finding credible suppliers that can provide quality services is a problem, and this in turn affects the demand for sanitation services (WSP, 2005). To help solve this, organisations such as Bremen Overseas Research & Development Association (BORDA) can play an important role to develop local private sector service providers with adequate technical skills.

There are also several interventions that government can undertake, such as regulating the sector, promoting firms that are registered, and taking actions against those who operate illegally. Another policy leverage is through strengthening consumers' rights for compensation in cases where construction is subpar. To reach the poorest households, government can also provide subsidies to communities where relevant.. Please refer to more technological options in Table 5.

3.3 Ensure policy to stimulate work of the Service Providers, for example in collection and transportation of household wastes and wastewaters

The majority of the developing world is served by onsite facilities. For these systems to function properly, the waste needs to be collected and transported for safe disposal. As for construction of hardware, this is usually a service provided by private firms.

One common issue with these transport service providers is that they can dispose of wastes untreated into lakes or rivers nearby to save on transportation and disposal costs. A potential scheme to avoid this is to use Output-Based Aid (OBA) to encourage discharges at designated points and stimulate the society to actively monitor these waste disposal companies through regular checks and reporting tools. This requires paying service providers for waste (compensating good behavior through positive reinforcement) brought to safe disposal points, rather than charging them to do so.

In contrast to the demand of wastewater treatment which is often low, the demand for collection services is high because households with septic tanks have little choice but to get their tanks emptied, otherwise they experience negative consequences. A potential issue for this segment is the monopoly over service provisions in a given areas. As in all situations of monopoly, the government should help to monitor and remove these when they occur.

3.4 Enable reuse of waste and resource recovery from household wastewater

Despite huge potential, resource recovery and reuse of wastewater still remains at an early stage in most developing countries, with more research needed to boost the interest in this area.

The waste (or sludge), after being transported and treated, ultimately needs to be either disposed of or reused. Large-scale disposal of urban wastewater often occurs in an unregulated manner. If a value can be found in the by-products so as to be able to reuse them productively, this will be of great help to discourage unsafe disposal.

Although the BCR for some of these reuse schemes can be high, most of the markets have so far failed to scale up (Trémolet S., 2012). High transport costs are a major issue for making the reuse of by-products economically viable, this is particularly true if urban areas are congested and fuel prices are high. Subsidies can be used to overcome this problem, but costs and benefits have to be analyzed to determine if this is a good policy. For example, it makes little sense to subsidise gasoline used for transport, only to recover a smaller amount of biogas from the waste it is carrying. Therefore most successful examples of reuse are document for locations where treatment facilities are located near large agricultural or industrial areas, therefore keeping transport costs low (Aquarec, 2006).

An option to overcome the cost of transportation is to reuse waste onsite. For example, there are urine dividing toilets separating feces and urine and other types of composting toilets that can allow for direct reuse in nearby fields. The Nepal Case Study of 2008 (ref 6.3 of Part 2 of the Policy Guidance Manual[7]) shows in detail what financial and socio-economic benefits urine diversion may bring. This model could be considered high tech and costly if used alone, but with support from the Government, along with the passage of enabling policies, it would be affordable and practical for poor communities and households.

Another technology module is the domestic biogas digester. It has been especially successful in rural areas without access to electricity. To generate sufficient biogas for a household it requires live stock as well and is therefore not suitable in urban areas. Biogas digesters come with a range of benefits. They provide biogas that can be used for cooking and for lighting at night time. The sludge, which is the remaining output of the wastewater, can be used as a fertilizer for growing crops. The biogas digester also has the indirect benefit of helping to keep the garden clean and free of animal feces.

According to a study by Water and Sanitation Program (WSP) in Viet Nam, a typical domestic biogas digester produces fertilizer for a value of USD 100, and biogas for USD 50 annually. The construction cost is approx. USD 600 – 700 with duration of 20 years if built with quality (WSP EES Viet Nam, 2012).

4. Cost-benefit analysis of sanitation interventions: examples from Viet Nam, Cambodia, Lao PDR

The purpose of doing a cost-benefit analysis (CBA) is to estimate benefits and costs of different options, and then compare the different options for better decision making. Since 2008, the WSP of the World Bank has been conducting in depth country studies of the economic impact of inadequate sanitation in nine Asian countries. The study indicates that poor sanitation was costing the economies of these countries an equivalent of between 0.5 and 7.2 percent of their annual GDP. In South-East Asian countries, the average is 2 percent of the GDP, whereas in South Asian countries, it is 6 percent of the GDP. For Viet Nam, Lao PDR and Cambodia the costs are 0.5 percent, 5.6 percent, and 7.2 percent of the GDP respectively.

[7]Source: ESCAP, UN-Habitat, AIT. (2015). Policy Guidance Manual on Wastewater Management and Sanitation with a Special Emphasis on Decentralised Wastewater Treatment Systems in South-East Asia, Part 2: Case Studies.

4.1 What is the definition of Benefit-Cost Ratio?

The Benefit-Cost Ratio (BCR) presents the relation between the benefit compared to the cost. A ratio above 1 means that the return is higher than the investment, i.e. for every 1 dollar invested the return is more than 1 dollar. It is important to understand what the benefit-cost ratio actually means. If the government invests in a wastewater treatment plant system with a BCR of 4, it does not mean that the government will receive a 4 dollar return on every 1 dollar invested. It is rather the entire society that will gain 4 dollars. You could say that GDP as a whole will increase by 4 dollar for every 1 dollar is invested. It is also essential to understand that the payback period of an investment can be more than 1 year. If a wastewater treatment plant system has a lifetime of 20 years, the BCR will reflect the benefits (and the costs) over this entire period. Typically the payback period for a pit latrine in rural areas (moving up from open defecation) is around 1 year. For a centralized treatment system it is considerably longer. For example, a person that used to practice open defecation, but now has access to a latrine, will likely have more free time to work and will get sick less frequently. The increased free time and improvement in health means that he or she will have more time to do something productive, and this can be translated into monetary value, which will be included in the return of the investment. The BCR may be different depending on the context. For example, the BCR of a specific solution may be greater in a rural setting than in an urban setting or vice versa. For example, the BCR of installing wet pit latrines in rural Lao PDR is 7.8, but 6.2 in an urban area.

Figure 3 presents a generalized picture of the sanitation "ladder". The higher up in the ladder the more advanced and costly the sanitation system is to set up and implement. At the bottom of the ladder is open defecation with no access to sanitation and at the top are flush toilets connected to sewerage. The BCR is typically higher in the lower parts of the ladder. This is because populations already using improved sanitation have already seen some benefit, so moving them up the ladder leads to fewer marginal benefits. Below is a list of the main benefits included in WSP's estimation of BCRs.

Health benefits include the reduction in diseases caused by the improved sanitation. The economic savings used to measure this are; 1) the averted health care cost 2) the economic cost of time lost due to illness and 3) the cost of premature deaths avoided.

Water benefits include the economic savings, such as paying less or walking further, to access clean water. It also takes into account the reduced cost of treating water due to concerns about safety and appearance.

Access Time is the time saved to access the improved sanitation, such as access time to a private toilet compared to finding an appropriate place for open defecation. The economic value of time is based on the same values as health related time savings.

Intangibles include comfort, privacy, convenience, safety, status, respect and prestige. These are difficult to measure in monetary terms, but they often play an important role to the demand of improved sanitation and the willingness to pay for it.

Reuse includes benefits from recycling of materials such as compost fertilisers and biogas. This is a good opportunity, especially, in rural areas where households have access to excreta from livestock.

Tourism is a sensitive industry to bad sanitation. Tourists that get diseases from food poisoning or can not find a clean bath rooms are less likely to return again.

The costs of moving up the sanitation ladder depend on the starting option, and whether an entirely new facility needs to be built, or whether the "higher" ladder option can utilize some or all of the existing hardware. For example, moving from a shared toilet to a private pit latrine, or from a pit latrine to a Urine-diverting Dry Toilet (UDDT), will require the full investment cost. Moving from a pit latrine to biogas can use some of the existing facilities, thus costing less.

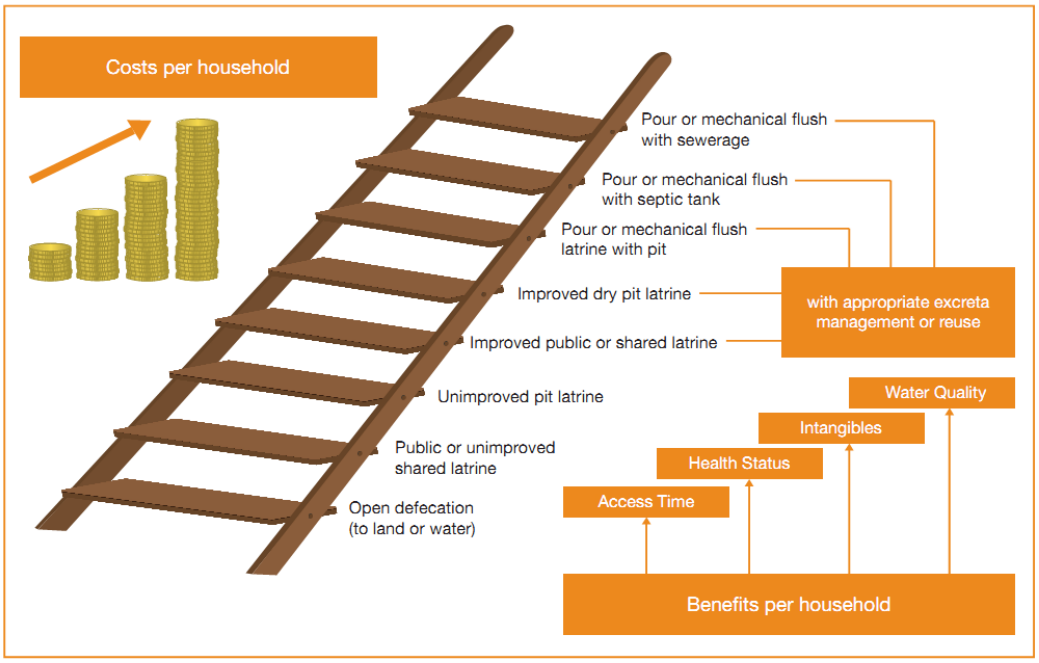

Figure 3: The sanitation "ladder[8]"

Figure 4 describes how the benefits are estimated in monetary terms. There are also intangible benefits that can not be expressed in monetary-terms. These include quality of life, gender impacts, convenience, comfort, privacy, status, security, etc. These should not be underestimated. Even though the greatest benefit for households are saved time and improved health, their greatest motivator may be dignity, comfort and privacy as presented in a study by Jenkins & Sugden, 2006.

However, there is limited research available how these benefits can be monetized, i.e. how they translate into revenues for governments or for households themselves (Tremolet S., 2012).

BENEFIT CATEGORY	POPULATION WITH UNIMPROVED SANITATION	POPULATION WITH IMPROVED SANITATION	BENEFIT ESTIMATED
HEALTH	Data on health risk per person, by age category & socioeconomic status	Generic risk reduction, using international literature	Averted health care costs, reduced productivity loss, reduced deaths
WATER	Data on water source and treatment practices	Observed changes in practices in populations with improved sanitation	Reduced water sourcing and water treatment costs
ACCESS TIME	Data on time to access toilet per person per day	Observed reductions in time to access toilet	Opportunity cost of time applied to time gains
INTANGIBLES	Attitudes and preferences of householders to sanitation	Benefits cited of improved sanitation	Strength of preferences for different sanitation aspects and willingness to pay
REUSE		Practices related to excreta reuse	Value gained, based on sales or own use

Figure 4: Categories and methods to estimate improved sanitation[9]

[8] *Source: WSP-ESI Assessment of Cambodia 2012*

[9] ibid

4.2 Benefit-Cost Ratios in Viet Nam

Viet Nam has experiences rapid growth in the 20 years and in less than a decade lifted around 20 million people out of poverty. According to the WHO/UNICEF Joint Monitoring Programme (JMP), the population of Viet Nam has enjoyed increased access to water sources, from 57 percent in 1990 to 95 percent in 2010, and increased sanitation access from 37 percent in 1990 to 76 percent in 2010 (JMP, 2012) However according to the National Target Programme only 40 percent of the rural population had access to clean domestic water sources in 2010, and only 55 percent of rural families have access to hygienic toilets (WSP ESI, 2012).

Among the various sanitation options, the most favorable economic performance was found for improved wet pit latrines, with a BCR of 8.6. The annual economic rate of return was more than

100 percent, requiring less than one year to recover the economic value of the initial investment costs. Septic tanks with no post-treatment were evaluated in four of the five urban sites, and have a benefit-cost ratio of 3.6. The sanitation options evaluated with improved off-site excreta management had a BCR of 2.7 (sewerage with treatment). These latter two ratios declined to 2.9 and 2.4, respectively, due to non-connection of septic tanks by households in the catchment area, and below optimal performance of the wastewater collection and treatment system. The two major contributors to the economic benefits were reduced mortality and access time savings associated with improved, private latrines. The reuse value of sludge from safe off-site septage management contributed a small proportion of economic benefits (less than 20 percent). The annualized wet pit latrines of 20 USD, with an investment cost averaging 88 USD across the sites, is by far the cheapest option. However, due to space limitations and risk of polluting groundwater and neighborhoods, pit latrines without treatment are not a feasible option in most urban areas of Viet Nam (WSP, ESI, 2011).

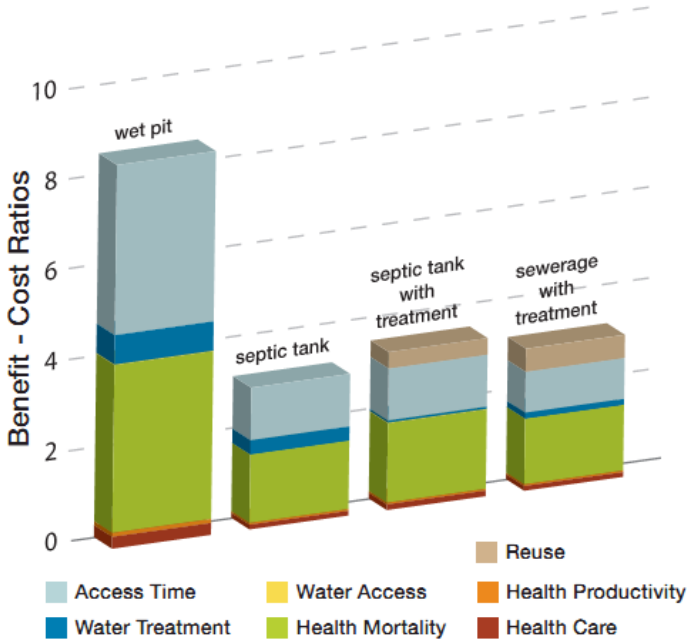

Figure 5: Benefit cost ratios in urban Viet Nam [10]

In rural areas pit latrines give the highest benefit ratio at 8 followed by composting latrines at 6. Biogas digesters and septic tanks are returning a benefit between 3 and 4. Most of the benefit

[10] Graphic source: WSP, Economic Returns of Sanitation Interventions in Viet Nam, 2011.

from the biogas digester is coming from the reuse of waste and wastewater Moreover, a major reason that benefits from other factors are minor is because it does not include having a toilet.

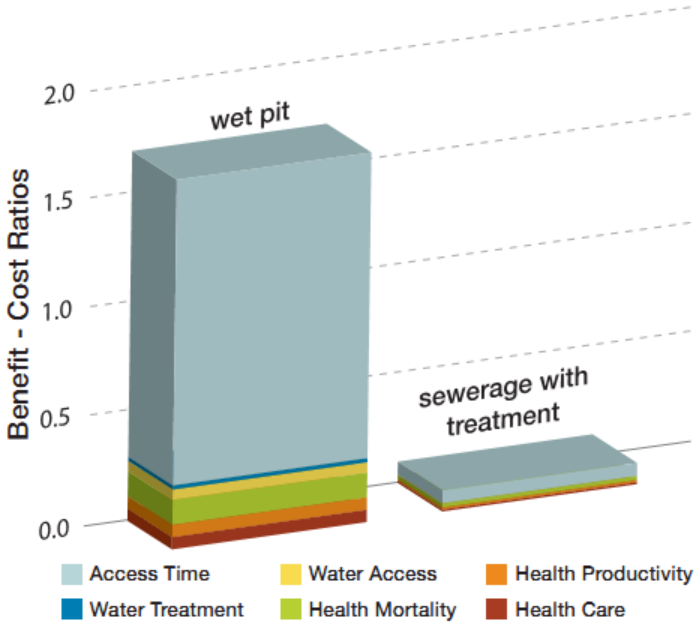

Figure 6: Benefit cost ratios in rural Viet Nam[11]

4.3 Benefit-Cost Ratios in Cambodia

One of Cambodia's MDG's is to provide 30 percent sanitation coverage for the rural population and 74 percent for the urban population by 2015. In rural areas progress has been slow and among of people having proper wastewater treatments systems was approximately 20 percent, with 75 percent still practicing open defecation in 2008. In urban areas the coverage was 81.5 percent by 2008. However, this number reflects access to toilets and not improved wastewater treatment (WSP, ESI, 2012)

Overall, BCRs are very low for interventions in Cambodia compared to other countries in the region. In urban areas, wet pits are giving a BCR of little more than 1.5, and sewerage with treatment from a central plan is returning less than 0.2 on the dollar. There are no other examples of centralised treatment plants in the region with a BCR less than 1, and the Cambodian government will need to review how it is spending its money.

In rural areas the situation is a little bit better. Wet pits are giving a return at between 2 and 3, while dry pits stands at 1.4 to 2. Wet pits are clearly the better option, and a major reason to this is that the life span of dry pits is quite short at about 1 year, while wet pits last for up to 8 years.

[11] *Graphic source: WSP, Economic Returns of Sanitation Interventions in Viet Nam, 2011*

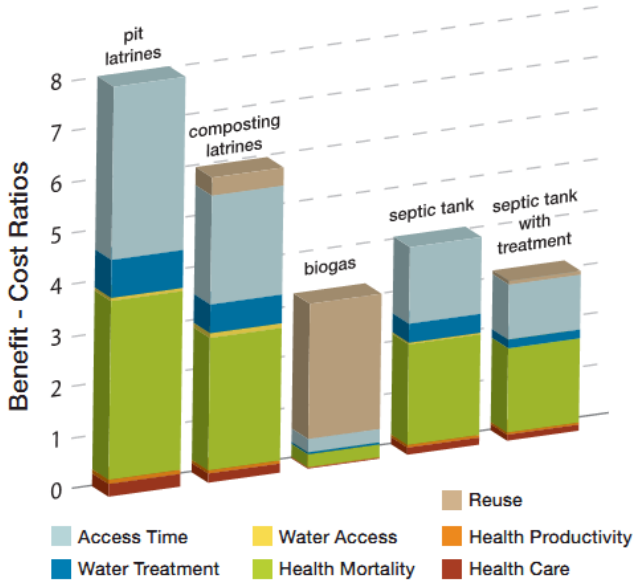

Figure 7: Benefit-cost ratios [12] in urban Cambodia

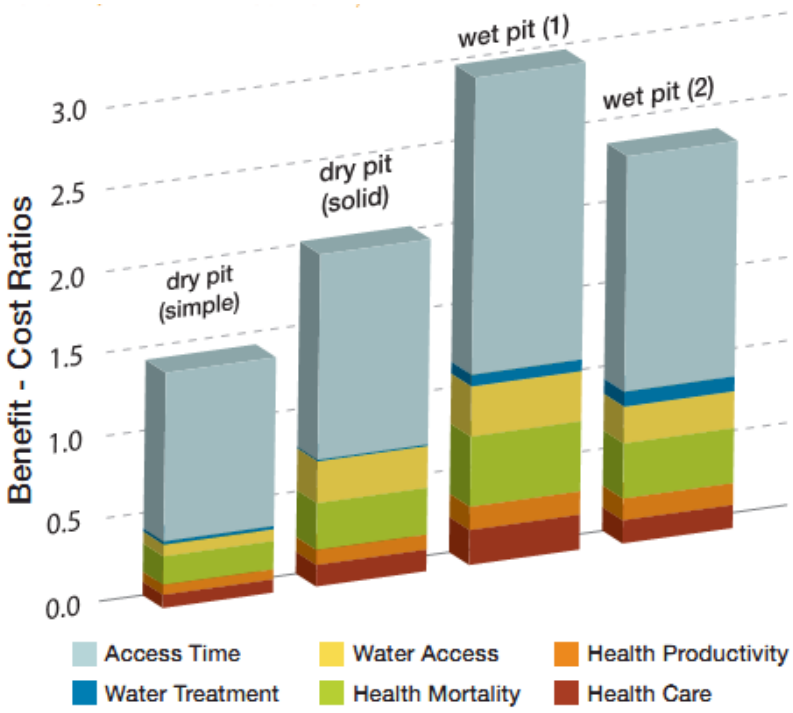

Figure 8: Benefit-cost ratios [13] in rural Cambodia

[12] *Graphic source: WSP, Economic Returns of Sanitation Interventions in Cambodia, 2012*

[13] *Graphic source: WSP, Economic Returns of Sanitation Interventions in Cambodia, 2012*

4.4 Benefit-Cost Ratios in Lao PDR

Lao PDR has made large improvements regarding access to sanitation facilities in recent years. The WHO/UNICEF JMP reports that the proportion of the population with access to improved sanitation increased by 18 percent between 2005 and 2010, from 45 percent to 63 percent, nationwide, exceeding the MDG target of 54 percent access to improved sanitation. However, what the reports also state is that sanitation conditions are worse in rural areas than in urban centres, where only 50 percent of the population having access to improved facilities and about 3 out of 10 people still practicing open defecation (WSP ESI, 2013).

Figure 9 (urban situation) and Figure 10 (rural situation) show the comparison of BCR for wet pit latrines and toilet to septic tank / toilet to sewer for Lao PDR. In urban areas wet pit latrines (shared and private) are given the highest benefit ratios with returns at between 5 and 6 per dollar invested. The return on investment from septic tanks stands around 2, and toilets to sewer at 3. Clearly wet latrines has provided the best return for money, but again this could be because they have provided an improvement from open defecation, while toilets to septic tanks have been an improvement from latrines.

In rural areas, shared wet pit latrines show the highest BCR at 10 followed by private dry and wet pit latrines at around 8 USD return on every dollar spent. The BCRs for toilets to septic tanks are between 3 and 4, which is still very good.

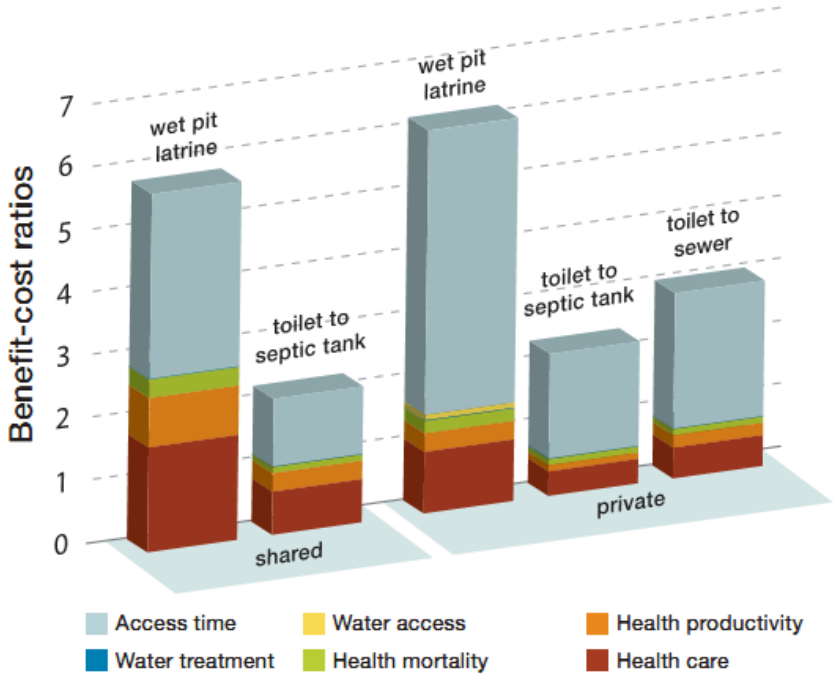

Figure 9: Benefit-cost ratios [14] in urban Lao PDR

[14] *Graphic source: WSP, Economic Returns of Sanitation Interventions in Lao PDR, 2013*

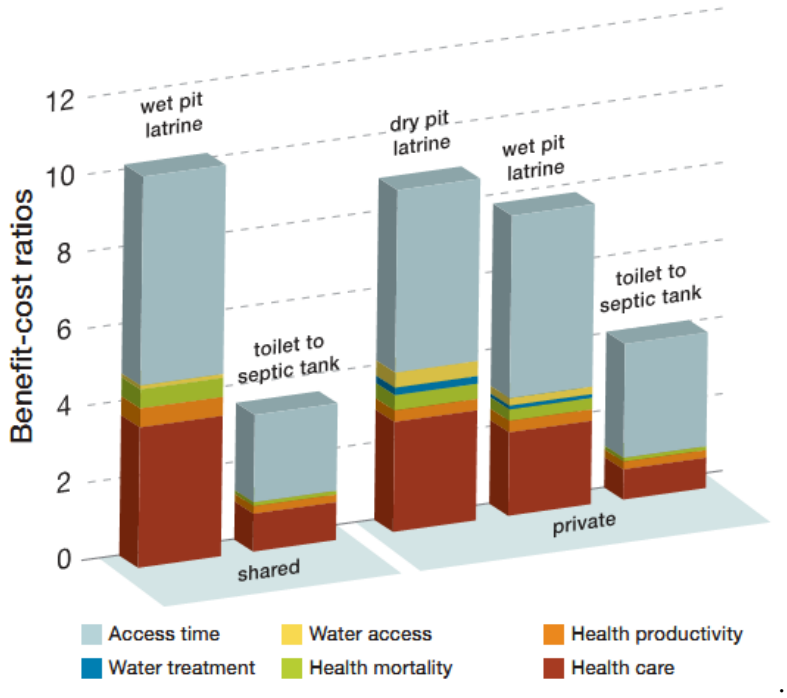

Figure 10: Benefit-cost ratios [15] in rural Lao PDR

4.5 Comparison of Benefit-Cost Ratios between countries in South-East Asia

By comparing BCRs between different countries, governments will get an indication how cost effective their interventions have been compared to others.

The following table shows comparisons of BCRs from urban and rural sites of six countries; Viet Nam, Philippines, Indonesia, Cambodia, Lao PDR, and China (Yunnan). In general, dry and wet pits return the highest benefits on investments. Centralized wastewater treatments systems have a positive return in all countries except for Cambodia, indicating that there is a need for them to review their current strategy.

Table 2: Comparisons of Benefit-Cost Ratios [16] in six countries.

Country	Rural			Urban		
	Dry pit	Wet pit	Septic tank	Wet pit	Sewerage with treatment	Septic tank with treatment
Viet Nam	8.0	N/A	4.0	8.1	3.0	3.8
Philippines	5.0	8.0	2.5	4.8	4.5	4.5
Indonesia	8.1	7.0	4.0	3.3	1.8	1.9
Cambodia	2.0	3.0	N/A	1.7	0.1	N/A
Lao PDR	8.3	10.0	3.8	6.0	N/A	N/A
China, Yunnan	5.8	N/A	3.8	5.0	2.0	2.8

[15] *Graphic source: WSP, Economic Returns of Sanitation Interventions in Lao PDR, 2013*

[16] *Source: Numbers are taken from WSP reports of economic returns of sanitation interventions in each country*

5. Public-Private Partnerships for Wastewater Treatment and Sanitation Services

Public-Private Partnership (PPP) describes a public service funded and operated through the partnership of governments (or institutions) with one or more private sector companies. A successful PPP requires a very detailed contract, inter alia, clear roles, responsibility, ownership, accountability, legitimacy, and expected results. All actors consent to substantial financial, technical, operational and risk obligation described in the contract. A PPP must be profitable and politically feasible when it comes to transboundary governance, with the scope ranging from public service and specific primary sectors, to security items such as food, water, energy and land. (Schäferhoff, Campe & Kaan, 2009)

The following recommendation on including the Private Sector into development financing was given as an outcome of The United Nations Secretary General's High Level Panel on Global Sustainability:

> Governments, international financial institutions and major companies should work together to create incentives for increased investments in sustainable technologies, innovations and infrastructures, including through the adoption of policies and targets that reduce investor uncertainty; the promotion of public-private networks to support research and development; the development of risk guarantee schemes and the provision of risk capital; and seed financing (Recommendation 35).[17]

PPPs are confronted with the general difficulty of building effective collaborations between companies or between business, government, and civil society actors. At the same time, such collaborations are vital to overcoming the market failures, governance gaps, institutional weaknesses, and resource constraints that can undermine efforts to achieve impact and scale in expanding economic opportunity.

In the case of Pro-Poor Public-Private Partnership (5P), this calls for the inclusion of the poor and their livelihood choices into the whole sanitation process. Employment and entrepreneurship are constrained by a wide range of interdependent obstacles, ranging from geographic isolation to market failures, weak institutions, and political exclusion. This suggests that when we think about improving sanitation sustainably, we should think broadly about creating the enabling economic opportunity as a basis. Economic opportunity is not a solution in itself; rather, it is a context in which individuals can create their own solutions. It is a combination of factors that enables the poor to manage their assets in ways that generate incomes and options. Step-By-Step approach on 5P for 3S is proposed in Chapter 5.2 below.

These factors, including assets, productivity tools, markets, and enabling conditions, should be assessed within the individual market segments of sanitation, in order to integrate and include the private sector into the sanitation scheme as much as possible.

5.1 Increasing investment to DEWATS and sanitation services through Public Private Partnerships and efficient coordination at the regional scale

Another recommendation of The United Nations Secretary General's High Level Panel on Global Sustainability is:

[17] Note: Copied from the United Nations Secretary-General High Level Panel on Global Sustainability Report (2012).

> Governments should use public investment to create enabling frameworks that catalyze very substantial additional financing from the private sector, for example, through the provision of infrastructure, risk-sharing, viability gap funding or advance purchase commitments (Recommendation 37).[18]

The major goal in water services sector reform is to promote sustainable service delivery by incrementally moving the burden of infrastructure finance from the public sector to shared investment by public and private sector (WPP, 2012). However, most of the private sector contributions have taken place in water supply rather than in wastewater treatment. The reason for this is simple; it is difficult to earn a return on the investment from wastewater treatment. It has also proven very difficult to finance operations & maintenance (O&M) costs from tariffs. According to an ADB survey covering 27 countries, only 24 percent of O&M costs for water and sanitation are met from tariffs.

There are still positive examples of private investments into wastewater treatment. One of the most successful countries in attracting private funds is China. The World Bank estimates that the private sector has contributed with 20 – 25 percent of investments in wastewater infrastructure in urban areas between 1991 and 2005. Table 3 shows the sources of funding for water supply and wastewater treatment in China.

One of the reasons for the success of China is its integration of water supply and wastewater treatment service bills. Integration of services is essential to achieve efficiency and for high quality of services. It also gives private sector actors a higher leverage over customers to make them pay their bills. With an integrated service, the water supply can be turned off, which is not the case when the bills are separate. For an example, see Case Study 5-on integrated water services in Shenzhen. The positive lesson learnt from this, with regards to building enabling conditions for coordination efficiency is found within the institutional support provide through the coordination among different government agencies responsible for the different sectors of water supply and wastewater treatment services.

Table 3: Financing sources of water supply and wastewater treatment in urban areas of China (Source: World Bank, 2007)

Sources of funding in China	Water	Wastewater
Municipal governments	20-30%	40-50%
Domestic banks	20-30%	10-20%
State bond program	10-20%	20-30%
Private sector	10-20%	10-20%
China Development Bank	10%	5%
International Financial Institutions	5%	10%

[18] Note: Copied from the United Nations Secretary-General High Level Panel on Global Sustainability Report (2012).

As mentioned earlier, private investors prefer to work in middle-income countries, where the risk is lower, which means it will take time before the least developed countries (LDC) can expect any major investments with the sanitation sector. However, governments can improve the investment environment and conditions to accelerate the private sector understanding the opportunities (versus risks) in joining with governments to provide water and sanitation services, particularly to the poor.

In summary, regular meetings of the technical working groups represented by all ministries in partnership with experts and the private sector, defined by the agreements, contracts, memorandums and Terms of Reference, would ensure better understanding of the issues and adequate planning.

5.2 Step-by-step guide for organizing a successful PPP framework for 3S

Pro-poor element of Public Private Partnership (5P) could be only ensured by the Government as well as the donors/philanthropists and development agencies. The five step approach is necessary in order to ensure 5P for 3S implementation process. Development of business cases on 3S, based on studies of market opportunities and diversification of revenue income, would provide a strategic area of intervention that can ensure a positive return of investment from state and private sector sources in the long run. The role of Government,, as the leading actor in these partnerships, specifically involves providing stability, financing credibility, and upholding laws.

The role of Service Providers, who could be selected from the social entrepreneur community, is also important, as they can serve disparate colonies of households and small industries (ref Figures 11 and 12), as well as be regularly trained, subsidized and empowered. Moreover, they can be oriented to develop innovative partnerships that provide increased access to financial capital, and ensure its return to the state budget in the future (both direct and indirect forms).

To guarantee the sustainability of the sanitation system, relevant policies, technologies and financial schemes will be widely discussed in local and regional meetings and consultations through participatory approach. After the discussion on the most efficient framework and engagement of relevant stakeholders, a partnership agreement will be signed by all involved to ensure the construction of the wastewater treatment and sludge handling system, and formalise the role of each actor. Below is a summary of detailed 5-step approach recommended for this process.

Step 1: Development of a National Programme (NP) to implement the strategy on 3S in the LDCs in a participatory process, including:

a. Assessment of policies and partners;
b. Inventory of technical facilities and infrastructure;
c. Target setting;
d. Stakeholder analysis and research;
e. Engagement of potential PPP investors to the market opportunities.

Step 2: Ensure Government commitment towards enabling policy on PPP for 3S:

a. Financial commitment in the form of budget allocation (e.g. in the form of Trust Fund) to be enabled as part of the National Programme (NP, based on vision and strategy);
b. Political commitment in the form of the policy, regulation and subsidy;
c. Selection of the financial scenario, using multi-philanthropic platform and inputs to the NP;

Step 3: Outreach/Negotiate with the philanthropists and convince in the need to create the PPP environment for encouraging SMEs and empowering communities, using the service and value chain in sanitation towards water security.

Step 4: Encouragement of SMEs and Private Sector to act as **Service Providers** and to follow one of the below proposed financial mechanisms, where Government input is ensured, for example through the financial contribution ratio: 30 percent (Govt, in-kind, cash): 60 percent (Philanthropist, cash):10 percent (RoI) that would be gradually changed into 30:40:30 percent..

Step 5: Develop the detailed tripartite (multi-stakeholder, multi-philanthropists) MoUs, Contracts, Agreements for PPP, accompanied by continuous:

- Assessment of the implementation of the Government strategy along with capacity building (workshops and study tours)
- Establishing of Political Framework to encourage and support DEWATS suppliers
- Research and assessment of potential PPP investors
- Training on O&M
- Coordination of PPP implementation, joint ventures or joint investment

6. Financial models and schemes for Decentralized Wastewater Management

Figure 11 below presents a suggested example framework for the development and financial management of sustainable sanitation services (3S). The framework is based on multi stakeholder or public-private-partnership (PPP) approaches, involving the government, private sector, donors and local communities. The role of the government is d to set enabling policies, manage the overall coordination, and ensure that regulatory frameworks are followed. The private sector should be engaged in early planning, for example, as service providers at a scale, in particular in construction and operation & maintenance of the DEWATS Facility. Donors and partners can cooperate with the government by providing seed funding and technical support through PPP agreements, following schemes of ratio of financing, like 1:1:1, conditioned to development objectives and operationalised through national programmes and revolving earmarked funds.

For example, one of the regional sources could be the support coming from the Sanitation Financing Partnership Trust Fund, which has been set up already in 2014, in a partnership between ADB and the Bill & Melinda Gates Foundation. The SFPTF aims to support identification, testing and pilot implementation of innovative sanitation solutions – new policies, business models, and technologies – to increase support for non-networked sanitation[19][20]. ADB is administering the fund under its Water Financing Partnership.

Different client and the market segments are elaborated as proposed in Chapters 6.2 and 6.3 (Ref Figure 13,14).

[19] Owens, D. 2010. "Wastewater treatment spending needs, 2010-29". http://www.oecd.org/env/resources/44863928.pdf)

[20] Source: http://www.adb.org/site/funds/funds/sanitation-financing-partnership-trust-fund-under-the-water-financing-partnership-facility

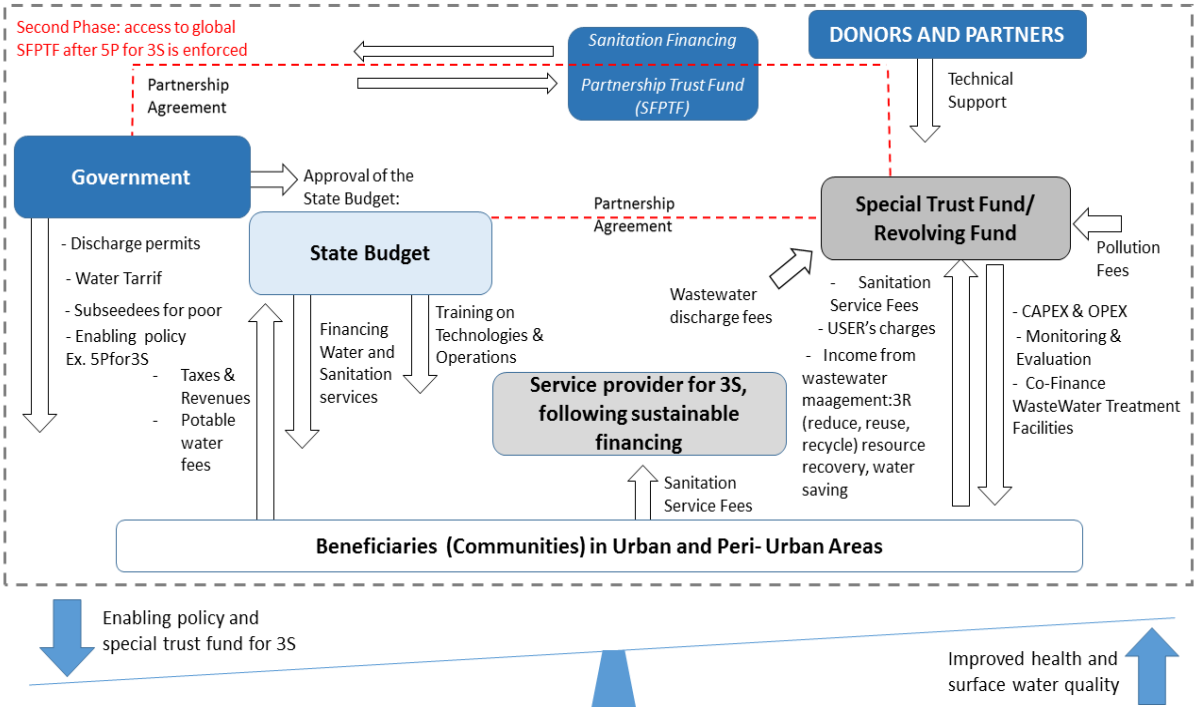

Figure 11: Regional Framework for Financing Sustainable Sanitation Services

6.1 Different Client and the Market Segments

The client market for wastewater treatment can be divided into segments by the sources of the wastewater. Figure 12 shows a list of different segments.

Industry	•Manufacturing facilities for foods, textiles, and other consumer goods •Industrial estates
Public Institutions	•Schools, colleges, dormitories •Hospitals, clinics, and healthcare centers •Other institutional buildings, offices, and related structures
Small and Medium-Sized Enterprises	•Hospitality businesses, such as restaurants, hotels, and resorts •Agricultural enterprises, including slaughterhouses and livestock raising
Households	•Single family homes •Multifamily dwellings, such as apartments or condominium buildings •Residential or commercial subdivisions

Figure 12: Different client segments for DEWATS

Every market segment has its own distinct characteristics and differences, and policy needs to be shaped accordingly. The three factors to take into consideration are 1) pollution level, 2) ability or willingness to pay, and 3) method of payment to recover cost (tariffs, taxes, etc.).

For instance, industry is releasing more heavily polluted water (also called black water) than other segments, and consequently they should pay for this damage. SMEs have a higher ability to pay than, for instance households. Households in poor areas have the least ability to pay and need to be subsidized. Considering these differences, it makes sense to apply different financing frameworks and schemes to different segments.

Methods of payment include mainly taxes and tariff. For industry, enforcement of green taxes to compensate for the pollution caused should be considered. For households, taxes would be part of income taxes paid. Considering the difficulties to cover O&M costs through tariffs it is not reasonable to expect that taxes can be excluded.

Tariffs can have different structures. It can be a flat fee. A water meter may not always to be available to measure the volume of water. It can be a volumetric tariff based on consumption level for a specified period. For a pro-poor solution volumetric tariff should increase with consumption. This will also encourage water conservation.

As discussed earlier, combining the tariff of wastewater and water supply is a good option because it increases the leverage that service providers have over customers, i.e. water supply can be turned off for non-paying customers. Even though this may be difficult to implement for existing residences, it should be possible to require this for new residential areas through legislation. See case study 10.1 of Part 2 of Policy Guidance Manual [21]of an example of legislation in San Fernando, Philippines.

Below are proposed financial frameworks for Industry & SMEs and Households

6.2 Financial framework with industry & SMEs as a drivers of DEWATS and 3S

Development of wastewater treatment for industry and other businesses needs to be driven by regulations and their enforcement. Campaigns to stimulate demand and highlight benefits are unlikely to work alone, as the costs for polluting the environment are mainly external costs, i.e. the negative effects are imposed on third parties and not themselves.

A guiding principle for industry and SMEs should be to try and avoid subsidies. In contrast to households, large industries have enough resources to pay for full cost recovery, and more incentives are needed to encourage water conservation and release less polluted water. One way to achieve this is through environmental taxes or green taxes.

In the "Low Carbon Growth Roadmap for Asia and the Pacific" of ESCAP, the green tax and budget reform towards environmental taxes (within the green growth framework) is proposed. Basically it refers to fiscal measures that have a potential to simultaneously increase revenue and foster green growth, such as: 1) shifting the tax burden from traditional areas of taxation, such as income, savings and capital gains, to products and activities with harmful impact on the environment, such as fossil fuels and waste, and 2) redirection of subsidies from environmentally harmful activities towards activities that promote green growth and poverty reduction.

[21] ESCAP, UN-Habitat, AIT. (2015). Policy Guidance Manual on Wastewater Management and Sanitation with a Special Emphasis on Decentralised Wastewater Treatment Systems in South-East Asia, Part 2: Case Studies.

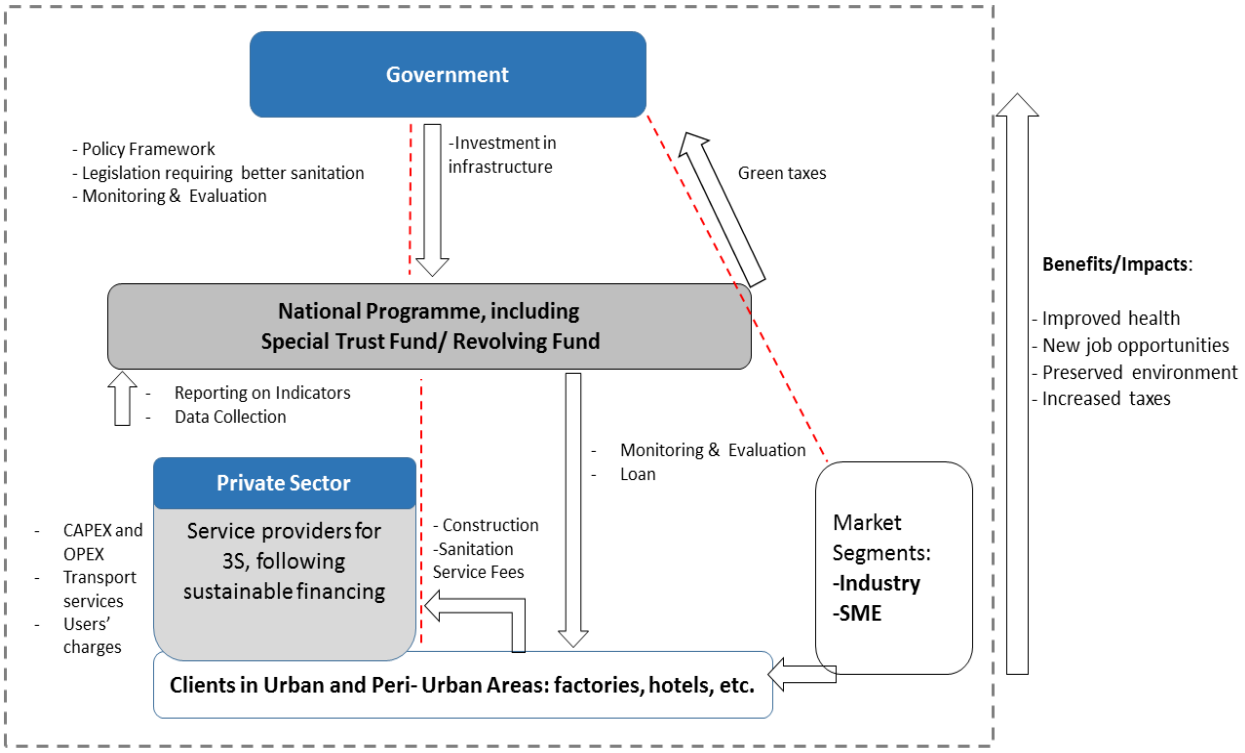

Figure 13: Financial scheme of wastewater treatment for industry and businesses

6.3 Financial framework with households as a driver for DEWATS and 3S

In contrast to industry, wastewater treatment for households is preferably driven by stimulation of demand. As mentioned earlier, no OECD country has managed to fund its sanitation infrastructure from private funds (ESCAP, 2013) and this is unlikely to be possible for developing countries with even scarcer resources. The basic idea behind stimulating the demand is to adopt financing schemes to maximise leverage ratios, i.e. maximize the ratio of privately invested funds versus public funds (Trémolet, S., 2012). It will also give households a greater sense of ownership, which will reduce the risk of building sanitation facilities that will not be used.

In this framework a National Programme (NP) should be set up to coordinate activities, ensure that responsibilities are in one location, and manage a special trust fund. Some of its activities and responsibilities would include:

- Marketing of DEWATS to stimulate demand
- Develop targeted subsidies and micro credit schemes
- Develop partnerships with MFIs, service providers and NGOs
- Attract funding from donors to boost the special trust fund
- Dispersal of funds to selected projects
- Nurturing of the private sector for constructing and installing septic tanks to ensure reliable supply
- Explore private investment opportunities
- Monitoring and evaluation of ongoing and completed projects

In the ideal case, requests for better sanitation services should come from the community; requests that can be picked up by NGOs or other private service providers and translated into proposals to the National Programme.

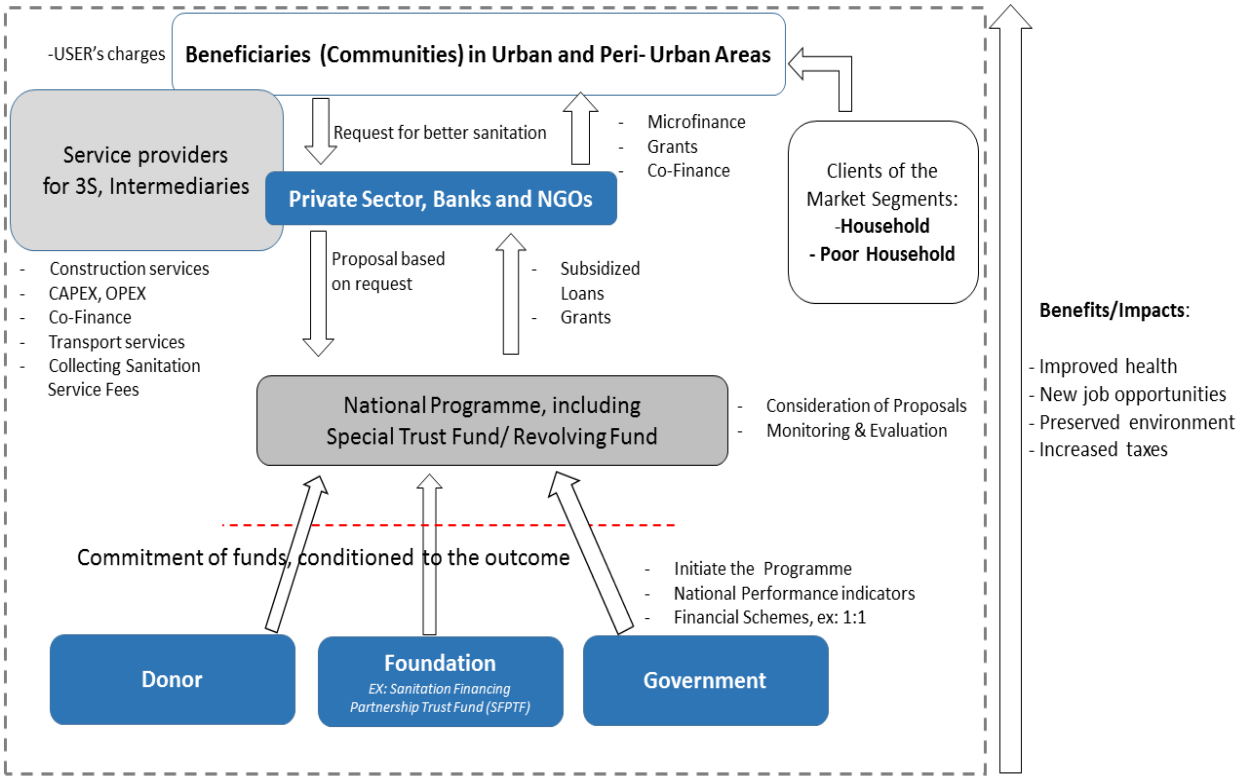

Figure 14: Financial scheme of wastewater treatment for households

7. Conclusion and Recommendations

This Analytical Report suggests that governments will have to invest in wastewater treatment without expectation of a return on investment in direct monetary terms. However, the CBA carried out by the World Bank suggest that returns can be as high as 10 USD per 1 USD of investment, when including factors such as time savings to access water and toilets, lower spending on health care, and higher productivity due to less sick leave. Of course, these benefits will broaden the tax base on a longer term, and the returns trickling back to governments will be larger than the ones that can be collected from tariffs alone.

Private Sector investments

Investments from the private sector have mainly taken place in middle-income countries where the perceived risk of doing business is lower than in LDCs. Even though LDCs receive donor money that is partly making up for this shortfall, donor money is commonly earmarked for the poor in rural areas. This means that urban and peri-urban areas are responsibility for governments to manage and fund.

The private sector has an important role to play in the construction of DEWATS and in collection and transportation of waste as well. But this role mainly comes in the form of delivering sustainable services rather than in investing its own capital.

Cost Recovery from reuse

Reuse of wastewater has a potential to recover at least part of investment costs, though more research is needed. Due to high transportation cost, most successful examples have taken place in areas with close proximity to industrial zones and large farms, where the large scale and volume of waste can be taken advantage of.

Recommendations

Designing legislation that can be enforced: Enforcement of laws is a difficult problem to overcome; especially in countries where the rule of law is weak. Businesses often ignore to cooperate if new regulations impose increased costs to their business operations. Focusing legislation on new development projects, governments can use their authority to withhold necessary licenses and permits as a leverage to ensure that laws and regulations are followed.

Demand studies prior to designing an intervention: governments should carry out demand studies so as to better understand what encourages or discourages households to invest, before designing interventions. There are many examples where large budgets have been spent on sanitation systems only to be left unused after a few years. In combination with cost benefit analysis of past interventions, the most suitable options can be selected.

Encourage behavior change to increase demand: The low demand for improved sanitation is a major issue to overcome. People who spent their life without improved sanitation often don't see the need to make large investments into something they managed without in the past. Changing people's behavior can be very difficult. Focusing interventions on schools can be an effective solution, where the school children will act as "agent of change". The school children will in turn ask for improved sanitation at home as well. This will ensure that demand will increase with time.

Develop scalable solutions: No solution will be successful if it is not scalable. For a solution to be scalable, communities/clients have to pay as high a share of the cost as possible, to minimize subsidies ensuring that public funds will last as long as possible. A good financing scheme will aim to have a high leverage ratio (i.e. ratio of privately invested funds compared to public funds). Much good work is carried out by NGOs for wastewater treatment, but to achieve universal coverage of sanitation a charity model will not work.

References

Asian Development Bank. 2009. Asian Sanitation Data Book 2008. Achieving Sanitation for All. ADB, CityNet, UNHABITAT, Veolia Environment.

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

Camdessus M. 2003. Financing Water for All: report of the World Panel on Financing Water Infrastructure. World Water Council, Global Water Partnership.

Chokewinyoo, P. and Khanayai, P. March 2013. Wastewater Production, Treatment, and Use in Thailand, 5th Regional Workshop on Safe Use of Wastewater in Agriculture Bali, Indonesia.

Perard, E. 2012. Private sector participation in water infrastructure: review of the last 20 years and the way forward. A deliverable from the PPI Database to IFC.

Trémolet, Sophie. 2011. Identifying the Potential for Results-Based Financing for Sanitation. Washington D.C., Water and Sanitation Program.

ESCAP. 2013. Development Financing for Tangible Results: a Paradigm Shift to Impact Investing and Outcome Models: The Case of Sanitation in Asia, Discussion Paper.

ESCAP. 2012. Low Carbon Green Growth Roadmap for Asia and the Pacific.

Jenkins, M., & Sugden, S. 2006. Rethinking Sanitation: Lessons and Innovation for Sustainability and Success in the New Millennium. Occasional Paper.

Joint Monitoring Programme. 2012. Estimates for the use of improved sanitation facilities in Viet Nam. World Health Organization, UNICEF. www.wssinfo.org

OECD. 2010. Wastewater treatment spending needs, 2010-29. Availableat http://www.oecd.org/env/resources/44863928.pdf.

Schäferhoff, Campe & Kaan, 2009

Trémolet, Sophie. December 2012. Sanitation Markets, Using economics to improve the delivery of services along the sanitation value chain. Pathfinder.

Water Partnership Program (WPP). 2012. Investing in Water Infrastructure: Capital, Operations and Maintenance.

Water and Sanitation Program (WSP). March 2012. Economic Assessment of Sanitation Interventions in Cambodia.

Water and Sanitation Program (WSP). August 2011. Economic Returns of Sanitation Interventions in Cambodia.

Water and Sanitation Program (WSP). August 2013. Economic Assessment of Sanitation Interventions in Lao People's Democratic Republic.

Water and Sanitation Program (WSP). June 2013. Economic Returns of Sanitation Interventions in Lao People's Democratic Republic.

Water and Sanitation Program (WSP). May 2012. Economic Assessment of Sanitation Interventions in Viet Nam, May 2012.

Water and Sanitation Program (WSP). August 2011. Economic Returns of Sanitation Interventions in Viet Nam.

Water and Sanitation Program (WSP). February 2005. *Private Sector Sanitation Delivery in Viet Nam: Harnessing Market Power for Rural Sanitation*.

World Bank. 2007. Stepping up - Improving the Performance of China's Urban Water Utilities.

Hutton G., and others. 2012. Economic Assessment of Sanitation Interventions in Southeast Asia. Washington DC. World Bank, Water and Sanitation Program.

World Health Organization. 2002. Unsafe Water, Sanitation and Hygiene. Comparative Quantification of Health Risks, Vol 6, Chapter 16.The Water Dialogues. Indonesia Contextual Analysis in Water Supply and Sanitation Sector. Available at http://www.waterdialogues.org/documents/8.6ContextualAnalysis.pdf

Ministry of Rural Development (Cambodia). 2010. Rural Water Supply, Sanitation and Hygiene Strategy 2010-2025.

Water and Sanitation Program. 2007. Supply Chains Assessment for Sanitary Latrines in Rural and peri-Urban Areas of Cambodia.

Nguyen Hong Tien. 2011. Legal Framework for Urban Sewage and Drainage in Viet Nam. Vung Tau.

Homchean, Kasimir. Fourth international Conference on Environmental Compliance and Enforcement, Thailand's Environmental Enforcement Program.

Suthirat, Kittipongvises. Legal framework for DEWATS and FSM sewage sludge management in case study countries.

Wijarn, Simachaya. 2009. Wastewater Tariffs in Thailand. Ocean & Coastal Management 52. page 378-382.

Water and Sanitation Program. 2009. Urban Sanitation in Indonesia: Planning for Progress.

Appendix 1: Case Studies and Good Practices

Below is a list of case studies with examples of best practices on wastewater management in the region compiled within Part 2 of the Policy Guidance Manual on Wastewater Management and Sanitation with a Special Emphasis on Decentralised Wastewater Treatment Systems in South-East Asia (ESCAP, UN-Habitat, AIT. 2015)

Case Study 10.1: Example of Legislation in San Fernando[22], Philippines

Case Study 6.2: Centralized Wastewater Treatment Plant in Sihanoukville[23], Cambodia

Case Study 8.7: Tariff Scheme in Phuket[24], Thailand

Case Study 6.3: Water aid in Nepal - Ecological sanitation (EcoSan)[25]

Case Study 7.3: Integrated Water Management Policy in Shenzhen[26], China

Case Study 7.4: Alternative Approaches to Stimulate Demand for Sanitation in India[27]

Case Study 8.8: Helioz - WADI Financing schemes[28]

Case Study 6.4: Drinking water through bio-sand filtration at household-level in Pakistan

Case Study 7.5. Platform for climate change advocacy

Case Study 10. Enable Impact and Unreasonable Institute

Case Study 7.6: Policy Framework on Measures to Stimulate Demand for DEWATS and Sanitation Services

Case Study 3.4: A Sanitation Model for Decentralized Local Governments

---

[22] Source: San Fernando City. (2010). Section 16LXVI.01. City Ordinance No. 2010-014 of San Fernando City, La Union Philippines.

[23] Source: National Workshop Pnomh Penh; Rathpiseth, Hengh (2014): A Presentation on Sewerage and Wastewater Management in Cambodia

[24] Source: http://www.phuketgazette.net/phuket-news/Patong-residents-pay-wastewater/10792

[25] Source:http://webcache.googleusercontent.com/search?q=cache:nvquGWVImyIJ:www.wateraid.org/~/media/Publications/ecological-sanitation-latrines-nepal.pdf+&cd=1&hl=de&ct=clnk&gl=th

[26] *Source: Every Drop Count, Learning from good practices in eight Asian cities, Asian Development Bank, 2010*

[27] *Source: (WSP, 2010a)*

[28] Source: *https://www.indiegogo.com/projects/helioz-wadi-a-new-inexpensive-and-sustainable-solar-water-disinfection-tool#home*

Appendix 2: List of Impact Investors and Potential Source of Funding for 3S

Table 4 presents the list of different impact investors and their potential source for funding for 3S activities.

Table 4 : Summary of different impact investors and their primary goals

High-net-worth individuals	Development finance institutions	Foundations	Values-and-faith-based organizations	Retail investors	Corporations	Public institutional investors/ sovereign funds
Primary goal						
Applications of business principles to philanthropy	Achieve both financial and developmental results	High social impact with the discipline of an investment	Consistent with social values	Social impact - donations	Corporate social responsibility programs	Deployment of set percentage of capital in socially responsible manner
Risk/return						
Moderate to high risk; willing to take more risk for social impact, but expecting a return	Moderate risk; need to preserve institutional stability, but often "funding of last resort"	Moderate to high risk; sometimes can forgo return for social impact	Low risk; may be willing to trade off return for social impact, but seeking safe investments	Low risk, because by law, vehicles available to retail investors cannot be too risky	Moderate to low risk; not willing to take inordinate risks outside core business	To be determined (still not clarified)
Examples						
Bob Johnson, John McCall MacBain, George Soros	OPIC (USA), IFC (World Bank Group), FMO (Netherlands), Proparco, DEG (Germany)	Rockefeller, Kellogg, Gates, Skoll, Omidyar, Google	TIAA-CREF, Thrivent, MMA Praxis Mutual Funds, GuideStone, Amana, Saddleback	Donors to Calvert Community Investment Notes, Microplace, Kiva	Cisco, Storebrand, Shell, Chevron, Starbucks	CalPERS, Government Pension Fund of Norway, Abu Dhabi Investment Authority

Notes: (i) Compiled by authors from information from Total Impact Advisors.
(ii) OPIC: Overseas Private Investment Corporation; DEG: German Investment Corporation; FMO: Netherlands Development Bank; IFC: International Finance Corporation; TIAA–CREF: Teachers Insurance and Annuity Association – College Retirement Equities Fund.

Potential source of funding from DAC member States: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom, United States

Potential source of funding from non-DAC States: Brazil, China, Taiwan, China, India, Indonesia, Iran, Israel, Kuwait, Libya, Lichtenstein, Malaysia, Pakistan, Russian Federation, Saudi Arabia, Singapore, South Africa, Thailand, United Arab Emirates, Republica Bolivariana de Venezuela

Potential source of funding from various donor sources:

Development Finance Institutions: OPIC (USA), IFC (World Bank Group), FMO (Netherlands), Proparco, DEG (Germany)

Foundations: Rockefeller, Kellog, Gates, Skoll, Omidyar, Google

Values- and Faith-Based Organizations: TIAA-CREF, Thrivent, MMA Praxis Mutual Funds, GuideStone, Amana, Saddleback

Retail Investors: Donors to Calvert Community Investment notes, Microplace, Kiva

Corporations: Cisco, Storebrand, Shell, Chevron, Starbucks

Public Institutional Investors/Sovereign Funds: CalPERS, Government Pension Fund Norway, Abu Dhabi Investment Authority

Appendix 3: List of Technologies

Approaches and technologies for wastewater treatment as well as its advantages and disadvantages are given in Table 5.

Table 5: List of alternative wastewater treatment technologies (source: BORDA)

type	kind of treatment	used for type of wastewater	advantages	disadvantages
horizontal gravel filter	aerobic-facultative-anaerobic degradation of dissolved and fine suspended solids, pathogen removal	suitable for domestic and weak industrial wastewater where settleable solids and most suspended solids already removed by pre-treatment	high treatment efficiency when properly constructed, pleasant landscaping possible, no wastewater above ground, can be cheap in construction if filter material is available at site, no nuisance of odour	high permanent space requirement, costly if right quality of gravel is not available, great knowledge and care required during construction, intensive maintenance and supervision during first 1 - 2 years
anaerobic pond	sedimentation, anaerobic degradation and sludge stabilisation	strong and medium industrial wastewater	simple in construction, flexible in respect to degree of treatment, little maintenance	wastewater pond occupies open land, there is always some odour, can even be stinky, mosquitoes are difficult to control
aerobic pond	aerobic degradation, pathogen removal	weak, mostly pre-treated wastewater from domestic and industrial sources	simple in construction, reliable in performance if proper dimensioned, high pathogen removal rate, can be used to create an almost natural environment, fish farming possible when large in size and low loaded	large permanent space requirement, mosquitoes and odour can become a nuisance if undersized, algae can raise effluent BOD

type	kind of treatment	used for type of wastewater	advantages	disadvantages
septic tank	sedimentation, sludge stabilisation	wastewater of settleable solids, especially domestic	simple, durable, little space because of being underground	low treatment efficiency, effluent not odourless
Imhoff tank	sedimentation, sludge stabilisation	wastewater of settleable solids, especially domestic	durable, little space because of being underground, odourless effluent	less simple than septic tank, needs very regular desludging
anaerobic filter	anaerobic degradation of suspended and dissolved solids	pre-settled domestic and industrial wastewater of narrow COD/BOD ratio	simple and fairly durable if well constructed and wastewater has been properly pre-treated, high treatment efficiency, little permanent space required because of being underground	costly in construction because of special filter material, blockage of filter possible, effluent smells slightly despite high treatment efficiency
baffled septic tank	anaerobic degradation of suspended and dissolved solids	pre-settled domestic and industrial wastewater of narrow COD/BOD ratio, suitable for strong industrial wastewater	simple and durable, high treatment efficiency, little permanent space required because of being underground, hardly any blockage, relatively cheap compared to anaerobic filter	requires larger space for construction, less efficient with weak wastewater, longer start-up phase than anaerobic filter