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An Overview of Municipal Solid Waste Collection in Singapore, Mongolia, and Nepal

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ABSTRACT

Municipal solid waste (MSW), including refuse and non-hazardous waste, is generated mainly from households. This article adopts the approach of describing the MSW collection systems in three Asian countries that are Singapore, Mongolia, and Nepal; by reviewing the literature related to this particular subject. Therefore, by going through the literature, it has been found that the authorities responsible for waste collection are: Public Waste Collectors (PWCs) appointed by National Environment Agency (NEA) in Singapore, the municipal government, and Tohijilt Uilchilgeenii Kompani (TKUs) in Mongolia, and 270 municipalities in Nepal. Along with this, the waste collection fee in Singapore is paid to Singapore Power (combined with utility bills); in Mongolia to TKUs (based on their performance); and in Nepal, it is fixed on ad hoc basis. Overall, based on the practices of waste collection discussed in this article, Singapore has a better waste collection system than that Mongolia and Nepal.

INTRODUCTION

Solid waste, unwanted or discarded solid materials, is one of the widely known and observed havoc around the globe. This waste can be generated from a multitude of activities; including municipal, industrial and commercial activities (Katiyar, 2016; Greencape, 2021; Nguyen, et al., 2022). Municipal solid waste (MSW) is referred to as domestic refuse along with non-hazardous waste generated mainly from households. In addition to this, it also includes waste from schools, institutions, municipal services, etc. Generally, MSW is majorly composed of food waste, paper, plastic, and glass; along with hazardous household waste (batteries, light bulbs, medicines, etc) (Magutu & Onsongo, 2010). However, the composition of municipal solid waste is not the same in all regions; instead, it varies from country to country (Abdel-Shafy & Mansour, 2018). The generation and quantity of municipal solid waste is increasing day by day, and the major factors responsible for this are the rise in population and increase in urbanization (Minghua et al., 2009). Additionally, this problem is also increasing due to the frequent use of disposable or single-use products in contemporary societies (Katiyar, 2016).

Furthermore, unorganized municipal solid waste has daunting impacts on the biotic and abiotic spheres of the environment; therefore it is very crucial to deal with this issue by managing it properly (Soni et al., 2016). In addition to this, solid waste management is now considered to be an integral concept in managing environmental issues and in achieving sustainability (Das et al., 2019). Plus, solid waste management is also now connected with one of those concepts that can play role in the fulfillment of the Sustainable Development Goals (SDGs) (Prajapati et al., 2021; Tsai et al, 2020). The collection of solid waste is a significant part of solid waste management, which highly impacts the overall treatment or disposal of solid waste materials. However, developing (middle income) and developed (high income) countries have a gap among them in terms of solid waste collection systems (Guerrero, et al., 2013; Bamba & Ishikawa, 2017; Aguilar, 2017). In addition to this, a questionnaire-based study demonstrated the concern of people regarding solid waste management facilities, along with analyzing which

concern had the most influence on public attitude about the new facility. The response was collected from the residents of three different municipalities having different backgrounds. The results depicted different ratings and responses, which highlighted the varying social and geographic backgrounds of the respondents. Moreover, the correlation analysis among five components (nuisance, pollution, facility planning, facility management, and merit/demerit) has revealed that there was no significant correlation. However, disagreement was found between actual impact and residents. Plus, the opposing or negative attitude was found to be less in those residents who have visited the SWM facility (Rahardyan, et al., 2004). This shows how public perception is related to the collection and disposal of solid waste. The purpose of this article is to provide an overview of municipal solid waste collection practices in Singapore, Mongolia, and Nepal; which are the high-income, previously upper-middle (in 2015) and now lower-middle income, and lower-middle-income countries of Asia respectively. In this way, this compares the collection practices of MSW in these three countries.

MUNICIPAL SOLID WASTE COLLECTION

Various studies have been conducted to analyze municipal solid waste collection and management in various countries around the globe. However, this study does not analyze the solid waste collection of any individual country; and compares the waste collection of three countries instead. The review of the solid waste collection in Singapore, Mongolia, and Nepal is inculcated in this article below

Municipal Solid Waste Collection in Singapore

Singapore is a high-income and developed Asian country having a gross national income of US $54,530 per capita (in 2017) (World Bank, 2019). The Public Waste Collectors (PWCs) that are contracted by National Environment Agency (NEA) is responsible for waste collection in Singapore (Anonymous, n.d; Xue, et al., 2015; Han Ng, et al., 2015). Currently, Singapore has three PWCs, which are working in six sectors (NEA, n.d.). The time or dates for collection of waste is decided by these PWCs in their respective areas. Moreover, in most of the districts in Singapore, large recycling bins are provided in every Housing and Development Board (HDB) block. Mixed recycling wastes are thrown in these bins by the residents. Along with this, color-coded bags are also provided to carry out the door-to-door waste collection. This door-to-door waste collection is conducted on the designated days between the time of 07:30 am to 07:00 pm. In some areas, one recycling bank is provided for five HDB blocks and a door-to-door collection takes place once every fortnight. Door-to-door recycling collections are conducted every week in most of the private properties in Singapore; whereas, this is conducted fortnightly in a few districts (Anonymous, n.d.).

1. Waste collection fee in Singapore

The waste collection fee in Singapore is paid in combined form within the household utility bills and is given to Singapore Power. After this, this fee is given to the relevant PWC. Moreover, these charges or fees for solid waste collection are not uniform, and they vary in different areas. However, the National Environment Agency (NEA) of Singapore is carrying out the gradual introduction of the Uniform Fee (UF) structure that will bring uniformity to the waste collection fee in all areas. Plus, NEA has carried out the revision of the collection fees for refuse for households, which will be implemented from 1st January 2022. According to this revision, the refuse collection fees will be $9.63 per month for HDB/private apartments and $32.07 per month for landed houses (NEA, n.d.).

2. Singapore's safe practices in waste collection

In Singapore, NEA works to ensure safety associated with waste collection. For this, it specifies the safety guidelines and guides the inspection of waste collection equipment (like hook-lifts and open-top containers). Additionally, NEA does not allow the overfilling of solid waste in OTCs (open-top containers). Along with this, NEA also provides guidelines regarding the placement of bins on public streets (NEA, n.d.).

Safe Practices		
Inspection of waste collection equipment	Prohibition of overfilling of solid waste in open top containers	Guidelines regarding the placement of bins on public streets

Figure 1. Singapore's safe practices in waste collection

Municipal Solid Collection in Mongolia

Mongolia, in 2015, was designated as an upper-middle-income country. However, in 2016, it was designated again as a lower-middle income country; and it's current per capita household income is US $1,787 (FAO, n.d.; Graceffo, 2022). According to the Environmental Protection Law of Mongolia (which was formulated in 1995), various administrative divisions in Mongolia are responsible for waste collection and management services. Along with this, the Mongolian Law on Waste Management (passed in 2012) aims to regulate the collection and other management activities regarding solid waste generated in households (Bamba & Ishikawa, 2017). However, Mongolia is currently facing some challenges related to waste collection services. These challenges include improper infrastructure and equipment for waste collection and irregular conduction of waste collection. Overall, waste collection coverage is 30% and 70% in rural and urban areas respectively (ADB, 2019).

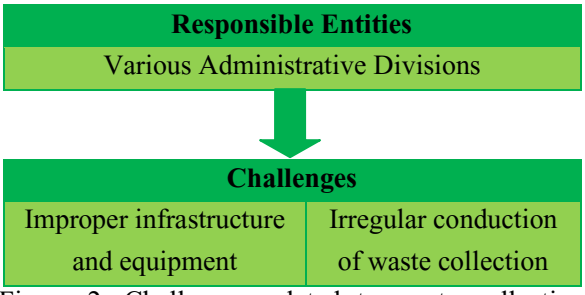

Figure 2. Challenges related to waste collection services in Mongolia

1. Waste collection in Mongolia's capital

Ulaanbaatar is the capital and largest city of Mongolia, in which more than 40% of the country's population resides, which means that almost half of the Mongolian population are residents of this city. There is a total of nine districts in Ulaanbaatar, and the waste collection activities are managed on these districts' levels. Every district is subdivided into service zones that are further divided into one or several Khoroos. These Khooros are divided into the smallest units of administration called '*Khesegs*'. The Public Service Department (PSD) has the authority to formulate the city's waste collection and management policies. Moreover, TUKs (Tohijilt Uilchilgeenii Kompani), which are waste collection companies, are in charge of waste collection in their respective zones (Bamba & Ishikawa, 2017).

Furthermore, there is a different waste collection frequency in areas of ger (informal settlements, which do not have basic infrastructure) and in areas of apartments. This frequency is 1–2 times per week in apartment areas and 1–2 times per month in ger areas. Additionally, door-to-door waste collection is conducted in the ger areas; whereas, disposal of waste in collection containers is practiced in apartment areas. So, more waste collection points (or containers) are present in apartment areas as compared to ger areas. Moreover, audit NGOs conduct monitoring of waste collection and the work performance of collection services (Bamba & Ishikawa, 2017).

2. Waste collection fee in Mongolia's capital

TUKs conduct waste collection whether the households have paid the households whether they have paid the waste service fee or not. Previously, this fee was collected from the ger areas as well, but now it is only confined to the apartment areas. TUKs are paid according to their performance, and they utilize 2% of the contract fees (based on contractual agreements made with districts) for workers' training and citizens' awareness about waste-related issues (Bamba & Ishikawa, 2017).

Municipal Solid Collection in Nepal

Altogether, Nepal has 270 municipalities, which include 4 metropolitan, 10 sub-metropolitan, and 256 municipalities that deal with solid waste collection and management (Maharajan & Lohani, 2020). According to a survey conducted by Asian Development Bank, almost 70% of households do not practice waste segregation in Nepal, and their waste is collected in the form of mixed waste by the municipalities. It means that only 30% of households carry out waste segregation at the source (ADB, 2013) Despite the efforts of 21 municipalities, effective waste segregation at the

source (before collection of waste) has not been conducted throughout this country. Moreover, it has also been found that the lack of separate waste collection methods sometimes results in the mixing of segregated waste during collection (ADB, 2013).

1. Waste collection fee in Nepal

Nepal is designated as a lower-middle income country, as its per capita income reached $ 1,090 in 2019 (Maharjan, 2021). In many cities of Nepal, private contractors get the fee paid from households to carry out door-to-door waste collection services. Although this fee is voluntary (not obligatory to be paid), yet it play an important role in municipal solid waste (MSW) management (Rai, et al., 2019; Bharadwaj, et al., 2020). The reason for the significance of this fee is that it helps to monetarily facilitate waste collection activities for which almost 70% of the total MSW management budget is allocated. Moreover, this fee or tariff is fixed based on ad hoc (only when it is necessary or required), which is why it is not sufficient for covering the operational costs (Maharajan et al., 2020).

2. An instance of Nepal's metropolitan city

A study based on a choice experiment was conducted in which the preferences and satisfaction of residents were analyzed regarding the solid waste collection services in Bharatpur (a metropolitan city of Nepal). As the above-mentioned text states that the waste collection fee is voluntary in Nepal, therefore, it was found in the study that there are some factors determine the willingness to pay for waste collection services (Figure 3) (Maharajan et al., 2020).

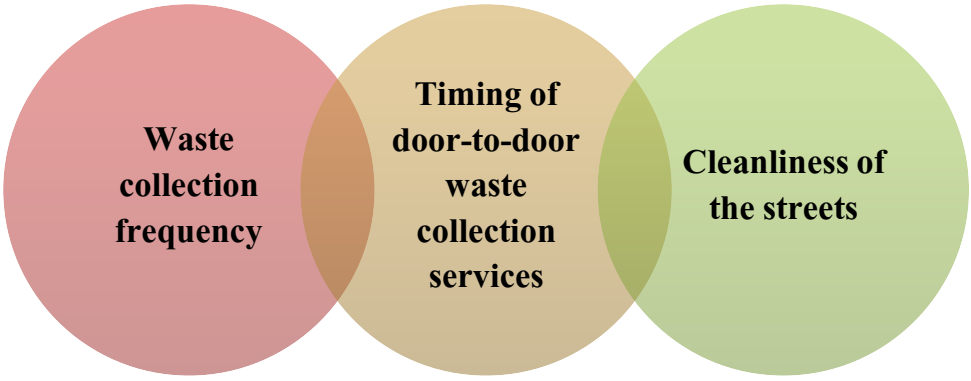

Figure 3: Factors determining the willingness to pay for waste collection services in Nepal

Additionally, in Bharatpur's 95% of households who were participating in waste collection services, 53% expressed dissatisfaction regarding the existing collection services. Plus, out of all households who used to pay a fee for waste collection, 93% had a door-to-door waste collection system. Whereas, the rest of them were living in those areas that were not accessible for the waste collectors, and they had a common waste collection point. Furthermore, households preferred designated time for waste collection along with waste collection bins at regular intervals. They suggested these bins for those pedestrians who used to throw waste on the streets due to the absence of waste bins. Households of Bharatpur were willing to pay an extra fee of 10-28% for waste collection services if the aforementioned improvements were taken place (Maharajan et al., 2020). As public perception and attitude are very important factors that can bring positive changes to the existing solid waste management systems (especially residential waste management), so the obtained results were positive in this particular aspect (Rahardyan et al., 2004; Bagui & Arellano, 2021).

Table 1. Comparison analysis of the waste collection system of Singapore, Mongolia, and Nepal

Country	Singapore	Mongolia	Nepal
Responsible authorities for waste collection	Public Waste Collectors (PWCs) appointed by National Environment Agency (NEA)	Municipal government and TKUs	270 municipalities (4 metropolitans, 10 sub-metropolitan, and 256 municipalities)
Waste collection fee	Paid to Singapore Power (combined with utility bills)	Paid to TKUs based on their performance	Voluntary (fixed on ad hoc basis)

Positive aspects of a waste collection system	1. Color-coded bags are for door-to-door waste collection 2. Safe practices in waste collection	1. Monitoring by auditor NGOs 2. TKUs invest 2% of the contract fees for the training of their workers and educating citizens	---
Loopholes in a waste collection system	---	1. Improper infrastructure and equipment for waste collection 2. Irregular waste collection	1. Lack of separate waste collection methods 2. The collection is not done on a daily basis

CONCLUSION

Among the three countries of Asia (Singapore: high income, Mongolia: upper-middle income in 2015 and lower-middle income since 2016, Nepal: lower-middle income) that have been compared, it has been analyzed that Singapore has the best waste collection system. Nevertheless, Mongolia and Nepal can improve their waste collection system by bringing improvements in their waste collection infrastructure and equipment; establishing separate waste collection methods for different wastes; and increasing the frequency of waste collection from households. Therefore, in terms of the solid waste collection system, the gap between developing and developed countries are required to be abridged.

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