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Country Report

Municipal solid waste management strategies in Turkey

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ABSTRACT

Municipal solid waste (MSW) is a major environmental problem in Turkey, as in many developing countries. Problems associated with municipal solid waste are difficult to address, but efforts towards more efficient collection and transportation and environmentally acceptable waste disposal continue in Turkey. Although strict regulations on the management of solid waste are in place, primitive disposal methods such as open dumping and discharge into surface water have been used in various parts of Turkey. This study presents a brief history of the legislative trends in Turkey for MSW management. The study also presents the MSW responsibility and management structure together with the present situation of generation, composition, recycling, and treatment. The results show that approximately 25 million ton of MSW are generated annually in Turkey. About 77% of the population receives MSW services. In spite of efforts to change open dumping areas into sanitary landfills and to build modern recycling and composting facilities, Turkey still has over 2000 open dumps.

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1. Introduction

The progress of modern civilization and the associated increase in population worldwide has contributed significantly to the increase in the quantity and variety of waste generated (Ziadat and Mott, 2005). The ever-increasing consumption of resources has resulted in huge amounts of solid waste from industrial to domestic activities, which can pose significant threats to human health (Frosch, 1996). Continuing advancements in science and technology have also contributed significantly to the increased volume and toxicity of waste generated (Sangodoyin and Ipadeola, 2000).

Improper management of solid waste has serious environmental and health consequences. Such practices contribute to widespread environmental pollution as well as the spread of diseases (Gulec et al., 2001). Health deterioration, accidents, flood occurrences, and environmental pressures are just a few of the negative effects. Other environmental effects include pollution of surface and subsurface waters, unpleasant odours, pest infestations, and gas explosions. The hazards associated with inappropriate solid waste disposal and the associated environmental health impacts should therefore be of utmost concern to waste management

experts. If waste pollution persists unchecked into the future, it may lead to unprecedented health consequences (Themelis, 2002; Ayomoh et al., in press).

In developing countries and developing areas with mixed economies, the problem of upgrading practices for the disposal of solid wastes is far more difficult than in developed countries. In most developing countries, municipal authorities lack the resources and trained staff to provide their rapidly growing populations with the necessary facilities and services for solid waste management to support an adequate quality of life (Bartone et al., 1994).

Within the framework of sustainable development, developing countries today face the challenge of balancing economic growth with environmental progress. A number of institutional and legislative elements of environmental reform have been put on the agenda as part of the environmental planning in these countries. These will require strengthened environmental efforts and cooperation between the central government, municipalities, and the private sector, which will create the necessary environmental infrastructure in urban and industrial areas.

In Turkey, an economically developing country, industrialization and increased standards of living have contributed to an increasing amount of solid waste and its consequent disposal problems. Turkey's traditional method of disposing of solid waste has been to dump it at open sites – of which there are over 2000 – or at sea. In Turkey, the accident of the Umraniye–Hekimbasi open dumpsite on 28 April 1993, which was caused by the explosion of gases compressed within the dumping area, resulted in the death of 39 people (Kocasoy and Curi, 1995). This accident became the starting point in the handling of the solid waste problem.

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The aim of this study is to present an overview of solid waste management in Turkey. The legally established MSW responsibility and management structure in Turkey is also presented. Finally, based primarily on data from the Turkish State Statistical Institute, MSW characteristics and management trends are presented.

2. Review of the Turkish institutional and legislative framework in MSW management

In 1983, the Ministry of Environment in Turkey published Environmental Law 2872 as the first stage in order to improve the environmental situation in the country. However, there was no consensus on the best option for MSW management in the law. In 1991, the Solid Waste Control Regulation came into force in order to manage solid waste. The regulation played a fundamental role in solid waste collection, storage, transport, and disposal. The regulation has been continuously updated. In addition, Turkey developed regulations for medical waste in 1993 and for hazardous waste in 1995. The Medical Waste Control Regulation established a basic action line for medical waste management based on the collection, storage, transport, and disposal or reuse of the waste by its owner. Some types of waste, such as radioactive wastes, were excluded from that law. The Hazardous Waste Control Regulation set the criteria for the collection, transport, and final disposal of hazardous waste, including options for landfilling or incineration, as well as the design criteria and the operational rules for sanitary landfills and incinerators. The regulation also focuses on the minimization of hazardous waste and encouragement of recycling.

By legal definition, municipal solid waste includes all the waste arising from human activities that are normally solid and that are discarded as useless or unwanted. Municipal solid waste generally consists of waste generated from residential to commercial areas, industries, parks, and streets (Berkun et al., 2005).

In cities in Turkey, community initiatives in solid waste management are currently being supported by the municipal authorities, who guide their activities according to the legislation and policies dictated by the Ministry of Environment and Forestry (MEF). The framework of responsibility and management of MSW in Turkey is shown in Fig. 1. MSW comes from commercial services, industries, healthcare facilities, and citizens in Turkey. Some private enterprises are responsible for the collection and transport of solid waste and for the sorting of separately collected packaging waste. After sorting, the packaging waste is directed towards the recycling industry.

3. MSW generation and composition

Until 1994, there were only estimates of MSW generation in Turkey because of the predominance of open dumping and the difficulty of recording MSW generation. The absence of reliable data and statistics for waste generation and composition makes a regional and national evaluation of MSW management difficult. The Turkish State Statistical Institute has compiled statistics about MSW management since 1994 (Metin et al., 2003). In the 1960s, 3–4 million ton of municipal solid waste per year was generated in Turkey. However, according to the Turkish State Statistical Institute's 2004 database, approximately 25 million ton of MSW was generated annually (Fig. 2). Increasing population levels, rapid economic growth, and the rise in community living standards will accelerate the future solid waste generation rate in Turkey. The amount of MSW per capita in the summer and winter seasons from 1994 to 2004 is given in Fig. 3. The generation rate per capita varies considerably from the summer season to the winter season. As seen in Fig. 3, in the 1990s Turkey generated a higher amount of MSW in the summer than in the winter. MSW generation rates in summer and in winter are 1.30 and 1.29 kg/cap/day in 2004, respec-

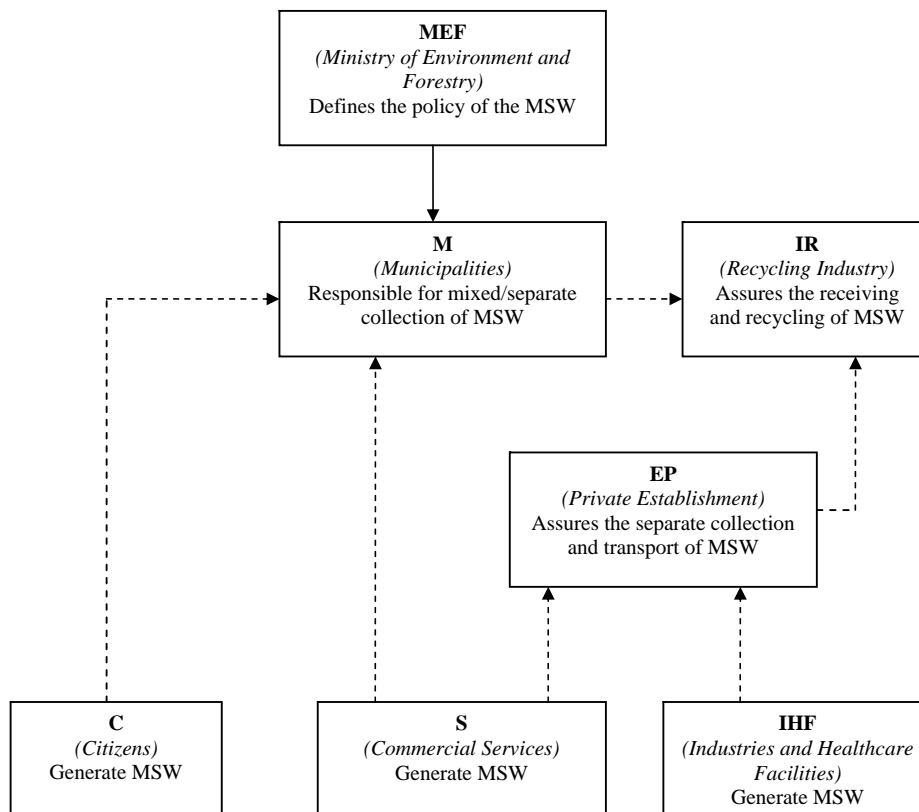


Fig. 1. Framework of responsibility and management of MSW in Turkey.

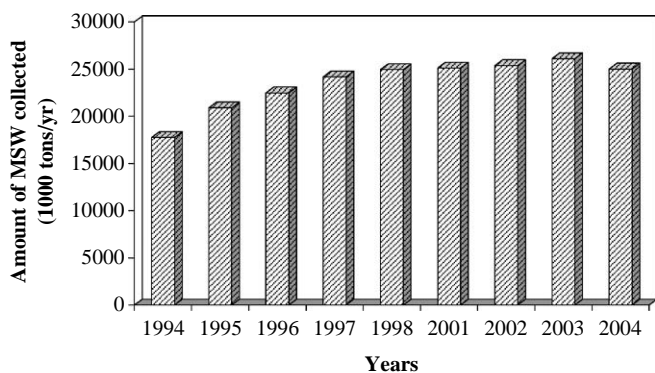


Fig. 2. Amount of MSW collected in Turkey.

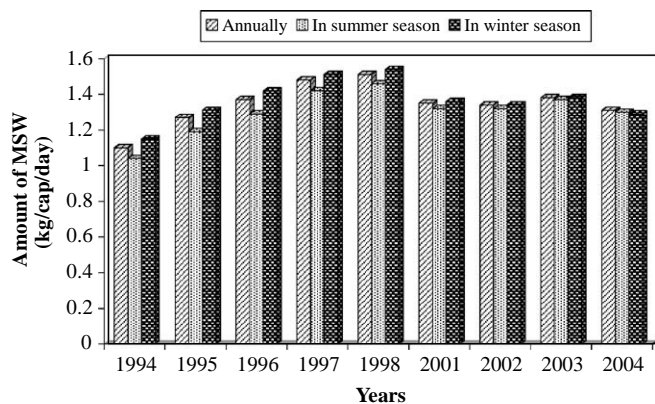


Fig. 3. Amount of MSW per capita (kg/cap/day).

tively. This is a result of the decreasing usage of fossil fuel for daily heating.

Approximately 68 million people live in Turkey, with quite different socioeconomic and demographic characteristics and dietary habits. Urbanization in Turkey is a response to a rapid population increase and migration from rural areas to cities. The quantities of solid waste generated by various population groups in Turkey are given in Table 1. The rate of waste generation is highly influenced by the population of the community. The rate of waste generation in the areas with the lowest population is 1.69 kg/cap/day, while in the areas with the highest population it is 1.25 kg/cap/day. As can be seen, solid waste generation is reduced when the population of the area increases.

The typical composition of municipal solid waste in Turkey is shown in Table 2. As can be seen, organic waste is the main component of MSW. Between 7% and 24% of the material is denoted as “other”, which mainly includes construction and demolition debris, coal ash, and hazardous waste. The high concentration of biodegradable matter and inert material results in a high waste density (weight-to-volume ratio) and high moisture content. In

Table 1
MSW generation based on population of communities in Turkey

Population groups	Waste generation		
	(kg/cap/day)	(tons/yr)	(%)
<100,000	1.69	67,657	0.27
100,000–500,000	1.41	3,360,938	13.66
500,000–1,000,000	1.36	5,659,519	23.00
1,000,000–2,000,000	1.21	5,962,242	24.23
>2,000,000	1.25	9,558,834	38.84

Table 2
Composition of MSW in Turkey

Components	Range (%) in weight
Organics	40–65
Paper/cardboard	7–18
Plastics	5–14
Metal	1–6
Glass	2–6
Others	7–24

the summer season, the MSW densities are relatively high in the high income region because of the higher quantities of organic waste compared to the low income regions. In low income regions, organic waste is fed to animals, used as soil conditioner, or used as fuel for ovens.

4. Collection and transport of MSW

There are 3225 municipalities in Turkey, and 16 of them are metropolitan municipalities. A total of 3028 municipalities have solid waste management services. The population receiving solid waste services from 1994 to 2004 is shown in Fig. 4. As can be seen, the percentage of the population receiving solid waste services increased from 71% in 1994 to 77% in 2004 (Fig. 4). However, the percentage of municipalities collecting and transporting solid waste in the municipalities is 95%.

In most of the settlement units of Turkey, the collection and transportation components of MSW management are generally well organized. The municipalities spend all of their efforts and budgets for these services. There are two types of collection systems in the municipal areas of Turkey (Ergun et al., 1998). The first collection system, which is operated in the central parts of the cities and large towns, is curbside pickup. In this collection system, a solid waste collection vehicle stops at each building to pick up the refuse, either in plastic bags or in kitchen bins. Where this system is operated, the waste is collected daily or twice a day. Some residents use specially produced plastic bags, but most use packaging plastic bags of various thickness and sizes. The kitchen bins used by the residents of most regions are not standard, either in size or in manufacturing material. The second collection system, which is commonly practised in small settlements and the poorly developed peripheral parts of urban areas, is the community bin system. Depending on the population of an area, community bins with various non-standard sizes and models are placed on the streets, and waste from these bins is collected by various types of vehicles, ranging from tractors to compactors. The bins are generally emptied or

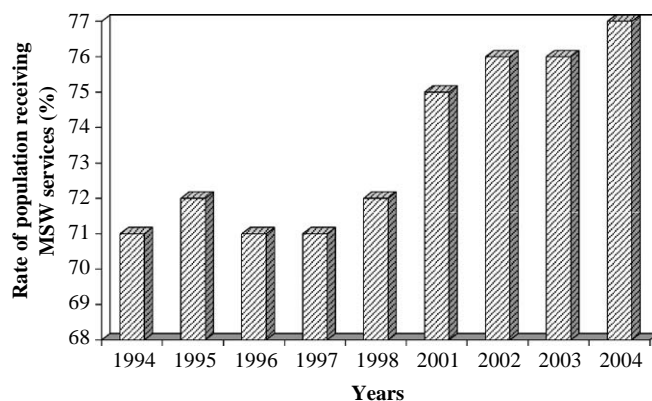


Fig. 4. Percentage of total population receiving solid waste services of Turkey.

replaced in some municipalities two or three times a week. Due to the increase of population and rapid urbanization, the roads in the peripheral parts in some urban centers are very poor, so the collection vehicles cannot reach the community bins in these areas during rainy periods and therefore the community bins cannot be emptied regularly. The MSW from these areas generally contains high concentrations of putrescible matter, which makes them particularly prone to cause aesthetic and environmental disturbances to neighbouring populations, especially when the community bins or chicken bins are not emptied within 48 h of adding the refuse to the bins. The volume of the most common type of street community bins is about 200 l.

Medical waste from healthcare establishments to other hazardous wastes are generally put into the community bins instead of being collected separately by specially designed trucks and workers. However, some municipalities separately apply collection and transportation systems, especially municipalities with high populations. A small amount of medical waste is disposed by burning in Turkey. The infectious solid waste, together with MSW, is generally discharged to dumping areas of municipalities.

Municipalities use their own vehicles for solid waste collection and transportation. Both the collection and transportation services are performed by the same vehicles. Generally, transfer models are not used in Turkey. The collection and transportation vehicles are generally trucks with capacities of 3.5–7 ton. Tractors are also used in many areas in large cities.

5. Disposal of MSW

In many cities in Turkey, deficiencies in the provision of waste services are the result of inadequate financial resources, management, and technical skills of municipalities and government authorities to deal with the rapid growth in demand for services. Methods of disposal of solid waste, according to the Turkish State Statistical Institute's 2004 database, are shown graphically in Fig. 5. There are 16 sanitary landfills, five composting plants (three of which are being actively operated), and three incineration plants in Turkey. In 2004 25,013,521 ton of MSW were collected, whereas 7,002,000, 351,000, and 8000 ton were disposed of in sanitary landfills, composted, and incinerated, respectively. A total of 17,661,254 ton of waste was disposed of without any control.

There are typically a large number of scavengers at refuse bins in Turkey. The materials collected are subjected to some level of intermediate processing, such as separating, washing, and drying. The reclaimed materials are then sold to refuse dealers, who fur-

ther separate the materials and sell them to appropriate processing/remolding mills and factories. It is estimated that approximately 10–15% of MSW is recycled by scavengers.

6. Management strategies

The conventional waste collection and disposal system in Turkey consists of garbage trucks and open dumping. However, the trend for disposal of MSW is towards implementing waste diversion and creating an integrated MSW management system. An integrated system requires many management options, such as source reduction, curbside recycling, material recovery, waste-to-energy, sanitary landfilling, and composting.

Physical and chemical data can be analyzed to determine the physical make-up and the chemical content of the MSW stream sequentially, providing important information for MSW management systems. Although the physical composition analysis may directly support the assessment of material recovery, curbside recycling, and composting, the energy content may greatly support the investigation of the thermal treatment potential.

Improving the standard of management and operation of some existing facilities at much lower cost may offer considerable improvement in environmental performance. Additionally, setting out a program of planned closure and remediation of the most polluted dumpsites will constitute an early step in the development of the national waste strategy (Taoeli, 2007).

Co-disposal of MSW with hazardous medical and industrial wastes creates a great concern for public health. From this point of view, the implementation of solid waste management strategies will reduce the risk of environmental pollution.

In Turkey, a negligible amount of MSW is currently being recycled. Poorly organized collection systems for recoverable wastes, lack of funding, and low tendency of residents to segregate waste are factors affecting the efficiency of recovery. If there are no recycling programs in cities, it is important for waste managers to determine the percentage of recyclables in the waste stream, as well as what percentage of these recyclables is marketable. If cities have had recycling programs, the amount of recyclable material could provide valuable information by identifying the capture rates in recycling centers.

Municipalities are responsible for ensuring that the waste generated by their residents and establishments is collected and properly managed. A major problem is the current poor condition of the economy in Turkey. The amount of funds available from municipal budgets for MSW improvements should be increased.

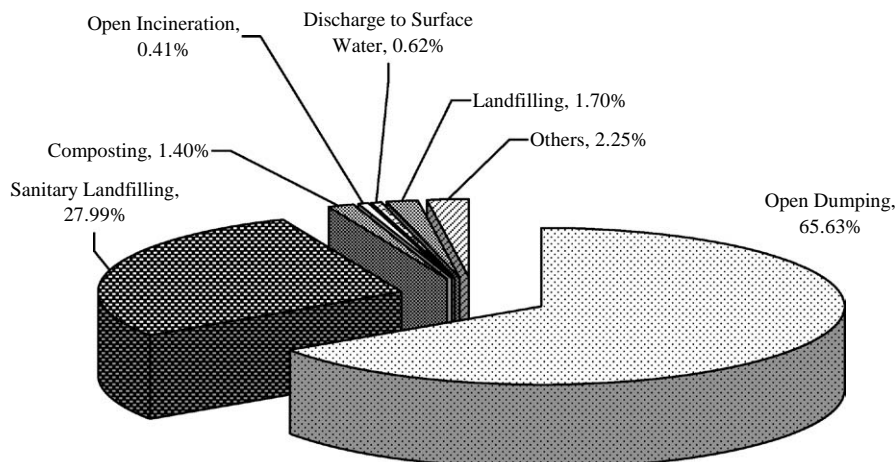


Fig. 5. MSW disposal methods in Turkey.

7. Discussion

A reliable database of waste characteristics may provide a resource for the comprehensive and informative evaluation of management options in all waste management programs. Based on the results of TURKSTAT, it can be concluded that MSW management is a major problem facing municipalities. The annual waste generation increases in proportion to the rise in the population and urbanization, and issues related to disposal have become challenging as more land is needed for the ultimate disposal of solid waste.

Open dumps can be detrimental to the urban environment. In spite of efforts to change open dumps into sanitary landfills and to build modern recycling and composting facilities, Turkey still has over 2000 open dumps. The Solid Waste Control Regulation is applied properly in the stages of collection and transportation, but the main problem is the preparation of sanitary landfills and rehabilitation of open dumps because of insufficient financing.

Composting is an excellent method of recycling biodegradable waste. However, many composting plants have failed because not enough attention was given to the quality of the product and to marketing activities.

Although various forms of incineration are widely used for waste management, there has been increased public debate in the last several decades over the expected benefits and the potential risk to human health that might result from the emission of pollutants generated by the incineration process (Chang and Davila, 2008). Currently, electricity production from waste incineration is rather low in Turkey. This is because several of incineration plants lack the capacity to produce electricity.

Determining methods of final waste disposal requires an understanding of the make-up of the MSW stream. A MSW decision-support system based on integrated solid waste management should be developed for cities in Turkey.

8. Conclusion

The amount of solid waste collected in Turkey in 2004 was 25,013,521 ton; 27.99%, 1.4%, and 0.03% of MSW is disposed of in sanitary landfills, composted, and incinerated, respectively. This indicates that 70.57% of the total amount of MSW was disposed of without any control. In Turkey, MSW is mostly composed of domestic residues, and its composition varies by season. Solid waste generated generally consists of a high organic fraction because of high consumption of vegetables and fruits. In rural areas, the ash content is higher due to the use of stoves for heating purposes in the winter.

In Turkey, as in many developing countries, there is a lack of organization and planning in MSW management due to insufficient information about regulations and due to financial restrictions. In the short term, the best policy might be to leave disposal methods without any controls, and use the resources available to upgrade them with environmental protection systems. In the long term, the construction of new sanitary landfill areas, composting, and incineration facilities could be planned. Public participation and awareness are also important issues in achieving the goals of the suggested management system, but it is difficult and takes a long time to make people aware of the importance and of the principles of the proposed management system and to effect their participation.

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