Efforts to design wastewater treatment systems for Tacloban North relocation sites

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ABSTRACT

The desire to construct permanent housing, especially housing of a superior structural quality than that of houses destroyed in the calamity, dominates post-disaster recovery and reconstruction actions while other aspects of infrastructure are neglected. Relocation projects in particular, often established on barren parcels lacking any formal civil infrastructure, face unique construction challenges. As a descriptive case study, this paper serves to chronicle the development of one of the most trying infrastructure challenges for relocation projects, improving conventional standards of wastewater treatment. Our context is Typhoon Yolanda recovery in Tacloban City, Philippines, where 40 percent of the population slated for relocation. We find innovative coordination channels and outside expertise were critical to the development of new wastewater interventions, yet conclude that deeper levels of community engagement are needed if the technologies are to be successful.

Keywords: infrastructure coordination, sanitation, post-disaster relocation, civil engineering

1. INTRODUCTION

The build back better paradigm carries an implication of holism. “Build” is extrapolated to include the planning, participation, and management processes antecedent to physical construction. “Better” is inferred to mean houses of a superior structural quality as well as reliable access to utilities, culturally appropriate designs, thoughtful urban planning and more. Despite expectations of integration, housing construction dominates post-disaster recovery actions. In the wake of haste for housing, additional necessary infrastructure, such as water provision, wastewater management, and engineered drainage, can be neglected. The conception of non-housing services as secondary features of construction trivializes the effort to install upgraded or even adequate infrastructure. Often, however, improving non-housing infrastructure can be more difficult than the task of constructing stronger houses, particularly in the case of sanitation. Obstacles plaguing routine construction of sanitation upgrades – weak political interest, limited technical capacity, lack of community buy-in – are exacerbated by post-disaster pressure for rapid reconstruction. Sanitation infrastructure also has a significantly large differential to

clear: often the objective is to jump from no access to improved sanitation at all, especially in informal dwellings, to exemplary treatment. Recognizing absence of literature examining this task in a post-disaster environment, we aim to describe the experience of one Philippine city as it endeavors to both reconstruct and dramatically change sanitation norms.

2. BACKGROUND ON RELOCATION AND SANITATION

Literature dedicated to investigating support infrastructure during reconstruction is sparse and often cursory. In their case study on housing and support infrastructure in post-tsunami Sri Lanka, Jean-Pierre and Staff (2010) note that management problems are under addressed. Where literature on sanitation in emergencies does exist, it is focused on emergency sanitation and fails to extend the analysis to long-term difficulties (Amin and Han 2009; Fenner et al. 2007). The case study that follows is focused on relocation projects in particular; several studies of relocation after the 2004 Indian Ocean tsunami (Ahmed and McEvoy 2014; Fernando et al. 2009; Jordan et al. 2015) report on sanitation infrastructure, but often stop short at the septic tank. We see a pattern in the literature indicating that where relocation is deemed necessary, the overarching and demanding goal of moving families out of hazard zones can override other goals for elegant and sustainable development, particularly improved sanitation. We found no literature detailing efforts to significantly upgrade sanitation infrastructure during the construction of post-disaster relocation communities. A dearth of literature indicates a lack of research into the intersection of reconstruction, relocation, and sanitation, as well as a lack of implementing improved sanitation at relocation sites; we suspect the latter to be the core issue. Such a gap is problematic because large-scale relocation can spawn direct environmental consequences as an unmarred landscape is inundated with the waste of thousands of newcomers.

Key advantages and pervasive issues of the selected technology – in general, decentralized wastewater treatment systems (DEWATS) – warrant mention before considering DEWATS application in the case of Tacloban North. Conventional wastewater treatment consists of pumping sewage to a centralized plant requiring high energy, operation, and maintenance inputs. In contrast, DEWAT systems use a series of biological processes, rely on gravity-fed flow, and are considered a more sustainable solution for rural or resource limited communities where the cost or complexity of conventional treatment is prohibitive (Singh et al. 2015). Despite appearances, classifying DEWATS as the simpler option is a misnomer. Decentralized systems require much more user participation than centralized systems and social dynamics are often to blame for failed DEWATS projects (Törnqvist et al. 2008).

3. CASE STUDY METHODOLOGY

We employed a descriptive case study methodology that is an introspective and reflective attempt to capture and share experiential knowledge. The case study emerged from an iterative dialogue between observant (academic) and participatory (government) members of our research team. Conversations with stakeholders, community visits, and observations of regional and local meetings further contributed to a comprehensive understanding of how the city is working toward correcting wastewater management in relocated communities.

3.1 Context: Wastewater treatment for Tacloban North

The path of the strongest storm to ever make landfall, Typhoon Yolanda, intersected with the economic and political heart of one of the poorest regions in the Philippines (PSA 2016). Tacloban City, Leyte, endured storm surges towering five meters high and sustain winds up to 195 mph (Jenner 2013). After Typhoon Yolanda destroyed a number of coastal communities, particularly the informal settlements that precariously hugged the shoreline of the San Jose peninsula, the local government decided to remove residents from dangerous land along the coast. In partnership with numerous nongovernmental, regional, and national agencies, they began an arduous effort to relocate 40% of the population, over 15,000 families, to largely undeveloped plots of land north of the central downtown area (Tacloban City 2016a). A quickly growing highly urbanized city already in need of alleviating population density, the government had identified northern lands as areas of opportunity for industrial growth and socialized housing prior to the storm (Tacloban City 2016b). Thus, the city benefited from some pre-storm relocation planning, but the advantage was slight – the demands of disaster greatly increased the necessary scale and speed. In an effort to both shelter survivors as quickly as possible as well as build-in time to thoughtfully plan the development of permanent sites, relocation was structured in two stages. First, to transitional shelters, made of readily available but structurally weak housing material; then to permanent homes in what has come to be known as 'Tacloban North'. The move to permanent relocation sites is still only in early implementation. As of August 3rd 2016, 2,024 families were moved into nine relocation sites (CHCDO 2016).

Even with staged construction, the threat of being faulted for slowing recovery prompted the city government to allow developers to begin work at permanent sites without completing the standard review process and securing permits. A lack of review contributes to the faulty state of sanitation at relocation sites, but cannot explain it entirely; *pre-typhoon* socialized housing projects approved through routine oversight procedures reveals similar substandard wastewater practices. For example, one NGO-led site installed a single three-chamber septic tank for each block of row houses, greatly exceeding tank capacity. This site, tucked away into the western foothills of the town, houses only several dozen families. The collective pollution from failing septic tanks is not enough to draw the attention, and draw out the pocketbooks, of government agencies. At Tacloban North relocation sites, wastewater failures are not able to hide in the same way. The project is too big, too concentrated, and threatens a much more obvious and direct impact on the San Juanico Straight – the bedrock of the local economy.

Post-Yolanda relocation homes are designed to adhere to the standards of the National Housing Authority (NHA). While there are minor differences depending on who manages the site – an NGO, the city, or the NHA – each home has a footprint of at least 22 m^2. (greater than the minimum national standard of 18 m^2) and indoor plumping (to eventually be connected to a piped water supply). Additionally each house, or occasionally a handful of houses, includes a septic tank. The installation of septic tanks, rather than conventional centralized treatment, is in line with sanitation norms of the Philippines; 74 percent of the Philippine population has access to improved sanitation facilities but less than 5 percent are connected to a sewer. Discharge from septic tanks is connected to the site drainage system, and then flows into the nearest creek and eventually to the San Juanico Straight. Dredging septage, the solids collecting in the septic tank, has been designated as the responsibility of the community members (a chancy expectation since research shows communities rarely feel desludging is their responsibility (Eales et al. 2013)).

Soon after the first hundred families move the city government voiced concerns that the population surge will dramatically disrupt existing environment stability, especially in the Suhi and Baruguan rivers flowing into the San Juanico Strait. Once notified, the National Economic and Development Authority, already established as the regional coordinating body for Typhoon Yolanda recovery, drew attention to the matter at a meeting of regional stakeholders and ordered wastewater quality tests. Samples were taken by City Health Office from Tacloban North Villages and Ridgeview, two of the largest relocation sites (Tacloban City 2016a). In total, three rounds of validation tests identified egregious levels of total and fecal coliforms – beyond limits dictated by Philippine law for discharge into waterways and wholly unsafe for the surrounding population (EMB 2016). With the magnitude of the wastewater predicament confirmed, the next step was to determine how to fix Tacloban North's substandard sanitation. This study narrows in on that process, disclosing unique challenges, emergent solutions to date, and outstanding weaknesses.

4. DISCUSSION

Below, we describe five themes based on the experience of supplying sanitation to relocation sites. First, institutional threats to block the implementation of decentralized water treatment systems (DEWATS). Resistance is multifaceted, grounded in both legitimate financial and technological issues as well as institutional and social norms. Then, we describe responses implemented by the city government, including: horizontal collaboration, vertical collaboration, and external partnerships, and community partnerships. Finally, we identify a need to draw out community buy-in of the onsite systems in order to ensure sustained operation and maintenance.

4.1 DEWATS and Institutional Inertia

Three primary concerns—cost, time, and acquisition of additional land—drove decisions regarding implementing treatment. Decentralized wastewater treatment systems were selected specifically for their relatively low cost and ease of construction, but post-disaster recovery is a time-stressed environment (Olshansky et al. 2012) and many stakeholders were not appeased quickly. The Tacloban City Government and supporting NGOs were up against a troublesome paradox: the problem was exposed only because several hundred families were already moved in, but this very fact, completed infrastructure, counteracted momentum for changes in sanitation. Upgrading sanitation at "finished" relocation sites requires demolishing and reconstruction roads and drainage lines, compounding cost and time and understandably frustrating developers. A final practical hurdle, mostly for the engineers, was the inability to gain full knowledge of the design parameters. Chemical oxygen demand (COD) is the best indicator of the magnitude of pollution in wastewater and is indispensible in calculating DEWATS (Sasse 1998). However, technical, political, and logistical difficulties block local and regional capability to test COD. Designs were stalled until additional expertise (in the form of outside consultants, see below) – and a willingness to be flexible – were infused into the process.

Reluctance within stakeholder organizations was fueled by both institutional inertia and suspicion of unfamiliar systems. Neither the city government nor the NHA had prior experience overseeing the design and construction of decentralized systems. This contributed to a pervasive *'Why here*

and why now?' hesitancy to alter established processes for socialized housing. Resistance due to internal unfamiliarity with DEWATS was compounded with external unfamiliarity – only a small percentage of the country's sewage receives treatment and there are few exemplar models to serve as guidance. Additionally, in a few isolated cases, we witnessed the rarity of wastewater treatment be incorrectly confused with the right to wastewater treatment, the rationale being beneficiaries of subsided homes are not entitled to receive a benefit most other Filipinos do not. We call this the "it's only socialized housing" syndrome, and while we admit it afflicts some individuals, we have not found it to be a ubiquitous belief of any stakeholder organization.

4.2 Horizontal Collaboration

In Tacloban, the conventional government hierarchy was unable to effectively handle problems due to the exceptional scale of relocation and unfamiliar demands of advanced wastewater management. To better comprehend needs and discover inventive solutions, a flexible collaboration among departments emerged, one that departed from traditional city government roles. Within the conventional arrangement, the City Health Office is assigned to oversee all sanitary matters. Where the risk of pollution poses not only a human health hazard but also environmental harm, the City Environment and Natural Resources Office is also assigned. The two offices specialize in monitoring for policy violations. In contrast, the majority of the city's technical expertise is housed in the City Engineer Office and the City Architect Office. Implementing a project as new and widespread wastewater treatment would naturally require cooperation among these offices, but likely in their standard methods. However, the plan for Tacloban North's decentralized systems has developed out of a much larger goal than treating wastewater itself; it developed under the umbrella of an ambitious desire to build back better. In an emergent and organic process, project planning for relocation was coalesced into a multi-stakeholder partnership called the Tacloban North Cluster, spearheaded by the City Housing and Community Development Office (CHCDO). Overshadowed in the early days of recovery, by 2015 wastewater needs began to earn dedicated attention through the establishment of a sewage and septage technical working group (S&S TWG), an inter-office subsidiary of the Tacloban North Cluster. As the full scope required for the massive relocation effort came to be understood, CHCDO worked to engage all relevant offices and also found itself playing a more prominent role in sewage and septage management than formally tasked.

From 2015 through 2016, the CHCDO led city collaboration and became the primary advocate for wastewater treatment. Since mid-2016, on the heels of the June inauguration of newly elected government officials from national to local levels, the management of Tacloban North has been renovated – reshuffled to again mirror the traditional hierarchy of the Tacloban City government. The Tacloban North Cluster remains, yet is now directly managed by the City Mayor's Office. Technical working groups continue but also with adjusted leadership. For the sewage and septage technical working group, this means the City Health Office is restored as the principal department. Although the management structure is returning to the conventional office structure of the city government, we do not see the change as a complete crystallization of collaboration. Rather, once problems, priorities, and solutions were more robustly defined within innovative and informal alliances, it became possible to then categorize them into the conventional office structure of the city government. The S&S TWG, developed to address relocation needs, lives on to tackle citywide wastewater dilemmas.

4.3 Vertical Coordination

Evolving the old practice of only installing septic tanks into a new practice of multi-staged biological treatment has required collaboration among local, regional, and national stakeholders in unprecedented ways. Just as new platforms for collaboration had to be created in the city government, an unconventional form of coordination among regional and national stakeholders also emerged. Customarily, local government units are connected to the national government through district and regional layers of bureaucracy. Tacloban's classification as a highly urbanized city allows it to skip these layers and communicate directly with the national government. However, much of the Post-Yolanda financial aid was deposited in national government departments then distributed to the regional level, coercing negotiation between Tacloban City and regional offices. In post-Yolanda Tacloban, the Region VIII National Economic and Development Authority (NEDA) became a key facilitator of coordination among regional and local departments. We believe two characteristics propelled NEDA to succeed as a coordination facilitator where other attempts to establish coordinating bodies failed. First, Region VIII NEDA was not directly involved in project implementation, allowing the office to arbitrate without accusations of advancing its own project goals. The NEDA office became a coordination liaison after OPARR, the body devised by the national government to direct recovery, ended its mandate. Second, NEDA has an immediate connection to financially influential offices: the Regional Development Council is housed inside NEDA's building. One noted critique of OPARR was its coordination capacity was limited by a lack of funding power. In contrast, NEDA was a tenacious partner in leveraging funding agencies. Figure 1 illustrates the relationship among local, regional, and national departments, demonstrating the unique facilitation role of NEDA and the use of technical working groups.

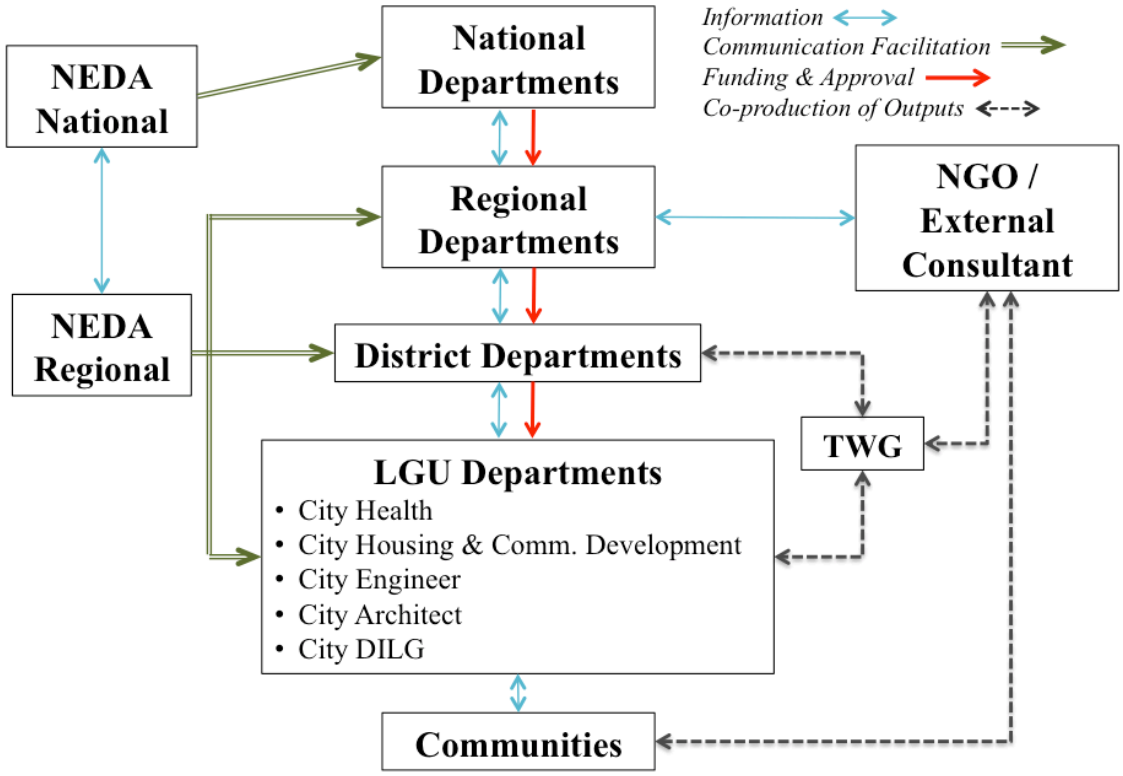

Figure 1. NEDA facilitation and consultation with outside experts

4.4 External Partnerships for Technical Expertise

Progress was hindered because government engineers, both in the city and Region VII office of NHA, had no prior experience designing secondary treatment. We find this phenomena to be uniquely distinct from housing reconstruction; the technical capacity to design and contruct houses is not a limiting factor in the Philippine context. To overcome unfamiliarity with decentralized wastewater treatment systems, the city reached out to the nongovernmental organization Oxfam. Over a period of several months, Oxfam assisted in the selection of the DEWAT recipe to be used at Tacloban North sites: post-septic tank discharge flowing sequentially through a settler, anaerobic baffled reactor (ABR), anaerobic filter, and a planted gravel filter before entering the nearest stream. The peak of the partnership was a capacity-building workshop, connecting government engineers to a Manila-based consultancy with a speciality in engineering decentralized systems. The consultancy, Basic Needs Services (a BORDA affiliate) contributed best practices for design and assumptions for chemical oxygen demand based off of years of experience implementing DEWATS throughout the Philippines. BNS continues to actively support design development and, pending the finalization of a Memorandum of Agreement, will also assist in construciton oversight.

5. AREA OF IMPROVEMENT: COMMUNITY BUY-IN

To date, community members have been under-informed of wastewater management. In general, community members have an incomplete understanding of sewage management; most are not able to narrate what happens to septic tank discharge. Limited wastewater awareness poses immediate health risks – at one site, children often play in the creek where discharge is released - and is also a barrier to ensuring the systems are adequately cared for. A major step in motivating community members to care for the systems is to first convince community members a problem exists in the first place. While not extensive, like any engineered system decentralized wastewater treatment requires attentive operation and maintenance for full functionality. Literature shows the healthiest systems are those in the charge of participatory community organizations with robust governmental support, but that truly active and engaged organizations can be difficult to cultivate (Eales et al. 2013). However, the city government advantageously already has an established architecture of organizing community leadership at relocation sites. These groups, installed by the City Housing and Community Development Office, should be involved by the City Health Office to ensure grassroots management of sanitation. We recommend social groups at relocation sites be notified about impending sanitation updates, consulted before designs finalize and construction proceeds, and trained as necessary for system maintenance.

6. CONCLUSION

Past post-disaster relocation projects emphasized housing construction and undervalued the complexity of building back better support infrastructure, particularly wastewater. After being devastated by Typhoon Yolanda, Tacloban City set out to relocate roughly 40% of the population, but neglected to incorporate sanitation in the first wave of implementation. Unless the proper treatment of sewage is prioritized, this could cause severe strain on the natural resources, endanger the public health, and economic. Ensuring secondary treatment at relocation sites

requires reversing a lack of technical capacity, overcoming an institutional resistance to change, and forging new conduits of communication among both local and regional agencies.

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