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Impact of socioeconomic status on municipal solid waste generation rate

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ABSTRACT

The solid waste generation rate was expected to vary in different socioeconomic groups due to many environmental and social factors. This paper reports the assessment of solid waste generation based on different socioeconomic parameters like education, occupation, income of the family, number of family members etc. A questionnaire survey was conducted in the study area to identify the different socioeconomic groups that may affect the solid waste generation rate and composition. The average waste generated in the municipality is 0.41 kg/capita/day in which the maximum waste was found to be generated by lower middle socioeconomic group (LMSEG) with average waste generation of 0.46 kg/capita/day. Waste characterization indicated that there was no much difference in the composition of wastes among different socioeconomic groups except ash residue and plastic. Ash residue is found to increase as we move lower down the socioeconomic groups with maximum (31%) in lower socioeconomic group (LSEG). The study area is a coal based city hence application of coal and wood as fuel for cooking in the lower socioeconomic group is the reason for high amount of ash content. Plastic waste is maximum (15%) in higher socioeconomic group (HSEG) and minimum (1%) in LSEG. Food waste is a major component of generated waste in almost every socioeconomic group with maximum (38%) in case of HSEG and minimum (28%) in LSEG. This study provides new insights on the role of various socioeconomic parameters on generation of household wastes.

1. Introduction

Municipal solid waste management (MSWM) is one of the major environmental challenges in most of the cities of developing countries like India. Improper management of municipal solid waste (MSW) causes hazards to inhabitants and environment. The solid waste management system needs to be updated to suit the waste quality, quantity and composition (Kalantarifard and Yang, 2011). The quantification of waste generation rate and characterization of its composition are essential to plan and design an effective solid waste management systems of any given region (Gidarakos et al., 2006; Gomez et al., 2008). Various authors conducted research to establish the relationship between waste generation, their composition and socioeconomic factors (Wang and Wu, 2001; Qu et al., 2009; Sujauddin et al., 2008; Saeed et al., 2009; Philippe and Culot, 2009; Ojeda-Benitez et al., 2008; Marquez et al., 2008). Medina (1997) reported that the solid waste generation is directly dependent on the income levels, and the upper-income individuals tend to consume more industrialized products, their garbage contains more recyclable materials than that of low-income communities. The consumption pattern of household is directly linked to the increase in income which results in changed composition and quantities of household waste (Ogwueleka, 2013). However, it has been found that this is not the only governing factor. Amongst other socioeconomic factors that have been said to influence MSW generation rate are number of family members, education, occupation, etc. (Bandara et al., 2007). The findings of Suthar and Singh (2015) suggest that there is a strong correlation between waste generation and family size of a household. The more a household get educated and aware of the side effect of unmanaged solid waste, the more it appreciate an effective waste management (Kayode and Omole, 2011). Viswanathan and Trankler (2003) reported that in a family with rich socioeconomic condition, daily waste generation rates are generally higher than the lower socioeconomic families.

The waste quantity is increasing at an alarming rate in India due to rapid urbanization and high population growth. The growth rate of population for India in last decade was 17.6% (Census of India, 2011). Urban waste generation rate in India is lower compared to other developing countries and approximately one-third to half that of developed countries (Asnani, 2006). A World Bank

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publication reports that the waste generation rate in urban areas of India will be approximately 0.7 kg/person/day by 2025, which is roughly four to six times higher than it was in 1999 (World Bank, 1999). The economic growth in the area in the recent past has led to a large increase in urban population, driving dramatic urban expansion, land use change and increase in generation of solid wastes (Mahini and Gholamalifard, 2006). The total waste generation increases in proportion to the rise in population and urbanization, and issues related to disposal have become demanding as more land is needed for the ultimate disposal of these solid wastes (Idris et al., 2004).

Environment problems associated with the generation of waste are part of societal changes where households play an important role (Monavari et al., 2012). These societal changes influence the characteristics of given households, including family size, income, education, occupation and residential location (Monavari et al., 2012). In addition, global warming has become a matter of public concern and MSW is implicated as an important source of anthropogenic greenhouse gas (GHG) emissions (IPCC, 2006).

MSW includes commercial and residential wastes generated in a municipal or notified areas in either solid or semi-solid form excluding industrial hazardous wastes but including treated biomedical waste (Solid Wastes Management Rules, 2015). It includes biodegradable (paper, textiles, food waste, straw and yard waste) and non-biodegradable materials (leather, plastics, rubbers, sanitary napkins, metals, glass, ash from fuel burning like coal, briquettes or woods, dust etc.) (Jha et al., 2007; Tchobanoglous et al., 1993).

Municipal bodies of cities in low-income group countries dispose MSW in low lying areas in the outskirt of the city and fill these areas one after the other haphazardly due to limited knowledge and awareness regarding contamination, waste reduction techniques and other aspects of MSWM (Da Zhu et al., 2008; Sharholy et al., 2008). It is common to find large heaps of garbage lying in an unsystematic manner at every nook and corner in those cities (Kansal, 2002). In India, it is observed that more than 90% of MSW is disposed of on land without taking any specific precaution, which poses a serious threat to the environment (Sengupta et al., 1998). In effect, it is reported that the chemicals from solid waste disposal sites pollute groundwater, rendering it unfit for consumption (Samsudin et al., 2006; Singh et al., 1999). Municipal services in most of the cities and towns are already over-burdened and simply cannot cope with the growing demand owing to insufficient manpower and materials, resulting in unhygienic and filthy living condition in the neighbourhood (Enayetullah et al., 2005; Hasan and Chowdhury, 2005). Estimation of the amount of waste generated, the availability of resources, and the environmental conditions of a particular society are important to develop a proper waste management system. Both planning and design of MSWM systems need accurate prediction of solid waste generation. It is quite challenging to achieve the anticipated prediction accuracy with regard to the generation trends in many fast-growing regions (Dyson and Chang, 2005). The waste generated in the developing countries is similar in composition however the variation between regions is due to the climatic, cultural, industrial, infrastructural and legal factors (Khajuria et al., 2010). The Municipal Corporation of Dhanbad face problems due to lack of organization, financial resources etc.

The present study was undertaken within the administrative area of the city of Dhanbad, one of the major cities of the state Jharkhand, India. It is called as the coal capital of India and does not have any scientific MSWM system. A detail study of the solid waste management deficiencies for the city is required to improve the MSWM practices, to analyse the strengths and deficiencies of the current practices in Dhanbad and to propose feasible solutions.

The major waste generating sources are households, markets, hotels, restaurants, shops and function halls. The estimate of MSW generation indicates that around 440 tonnes of waste is

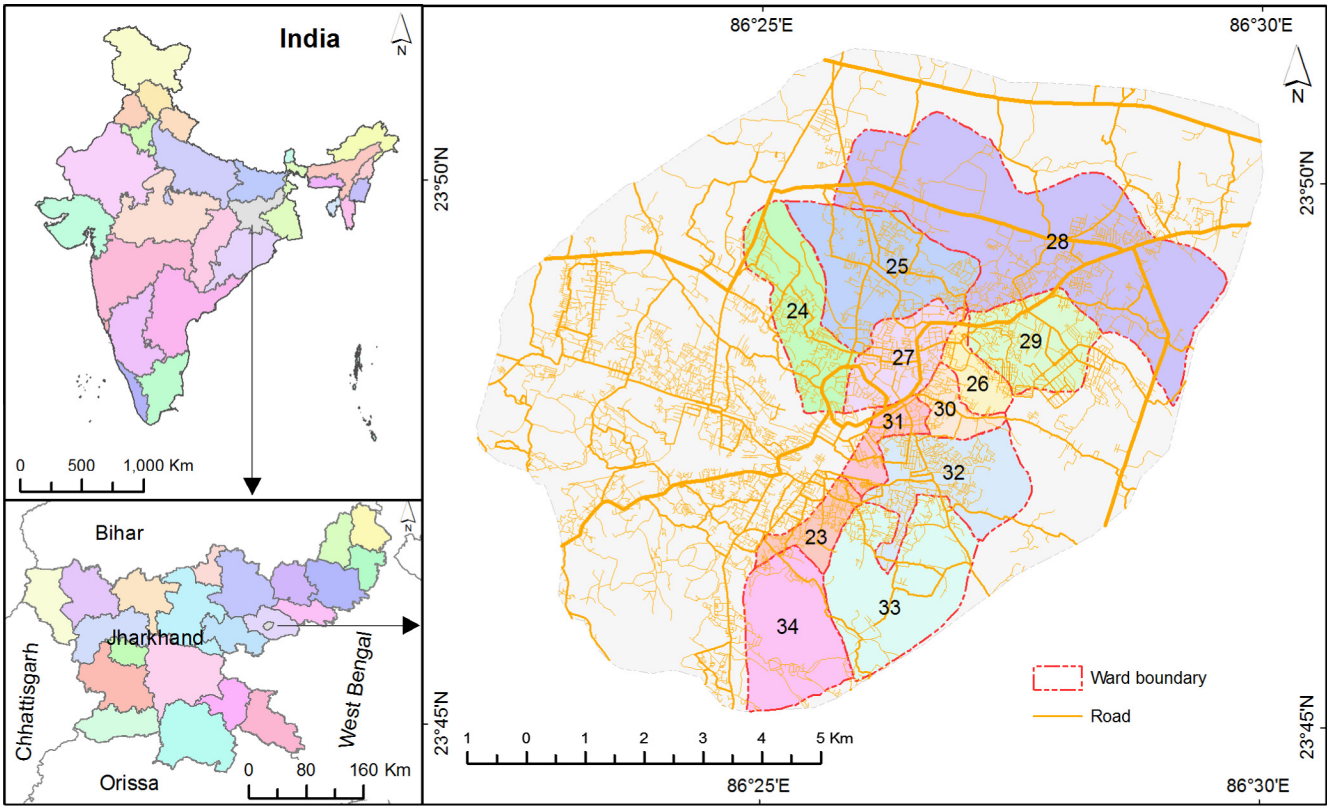

Fig. 1. Location map of the study area.

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