

URBAN DOMESTIC WASTEWATER MANAGEMENT IN VIETNAM - CHALLENGES AND OPPORTUNITIES

1. Introduction

Vietnam is going through a crucial period of urbanisation and the Government of Vietnam has placed strong emphasis on sustainable urban development. As of September 2013, Vietnam had 765 urban areas classified into six categories, one of which is comprised of two special urban areas (Hanoi and Ho Chi Minh City), the remaining being categories I, II, III, IV and V. The number of urban areas is expected to rise to 1,000 by 2025 with a total estimated urban population of 52 million (Tien, 2013). The urban classification system, established in 2001 and updated in 2009 with the inception of Decree No. 42/2009/ND-CP, serves as an important tool in urban policy and management in Vietnam. The grading of urban areas depends on the level of economic activity, physical development, population, population density and infrastructure provision. The Government of Vietnam has been focusing on developing technical infrastructure systems, particularly in relation to water supply, drainage and sewerage systems, as well as urban wastewater treatment both to meet the growing needs of the population and achieve its sustainable urban development target as well as the sector's targets as set in the "Orientations for sewerage and drainage development in urban centers and industrial zones up to 2025 and a vision for 2050". Along with economic growth and urbanisation, urban population is growing constantly. In 2013, Vietnam's total population was about 90 million people, of which urban population accounted for approximately 32.9%. According to the Vietnam Population and Housing Census 2009, on average, the annual urban population growth rate was 3.4% in the period from 1999-2009. This has led to huge pressures on the urban environment, particularly on infrastructure systems such as sewerage and drainage systems, which are

outdated and cannot keep up with the pace of growth.

In Vietnam, most of the urban areas in category IV or higher have combined sewerage and drainage systems, which collect both rainwater and wastewater via pipeline collection networks or drainage canals. According to the water sector review report (ADB, 2009), the average drainage coverage in Vietnam is about 40–50 %, which is much lower than water supply service of over 70 %. The coverage rate ranges from 70% in large urban areas to only 10–20% in category IV. However, most of the domestic wastewater in urban areas is not centrally treated but only treated by household's septic tank and discharged directly into the environment, such as rivers, lakes, streams. Only a few big cities like Hanoi, Ho Chi Minh City, Da Nang, Quang Ninh, Da Lat and Buon Ma Thuat have centralised wastewater treatment plants.

Similarly to the wastewater situation, septage, which is often defined as "liquid and solid material pumped from a septic tank, cesspool or other primary treatment source" (Tilley, 2008), has not been treated properly before being discharged into environment. In large provinces or cities, it is often collected by the province or city-owned companies or private companies based on requests from households. In theory, this sludge should be transported to landfills or septage treatment facilities for final disposal, but in reality is often illegally dumped into vacant land, canals or ponds or even discharged directly into the rivers and ponds near sludge emptying points.

In recent years, thanks to the government's appropriate attention, as well as financial and technical supports from international donor agencies such as the Japan International

Cooperation Agency (JICA), the World Bank (WB) and the Asian Development Bank (ADB), management of urban wastewater in Vietnam has been improved significantly. However, if compared to many other countries in the region, the proportion of urban wastewater treated in Vietnam is still relatively low, which has led to serious pollution of lakes and rivers. The World Bank's estimate for the total economic damage caused by poor sanitation in Vietnam is 780 million USD per year (based on 2005 prices), equivalent to 1.3% of gross domestic product (GDP) (WSP, 2008).

This policy brief aims to review the current status of urban wastewater and septage management in Vietnam to identify major challenges and barriers, as well as factors that play a key role in improving and enhancing the performance of the wastewater sector. Based on this information, appropriate policies will be recommended to assist policymakers in making decisions toward improving the current status of urban wastewater and septage management in Vietnam.

2. Urban sanitation development in Vietnam

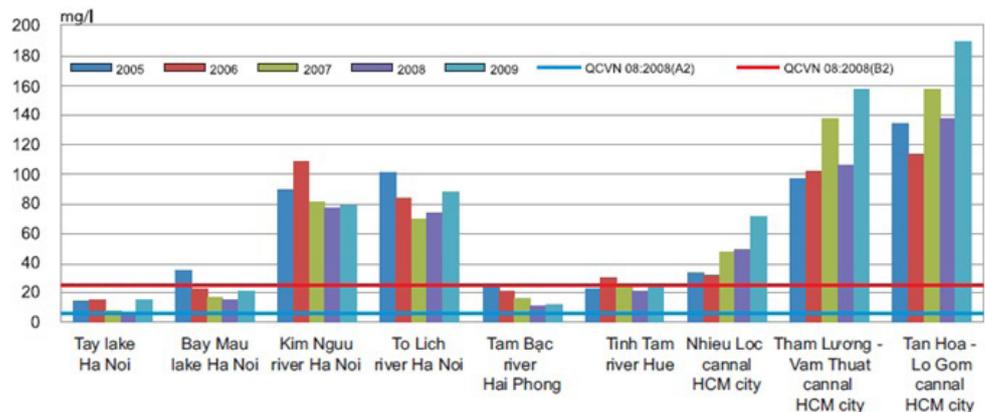
a. Demographic, socio-economic and environmental conditions

Vietnam has achieved noteworthy progress in economic development since its successful transition from a centrally planned economy to a market economy. Total domestic product (GDP) grew on average 7.5% per year over 2000–2009. GDP per capita increased from 700 USD in 2005 to 1,749 USD in 2012, primarily generated in urban areas (VGP, 2013). Along with this rapid pace of economic growth and urbanisation,

the proportion of urban population has increased dramatically over recent years.

The process of rapid urbanization and population growth has created huge pressures on infrastructure systems which were built decades ago, especially urban drainage and sewerage systems. Results of water quality monitoring of major canals, lakes and rivers in Vietnam showed that concentrations of organic pollutants are 1.5 to 3 times, or even 10-20 times higher than the permitted standard in some areas (VEA, 2010) (Fig. 1). This situation has existed for many years, and has led to serious consequences for local populations and their immediate environment.

Figure 1



BOD5 loads in major selected canals, lakes and rivers in Vietnam (2005–2009)

Source: VEA, 2010

Note:

QCVN 08:2008 – National regulation on surface water quality

QCVN 08:2008 (A2)- Applied for surface water source, which is able to use for domestic supply after appropriate treatment

QCVN 08:2008 (B2)- Applied for waterway transport and other purposes with low requirements of water quality.

b. Major challenges and constraints in domestic wastewater and septage management

i. Current status of urban wastewater management

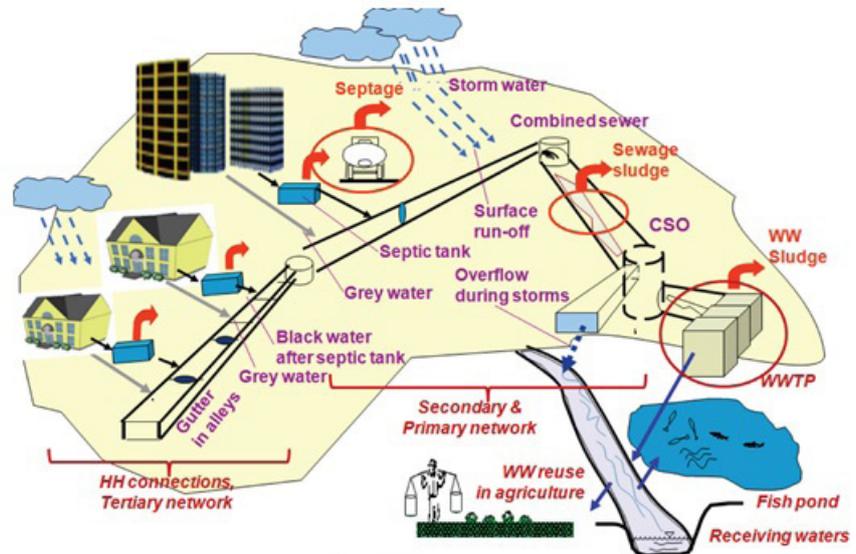
Most drainage and sewerage systems in large cities of Vietnam were constructed over three decades ago and more than 90% of wastewater is conveyed by use of combined sewer systems, primarily serving as storm-water drainage, and “taking away” domestic wastewater to prevent flooding in the streets. Some newly developed urban areas introduce separate sewer and drainage systems; however, as most urban wastewater is untreated, thus both storm-water and domestic wastewater are finally discharged together into nearby water environments such as rivers, lakes and canals. Meanwhile, service coverage of sewerage and wastewater treatment is still rather low compared to the drinking water supply service coverage. The coverage of sewer networks average just 40–50%, with 70% in large urban areas and only 1–2% in category V urban areas (JICA, 2011).

These sewerage systems are normally managed by province or city-owned companies (sometimes also referred to as “state-owned companies”). According to Nguyen Hong Tien, Director of the Technical Infrastructure Department under the Ministry

of Construction, the total capacity of 24 existing centralised wastewater treatment plants is about 670,000 m³/day (Tien, 2013). According to the recent estimation from World Bank, only 10 percent of urban wastewater is treated in Vietnam (World Bank, 2013).

Domestic wastewater from households is mainly treated in household’s septic tank before being discharging into combined sewer systems, then into rivers, lakes, and canals without any further treatment, except in some big cities such as Hanoi and Ho Chi Minh City (Fig. 2). Nearly 90% of households in urban areas have septic tanks. The remaining households are either equipped with other type of onsite sanitation such as double vault composting toilet (DVCT), pit latrines or directly discharge their wastewater into combined sewers without any treatment. According to the Ministry of Construction, before Nov. 2013 only eight urban areas in Vietnam had centralised wastewater treatment plants, mainly in big cities including Hanoi, Ho Chi Minh City, Da Nang, Quang Ninh, Da Lat, Buon Ma Thuat, Bac Giang and Phan Rang (Hoa and Viet-Anh, 2013). However, in recent years a large number of decentralised wastewater treatment plants have been constructed in both large and medium-sized urban areas such as Hanoi, Bac Ninh, Vinh and Can Tho under support from the Vietnam Government and a number of international organisations.

Figure 2



Typical combined sewer and drainage system found in cities of Vietnam(2005–2009)

Source: Hoa & Viet-Anh, 2013; World Bank, 2013

Regarding wastewater treatment technologies at centralised treatment plants, the most common technologies are based on activated sludge (AS) process, such as aeration tanks or sequencing batch reactors (SBR); for example, Kim Lien & Truc Bach pilot wastewater treatment plant (WWTP), North Thang Long WWTP, Yen So WWTP, Bai Chay WWTP, Quang Ninh WWTP. In addition, there are a number of wastewater treatment plants utilising low-cost and environmentally sound sanitation technologies, such as waste stabilisation ponds or constructed wetlands. Examples of these are the WWTPs in Ho Chi Minh City (Binh Hung Hoa WWTP), Da Nang and Buon Ma Thuat.

Concerning on decentralised wastewater treatment technologies, basically, activated sludge based-treatment process and biological filtration are among the most

commonly used. Recently, a new type of septic tank has been introduced, namely baffled septic tank, sometimes it has been used in combination with waste stabilisation pond or constructed wetland system. These technologies have been applied in a domestic wastewater treatment plant in Kieu Ky commune of Hanoi, WWTP at Thanh Hoa Pediatrics Hospital, WWTP in small towns in Vietnam such as Minh Duc in Hai Phong city, An Bai in Thai Binh and Cho Moi in Bac Can. Currently, there are no exact figures or data on the total number and capacity of decentralised wastewater treatment plants in Vietnam; however, it has been estimated that several thousand decentralised wastewater treatment plants, excluding septic tanks, have been constructed and installed across the country (Viet-Anh, 2010) for the purpose of treating domestic wastewater from residential areas, hospitals, hotels and office buildings.

Major challenges and barriers related to urban wastewater management in Vietnam

- *On-site treatment system:* On-site treatment systems such as septic tanks play a key role in wastewater treatment activities in Vietnam. Septic tanks are in fact “low-rate” anaerobic treatment units, and much evidence proves they are often of low performance and low efficiency, are under-maintained and cause groundwater pollution. Their actual BOD5 removal efficiency is only about 20–30% (Anh et al., 2002). According to the authors’ observation, the majority of household septic tanks in Vietnam are only used to treat black water, while greywater from bathrooms, kitchens, washing machines, for example, is not treated in septic tanks. This greywater has often been discharged directly to canals or sewer system, especially

in big cities like Hanoi and Ho Chi Minh. The survey results showed that grey water accounts for nearly 88% and 70% of the BOD load in domestic wastewater in Thailand and Japan, respectively (WEPA-MOEJ, 2012). Most septic tanks in Vietnam are not properly maintained and not emptied frequently. Households only contact the urban environment company (URENCO) or a private enterprise (either state-owned, limited liability or private companies) when problems such as clogging or overflowing occur. Most septic tanks are built underground and indoors, making it is very difficult for desludging crews to actually find them to access the drain hole. Workers normally have to drill a hole through the floor just above the septic tank to insert a suction pipe and empty the sludge. In some cities like Hai Phong, a plastic cover will be installed on the access hole by workers after emptying septage (Fig. 3).

Figure 3



Worker installing plastic cover to the access hole after emptying septage in Hai Phong city
Source: Author

Another issue is that septic tanks are usually constructed in areas where a combined drainage system was utilised, therefore actual BOD in wastewater prior to the wastewater treatment plant is normally much lower compared to the BOD in a separate sewerage system. According to a collaborative survey between the Ministry of Construction and Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, the average influent BOD in water prior to wastewater treatment plants in Vietnam is around 49 mg/l (WMP-GIZ, 2013). As a result, a low influent BOD concentration may interfere with microbial decomposition in the wastewater treatment plants. Further, no technical guidance or regulations on designing, operating and maintaining septic tanks exists.

- *Wastewater collection system:* Approximately 92% of urban wastewater collection is done via the combined system; a separate system is used for the remaining 8%. As most of the sewer systems were built or renovated two to three decades ago, many of them have deteriorated and do not function properly due to poor maintenance. New construction or renovation is often patchy and unplanned from the outset; further, this work has not been carried out in sync with the construction of wastewater treatment plants located along the network. Many sewage treatment plants have not realized their full capacity due to a lack of sewer networks. For example, North Thang Long-Van Tri WWTP was designed and constructed with a capacity of 42,000 m³/day but in reality the plant only operated at the capacity of 7,000 m³/day as the domestic wastewater from the surrounding residential areas have not yet been connected to the plant due to a reason that the sewer networks have not been fully covered in the area. (Survey by author, 2012). Similar situations have been reported in Phu Ly WWTP in Ha Nam province and a WWTP in Vinh-Nghe An province (World Bank, 2013).

- *Centralised wastewater treatment system:* Most sanitation projects tend to choose or adopt advanced and expensive wastewater treatment technologies, which are popular in developed countries, without considering local conditions such as financial recovery capacity and affordability for users. These technologies are often known as activated sludge treatment technologies. Of the 31 new centralised wastewater treatment plants planned for the near future, up to 28, or 90%, will use activated sludge-based treatment technologies (Anh, 2013), which may negatively impact on sustainability and viability of the sanitation projects over the long term.

ii. Current status of septage management

Due to a lack of septage treatment facilities in Vietnam, desludging service providers sometimes dispose of septage on vacant land, in drains, fish farms and waterways such as rivers, lakes, ponds and canals close to sludge-emptying areas to save on the transportation cost (Fig. 4). In general, septage has not been utilised to make compost – in fact, less than 4% of generated septage is collected and treated properly (AECOM & SANDEC, 2010), mostly in big cities such as Hanoi, Hai Phong, Da Nang, Ho Chi Minh City.

Presently there are no national laws governing the collection and treatment of septage, and the national government has no mandate for septage management or policy guidance. Therefore, all desludging operators in urban areas are only required to obtain a business license before starting operations. As a result, local governments have no incentive to promote septage management, invest scarce resources in operating treatment facilities, or support such projects once ODA project funding dries up (AECOM & SANDEC, 2010).

Most cities in Vietnam lack strict regulations, long-term strategies or a master plan for septage management. The majority of septage in urban areas of Vietnam is not periodically emptied. Recently, thanks to a sanitation improvement project sponsored by the World Bank, the percentage of households emptying septic tanks at least once since construction have increased to 59% in Hai Phong, compared to 38% in Hanoi and 35% in Ho Chi Minh City. The desludging frequency or interval in Hai Phong was about 4.4 years, while in Hanoi was 6.2 years, and Ho Chi Minh was 4.4 years (World Bank, 2013).

Figure 4



Direct discharge of septage into fish pond in the peri-urban area
Source: Author

3. Centralised vs. Decentralised Wastewater Management Approach

Decentralisation, in association with an appropriate local governance model, is increasingly being recognised as a potential means towards reducing the lack of access to clean water or proper sanitation throughout the world (Bieker et al., 2010; Libralato et al., 2012). Recently, decentralisation appears to satisfy all the advantages of conventional centralised wastewater treatment approach, with some value added mainly via the ability to minimise potential residual effluent contamination and ecosystem disruption by removing emerging micro-pollutants such as metals, pharmaceuticals and personal care products (Borsuk et al., 2008; Libralato et al., 2012). For these reasons, decentralised wastewater treatment is increasingly considered by sanitation planners and policymakers in Vietnam as the solution for sustainable sanitation, particularly for low density peri-urban areas.

The main advantages, disadvantages, criticisms and limitations of both centralised and decentralised wastewater treatment approaches have been extensively summarized by Libralato et al. 2012, who showed that none of the approaches could be excluded a priori, and that various combinations of the two generally work better, depending on the local context.

The selection of appropriate and sustainable wastewater management solutions for cities or provinces in Vietnam depends on various criteria, such as population density, land requirements, proportion of connected households, construction, operation and maintenance (O&M) costs, social norms and practices in each locality and ability to recover O&M costs and at least part of construction costs as stipulated in Decree No. 88/2007/ND-CP, Decision 1930/QD-TTg and Decree No. 25/2013/ND-CP. However, in practice, economic and financial viability, as well as land requirement are often considered the most important criteria. It is evident that in most cases a decentralised approach in densely populated areas with an existing sewage collection system would not be a viable alternative to centralised treatment (Libralato et al. 2012). The selection of either the decentralised or centralised approach should be incorporated into urban infrastructure planning as well as the sectoral master plan.

As mentioned earlier, thousands of decentralised wastewater treatment plants have been constructed and installed in Vietnam to date, many of which operate effectively. In particular, as a result of a Finland-Vietnam government tie-up, the Water and Sanitation Programme for Small Towns in Vietnam has realised decentralised wastewater treatment using low-cost sanitation technologies, and has shown to be a promising and appropriate technical solution for many sanitation projects in Vietnam's small and medium-sized towns. However, many obstacles have to be overcome in order to replicate this decentralised model across the country.

Some of the major challenges are pointed out below:

- Technical aspects: lack of standards, guidelines and technical manuals for the design, construction, operation and maintenance of decentralised wastewater treatment systems as well as sludge management from decentralized sanitation facilities, including septage. Relevant stakeholders often lack information and knowledge related to decentralised options.
- Financial aspects: the wastewater fee in urban areas is still too low to recover O&M costs or system upgrades. In addition, financial sustainability of sanitation projects after their construction is still a big concern.
- Social aspect: there is no public awareness of the need to treat wastewater in an appropriate manner before discharging it into the environment. Coordination between populations and the sectoral authorities in the collection and proper management of septage is limited.

4. Institutional arrangements and legal framework

Urban sanitation in Vietnam is guided by a number of ministries and agencies, including the Ministry of Construction (MoC), Ministry of Health (MoH), Ministry of Natural Resources and Environment (MoNRE) and Ministry of Science and Technologies (MoST) (Table 1). For example, MoC is responsible for development planning, introducing technologies, issuing regulations and construction standards for these activities. Meanwhile, water source and water source

protection are the responsibility of MoNRE. Water quality and standards for drinking water and domestic water are managed by MoH. Further, many water supply and sanitation projects were implemented with support from donors, international organizations, local communities or private sector.

However, overall responsibility for the sector falls under MoC, although work is now increasingly being decentralised to the provincial public service providers at the municipal level.

Ministries	Functions
Ministry of Construction (MoC)	Line Ministry of urban water supply, sanitation and drainage
Ministry of Natural Resources and Environment (MoNRE)	Manages water sources, water use, pollution and hydrology
Ministry of Health (MoH)	Controls drinking water and sanitation quality
Ministry of Science and Technology (MoST)	Manages standardisation and technology in water and sanitation
Ministry of Planning and Investment (MPI)	Allocates state budget. Approves investment projects (all projects need approval)
Ministry of Finance (MoF)	Distributes state funds to sectors and projects, sets annual sector goals and regulates accounting
Local Provincial People's Committee	Manages local water supply and sanitation

Existing legal framework

A number of environmental law and regulations in Vietnam have been developed, but many problems have been recognized during actual implementation stages. There are a number of major legal documents directly related to the management and development of urban drainage and sewerage systems, including:

- Law on Environmental Protection promulgated November 29 2005, effective July 2006
- Decree No. 88/2007/ND-CP of 28 May 2007 on Urban and Industrial-Park Water Drainage, which provides for water drainage activities in urban centers and industrial parks, economic zones, export processing zones and hi-tech parks and sets out rights and obligations of organizations, individuals and households involved in water drainage activities. This Decree will be expired from January 1st 2015, and replaced by new Decree No. 80/2014/ND-CP dated August 06th 2014 on Drainage and Wastewater Treatment.
- Circular No.09/2009/TT-BXD on 21/05/2009 of Ministry of Construction on provisions implementing the content of Prime Minister's Decree No. 88/2007/ND-CP dated 28/05/2007 on Urban Drainage and Industrial Areas
- Decision 1930/QD-TTg on 20/11/2009 of Prime Minister approving Orientations for sewerage and drainage development in urban centers and industrial zones up to 2025 and a vision for 2050. This is one of the main points and objectives set out in the direction of systems related to collection and treatment of urban wastewater. Accordingly, by 2025, service coverage of storm-water drainage systems is to be expanded to 100% in urban centers of category IV or higher; sewerage systems shall be constructed in urban centers of category IV or higher; 70–80% of domestic wastewater shall be collected, conveyed and treated in accordance with the effluent standards; in urban centers of category V and craft villages, 50% of wastewater shall be treated in accordance with effluent standards; in craft villages, decentralised WWTP shall be constructed for treatment of wastewater in accordance with effluent standards; 20–30% of treated wastewater shall be recycled for watering plants, cleaning roads and for other purposes in urban centers and industrial parks.
- Decision No.16/2008/QD-BTNMT on 31/12/2008 of MONRE on national technical regulations covering surface water quality, underground water quality, coastal water, wastewater, pesticide residues in soil.
- Decree No. 25/2013/ND-CP dated 03/29/2013 on environmental protection charges for wastewater. This Decree replaces Decree No. 67/2003/ND-CP dated 13/06/2003, No. 04/2007/ND-CP and 26/2010/ND-CP.
- Vietnam national code for wastewater effluent quality QCVN 14: 2008/BTNMT
- National regulation on surface water quality QCVN 08:2008 /BTNMT

5. Management Models and Participation of Private Sector

Current status of urban drainage management is mainly based on two management models, including One Member State-owned Limited Company and Joint Stock Company (JSC) which the government holds 51% of the shares. Existing management models of urban drainage and sewerage system in Vietnam are operated based on asset management mechanism from the city government, where public enterprises are assigned to manage properties of urban drainage systems, but properties themselves are still owned by the provincial or city governments. A fixed annual budget is planned, approved and allocated from the city budget by the city authority, which often does not allow the company to put sufficient invest in research and development activities to optimize the operation of the wastewater systems.

Most of the costs for operation and maintenance of drainage and wastewater treatment systems are covered by provincial or city budgets; however, this budget is only sufficient to meet about 10–20% of O&M costs for collection systems, and excludes O&M costs of wastewater treatment plants. Revenue for wastewater operations is mostly generated by application of a wastewater surcharge on the water bills for all customers, based on Decree No. 67/2003/ND-CP and its replacement, Decree No. 25/2013/ND-CP.

In general, the current wastewater surcharge for households is set at 10% of the water tariff, except Hai Phong city with 15% (Hai Phong Portal, 2013) and Da Nang city with 21%, expected to increase to 25% by 2015 (Da Nang Portal, 2013) as a part of commitment signed between World Bank and Vietnamese Government within the World Bank's Three Cities Sanitation Project (Ha Phong, Dang Nang and Quang Ninh).

Because revenue from the wastewater fee is still too low and does not cover construction and O&M costs for wastewater operations. Actual operational costs are generally subsidised by city or provincial budgets. Consequently, the private sector in Vietnam found it an unattractive investment, unlike in the water sector. In addition, private sector investment is often left out of city sanitation planning owing to the lack of regulatory regimes, policies and incentive systems to attract investments from the private sector.

6. Provision of finance and investment for urban sanitation

The responsibility for urban infrastructure in Vietnam, especially wastewater services, often rests with local governments, but most do not have the financial and/or technical capacity to manage the scale, complexity, and costs of urban environment programmes. Many wastewater utilities are not fully prepared to operate on commercial principles and attract private sector financing and expertise. A sustained capacity-building effort is therefore required to implement urban wastewater management systems on a large scale. While new wastewater treatment facilities have been constructed, a recent ADB performance review (ADB, 2013) found that legislation and regulations governing these projects need to be amended to ensure the limited financial resources are directed to high-priority areas. Some investments were misdirected to unnecessarily costly treatment options or systems with high energy requirements.

It is estimated that current annual investment in the sanitation sector in Vietnam accounts for 0.45% of GDP, or about 250 million USD (WMP-GIZ, 2013). Meanwhile, the average per capita cost to connect to a new wastewater system with adequate treatment is 200–600 USD, suggesting that the government will need to invest 6.4–20 billion USD over 12 years to meet its target (ADB, 2013).

In order to meet the target, the government should encourage and attract the private sector to invest in the wastewater sector in the form of Public-Private Partnerships (PPP model) in order to realise improvements in operational efficiency and service quality. However, this would require clarity on asset ownership, reliable information on existing infrastructure, clear assignment of responsibility for operation and maintenance, standardisation of accounts and procedures in line with international standards, and the timely introduction and enforcement of water and wastewater tariff increases to ensure at least cost recovery.

7. Conclusions remarks

Urban wastewater treatment in Vietnam is still in the early stages of development, thus many challenges and obstacles have been identified. However, there are also many opportunities to improve the sector's performance. The following key policies should be considered in the sector's planning process at both national and local levels:

- Political will and improvements to existing institutional and legal framework.

- Appropriate wastewater management should not be limited to wastewater. Septage management should be considered a critical aspect of sanitation planning as well.

- Selection of either centralised or decentralised approach, or combination of both approaches should be considered based on actual local socio-cultural, institutional, technical, economic and financial conditions. In addition, the selected solution should be incorporated into urban infrastructure planning as well as the sectoral master plan at an early stage.

- Promulgation of regulations, national standards and technical guidelines related to decentralised wastewater treatment models; management of decentralised wastewater treatment works.

- Ensure financial stability and sustainability of the sector by utilising innovative and effective financial management mechanisms and economic instruments.

- Encourage pro-active participation from all relevant stakeholders, including households and private sector involvement, and attract investment into the sector in order to improve the efficiency and quality of services.

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Figure 3 & Figure 4: Pictures taken during the author's field survey in Vietnam.

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