Evolving policies and the roles of public and private stakeholders in wastewater and faecal-sludge management in India, China and Ghana

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Abstract
In this article the authors document evolving attitudes, policies and roles of stakeholders in wastewater and faecal-sludge management in India, China and Ghana. In each country there is momentum for expanding not just access to sanitation at the household/community levels, but also for greater treatment and safe end-of-life management of human excreta. Governments are increasingly looking to engage the private sector, but models of engagement that make a compelling business case and instil confidence in cost recovery will have to emerge before the private sector takes an active role in wastewater and faecal sludge treatment in low-income countries.

Keywords: sanitation, developing countries, public-private partnerships, wastewater treatment

Introduction

For decades, the provision of sanitation has lagged behind safe drinking water. Only 37% of aid funding for water and sanitation was directed to the latter in 2008; national sanitation policies seldom exist; and local communities share this bias (WHO 2004, UNDP 2006, WHO and UN-Water 2010). Sanitation was tacked on to Millennium Development Goals (MDGs) as an afterthought in 2002 as a result of pressure from sector professionals (International Water Association Sanitation 21 Task Force 2007). Today improved sanitation [1] is widely recognized as a critical component of community and environmental health. Sanitation interventions alone have the potential to reduce diarrhoea-related diseases by up to 37% (Mara *et al*. 2010), a significant share of the 7% of global disease attributed to inadequate water, sanitation and hygiene (Pruss-Ustun Bos *et al*. 2008).

Yet progress has inched toward meeting even the conservative MDG of "halving the proportion of people without access to improved sanitation by 2015 (from the 1990 baseline figure)". By 2006, this proportion had only decreased by eight percentage points, and at the current pace, Africa will not meet the sanitation MDG until 2108 (WHO and UNICEF 2008, Cairncross *et al.* 2010).

Sanitation scholars and practitioners are increasingly questioning the extent to which proper conveyance, treatment and final disposal/reuse of wastewater and faecal sludge [2] (FS) can be ignored – as they largely have been to date – in the broader effort to achieve the benefits of sanitation (International Water Association Sanitation 21 Task Force2007, Hall and Lobina 2008, World Water Assessment Program 2009).

In most low- and middle-income countries in Asia and Africa, wastewater and FS undergo no or minimum treatment – even if the population is considered to have improved sanitation. However, changes in policies and regulatory frameworks, increasing scarcity of freshwater resources, economic development and desire to attract local and foreign investment, and pressure from donor agencies may all be contributing to an upsurge in investment and

attention to wastewater and FS treatment beyond providing access to a toilet. In this context, we consider adequate sanitation from the perspective of local institutions. In particular, we present three case studies from low- and middle-income countries – India, China and Ghana – that detail public and private efforts and interactions, key challenges and incentives for expanding wastewater and FS treatment.

India and China, the world's most populous countries, are home to 38% of the 1.3 billion people who have gained access to improved sanitation between 1990 and 2008 (WHO and UNICEF 2010). Thus, it is interesting to consider their progress towards the next level of sanitation. At the other end of the spectrum is Sub-Saharan Africa, with less than 50% coverage of improved sanitation. We selected Ghana as representative of this group.

Methods

Each case study comprises a three-part descriptive summary of the country's sanitation sector that includes situational, institutional and private-sector analyses. Each relies on primary data collection, including key informant interviews and site visits, combined with secondary data collection from government reports, published statistics and databases and literature reviews.

India

Situational analysis: current levels of wastewater treatment

Urban wastewater generation in India grew by over 80% between 1947 and 1997 (estimate of Winrock International India [2007]). According to the Central Pollution Control Board, 16 GL/day of wastewater is generated from Class-1 cities (with a population greater than 100,000 people), and 1.6 GL/day from Class-2 cities [3] (with a population of 50,000 to 100,000 people) (CPCB 2008). India has 45,000 km of rivers and 6,000 km of them are heavily polluted with wastewater, making the water unfit for drinking even after treatment (CPCB 2008).

Untreated wastewater from domestic, hospital and industrial areas pollutes rivers and other natural water bodies. Only 4 GL/day of the 17.6 GL/day of wastewater generated in India's Class-1 and Class-2 cities are treated; due to lack of infrastructure and resources for treatment, 80% of wastewater generated is discharged untreated into natural water bodies. Downstream farmers divert much of this water for irrigation (Winrock International India 2007).

Untreated and partially treated wastewater from the major cities of India irrigates thousands of hectares of agricultural land, generating employment and ensuring food security for millions of peri-urban farmers and their families. A variety of crops are irrigated with wastewater including: cereals, such as rice (in Hyderabad along the Musi River) (Mekala *et al*. 2008) and wheat in Ahmedabad and Kanpur (Winrock International India 2007); a variety of vegetables including gourds, eggplant, okra, coriander, spinach, mustard, cauliflower, cabbage and many more, in almost all major cities like New Delhi, Mumbai, Kolkatta, Hyderabad and Bangalore (Buechler and Mekala 2008); flowers, including roses and marigolds in Kanpur, jasmine in Hyderabad (Mekala *et al*. 2008); fodder crops, such as para grass (Buechler and Mekala 2008); aquaculture in East Calcutta (Chattopadhyay 2004); and agroforestry near Hubli-Dharwad in Karnataka (Bradford *et al*. 2003).

Institutional analysis

India's wastewater sector: policies, objectives and programmes

The drought of 1987 led to the development of a National Water Policy (NWP) by the Indian Ministry of Water Resources in September of that year; it was updated in September 2002. The NWP contains guidelines for wastewater management, including the stipulation that all urban wastewater be treated. It defines the practices required to ensure water quality, endorses the "polluter pays" principle, and recognizes the need to increase urban water tariffs and wastewater treatment coverage. Increased participation in water resources management by the private sector is also emphasized, with the expectation that it will lead to efficiency gains.

The Ganga Action Plan (GAP) Phase-I was taken up in June 1985 as a 100% centrally funded scheme to prevent and mitigate pollution of the River Ganga. The plan was later extended to other major rivers of the country under two separate schemes of GAP Phase-II and the National River Conservation Plan (NRCP). As of 31 December 2009, a total of Rs 29.6 B (USD 621 M) was released by the central government for the construction of sewage treatment plants (STP) to clean up 38 rivers across 20 states to tackle a pollution load of more than 4,000 ML/day. [4]

Legal regulations related to water pollution in India are incomplete. The Water Act (1974 and amended in 1988) covers industrial effluent standards, but ignores the domestic and municipal effluents even though they constitute 90% of India's wastewater volumes (Sawhney 2004). Pollution of both surface and groundwater sources and its associated problems constitute one of India's biggest environmental problems. The market for advanced wastewater-treatment technologies among industries and municipal corporations accounts for the largest percentage of the total environmental market in India (Winrock International India 2007).

A survey by the US Trade Department (quoted in Swiss Business Hub India *et al*. [2004]) found that the total market potential for water and wastewater treatment including the requirements of the municipal and industrial sectors was on the order of US$900 million, and is expected to grow at approximately 14% each year. In economic terms, industrial wastewater treatment accounts for nearly half of the total market for wastewater treatment, given the higher cost of technologies that are effective for such waste streams compared to municipal wastewater. The water and wastewater treatment sectors also account for the highest environmental spending within both the public and private sectors. Considering the fact that conventional treatment techniques are extremely expensive for countries such as India, there is an urgent need for the development of alternate and affordable methods of treating and recycling wastewater.

Investment in urban water supply and sanitation has increased during the first decade of the twenty-first century. Under the Jawaharlal Nehru National Urban Renewal Mission, along with loans from the Housing and Urban Development Corporation (HUDCO), there has been an increase in central government grants made available. The 11th Five-year Plan (2007–12) foresees investments of Rs 1270 billion (US$28.8 billion) for urban water supply and sanitation, including urban (stormwater) drainage and solid-waste management (Planning Commission of India2007). Fifty-five percent of the investments foreseen under the 11th Plan are to be financed by the central government, 28% by state governments, 8% by "institutional financing" such as HUDCO, 8% by external agencies and 1.5% by the private sector. The volume of investments is expected to double to reach 0.7% of GDP (Planning Commission of India 2007).

Private sector analysis: regulations and roles of the private sector

The private sector's role in water and sanitation is gradually increasing, although it is currently concentrated in the provision of water supply. For example, the Jamshedpur Utilities & Services Company (Jusco), a subsidiary of Tata Steel, and the French water company Veolia, among other companies, have numerous management contracts for water provision in cities across the country (The Financial Express 2007). The Hyderabad Metro Water Supply and Sewerage Board is currently soliciting private-sector participation in the billing and metering of its water supply. The Board likely will seek similar input from the private sector in the future, to achieve efficiency gains in the maintenance of its sewerage treatment plants in (Mekala 2010).

While private investment in water and sanitation remains low, in 2006 India attracted more private investment in infrastructure than any other developing country (Harris 2008). Government officials express great interest in private-sector involvement and have welcomed the Asian Development Bank's Water Financing Program to increase water investments (Tamaki 2008). This is a stark turnaround from previous decades when India's state and federal governments effectively shut out the capital-rich private sector with legal and regulatory hurdles (Tamaki 2008).

Summary of India case study

India is one of the most resilient and fastest growing Asian economies, with a real growth rate exceeding 7% every year since 2005. Increasing household incomes have two implications for wastewater management. First, the growing middle class spend more on consumer goods, thus increasing the pressure on the industrial and agricultural demand for water. This could possibly create a market for recycled wastewater.

Second, that middle class will increasingly demand clean water and better sanitation facilities (Bhattacharya 2008). However, this will only materialize if the necessary institutions are in place to internalize all of the externalities (Panayotou 2000, Dasgupta *et al.* 2002, Yandle *et al*. 2002, Richmond *et al.* 2007). Therefore, a detailed institutional analysis must be undertaken to assess the quality of the institutions and policies that address and influence wastewater management.

In light of the depleting supply and quality of water resources, and the increasing costs of tapping new water sources, wastewater treatment and reuse is increasingly essential to sustain and propel economic growth. More cities are increasing investments in sewage-treatment plants. While policy makers, water boards and the private sector are beginning to recognize the importance of wastewater treatment and reuse, enforcement of legal regulations and policy mandates remains weak, the investment gap large, and private participation only slowly emerging. Thus, it appears that it will be many years before substantive progress in sanitation materializes across India.

China

Situational analysis: current levels of wastewater and faecal-sludge treatment

After China's first centralized municipal wastewater-treatment plant (WWTP) was built in the 1980s, further expansion was slow until the late 1990s and early 2000s when an extensive amount of state and private investment entered the sector. Between 2001 and 2008 the average rate of domestic wastewater treatment grew substantially from 19% to 57%; [5] the number of cities served increased from about 200 to 488 (of 655 Chinese cities); and the proportion of plants that employ secondary and tertiary treatment increased from 66% to 90% (MEP 2009). However, WWTP capacity continues to outstrip actual utilization by an average

of about 25% due to delayed construction of sewer networks, high costs of plant operation that lead to shutdowns and overdesign (MHURD 2009). In addition, sewage-treatment levels and facility performance vary across cities and regions. For instance, by 2008 most cites in higher-income eastern China treated at least 70% of their sewage (some even up to 92%), while the average treatment level was less than 40% in the less developed western and northern regions of the country (MEP 2009).

In contrast to urban areas, wastewater and FS treatment in rural areas has been underemphasized. There is little understanding of the volume of wastewater and FS generated by China's rural residents, who comprise approximately 50% of the country's population. However, due to China's age-old tradition of using night soil in agriculture, a considerable portion of human waste is applied to fields. Meanwhile, household biogas digesters, promoted to improve access to clean energy in rural areas, have had important indirect benefits on treatment and the safety of subsequent land application of sludge (Remais *et al*. 2009). By 2005, 7% of rural households had installed biogas systems, which are used to treat human and livestock waste, and thus produce a viable volume of fuel for household cooking (MA 2007).

Institutional analysis

China's sanitation sector: policies, objectives and programmes

Since 2001, when the 10th Five-year Plan was released, domestic wastewater treatment has garnered increasing priority on political and institutional agendas in China. The 10th Five-year Plan was the first to specify a clear target for municipal domesticwastewater treatment coverage, which was to reach 45% in urban areas by 2005. In the 11th Five-year Plan (the Plan, hereafter) the country even developed a special sub-plan for the wastewater sector. Although the target of 45% was not achieved on time – there was an average coverage of 37% [6] coverage in 2005 (MEP 2009) – an even more ambitious target of 70% by 2010 was stipulated in the new Plan. It was estimated that 332 billion CNY (US$48 billion) would be required to finance this vast expansion (NDRC *et al*. 2006).

While the number of WWTPs and total coverage may be high among developing countries, the rapid expansion of conventional energy intensive WWTPs has left little room for integrated planning and has led to unaffordability and inefficiency in many Chinese cities (Browder *et al*. 2007). Apart from a predominant preference for large-scale centralized WWTPs, a stringent discharge standard for all WWTPs is applied across the economically diverse country, which has forced lower-income cities to construct WWTPs that they cannot afford to operate (MEP 2002, Browder *et al.*2007). This not only requires many cities to go from no wastewater treatment to technologically advanced and expensive plants but also has deterred wastewater reuse in the agricultural sector. Like many developing nations, China has been practicing unplanned wastewater irrigation for decades (Scott *et al*. 2004), but there are limited cases of deliberate reuse in practice. Past experiences of high health risks have given rise to more “advanced” (correspondingly more expensive) and “safer” practice such as industrial and municipal reuse. A case in point is Beijing: two thirds of its reused 600 Mm^3 of municipal wastewater in 2008 received tertiary or more advanced treatment (Beijing Drainage n.d.); however, this is not realistic for many of China's cities and may not be necessary for certain crop types.

Another important reason for insufficient planned agricultural reuse is the singular association between reuse and scarcity in China. While it was a step forward for the Plan to explicitly establish a reuse target of 20% for northern China by 2010 (NDRC *et al.* 2006), the specific emphasis on increasing reuse in the extremely thirsty north rather than the whole

nation echoes the institutional failure to recognize wastewater reuse as a means of environmental protection. In the same manner, productive reuses of sludge, such as in agriculture and as an alternative fuel in cement manufacturing, have only been prioritized (over landfilling) recently, when land scarcity became an issue (NDRC *et al*. 2006, MHURD *et al.* 2009).

Current practice is to reuse most rural faecal sludge. However, due to a bias against dry toilets as being backward, the Ministry of Health recommends flush toilets as a means of improved sanitation, just as in urban areas (MH 2009). By 2009, 16% of improved toilets in place were flush toilets (MH 2010). The Chinese government has invested large sums in the sanitation sector in recent years. Responding to the global financial crisis in 2008, the government announced a 4 trillion CNY (US$600 billion) stimulus package specifically for infrastructure development. Of this, 350 billion CNY (US$53 billion) were earmarked for environmental protection, including wastewater-treatment plants (RightSite Team 2009). The recently released 12th Five-Year Plan (2011–5) indicates further significant investment in wastewater and sludge treatment and reuse. Aiming at attaining full cost recovery, the National Development and Reform Commission has required that household-level tariffs for sewage progressively rise from basically zero to at least 0.8 CNY/ton (Zhang and Zheng 2008). Yet this may not be enough. The World Bank estimates that tariffs need to be 2.0-3.0 CNY/ton to achieve full cost recovery – inclusive of conveyance, operation and maintenance (O & M) of treatment plants, and debt financing – and 1.0-1.5 CNY/ton just to cover direct treatment costs. These rates likely exceed the ability to pay of lower income customers (Browder *et al*. 2007).

Private sector analysis: regulations and roles of the private sector

In addition to government financing and modest user fees, private investment in sanitation is increasing in China. To help achieve its ambitious wastewater treatment goals, China has been opening its traditionally centrally planned wastewater sector to private practitioners – local and foreign. A chain of policy papers issued in the early 2000s have been employed to facilitate various forms of public–private partnerships (Zhong *et al.* 2008), but no overarching legislation exists yet. Seeing that financing was a critical constraint in the expansion of wastewater infrastructure during the 10th Plan period, the 11th Plan explicitly emphasizes the significance of furthering private involvement.

By 2009 the private sector was responsible for approximately 70% of China's wastewater market, according to estimates of the Tsinghua Water Policy Research Center (Fu 2009). The combined foreign share of the market reached 36.5% in 2009, compared to just 10% in 2006 (RightSite Team 2009). Competition among private actors has become increasingly fierce, with local companies tending to compete through lower prices, while foreign companies leverage their access to more advanced technologies (JLJ Group 2010). Private involvement in sanitation is limited primarily to treatment facilities; less financially attractive investments such as sewer construction remain the government's responsibility (Browder *et al.* 2007).

Summary of China case study

Prompted by its severely degraded waters, China has been trying to catch up with the vast wastewater treatment demand that rapid development has imposed. This debt-paying behaviour has fostered dramatic expansion of wastewater treatment capacity in a very short time. While it is warranted on environmental grounds if viewed from a treatment-for-disposal perspective, the pace and means of investment has proven unaffordable and inefficient. With a formally written reuse target, the institutional landscape needs further rearrangement to facilitate reuse-oriented planning.

The private sector has played a critical role in meeting the long-overdue financial demands of China's expanding wastewater treatment. Nevertheless, greater private involvement in sewer investments requires additional incentives, including an improved legal framework to regulate private-sector performance.

Ghana

Situational analysis: current levels of wastewater and faecal-sludge treatment

Like most countries in the developing world, Ghana is struggling to achieve control of its increasingly severe urban sanitation challenge. Unlike the previous two case studies, most of Ghana's excreta is generated in the form of FS. Every day in the capital city of Accra for example, over 750 m^3 of FS are discharged directly into the ocean (pers. comm. between employee of Accra Sewage Department and A. Murray on faecal-sludge generation and discharge in Accra, 17 August 2010). Likewise, the wastewater generated in the 15% of the city that is served by a central sewer system is diverted around the broken-down upflow anaerobic sludge blanket (UASB) and discharged to the ocean. The UASB was built in 2002, but since breaking down in 2004, it has served as an infamous icon of the financial, technical and institutional difficulties that plague the sector.

In addition to Accra's central sewerage system, there are about 20 small-scale wastewater-treatment systems representing an array of technologies within the metropolitan area. These have been constructed and are operated by a range of institutions including schools, military camps, hotels and the airport; only those at the for-profit entities have any effective operating capacity (Murray and Drechsel 2011).

Tema is the only city in Ghana with a comprehensive sewer system; it serves 12 communities, the harbour and the industrial area (Murray and Drechsel 2011). In 1994, under the World Bank funded Urban Environmental Sanitation Project Phase (UESP) II, a waste stabilization pond system was built with a daily capacity of 20,000 m^3. The plant operated for almost five years, but since falling into disrepair in the early 2000s, the wastewater has been diverted to the ocean (pers. comm. between employee at Tema Waste Management Department and A. Murray about implementation and operation of Tema Waste Stabilization Pond System, 11 June 2008).

The sanitation situation is slightly better in Kumasi, Ghana's second largest city. The city has three community-based waste stabilization ponds with marginal performance (deferred maintenance is a perennial problem); the local university, Kwame Nkrumah University of Science and Technology (KNUST), also has its own wastewater treatment plant, which was recently rehabilitated (IWMI 2008). Most of the city's waste is generated in on-site systems and there is one large-scale FS treatment plant that receives that waste.

There are no quantitative assessments of the total volume of wastewater and FS that receive treatment in Ghana. However, it is known to be extremely limited: of the approximately 70 primarily decentralized treatment plants across the country, fewer than 10 operate effectively (Murray and Drechsel 2011). Most cities – Greater Accra, Cape Coast, Sekondi-Takoradi, Tamale – are currently without any operating municipal wastewater or FS-treatment plants; therefore, it can be conservatively estimated that no more than 10% even of the urban wastewater/FS is treated nationwide.

Institutional analysis: Ghana's sanitation sector: policies, objectives and programmes

Improving sanitation is high on the political and institutional agendas in Ghana. In August 2010, the Ministry of Local Government and Rural Development (MLGRD) (which is responsible for overseeing the sanitation sector) announced that Ghana would join a global

partnership, the Sanitation and Water for All Compact [7] (Ghana News Agency 2010). The Compact aims to address barriers to adequate access to water and sanitation and by signing on, the MLGRD has committed Ghana to investing at least USD 200 M annually toward water and sanitation improvements to meet the Millennium Development Goals, and to make an additional annual investment of US$150 million toward FS and wastewater treatment (Ghana News Agency 2010). Just after ratifying this Compact, the Ministry released Ghana's National Environmental Sanitation Strategy and Action Plan (NESSAP), which aims to be a roadmap for sanitation reform and guidance for how and where to allocate dedicated sanitation funds.

The NESSAP's short-term goal is to expand household-level access to sanitation – goals that are squarely aligned with the requirements for achieving the sanitation MDG. However, longer-term targets have a definitive emphasis on proper treatment and end-of-life [8] management of wastewater and FS. By 2024, the NESSAP aims for nationwide coverage of systems that provide adequate treatment and reuse/disposal of wastewater and FS (MLGRD and EHSD2010). Simultaneously, between 2008 and 2024, the Plan calls on the MLGRD and the Environmental Protection Agency to step up enforcement of legislation that prohibits dumping of waste in waterways and drains (MLGRD and EHSD 2010).

A notable theme of the NESSAP is its emphasis on reuse. The underlying philosophy of the Plan's strategies and suggested actions is "MINT" – Materials in Transition – which is about re-conceiving of waste as a resource that can be transformed for productive uses (for example, compost or energy production) (MLGRD and EHSD 2010). Indeed, mainstreaming reuse would represent a notable departure from the *status quo*.

While unplanned reuse of untreated wastewater is the *modus operandi* for urban agriculture in Ghana (Pruss-Ustun *et al.* 2008), there are very few instances of deliberate reuse of wastewater or FS, particularly at scale. However, among other criteria for reuse to take hold, the personnel and management structures that govern sanitation systems (on-site and centralized) must be actively designed for, and committed to, reuse as opposed to disposal (for example, through financial or other incentives that reward efficient and innovative reuse) (Murray and Buckley 2010). Foregone reuse opportunities are everywhere. For example, anaerobic treatment systems are an increasingly favoured low-cost sanitation technology by institutions like schools and hospitals. Although biogas could be harnessed for cooking or power generation, its fate is usually the atmosphere, as the operation and management structures are seldom in place to make effective and reliable use of it. [9]

It is also up to outside actors, including donors, investors and non-governmental organizations (NGOs), to recognize reuse as their new mandate when engaging with Ghana, and thereby work to foster the entrance of (ideally money-making) resource-recovery waste management systems in place of waste treatment and disposal systems. The African Water Facility, which might be characterized as the smaller, less risk-averse and more innovative offspring of the African Development Bank (AfDB), is helping to push forward the wastewater/FS-reuse agenda in Ghana. They have recently funded a project proposed by the International Water Management Institute (IWMI) and the Water Resources Commission that will quantify through detailed cost-benefit analyses and demonstrate through implementation, the economic, social and operational benefits of four resource recovery options: irrigation, land application of faecal sludge, aquaculture and biogas recovery. However, the two biggest (donor-funded) sanitation infrastructure projects underway in Ghana, which to be fair were in existence long before the NESSAP, have no reuse component at all. The Accra Sewage Improvement Project, financed by the AfDB, comprises expansion of the sewer network and over 4,000 new household connections, provision of 100 public toilets, and construction of at least one (originally three) large-scale waste stabilization ponds to receive the sewage

(African Development Fund 2005). Though the possibility of reuse was mentioned in the Appraisal Report (African Development Fund 2005), at present the embodied energy, nutrients and treated effluent are destined for discharge (pers. comm. between employee of Accra Sewage Department on Accra sewage improvement project and opportunities to incorporate reuse and A. Murray, 6 July 2009). Similarly, the World Bank's still active UESP II is targeting the rehabilitation and construction of new treatment plants, but there are no plans for resource recovery.

Donor funds are a major source of revenue for the sanitation sector in Ghana. Between 2004 and 2010, approximately US$293 million were invested in water and environmental sanitation projects (including solid and liquid-waste management, hygiene education, water treatment and provision), much of which came from donors including AfDB, DANIDA, and the World Bank (MLGRD and EHSD 2010). Government contributions have been relatively small. In 2007 government funds accounted for just 7.8% (approximately USD 2 M) of spending specifically in the sanitation sector (MLGRD and EHSD 2010). However, as described above, Ghana's participation in the Sanitation and Water for All Compact should bring substantial growth in the government's investment in the sector.

Private sector analysis: regulations and roles of the private sector

The NESSAP has ambitious near-term goals for tapping the private sector, specifically by way of: management/service contracts; joint ventures; build-operate-transfer (BOT)/build-own-operate (BOO); and partial privatization. The NESSAP has specific goals for the level of private engagement, including fully privatizing cesspit-emptying services and the operation of all government-built wastewater and FS treatment plants by 2015; expanding the private provision and management of community/public toilet blocks; and, linked to reuse, increasing the private provision and management of decentralized excreta treatment *cum* resource recovery systems (MLGRD and EHSD 2010).

The private sector already has a large presence in cesspit emptying services [10] and in the provision and management of community/public toilet blocks in most Ghanaian cities. This is perhaps not surprising, as these two components of the conventional sanitation value chain elicit far more private demand (that is, willingness to pay) than treatment and safe disposal. While the Government of Ghana endorses full cost recovery for treatment through user fees and tariffs based on the “polluter pays” principle, it is not clear how realistic this is, given the low-income demographics of many of the communities in need of improved services. Thus, in addition to promoting a business-friendly institutional and policy environment, the key to attracting the broader private-sector engagement endorsed by the NESSAP may be identifying reliable profit-making opportunities at other, more neglected, points in the sanitation value chain, especially treatment and end-of-life. Sanitation business models that are built around productive and profitable reuse are one promising option (See Murray *et al*. this issue).

Summary of Ghana case study

The NESSAP provides a clear directive for transforming current approaches to sanitation in Ghana. It is a vision that was arrived at by Ghanaians for Ghana – a testament to local stakeholder commitment to improving and developing the sector. There is no doubt significant activity in the sector prompted by local governments, national and international entrepreneurs, non-governmental organizations (NGOs) and multilateral donors. And while conventional disposal-oriented, government-operated treatment plants are still being pursued, new public–private partnerships are also being formed, novel high-density sanitation solutions are being demonstrated and innovative reuse systems are being piloted.

Taking these early efforts to scale and achieving the bold objectives of the NESSAP will require substantial, sustained commitment by the government and their private and donor partners. Many hurdles must be overcome, including improving human-resource availability and technical capacity in the sanitation sector, better articulating and delineating institutional roles and responsibilities for various aspects of sanitation, and perhaps most importantly, the cycle of perpetual monetary shortages for covering capital and ongoing costs of sanitation systems and infrastructure must be broken.

Analysis of case studies and recommendations

It is encouraging to see the momentum behind expanding not just access to sanitation at the household/community levels, but also the expansion of treatment and safe end-of-life management of human excreta in the three case study countries. A comparison of key outcomes of the situational, institutional and private-sector analyses for each country is provided in Table 1.

Table 1. Comparison of key outcomes of the situational, institutional and private-sector analyses of the sanitation sectors in India, China and Ghana

	India	China	Ghana
Situational analysis	<20% of urban wastewater treated.	Avg. 57% of urban wastewater treated: up to 92% and as low as <40% in some cities.	<10% of wastewater/FS treated.
Institutional analysis	2002 National Water Policy mandates 100% urban wastewater is treated.	Five-Year Plans mandate increasing wastewater treatment since 2001. -10th Five-Year Plan: 45% urban wastewater treated-11th Five-Year Plan: 70% urban wastewater treated.	2010 NESSAP aims for 100% treatment by 2024.
	Major gaps in enforcement.	Increasing enforcement through fines and personal accountability.	Goal to increasingly improve enforcement of sanitation legislation between 2008 and 2024.
	No explicit reuse target identified.	Explicit reuse target of 20% for water-scarce North, otherwise reuse very limited.	Endorse reuse (MINTing) without a specific target (emphasis on cost recovery).
	Government investment includes USD 28.8 B for water and sanitation in 11th Five-Year Plan; GAP Phase-II spent USD 621 M on treatment plants by 2009.	Government investment includes USD 53 B in treatment (2008–10); USD 690 M likely allocated for 12th Five-Year Plan; private sector very significant source of funds.	Government investment earmarked for example, USD 150 M/yr for treatment through 2015; donor funds major source of revenue; private-sector investment expected to increase.
	Endorse polluter pays principle.	Employ user fees and polluter-pays principle with legally enforced minimum tariffs; aim is full cost recovery but fees too low.	Endorse polluter-pays principle; no minimum levels, collection inefficient.
Private-sector analysis	Government slowly opening up to private sector involvement, especially treatment plant O&M; no specific target.	Government actively seeking private-sector involvement, especially treatment plant construction and O&M, without specific target.	Government has ambitious and explicit targets for private-sector involvement across sanitation sector/value chain.

	Private sector very limited engagement in sanitation.	Private sector controls 70% of wastewater market (36.5% foreign).	Private sector highly engaged in FS collection/conveyance and toilet blocks; no current presence in treatment plant construction or O&M.

In each country, treatment has fairly recently been elevated on policy agendas, spurred by the National Water Policy in India, the Five-year Plans in China and the NESSAP in Ghana. China has made the most progress, with an increase from 19% to an estimated average 57% wastewater treatment coverage in urban areas since enacting their policy. For India and Ghana wastewater/FS treatment policies are good intentions that have yet to materialize into substantive progress.

China's rapid expansion of wastewater treatment over the course of a decade may be explained in part by their incremental and specific target setting, combined with increasing enforcement of environmental protection policies. In contrast, while India has had a policy of 100% urban wastewater treatment since 2002, the gap between desired and achieved treatment has increased. Researchers have argued that overly ambitious targets can limit actual progress in sanitation. Stepwise standards that can evolve with improvements in institutional and financial capacity are a more effective way to achieve progress (von Sperling and Augusto de Lemos Chernicharo 2002). While Ghana has given itself a reasonable time period for achieving nationwide treatment (by 2024), like China, they will likely need to develop shorter-term targets and enforceable legislation to achieve that objective.

All three countries are seeking to expand the financial base of the sanitation sector by engaging private actors in the provision of various components of sanitation services. Estimates suggest that closing the gap in service provision and meeting the future needs of South Asian countries, for example, will require infrastructure investment in the range of 7–8% of gross domestic product (GDP) per year (Harris 2008). The private sector can help close the region's infrastructure service deficit, provided the region's governments successfully close the infrastructure policy deficit, manifested as distorted pricing, poor governance and accountability, and weak financial and operational performance (Harris 2008).

Ghana has perhaps the most explicit expectations for the private sector, which include complete privatization of components of the sanitation value chain by 2015. The challenge, of course, is attracting private investment to a sector that has historically been in the public domain. The private sector has never invested significantly in sanitation infrastructure in developed countries, and has contributed only trivially to sanitation infrastructure in developing countries during the last 20 years (Hall and Lobina 2008). One might worry, therefore, that a policy of tapping the private sector – particularly in lower income cities and countries – amounts to a policy of passing responsibility to an unwilling recipient.

According to Moss (2008), the benefit of investing in sanitation depends on the quality of projects and contracts. The private sector will not be attracted, for example, without a secure revenue stream, manageable risk profile, and confidence and certainty in the terms of engagement. The revenue streams to compensate investors can take many forms, including user fees (through water bills), tax contributions, government payments and Official Development Assistance (Moss 2008). Given the difficulty that public and private operators have in recovering the costs of operating wastewater treatment plants in China, it seems unlikely that the sector could be more solvent in lower-income countries such as Ghana. This might also explain the private sector's absence in India.

If the private sector is to play a significant role in end-of-life management of wastewater/FS in countries such as Ghana and India, the business prospects will need to improve, such that new modes of engagement and business models that do not depend on household user fees or citizen taxes must emerge. Ghana's endorsement of “MINTing” in their NESSAP might be a step in the right direction, as reuse-oriented sanitation and “waste-based” businesses

(described by Murray *et al*. in this issue) might provide a more enticing and reliable revenue stream for private actors than is possible within the *status quo* approach of treatment for disposal.

Notes

1. Defined as a system that "hygienically separates human excreta from human contact" (WHO and UNICEF 2010).

2. The contents of non-sewered pit latrines and septic tanks.

3. 1 GL = 1,000,000 m^3.

4. More details are available on the Ministry of Environment and Forests' website: (http://envfor.nic.in/nrcd/NRCD/table.htm).

5. The actual domestic treatment rate is considerably lower, as published statistics do not acknowledge that most WWTPs take industrial wastewater (sometimes over 50% of total influent), which reduces the volume of treated sewage and jeopardizes the performance of treatment facilities. This caveat applies to all Chinese treatment rate data.

6. The Plan claims 52% as the treatment rate. In light of pressure to demonstrate achievement of the objective, the lower rate given in the environment yearbook is likely more reliable.

7. http://www.sanitationandwaterforall.org/

8. The final disposal and/or reuse of human waste.

9. This conclusion is based on site visits and personal communications by A. Murray

10. In the Accra Municipal Assembly, for example, 26 registered cesspit emptying companies with a total of 39 trucks serve households and public/community toilet blocks, charging GH¢ 80–120 (US$55.00–84.00) for each service.

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