Integrated Solid Waste Management Solutions for Puerto Rico: Small, Replicable Steps Towards Achieving Drastic Changes

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Abstract**—***This project recommends strategies for developing an Integrated Solid Waste Management Plan for Local Government Units (LGUs), which, in the case of Puerto Rico, applies to Municipal Governments, for their implementation that would include suggestions for agencies' integration towards this effort. These strategies are suggested with the projection that guidelines will be developed and provided to Municipal Governments for the achievement of comprehensive integrated waste management solutions; primarily regionally –based. As a basic strategy, the empowerment of Municipal Recycling Coordinators (MRCs) is herein enforced by providing a strategic plan for education of the MRCs.*

Key Terms*—Integrated Solid Waste Management (ISWM), Municipal Recycling Coordinators (MRCs), Solid Waste Association of North America (SWANA) Caribbean Chapter, Puerto Rico Recycling Partnership (PRRP).*

INTRODUCTION TO THE PROBLEM

Waste management throughout the Caribbean is, at best, ineffective. The lack of integrated solid waste management (ISWM) efforts and coordination from all sectors has severely compromised the effectiveness of the system. The Solid Waste Association of North America (SWANA) defines ISWM as "a series of complimentary actions dedicated to reducing the amount of solid waste generated and managing that which is generated in an economically and environmentally sound manner" [1].

Each island is confronted with a unique situation that range from gubernatorial complications to geographical location. But throughout the Caribbean, this situation presents immeasurable environmental problems.

This project recommends adaptable strategies focused on tackling the situation at Puerto Rico's State Government level with the idea of exploiting the knowledge that "all waste is local" with the understanding that current laws apprehend the responsibility of waste management at the municipality level. Municipal government instability and their individual lack of understanding on how "by joining forces, more can be accomplished" has led to utter lack of coordination in regards to waste management.

Project Scope

Strategies herein recommended are focused on tackling the situation at Puerto Rico's State Government level is the most straightforward way of arriving at a reasonable regionalization of waste management. The idea emerges from the knowledge that "all waste is local" and current laws apprehend the responsibility of waste management at the municipality level.

A feasible approach to a solution is herein recommended by way of providing guidelines towards formalizing a regionally-based integrated waste management plan. This would be a first step towards providing a better outlook on a long-term, island-wide solution to the solid waste management crisis.

This integrated solid waste management philosophy accompanies a strict focus on Municipal Governments. The idea of tackling the situation at the Municipal Government level is the most straightforward way of arriving at a reasonable regionalization of waste management. Hence, the recommendations are focused on providing guidelines to Municipal Governments by way of Municipal Recycling Coordinators (MRCs) for the

achievement of comprehensive integrated waste management solutions.

Proper education and empowerment provided to the right people involved in solid waste management is a good start. Concurrently, analyses of needs, opinions, or goals as provided by Municipal Recycling Coordinators (MRCs) are significant once adequately analyzed and geographically referenced. This would provide a better understanding of difficulties faced by some of these MRCs as well as when comparing infrastructure needs. These efforts may provide a better outlook at the current situation and provide a pathway for presenting integrated solid waste management indicators that may be set in motion for change to occur.

In an effort to empower Municipal Recycling Coordinators (MRCs) in carrying out these integrated waste management efforts, this project focuses on:

- Developing a strategic plan for education of the MRCs for use by the P.R. Solid Waste Authority or the newly created MRCs' Coalition (CCOREM, as per its Spanish Acronym).
- Suggesting guidelines for the integration of diverse divisions charged with waste management responsibilities (Public Works Authority, Permits Offices, etc.).

LITERATURE REVIEW

The system herein proposed may be adapted regionally and emerges from a Total Quality Approach for the development of this Integrated Solid Waste Management System. Current practices have focused on "Bold-On" Approaches, where fixes or short-term decisions result in higher costs and higher life cycle burdens of the materials. Reference [2] cites that "the Total Quality objective would be to minimize the environmental burdens of the whole waste management system, whilst keeping the economic costs to an acceptable level".

ISWM is the type of strategy herein proposed is implemented on the island. Reference [3] states that "the management of municipal solid waste (MSW) is a high priority issue for many communities throughout the United States. Rising MSW generation rates and disposal costs, environmental and health concerns, limited landfill space, legislative changes, political climate, and social attitudes have a significant impact on waste management efforts. Increasingly, many communities are adopting the concept of integrated solid waste management as a means of better managing their MSW."

The initial focus for the development of this emerges from need to truly implement the solid waste management hierarchy identified by the United States Environmental Protection Agency (EPA). The priority must be waste reduction at the source of potential generation, including the application of recycling activities such as "material selection when shopping, and reducing toxicity of products in manufacturing prior to recycling, which helps reduce the amounts of municipal solid wastes generated" [4].

Waste reduction precedes efforts to be performed once the waste is generated: reuse, recycling, energy recovery, treatment, and disposal; refer to Figure 1.

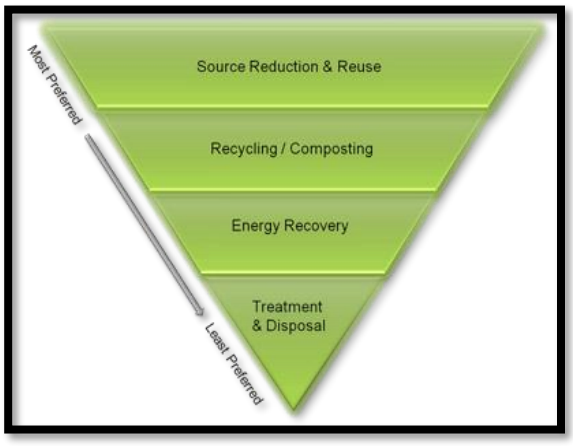

Figure 1

Waste Management Hierarchy [5]

Furthermore, management strategies, which are stated in Figure 1 in a hierarchical manner, are also identified by the EPA for ISWM as interactive: "(1) source reduction, (2) recycling and composting, (3)

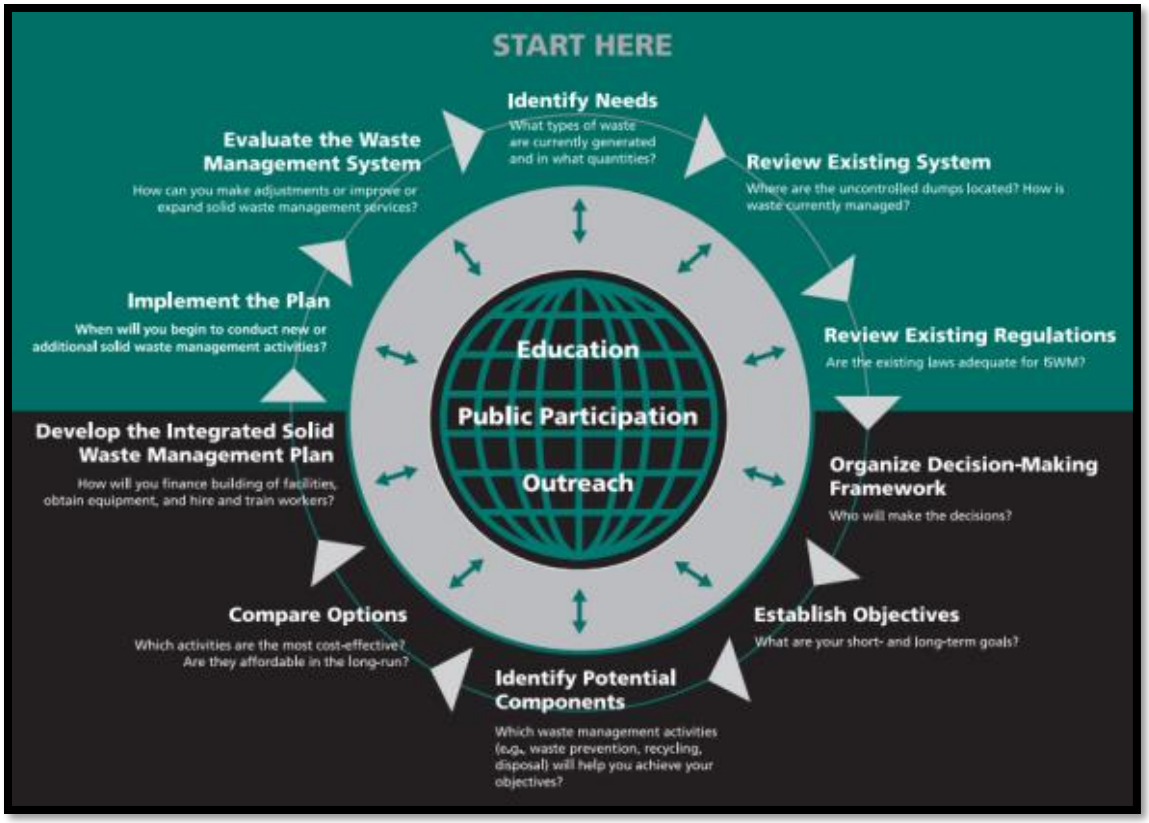

Figure 2

Comprehensive Integrated Solid Waste Management (ISWM) Planning Process [12]

combustion (waste-to-energy facilities), and (4) landfills" [4]. There are ways of integrating these strategies in a thoughtful and sustainable manner.

Figure 2 shows steps to implement in order to stage integrated solid waste management strategies.

Analyses emerging from Figure 2 shall provide enough knowledge in order to define the waste management system components. Comprehensive knowledge of the system currently in place will aid in identifying interrelationships, such as those presented in Figure 3.

Reference [4] states: "Long-term planning at the local, state, and even regional level is the only way to come up with a good mix of management tools. It must address both environmental concerns and economic constraints".

Hence the reiteration of a comprehensive planning process, as the one depicted in Figure 2 and the following guidelines, as adapted and summarized from reference [4], must be taken into account by planners:

1. Long-term focus;
2. Full integration of solid waste management accounting, no matter the divisions each effort may encounter at the municipal level;
3. Proper environmental controls and compliance;
4. Adequate recyclable materials market research;
5. Full understanding of facility permitting, and;
6. Look beyond local options.

Regional ISWM Planning Initiative

An important focus should be exalted: "solid waste management systems need to ensure human health and safety" [2]. The waste management

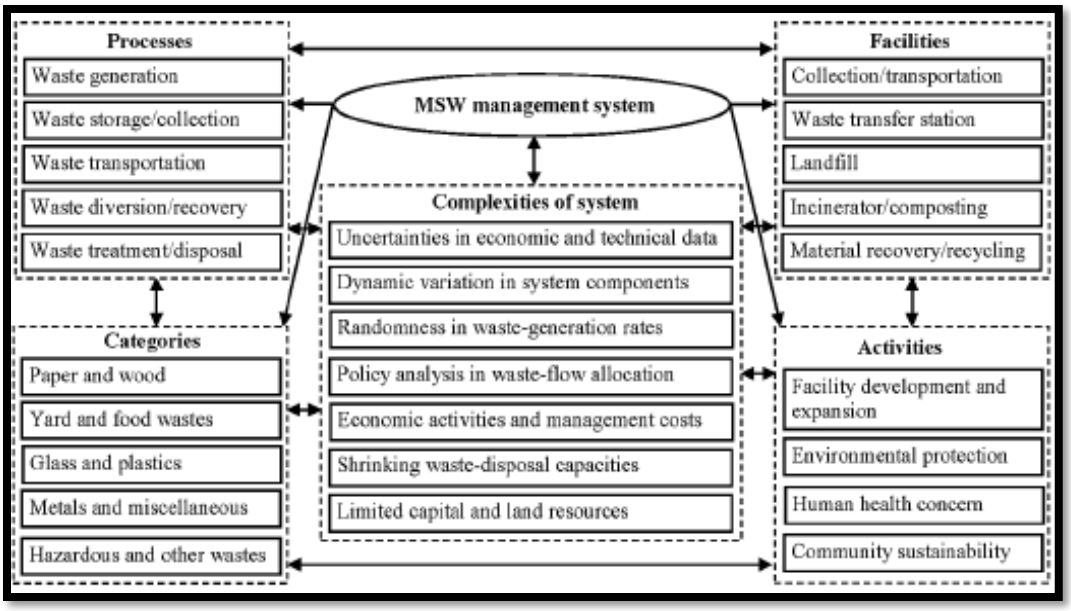

Figure 3

Interrelationships among various systems [11]

crisis in Puerto Rico should be foreseen as a health and safety issue and as such must be prioritized. The idea of integrating alternatives or strategies provides a planned view for decision makers.

A long-term plan has been developed in this field in the past decades in Puerto Rico, which is known as the "Dynamic Itinerary for Infrastructure Projects", but no true integration of this itinerary into decision-making has been proven successful.

The "Dynamic Itinerary" takes into account several strategies to implement by taking into account two base cases: (1) PRSWA diversion goals were met (35% in 2006) and (2) 35% diversion rate is reached in 2026 [6]. This document must be revised to not only include current applicable metrics but also to propose and integrate regionalization of solid waste management.

By presenting regional plans or perspectives for the integration of solid waste management efforts, priorities can be catalogued in a more realistic manner. Municipalities must look beyond political boundaries and work together towards developing comprehensive regional solutions. The primary boundary that impedes most planning efforts on island is the lack of metrics and reliable data.

Data collected is then used for strategic decisions; which, in the case of regional ISWM, would mean comprehensive and interrelated decisions that would benefit the entire region without compromising the environment or human health at any level.

Municipal Recycling Coordinators Empowerment Initiative

A large part of decision making in solid waste management is decided upon by municipal governments in Puerto Rico. Each municipality is unique in its waste management perspectives, needs and delegated responsibilities to municipal departments. Municipal Public Works Departments are generally charged with coordination of waste collection and transfer systems, which may be carried out by municipal employees or contracted to private companies.

If the municipality decides to contract these services, then the procurement process must

provide a “fair, open and competitive process” as well as ensure public health and welfare [7]. This process may be a complex one depending on the range and extent of services, for which professional technical and legal services may need to be integrated to the procurement team.

The integration of diverse aspects and elements in coordination with or for the health and welfare of stakeholders would create feasible long-term strategies that could be identified as sustainable. Figure 4 depicts this identification of elements that would need to be integrated and reliant upon each other during the entire planning or any procurement process.

Figure 4

Integrated and Sustainable Waste Management Overview [8]

For this procurement process, the municipality must have knowledge of the type of customers to be serviced, identification of acceptable materials, among other terms. This is the stage where proper metrics and data are evaluated by being projected on a regional level.

A training guide for MRCs is herein proposed that would provide the necessary tools for these key players. This guide would subsequently serve as basic training for those Public Works Departments or divisions charged with other waste management responsibilities such as collection and transfer.

INITIATIVES BY LOCAL ORGANIZATIONS

The Caribbean Chapter of the Solid Waste Association of North America (SWANA) is the professional organization, covering the region South of Florida, which is prepared to provide support in waste management matters including advocacy and education. The Chapter has created specific goals somewhat aligned with the needs identified and mainly developed by the Private Sector in Puerto Rico, refer to Figure 5.

Figure 5

SWANA Caribbean Long-Term Goals, 2013 [9]

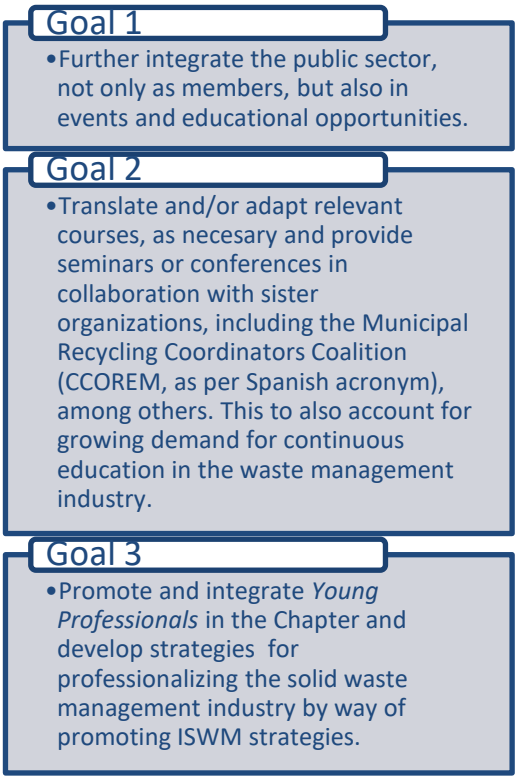

Figure 6

Regional Map (PREQB) [13]

Expanding primarily Goals number 1 and 2, the island is to be divided into Regions, in the case of the example provided in Figure 6, division as identified by the P.R. Environmental Quality Board (PREQB). This regional distribution is recommended be adopted for planning and MRC Coalition events and educational efforts.

By not only motivating MRCs but also creating forums or providing technical sessions in the different regions, SWANA represents a reliable asset for the MRCs Coalition. Courses administered by SWANA Staff to be offered to specific audiences are the following:

- Courses to be provided by region in possible coordination with forums (prioritized list):
  - One-day course in *Collection System Basics;*
  - One-day course in *Waste Screening;*
  - Three-day course in *Integrated Solid Waste Management* (involve decision-makers in this course);
  - Three-day course in *Collection and Transfer Systems* (to be provided to municipalities that provide waste collection services by way of municipal employees), and;
  - Three-day course in *Recycling Systems* (as needed)
- Municipalities with landfill operations within their political boundaries:
  - One-day course in *Landfill Operation Basics*, and;
  - Three-day course in *Management of Landfill Operations* (for municipalities that perform these tasks by utilizing municipal employees, not contracted services)

These courses have been presented to the MRCs Coalition and are integrated into their strategic plan.

As a broader perspective, the Puerto Rico Recycling Partnership (PRRP) was established by the EPA to "promote waste reduction, reuse, recycling and clean composting through a working partnership including government (at all levels), non-profit organizations, citizens, environmental groups, and the private sector" [10]. Strategies developed by the PRRP are precisely the implementation goals the state government must act on in coordination with regional and municipal efforts herein suggested.

The ISWM goals (refer to Figure 7) and strategies developed and reported by the PRRP have involved input from diverse sectors and must continue to receive private and public sector support. Firsthand knowledge of the dedicated time, efforts, and professional quality of the PRRP and

the corresponding report are hereby reiterated by a founding member of the PRRP.

Figure 7

ISWM Goals as delineated by the PRRP [10]

MRC Coalition Strategic Plan

The following Strategic Plan is presented as an educated recommendation to the MRC Coalition that includes goals for the first two (2) years and initially identified long term goals. Three major goals pave the way to identified strategic guidelines provided.

MRC Coalition Mission Statement

To support, promote and develop recycling in Puerto Rico.

Introduction

This strategic plan is being presented for the development and growth of the MRC Coalition. This document is meant to guide the MRC coalition through strategies to reach goals identified for the primary purpose of focusing an island-wide view focused on ISWM.

Definitions

- MRCs: Municipal Recycling Coordinators
- Program Year 1: April 1, 2014 – March 31, 2015
- Program Year 2: April 1, 2015 – March 31, 2016
- Long term strategies: Strategies to be completed in the next 2-5 years

Goals and Strategies

Goal 1: Increase Involvement of MRCs in the MRC Coalition

Engage current MRCs in dialogue to understand their educational needs from the MRC Coalition,

Goal 1 Strategies:

- Program Year 1:
  - Develop and implement a Regional MRC Representation Plan.
  - Appoint Regional Representatives for each of the six (6) regions.
  - Initiate regional meetings to promote the Coalition and involvement of MRCs.
- Program Year 2:
  - Implement quarterly forums for discussing needs and motivating creative thinking.
  - Involve the PR Solid Waste Authority (PRSWA) to these forums and other educational activities.
  - Develop a SWANA Young Professionals (YP) “Geek Squad” to attend meetings and motivate MRCs to use innovative applications and provide technical support.
- Long Term
  - Motivate MRCs to get involved in advocacy and take a more active role in integrating all waste management related efforts performed in their municipalities for the sake of sound decision making.

Goal 2: Foster Professional Development of MRCs

Update and integrate PRSWA resources and tools that provide MRCs the basic information to perform in their positions. Integrate SWANA resources where specific technical training is needed,

Goal 1 Strategies:

- Program Year 1:
    - Revise PRSWA educational materials to further promote ISWM strategies.
    - Provide initial SWANA trainings as identified earlier in this document.
    - Evaluation and scheduling of more specialized SWANA trainings looking forward to Program Year 2.
- Program Year 2:
    - Provide MRCs the tools to identify measurable flaws in their municipalities.
    - Integrate certified SWANA trainings as identified earlier in this document.
    - Develop facility tours and e-Tours (video tours from different waste management facilities.
- Long Term:
    - Integrate "Lessons Learned in my Community" reports to quarterly regional forums. This may also turn into continuous problem-solving dynamic for the group.
    - Provide and schedule refresher or continuous education courses for MRCs.

Goal 3: Create or promote synergy for divisions charged with waste management responsibilities (Public Works Authority, Permits Offices, etc.) within the municipality.

The different waste management systems, as identified in Figure 3, may be assigned to different divisions or departments within the municipality. This practice promotes decision making delays and mis-coordination due to individual bureaucracies and misinformation. Suggested strategies to be coordinated through the MRC Coalition follow.

Goal 3 Strategies:

- Program Year 1:
    - Coordinate short MRC Coalition introductory meetings at the regional level to promote continuous communication and industry knowledge.
    - Promote continuous communication at the municipal level between MRCs and departments charged with waste management tasks.
- Program Year 2:
    - Identify solid waste management industry-related training needs within the numerous departments and positions within the municipality.
    - Provide initial SWANA trainings in these departments and position.
- Long Term:
    - Integrate learning and planning forums at the municipal and regional level.
    - Promote continuous evaluation and optimization of regional-level integrated waste management (ISWM) system efforts.

The MRC Coalition successfully carried out the organization´s first symposium. With the

support of the SWANA Caribbean Chapter, primarily by way of the Chapter´s Young Professionals (YP) Group, this event was a true success in promoting the organization´s mission statement and future plans.

CONCLUSION

The integration of ISWM focus in all MRC Coalition technical sessions, meetings, and events herein suggested would ensure coordinated efforts on behalf of one of the most important public sector divisions for the island. Such coordination would fall par to efforts currently underway at the State Government level at the PREQB and the PRSWA involving identification of needs, including metrics gathering and reviews of existing systems.

As identified earlier, in Figure 2, reviews of existing regulations is an important step in the superior part of this comprehensive ISWM diagram. As a known priority, the PREQB has been drafting a revision of the Non-Hazardous Waste Management Regulation, particularly the Landfill Management section of this rule.

This type of prioritization must be appropriated to supporting waste management alternatives on the uppermost section of the Waste Management Hierarchy shown in this document in Figure 1. Furthermore, strategies provided by the PRRP in the ISWM Report [10] must be acknowledged by all sectors involved and acted upon.

On a longer termed basis, analyses of interrelationships between the all systems (Figure 3) would potentially be performed in order to adequately optimize the overall, or island-wide, ISWM system.

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