



Public perception of hazardousness caused by current trends of municipal solid waste management



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ABSTRACT

Municipal solid waste (MSW) piling up is becoming a serious problem in all developing countries (DC) as a result of inequitable waste collection and treatment. Citizens' collaboration is partly based on understanding their views and their active involvement in MSW planning; on the other hand the assessment of the perception of hazardousness related with MSW is considered rather important as well since the identification of the weak points of the applied MWM strategy is eased and the level of required training is determined. Researchers implemented a case study in the West Bank (WB) and Gaza Strip (GS) regions of Palestine, taking into consideration previous researches in other developing countries. They reached to safe and useful conclusions regarding the parameters which mean the greatest in the waste management field as far as DC are concerned. Lack of skilled manpower, irregular collection services, inadequate equipment used for waste collection, inadequate legal provisions, and resource constraints are additional factors that are confirmed to be challenging the waste management scenarios in all DCs today. The research takes those factors under consideration but focuses on the educational gap and the results revealed interesting trends a significant relationship between respondent's educational attainment and their awareness of hazardous waste (hazard perception); the results will indicate the measure taking required to avoid accidents occurred in those regions (burns from toxics, cuts from sharps, etc). National policy and legislation development based on the research outcomes will ensure equitable and accessible services are in place in order to move towards a healthier environment. Specialized health education and training programs on national scale are also needed to enhance awareness on hazardous waste.

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1. Introduction

Environmental sustainability is among the important targets for every nation since it is linked with the citizens' wellbeing and it is considered as citizenship's right and privilege. An integrated municipal solid waste (MSW) management plan plays a vital role in reducing mortality and morbidity rates since it involves sustainable treatment of hazardous and non-hazardous wastes generated by households and other commercial sources within the municipality (Nemerow et al., 2009). Sustainable solid waste management

(SWM) highlights the need to consider the human factor, in addition to the technical and institutional aspects in planning and operation of solid waste services (Caniato et al., 2014); service beneficiaries should be directly and actively involved to achieve sustainability of the solid waste services.

In most developing countries, the inadequate treatment of MSW poses a serious threat to the environment (Pin-Jing, 2012; Perkoulidis et al., 2011). Activities such as collection, temporal storage, transportation, processing, treatment and disposal (Nemerow et al., 2009) which are at the responsibility of municipalities (Abdrabo 2008; Moghadam et al., 2009) are not performed due to lack of organization, financial resources, complexity and system multi dimensionality (Burntley, 2007; Guerrero et al., 2013; Sujauddin et al., 2008). It is well documented that uncontrolled ways used to get rid of household solid waste face many environmental changes (rain, sun, wind), that contribute in creating unsanitary conditions, waste leachate and spread of odors, all of which pose a threat to public health and cause environmental

Abbreviations: CI, confidence interval; DALY, Disability-Adjusted Life Years; DC, developing countries; DEFF, effect of the sample design; E, Margin of error postulated for every region; GS, Gaza Strip; MSW, municipal solid waste; n, total sample size; OR, Odds Ratio estimation; P, value of the primary; S², contrast estimation; SWM, solid waste management; t, confidence factor; WB, West Bank (region); WM, waste management.

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pollution (Thanh et al., 2010; Edjabou et al., 2012; Musleh, 2002; Abdrabo, 2008; Moghadam et al., 2009), health hazards including injuries; 58% of the interviewed children have been injured from glass disposed in the streets (Al-Khatib, 2009).

Due to low industrialization the complexity and quantity of waste in developing countries (countries whose indexes in terms of living standard, industrial development, Gross National Income, etc. is relative to other countries) is not similar to that of the developed ones (Abd Manaf et al., 2009; Moghadam et al., 2009). However the currently applied methods to manage MSW involve open dumping, open burning which have a negative impact on both the environment and the human health and in some rare cases landfills (Nemerow et al., 2009).

Generally in developing countries where environmental targets are not set locally the introduced schemes need to create a strong linkage among environmental and economic performance. New market opportunities should be investigated to relate with WM solutions. In EU the focus may be moving from waste management towards environmental planning but in developing countries this is not the issue just yet since the deal with waste related problems under the local specific constraints; indigenous population, social inequality, financial limitations, etc. All processes should be downstreamed in order to be closest to citizens; otherwise they will not be implemented.

Certain categories of hazardous wastes are generated within households containing remnants of chemical fertilizers, pesticides, herbicides, cleaning products etc and are usually found in dump sites or even landfills where they are disposed. The substances contained in this waste category are accused of causing premature death and long term morbidity (such as liver cancer) to population living near these sites (Slack et al., 2007; Slack et al., 2004; Slack et al., 2005; Guerriero and Cairns, 2009) or the personnel of those sites (Kontogianni et al., 2014). Prüss-Ustün et al. (2011) reported that globally 4.9 million deaths and 86 million Disability-Adjusted Life Years (DALYs) were attributable to environmental exposure and management of such chemicals in 2004. The hazardous waste contained in household waste stream present no difference than other sources of hazardous waste in terms of properties and characteristics; based on international standards they bear ignitable, corrosive, toxic and reactive characteristics (Hennebert et al., 2013). Even dioxin can be found in MSW before any treatment (Rada et al., 2011). The existence of hazardous wastes within MSW result into the occurrence of accidents such as burns from toxics, cuts from sharp objects and diseases from genotoxics.

Reduction of MSW including hazardous waste disposed in landfills and dumpsites as well is highly dependent on the source separation of waste, which is not practiced in most DCs. The household awareness and capacity to distinguish between hazardous and non-hazardous waste is a key element and can contribute to the reduction of many waste related hazards such as ignitability, radioactivity, corrosivity and toxicity which are common features of household hazardous waste, to which the vast majority of the household owners in DCs are unfamiliar with due to lack of education and provision of information by the local WM regulators.

The public, NGOs and WM regulators are closely related to the integration of WM programs. Thus they need to cooperate in order to evaluate parameters related to the risk, the efficiency, the local or potential future markets etc. To this direction the integration and the strategy which will be followed is selected by the WM regulators but the public and NGOs are the main actors which will evaluate the safety and the quality of those strategies. Local conditions understanding backed up with citizens' satisfaction will pave the way towards local sustainability. The aforementioned requires a physiological research before and after the strategy implementation to estimate the local perception. The main objective is to assess the current status of public perception of waste

hazardousness in order to locate the weak points and correct/upgrade the local WM strategy. The aforementioned may lead to targeted education which a key factor towards the successful implementation of WM strategies.

In order to provide sufficient evidence for the decision makers to translate the holistic knowledge and apply it to their local contexts by implementing relevant policies to control the MSW activities, this study aimed to describe the overall current status of solid waste management in Palestine under the perspective of the population satisfaction with the level of collection services at their region. In parallel the public knowledge and awareness on household hazardous waste was evaluated in order to identify the level of human resource capacity. Behavior change and waste prevention policy, designed with convenience in mind, based on the need of today's households for time and space, has proven to encourage householders to engage in waste management practices, provided that such a scheme is well publicized (Bortoleto et al., 2012).

2. Status and organization of SWM in Palestine

In Palestine, the SWM is summarized by: collect – transfer – and random disposal. Only limited recycling initiatives have been put into practice in the WB region. These initiatives were mostly privately owned and focused mainly on metals, paper, and glass recycling (Al-Khatib and Arafat, 2010a; Al-Khatib et al., 2010b). Recently, SWM has gained significant attention by the Palestinian national authority (PNA) due to its environmental, social and economical implications. The PNA managed to take actions including: passage of local authorities' law No. (1) 1997, the environmental law No. (7) 1999, public health law of 2004 and medical waste management regulations. In addition, the PNA has launched a number of regional sanitary landfill facilities: one in the north of the WB (constructed and operational), the second in the southern WB (constructed), and the third in the middle of the WB (in the planning phase).

Up-to-date, there is no official waste management system that incorporates the 3R's principle of waste management. In southern WB, Hebron governorate, a program of waste segregation at the source (wet and dry) is currently implemented in a specific suburb of the Hebron city as pilot, but the expansion of the project cannot be implemented until this 1st phase evaluation is performed by those responsible from the community. The Joint Service Council for solid waste management in Hebron and Bethlehem regions has taken steps toward improving SWM including: construction of two solid waste transfer stations, cardboard and plastic separation and bailing facilities, and medical waste treatment facility (Al-Khatib et al., 2014).

Currently, solid waste generated in southern WB (Hebron and Bethlehem governorate) amount 629 tons per day (IFC, 2012) and a sanitary landfill is being constructed to serve the southern part of the WB of an area 25 hectare within the framework of southern WB SWM project.

3. Methodology

The Palestinian territory (WB and Gaza) was the study area of this field research. The data was collected through a structured questionnaire by targeted individuals aged 18 years and older. In overall the study assessed the opinions of citizens on the current status of household solid waste management, the awareness regarding the household hazardous waste included in MSW and the willingness to treat food and organic waste in a sustainable way. To achieve this, a set of indicators were developed based on the research team's accumulated experience (from previous

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