Participatory Solid Waste Management
A proposal for Jamaica’s Informal Settlements

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Introduction

On March 11, 2015, the Riverton City Dump, the largest dump in Jamaica started to burn; by March 16th the Kingston Fire Brigade said that the entire 31.25-hectare facility was ablaze. During the estimated 2 weeks that the dump burned the Ministry of Health stated that over 800 people across three different parishes visited hospitals for respiratory-related complications and schools and businesses in the area were forced to close. The landfill receives over 60% of the nationally collected solid waste, on a site without an impermeable-lined base layer, without surface covering and without frequent compaction of waste. Since 2007, an estimated 2406.4 tonnes of unmonitored waste was added to the dump daily. Sporadic burning of wastes from spontaneous combustion has not been uncommon.

The historic March incident brought national attention to the woefully inadequate management of the landfill and the unpreparedness of government agencies to handle environmental and health crises, and started a public discourse on the future of the landfill. Concern about Riverton was intensified because of the landfill's proximity to densely populated urban areas, industry, and commerce. Despite this, however, the issues and concerns are not unique to Riverton but prevalent throughout all the dumps and landfills across the island.

What was missing from the public discourse was a comprehensive examination of the national solid waste management strategy, particularly waste generation, disposal patterns and trends within the context of a developing country confined by its small island boundaries. Consequently, this applied research project seeks to provide a critical analysis of the solid waste management sector in Jamaica and the environmental and socioeconomic implications, and to propose a series of decentralized recommendations for communities that are chronically underserved by municipal solid waste management providers.

While the discipline of solid waste management seeks to address all possible sources of solid waste generation, disposal and all the processes that occur between; this paper focuses on the management of waste prior to landfill disposal. It is important to note that the state of landfills is only symptomatic of the larger solid waste context, hence the scope of the analysis will encompass processes that occur prior to landfilling, such as waste collection, separation, and reuse.
Solid Waste Management in Jamaica

Characteristics of Issue

Pollution and the growing volumes of solid and hazardous wastes are major threats to the environment and sustainable development of Jamaica. Globalization, economic development, and growth has propelled the island into rapid urbanization and increased levels of consumption of local, imported, natural and processed goods. Despite significant improvements since independence in 1962, Jamaica remains a highly indebted nation whose increase in consumption has not been met with an equal increase in capability to manage the quantity and quality of waste generated. Solid waste management is an essential public good which contributes to a basic public-space aesthetic but more importantly ensures public health, and safety.

In 2006 approximately 55% of Jamaican households disposed of their garbage by way of garbage truck collection, 38% burned their garbage and the remaining 7% either buried or disposed of their waste in empty lots or gullies (PIOJ 2007). The burning of garbage, especially during the dry months has been the root cause of numerous residential and brush fires; however it still remains a widely practiced activity. Within the island context, uncollected and unconsolidated waste ends up in drains, streams, wetlands, rivers and eventually enters the sea, contaminating those ecosystems. The clogging of drains and gullies exacerbates the risks of flooding which contributes to outbreaks of waterborne diseases such as gastroenteritis and mosquito-borne diseases such as Dengue Fever, Chikungunya, and the Zika virus.

The role of human behavioral is central to solid waste management. Every household has a particular rate of waste generation and also its own way of managing that waste; both are factors of their income, knowledge, and convenience (among other things). Equally important is the role of government in minimizing, collecting and disposing of solid waste. The characteristics of the Jamaican solid waste industry consist of a changing waste stream, increasing quantities of waste, poor storage, and inadequate waste collection.

Waste Generation

The United Nations Environmental Program calculated that over the 30 year period from 1970 – 2000, the per capita generation of solid waste in both Latin America and the Caribbean doubled from 0.2-0.5 kg/day to 0.5-1.0 kg/day (UNEP 2000). Jamaica has had a particularly sudden increase, moving from 1 kg/day to 1.5 kg/day; a 50 percent growth between 2000 and 2005 (NSWMA 2013). As the island’s population continues to increase, so too has the solid waste generated per capita, with a 6.5% increase in population between 1996 and 2006 resulting in a doubling of solid waste (Planning Institute of Jamaica 2007).

Most of the stresses on solid waste management are felt in urban areas where the majority of the island’s population reside. In 2015 55% of the population lived in urban areas. The Planning Institute of Jamaica has said that the growth in the urban population has coincided with a rise in informal settlements due to the scarcity of housing and unregulated developments. The inadequacy of garbage truck fleet within urban areas is compounded by the inaccessibility of informal communities for waste pickup trucks and the lack of suitable disposal facilities.

As incomes grow, so too does consumption on both an individual and national level. Growth in Jamaica’s economy and standard of living for the masses improves allows for increased consumption of goods and services. This wealth factor also affects the type of consumption and consequently the type of waste generated. Wealthy communities form ‘throw away societies’ whereas poor communities have less to throw away and are more ingenious in reusing, recycling and refurbishing articles that a wealthier
community would discard (Blight and Mbande 1998). In a study carried out by NSWMA in 2006, 69% of solid waste produced in Jamaica was organic, which suggests that we are not ‘throwing’ much away (Planning Institute of Jamaica 2007). Developing countries consume less processed goods and therefore less inorganic waste products such as plastics and glass (see Figure 1).

Table 3. Comparison of Percentage Solid Waste Composition, 1999, 2000

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Figure 1: Comparison of Percentage Solid Waste Composition
(Planning Institute of Jamaica 2007)

The Planning Institute of Jamaica (PIOJ) reported that “The whole matter of waste generation is influenced by government policy. Often policies are formulated without addressing the management of waste”. PIOJ was referring to specific policies that encouraged the importation of manufactured and processed goods but had no strategy for how the inorganic waste products and by-products would be managed. One such example is The Motor Vehicle Liberalization Policy introduced in 1989 which made private transportation more accessible to a larger population. The Institute claims that the increase in the importation of used/reconditioned vehicles from countries such as Japan has, in turn, created demand for motor vehicle accessories/components such as lead acid batteries and tires. At the end of their usefulness, these items, in addition to e-waste, household appliances, and other hazardous materials, ended up in the domestic waste stream with no regulation for their separation or specific disposal (Planning Institute of Jamaica 2007).

Waste containment

In Jamaica, with about 20% of its 2012 population living in poverty, the issue of solid waste containment is extremely problematic (Bank 2015). As the rate of solid waste generation varies according to income level, so too does the suitability of waste containment devices. This is relevant as the type of containment device influences the length of time waste can be stored, the ease of haulage to disposal sites and the general sanitation of the residence. In one study researchers found that residents of one urban low-income community used milk crates, five gallon PVC pails and cardboard boxes to store garbage until pick up. In a survey almost all of the sample population from that community said that they would be willing to buy a 10 gallon pail specifically for waste disposal but their main obstacle was the fact that they were unwilling/unable to spend above the $JMD100 - $JMD300 range for a $JMD500 garbage pail (Gage 1998). In middle to upper-income communities the storage containers had larger capacities, with the most popular being; 45-gallon drums, or steel mesh containers into which
plastic garbage bags would be stored until pickup. Jamaica has no defined standard or requirement for solid waste containers (Gage 1998).

Waste Collection

Only 55% of Jamaican households dispose of their waste by way of garbage truck collection, the remaining 45% is unmonitored and unregulated. The National Solid Waste Management Authority’s (NSWMA) capacity for collecting waste is hindered by a limited truck fleet across the island. With an estimated 4010.7 tonnes of solid waste generated every day an average of about 250 trucks is required to efficiently collect and dispose of garbage island-wide. With a fleet of about 75 private company trucks and 145 NSWMA trucks, the fleet remains 30 trucks short of needed base-level capacity (Planning Institute of Jamaica 2007). This limitation means that curbside garbage collection is not uniform nor consistent, except in middle to upper-class urban areas where the pickup is significantly more frequent than anywhere else. In rural, low-income and informal settlements enforcement of garbage disposal is difficult to carry out, because of the lack of suitable waste receptacles in and around these communities. Commercial and industrial waste is also poorly monitored for their solid waste disposal because of the Authority's technical and financial limitations.

Significance to Environmental and Public Health

Throughout the island, poor solid waste management practices have resulted in specific environmental problems which have led to public health crises of varying magnitudes. Most significant are the frequent landfill fires, leaching and the persistence of vermin and other vectors in the nation’s landfills (Gage 1998). Other symptoms include air pollution from domestic and municipal waste burning and marine pollution.

As an example, on March 11, 2015, the Riverton City Dump, the largest dump in Jamaica started to burn; by March 16th the Kingston Fire Brigade said that the entire 31.25-hectare facility was ablaze. The landfill receives over 60% of the nationally collected solid waste, which equals about 240.4 tons of waste per day. During the estimated 2 weeks that the dump burned the Ministry of Health stated that over 800 people across three different parishes visited hospitals for respiratory-related complications and schools and business in the area were forced to close (Office of the Public Defender 2016).

The National Environmental Protection Agency (NEPA) report on ambient air quality confirmed that the 2015 fire was the most detrimental fire in the landfill’s history (National Environmental Planning Agency 2015). The report found that over the first seven days (within a 5km radius of the fire) PM10 readings were categorized as “Very High Risk” according to the US EPA Air Quality Index. Twenty-six VOCs were detected by NEPA on samples collected from three different monitoring stations around the dump. Sixteen of these were found to be above concentration limits for preserving public health. SO2 was also above-average readings during and after the fire. The 24 hour reading during the first week of the fire was significantly higher than the highest reading recorded the year before, in 2014 (National Environmental Planning Agency 2015).

The National Solid Waste Management Authority (NSWMA) was sued following the March 2015 fire. The suit cited a long history of uncontrolled fires that required fire brigade assistance to extinguish. The fire department identified 415 fires (See Table 1) at the Riverton Disposal Facility between 1996 and 2015. With an average of about 21.8 fires per year; the lack of waste separation prior to landfilling is partially to blame (Office of the Public Defender 2016). The tons of untreated organic waste brought to the dump resulted in spontaneous combustion from the decomposition process. These natural combustions were made worse by the unseparated inorganic material such as tires that facilitated the growth and spreading of fires.
The current concern regarding solid waste management across Jamaica is directly due to the negative impacts it has had on human health. The implications for health are determined by factors such as the type of waste, the method of storage and disposal and also its pathways throughout the environment (Pinnock 1998). The most persistent solid waste impact on human health is the proliferation of disease vectors such as houseflies, mosquitoes, roaches and domestic rodents (Pinnock 1998).

In the Jamaican context, indiscriminate dumping of garbage and poorly managed disposal sites are the perfect breeding ground for such pests. Both Chikungunya and Zika viruses are the result of mosquitoes that breed in stagnant water around densely populated areas. In Jamaica, stagnant water is usually found in areas of uncovered trash piles, such as gullies or scrap yards. The poor disposal of waste contributes to the pooling of stagnant water which harbors mosquito larvae which can devastate entire populations. The year 2014 represented the first recorded outbreak of Chikungunya disease outside of Africa or Asia. The virus which is spread by the Aedes Aegypto mosquito ravished the Caribbean region, affecting approximately 355,000 people (CIDRAP 2014). Two years later in 2016, another epidemic was spread again by the Aedes Aegypto mosquito. As of November 2016, Jamaica had over 90 confirmed cases of Zika, and the Ministry of Health said that the metropolitan areas of Kingston, St. Andrew and St. Catherine had the highest number of reported cases (Scott 2016).

The figure below (Figure 2) shows the pathways of pathogen transmission from solid waste to the human body. Improper disposal and storage of waste provide an ideal medium for disease vectors to thrive. Rodents, mosquitoes, and flies are both mechanical and biological carriers of disease organisms (Pinnock 1998).
Another implication of Jamaica’s solid waste management context is frequent urban flooding. Large man-made conveyance channels called gullies are a common sight throughout the island’s cities. For decades, they have been used to catch runoff and prevent flooding by rapidly directing urban stormwater to the sea. However, gullies have become the dumping ground for large volumes of solid waste and debris from mainly domestic (non-commercial or industrial) source points. In Montego Bay, Jamaica’s second largest city, the South Gully drains a significant area of the city and the surrounding hills. Within a few months after its construction, the lower section of the gully flooded, resulting in damages to businesses and residences, costing the city over J$20 million (Jamaica Environment Trust 2016). The garbage found in the gully was predominantly domestic waste, such as plastic bottles, plastic bags, and Styrofoam food containers—either dumped directly into the gully or washed into it from open lots and streets.

In Montego Bay and other urban areas island-wide the debris-filled effluence carried by gullies has made its way to the coast and further out to sea. The obvious result is a significant detriment to the health of coastal ecosystems, particularly coral reefs. In one research study of the coast of Montego Bay, a marine researcher found that run-off from urban gullies was filled with garbage and nutrients which promoted the growth of algae, causing degradation of coral reefs (Jamaica Environment Trust 2016). Additionally, much of the debris was mistaken for food by marine animals such as turtles and other marine mammals, posing risks of choking, entanglement of poisoning (Jamaica Environment Trust 2016).
With the largest landfill fire in Jamaica’s history occurring last March and an outbreak of mosquito-borne diseases such as Zika and Chikungunya, solid waste management is not only a topical issue but one that the entire nation is interested in seeing improve. The issue of solid waste management on a small island state is a comprehensive one that involves a wide range of stakeholders (See Table 2) with varying interests and levels of influence and concerned with matters such as environmental protection, public health, and economic development. The stakeholders come from different segments of the Jamaican society including the citizenry, civil society, the public and private sectors.

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<thead>
<tr>
<th>Stakeholders</th>
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<td>Waste hauler companies</td>
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<td>Environmental orgs</td>
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Table 2: Stakeholder Analysis for SWM and SWM reform in Jamaica
Public Sector

Public sector stakeholders include the National Solid Waste Management Authority (NSWMA), the Ministry of Local Government, the Planning Institute of Jamaica (PIOJ), National Environmental Planning Agency (NEPA) and the Ministry of Health.

The 2001 the National Solid Waste Management Act established NSWMA as the corporate body responsible for the interpretation of the act. Part II section 4 of the act lays out the mandate for the NSWMA (National Solid Waste Management Act 2002):

“Take all such steps as are necessary for the effective management of solid waste in Jamaica in order to safeguard public health, ensure that the waste is collected, stored, transported, recycled, reused or disposed of in an environmentally sound manner and promote safety standards in relation to such waste.”

In a court case brought against the NSWMA following the March 2015 fire at Riverton, several critical pronouncements have been made by the presiding judge. First, NSWMA failed to fulfill its legal duty to safeguard public health of all Jamaicans and has operated with scant regard for its duty guaranteeing the public a healthy environment free from ecological degradation. Second, it has been operating Riverton disposal facility without an environmental permit. NSWMA has direct authority over SWM reform in Jamaica, and so has a high level of interest and influence.

The Ministry of Local Government is comprised of all the local entities responsible for making by-laws, regulations, and rules for the good governance and order of the parishes over which they have jurisdiction. Specific tasks include the management and maintenance of infrastructure, water supplies, parks, markets, public sanitation and the provision of public cleansing and public health (Ministry of Local Government 2013). The NSWMA is housed in and funded by the Ministry of Local Government. Even though the authority is independent of the ministry, the Minister appoints members to the NSWMA board. Additionally, he/she can give NSWMA specific policy directives (National Solid Waste Management Act 2002). Currently, the Minister of Local Government Desmond McKenzie is exploring the feasibility of privatizing NSWMA.

The Planning Institute of Jamaica is the foremost planning agency of the government. Its main function is to initiate and coordinate development of policies, plans, and programs for the economic, financial, social, cultural and physical development of Jamaica (Planning Institute of Jamaica 2012). More relevantly, PIOJ is responsible for undertaking research on national development issues and providing technical support to the Cabinet. The institute has carried out several in-depth studies about the state of waste management in the island that have guided both public and political discourse.

The Ministry of Health (MOH) is responsible for the “provision of quality health services and the promotion of healthy lifestyles and environmental practices” (The Ministry of Health 2016). A primary focus of MOH is the management of outbreaks and emergency events relating to vector-borne diseases. In 2016 the ministry ran a robust media campaign, promoting healthy and clean environments as a prevention mechanism for the spread of mosquito-borne diseases. The ministry has also been promoting community cleanups of shared spaces such as gullies, open lots and other water bodies in an effort to destroy mosquito breeding grounds.

The National Environment and Planning Agency (NEPA) was founded in 2001 to carry out the technical and administrative mandate of three statutory bodies: National Conservation Authority, the Town & Country Planning Authority and the Land Development and Utilisation Commission. NEPA’s operation include natural resources management, environmental management, spatial planning, compliance/enforcement and public education. NEPA has threatened the suspension of NSWMA’s environmental permit to run the Riverton Dump because
of its breaches of the permit. NEPA has partnered with NSWMA to promote recycling. Most recently NEPA initiated an environmental campaign promoting the use of reusable plastic bags as opposed to single-use plastic bags.

The NEPA, NSWMA and the Ministry of Local Government both have a high level of interest and influence on the issue of solid waste management. Additionally, the bodies have the most impact on the policies, regulations and enforcement set to affect the solid waste stream, regulation of collection and separation and the creation of national industry standards for disposal facilities. The PIOJ as a research body has little authority on how their policy and planning recommendations are implemented; as such their influence and interest in this issue are both medium. However, the input of the PIOJ and other research agencies is invaluable, as they offer a (relatively) objective assessment of the solid waste system in Jamaica and an assessment of NSWMA’s performance. MOH has a moderate interest in this issue, as it is not their primary mandate but can exert their influence to encourage favorable policy.

Private
Private sector stakeholders include large scale recyclers, private waste haulers, and potential investors in waste to energy plants. Over the past few years, private sector interest in recycling, waste separation and alternative energy generation has increased. The recent fire at the Riverton City Dump has intensified calls for the privatization of the Riverton Landfill and the privatization of municipal waste collection services. While formal requests for proposals have not been made from the government, the potential for privatization draws several private waste hauling companies to the forefront as major stakeholders with significant interest and influence in the issues. There are 16 registered recyclers nationwide, that are highly interested in the reformation of the industry and collectively can exert some influence on regulation and policy to be made. The recyclers would be in support of any mandate that enforces waste separation behavior, as this would increase the viability of their businesses. Waste to energy generation is a much newer industry with no precedence in the island but much political support for the creation of the industry. Investors interested in breaking into this market are also highly interested in reformation but only have moderate ability to influence the direction of policy changes.

Citizenry
Citizen stakeholders include all households underserved by the current waste management system, waste pickers who reside in and make a living from the landfill, and communities neighboring dumps around the island. On a national scale, the entire Jamaican population is a stakeholder in this issue as public sanitation is a central theme in the assurance of public health and welfare.

According to the 2001 Jamaica Population Census Country Report, 2,454 persons lived on and around the Riverton landfill; the size of this population across all the island’s landfills is unknown. Waste pickers earn a living by sorting solid waste, removing valuable items/materials and then selling them. The people who live around landfills reside in squalid, unhealthy and often time dangerous environments, risking health and safety to carve out a living. This population, who is often seen as a nuisance to the landfill management process is heavily interested in the outcomes of any policy that might affect the solid waste system, but because they are unrecognized as a part of the management process lack any sort of influence in decision-making.

The two official landfills and several dumps that exist in Jamaica are not located in isolated regions but neighbor industrial or lower-income residential areas. Consequently, these residents are the first to face environmental harm and experience health implications from the controlled/uncontrolled burning of waste, water contamination and smell or traffic nuisance.
caused by the landfill. This group is also significantly interested in this issue but lacks the collective wealth or power to influence policy-making.

The provision of solid waste management is a public good, which (ideally) serves the entire population of the nation; resultantly the entire Jamaican population should be interested in any policy/plan affecting the solid waste management systems nationwide. In actuality, however, services such as waste pickup are only consistently provided in middle to upper-class urban communities, meaning that the negative externalities of failed solid waste management disproportionately affects the poor. As a collective, the public is moderately concerned with this issue but does not have significant influence over the process (unless through a strong civilian movement).

**Non-Profits**

Jamaica Environment Trust (JET) is the country's most prominent and active environmental advocacy group that focuses on environmental education, law, and conservation. JET has made continuous calls for the introduction of recycling policy and reformation of the management of all the nation's landfills. As the leading environmental watchdog, JET has also called for the restructuring of NSWMA administrative staff as claims of misappropriation of funds and inefficient operation were circulated in the media. What JET does lack in financial resources they compensate for in their ability to garner public attention. As a result, JET and other environmental groups do have a moderately high level of influence and a high level of interest in this issue.

Other non-profits include those invested in the development of low-income or informal communities. One of the major advocates for social and physical capital improvements is Jamaica Social Invest Fund, which was formed out of the Government of Jamaica’s poverty alleviation strategy. The organization is designed to mobilize resources to community-based socio-economic infrastructure and social services projects. Organizations like this one are interested in SWM reform and how it can improve their constituents' lives.
Centralized versus Decentralized SWM

Significant literature exists discussing the advantages of a decentralized SWM system, particularly in the developing world. Asher and Gandhi find that, up until recently, municipal solid waste (MSW) management in India has been considered to be almost the sole responsibility of urban governments; without the participation of citizens and other stakeholders (Asher and Gandhi 2008). India’s Ministry of Environment and Forests and the Supreme Court, however, have urged that the issue be addressed with multiple stakeholder participation. The Municipal Solid Wastes Rules, a policy enacted in 2000, outlined approaches to SWM, various components to be focused on and compliance criteria necessary to address them. One aspect of SWM highlighted was the segregation of municipal solid wastes; its compliance criteria states “that the municipal authority shall undertake programs to ensure community participation in waste segregation” (Municipal Solid Wastes Management and Handling Rules 1999). Much of the literature surrounding the decentralization of SWM comes from India, particularly because of the passage of this law.

Asher and Gandhi (2008) describe several limitations of centralized SWM in India, which include:

i. No distinguishing between the different need of the neighborhood within each city and between cities
ii. Centralized arrangements are often capital and land intensive; the urban areas which have the largest concentration of MSW are also the most land scare
iii. Limited scope for community-based participation, social entrepreneurship, livelihood generation and innovations
iv. The problem is shifted from the source of waste generation to waste disposal sites
v. More susceptible to neighborhood resistance (NIMBY)

(Asher and Gandhi 2008) conclude that decentralized community-based waste management arrangements do not suffer from the above limitations, and thus should be considered as a better alternative to traditional SWM. They note that because of the current dominance of centralized arrangements, India has no choice but to make them work better, while simultaneously encouraging decentralized arrangements.

Another policy research project highlighting the potential of decentralization of SWM was the Municipal Solid Waste Management Manual 2016, completed by the Ministry of Urban Development, under the Government of India. The compendium explained that centralized public-private-partnerships in SWM were most suitable for urban areas where significant economies of scale were possible and the composition of waste allowed for the greater extraction of value (Central Public Health and Environmental Engineering Organization 2016). In regions where economies of scale are not possible, a decentralized approach allows micro-entrepreneurs to work with local authorities to provide waste separation and processing services.

(Central Public Health and Environmental Engineering Organization 2016) defines decentralized SWM processing as the establishment of dispersed facilities for maximizing the processing of bio-degradable waste and recovery of recyclables closest to the source of generation so as to minimize transportation of waste for processing or disposal. Examples of decentralized SWM activities encouraged by the compendium include community-managed primary waste collection systems. It is suggested that they are managed by community-based organizations such as residents’ associations, cooperatives, welfare societies or slum level
federations. The creation of waste processing activities, such as composting or small-scale biogas development can also be carried out by community organizations at the source of generation, as opposed to a centralized site, such as a landfill. The Manual alludes to the economic development potential of decentralized SWM to create revenue streams for low-income individuals involved with waste collection, separation, and processing (Central Public Health and Environmental Engineering Organization 2016).

**Informal Settlements and SWM**

Literature suggests that decentralized SWM is most suited for regions where economies of scale are not possible, and where the composition of waste does not allow for the greatest extraction of value. In particular, informal settlements which are found around the island, lend themselves to this solution. Informal settlements are characterized by the act of “squatting”, which is the illegal or unauthorized occupation of land or housing. A squatter or informal settlement is thus a residential area which has developed without legal claims to the land and or permission from the concerned authorities to build (Ministry of Housing 2008). Due to this informal status, infrastructure and services such as SWM are usually inadequate or completely absent.

In 2008 a total of seven hundred and fifty-four informal settlements were identified across Jamaica. Rough estimations from the Ministry of Housing state that as much as 20% of the nation’s population resides in squatter settlements (Ministry of Housing 2008). Socially, the population in these settlements are from lower income and largely employed in the informal sector (Ministry of Housing 2008). From a survey given to a sample of 320 squatter settlements in addition to GIS analysis, several findings were made about these communities:

- In informal settlements where roads exist, 64% are unpaved
- 85% of settlements had access to water through established distribution systems (legally and illegally)
- 95% of settlements have access to electricity (mainly illegal)
- The dominant methods of sewage disposal is pit latrine (50%) and private flush toilet (35%)
- 37% of the settlements benefit from municipal garbage collection, the remainder use open dumps or burn waste

The largest number of informal settlements are in the most urban parishes of Kingston and St. Andrew (17%). However, when aggregating rural versus urban, rural parishes contained 62% of the settlements and urban parishes had 35% (Ministry of Housing 2008). From the surveyed settlements, the vast majority of the settlements (43%) had between 11-99 households. An additional 22% contained between 100-500 households.

These heterogenous characteristics of informal settlements, along with the poor infrastructural landscape make solid waste management particularly challenging. All components of the SWM value chain are hindered in these communities and economies of scale are rarely achieved.

**Containment**

The type of container used to store solid waste determines how long it can be kept; the smaller the container the shorter the storage period (Gage 1998). Proper containment is also a public health essential as it can mitigate the proliferation of vectors and maintain community aesthetics. In informal settlements and other communities with
predominantly lower-income residents, container choices for solid waste are factors of cost and convenience. This results in a myriad of containers, from milk crates to five-gallon pails to cardboard boxes to plastic bags (Gage 1998). By comparison, middle-income households usually have a welded expanded metal receptacle, in which bags of garbage can be placed in and secured from dogs and other scavengers. The containment type affects the efficiency of waste pickup, as several small containers increase the average time a truck takes at each stop (Gage 1998).

**Disposal**

Of the total 585 mapped informal settlements, more than 50% of them are within 100m of a waterway (see Fig. 3) (Ministry of Housing 2008). A common sight is that of swaths of informal settlers "squatting" along the banks of gullies and rivers in urban areas where available land is scarce. The lack of proper containment and poor disposal practices means that much of the solid waste generated in these communities go directly into the gullies or rivers. As explained earlier, this practice inhibits the flow of water, thus increasing the likelihood of flooding.

**Collection**

"The collection system is generally inadequate. In some instances, there is a capacity problem and in others, the nature of the community does not allow for proper collection" (Gage 1998). The latter is often the situation in informal settlements. Components of the layout that make collection difficult and expensive include settlements in steep or precarious terrains or settlements with narrow or poorly maintained roads. Even in informal communities that have received some sort of regularization and municipal infrastructure - roads still remain too narrow to allow garbage trucks to operate on them.

In one study, author Ian Gage (1998) compared the processes of solid waste management in a formal community versus an informal community in the municipal area of Kingston and St. Andrew. Trench Town, characteristic of urban informal settlements had narrow
streets, ranging from 10 to 15 feet wide connecting a community of about 50,000 residents. In contrast, Trafalgar Park was a middle-income community and representative of a typical planned community. With a less dense housing stock and larger housing units, the streets were standardized at 20 feet wide with 30-foot reservations.

**Why are cooperatives popular structures for decentralized SWM?**

The International Cooperative Alliance (ICA) (International Co-operative Alliance 2016)) defines a cooperative (co-op) as an autonomous association of persons united voluntarily to meet their common economic, social, and cultural needs and aspirations through a jointly-owned and democratically controlled enterprise. The ICA states the United Nations in 1994 estimated that the livelihood of nearly 3 billion people was made secure by cooperative enterprise. The UN declared 2012 "the international year of cooperatives", highlighting the idea that cooperative enterprises build a better world. ICA defines the seven cooperative principles, which are guidelines by which co-ops put their values into practice (International Co-operative Alliance 2016);

1. Voluntary and Open Membership
2. Democratic Member Control
3. Member Economic Participation
4. Autonomy and Independence
5. Education, Training, and Information
6. Co-operation among Co-operatives
7. Concern for community

(Nembhard 2014) in her book, Collective Courage, gathered evidence of the history of African American cooperative economic thought and practice from the early 1800s to the present. She finds that “the cooperative solution is one that has addressed the same conditions throughout history; it helps address the challenges of market failures, capitalism, marginalization in labor, capital and product markets, and the lack of adequate, affordable, quality services.” Underpinning the importance of these organizations is her finding that coops stabilize their communities by increasing economic activity, creating good jobs, increasing benefits and wages, and encouraging civic participation.

The cooperative advantage, as Nembhard (2014) puts it, is based on the associative nature of cooperatives and their tight bonds with the community. This, in turn, "provides a uniquely favorable basis for the utilization of social capital, its reproduction, and accumulation." She states that this factor "attracts nontraditional resources, reduces costs of ownership, provides a network of trust relationships" which reduces asymmetric information and allows more efficient economic exchanges and activities. Nembhard concludes that cooperatives address market failure, specifically the provision of services and goods to marginalized populations.

The literature on cooperatives focuses heavily on the advantages the organizational structure of co-ops provides when compared to other business forms. Diaz-Foncea and Marcuello (Diaz-Foncea and Marcuello 2013) focus on the role of entrepreneurs in cooperative organizations and created a matrix classifying economic organizations by categorizing owners and beneficiaries. They define cooperative entrepreneurship as “a way to do business that is practiced within voluntarily formed economic organizations with the objective of obtaining a common benefit that would be impossible to achieve individually by the members who form the organization.”

Diaz- Foncea and Marcuello go on to explain the political support that cooperatives have received in different parts of the world. They found that the European Commission has to come
to see cooperatives as a means of increasing the economic power of small and medium-sized enterprises, which has the potential to provide high-quality services to groups that otherwise would not have access to them (Diaz-Foncea and Marcuello 2013). Support for co-ops comes also from the fact that there is a wide range of stakeholders who can benefit from the organization's structure. "In worker coops, the ownership of the organization is assigned to workers themselves such that the main goal is to maximize their well-being through waged or working conditions. In consumer coops, product quality and price characteristics are adjusted so that consumers benefit the most" (Diaz-Foncea and Marcuello 2013). Their research also claims that cooperatives are often cited as a benchmark of high participation.

**Co-ops and SWM in the Global South**

While cooperatives have been employed in numerous sectors to provide a wide variety of services and goods; cooperatives within SWM are a newer phenomenon. Jutta Gutberlet in her publication discusses the relationship between waste, poverty, and recycling, particularly in the informal segment of Brazil's SWM sector. She discusses the role of those involved in collection, separation, and sale of recyclables and their marginalization in society and exclusion from the formal SWM economy. Gutberlet then highlights a new theoretical model of inclusive waste management that provides a radical approach to poverty eradication, whilst improving environmental health (Gutberlet, Waste, poverty and recycling 2010).

Participatory Sustainable Waste Management (PSWM) over the past five years has come to be defined as "Solid waste recovery, reuse and recycling practices with organized and empowered recycling co-ops supported with public policies, embedded in the solidarity-economy and targeting social equity and environmental sustainability" (Gutberlet, 2010). PSWM as a theory has not been adopted on a significant scale in Brazil, despite its potential to address a multitude of social and environmental predicaments on a local level. The appreciation of recycling cooperatives' ability to provide services such as street sweeping, environmental education/awareness, door-to-door collection of recyclables and organic household waste is severely lacking on a political level (Gutberlet, Waste, poverty and recycling 2010). The author stresses the value of these organizations in low-income neighborhoods lacking sufficient SWM services to contribute to maintaining the urban environment and redistributing income among the urban poor (Gutberlet, Waste, poverty and recycling 2010).

Gutberlet in another publication (Gutberlet, Informal and Cooperative Recycling as a Poverty Eradication Strategy 2012) talks again about the informal waste collection and separation in Brazil and how through cooperative partnership, these groups have been able to improve social acceptance, increase member self-esteem and improve their living and working conditions. Her argument states that considering the services provided by these recycling cooperatives and the environmental gains of their work- this economy tackles the Millennium Development Goal of poverty alleviation. (Gutberlet 2012) describes the threats to the informal and organized resource recovery economy promulgated by waste to energy infrastructural development. A transition to capital-intensive, highly centralized waste to energy facilities, the author says could result in a disastrous loss of income for people involved with cooperative recycling. The author concludes by proposing that if services provided by informal or cooperative recyclers should become eligible for carbon credits, that significant poverty reduction, would be seen nationwide.

(King and Gutberlet 2013) attempt to quantify the environmental contribution of recycling cooperatives by creating a model to estimate energy savings and greenhouse gas (GHG) emissions abated due to recycling. The model was created to encourage the inclusion of informal waste recycling in Brazil's carbon credit market. The study carried out in Ribeirão Pires, Brazil found that the informal/cooperative recycling sector is capable of achieving GHG
emissions reductions similar to those achieved by recycling and landfill gas capture/flaring within formal MSW management systems (King and Gutberlet 2013).

With this finding, the authors proposed the expansion of this informal sector throughout the region as well as capital investments to help improve service. An inclusion of this sector in the carbon credit market of Brazil could facilitate its expansion. Their main recommendation is that "government support for informal/cooperative sector recycling and the co-management of recyclable resources is crucial to the realization of 'triple bottom line' sustainable, inclusive, integrated municipal solid waste management in Ribeirão Pires (King and Gutberlet 2013)."
Attitudes towards SWM

The characteristics of the Jamaican solid waste management context highlights a critical lack of citizen and community-level responsibility as well as insufficient engagement in the process. This low level of engagement and pessimism towards the potential of individual action to effect change in the environment was noted in the 1998 national survey, “Attitudes of Jamaicans to the Environment”. In 1991 the most commonly mentioned environmental concern was garbage disposal (18.2%), by 1998 this concern had almost doubled to 35.9% (Espeut, 1998). Despite the centrality of individual behavior in waste disposal, in 1998 only 29% of survey respondents believed that individuals like themselves could make a difference in the environment, 32% felt that they would make little difference (Espeut, 1998). As the author concluded “if people do not believe that activism can be effective in achieving environmental goals, then, even if they are aware of the problems, they may not try to effect a change” (Espeut, 1998).

Perhaps as a result of this pessimism towards environmental action, the survey highlighted a high level of inactivity in the Individual Environmental Activity Index (Espeut, 1998). Important to note was the fact that respondents from Kingston Metropolitan areas were the most inactive. Another important finding from Espeut (1998) was the conclusion that knowledge about the environment is, by itself not the determinative of environmental activity (Espeut, 1998). Seventy-eight percent of the respondents who were “aware” of environmental issues in the local environment were also classified as “inactive” in the Individual Environmental Activity Index. “People’s actions are governed by the norms and values they hold dear, not by the information they have, and those interested in increasing environmental activism need to make interventions which will impact at the normative level” (Espeut, 1998).

The takeaways (Table 3) from this survey suggest that to create substantial change in the public’s attitudes towards SWM, steps should be taken engage a wide cross section of the citizenry in community-level SWM behaviors. To overcome the pessimism of the potential of individual actions to create changes, community level actions need to be promoted. These will encourage behavioral change through social pressures and will multiply the benefits of individual actions. The survey also leads to the conclusion that that behavior change efforts should not only include education but aim to impact norms and values of the community. As the survey suggests awareness of environmental issues is not sufficient to alter behavior. Instead, attempts should be made to ingrain sustainable SWM behavior in the norms and values of communities through culturally relevant incentives.

<table>
<thead>
<tr>
<th>Takeaways</th>
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<tbody>
<tr>
<td>1 Engage a wide cross section of the citizenry in community-level SWM behaviors</td>
</tr>
<tr>
<td>2 Embed sustainable SWM practices in local norms and values systems of the community</td>
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Table 3: Key takeaways from survey on how to alter attitudes toward SWM
(Espeut, Attitudes to the Environment in Jamaica 1998)
Case Studies

The diagram below aims to summarize both the current centralized SWM context in Jamaica’s informal settlements, as well as the perceived areas of responsibility for the individual versus the government [Fig 4]. Waste generation is mainly a result of personal choice and an ability to consume, similarly, containment of waste is a factor of income and convenience. In informal settlements, as with other low-income areas, waste is not properly contained and is left open to the elements and other vermin. Because of the inaccessibility of informal settlements, waste collection happens infrequently, forcing residents to indiscriminately discard of waste in open lots, gullies or other marine environments. The final disposal of waste at a landfill is solely a responsibility of the NSWMA. The result of marine pollution, within the small island context, is the clogging of drains and gullies, which are also the responsibility of NSWMA and other local government authorities.

![Figure 4: Structure of current SWM process in informal settlements](image)

This highly centralized and linear model has proven unsuccessful for populations residing in informal settlements, as their urban context does not facilitate the economies of scale required for traditional municipal waste collection. Participatory solid waste management (PSWM), as an alternative to traditionally centralized SWM, centers the community’s role in the process of waste management. PSWM is defined as "solid waste recovery, reuse, and recycling practices with organized and empowered community organizations (cooperatives) supported with public policies, embedded in solidarity economy, targeting social equity and environmental sustainability" (Gutberlet 2012). PSWM is composed of three pillars (Gutberlet 2012):

- **Governance and deliberative democracy**: offering new forms of public-private partnerships and redefining the role of government, addressing the political and social contexts in waste management
- **Social and solidarity economy**: focusing on collective over individual objectives and outcomes and proposing a ground-breaking model for economic development

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• **Co-management**: highlighting the participation of different stakeholders in resource management decision-making.

The PSWM model sets the framework for this prescriptive analysis as well as a set of criteria for selecting relevant case studies. Gutberlet’s (2012) concept of governance and deliberative democracy refers to the process of steering societies and organizations through democratic and inclusive decision making. Within this concept, public participation is essential and social learning is an outcome. “When people are part of a deliberation process, there is a sense of ownership and agreed results have a higher potential for validation and acceptability” (Gutberlet 2012). The author’s conceptualization of a solidarity economy is one that brings issues of social justice, values such as cooperation, redistribution, and reciprocity into the economy. Cooperatives stand in the middle of the solidarity economy, as institutions that center the needs of the community over profits and are dedicated to community education and development.

The last principle; co-management is defined by the sharing of responsibilities between government agencies and stakeholders for the well-being of the resource (Gutberlet 2012). Co-management allows for a level of flexibility to meet the unique needs of different communities. As a whole, the principles of PSWM have the ability to transform residents and other stakeholders in Jamaica’s informal communities from passive participants in SWM, to active, empowered and personally responsible actors in a vitally important environmental process. Case studies should, therefore, reflect at least one of the principles of Participatory Solid Waste Management.

Other principles informing this work are the key lessons from the Attitudes towards SWM survey. The two lessons are integral in addressing the process of altering behavior related to SWM. Figure 4 shows a citizenry that is not heavily involved in the process of SWM, as there are no SWM responsibilities that take place at the community level. Building upon the PSWM framework this project will also aim to engage a wide cross section of the citizenry to participate in community-level sustainable SWM behaviors. The more people practicing these behaviors leads to the linking of these practices to local norms and values. Embedding behavioral change in the culture and norms of a society is not a short term process but necessary for long-term improvement.
Selection
A case study selection and analysis process was completed for this prescriptive project, to provide ideas and descriptions of decentralized SWM approaches for informal communities that have been successful in the Global South. The case studies were identified during a literature review and were selected based on their ability to fit the description of a participatory solid waste management model. All the cases reflected at least one of the three PSWM principles and addressed methods of altering behavior. Cases selected followed the following criteria in their SWM operations:

- **Governance and deliberative democracy**: offering new forms of public-private partnerships and redefining the role of government, addressing the political and social contexts in waste management

- **Social and solidarity economy**: focusing on collective over individual objectives and outcomes and proposing a ground-breaking model for economic development

- **Co-management**: highlighting the participation of different stakeholders in resource management decision-making.

- Engaged a **wide cross section of the citizenry** in community-level SWM behaviors

- Embed sustainable SWM practices in **local norms and values** systems of the community

Four cases were selected from urban areas in India, Thailand, Bangladesh and Jamaica. Their organizational structures ranged from cooperative and nonprofit styles, to multi-stakeholder partnerships between universities and the municipality and the municipality and community-based organizations. Three of the cases dealt with separation and collection of waste and one case study focused only on waste collection. They employed various funding mechanisms, with two of the four being self-sustaining and the other two dependent municipal funding or donor funding. Three different methods of altering behavior were identified; financial incentives/sacrifices, bartering system and community engagement. These methods incentivized a change in behavior by revealing the economic value in separated waste or by highlighting the public good related to SWM that encouraged collective participation. The findings are summarized below.
Waste picker-run biogas plants

SWM value chain component: Separation, Collection and Treatment Monetization of

Key takeaway: Waste treatment and collection process

Location: Mumbai, Maharashtra State, India

"The enormous quantity of waste generated in the city of Mumbai makes large-scale, technology-driven solutions tempting. However, the opposite approach—a highly decentralized, people-powered model of waste management has proven successful" (Gokaldas, Waste Picker-Run Biogas Plants as a Decentralized Solution 2012). The Indian Municipal Solid Waste Rules enacted in 2000, required source separation of waste and prohibited landfilling of biodegradable waste. Since then, there has been no formal recycling or composting program, but there is a thriving informal sector providing these services (Gokaldas, Waste Picker-Run Biogas Plants as a Decentralized Solution 2012). One such initiative is the Parisar Vikas cooperative that mobilizes poor, low-caste women to sort and handle waste from institutions and multi-family dwellings, to manage both composting and biogas activities.

Parisar Vikas (PV) was started by the non-profit organization Stree Mukti Sanghatana (SMS) that has been training and organizing female waste pickers since the 1970s. SMS programs, which include PV and other similar co-ops facilitate the employment of 6000 women in almost 150 project locations in Mumbai. At most of these locations, waste pickers collect, aggregate and sell dry recyclables and depending on the waste stream they may also collect wet waste for composting or for use in small-scale biogas plants. These women earn an income from the sale of recyclables, waste by-products and at many sites also receive a service fee (Gokaldas, Waste Picker-Run Biogas Plants as a Decentralized Solution 2012). They operate as an informal private SWM service provider, operating in spaces where municipal services are not available or inadequately provided.

A significant innovation in the PV model was the creation of the Nisargruna Biogas Plant. Developed to convert on-site organic waste at an individual institution or apartment building level into methane or high-quality fertilizer, which is then sold back to the client. SMS and its cooperatives operate a total of eight biogas plants around Mumbai. The plant is owned by the institution where it is located and PV is contracted annually to operate them. In all instances (Fig 5), customers utilize the gas for cooking as the plants produce too little biogas for electricity generation (Gokaldas, Waste Picker-Run Biogas Plants as a Decentralized Solution 2012).
Garbage for Eggs

**SWM value chain component:** Separation and Collection

**Key takeaway:** Incentivizing waste separation practices

**Location:** Yala, Thailand

Garbage for Eggs (GFE) was an urban planning pilot study in decentralized, participatory SWM, conducted between 1999 and 2001 and initiated by the Yala Municipal Administration and the Canadian Universities Consortium’s Urban Environmental Management Project. The project’s ultimate goal was to strengthen capacity-building and introduce the concepts of participatory community-based development and good governance into the local government. GFE is a recycling project that incentivized residents’ participation in separating waste and bringing valued recyclables to exchange points. In return, residents received eggs for the quantity and quality of the recyclable waste (Mongkolnchaiarunya 2005).

GFE was initially utilized in a low-income slum area in Bangkok as a means to solve its flooding problem, which was caused by solid waste blocking drainage canals. The findings of the pilot study noted that on average, each egg was exchanged for 1.35kg of recyclables. It was found that the eggs were a significant motivator for resident participation in the program. They provided a big profit margin, purchased at wholesale price by the municipality – residents calculated what they earned at the retail market price, which made the eggs more valuable for them. Even on a cultural level, eggs were still a good incentive as some participants may not have wanted to separate recyclables for money (in fear of social stigma), but to exchange for eggs was more appealing (Mongkolnchaiarunya 2005).
There was a downward trend of recyclables collected over the course of the pilot (See Fig 6). Researchers stated that the high quantity recycled was enhanced by the gathering of a backlog of materials that had been discarded previously around the communities. After the backlog had been cleared the quantity recycled leveled out on a month to month basis. Researchers concluded that GFE was a success and appeared to be more appropriate in poor communities. Even though these populations discarded less valuable waste, they were more motivated by getting a benefit in return for their efforts. “There is strong evidence that, when the capacity and bargaining power of the local community have been increased, the dependency relationship to the local government [for services] can be reduced.”

![J. Mongkolnchaiaunyia / Habitat International 29 (2005) 27-40](image)

**Figure 6: Community participation as reflected by weight of recyclables collected**
(Mongkolnchaiaunyia 2005)

**Paid door-to-door service**

**SWM value chain component:** Collection

**Key takeaway:** Household payments for SWM services

**Location:** Khulna City, Bangladesh

The initial idea for this project began with a community member motivating members of his local community in Khulna City to pay for a door-to-door waste collection service. His city was underserved by the municipal authorities so the payment for SWM services was able to clean up the neighborhood, reduce indiscriminate disposal in drains and reduce the persistence of rodents. The success of this initiative was replicated by the Water and Sanitation Program in 1997. The main objective of their pilot study was to establish a community-based approach to SWM “in which responsibilities are shared between households and the city authorities” (Khulna City Corporation 2000).

The program saw households gather their day’s waste and hand them over to a rickshaw diver who took the waste to a local transfer point, wherein it would be collected by municipal SWM trucks (See figure 7). The pilot was rolled out in three phases: Project initiation; which included training and capacity building for the organizing non-profit. Phase 2 included community education and training members of the community to take over the operation and maintenance of the primary collection systems. Necessary components for waste collection
within a community waste collection zone (500 households) included a rickshaw van, a driver, and an assistant. Phase 3 was the final rollout and operation of the community led primary collection system (Khulna City Corporation 2000).

The primary collection operations were heavily supported by the non-profit and the municipality, but as the community participants became more experienced they became more independent. The non-profit was responsible for collecting a monthly fee from each household for the waste collection services. Fees were calculated on a sliding scale, depending on income. The fees were expected to cover operations, maintenance costs and generate profit, thus making primary collection financially viable for operation by the non-profit or other microenterprise (Khulna City Corporation 2000).

Figure 7: Schematic diagram showing conventional and community-based approach to SWM (Khulna City Corporation 2000)
Local ‘Springboard’ initiative

SWM value chain component: Separation, Collection, Treatment
Key takeaway: Promotion of community leadership
Location: Multiple communities, Jamaica

It is important that any prescriptions for the management of solid waste in informal settlements in Jamaica be connected to existing, successful programs. One such program is the Integrated Community Development Project (ICDP) which was the result of a US$42 million loan given to the government of Jamaica from the World Bank. ICDP aims to promote public safety and transformation through the delivery of basic infrastructure and social services in 30 informal and at-risk communities around the island (Jamaica Social Investment Fund 2016). The program is implemented by the Jamaica Social Investment Fund and other relevant governmental agencies. ICDP aims to improve access to the following basic infrastructure (Jamaica Social Investment Fund 2016):

- Road rehabilitation
- Improving stormwater drainage
- Installing water supply and sanitation household connections
- Promoting behavior change related to water supply, sanitation, electrical connections and solid waste management
- Improving electricity connections and lightning in communities
- Extension of the electricity network and regularization of illegal connections
- Rehabilitation of educational facilities
- Construction of community integrated spaces
- Solid Waste Management - clean up and beautification, provision of equipment, infrastructure, training of environmental wardens
- Maintenance training and facilities management

Other components of ICDP include public safety initiatives, institutional strengthening, economic livelihood projects such as micro-enterprise development, education and skills training and youth recreational programs. The project which started in 2014 will end in 2020, however, it is the solid base, upon which specific interventions can be made for the management of solid waste in these communities.

Jamaica Social Investment Fund in partnership with the National Solid Waste Management Authority has employed a partially decentralized approach to SWM in informal communities. In an interview with Phillip Morgan, a principal investigator at NSWMA he highlighted that “The partnership aims to promote a cohesive development process for SWM, improve customer relations with the agency and most importantly upgrade the competencies of the communities to manage solid waste”. Funding for the program was split between improving NSWMA’s technical capacity to collect waste from these communities and improving the communities' social and physical ability to better manage their waste (JSIF 2016).

Some of the major environmental interventions and activities implemented by JSIF throughout the target communities include the construction of 120 concrete enclosures equipped with garbage skips and drums (See Figure 8). These concrete enclosures are a community-wide area for the containment of waste, from which municipal trucks can collect waste- without having to collect from each individual household. Similarly, waste separation is an introduced practice, taking place at the block-level. With the provision of
approximately 66 bins per community, with 3 different colors; residents must separate plastics (PET bottles only) from organic waste and other types of waste (JSIF 2016) (Morgan 2018). The plastics represent a high-value item and are recycled, while the organics are lower value and composting is encouraged. All other waste is dumped in the concrete enclosures for NSWMA pickup. To facilitate the pickup; several small garbage compactor trucks were procured as part of the program, to support waste collection by NSWMA.

The conversion of separated waste into monetary value is facilitated through recycling and community-level composting. The program funded the construction of composting structures and recycling depots in all 30 communities. Recyclers come to these depots and collect plastic and issue cash vouchers for resident collectors, currently, plastic is purchased at a rate of $USD 0.06 - $USD 0.11 per pound (Morgan 2018). Unfortunately, Mr. Morgan stated that community members have not gravitated towards the separation and processing of organic waste because the process lacks the financial reward that plastic waste collection has.

The key component of the ICDP program is the environmental warden and community education component. Phillip Morgan’s main role with the NSWMA is that of a community educator; he is responsible for training and certifying environmental wardens. In an interview, he explained that through a community engagement process with NSWMA and JSIF, community leader nominated residents to participate in the wardens' program. Between 4 and 7 residents per community enrolled in a week-long training program where NSWMA staff educated them on Jamaica’s environmental laws and solid waste best practices. In the end, the residents became authorized, paid officers of the NSWMA. The wardens role involves community-level street cleaning, environmental education, managing waste enclosures, recycling depots and compost piles.

A key component of this program is the incentive mechanism, which rewards wardens for above average performance. A third party non-profit organization monitors the wardens’ performance and then awards a 10% increase in the salary of those performing well. Morgan noted that with this performance incentive, the position of environmental warden became highly coveted within the communities, particularly since unemployment is high. He said the NSWMA received more applications from residents, than were positions available. The position gave residents a sense of pride, from completing the training process and being part of a respected governmental institution (NSWMA) (Morgan 2018). Wardens, in addition to their physical sanitation duties, are responsible for communicating with their fellow residents the importance of proper sanitation practices. If a resident is not taking...
responsibility for their waste, the warden can issue a cleanup notice and confront the resident if compliance is not achieved. The warden also serves as an intermediary between the community and the NSWMA, indicating when there is a backlog of garbage and scheduling pickups. “People are used to mobilizing around political issues (along tribal lines) but are not used to doing the same for environmental issues” (Morgan 2018). With these programs, residents now
have a sense of ownership and level of personal responsibility that makes them demand better SWM practices from one another and better municipal services from the government.

**Summary**

The table below summarizes the key lessons from each of the case studies:

<table>
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<tr>
<th>Case Study</th>
<th>Location</th>
<th>SWM component</th>
<th>Managing Organization</th>
<th>Funding</th>
<th>PSWM Principle</th>
<th>Altering Behaviors</th>
<th>Key Takeaway</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waste picker-run biogas plants</td>
<td>Mumbai, India</td>
<td>• Separation • Collection • Treatment</td>
<td>Cooperative</td>
<td>Commercialization of private SWM services</td>
<td>• 1st principle • 2nd principle</td>
<td>Financial incentives</td>
<td>Creation of entrepreneurial SWM enterprises</td>
</tr>
<tr>
<td>Garbage for Eggs</td>
<td>Yala, Thailand</td>
<td>• Separation • Collection</td>
<td>Municipality • University</td>
<td>Municipal funds</td>
<td>1st principle</td>
<td>Barter system</td>
<td>Incentives for separation</td>
</tr>
<tr>
<td>Paid door-door Service</td>
<td>Khulna City</td>
<td>• Collection</td>
<td>Non-profit • Municipality</td>
<td>Household fees for SWM</td>
<td>2nd principle • 3rd principle</td>
<td>Financial sacrifices</td>
<td>Community financial investment in SWM</td>
</tr>
<tr>
<td>Integrated Community Development Project</td>
<td>Multiple communities in Jamaica</td>
<td>• Separation • Collection • Treatment</td>
<td>Community based organization</td>
<td>World Bank Loan and Municipality funding</td>
<td>3rd principle</td>
<td>Community engagement</td>
<td>Promotion of community leadership</td>
</tr>
</tbody>
</table>

Table 4: Summary of Case Studies and the PSWM principle they reflected

1st principle: Governance and Deliberative Democracy. 2nd principle: Solidarity Economy. 3rd principle: Co-management
New Paradigm: PSWM

Recommendations for this project will aim to usher in a paradigm shift in the SWM sector; away from the traditional, centralized model that fails to address the needs of many informal communities in Jamaica, to a decentralized model that is more appropriate for the context. The participatory solid waste management model consists of three main elements; a deliberatively democratic governance structure, a solidarity-based economy, and co-management of solid waste. This structure will facilitate five main activities that will help achieve the overarching goal of improved community resilience [Fig 9].

Resilience is defined as the capacity of a community to respond overtime to shocks and to proactively reduce the risk of future shocks; these actions contribute to growth and development rather than merely maintain stability (Bernier and Meinzen-Dick 2014). Shocks, in the context of informal communities, are two-fold; shocks to the actual SWM system and shocks to the community itself. While the two are related, shocks to the system may include damage to waste-related infrastructure, unexpected interruptions to the process of waste management and disturbances between coordinated community-level and regional SWM efforts. Shocks to the community include physical elements: extreme weather, development and social elements: crime, violence, displacement or recession.

Recent studies state that there are three central capacities for resilience: persistence, adaptation, and transformation (Bernier and Meinzen-Dick 2014).

**Persistence capacities:** the ability of resilient systems to cope with shocks, ex-post, and restore wellbeing to current levels after the event (Bernier and Meinzen-Dick 2014). The persistent capacity of a resilient SWM system would enable a community to deal with its waste in lieu of municipally provided waste pickup. It would also enable the community to deal with the effects of natural disasters such as floods or storms on waste collection, storage, and disposal.

**Adaptation capacities:** preventative actions that individuals or communities employ to learn from experience or to reduce the impact of predicted shocks. This capacity enables communities to prevent things like rodent infestation due to improper waste containment, or prevent the indiscriminate disposal of waste in gullies which may lead to flooding.
Transformative capacities: the abilities of people to change the larger structures and systems in which they live. This capacity can mean many things, but it can be envisioned as the potential of the monetization and commercialization of waste products and services to stimulate economic development in the local community. It could also speak to the empowerment of a community to access powerful solid waste stakeholders to bring about larger structural changes such as the banning of plastic bags.

All three of these capacities must exist simultaneously, for there to be resilience in any system. The five main SWM activities: Co-op development, Social capital building, Household SWM payments, Entrepreneurial ventures and Partnerships with the NSWMA aim to increase these capacities in informal communities by building up the community’s social, infrastructural and financial capabilities to manage their own solid waste, transform and or dispose of it in a safe way. The activities also have a deliberative impact on the behavior of individual stakeholders, by incentivizing group actions and creating a culture around sustainable management of waste.

The development of a waste-focused cooperative, exercises existing local relationships to create a democratic organization that can address problems faced by the entire community. Potential members of the co-op have interpersonal, familial and cultural ties which are used regularly for other collective behavior and can be used to address SWM. If social ties and trust are already strong in the community, collective payments for waste services can be a feasible step to expand the services of the cooperative. These payments help to fund services and infrastructure that make the SWM system more persistent and adaptable to shocks in the environment.

Entrepreneurial ventures, such as the sale of recyclables and processing of organic waste gives the community the opportunity to create formal relationship with individuals/ institutions outside of their socio-economic class. These relationships facilitate economic opportunities from the conversion or reuse of waste. This economic process incentivizes behavior change, which helps increase the adaptation capacity of the entire community by reducing the potential impact of indiscriminately disposed of waste.

The scaling of these economic enterprises is a transformative act for participating cooperatives. The pooling together of resources, knowledge and expertise gives the cooperative political and economic power to interface/interact with the recycling industry and demand better prices for their products. This collective power, rooted in local communities filters benefits across the cooperatives and can create job opportunities, thus reducing poverty.

The co-management of SWM and the partnership between informal communities and NSWMA is transformative in its assertion of the value in community knowledge and community leadership. This relationship shares expert and local knowledge between stakeholders, which gives the community greater capacity to alter their SWM system to benefit the wider community. The collection of data, encourages communities to better understand resilience and gives opportunities for action, on the part of the community and the municipality.
Activities

Governance and Deliberative Democracy

Co-op development

The creation of a community level consumer-owned cooperative will be the core component of the SWM transformation. As an autonomous association of local residents, the co-op will be a self-sufficient entity, charged with the management of solid waste and any other revenue generation activity developed around solid waste. The cooperative will serve as the intermediary between the community and the National Solid Waste Management Authority, with the ability to demand specific services or collaborate on certain issues.

Based on the existing success of the ICDP Environmental Warden program, the cooperative should be built upon this grouping of community leaders, who have already been operating in a similar capacity. The members of the cooperative will include individuals living in the local community, who through a membership fee will be eligible for SWM services. The leadership of the cooperative should include current environmental wardens and in non-ICDP communities a similar selection process should take place to find community members who can serve as wardens.

Waste Cooperative

Figure 10: Waste Cooperative is comprised of several Environmental Wardens, who are elected from the local community

Social capital building

The mission of the cooperative is twofold; reduce the community's risk of solid waste related hazards and improve the capacity of the community to withstand these and other environmental risks. It is argued that social capital builds and strengthens the resilience of communities, by influencing their persistence, adaptive and transformative capacities (Bernier and Meinzen-Dick 2014). Social capital should not be simplified in this hypothesis, as there exist three distinct types: bonding, bridging and linking social capital. Bonding refers to the interpersonal connections that lead to social cohesion and bridging capital refers to relationships that cross social stratifications. Linking capital creates the opportunity to engage
with external agencies and to influence policy. All three types of capital must exist simultaneously if resiliency is to be achieved.

Lower income communities, often have an abundance of bonding capital, less bridging capital and little to no linking capital. The proposed cooperative aims to strategically strengthen bonding and building capital and create new linking social capital.

![Image of reducing risk and increasing capacity]

**Figure 11: Aim of the cooperative is to reduce risks and increase community capacity**

**Bonding Capital.** “Resilience in informal settlements requires coordinated action amongst many local actors over time. Leadership will not be effective if it is too concentrated amongst a few members of the slum community, or not maintained over time” (Elliott, Iyer and Chauhan 2017). It will be the mandate of the cooperative to engage the wider community in environmental education and leadership, through sustained community engagement activities. The staff of the cooperative (environmental wardens) will carry out regular community meeting to discuss solid waste behaviors, resilience related topics and other issues related to community development.

**Bridging Capital.** Technological approaches to resilience fail not only because they are not cost effective but also the implementation is not market enabled (Elliott, Iyer and Chauhan 2017). If the monetization of waste by-products and other reclaimed material will help sustain the cooperative and its staff, then effective partnerships must be made with commercial recyclers and other potential clients. The collection or creation of recyclables, compost, and any other waste-product must be done collaboratively, to ensure consumer preferences and needs are being met.

**Linking Capital.** “Resilience in informal settlements requires coordinated action at the slum, community and city level. Therefore, leadership works best when it is developed and interacts at all these levels” (Elliott, Iyer and Chauhan 2017). The cooperative leadership will have effective communication and coordination with the municipal providers of solid waste services (NSWMA). This relationship will ensure effective coordination of community waste pickup from centralized waste enclosures. It will also serve as an avenue for sharing knowledge and expertise.

“Scientific knowledge sharing to communities requires systematic, repeated and innovative communication tools to enable future-oriented thinking, especially with communities which are used to thinking short-term” (Elliott, Iyer and Chauhan 2017). The current curriculum for the environmental warden program is an existing example of a communication tool between the
city and the community but should be developed to include the role of the wider community, not just wardens. This structured sharing of knowledge should be a bi-directional process that disseminates expertise from the NSWMA to the community but also shares local data collected in the community to the authorities.

“Community-based data collection leads to an increased understanding of the community’s vulnerabilities and opportunities for action thereby leading to more resilient actions and investments” (Elliott, Iyer and Chauhan 2017). An undeniable feature of informal settlements worldwide is the lack of consistent data collection, related to waste patterns and waste infrastructure. The cooperative, though technical training from the NSWMA will have the technical knowledge to conduct assessments of waste generation, separation and collection patterns. This data can be used to improve cooperative operations, but it can also be used to inform NSWMA and justify additional resources.

Social and Solidarity Economy

Social and Solidarity Economy (SSE) provides a vision of local development that proactively regenerates and develops local areas through employment generation, mobilizing local resources, community risk management and retaining and reinvesting surplus (TFSSE 2016). The cooperative will facilitate this type of alternative economics, within in local area through member economic participation and the monetization of waste byproducts and reclaimed valuable materials.

Household SWM payments

The third principle of cooperative economics states the responsibilities of members to their co-op and how funds should be utilized. The International Co-operative Alliance states (International Co-operative Alliance 2016):

“Members contribute equitably to, and democratically control, the capital of their cooperative. At least part of that capital is usually the common property of the cooperative. Members usually receive limited compensation, if any, on capital subscribed as a condition of membership...”

Membership fees will be collected from each household in the informal community on a monthly/weekly basis. The majority of the funds will be used to carry out the co-op’s cleaning activities, pay environmental wardens and invest in new recycling, composting or biogas related capital expenses. A portion of the total revenue collected will be set aside as indivisible reserves, used only for non-quotidian activities.

The process of determining informal communities’ willingness and ability to pay membership fees for the cooperative should incorporate survey data and use well-recognized economic methods. Various studies have calculated communities’ willingness to pay (WTP) for improved solid waste management in lower to middle-income communities around the Global South. (Bhattarai 2015), combines an environmental perception survey along with a contingent valuation method to determine levels of WTP for municipal SWM in the Banepa Municipality in Nepal. Similarly, Adetola and Benedicta (2014) applied both methods but included an analysis of multidimensional poverty to distinguish between lower and higher income households’ ability to pay (Adetola and Benedicta 2014).

Bhattarai’s analysis finds that the vast majority of respondents (83%) are willing to pay for improved solid waste management at a rate of USD 1.69 per month. His sample size had a mean income of USD $168.15/month and had an average educational attainment of less than a
secondary education. The WTP was influenced positively by the educational status of the household head, the number of working household members and negatively by the household’s poverty status (Adetola and Benedicta 2014).

Bhattarai did observe a big difference between levels of income, where the range was between USD $71.42/month to USD $612.18/month. It is important to note that at a rate of USD $1.53/month 100% of survey respondents were willing to pay for SWM services (Bhattarai 2015). (Adetola and Benedicta 2014) concluded that the attributes that most influence WTP include: whether or not waste would be separated, provision of waste containers, disposal method then collection frequency. The Planning Institute of Jamaica or the National Environmental Protection Agency both have the capacity to conduct such research efforts. Alternatively, the NSWMA could seek assistance from university level institutions to conduct these studies in pilot ICDP communities.

**Entrepreneurial ventures**

In addition to the collection of membership fees, the cooperative will initiate other profit-making enterprises to ensure the financial viability of the cooperative and all its other activities. The range of enterprises a community can create will be determined by features of the local SWM system and the community itself. These features can include waste characteristics, land availability, available markets for new products and access to technical expertise. The foundation of these activities will replicate the existing waste separation and processing that occurs in the ICDP pilot communities.

An essential component of all these entrepreneurial ventures is the separation of waste at the household level. The cooperative will be responsible for running this waste separation program throughout the community, along with the sale of reclaimed materials and conversion of organic waste. The ICDP program provided around 60 color-coded bins per community, which facilitated the separation of plastics, organic and inorganic waste. Each household is responsible for separating its waste and placing it in the nearest bin, which will be at the end of each block or street (Fig 12). Replicating this process, the staff of the cooperative (environmental wardens) will move these waste bins to the designated waste collection point - which is a secured concrete enclosure for recyclables, organics, and inorganics.

The recyclables and organics can be used for income generation by the cooperative, while the remainder of the waste will be collected by NSWMA and be deposited at the landfill. The location of skips and or concrete enclosures used to store different types of waste is very important. Because of the urban form of informal communities the most accessible portions of the community are usually the edges facing main or public roads. It is thus recommended that the collection and storage points for all types of waste be along the edges of the community, facing publicly accessible roads.
**Commercialization of Recyclables.** "Autonomy or self-determination, rather than paternalistic dependency, is key in social solidarity economy. Social relations based on autonomy have the potential for social innovation, from both an institutional (governance) perspective and an economic (satisfaction of needs) perspective" (Yates and Gutberlet 2011). In Jamaica as in the rest of the Global South, some of the most impoverished and marginalized citizens attempt to carve out a living through the collection and sale of recyclable material. These waste pickers, operating outside of the realm of formal enterprises, have no choice but to sell their material directly to intermediaries, thus exposing themselves to exploitation (Yates and Gutberlet 2011). If these activities are formalized and the workers recognized, dependence on the intermediaries would be reduced and more could be done to improve worker-safety and welfare.

**The Network.** A network of community-level waste cooperatives could serve as an avenue for collective waste-picker formalization. Through increased organization, coordination and empowerment the network would be able to expand their scale, allowing for commercialization directly with the recycling industry. Each individual waste co-op operating within an informal community will be responsible for collecting the recyclable material from their respective communities and then transferring it to a depot or collection point, managed by the wider network. From there the network can partner with large-scale recyclers in the sale of that material. The profits earned from that sale would be redistributed to the co-ops (proportionally to the quantity of material collected) and then divvied up to the individual wardens.
PSWM pilot projects in Brazil found significant differences between selling recyclables to intermediaries and directly to the industry (Table 5). The study found, on average, groups that collectively commercialized earned 55% more than they would had they individually sold material to intermediaries. Selling directly to the industry requires large volumes of material, persistent quality, access to transport and administrative capabilities (Yates and Gutberlet 2011). Through the formalization of the recycling process, cooperatives and the network were able to access microcredit, which enabled them to increase their capacity and capabilities.

Table 2: Price differences between individual and collective commercialisation

<table>
<thead>
<tr>
<th>Material</th>
<th>Middlemen price (in $)</th>
<th>Industry price (in $)</th>
<th>Increase in %</th>
<th>Data collected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardboard</td>
<td>0.15 - 0.18</td>
<td>0.29</td>
<td>61 to 93%</td>
<td>December 2006</td>
</tr>
<tr>
<td>White Paper</td>
<td>0.35</td>
<td>0.52</td>
<td>49%</td>
<td>December 2006</td>
</tr>
<tr>
<td>Tetrapak</td>
<td>0.16</td>
<td>0.30</td>
<td>87%</td>
<td>October 2007</td>
</tr>
<tr>
<td>Plastic (PP)</td>
<td>1.00</td>
<td>1.55</td>
<td>55%</td>
<td>October 2007</td>
</tr>
<tr>
<td>Plastic (PEAD)</td>
<td>0.80</td>
<td>1.10</td>
<td>37%</td>
<td>October 2007</td>
</tr>
<tr>
<td>Plastic (PET)</td>
<td>1.05</td>
<td>1.20</td>
<td>14%</td>
<td>October 2007</td>
</tr>
</tbody>
</table>

Table 5: Price difference between individual and collective commercialization of recyclables (Yates and Gutberlet 2011)

The Jamaican recycling industry is particularly fickle and vulnerable to the fluctuations of international oil markets. Because PET plastic is derived from petroleum, the price is determined by the price of petroleum internationally. Despite this, however, there are 16 registered recyclers scattered across the island accepting: plastics, paper, cardboard, Styrofoam, glass, electronics
and car batteries (Jamaica Environment Trust 2017). Due to the high cost of energy in Jamaica, recyclers usually accept, store and crush recycled materials at their large-scale depots then export it to the US for processing. The proposed partnership created between the network and the recyclers ensures that the co-ops and their members are able to create higher value-added products, and consume a greater portion of the potential profit in the industry.

Participating PSWM cities across Brazil found that collective commercialization and the new-found access to microcredit facilitated the creation of depots large enough to store waste from multiple communities and develop transportation options to and from industry recyclers. To get to this level of expansion the network must seek financial education and training for its members. In Brazil educational institutions supporting the PSWM project launched a series of workshops on micro-finance, banking and administrative skills.

There is significant evidence from Brazil that this type of organized recycling generates social, economic and environmental benefits that radically address poverty reduction and actually achieves several Millennium Development Goals (Gutberlet 2012). The key outcome of this proposal that should help garner widespread support is the ability to generate work and employment for the urban poor. Not only are jobs created in the recycling sector, but also in awareness building and public education. Collective and democratic structures such as the cooperative and the network “are not final and definite solutions, but are important in a process of societal transformation” (Gutberlet 2012).

Recirculating Organic Waste “The marginal poor in Diadema, as in most other cities in Brazil, lack access to affordable fresh fruit and vegetables yet must cope with a disproportionate accumulation of uncollected waste” (Yates and Gutberlet 2011). The realization of these two seemingly disparate facts led to a social experiment in the lower-income city of Diadema in Brazil, which was later called Reciprocal Organic Waste Networks (Yates and Gutberlet 2011). The idea of an integrated organic waste management system consists of the decentralized collection of household organic waste by waste cooperatives, waste processing and the utilization of food waste for composting and urban food production (Fig 14). The context of Jamaica’s informal communities is well suited for the application of this type of organic waste system.

Jamaica, like most Caribbean islands, faces a unique form of food insecurity, based on their high levels of urbanization and small land mass. The Food and Agriculture Organization (FAO) states that the region faces instability caused by natural and economic shocks constantly undermining efforts to advance food and nutrition security (Food and Agriculture Organization of the United Nations 2015). Between 1990 and 2014, 182 major natural disasters occurred in the region, affecting 11.5 million persons (65% of total CARICOM population). Compounded with that issue is the fact that almost all nation members of the Caribbean Economic Community (CARICOM) import more than 60% of the food they consume, much of which has been characterized by FAO as nutritionally poor. These issues have resulted in several issues: an increase in the prevalence of undernourished people since 2000, and an increase prevalence of obesity and other chronic nutrition-related diseases (Food and Agriculture Organization of the United Nations 2015).
Collection. NSWMA stated that in 2006 69% of solid waste in Jamaica was organic, this number is likely to be higher in informal settlement. Therefore the solid waste context of informal settlements in Jamaica presents an opportunity to address these food availability issues while reducing the accumulation of uncollected waste. Replicating the Reciprocal Organic Waste Networks in the local context will require leadership and management by the proposed waste cooperatives. Households will be responsible for separating their organic waste and disposing of it in the appropriate color-coded bins, located at the block/street level. This waste will be removed by environmental wardens to a community-level organic waste depot.

Waste Processing & Circulation. Interviews with NSWMA staff noted that efforts to promote composting in ICDP pilot communities were unsuccessful because the benefits of organic waste were not easily monetizable (Morgan 2018). The Diadema pilot study observed that compost was not created to sell for profit, but was a source of trade between community members. Co-op members and urban gardeners established mutually supportive reciprocal systems, exchanging food waste for fresh fruits and vegetables (Yates and Gutberlet 2011). One gardener described the collective benefit of the trade:

“The garden will be useful for me and...many other families and children in need. We don’t sell it to anyone. The garden is for our own consumption” (Yates and Gutberlet 2011).

Jamaica currently has community-level agriculture programs, which can be aided with the provision of locally-produced compost. In 2016 the Ministry of Agriculture and Fisheries re-launched the National School Gardening Programme, which aims to feed school children and reduce the percentage that attends school without breakfast (Rural Agricultural Development Agency 2017). A partnership between the waste cooperative and a participating school garden can provide mutually beneficial results.
The separated and consolidated organic waste produced by the community can be given to the school gardener, who will be trained by the national program to produce compost. Under the program, participating schools will be provided the seeds, agricultural tools and irrigation systems necessary to produce crops that meet the dietary needs of a healthy breakfast program. Excess produce can be redistributed to the co-op and or the local community. This arrangement asserts that the behavior of organic waste separation is a public good, as it contributes to the well-being of the community's children.

**Encouraging Participation.** This exchange mechanism reflects one post-capitalist theorist calls for “equitable distribution of surplus and the possibilities to replenish the commons, via economic strategies that are not market-oriented” (Yates and Gutberlet 2011). The key to achieving this outcome is maximum participation and sustained waste separation behavior. This can be achieved with a focus on environmental education, in particular, organic waste cycles and agriculture at the primary level. The exchange between the cooperative and the schools means that children are major stakeholders in this process and through their “ pestering power” can influence the behavior of their families. “Pester power” is a marketing term which is used to describe children’s ability to influence their parents’ consumption patterns (Otsuka 2015).

This concept is also present in environmental literature; one research publication found strong evidence that environmental education can be transferred between generations and indirectly induce targeted behavioral changes (Damerell, Howe and Milner-Gulland 2012). While other similar studies found less promising results, childhood education must be part of the process of altering community behavior but so too; deliberate community outreach by the cooperative.

**Co-management of SWM**

Co-management of common-pool resources differs from purely ‘top-down’ and ‘self-organized’ management approaches as it combines the comparative advantages of communities, the government and education institutions. Enforcement of the rules as well as technical and financial support is usually provided by the government whilst the community democratically decides on the policies they want to be implemented. While much of the policy recommendations listed in this project are focused on community-organized interventions, co-management of certain aspects of the SWM sector will take place in concert with the NSWMA and local research universities.

The co-management process is based on the realization that the limited capacity of the community and local government to sustainably protect the environment can be complemented by participation of other stakeholders at various levels (Consultative Group for International Agricultural Research 2014). Responsibilities that will be shared include SWM staff training, financing of critical infrastructure, waste disposal, data collection and evaluation.

**SWM staff training.** Replicating the model used in the ICDP program, NSWMA staff will train environmental wardens from various informal communities. NSWMA, as the expert has the technical knowledge and best practices necessary to ensure a safe and efficient work environment for staff of the co-op. This relationship will be a formalized channel for contact between the two groups, with NSWMA providing standardized and appropriate educational material for cooperative and their unique needs. Technical information that the co-ops would benefit from include: composting guides, distinguishing between different types of plastics, and social enforcement approaches.

An existing initiative in ICDP communities is a ‘buddy system’, where a lead environmental warden is partnered with a NSWMA staff member. This partnership facilitates the bi-directional facilitation of information between community and government agency.
**Critical infrastructure.** The integrated Community Development Project (ICDP) was funded by a US$42 million loan given to the government of Jamaica from the World Bank. This loan funded the provision of 66 color-coded bins to each of the 130 informal communities in the project. These bins, in addition to the concrete enclosures are critical pieces of infrastructure necessary to facilitate waste separation behavior. In communities where the social and financial capabilities are higher the cooperative may be able to help raise collective funds to contribute to municipal provision of these storage devices. The concrete enclosures that store separated waste until transportation are also critical infrastructures which enable more efficient removal of the waste.

**Data Collection.** Much of the literature on decentralized, community-driven sustainability-related initiatives highlights the importance of putting local people and their knowledge first. Residents of informal settlements around Jamaica know the local environment better than the municipality or its agencies, as such their knowledge is instrumental in transforming the current waste management practices. Another proposal of this plan involves giving communities the capacity to collect vulnerability-related data, which when combined with their local knowledge can increase understanding of community vulnerabilities and increase opportunities for action.

As part of the waste co-ops partnership with the NSWMA, the co-op will be given the tools to conduct regular vulnerability assessments and waste pattern evaluations. The results will be used locally, to adjust community outreach material and also to better plan ahead for the co-op’s various entrepreneurial enterprises. Data collected should also be shared with the NSWMA and the municipality, as there is a fundamental lack of data on informal settlements. Data to be included in the assessments include (but are not limited to):

- Waste generation rates
- Waste characteristics (organic, inorganic, plastics, glass...)
- Rates of participation in household waste separation
- Descriptive measures of waste clogging gulley’s or in public lots

The transfer of this data can be facilitated through the ‘buddy program’ and can attract the expertise of various university research groups. The ability of communities to monitor their own behavior, their environment and changes in it is a valuable tool in thinking about climate change resilience.
### Potential Outcomes

<table>
<thead>
<tr>
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<th>Capital being built</th>
<th>Capacities being created</th>
<th>PSWM Principle</th>
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<tbody>
<tr>
<td>Co-op Development</td>
<td>Community</td>
<td>Bonding</td>
<td>Persistence/adaptation/transformation</td>
<td>• Governance • Deliberative Democracy</td>
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<td>Bonding</td>
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<td>Solidarity Economy</td>
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<td>Bridging</td>
<td>Persistence/adaptation</td>
<td>Solidarity Economy</td>
</tr>
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<td>Bridging/Linking</td>
<td>Transformation/adaptation</td>
<td>Solidarity Economy</td>
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<tr>
<td>Co-management of SWM</td>
<td>Regional</td>
<td>Linking</td>
<td>Transformation</td>
<td>• Governance • Deliberative Democracy • Co-management of SWM</td>
</tr>
</tbody>
</table>

| Table 6: Potential outcomes of proposed activities |

The interventions presented represent a shift from the centralized model and usher in a decentralized, participatory alternative. All five activities (Table 6) vary the scale at which SWM processes are completed. Unlike the contemporary model where responsibilities are for the individual, community, regional, and the municipality. The model aims to engage a wide cross-section of the citizenry in sustainable waste practices that include separation, recycling, composting, and commercialization. In the process, bonding capital is being leveraged, and bridging and linking capital are being created.

Low-income communities are known to have significant bonding capital that consists of personal and familial relations which enable the sharing of resources. This type of capital is instrumental in creating the trust ties that facilitate the waste cooperatives and the payment of SWM fees. The commercialization of recyclables and recirculating organic waste gives community members the opportunity to form economic and trade ties with other stakeholders, this leads to an increase in bridging capital. Linking capital comes with partnerships with powerful stakeholders who have the ability to affect the SWM system.

The presence of these three capitals within this reimagined system leads to increased community resilience. Resilience is defined as the capacity of a community to respond over time to shocks and to proactively reduce the risk of future shocks. These proposed actions contribute to growth and development rather than merely maintain stability (Bernier and Meinzen-Dick 2014) of the local community.
Conclusion

This analysis and prospectus project sought to analyze Jamaica’s current solid waste management system and to further examine the implication of that system on informal communities. Centralized SWM systems are most suitable for urban areas where significant economies of scale are possible and where the composition of waste allows for the greater extraction of value. Informal settlements, based on their urban form and their informal land tenure do not allow for economies of scale resultantly, only 37% in Jamaica benefit from municipal waste services. Compounded with the lack of other essential infrastructures such as running water and paved roads, informal settlements are particularly vulnerable to public health and environmental risks.

Through an analysis of various case studies and literature review of decentralized approaches to SWM, a participatory solid waste management framework was selected as a potential alternative. PSWM, originated in Brazil and is based on three principles: Governance & Deliberative Democracy, Social & Solidarity Economy and Co-management of the SWM sector. This proposed framework centers local and resource-poor communities in the creation of solutions to the problems faced in their urban environment. It also connects them with the formal and public sector decision-making processes through collective action and political power.

The potential of PSWM to alter the landscape of Jamaica’s informal communities is immense. The major intervention is the creation of a community-level waste cooperative, whose mission is twofold: reduce the community’s risk of solid waste related hazards and improve the capacity of the community to withstand these and other environmental risks. By building social capital, the cooperative will help to strengthen the resilience of local communities. Resilience is only attained when persistence, adaptive and transformative capacities of a community are achieved simultaneously.


Morgan, Phillip, interview by Dorraine Duncan. 2018. *NSWMA’s role in JSIF’s Integrated Community Development Project* (02:02).


National Solid Waste Management Act. 2002. 27 (Jamaica, April 1).


