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Analyzing the structure of barriers to municipal solid waste management policy planning in Maputo city, Mozambique

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ABSTRACT

A waste management policy is crucial to establish an effective and satisfactory waste management system. However, the establishment of waste policies is hindered by several multi-faceted and interrelated barriers, particularly in developing countries, adding complexity to already complex waste management tasks. Thus, this study aims to assess the barriers to a waste management policy in Maputo City, the capital of Mozambique, and to identify the most onerous barriers to the effective implementation of the policy through the combined application of the structural modeling methods, Interpretive Structural Modeling (ISM) and Decision-Making Trial and Evaluation Laboratory (DEMATEL). The structures of the interrelationships of the barriers were effectively clarified: ISM provided the hierarchical structure, and DEMATEL provided the cause and effect structure. The results indicated that institutional structural weakness and a lack of cooperation among stakeholders are the major contributors to poor waste policy performance in Maputo City.

1. Introduction

Urbanization, industrialization, increasing population, and economic development contribute to the rise in waste and to its increasing complexity and hazardousness. More than 1.3 billion tons of municipal solid waste (MSW) was generated in 2012, and 2.2 billion tons a year is expected worldwide by 2025 (Hyman et al., 2013). To address this challenging situation, national waste management policies are put in place, in which each country applies its own particular style of inventiveness to its own complexities. Nevertheless, in most cases, the poorer a country is, the fewer genuine waste policies it has (Chalmin and Gaillochet, 2009). While developed countries addressed their solid waste management needs by implementing effective and functioning policy measures, in many cities of the developing world remedial measures have been elusive, efforts are uncoordinated or ad hoc and the resources invested in the sector inadequate; these factors are compounded by economic, administrative and technological weaknesses (Marshall and Farahbakhsh, 2013; Konteh, 2009). This is also the reality in urban centers of the Republic of Mozambique, particularly in the capital Maputo City.

Maputo City is the most prominent Mozambican city and home to a growing population of approximately 1.2 million. In

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Mozambique, national laws and policies provide a framework to set up municipal by-laws and regulations and to establish and implement municipal solid waste management (MSWM) systems. Nonetheless, most municipal authorities have proven unable to solve or mitigate the causes and effects of this and other urban environmental challenges. Maputo City is a representative example of that, where poor sanitation continues to be a major contributor to the prevalence of infectious diseases, such as cholera and malaria (Stretz, 2012; UN-HABITAT, 2010; Maputo Municipal Council, 2007). In 2008, the authorities of Maputo City published a MSWM by-law and a new solid waste management master plan. However, the MSWM continues to be poor and the gap between the policy in place and its implementation is more evident. For instance, the authorities aim to have an institution that is effective and efficient in its work, that is financially sustainable and with a comprehensive reach; however, studies point out that this institution is currently dealing with unqualified personnel with low levels of motivation, lack of trust between the authority and the private sector, low cost recovery rate (62%) and a non-recognition of scavengers' role. The need for waste recovery, sustainable treatment and final disposal is recognized within the policy and indeed reuse, recycling and composting activities exist; yet, those are not significant and more than 70% of total MSW generated is being finally disposed in the least sustainable way-open dumps. Furthermore, the intent to raise awareness and public participation has not yet presented substantial results, as the present levels are low and public litter and misconduct are common (Maputo Municipal Council, 2007; Allen and Jossias, 2011; Stretz, 2012; Ministry for Co-ordination of Environmental Action of Mozambique 2012; Buque, 2013; dos Muchangos, 2014; Ferrao, 2006; Segala, Opressa, and Palalane, 2008; Mozambique National Cleaner Production Centre, 2007).

As mentioned earlier, there are several studies addressing Maputo City's MSWM issues and some examples are presented as follows. Nhacolo (1999) studied sanitation problems, including solid waste management, in one of the most problematic neighborhoods of Maputo City; Macuacua (2002) looked at the relationship between municipal authority and private companies in waste removal and final disposal processes; Daud (2002), contributed to the management of solid waste and persistent toxic substances, focusing on Maputo and Matola cities; Ferrao (2006) evaluated the removal and final disposal of solid waste in Maputo City; Chingotuane (2008) considered the effect of civic education on plastic waste recycling; Allen and Jossias (2011) assessed the policy context surrounding waste scavengers; and Buque (2013) looked at the contribution, challenges and perspectives of the selective collection of waste in Maputo. From the totality of investigated studies, as far as our limited knowledge, none of them focused on the causality relationship between the existing problems and there is no answer to how much each one of those problems negatively affect the policy performance. In this study we aim to address this missing aspect by looking at the barriers to the waste management policy in Maputo City and by clarifying how these barriers interrelate and influence the current poor policy performance.

Barriers in a group context are often interrelated and a barrier may alleviate, augment, reinforce, or trigger another. Understanding these interactions is crucial to arrive at reasonable measures to overcome them. However it is not always possible or logical to overcome all barriers in a system, due to constraints in resources, time, and capability; thus finding the main artery of the system is a real cost-saving aid (Raeesi et al., 2013). Besides, these interactions among barriers add complexity to the analysis and make it difficult to complete the task if the barriers are not clearly structured. Therefore it is essential to identify appropriate methods that can aid in this task. Interpretive Structural Modeling (ISM) and the Decision-Making Trial and Evaluation Laboratory (DEMATEL) seem to be such methods. Both are complementing and powerful structural modeling methods that enable clear representation of elements within a system, which is their relationship structures and their status, thus, strategically aiding, and being a tool for Multi-Criteria Decision-Making (MCDM) problems such as the analysis of barriers to waste management policy. In one hand ISM allows the clarification of the inter-relationships among the waste policy barriers in an ordered and directional framework – the hierarchy structure, without consideration of each barrier strength/weight. On the other hand DEMATEL is more detailed and it is used to visualize the causal structure and determine the strength of barriers' interrelationships.

Having previously identified 26 barriers to waste management policy in Maputo City, through the application of a group-decision making methodology-Delphi method (dos Muchangos et al., in press), the main objectives of this study are to (1) clarify and analyze the hierarchical and the causal structures of the interrelationships between the waste policy barriers, through application of ISM and DEMATEL; (2) based on the clarification of barriers' hierarchical and cause–effect structures, identify the barriers that hinder the most the waste management policy, hence the ones that require priority intervention. In this study, the combination of ISM and DEMATEL is demonstrated as a suitable tool for decision makers to, in an insightful way, evaluate and effectively act on the barriers to waste management policy, to guarantee significant improvement of policy implementation and update.

The remainder of this study is organized as follows. Section 2 presents relevant literature on role of multi-criteria decision-making tools in waste management policy and the description of ISM and DEMATEL methods. The proposed research framework is described in Section 3. Section 4 shows the application and results of ISM and DEMATEL. The implications of the findings and conclusions are presented in Sections 5 and 6, respectively.

2. Literature review

This section presents the theoretical composition and the basis of the methods applied in this study, including the explanation of the function of ISM and DEMATEL in the decision making process involving several interdependent criteria, and the introduction of ISM and DEMATEL methods and previous applications by different scholars.