5th EURASIA WASTE MANAGEMENT SYMPOSIUM
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Waste Management in E.U., Asia and Turkey

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Abstract

Practices of municipal solid waste (MSW) management in various countries depend on existing rules and regulations as well as their dedication to attaining sustainable waste management. Most of the developing countries suffer from lack of optimal MSW management which cause environmental problems and economic losses whereas in many developed countries better management of MSW brings environmental and economic benefits. This paper starts with a brief literature review of waste management practices and the share of the disposal methods for the countries in the world. It is noted that in the E.U., recycling and composting are applied to 46% of the waste whereas waste-to-energy (WTE) is used for 27.3% and landfilling is employed for only 26.3% of the wastes. A good example of waste management is the city of Milano in Italy and the statisitcs are presented in this paper along with the reasons behind the highly advanced waste management in this city. Milano (population: 1.5 million), has achieved 23% recycling and 17% composting rates while the rest of the MSW is utilized as fuel for electricity recovery in a WTE power plant. Moreover, recent developments for China in waste management are presented and the background of this development is explained. China is the first developing country to realize that WTE as an environmentally superior alternative to landfilling. In 2018, there were 450 WTE plants which recovered energy from 395,000 tons of waste per day. Finally, this paper shows the status of Turkey's waste management practice and share of disposal methods among all applications. It can be said that Turkey needs improvement on recycling and composting rate, which was only 12% in 2018, while an initiation to the WTE technology is necessary. Uncontrolled landfilling still constitutes 20% of all disposal methods whereas WTE is almost none for the country.

Keywords: Asia, EU, MSW, Turkey, waste management. Waste-to-energy, WTE

1. INTRODUCTION

Municipal solid waste (MSW) which is also called as trash or garbage consists of discarded everyday items which are not used by public anymore [1]. MSW includes wastes from food, furniture, clothing, newspapers, bottles and cans, electrical and electronic devices [1]. MSW becomes a significant environmental issue with the rapid urbanization and high industrialization if it is not properly handled. A recent report by Worldbank (2018) states that 2.01 billion metric tons of MSW is generated worldwide annually and is expected to reach 3.40 billion metric tons by 2050 [2]. To attain a sustainable waste management, it is vital for governments to take environmentally and economically beneficial actions. Practices of municipal solid waste (MSW) management vary based on related rules and regulations of the countries as well as their dedication to attaining sustainable waste management. Most of the developing countries suffer from lack of optimal MSW management which cause environmental problems and economic losses whereas in many developed countries

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better management of MSW brings environmental and economic benefits. This paper presents different management levels for MSW in different parts of the world. First, statistics from practices of E.U. countries are given along with a good example of MSW management in a city in E.U. is presented. Then, a promising development in MSW area with how this is being achieved is in Asia is mentioned. Finally, MSW management methods of a country which is located at the intersection between Europe and Asia (Turkey) is demonstrated. The aim of this paper is to compare the practices of different levels of MSW in EU and Asia and lists recommendations from good practices to the developing ones.

2. LITERATURE REVIEW

There have been several studies which investigated the status of MSW of countries around the world. A review of studies is presented which explored MSW treatment methods in different parts of the world in the subsections.

2.1. MSW management in Asia, Africa, Americas, and Australia

The studies on the MSW management in Asian countries show that the disposal of MSW is done mostly on landfills. Gupta et al. (2015) reviewed the status of MSW in India; stating that %93 of the MSW went on landfills and 7% was composted [3]. Sethy et al. (2013) assert that there are no alternatives of uncontrolled dump sites in Cambodia for MSW treatment which means 100% of the MSW goes on them [4]. Damanhuri et al. (2014) state that almost 70% of MSW is left on the landfills in Indonesia where the rest is treated by dumping on land and river, composting and incineration [5]. It is stated that 95% of MSW is disposed on landfills in Malaysia [6]. The studies on the management of MSW in African countries emphasize the uncontrolled nature of MSW management. In Nigeria, it is stated that the most common disposal method is landfilling, but the landfills are not sanitary [7]. Tassie et al. (2019) reviewed the MSW management status in Ethiopia and stated that 30 to 60% of MSW left uncontrolled and not treated in the country [8]. Amo-Asamoah et al. (2020) states that 96% of MSW goes to landfills where the rest is uncontrolled in a metropolis area in Ghana [9]. On the other hand, a report by EPA (2017) shows that 52% of MSW was landfilled, 35% composted or recycled and 13% combusted energy recovery in the US [10]. Grau et al. (2015) argue that on average 55% of MSW in Latin America and Caribbean is controlled landfilling where the rest is still uncontrollably disposed [11]. Pandey and Shukla (2019) stated that 60% of the MSW was either recovered or recycled and 40% was landfilled in Australia in 2010-2011[12]. Overall, it can be said that MSW is mostly disposed on landfills in Asian, African, and Latin American countries whereas recycling and recovery are also part of the MSW management in the US and Australia.

2.2. MSW management in E.U. countries

Figure 1 shows the change in amount of MSW which are treated by different methods between 1995 and 2015 in 27 E.U. countries. It is shown that landfilling rate has been decreasing while composting, recycling, and waste to energy (WTE) share in MSW management have been increasing with time.

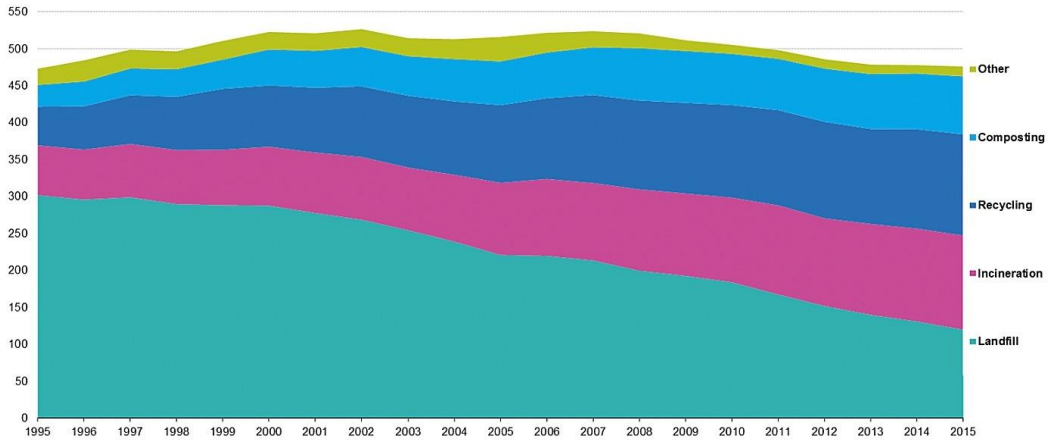

Figure 1. Change in amount of MSW (kg per capita) by MSW treatment methods in 27 E.U. countries [13].

Moreover, Figure 2 shows the share of MSW treatment methods for each in E.U. countries in 2018 [14]. It can be seen from Figure 2 that on average there is 23% of landfilling, 28% of waste-to-energy and 47% of recycling for 28 E.U. countries and Switzerland, Norway, and Iceland [14].

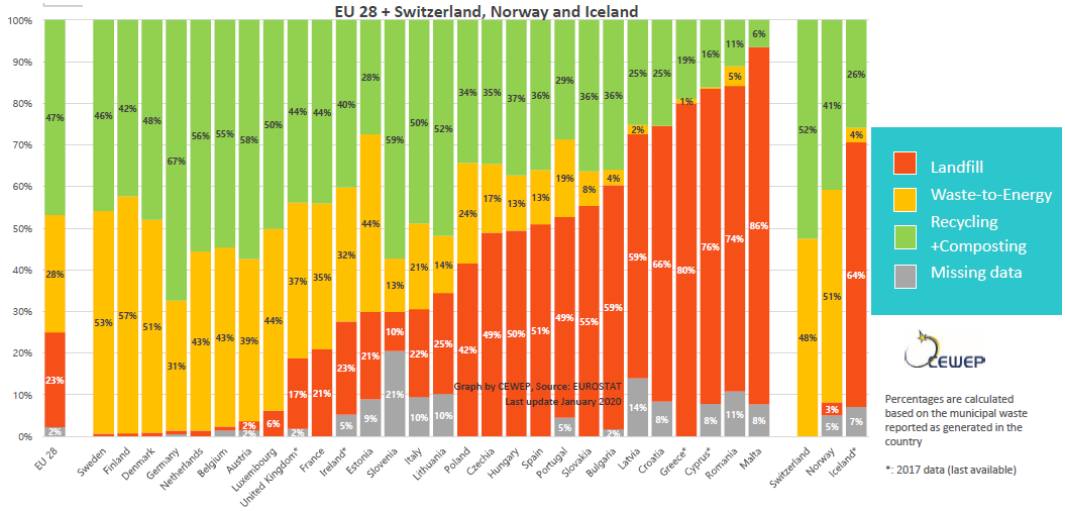

Figure 2. MSW treatment method shares for E.U. countries, Switzerland, Norway, and Iceland as of 2018 [14].

These two figures show that there is a big discrepancy between E.U. countries such that while Malta has 6% of recycling and 86% of landfilling, Germany treats 67% of their waste by recycling where only 2% of them are treated by landfilling [14]. Therefore, there is a need to learn from better management of MSW for the ones which need to improve.

In the following section, a good management example of MSW will be presented with details of policies which lead to the success and one promising and one developing case will be presented to determine necessary improvement points.

3. CASE STUDIES

This paper takes three cases to present: Milano city is presented as a good MSW management example; China is presented as a promising MSW management example and Turkey is presented as a developing MSW management example.

3.1. A good management example of MSW: Milano case

Milano is a city located in Italy with a population of 1.35 million as of 2015. 80% of the population lives in high rise buildings with several households where five different bins are provided for every household [15]. Five bins for paper, glass, metals/plastics, compost, and trash are used to separate the MSW at the source.

As it can be seen from Table 1 Milano achieved zero landfilling by treating their MSW with waste-to-energy, recycling, and composting. Almost 60% of MSW of Milano city was treated with WTE where 23% was recycled and 17% was composted [15].

The achievement of high recycling is due to the strict rules and regulations applied by city of Milano. The city does periodic inspections on the recycling bins where there is a $200 fine for every household if there is a violence of the rule of recycling bin seperation [15].

Table 1. MSW amount by treatment method in Milano [15].

Materials collected	**Tons/year**	**%**
Paper	78,000	9.6%
Plastics & metal	44,000	5.4%
Glass	65,000	8.0%
Total recycled	187,000	23.1%
Composted	141,000	17.4%
Total recycled and composted	328,000	40.4%
Post-recycling waste to Silla 2 WTE Power Plant	483,000*	59.6%
Total MSW, tons/year	811,000	100.0%

3.2. A promising example of MSW: Chinese case

China has been developing its MSW management in the last two decades. By the end of the 20th century, there was no other alternatives of landfills in the country. Thanks to the national energy plans that the country put into perspective, the share of treatment methods for MSW has been reshaped. As a result, waste-to-energy has been tremendously developed in the last two decades. Figure 3 shows the MSW disposal rate and share by different methods of MSW treatment in China. As it can be seen from Figure 3, landfilling is still 50% of all MSW whereas incineration is applied for around 35% of MSW. However, it is also noticable from Figure 3 that there is still lack of recycling and composting from MSW.

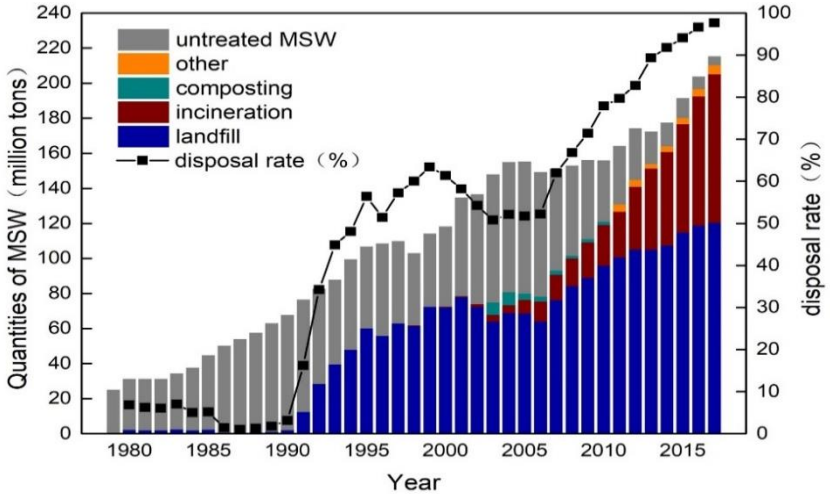

Figure 3. Generation and disposition of MSW in China, 1980-2018 [15].

Figure 4 shows the change in amount of MSW treated in WTE plants and number of WTE plants between 1998 and 2018 when total capacity of WTE plants reached from 0 to more than 400,000 tons per day, respectively [15]. It can also be seen from Figure 4 that the total number of WTE plants reached to almost 500 as of 2018 [15]. This development was realized by research and development (R&D) activities, policies and incentives which resulted with a capital cost reduction of WTE plants [15].

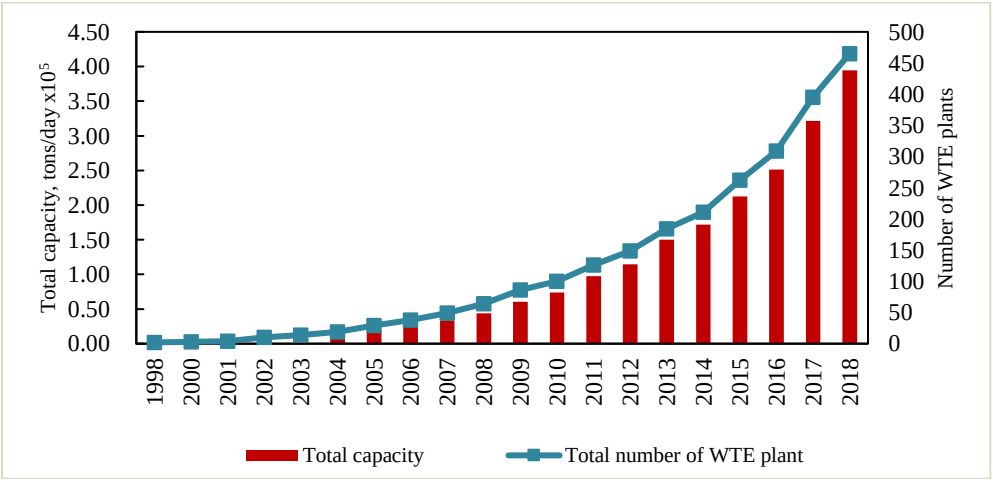

Figure 4. Growth of WTE industry in China [15].

3.3. A developing example of MSW: Turkish case

Turkey is a developing country which has high urbanization and population growth which lead to a need for a good MSW management. Figure 5 shows a timely change of amount in MSW by treatment methods in the country. It can be seen from Figure 5 that dumping has been reducing while sanitary landfilling has been increasing in the share of methods [16]. Also, recovery is named as material and energy recovery by the data supplier, therefore there is an uncertainty about the certain amount of MSW treated by recycling and waste-to-energy. Recovery has recently been applied and gradually increased in the share of MSW methods [16].

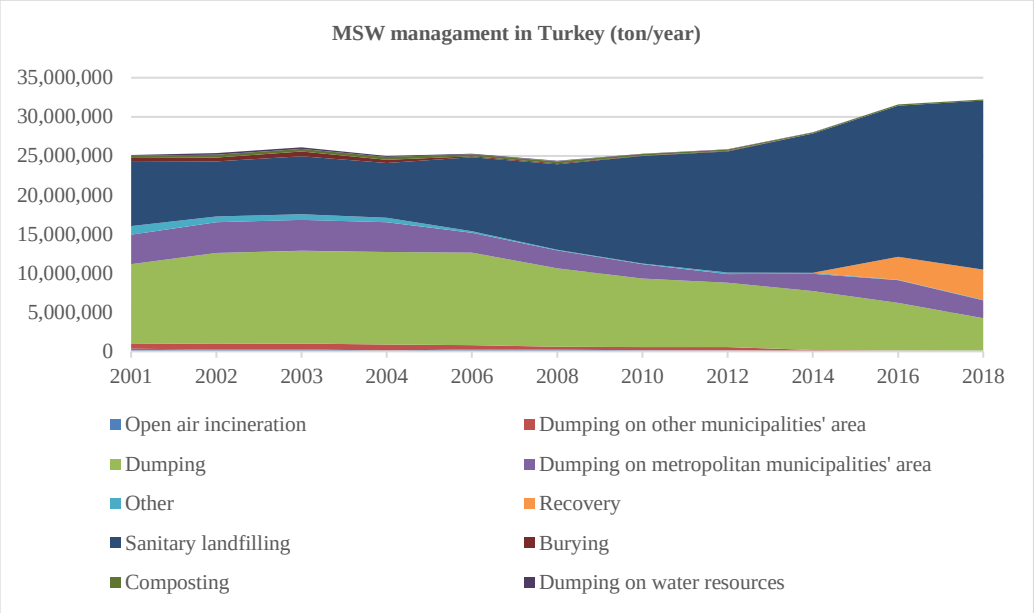

Figure 5. MSW management by treatment methods in time for Turkey [16].

Figure 6 shows the share of MSW treatment methods as of 2018 [16]. It is seen in Figure 6 that sanitary landfilling (67%) is the most common method followed by uncontrolled dumping (20%) in Turkey. Recovery is applied to 12% of MSW whereas composting is used for only 1% of the MSW. It should be noted that recylcing of materials and waste-to-energy is summed and named as recycling and recovery in the data supplier. Therefore, there is no clear distinction between recycling and waste-to-energy share for the MSW treatment in the country.

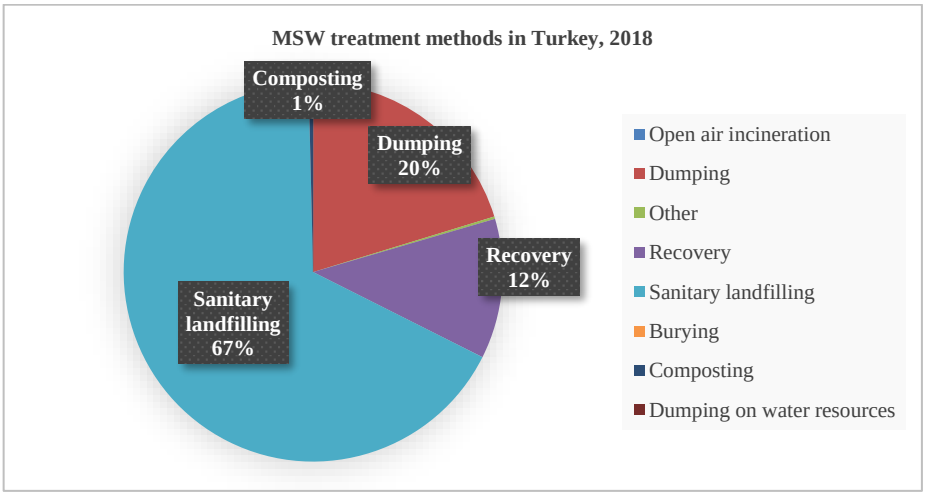

Figure 6. MSW management by treatment methods for Turkey as of 2018 [16].

4. COMPARISON OF THREE CASES AND RECOMMENDATIONS

In this paper, MSW management of Milano city is presented as a good, Chinese example as a promising and Turkish example as a developing case. Table 2 compares the shares of MSW treatment methods for these three cases. It can be seen from Table 2 that eliminating landfilling is possible and Milano city achieved it whereas there is still room for China and Turkey to reduce their landfilling rate. China can improve on recycling part as it achieved WTE development rapidly. Turkey must improve on both recycling and WTE development to achieve better MSW management in the country.

Table 2. Comparison of MSW treatment methods for three cases.

Method	**Milano**	**China**	**Turkey**
Recycling	23%	0%	12% (with WTE)
Composting	17%	0%	1%
Waste-to-energy	60%	35%	-
Sanitary landfilling	0%	50%	67%
Dumping	0%	15%	20%

Following recommendations can be listed based on successful management examples of MSW:

- To develop a good MSW management level, there must be a collective action with governments and people together.
- High recycling rate can be achieved, and it can be done by policies and enforcements.
- High deployment of WTE is realized when government incentives, policies and R&D are applied.
- National energy plans may be beneficial for the countries for WTE deployment.

5. CONCLUSIONS

The best management of MSW means sending the least amount of MSW on landfills, maximum recycling and waste-to-energy for post-recycling and composting materials. This is achieved by Milano city which has done this by establishing regulations and reinforcement. China, by means of a national energy plan, has dramatically benefitted from WTE for MSW management in the last decade. China can apply similar regulations as the city of Milano and also increase its rates of recycling and composting. Turkey, however, has much room to improve on both recycling and waste-to-energy and thus arrive at a better state of MSW management. To do that, there is a need for more R&D as well as national policies and local incentives for recycling and WTE for Turkey.

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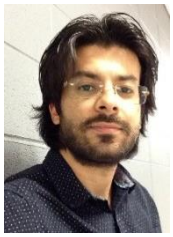

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