

Review of Community-Managed Decentralized Wastewater Treatment Systems in Indonesia

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Executive Summary

Effective management of sanitation and wastewater is a growing challenge in dense urban settlements. In many developing countries, centralized sewerage and wastewater treatment systems cover only a portion of larger urban areas, and on-site sanitation is often inappropriate in densely populated settlements. Intermediate and complementary solutions are needed.

Community-managed anaerobic decentralized wastewater treatment systems (DEWATS) offer the possibility of relatively swift sanitation improvements in high priority neighborhoods that communities can manage themselves, where local government does not yet provide a full sanitation service.

This review explores Indonesia's experience in implementing community-managed DEWATS on a growing scale. In a context of extremely low sewer coverage, the Government of Indonesia sees community-managed DEWATS as its best available option for eradicating open defecation and improving sanitation in selected poor dense urban settlements until full municipal sewerage and wastewater treatment are feasible.

Three types of DEWATS are being implemented. To date, 77% have been community sanitation centers (CSCs), with toilets, washing and laundry facilities. Alternatively, in 16% of cases wastewater is collected from household toilets by a simplified sewer system (SSS) and gravity-fed to a DEWATS plant. In a further 6%, a local sewer network and a communal sanitation facility are combined, making these the most inclusive as they accommodate both household connections as well as access to sanitation for those unable to connect to the network.

More than 80% of DEWATS installations function well day to day, comply with environmental discharge regulations, and enable far-reaching changes in environmental health and personal behaviors in urban areas otherwise likely to remain unserved for some time.

The simplified sewer systems retain higher usage levels than community-sanitation centers as they offer users greater convenience and privacy. They are more resilient in the face of weak management as they require less operating income and maintenance than communal facilities. Communal sanitation centers have the highest number of users and work best where

- a) there is a high population of tenants or non-permanent residents
- b) there is no space for households to build their own toilets or soak pits/septic tanks,
- c) the area is prone to flooding or subsidence, and/or
- d) the water source serving the community sanitation center will be the primary local source of reliable, good quality water.

The cost-effectiveness of DEWATS is shaped primarily by the number of people using a particular facility. Where the number of users per site is above 50 households, the average cost is substantially lower than centralized systems.

The sustainability of service provision with community-managed DEWATS is vulnerable to a range of challenges: varying levels of motivation by community management structures, inadequate operating income to cover major repairs, limited concern for wastewater treatment performance relative to functioning facilities and free-flowing sewers, and inadequate external support when things go wrong.

The assumption that communities can and will manage facilities and wastewater treatment on their own without external support is overstated. Community-based organizations lose enthusiasm; desludging is neglected; and even the most committed users are reluctant to fund major repairs and refurbishment on their own. Sustained use of the infrastructure and good treatment performance long term are unlikely without external monitoring and support for technical and non-technical problem solving.

Community management should be reconceived as co-management, where user communities take responsibility for routine operation and maintenance, and local government and its partners provide greater technical and non-technical support. Sustained improvements in sanitation and hygiene practices require ongoing reinforcement, support and monitoring.

Community-managed DEWATS do not absolve local government of its sanitation management responsibilities and should not delay more comprehensive planning and investment in integrated sanitation improvement using both improved on-site and off-site sewerage systems.

DEWATS as a scalable urban sanitation option should be developed only in the context of a bigger picture that maps where decentralized systems fit into a broader city sanitation strategy: which areas will be integrated into evolving centralized sewer systems, and within what time frames, and which areas are likely to remain stand-alone decentralized systems long term.

Decentralized systems that can be operated and managed by users are much more likely to reach the poor in the short and medium term than the centralized piped systems and treatment works that prioritize central business and dense downtown areas first.

In summary, community-managed DEWATS can be effective for serving poor communities where the **appropriate type of system** is built well in the right location, **the number of users is optimized** and sustained, and there is **shared responsibility with government** for operation and maintenance. Community-managed DEWATS should be developed as **part of a broader city sanitation plan** and only where a **community has the motivation** to make them work.

I. Introduction

In this review the term **decentralized wastewater treatment systems (DEWATS)** refers specifically to **passive anaerobic treatment systems**. The most commonly used technology in Indonesia's community-managed DEWATS programs is an anaerobic baffled reactor (ABR).

Effective management of sanitation and wastewater is a growing challenge in dense urban settlements. Rapidly increasing urbanization and, along with that, rising settlement densities in low-income urban and peri-urban areas highlight the need for sanitation technologies and management systems that are robust and affordable, and which lessen the pollution load on local water sources.

In many developing countries, centralized sewerage and wastewater treatment systems cover only a portion of larger urban areas, and are often not yet planned for smaller towns and densely populated, low-income areas of cities. On-site sanitation is often inappropriate in the denser settlements and slum areas, thus requiring intermediate and complementary solutions.

Decentralized wastewater treatment systems (DEWATS) connected to simplified sewer systems or communal sanitation centers have the potential to close the gap between on-site and centralized systems. Community-managed DEWATS offer the possibility of swift sanitation improvements in high priority neighborhoods that communities can manage themselves, where local government does not yet provide a full sanitation service.

The Government of Indonesia sees community-managed DEWATS as its best available option for eradicating open defecation and improving sanitation in selected poor dense settlements until full municipal sewerage and wastewater treatment are feasible. It aims to reach 5% of the urban population, or six million people, by 2014, through thousands of DEWATS installations. Indonesia is giving equal weight to centralized and decentralized systems in pursuing its Millennium Development Goals (MDG) and sector goals: by 2014, it is aiming for 5% coverage by centralized systems too.

This review explores Indonesia's experience in implementing community-managed DEWATS on a growing scale, and more specifically, whether community-managed DEWATS are a viable urban sanitation option for serving poor households in dense settlements.

Figure 1: Community-Managed Dewats Can Offer Significant Improvements in Dense Settlements Not Served by Centralized Sewer Systems



The performance of DEWATS in treating wastewater has been documented elsewhere¹; this assessment is more concerned with whether operation and management of DEWATS by neighborhood-based self-help groups is a viable option for supporting service improvements in low-income urban areas at scale. The emphasis is less on the ‘T’ in DEWATS for ‘treatment’ than the ‘S’ for ‘systems’ in the widest sense.

This review draws on quantitative and qualitative data from nearly 400 sites implemented between 2003 and 2011 (representing about 70% of the DEWATS developed between 2003 and 2009) and the experiences of a wide range of stakeholders. It reflects on some outcomes and learning over the decade since the first projects were piloted in 2003.

Box 1: Community-Managed Dewats in Indonesia

Thousands of community-managed DEWATS are being developed across Indonesia. Government funds most of the infrastructure development, and project implementation has a strong emphasis on community engagement and empowerment. There are three main types. The majority are colorful tiled community sanitation centers (CSCs), with toilets, washing and laundry facilities. Alternatively, wastewater is collected from households by a simplified sewer system (SSS), with the treatment infrastructure often built under the road to save space and lower costs in dense settlements. A small minority offers both a local sewer network and a communal sanitation facility, and serves households that have their own toilet and washing facilities as well as those that do not. Each system typically serves between 20 and 100 households, and is managed by a small committee of residents who are responsible for long-term operation and maintenance.

Figure 2: Community Sanitation Centers with DEWATS



Figure 3: Neighborhoods Served by Simplified Sewers and a Communal Treatment Plant



¹ Ulrich, A, Reuter, S, and Gutterer, B (eds.), with Sasse, L., Panzerbieter, T. and Reckerzügel, T. (2009) Decentralised Wastewater Treatment Systems (DEWATS) and Sanitation in Developing Countries.

II. Indonesia's Urban Sanitation Challenges

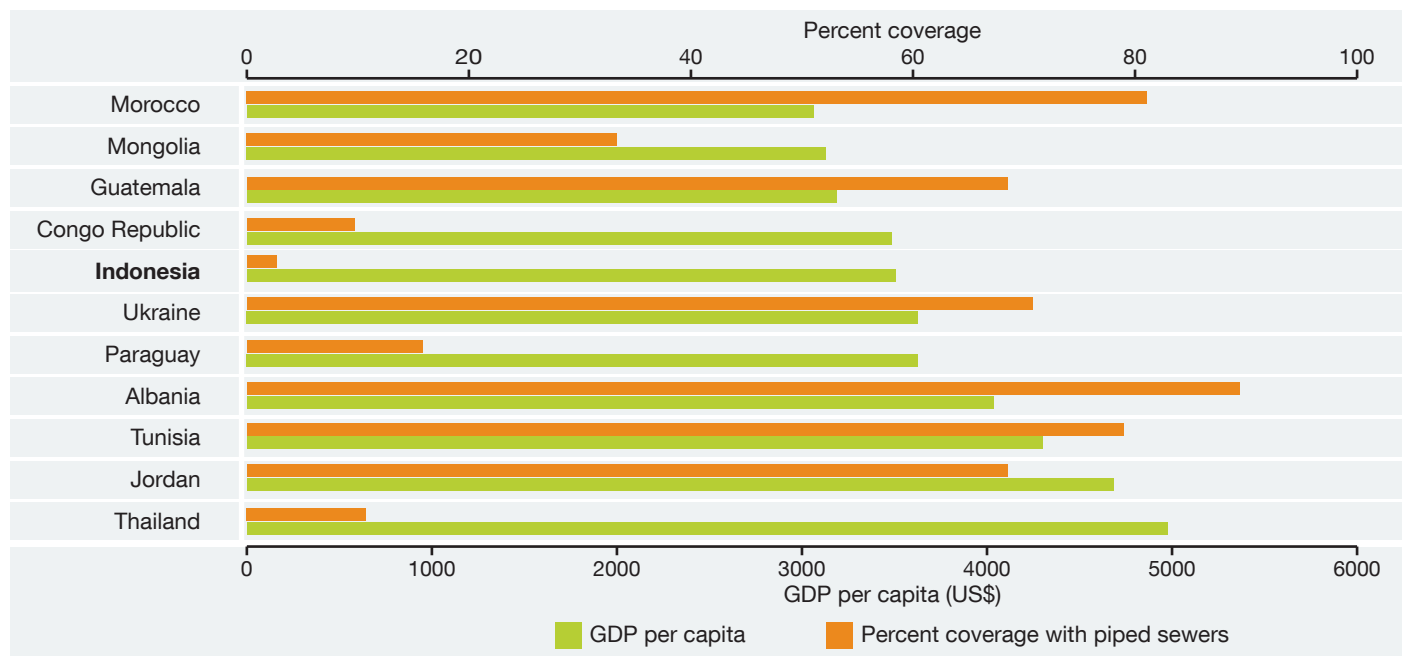
Indonesia's urban sanitation challenges are acute. Half of Indonesia's population of 242 million people live in urban settlements, yet less than 2% are connected to a centralized sewer network and treatment system. Just twelve cities have any centralized sewerage, and even Jakarta, the capital, with nearly 14 million people, has under 2% sewer coverage. Indonesia's piped sewer coverage compares poorly with other countries with a similar Gross Domestic Product (GDP) per capita.

Historically, sanitation improvement in Indonesia has been seen as a household responsibility, and public demand for

investment in sewer infrastructure has been low. Seventy-three percent of people in towns and cities have improved sanitation, but the vast majority rely on toilets connected to soak pits or poorly constructed, open-bottomed "tanki septik".

An estimated 14% of the urban population still practice open defecation or use overhanging 'helicopter toilets' that discharge directly into canals and rivers below. The extent of water pollution is severe. Two-thirds – 66% – of Indonesia's urban population are still not connected to a piped water network, and rely heavily on untreated groundwater.

Figure 4: Indicative Piped Sewer Coverage in Countries with a Comparable GDP Per Capita



Source; UNICEF/ WHO JMP, 2012; World Bank, 2012

Poor sanitation is holding back Indonesia’s human and economic development. The real annual economic cost of poor sanitation in Indonesia has been quantified as US\$6.3 billion (2006 figures), equivalent to 2.3% of GDP. Poor sanitation and water contribute extensively to health problems, and diarrhea, Hepatitis A and E, scabies, worm infestations and typhoid are common.

Local government is formally responsible for ensuring the availability of basic services, but gives sanitation low priority. Urban sanitation is almost entirely private and on-site, and there is little institutional capacity yet to manage sanitation services.

Box 2: The Meaning of DEWATS in Indonesia

If centralized wastewater management is characterized by one wastewater treatment plant for the largest possible confined catchment area in a region, decentralization simply means the break-up of the catchment area into smaller areas (IWA, n.d.). The smallest possible decentralized system is an on-site facility.

Decentralized systems vary in size, and include a range of technologies – aerobic, anaerobic or combined systems; attached or dispersed media; passive or active systems, and so on. In this review, DEWATS is used to refer specifically to passive anaerobic treatment systems.

The DEWATS used in Indonesia are typically one of the following:

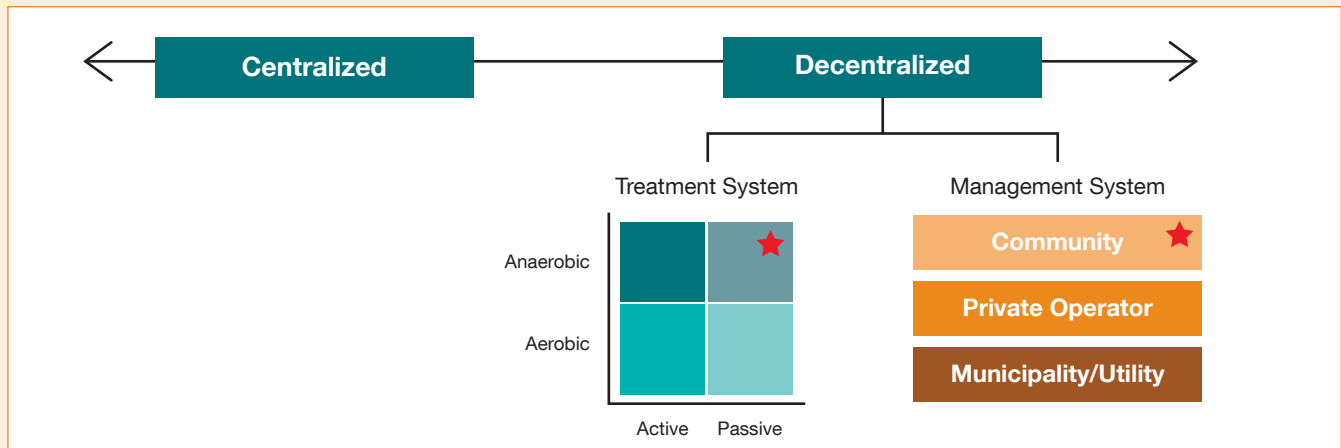
- Communal septic tank
- Biodigester plus anaerobic baffled reactor plus anaerobic filter
- Settler plus anaerobic baffled reactor plus anaerobic filter
- Proprietary system using a permutation of the above systems

To date, anaerobic baffled reactors (ABRs), have been the most commonly used technology in Indonesia’s community-managed DEWATS programs.

DEWATS plants may include secondary and tertiary aerobic and anaerobic treatment in planted gravel filters and/or ponds. None of the domestic systems reviewed here uses planted gravel filters or ponds, primarily because of space constraints in dense settlements. The treated effluent is piped to an open drain, river or canal.

Anaerobic wastewater treatment systems have no moving parts, low running costs and, with adequate training and support, can be operated and managed by the user community itself.

Figure 5: Community-Managed DEWATS as a Permutation of Decentralized Wastewater Management Systems



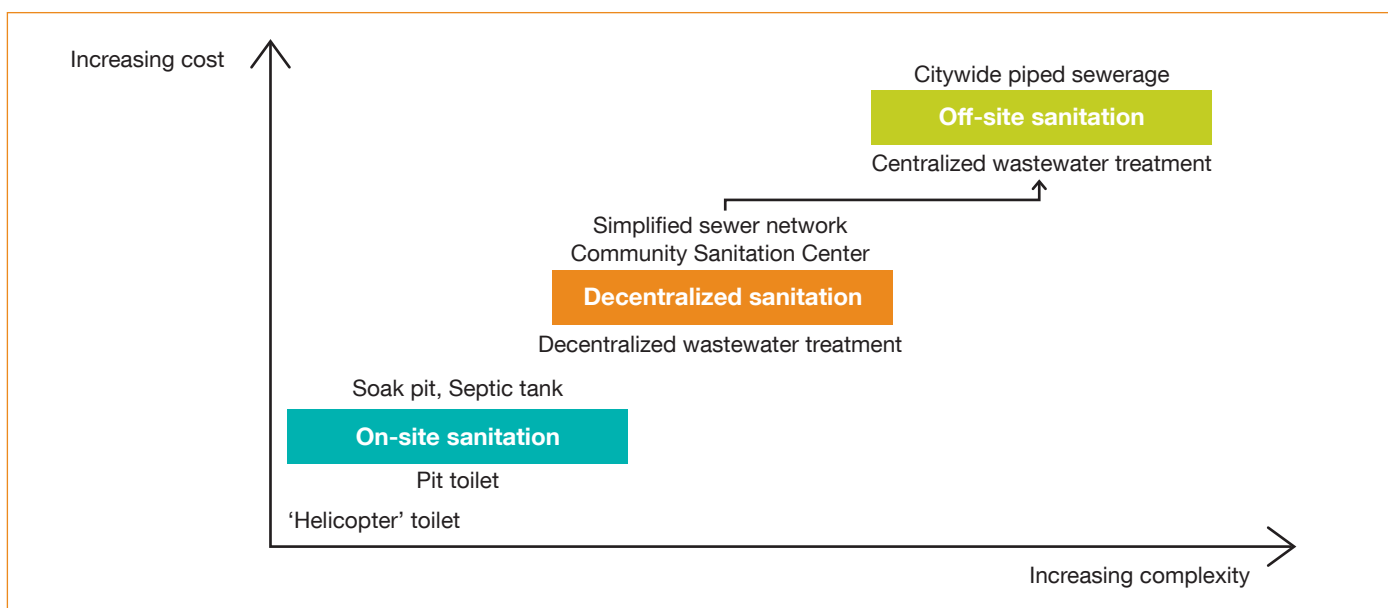
III. The Rise of Community-Managed DEWATS in Indonesia

Indonesia's community-managed DEWATS approach, known as SANIMAS (*Sanitasi Oleh Masyarakat*, or 'Sanitation by Communities'), was piloted in seven sites in 2003-04, in support of a wider sector policy reform initiative led by government. The SANIMAS concept was developed in the context of rapid decentralization of a range of powers and functions to local government, and soon after Indonesia's financial crisis of the late 1990s, which stalled government investment in major infrastructure developments. At that time there was limited capacity to fund, develop or operate centralized sanitation systems. SANIMAS emphasized building and responding to demand for sanitation improvements at neighborhood level, respecting the choices and

preferences of users so that they would be willing to accept responsibility for a system that they liked and could manage, and equipping community management structures to operate the systems long term.

The outcomes of the SANIMAS pilot program were encouraging, and from 2006 the Ministry of Public Works led the replication of SANIMAS more widely, developing 50 to 100 systems per year in poor neighborhoods. Implementation approaches were shaped strongly by a partnership of NGOs with expertise in decentralized wastewater management and community development. By 2009 there were more than 420 SANIMAS installations around Indonesia.

Figure 6: Decentralized Systems as an Intermediate Step and Bridge to Centralized Sewerage and Wastewater Management



Source: Adapted from BORDA (2005), Blackett & Perez (2006) and Utomo (2012)

Since 2007 Indonesia's government has given growing attention to national sanitation improvement. The reasons have less to do with rising popular demand than with the combination, at national government level, of evidence-based advocacy (notably WSP's Economics of Sanitation study that quantified the impacts of poor sanitation), pressure to address Millennium Development Goals, and economic recovery and growing macro-economic fiscal space (WSP, 2011b). At city level, a national sanitation sector development program focused attention on building sanitation capacity, mainly through supporting detailed city-level assessment of sanitation needs and the development of city-wide poor-inclusive strategic sanitation plans.

In 2009, the government announced a five-year Acceleration of Sanitation Development in Human Settlements Program (Percepatan Pembangunan Sanitasi Permukiman, or PPSP) as part of a wider five-year (2010-2014) national development plan, with substantially increased funding for urban sanitation development. Its priority was to eradicate open defecation and improve urban wastewater management, by developing centralized col-

lection and treatment systems in 15 cities and implementing decentralized community-managed systems in 226 cities.

Indonesia's government is now massively expanding DEWATS implementation and aims to reach 5% of the urban population – 6 million people – by 2014. Three national projects are underway, with a fourth being launched in 2013. In parallel, it aims to expand the coverage of centralized sewer networks and wastewater treatment systems to reach a further 5% of the urban population. Government is extending coverage by piped sewers in five cities with centralized systems, and planning new sewerage developments in a further eight cities.

The National Development Planning Agency, BAPPENAS, is promoting community-managed DEWATS as an intermediate solution for selected poor dense settlements until full municipal sewerage and wastewater treatment are feasible. Local networks developed for DEWATS will in time be integrated into a wider sewer system with centralized treatment wherever possible.

IV. Purpose of This Review

This review was undertaken over a period of eight months in 2011-2012 at the request of the Government of Indonesia, to assist in improving its scale-up plans. It aimed to assess the effectiveness and outcomes of community-managed DEWATS projects implemented mainly in the

period to 2009, before the surge in the scale of implementation, and to identify lessons for a wider international audience, since Indonesia is currently one of the countries with the highest number of DEWATS in operation.



V. Methodology

This review drew on a range of primary information sources, including three site-based surveys covering nearly 400 community-based DEWATS sites, or 70% of the total developed between 2003 and 2012. The largest survey, of 298 installations operational for at least a year, was commissioned for this review and covered the majority of SANIMAS sites completed by 2009. It is cited as BORDA-WSP 2011.² These quantitative data were complemented by qualitative data from 50 further sites in seven cities; focus group discussions with users and community management representatives at 37 of those sites; and interviews with a wide range of stakeholders. A growing body of relevant secondary literature informed the assessment.

Table 1. Summary of Primary Data Sets and Survey Sites

Data Set	Community Sanitation Centers (CSC)	Simple Sewer Systems (SSS)	Combined CSC and SSS	Total
Ministry of Public Works 2011	27	5	8	40
WSP-BORDA 2011	198	69	31	298
WSP – Site visits 2011/12	31	13	6	50
WSP – Focus Groups 2012	18	13	6	37

Figure 7: Location of the Seven Cities Visited by the WSP Research Team. Jakarta is Shown Here as a Point of Reference Only



²The survey included sites in which BORDA had an involvement and those which were wholly implemented by government.

VI. Key Findings and Recommendations

Key findings and recommendations are grouped into four broad areas of assessment: institutional roles, sustainability and urban integration aspects; technical aspects; financial and economic aspects; and equity and pro-poor aspects.

INSTITUTIONAL ROLES, SUSTAINABILITY AND URBAN INTEGRATION ASPECTS

KEY FINDINGS:

- **Over 80% of installations are functioning well day to day.** There is strong evidence that most communities are willing and able to take responsibility for day-to-day operation and maintenance, and that they appreciate the benefits and quality of the facilities.
- **Many community management structures do not function as assumed.** Management structures were in place in two-thirds of the sites surveyed, although some are inactive and exist in name only. A small cluster in West Java is managed semi-commercially by an NGO; some are run informally by an adjacent mosque or by users, or are overseen by the head of the neighborhood administration. About 10% of facilities are completely dysfunctional and not in use. Simplified sewer systems appear to be the most resilient in the face of weak management, as they require the least maintenance and income and do not need a full-time operator.
- **Community management approaches are more effective in some areas than in others, and are vulnerable to changes in community leadership.** Management structures work particularly well in settlements with a strong ethic of voluntary service for the good of the community; this is particularly pronounced in central and eastern Java. Maintaining motivation and continuity among voluntary office bearers is often a challenge, in particular when community leadership changes.
- **Few user communities regard desludging as necessary or their responsibility,** and very few DEWATS have been desludged to date. Desludging does not impact on their ability to utilize the facilities; congenial facilities and sewer networks that drain well matter far more to users than a concern for the quality of discharged effluent. The evidence suggests local government will need to play an active role in undertaking, subsidizing or facilitating desludging at DEWATS facilities.

Figure 8: Many Community Sanitation Centers are Designed to Provide a Meeting Space for Local Residents Living in Dense Settlements with Limited Public Space



- **Local government support, in particular post-construction, is largely absent.** The benefits of substantial public investment in sanitation improvement are being compromised by weak systems for monitoring, support and intervention once construction has been completed. Users and their management committees need both technical and non-technical support; keeping the infrastructure working is essential, but managing community dynamics, sustaining behavior change and motivating users to pay matter even more. The review found evidence of a range of problems and difficulties requiring external intervention. With a few exceptions, there is almost no monitoring of usage or performance post construction, no provision for ongoing support and training for community management structures post construction, and no help lines or referral systems for those seeking help.
- **NGO implementation approaches are not readily replicable by government at scale.** The implementation approach adopted for community-managed DEWATS is relatively resource intensive. Given the growing scale of implementation nationally, the number of facilitators, contractors, and project administrators involved is immense, and the transaction costs are relatively high. A parallel sanitation training and capacity study concluded that a significant gap of available personnel would have a critical impact on achieving Indonesia's sanitation targets³. Government does not have the capacity and resources to shape and nurture a multitude of small projects in the way that an NGO network can when working at a modest scale with a cadre of experienced development practitioners in multi-disciplinary teams.
- **There are significant bottlenecks in the recruitment, training and support of project facilitators.** It takes skilled facilitation to mobilize residents effectively for lasting sanitation improvement and to accept responsibility for long-term operation and management of facilities. Rapid scaling up of project implementation has raised demand for experienced facilitators well beyond the available supply, and government is struggling to provide adequate training and support to new recruits on the scale required. There are big differences in the remuneration

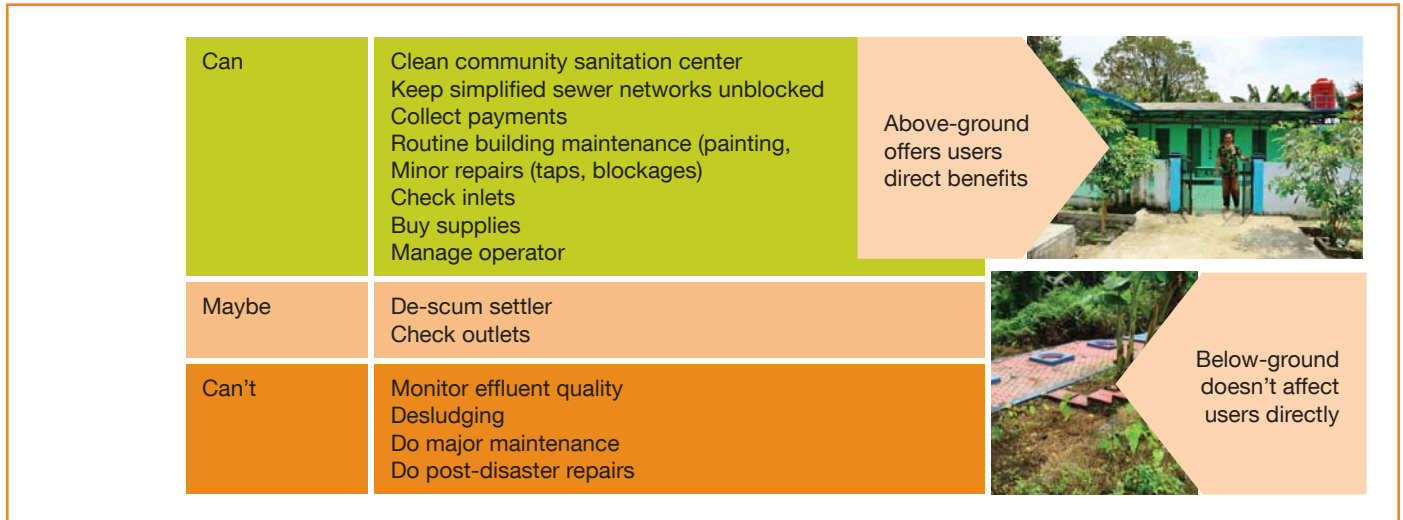
and working conditions of facilitators supporting the different programs, and local government is not yet allocating adequate funds to prepare communities adequately to manage local services sustainably.

RECOMMENDATIONS:

- **Integrate DEWATS into wider city sanitation planning and management.** Develop DEWATS only in the context of a wider sanitation plan that maps where decentralized systems fit into the overall city sanitation improvement strategy. This will include which areas will continue to use on-site systems; which areas will be integrated into evolving centralized sewer systems, and within what time frames; and which areas are likely to remain stand-alone decentralized systems in the long term.
- **Move from 'Sanitation by Communities' to Co-management, or 'Sanitation with Communities'.** Community-managed DEWATS should be reconceived as a **co-management partnership**, with a straightforward and transparent division of responsibilities: communities are responsible for 'above ground' day-to-day operation and maintenance and minor repairs that they can easily detect and fix, while local government and potentially outsourced private partners are responsible for 'below ground' sustainability and provide desludging and disposal of sludge and major maintenance support, along with non-technical support to professionalize community-based organizations. Building strong monitoring systems in local government, supported by up-to-date databases, is essential for the sustainability of the systems, as is a firm plan and institutional framework for post-construction support over the long term.
- **Develop co-management capacity in local government as an integral part of its institutional models for addressing sanitation, wastewater and septage management responsibilities.** Central government should stimulate institution building for sanitation in local government by offering financial incentives to cities that set up an autonomous municipal wastewater utility, or take steps towards this goal with a technical service unit or regional service delivery entity.

³PT Qipra Galang Kualita (2012). Sanitation Training and Capacity Study. Water and Sanitation Program, March 2012.

Figure 9: What Communities Can Be Expected to Manage



Box 3: Mainstreaming DEWATS into Integrated Wastewater and Septage Management

The city of Makassar is building the institutional framework for an integrated sanitation, septage and wastewater utility. It began by setting up a mobile support team in its Human Settlements Department to provide post-construction support to community-managed DEWATS. In mid-2012, it transferred the team to a new technical service unit with responsibility for monitoring and supporting DEWATS, providing a desludging service and managing septage and drainage in the city. The mobile support team continues to work closely with Health and Community Development staff. From 2014 the unit will be restructured to also manage the new centralized sewerage and treatment system being built to serve the city's central business and recreation district. In time the organization could become a full commercial utility company straddling centralized and decentralized wastewater management, septage collection and treatment and drainage.

Figure 10: Members of Makassar's Mobile Unit Provide Support to Community-Managed DEWATS



- **Before construction starts, ensure that local residents understand what they will have to do, manage and fund long term.** Clarify the respective roles of central, local government, and local residents and secure a formal agreement between all parties through a memorandum of understanding for every site.
- **Integrate water and sanitation planning: develop simplified sewer systems in areas served or to be served by piped water.** Increased availability of piped water will result in greater volumes of wastewater that require management. Where houses are owner-occupied and there is enough space to build, households that obtain a piped water connection are more likely to develop their own household toilet and washing facilities, and usage of community sanitation centers may well decline.
- **Ensure regular desludging and safe sludge treatment disposal or reuse.** Consider the full sanitation service chain, from excreta collection to septage disposal or reuse. DEWATS plants should be accessible to sludge collection vehicles either by appropriate siting in relation to road access or by ensuring smaller vehicles are available and able to navigate narrow alleys. Without effective septage management, the health and environmental benefits of improved wastewater treatment in one neighborhood will be undermined by indiscriminate dumping of septage somewhere else.
- **Develop a sound scaling up approach, not replication.** Scaling up entails more than replicating a large number of discrete projects, and requires different institutional arrangements, making the most effective use of available resources. Align implementation approaches with the funding and project implementation cycles and the bureaucratic requirements of government. Work within government implementation frameworks, with mechanisms and incentives to strengthen multi-sectoral coordination, cooperation and accountability between sector departments. Shift from a project-by-project approach to broader programming, with some elements – community management training, sanitation promotion and social marketing, post-construction monitoring and so on – addressed collectively on a larger scale to mobilize the wider resources and systems of the public sector.

Figure 11: Integrated Citywide Sanitation Planning is Essential to Achieve Lasting Improvements



TECHNICAL ASPECTS

KEY FINDINGS:

- **The vast majority of community-managed DEWATS in Indonesia are community sanitation centers.** These constitute 77% of all systems developed through the SANIMAS program between 2003 and 2010, followed by simplified sewer systems (16%) and combined systems (6%). Early program guidelines envisaged community sanitation centers servicing users who were not permanent residents and had little incentive to invest in toilets of their own, and simplified sewer systems as the default. Users are involved in developing the design and layout of the facilities, but the choice of wastewater treatment technology and whether to build a community sanitation center or simplified sewer system is often decided elsewhere, not by users. An attractive community sanitation center is more conspicuous than a buried simple sewer network, and perhaps reflects well on the standing of a local leader.
- **There are important differences in DEWATS serving community sanitation centers and settlements with house connections and simplified sewers.** Simplified sewer systems collect effluent from people's homes, whereas community sanitation centers provide communal facilities and consequently require more land for a top-structure, and have greater management and income requirements. Systems with house connections offer users greater convenience, and collect wastewater from a larger area.

Box 4: Characteristics of Community Sanitation Centers with High Usage

- Little space for residents to build their own toilets and effluent management systems
- Challenging environments prone to flooding or subsidence that deter households from investing in their own toilets
- The majority of residents are not permanent and have little incentive to invest in developing their own toilets
- Many casual users, because of nearby markets, transport hubs, schools or major thoroughfares
- The facility provides a reliable source of good quality water in an area where there are no piped connections or the quality of service is poor, or where alternative sources are unreliable or poor quality

- **Two-thirds of the systems developed to date use an anaerobic baffled reactor (ABR).** A minority use a septic tank or proprietary system based on a septic tank. There is growing use of prefabricated proprietary systems made from fiber-reinforced plastics.
- **Simplified sewer systems have been developed mainly where most users already had a toilet at a home.** Community sanitation centers were developed mainly in areas where most people did not have their own facilities, yet households in more than a third of neighborhoods served by community sanitation centers went on to invest in building their own toilets. This is positive for reducing open defecation and supporting better household sanitation practices, but the type of facilities built generally offers less effective treatment than DEWATS, and contribute to ongoing water pollution.
- **Over 90% of systems tested complied with environmental standards.** Indonesian environmental regulations stipulate a maximum biological oxygen demand (BOD) level of 100 mg/liter for discharged effluent. BORDA-WSP data from a sample of 99 sites with ABRs implemented with support from BORDA shows that 92% complied with Indonesian regulations for reducing the organic content of treated effluent. These findings are consistent with tests done

in 2011 at 22 sites for the Ministry of Public Works, which were mainly on non-BORDA ABR plants. Insufficient data were available to support assessment of the treatment performance of non-ABR systems.

- **Prefabricated wastewater treatment units are a good option for managing construction quality and reducing project management risks, if supplied by manufacturers that meet quality and performance standards.** But if those quality and performance standards are set too high, few suppliers will meet them and the potential benefits of prefabricated systems will be compromised. As yet there are no manufacturing quality or performance standards and systems in place.
- **Usage of biogas is low.** The majority of SANIMAS community sanitation centers with ABRs have a biodigester to collect biogas for fuel, but the biogas is used at just one third of them, mainly by operators and almost exclusively for cooking. The reasons seem to be technical problems with biogas collection (gas leaks, broken or missing pipes) and the low volumes of gas produced from weak effluent, rather than user reluctance. Few operators understand how to manage the digester, and the number burning off unused biogas is negligible; gas build-up in the digester can compromise overall treatment performance.

Box 5: Advantages of Prefabricated Modular Dewats Components

- Mitigate a shortage of wastewater treatment design and construction professionals with standardized modular components
- Achieve consistent manufacturing and construction quality by pre-certifying manufacturers
- Reduce implementation times, and simplify construction on site
- Suitable for challenging environments in tidal areas or a high water table
- Reduce the project oversight responsibilities of the community management organization
- Reduce the facilitator's scope of work and training requirements
- More transparent standardized costing
- Easier maintenance with lightweight manhole covers

Figure 12: Laundry Facilities at a Community Sanitation Center Offer Good Quality Water, Good Drainage and Company



RECOMMENDATIONS:

- **Select the right system for the neighborhood: develop simplified sewer systems, or combined systems, as the default wherever local conditions permit.** Communities are more likely to use the facilities and take responsibility for daily operations and maintenance if they are what people want and need, and are the right type of system to meet the needs of a particular neighborhood. Community sanitation centers work best where there is no space for households to build their own toilets or soak pits/septic tanks, the area is prone to flooding or subsidence, there is a high population of tenants or non-permanent residents, and/or the water source serving the community sanitation center will be the primary local source of reliable, good quality water. Combined systems are the most inclusive, as they accommodate household connections and those unable to connect to the network. Depending on the topography and slope, a combined system may allow community sanitation center users who invest in their own toilet to connect to the network and communal wastewater treatment plant.
- **Build understanding of the merits of anaerobic baffled reactors as the most suitable treatment technology for the majority of installations.** ABRs achieve a higher level of chemical oxygen demand

(COD) and biological oxygen demand (BOD) removal than septic tank systems or biodigesters, tolerate fluctuating loads well, and produce low volumes of biomass. The evidence suggests they can perform well even when operated by unskilled and untrained people. The additional cost of constructing internal compartments is offset by longer intervals between desludging, thus lowering operating costs for users.

- **Develop biogas systems only where there is overt community demand, technical support available, and where sufficient biogas will be generated to warrant the added costs and operating risks.**

FINANCIAL AND ECONOMIC ASPECTS

KEY FINDINGS:

- **The number of users per site is lower than planned.** Median usage is 100 people per site, not the intended 50 to 100 households (250-500 people). The lower the number of users per site, the higher the capital cost and life cycle cost per capita, and wastewater treatment capacity is wasted. The difference between planned and current use is greatest in systems with community sanitation centers. Some were developed in neighborhoods where many residents already had their own toilets, indicating poor site selection; in other areas, residents subsequently invested in their own toilets. If median levels of use were applied across all installations nationally, current programs would need to develop five times as many sites to meet government targets.
- **Low usage raises the capital cost per capita substantially.** Systems with a high number of users are very cost-effective, with costs well below US\$150 per person. Median usage below planned use is most pronounced at community sanitation centers, and consequently the median cost per capita of community sanitation centers (US\$294) is considerably higher than for systems with house connections and simplified sewers (US\$228). Combined systems generally have the highest installation cost but retain the highest levels of utilization and serve the widest range of users.

- **Capital costs are significantly lower than for centralized systems.** Data collected for the WSP’s Economics of Sanitation Initiative in Indonesia indicate that the optimal capital cost per household of a centralized sewer and treatment system was 50% greater than the optimal cost of a community sanitation center with DEWATS. The actual capital cost per household of a centralized sewer and treatment system was more than four times the actual cost of a community sanitation system with DEWATS. Operating and maintenance costs were substantially lower for the DEWATS.
- **The income of the facility is too low to support sustainable operation and management at a significant number of sites.** Most user communities are addressing only day-to-day operations and basic maintenance; few set funds aside for desludging and major maintenance, and expenses like pump repairs or replacement are usually funded by ad hoc collections. Community sanitation centers that charge per use generally have higher incomes, but it is usu-

ally cheaper and more convenient for users to pay monthly rather than per use. Casual users frequently pay more per use and more consistently than residential users, but it is local users who contribute to ad hoc collections to cover big expenses. Most households resist paying more than a nominal tariff.

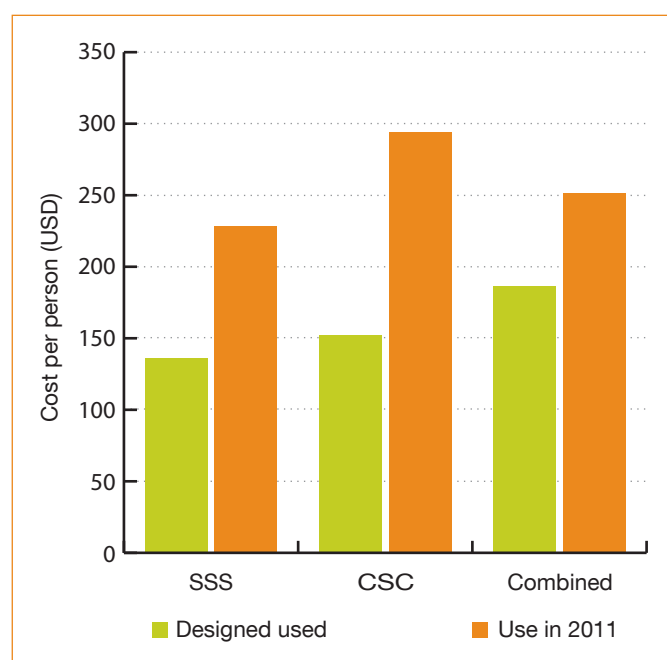
- **More than a quarter of community sanitation centers have no regular income at all, and over half of simplified sewer systems rely solely on ad hoc collections as necessary.** Low payment levels appear to be shaped more by weak financial administration than unwillingness to pay. These findings call into question the long-term viability and sustainability of most installations, and suggest that local government will need to make provision for funding the shortfall.
- **Over half the operators surveyed are working without cash payment,** although many receive non-cash benefits like a room. Low or no wages contribute to a frequent turnover in operators, and the loss of any benefits from one-off operator training during the project phase.

Table 2. Indicative User Charges

	Simplified Sewer System	Community Sanitation Center
No regular payment	47% of sites	30% of sites
Pay monthly per household	53% of sites Graywater and blackwater US\$0.11-1.05 Median: US\$0.31	29% of sites Toilets, washing and laundry US\$0.11-2.10* Median: US\$0.53
Pay per use	Not applicable	41% of sites Toilet: US\$0.03-0.11 Median: US\$0.05 Shower: US\$0.03-0.11 Median: US\$0.05 Laundry: US\$0.05-0.3 Median: US\$0.11

*Includes water for home use

Figure 13: Median Capital Cost Per Capita of a Sample of SANIMAS Projects Implemented in 2006-2009



Source: BORDA-WSP (2011)

Figure 14: Well-run DEWATS Facilities Have a Significant Impact on Local Health and Hygiene



RECOMMENDATIONS:

- **Optimize the system size for impact, cost-effectiveness and financial viability.** Developing discrete DEWATS and equipping the user community to manage routine operation and maintenance can be resource-intensive unless each installation is able to serve at least a hundred households. With fewer users, the cost per capita is high, the improvement in service coverage and public health is limited, and the tariff income is too low to cover costs. In less dense settlements, if there are sound reasons for building

communal facilities, or where there is no central location that is easily accessible by most residents, consider building several smaller community sanitation centers rather than one large one.

- **Build understanding of the real costs of keeping DEWATS facilities working long term.** Give greater emphasis to financial management and raising sufficient revenue when training community management representatives. Increase understanding among users of the benefits of improved sanitation and a clean environment, and use social marketing and other methods to maintain willingness to pay for these benefits. Ensure local government budgets for its co-management responsibilities, including monitoring, ad hoc support and major maintenance.

EQUITY AND PRO-POOR ASPECTS

KEY FINDINGS:

- **Targeting of low-income areas is good.** The majority of DEWATS installed serve neighborhoods where average household incomes are below US\$104 per month. No significant differences were detected between system choices: a slightly higher proportion of sites with simplified sewer systems serve users with average monthly incomes above US\$104, but roughly the same proportion of poor households earning below US\$52 (typically bicycle taxi drivers or factory workers) live in neighborhoods served by either community sanitation centers or simple sewer systems.
- **Communal facilities can provide substantial sanitation improvements.** This review found numerous facilities that were attractive, well managed and well maintained, and serving local needs effectively where toilets for individual households were not feasible for a range of reasons. This challenges the perception that communal toilets fall outside the category of 'improved' sanitation facilities.
- **DEWATS facilities are poor inclusive – but not accessible to everyone.** The evidence suggests that

facilities are enjoyed by people with limited means as well as those who are better off. The strong ethos prevailing in many parts of Indonesia of accommodating those with meager resources results in poor families being asked to contribute what they can. At the same time, inclusiveness on the basis of physical mobility is more qualified. Users generally have to climb some stairs to use the facilities, and most community sanitation centers are raised above the ground; this saves excavation costs as they are generally built on top of the treatment plant, and prevents storm water ingress or flooding, but leaves those with disabilities without access.

- **Improvements in hygiene were evident based on a health impact assessment in 2010.** BORDA's assessment of 68 sites across Indonesia revealed lower rates of open defecation, higher toilet usage and usage of soap at critical times, and reportedly better quality of water from the main source of water for bathing and cooking as well as an improvement in privacy for women compared to the baseline. There was a very low incidence of reversion to unimproved toilets and open defecation.

RECOMMENDATIONS:

- **Build attractive, disability-accessible community sanitation centers, not just public or communal toilets.** Attractive communal sanitation facilities that are customized to the needs and preferences of the targeted user community are more likely to be valued and cared for than standard institutional designs which focus solely on generic functionality. Attractive community sanitation centers which residents readily keep clean and enjoy using meet the criteria for an improved sanitation facility. The disability accessibility is more difficult to convey, as this is not a widely recognized problem in the sector in Indonesia. Community members often do not recognize the need, and while local governments have a role to play in public education, they are often ill equipped to do so. Home-based facilities linked to a

simplified sewer system are considerably more accessible for those with disabilities, further reinforcing the need to make these the 'default' option for the majority of future installations.

- **Sustain improvements in sanitation and hygiene practices through ongoing reinforcement, support and monitoring.** Forge close links between infrastructure development, health, community development and other departments to achieve a more integrated approach to sanitation improvement, and to ensure ongoing interaction and support beyond the project phase. Adapt community-led total sanitation approaches to trigger demand and reinforce support for community-managed DEWATS. Reciprocally, community-managed DEWATS offer communities the means to act collectively on key messages of community-led total sanitation approaches, especially the achievement and sustaining of an open defecation-free community, and sustainable sanitation and hygiene improvements.

Figure 15: A Woman Feeds a Small Child at a Community Sanitation Center



VII. Overall Assessment

This review found that community-managed DEWATS can deliver substantial benefits and enable far-reaching changes in environmental health and personal behavior in urban areas otherwise likely to remain unserved for some time.

Community-managed DEWATS are effective for serving poor communities in dense urban settlements where

- the appropriate type of system is built well and in the right location
- the number of users is optimized and sustained
- responsibility for operation and maintenance is shared with government
- the development forms part of a broader sanitation plan

SUSTAINABILITY

The majority of DEWATS are functioning well day to day. The sustainability of service provision with community-managed DEWATS is vulnerable to a range of challenges: varying levels of motivation by community management structures, inadequate operating income to cover major repairs, limited concern for wastewater treatment performance relative to functioning facilities and free-flowing sewers, and inadequate external support when things go wrong.

The assumption that communities can and will manage facilities and wastewater treatment on their own without external support is overstated. CBOs lose enthusiasm; desludging is neglected and even the most committed users are reluctant to fund major repairs and refurbishment on their

own. Sustained use of the infrastructure and good treatment performance long term is unlikely without external monitoring and support for technical and non-technical problem solving.

Community management needs to be reconceived as co-management, where user-communities take responsibility for routine operation and maintenance, and local government and its partners provide greater technical and non-technical support. Local authorities should monitor DEWATS regularly, budget for interventions, and develop their co-management capacity as an integral part of addressing their sanitation, wastewater and septage management responsibilities. Central government can provide financial incentives to municipalities to pursue this.

COST-EFFECTIVENESS

The cost-effectiveness of DEWATS is shaped primarily by the number of people using a particular facility. Where the number of users per site is above 50 households, the average cost is substantially lower than centralized systems. Simplified sewer and combined systems retain higher usage rates than community sanitation centers, serve more people, and collect wastewater from a far wider area. Greater cost-effectiveness may be achieved by developing simplified sewer systems, not community sanitation centers, as the default, and by developing systems that reach as many people as possible. The most important consideration is to develop facilities at sites where people want and need them, with systems that are appropriate to the needs of the majority of local residents.

INTEGRATED SANITATION IMPROVEMENT

Most community-managed DEWATS developments to date have been discrete and scattered, with usage well below what government's plans and budgets presuppose. Most have been implemented outside of a larger strategic plan which maps how or whether they will relate to possible future sewer networks, or what external monitoring, support or third party servicing is needed to keep them working.

DEWATS are a complementary third option for urban sanitation, alongside centralized and on-site systems, and each system has its place. Decentralized systems that can be operated and managed by local users are much more likely to reach the poor in the short and medium term (in the next five to ten years) than centralized piped systems and treatment works. But DEWATS as a scalable urban sanitation option makes sense only in the context of a bigger picture that maps where decentralized systems fit into a broader city sanitation strategy.

Community-managed DEWATS do not absolve local authorities from their sanitation management responsibilities, and must not be allowed to retard more comprehensive planning and investment in the centralized systems that Indonesia's cities need.

Indonesia's government regards DEWATS as an intermediate technology; as a bridge towards centralized sewerage and wastewater management. In areas where community-managed DEWATS will be integrated into a centralized network within the next ten to fifteen years, it can be seen as both intermediate and interim. But there are many areas that are likely to remain outside of centralized sewer networks for the foreseeable future. In time, management of decentralized systems by communities there could in due course perhaps be taken over by local utilities or private operators.

Indonesia's first priority should be to develop citywide sanitation strategies, with clear plans and time frames for developing centralized networks and decentralized systems and the linkages between them.

VIII. Next Steps

In response to a preliminary report on the findings of this review presented to the Government of Indonesia, key senior government stakeholders worked swiftly to adjust some aspects of the community-managed DEWATS programs to strengthen their impact, reach and sustainability. Government has endorsed the idea of co-management by user communities and local authorities, and has revised its implementation guidelines to emphasize long-term service sustainability. It is also exploring new institutional models for septage management, and

is adapting the national community-led total sanitation program to an urban context: it aims to promote sanitation-related behavior change through campaigns that complement and reinforce community-managed DEWATS.

These responses signal government's readiness to address vulnerabilities in DEWATS programs, and a renewed commitment to supporting successful implementation of community-managed DEWATS at scale.

Bibliography

Asian Development Bank, 2011. *Urban Sanitation and Rural Infrastructure Support to PNPM Mandiri Project: Indonesia*. Report and recommendation of the President to the Board of Directors, July 2011.

Australian Agency for International Development / Indonesia Infrastructure Initiative. 2011. *Project Design Document*. Australia Indonesia Infrastructure Grants for Municipal Sanitation.

Australia Indonesia Partnership, 2011. *Prakarsa Compendium*. Highlights from the Journal of the Australia Indonesia Partnership, 2011. *Special issue on Urban Sanitation*, Issue 7 *Prakarsa Journal of the Indonesia Infrastructure Initiative*.

Australia Indonesia Partnership, Indonesia Infrastructure Initiative, 2010. *Program Design Document. Urban Water Supply and sanitation components*. Water and Sanitation Initiative – Indonesia. Australia Indonesia Partnership.

BORDA Indonesia, 'Health Impacts Assessment for CBS DEWATS 2009'. Unpublished results of monitoring across 68 sites implemented in 2008.

BORDA-WSP, 2011. 'Survey of 298 SANIMAS sites using DEWATS, August-November 2011'. Unpublished database.

Collende G, 2011. Urban sanitation: an unprecedented and growing challenge. In *Water Lines*, Vol. 30: 4, October 2011.

Foley, S., Soedjarwo, A. & Pollard, R., 2000. *Of the people, by the people, for the people : community-based sewer systems in Malang, Indonesia : case study*. [online] Jakarta, Indonesia: Water and Sanitation Program, WSP.

Government of Indonesia: BAPPENAS, 2010. *Report on the Achievement of the Millennium Development Goals in Indonesia*.

Government of Indonesia: BAPPENAS et al, 2003. *National Policy. Development of Community-Based Water Supply and Environmental Sanitation*

Government of Indonesia: Ministry of Public Works. 2010. *Improvement of Sanitation in Indonesia. (Achieving in IYS and Next Step)*. Directorate General of Human Settlements. Presentation to the Follow up Conference, International Year of Sanitation. Tokyo, January 26-27, 2010.

Government of Indonesia: Ministry of Public Works. Monitoring dan Evaluasi Sanitasi Berbasis Masyarakat (SANIMAS). July 2011.

International Water Association (n.d.) 'Decentralized wastewater management – an overview.' Prepared by: Specialist Group on Sanitation and Water Management in Developing Countries of the International Water Association. <http://www.iwahq.org/contentsuite/upload/iwa/all/Specialist%20groups/Specialist%20groups/Water%20Management%20in%20Developing%20Countries/SG%20resources/Decentralised%20wastewater%20management-draft.doc>

Kerstens, S. M., Legowo, H B and & Hendra Gupta, & I B, 2011. *Evaluation of DEWATS systems in Java, Indonesia*.

Japan Sanitation Consortium (JSC), 2010. 'Contact Mission to Indonesia' (Nov.30-Dec.4, 2009). Mission report. Knowledge Hub for Sanitation. January 18, 2010. <http://ebookbrowse.com/jsc-report-1st-mission-to-indonesia-30-nov-5-dec-2009-pdf-d80236357>

Lambertus, A, 2005. *Mainstreaming Community-Based Sanitation: Lessons Learnt from the SANIMAS Project*. Unpublished paper prepared for Indowater 2005.

Marfai, M A, King, L., Sartohadi, J., Sudrajat, S., Budiani, S R. and Yuianto, F. 2008. 'The impact of tidal flooding on a coastal community Semarang, Indonesia'. *Environmentalist*, 28 2008. http://dev.thegnrcs.org/sitefiles/file/Indonesia_Coast_Marfai_2007b.pdf

- Mungkasa, O, 2010. *Mainstreaming of Sanimas as the solution for urban sanitation development in Indonesia*. Directorate of Settlement and Housing, National Development Planning Agency/BAPPENAS. Presentation to the IWA Conference on DEWATS, Surabaya, 2010.
- Parkinson, J & Taylor, K. 2003. 'Decentralized wastewater management in peri-urban areas in low-income countries', in *Environment & Urbanisation*, Vol. 15:1 April 2003
- Pillay, S & Buckley, C. 2010. 'Closing the loop with decentralized wastewater treatment systems'. Second Small Wastewater Treatment Systems Conference, East London, 23 November 2010. www.ewisa.co.za/misc/CONFERENCEWISA/2ndSWWTW.htm
- Pokja AMPL/Drinking Water and Environmental Sanitation Task Force in cooperation with BORDA, Balifokus, LPTP, BEST, 2011. *Seven Years of Sanimas*. PERCIK Special Edition, March 2011.
- Porter, R.C. & Singh, K.A. 1995. 'Jakarta: the economics of water and waste'. Case study 4 produced for USAID's Environmental and Natural Resources Policy and Training (EPAT) project. <http://ageconsearch.umn.edu/bitstream/11876/1/cs4.pdf>
- Prihandrijanti, M and Firdayati, M. 2011. 'Current situation and considerations of domestic wastewater treatment systems for big cities in Indonesia (Case Study: Surabaya and Bandung)'. *Journal of Water Sustainability* 1:2 September 2011.
- PT Qipra Galang Kualita (2012). *Sanitation Training and Capacity Study*. Water and Sanitation Program, March 2012.
- PT Waseco Tirta. 2012. 'Report of SANIMAS Monitoring Program 2008-2009 by PT Waseco Tirta for the Ministry of Public Works'.
- Rochmadi, R., Ciptaraharja I. and Setiadi, T. 2010. Evaluation of the Decentralized Wastewater Treatment Plants in Four Provinces in Indonesia', *Water Practice & Technology* Vol. 5:4
- Salendu, B. 2010. 'Quality assessment and interrelations of water supply and sanitation; a case study of Yogyakarta City, Indonesia. Unpublished Urban Planning and Management Master's thesis, International Institute for Geo-Information Science and Earth Observation, Ensche, The Netherlands.http://www.itc.nl/library/papers_2010/msc/upm/salendu.pdf
- Susila, B, Fladerer, F and Gressiadi, A. (2011) 'Lessons learned from Health Impact Assessment on 68 locations DEWATS-CBS 2008 in Indonesia'. Unpublished presentation to the IWA-DEWATS International Conference, Manila, Philippines, 25-28 May 2011
- TTPS/Sanitation Development Technical Team, 2010. *Roadmap to Sanitation Development, 2010-2014*. Government of Indonesia.
- Ulrich, A., Reuter, S & Gutterer, G. 2009. *Decentralized Wastewater Treatment Systems (DEWATS) and Sanitation in Developing Countries. A Practical Guide*.
- UN Department of Economic and Social Affairs / Population Division. 2012. *World Urbanization Prospects: The 2011 Revision*
- UNESCAP/Pro-Poor Water and Wastewater Management in Small Towns. 2007. *Sanitation by the Community in Denpasar, Indonesia (SANIMAS)*.
- UN Inter-agency Group for Child Mortality Estimation, 2012. Levels and Trends in Child Mortality: Report 2012. Estimates Developed by the UN Inter-agency Group for Child Mortality Estimation (UNICEF, WHO, World Bank, UN DESA, UNPD).

UNICEF/World Health Organization, Joint Monitoring Program for Water Supply and Sanitation, 2012. *Progress on Drinking Water and Sanitation*. 2012 Update.

USAID, 2006. Comparative Study. *Centralised Wastewater Treatment Plants in Indonesia*.

USAID 2009, *Support on Water and Sanitation. Sector Analysis and Program. Final. 2009-2014*.

USAID, 2010. *A Rapid Assessment of Septage Management in Asia*.

Utomo, N T, 2012a. *Indonesia Sanitation Development 2010-14 and Beyond*. Presentation to ICSS-Asia 2012: Sustainable Sanitation in Developing Countries.

Utomo, N. T. 2012b. *Managing Transformation. Sanitation Development in Indonesia 2006-2011*. Presentation to the World Water Forum, Marseille, France, 13 March 2012.

WASPOLA, 2006. *Report: Sanimas Outcome Monitoring Study (SOMS). Final Report. April 2006*.

Water and Sanitation Program, 2000. *Case Study: Of the people, by the people, for the people: community-based sewer systems in Malang, Indonesia*. Field Note.

Water and Sanitation Program, 2009. *Urban Sanitation in Indonesia. Planning for Progress*. Field note.

Water and Sanitation Program, 2010. 'SANIMAS: A sanitation model for decentralized local government.' Unpublished report.

Water and Sanitation Program, 2011a. *Economic Assessment of Sanitation Interventions in Indonesia. A six country study conducted in Cambodia, China, Indonesia, Lao PDR, the Philippines and Vietnam under the Economics of Sanitation Initiative (ESI)*.

Water and Sanitation Program, 2011b. *The Political Economy of Sanitation: How can we increase investment and improve service for the poor? Operational experiences from case studies in Brazil, India, Indonesia and Senegal*. WSP Sanitation Global Practice Team.

Wedgewood, A 2005, 'Practical challenges for Demand Responsive Approaches: A Discussion Paper'. Presented to the Overseas Development Institute ESRC Seminar on Access, Poverty and Social Exclusion, London, 1 March 2005. <http://www.odi.org.uk/events/docs/3228.pdf>

Weitz, A, Blackett, I & NT Utomo, 'Accelerating Sanitation Development in Urban Settlements. How Sanitation in Indonesia has been Transformed'. Presentation to World Water Week, August 2011. http://www.worldwaterweek.org/documents/WWW_PDF/2011/Wednesday/K23/Getting-the-Drive-to-2015-on-track-in-Urban-Settlements/Accelerating-sanitation-development-in-urban-settlements.pdf

World Bank/WSP 2012, *East Asia and Pacific Regional Water and Sanitation Sector Review*.

