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Using social network and stakeholder analysis to help evaluate infectious waste management: A step towards a holistic assessment

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ABSTRACT

Assessing the strengths and weaknesses of a solid waste management scheme requires an accurate analysis and integration of several determining features. In addition to the technical aspects, any such system shows a complex interaction of actors with varying stakes, decision-making power and influence, as well as a favourable or disabling environment. When capitalizing on the knowledge and experience from a specific case, it is also crucial that experts do not "forget" or underestimate the importance of such social determinants and that they are familiar with the methods and tools to assess them. Social network analysis (SNA) and stakeholder analysis (SA) methods can be successfully applied to better understand actors' role and actions, analyse driving forces and existing coordination among stakeholders, as well as identify bottlenecks in communication which affect daily operations or strategic planning for the future way forward. SNA and SA, appropriately adjusted for a certain system, can provide a useful integration to methods by assessing other aspects to ensure a comprehensive picture of the situation. This paper describes how to integrate SNA and SA in order to survey a solid waste management system. This paper presents the results of an analysis of On-Nuch infectious waste incinerator in Bangkok, Thailand. Stakeholders were interviewed and asked to prioritize characteristics and relationships which they consider particularly important for system development and success of the scheme. In such a way, a large quantity of information about organization, communication between stakeholders and their perception about operation, environmental and health impact, and potential alternatives for the system was collected in a systematic way. The survey results suggest that stakeholders are generally satisfied with the system operation, though communication should be improved. Moreover, stakeholders should be strategically more involved in system development planning, according to their characteristics, to prevent negative reactions.

1. Introduction

Solid waste still represents a major challenge, especially in rapid urbanizing cities in the developing world (Di Bella and Vaccari, 2014; Diaz et al., 2005; Guerrero et al., 2013). No single solution is available as each city has different characteristics in terms of physical environment as well as institutional organization, municipal capacities, financial resources, sociocultural and socio-economic contexts. Several management decisions are required to provide effective, efficient and sustainable solid waste services; such decisions have an effect on many actors, as well as are influenced by some of them. By applying the "affect criterion" it is possible to identify stakeholders (Heidrich et al., 2009). The type of 'stakeholder groups' varies according to the problem in question and

Abbreviations: AIT, Asian Institute of Technology; AHP, analytical hierarchy process; BMA, Bangkok Metropolitan Administration; HA, hospital accreditation; HCW, healthcare waste; ISO, International Organization for Standardization; ISSOWAMA, Integrated Sustainable Solid Waste Management in Asia; ISWM, integrated and sustainable solid waste management; KT, Krugthep Thanakom; MoI, Ministry of Industry; MoL, Ministry of Labor; MoNRE, Ministry of Natural Resources and Environment; MoPH, Ministry of Public Health; NHSO, National Health Security Office; PCD, Pollution Control Department; PPP, public private partnership; SA, stakeholder analysis; SNA, social network analysis; SSD, Social Security Department; UNEP, United Nations Environment Programme; WIRC, Waste Incineration Research Center.

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its solution (Contreras et al., 2008), but it is important to apply clear definitions (Fassin, 2008), or everybody could be considered a potential stakeholder (Tullberg, 2013). The concept of integrated and sustainable solid waste management (ISWM) (Van de Klundert and Anschütz, 2001) highlights the need to consider the human factor, in addition to the technical and institutional aspects in planning and operation of solid waste services (Wilson et al., 2012). In developing countries, experience suggests that service beneficiaries should be directly involved to achieve sustainability of the solid waste services (Wilson et al., 2013). In particular, the impact on people, linked to waste recovery and public awareness, are groups of development drivers of a SWM system (Wilson, 2007). When capitalizing and learning from existing cases, similarly, all these aspects must be incorporated so that decision-makers can translate this holistic knowledge and apply it to their local contexts (Collivignarelli et al., 2010; Di Bella et al., 2012; Zurbrügg et al., 2012).

"Solid waste management experts" must thus have a wide and comprehensive view of the situation and context, taking into consideration several aspects including the complex interaction of stakeholders. In fact only a multidisciplinary knowledge, including also environmental and social sciences, politics, and ethics can properly address multifaceted environmental decisions (Benn et al., 2009). It is important to understand what enhances project success and what hinders it. In particular, for waste management, several projects though technically and economically well designed, failed due to the "Not In My Backyard" (NIMBY) syndrome which reflects social, ethical and political issues (Galante et al., 2010).

Several efforts have been made to properly consider and evaluate all issues; multi-criteria and multi-objective approaches have been developed and tested during the last 10 years (Huang et al., 2011). Galante et al. (2010) optimize two conflicting objectives: minimization of both the total cost and the environmental impact. These are the typical objective-oriented criteria used in other studies based on multi-criteria analysis for decision making (Karagiannidis and Perkoulidis, 2009) which also includes a certain level of uncertainty (El Hanandeh and El-Zein, 2010). Only few studies have included social criteria; for instance Kaya (2012) considers organizational capacity, while Banar et al. (2007) also consider public reaction, expressed by a proxy indicator of the distance of the waste facility from residential areas.

Assessment methodologies have been continuously improved, by including different aspects: Life Cycle Assessment (LCA) approaches have integrated the working environment, where occupational health and indoor pollution are included (Hellweg et al., 2009; Kim and Hur, 2009). Nevertheless it proves to be difficult to effectively consider these aspects in general terms, as health and safety standards, acceptance of risk, etc. greatly vary. Accepted occupational exposure, microbiological dose/response relationships, as well as the priorities as defined by the workers, authorities and population vary from country to country, depending on national/cultural and climatic settings, (Jonsson, 1997). In recent years several studies, also in developing countries, have involved stakeholders and experts in agreeing on a hierarchy of priorities and attributing a level of importance to each aspect of a specific subject (Lohri et al., 2013; Vaccari et al., 2013, 2012). In the complex sector of waste management, this was practiced particularly for landfill and treatment plant placement: merging objective and subjective issues using the support of the Analytical Hierarchy Process (AHP) (Bao et al., 2013; De Feo and De Gisi, 2010) with the possibility of including other tools like GIS (Moeinaddini et al., 2010; Nas et al., 2010; Tavares et al., 2011). In some cases stakeholders were involved at the beginning, in order to define and weigh criteria (Geneletti, 2010). AHP was also applied for weighing criteria leading to the selection of infectious waste treatment technologies, whereby also public acceptance was listed as criteria (Karagiannidis et al., 2010). Recently in Thailand stakeholder preferences were investigated regarding the biomass Clean Development Mechanism (CDM) project (Parnphumeesup and Kerr, 2011).

However, until now little attention has been given to stakeholders' characteristics, their relationships and how they influence each other. Practically stakeholder systems are often considered as a set of actors, isolated and not subjected to continuous interaction. Using a network perspective instead means to assume that relationships are important and can be considered as material or immaterial flows (e.g. money, goods, or information, trust). Actors are thus interdependent rather than autonomous, and network structures can either enhance or inhibit stakeholder interactions and influence project performance. Assessing the system structure and then communicating the results back to stakeholders can enhance their involvement and encourage them towards new initiatives ("network weaving") (Vance-Borland and Holley, 2011). Daniere et al. (2002) showed in Bangkok how social capital and social networks should be carefully analysed as they affect community participation and involvement as well as the effectiveness and success of environmental projects. Similarly, analysis of organizational networks shows that these can be reasonable indicators on the capacity to tackle complex environmental problems (Kegler et al., 2010). Nevertheless, every network is particular, defined by several characteristics, and therefore a representative structure cannot describe all cases, especially regarding environmental resources (Bodin et al., 2006).

The study presented in this paper had the objective of deepening the knowledge on non-technical aspects related to one specific waste management system - healthcare waste (HCW) management - to analyse their importance for its development, daily operation and future strategic planning. In particular, starting from the holistic approach proposed by Zurbrügg et al. (2012), the study focused on stakeholders' characteristics and their interactions, including social aspects, organizational strength and institutional support. Social network analysis (SNA) and stakeholder analysis (SA) were used as tools to analyse such non-technical aspects and assess which of these are perceived to be of higher importance than others for sustainability and success of the waste management scheme. The survey, and in particular SNA and SA integration, adjusted for the selected case study, can be applied to other systems following the same scheme: surveying tools will be adapted to peculiarities of the case, in accordance with available information, but the general approach is potentially valid for any solid waste management system. Such an approach can lead to an effective evaluation of a system, if it is utilization-focused (Patton, 2008); SNA and SA can give an important contribution, since interaction and dialogue between stakeholders are essential to improve decision-making and awareness about several topics (Andrè et al., 2012; Evers et al., 2012; Johansen and Nielsen, 2011).

2. Study area: On-Nuch incineration plant and infectious waste management in Bangkok

The case of HCW management in Bangkok was selected basing on a previous EU-FP7 funded project called Integrated Sustainable Solid Waste Management in Asia (ISSOWAMA) which identified good practices in Asia to highlight lessons learned and enhance knowledge sharing. In fact in Asian countries HCW management is particularly burdensome (Kühling and Pieper, 2012; Syed et al., 2012), including the simple generation estimation (Patwary et al., 2009). Research focused in particular on the central element of this system, the On-Nuch incinerator for infectious waste treatment, and relations established between stakeholders about waste flow.

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