Developing Guidance Policies for the Management of Decentralized Wastewater Treatment Systems (DEWATS) by Local Governments

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Abstract
Improving sanitation is on the agenda of many local governments in developing countries. As centralized sewerage systems are beyond the means of most cities and municipalities, decision makers are increasingly turning to decentralized wastewater treatment systems (DEWATS) to manage point-sources of wastewater from schools, public markets, subdivisions, hospitals, and others. Local governments have an important role in fostering an enabling environment for the development of DEWATS. The enabling environment may include incentive programs that encourage people to install and use DEWATS; sludge treatment facilities where septage and sludge from DEWATS may be properly discharged; and ordinances that support, rather than inhibit, effective, appropriate, and sustainable technological solutions for wastewater treatment, dispersal, and reuse. Guidance policies are tools that can augment the enabling environment to set standards for appropriate design and proper installation, as well as to stimulate local initiative, interest, and investment in DEWATS. This paper describes the steps that define an organized and systematic approach to DEWATS; the institutional arrangements for managing the associated activities; and recommended policy concepts local governments may adapt to direct activities in pursuit of the long-term goal of community-wide sanitation improvement.

Keywords:
Decentralized wastewater, guidance, sewerage, sanitation

INTRODUCTION

Improving sanitation is on the agenda of many local governments in developing countries. Because centralized wastewater treatment systems are impractical for all but the largest urban centers, many cities are looking toward decentralized wastewater treatment systems (DEWATS) to fill the need (Kraemer et al., 2010; Norton, 2010). Such systems can generally be less mechanized and more easily constructed with local materials and labor; they require lower sophistication in terms of operations requirements and provide localized reuse opportunities for recycling the effluent or deriving other added values, such as biogas from anaerobic digestion and fertilizer produced by composting biosolids. With all of these benefits, and after many years of promoting the concept, why have DEWATS still not moved from demonstration and pilot project activities to wide-scale implementation?

There are many reasons behind the lack of wide-scale implementation of DEWATS (Fladerer, 2010). Foremost may be a continued lack of understanding by the general public about the importance of proper wastewater management and the relationship between unregulated sewage discharge and disease. In addition, wastewater systems, including DEWATS that are constructed with local materials and labor, are still expensive to install relative to local income in many areas, and the financing options that are available are complicated and poorly defined. Further, the knowledge of local service providers in good DEWATS practice is limited; and the regulatory environment is generally convoluted, confusing, and inadequate to support DEWATS at scale.

To address these obstacles local governments can unlock DEWATS in their communities through a three-pronged approach that

- drives demand for wastewater treatment through education, promotions, and incentives;
- supports DEWATS developers through an enabling environment that includes transparent policies and financing opportunities; and
- promotes a flexible but unified approach to making sound DEWATS decisions.

The private-sector DEWATS service providers will be quick to pursue business opportunities spurred by increased demand, which can reduce costs, improve services, and make DEWATS available to more people. Developing effective policies through a stakeholder-driven process can help make this happen, especially when timed with evidence-based promotion campaigns.

Once unlocked, how do local governments scale up DEWATS so that it becomes a true alternative to centralized sewerage? There are established approaches to site-specific wastewater treatment that have had important successes and provide partial

One BNS-BORDA approach of combining anaerobic baffled reactors with constructed wetlands appears to be very effective and has been replicated numerous times for a variety of sources. The DEWATS system at the Dumaguete Public Market, built by BNS-BORDA in 2007, is a prime example. PSA's use of mechanized systems (sequencing batch reactors) for sites with limited land area has also shown success. Their systems in Muntinlupa, San Fernando City (La Union Province), and Sta. Ana for city-owned public markets are good examples of this technology, as are the CAPS EcoSan projects that use urine diversion toilets for housing and institutional buildings.

answers to this question. In the Philippines, Basic Needs Services Philippines Inc. (BNS-BORDA), The Philippine Sanitation Alliance (PSA), and the Center for Advanced Philippine Studies (CAPS) have been the leaders to date with many successful DEWATS implementations.

While these are all good pilot and demonstration projects, they have not led the way to large-scale community replication. This may be due in part to the wide variety of wastewater sources found in a typical urban environment and the extreme variability in site conditions, each with its own set of constraints, which demands a more flexible approach to DEWATS planning at scale. Such an approach must be based on both source and site characterizations that allow the technologies to be adapted to the unique needs of any locality. The steps laid out here build on the experience with the established methodologies referenced above, but distill the process to the critical steps that local authorities need to consider in their policies and technical standards for DEWATS.

Finally, the DEWATS planning and design process must be demystified and simplified through a step-by-step approach that can be understood and conducted by local service providers. Only then can the process that currently is practiced mainly by nongovernmental and donor-funded organizations be transferred to local service providers to facilitate rapid scale-up through a market-based approach.

This paper will explore not only how local governments can successfully integrate DEWATS into their communities through policies, but also what is needed, at a more detailed policy level, to ensure that DEWATS delivers on the promise of cost-effective and sustainable community-wide sanitation.

THE PATH TO WIDESPREAD DEWATS IMPLEMENTATION

First, Driving Demand through Economic Incentives

One of the more recent local DEWATS policies is the Amended Sanitation Code for San Fernando City, La Union, Philippines (San Fernando City, 2010). It sets a clear path for DEWATS implementation by defining where DEWATS are required, how to go about obtaining permits to construct DEWATS, and the consequences of non-compliance. Some features of the ordinance are especially insightful and geared toward simplifying the DEWATS process and creating a transparent regulatory framework.

The ordinance defines clearly who shall be required to have proper wastewater management systems in article LXVI. These wastewater management system requirements make the following mandatory:

> Owners of all new buildings and structures, whether public or private, residential, commercial, institutional, and/or industrial, must have proper wastewater management systems. Owners of existing buildings shall be required to provide compliant wastewater systems when buildings are sold, substantially remodeled, or in the case where an imminent public health hazard exists (San

San Fernando City's Sanitation Code has developed over the last several years through the dedication and vision of its elected officials, as well as through keen interest by donors. The 2010 amendments referenced in this paper are a direct result of work performed under the USAID–Rotary International Water Alliance program. The San Fernando project is managed by PSA and implemented by AECOM.

Fernando City, 2010).

The policy recognizes that in some instances, it is difficult, if not impossible, for owners of existing buildings to fully comply with this law, due to space or other site constraints. In these instances the policy provides for the following:

> If upgrading is not feasible, and no imminent health threat exists, a condition of non-compliance shall be attached to the property deed, and provisional approval for continued use of the property may be granted (San Fernando City, 2010).

In considering this language, the city recognized that it would be of little benefit to pass an ordinance that was unenforceable or that placed an unreasonable burden upon its citizens. The above referenced policy represents a Philippines version of the "grandfather clause" that grants exceptions to new rules for existing situations. Where provisional approval cannot be granted due to environmental health reasons, the law authorizes penalties for non-compliance, which provides an economic incentive for these building owners to install approved systems.

While not yet codified into law, San Fernando City provides additional economic incentives for the very poor through subsidies to help drive sanitation improvements in these communities. Their urban EcoTanks DEWATS program, implemented by CITYNET (http://www.citynet-ap.org) and supported by the United Nations Institute for Training and Research (UNITAR) and the Prince Albert II of Monaco Foundation, is a replicable model of a simple, low-cost, and easy-to-construct DEWATS technology for urban poor communities to follow (Robbins, 2009).

The Laguna Lake Development Authority (LLDA), in the Central Philippines, is another example of a government agency that promotes DEWATS through economic incentives. Laguna Lake is the second largest lake in Southeast Asia, with a surface area of 90,000 hectares, collecting drainage from 21 rivers. In 1994, there were 1,481 factories discharging into the watershed. In 2011, there are over 8,000. Because of this rapid development, the LLDA promulgated regulations for DEWATS, one of which sets a regulatory minimum flow volume of 12 cubic meters per day while setting stiff fines for non-compliance. Those sources that generate less volume are exempted from the regulations. In this case, characterizing the source in terms of flow is a key driver for generating DEWATS demand.

As these examples illustrate, local authorities can use economic incentives to encourage DEWATS adoption through policies that (1) condition revenue streams on DEWATS, (2) reduce costs of installing DEWATS for low-income users, and (3) raise the costs of non-compliance.

Then, Increasing Demand through Social Incentives

Rapid scaling up of sanitation infrastructure can result when economic incentives are matched with efforts to educate people on how sanitation ties in to health and disease reduction, and then building in social incentives that speak to key motivators. Understanding why people would be willing to invest in sanitation can be determined through evidence-based information gathering activities, such as surveys and focus group discussions. Key motivators may be related to health and

Marikina City's Nasipsip Na! program rewards compliance with window stickers—the program promotes the septic tank desludging through community pride.

disease reduction, status, convenience, community pride, shame avoidance, and other factors. Two such programs are presented as examples of the power of social incentives.

The Marikina City, Philippines, *Nasipsip Na! Oplan todo Sipsip* (the plan for septic tank pumping) program rewards those families that participate in the city septage management program with a window sticker that advertises that the family is part of this growing movement for environmental protection. The city linked the desludging effort with a promotions campaign that ties desludging septic tanks to improved water quality in the Marikina River, a beloved feature of the community. It also provided for penalties for non-compliance. The program, run jointly by Marikina City and Manila Water Company, Inc., has been highly successful.[1] In an interview with the Asian Development Bank (ADB), Marikina's Mayor Fernando said, "Desludging of septic tanks in residential areas is in full blast. There have been positive responses from people once we made them realize that this is the least they can do to help improve the quality of the river water" (ADB, 2009).

Another example is the *WC-Ku Sehat!* (I have a healthy latrine!) program, which is part of a social marketing campaign to improve latrine coverage and end open-air defecation in parts of Indonesia. Funded in part by the Water and Sanitation Program, the signs are provided for those families that improve their latrines as a way of showing their pride in their community and their commitment to improving health. This is but one small part of an integrated strategy that resulted in 615,000 people with improved sanitation (Devine & Paynter, 2010).

The lessons learned from these successful programs can be applied to DEWATS promotion and scaling up, and have a place in local ordinances. Those commercial facilities that comply by installing proper wastewater systems can be rewarded with window placards advising the public that the facility is compliant. This is a similar concept to providing restaurants with grade cards based on their sanitary status. The procedures for issuing (or removing) such placards can be provided for in the ordinance.

Next, Providing an Enabling Regulatory Environment

Ordinances that spell out institutional arrangements and procedures for achieving positive outcomes are an important component of scaling up DEWATS. Components of an enabling regulatory environment are developed through a transparent, stakeholder-driven process and implemented through rigorous technical reviews and inspections. Regulatory review of private-sector outputs is important to ensure safety and sustainable outcomes. These may include site inspections to verify the findings of site investigation reports, technical reviews of submitted engineering plans and specifications, construction inspections to verify that DEWATS construction conforms to approved plans, and post construction compliance inspections.

San Fernando City achieves this in part through the work of the City Wastewater Management Council (CWMC). Article LXV of their Amended Sanitation Code provides that the CWMC is a body composed of parties responsible for septage and sewerage in the city. It includes the mayor; officials from each of the local government offices with an

[1] The city received assistance in developing this model program from the Environmental Cooperation – Asia (ECO-Asia) program, implemented by AECOM and funded by USAID.

interest in wastewater (Engineering, Health, Environment, Finance, Planning and Development, Assessor, Legal, City Council); representatives of national government offices; and members at large, representing stakeholders, users, and consumers of DEWATS services. Among the duties of the CWMC is making available to the public information related to wastewater treatment and septage management, including lists of service providers. The CWMC provides an organized approach to regulation, with all of the local and national agencies working together to develop and refine procedures, issue permits, hear complaints, and solve wastewater problems. Achieving a fair and open forum provides confidence in the process and helps to reduce roadblocks that can stifle demand.

In San Fernando City, most DEWATS projects are still reviewed and approved by the Department of Environment and Natural Resources (DENR), a national agency responsible for environmental programs. However, local involvement by the City Engineering Office, along with oversight by the CWMC, is designed to improve transparency while giving local officials an opportunity to monitor and provide input to the process.

The City Engineering Office also provides the Wastewater Management Application Form required for any DEWATS application. The form specifies the detailed information applicants shall provide to facilitate the review of the project. In addition, the Engineering Office makes site inspections of all proposed DEWATS systems as a routine part of the regulatory process. While these provisions may seem onerous, they are designed with two important goals in mind:

More information about the San Fernando City Sewerage and Septage Management project can be found at their project website: www.sfluseptage.blogspot.com. A link to the full text of Chapter 16 of the San Fernando City's Amended Sanitization Code can be found in the reference section below.

1. To provide applicants with the knowledge of the specific requirements that they must meet to achieve successful outcomes, thereby demystifying the process.

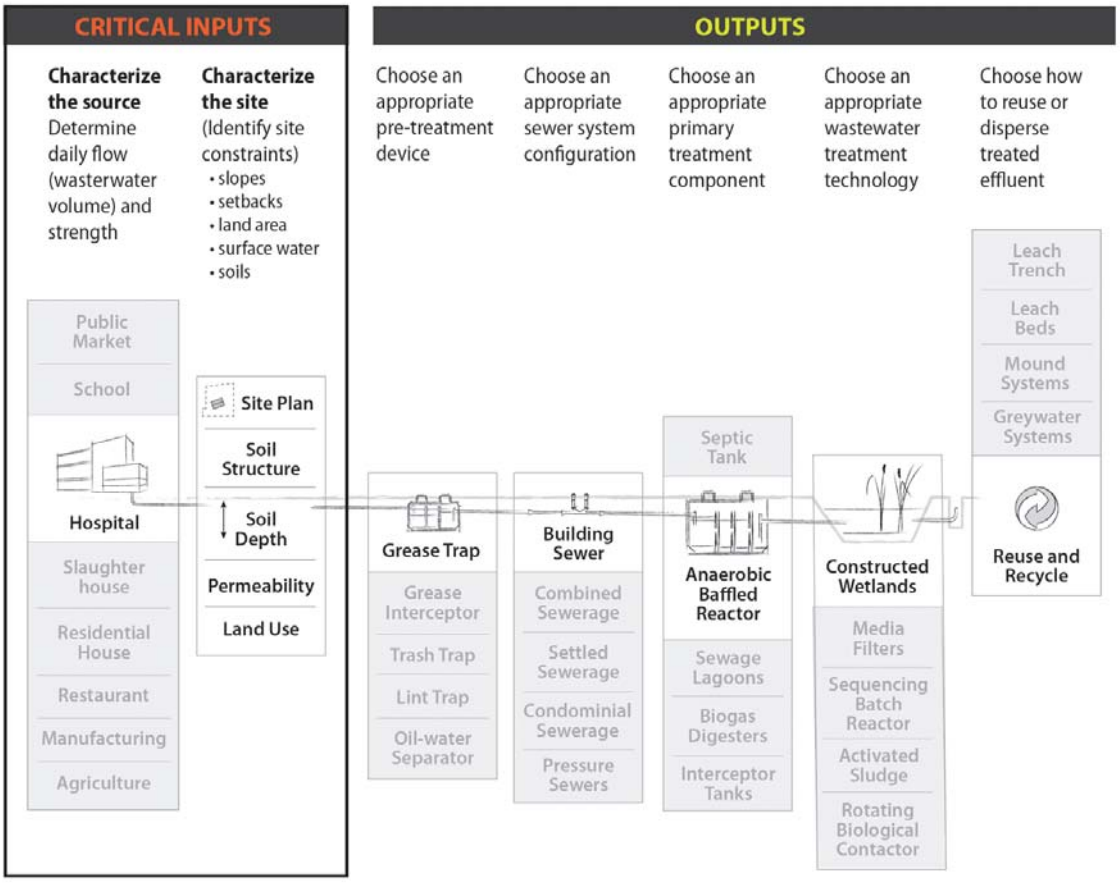
2. To improve the quality of outputs by performing proper reviews and site inspections to verify that the proposed technologies are appropriate for the site conditions. Oversight provides a valuable service to the client and helps minimize full lifecycle costs by reducing system failure that may result from poor decisions or errors in design.

These provisions of the San Fernando ordinance are key tools for unlocking DEWATS for wide-scale implementation by providing an effective regulatory mechanism that increases confidence and provides for better service and more sustainable outcomes.

THE STEP-BY-STEP APPROACH TO MAKING SOUND DEWATS DECISIONS

For local governments that wish to harness the power of DEWATS to solve their wastewater problems, a primary goal is to have installed systems function properly. DEWATS may fail for several reasons, including poor designs that do not properly account for actual hydraulic or organic loading and failure to provide appropriate pretreatment devices (i.e., grease traps for restaurants). DEWATS that fail prematurely or do not meet the regulatory requirements harm the entire industry while driving up full lifecycle costs. Local governments can help achieve positive DEWATS results by taking an active role in guiding service providers to achieve desired outcomes through guidance policies and procedures.

The following graphic illustrates the complexities of the DEWATS decision-making process by highlighting some of the various tasks and options that need to be considered to achieve desired results.



The process starts on the left with source and site characterization; with that knowledge, appropriate decisions on specific technologies are made.

Characterizing the source and identifying site conditions and constraints are the first two steps in the DEWATS design process. These two evaluations, source and site, are the vital links between well-documented DEWATS technology and their adaptation to the myriad site conditions found around the world (or around the block), each with unique requirements. Local governments that take an active role in these aspects of DEWATS development provide a valuable service to the client by helping to ensure that proper data are obtained from which to base DEWATS design decisions. This may be fostered through the adoption of policies that direct the data collection and reporting of findings along with the engineering design report.

Evaluating the Source (Step One)
Wastewater sources may include the following:

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

There are a number of free resources that local governments may use to better understand the DEWATS process and the various technology choices. The Compendium of Sanitation Systems and Technologies (Eawag& Sandec) is one widely recognized resource. Download this and many other resources for free at: http://www.wsscc.org/topics/sanitation/environmental-sanitation

Evaluating the source for DEWATS includes determining the volume of wastewater generated per day (hydraulic loading), fluctuations in flow from day to day or by season, and the constituents (strength) of the sewage in terms of the concentration of various pollutants. The volume and strength of the source wastewater relates directly to the treatment technology considerations; how much land they will require; and the cost to construct, operate, and maintain.

Policies and procedures should specify the three methods of obtaining source data for determining design flow and strength and require that collected data be submitted with engineering designs. The three methods are as follows:

- *Water meter readings and laboratory analysis* for existing buildings and structures. Water meters provide the most accurate method of determining hydraulic loading. Water bills should be evaluated for peak months and flow fluctuations and be adjusted through the use of a wastewater conversion factor that accounts for potable water delivered to the building that is not converted to wastewater (such as irrigation water or water used for vehicle washing). Laboratory analysis can provide information on organic loading and any other pollution constituents in the wastewater that might affect downstream DEWATS performance.
- *Published tables* that provide information on hydraulic and organic loading by key industry. These may be adjusted for local knowledge and conditions.

- *Comparison to similar projects*. This is especially useful for new buildings where water meter data do not exist and published tables show excessive values according to local knowledge.

Whichever method is used, policy should dictate that the source and flow data be analyzed and submitted with engineering design reports.

Evaluating the Site (Step Two)
Procedures for conducting site evaluations may also be established in a local ordinance. Failure to properly evaluate the site can lead to premature system failure, cost overruns, or environmental hazards. Site evaluations include the following:

- *Drawing a site plan.* This should show the property to scale; location of all buildings, wells, property lines, roads, and parking areas; surface water features and floodplains; slope and topography; and the proposed location of DEWATS infrastructure.

- *Analyzing soils* to identify depth, permeability, and soil-bearing capacity. Soil depth is the vertical separation from the surface to a limiting feature, such as bedrock or seasonally high groundwater. This is most important information when considering DEWATS structures such as tanks or ponds that require excavation. Knowledge of soil depth and structure as well as bearing capacity can help engineers and designers choose appropriate technologies and provide accurate cost estimates for installation. The soils' permeability and depth to groundwater are important for any DEWATS system that uses soils-based leaching for effluent dispersal. Local ordinances can specify (based on local conditions) the number of soils test holes and percolation tests or soils evaluations required to adequately characterize the soils.

- *Conducting land use planning review*. Site evaluators should consider land use patterns surrounding the proposed site of a DEWATS to help guide technology decisions. Certain technologies, such as sewage lagoons, should be avoided in dense population centers because of the potential for odors and other nuisances.

NEXT STEPS IN DEWATS DEVELOPMENT—POLICY RECOMMENDATIONS

It is critical to the adoption and implementation of sustainable DEWATS that project proponents perform rigorous data collection through standardized methods for source and site characterization. These first two steps referenced above guide the design of appropriate technical solutions and help delineate the role of local government in the subsequent steps. Once the site is evaluated, project proponents may begin to identify the various components of the DEWATS, including the building sewer that connects the building to the treatment system; any pretreatment devices; the treatment components; and systems for effluent reuse, dispersal, or discharge.

Designing DEWATS may be just as much an art as it is an engineering science. Matching the "best" and most cost-effective technologies with the actual source and site conditions is imperative for cost-effective DEWATS solutions. Technology choices should be grounded in the realities of the amount of capital they cost to construct; land area requirements; ease of operation; system longevity and the cost of replacement parts; and the potential for systems to generate nuisances, such as odors and mosquito breeding. These costs should be balanced against the potential benefits of cost recovery opportunities from wastewater residuals, such as the value of treated effluent for reuse and recycling, biosolids processing for soils

amendment or fertilizer production, and biogas recovery. Technology choices should be based on an understanding of which components are required by ordinance (such as grease traps for restaurants), and which processes will need to be used to achieve effluent standards. Performing a cost/benefit analysis can help guide the technology decision-making process.

Reviewing and approving engineered designs may be beyond the ability and responsibility of many local governments, and fall to regional or national agencies.[2] However, as DEWATS have a local impact, local governments should have a say in the overall permit approval process. San Fernando accomplishes this by requiring that engineered plans be first submitted to the City Engineering Office for an initial review prior to being routed to the regional office of the national agency for processing and permit issuance. Permit applications are requests to authorize construction. They contain information about the project proponent, property location, the proposed design, proposed construction schedule, and affidavit of compliance. Once all documents are in order, the regulatory authority issues the permit to construct. No construction should be permitted unless a permit to construct is issued.

Construction inspections are provided as a service to owners so that they know construction is being performed in accordance to the approved plans. Failure to perform construction inspections invites poor workmanship, cutting corners, and higher lifecycle costs. The construction inspections are a prelude to the approval of construction. Once the construction is complete, the finished system should be tested, certified, and approved. Prior to the final inspection, the contractor should be required to submit to the regulatory official the "as-built" and record drawings and an operations and maintenance plan, which become permanent records for future reference. The record drawings should be reviewed for consistency with the actual construction. For new construction, permission to occupy the building should be withheld until the wastewater system is approved. Approvals should also be based on simple tests that can be conducted in the field to verify construction compliance, such as the leak test. A requirement for leak testing for all tanks and basins that are components of DEWATS systems can be accomplished with a simple policy statement and procedure that can dramatically increase the long term effectiveness of DEWATS.

Monitoring systems after the construction is completed and systems are in operation helps to ensure long-term functionality. Often, DEWATS are monitored by national agencies that have a broader mandate for water quality and environmental protection. Local governments may wish to receive copies of monitoring reports or make spot inspections to gauge levels of ongoing compliance. Such activities help to assess the effectiveness of DEWATS regulations and procedures and may suggest opportunities for improvement.

Some Additional DEWATS Provisions of the San Fernando City Amended Sanitation Code

Local governments may consider some of these additional concepts for adaptation to their own DEWATS policies:

- *Compliance schedules*. The San Fernando policies set forth a mechanism for achieving compliance for violators with extenuating circumstances. For those

[2] It should be noted that in many instances, local governments are ill equipped to carry out technical roles related to reviewing and approving DEWATS. In such circumstances, they may rely on private-sector service providers who may be contracted with to provide key services, or work with regional staff of national agencies.

individuals or businesses served with notices of violation, the CWMC, at their regular sessions, may hold a hearing to better understand the factors affecting the compliance status. Based on the outcome of the hearing, the CWMC may negotiate schedules or plans with the violator and agree upon a reasonable timeframe for compliance.

- *Proprietary products*. San Fernando City encourages innovation in addressing wastewater needs. Proprietary or engineered products that meet the specifications for sizing and construction as provided in national law may be used without restriction. Those proprietary or engineered products that do not adhere to these specifications may be permitted, but must undergo third-party testing and certification.

- *Greywater management*. San Fernando City recognizes the importance of proper management of wastewater from laundry washing, tubs, and sinks; as uncontrolled discharge of this greywater may lead to environmental health hazards. Therefore, by policy, they have stipulated that greywater may not be permitted to accumulate or pond near homes. Instead it must be combined with other household wastewater and disposed into a septic tank, or be treated and disbursed or reused in accordance with the provisions set forth in the ordinance.

CONCLUSION

Local governments can utilize DEWATS as a viable strategy for sanitation improvement by creating an enabling environment that includes clear and transparent institutional arrangements, establishing economic and social incentives, and taking an active role in monitoring service providers. By providing clear guidance on source and site evaluations, local governments can ensure technical rigor while accommodating the wide variations inherent in urban environments. This may be achieved in part by developing guidance policies and procedures encoded in local ordinances. A model ordinance, the Revised Sanitation Code of San Fernando, La Union, Philippines, may be used as a starting point for other local governments wishing to unlock the power of DEWATS for widespread sanitation improvement.

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