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# Waste Management Applications in Turkey

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#### Abstract

The article tries to explore the various strategies and practices employed in Turkey to address the complex challenges of waste management. It delves into various aspects of waste management, encompassing collection, recycling, disposal, and governmental initiatives. The article also sheds light on the role of municipalities in waste management, emphasizing their responsibilities in waste collection, recycling promotion, proper disposal, and public education. It also highlights the challenges faced by Turkish municipalities, including limited resources, inadequate infrastructure, and the necessity for significant investments in modern waste management facilities. Furthermore, it touches upon the Turkish government's integral role in waste management practices. It discusses how the government formulates and enforces regulations, encourages the development of modern waste management facilities, and emphasizes public awareness and education to instill responsible waste practices. Therefore, the article provides a comprehensive overview of waste management applications in Turkey, addressing the multifaceted challenges and solutions in the context of municipal and governmental efforts.

*Keywords:* Waste, waste management, recycling, municipalities, Turkey. *JEL Codes:* Q50, Q53, Q56.

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Özet

## Türkiye'de Atık Yönetimi Uygulamaları

Bu makale, atık yönetiminin karmaşık zorluklarının üstesinden gelmek için Türkiye'de kullanılan çeşitli strateji ve uygulamaları incelemeyi amaçlamaktadır. Çalışma, toplama, geri dönüşüm, bertaraf ve hükümet girişimlerini kapsayan atık yönetiminin çeşitli yönlerini ele alır. Makale aynı zamanda belediyelerin atık yönetimindeki rolüne de değinmekte; atık toplama, geri dönüşümün teşvik edilmesi, uygun şekilde imha edilmesi ve halkın eğitimi konularındaki sorumluluklarını vurgulamaktadır. Aynı zamanda, sınırlı kaynaklar, yetersiz altyapı ve modern atık yönetimi tesislerine önemli yatırımlar yapılması gerekliliği de dahil olmak üzere belediyelerin karşılaştığı zorlukların altını çizmektedir. Çalışmada, Türk hükümetinin atık yönetimi uygulamalarındaki tamamlayıcı rolüne de değinilmektedir. Dolayısıyla makale, belediye ve hükümet çabaları bağlamında çok yönlü zorlukları ve çözümleri ele alarak Türkiye'deki atık yönetimi uygulamalarına kapsamlı bir genel bakış sunmaktadır.

Anahtar Kelimeler: Atık, atık yönetimi, geri dönüşüm, belediyeler, Türkiye. JEL Kodları: Q50, Q53, Q56.

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## 1. Introduction

Environmental degradation is one of the most important problems of the 21st century. It refers to damage to the environment through the destruction of air, water and soil, as well as ecosystems and wildlife, i.e. depletion of resources. Solid waste is also an important problem that threatens human survival and contributes to environmental diseases and air pollution. Waste is defined as anything that is left over or that someone plans to leave behind. Change in the shape of the object after the production process or consumption, or over time, can also be a source of "waste". Thus, wastes are "the majority of human activities or processes that are considered unnecessary and extraordinary, both directly and indirectly, in the industrial, agricultural and urban sectors.

One of the ways to combat environmental degradation is to implement proper solid waste management. Solid waste production has increased due to rapid urbanization, industrialization, population growth, changes in consumption habits and increased technological progress. Effectively managing and disposing of waste guides preventing waste generation, conserving resources, and supporting a healthier ecosystem for both people and wildlife. The use of an integrated solid waste management program plays a very important role and is also a valuable tool for reducing the use of natural resources and efficient processing of solid waste (Berkun, Aras, and Anılan, 2011). Therefore, solid waste management is a significant challenge that requires proper implementation and implementation of appropriate management practices

In Turkey, despite its geographical location, environmental degradation and waste accumulation caused by overpopulation, excessive consumption, forest destruction, excessive construction, dependence on imports rather than exports create management challenges for the country. Rapid urbanization has caused further pressure on infrastructure and resources and placed great pressure on the environment. These concerns and challenges translate into a range of environmental problems such as climate change, deforestation, water scarcity, wildlife destruction and marine pollution, making them difficult and complex to manage and address.

This study aims to conduct a comprehensive analysis of Turkey's waste management system, with a particular emphasis on evaluating its positive and negative aspects. It tries to ascertain the extent to which the handling of solid waste and waste management practices are implemented in Turkey. More specifically, it examines which practices and methods are used in solid waste management in Turkey and how solid waste management is perceived by Turkish citizens. Moreover, it is discussed what kind of policies and regulations should be implemented to make solid waste management effective in Turkey.

## **II. Conceptual Framework and Literature Review**

All unwanted or unusable items are called waste and are usually thrown away by their owners (Pinheiro, 2015). Waste refers to materials or items that are discarded, intended for disposal, or obligated to be disposed of according to the regulations set by national law, according to Article 2 of the Basel Convention on the control of transboundary movements of hazardous wastes and their disposal (UNEP, 2014). It can be divided into three main types according to its physical state: solid, liquid, and gaseous wastes (White et al, 1995). Solid waste refers to the materials that are generated through human and animal activities, which are typically in solid form and are commonly disposed of due to unwanted or useless. (Syed, 2006) for example: bottles, plastic, cans, scrap iron, papers, etc. Liquid waste refers to the water that is discharged from homes, commercial establishments, and institutions, which may be either unwanted or has been used. For instance, domestic washings, oils, chemicals, wastewater from ponds, etc. Gaseous waste is the waste that is generated by the activities of factories, automobiles, and vehicles, and can harm the environment and public health as well. For example, methane, carbon dioxide, hydrogen sulfide, nitrogen gases, etc.

Since the beginning of human life, most human activities have produced waste. Due to the increase in human population, the rate and amount of waste generation has increased rapidly. Due to the Industrial Revolution, people began to migrate from rural areas to urban areas, which caused a significant increase in the amount and type of waste production due to the population explosion (Wilson, 2007; Vergara and Tchobanoglous, 2012). Among the many environmental problems in urban areas, waste production is undoubtedly the most prominent (Ngoc and Schnitzer, 2009).

Inappropriate waste management, accompanied by factors such as population growth, poverty, urbanization and industrial development, contributes to environmental degradation and public health problems. Therefore, the rapid population growth,

increase in the extent and capacity of industrial facilities, changing consumption patterns, and urbanization have led to the need for a comprehensive waste management strategy to effectively control and reduce waste management generation and its adverse impact on environmental degradation and public health (Amasuomo and Baird, 2016). Nowadays, due to the increase in waste generation in both rural and urban areas, the waste management system has become an essential component of a comprehensive management system. According to Yılmaz and Bozkurt (2010), in order to protect environmental health, there is a need for planned waste management in order to periodically collect, store, transport and dispose of waste in urban areas without causing significant problems.

According to Amasuomo and Baird (2016), waste management is the process of collecting, processing, transporting, recycling, disposing of and monitoring waste material. According to Tchobanoglous et al. (1993), it is the effective supervision and management of waste in a way that protects the environment and the public during the collection, storage, transportation, processing and disposal of waste. Waste management entails a comprehensive strategy to efficiently and effectively eliminate waste, avoiding any impact on environment or the society. A comprehensive waste collection system, and appropriate storage facilities and containers are essential factors for effective solid waste management that reduces and minimizes waste generation and accidents.

The components of a typical waste management system consist of collection, transportation, pre-treatment, processing, and disposal (Kan, 2009: 55). These components play a crucial role in achieving sustainable waste management practices. Correct use of these components allows effective waste management and reduces the negative impact of waste on the environment and public health. Waste management has different practical applications for urban and rural areas, as well as for industrial, residential and manufacturers, as well as for developing and developed countries.

Additionally, education and awareness have effects and benefits in the field of waste management (Demirbaş, 2011). In addition, education and training programs that aim to teach individuals the principles of waste separation, recycling and appropriate disposal techniques ultimately lead to more effective and efficient waste management practices.

Waste management generally involves an integrated approach and the implementation of a comprehensive strategy that effectively and efficiently removes and disposes of waste to minimize its negative social and environmental consequences. The development of technologies such as biotechnology and management systems offers new possibilities and opportunities for improving waste management (Lead et al., 2005). In addition, the sale of products obtained from waste through direct reuse, recycling and recovery methods, or more complex technological processes has helped develop businesses suitable for the socioeconomic conditions of the region or country. Troschinetz and Mihelcic (2009) stated that some waste management techniques are widely preferred over others (Amasuomo and Baird, 2016). All methods of waste management play a vital role, are important and offer various advantages; Among these methods, reuse and recycling are the most preferred. Reuse contributes to the reduction of waste, while recycling indicates that materials are effectively transformed and transformed into new valuable products with greater potential benefits.

The implementation of effective waste management necessitates the identification of waste origins, waste segregation, leading to the reduction of waste generation and improved efficiency (Yılmaz and Bozkurt, 2010). For a waste management system to be effective, the general public must accept it (Bharuka and Shrivastava, 2020). To ensure sustainability, the system must meet three criteria: being environmentally beneficial, economically viable and socially acceptable. Sustainability of the system is ensured by efficient use of resources and protection of the environment by preventing harmful substances released into the environment and nature. In addition, to be

financially viable, a system must effectively manage its operating costs and also effectively address the needs and aspirations of its communities through community engagement, social equity, and social impact considerations.

Waste management has several benefits, such as reducing the need for natural resources to create new products, as well as reducing waste and its costs during the production process or product disposal (US EPA, 2010). Waste management contributes to sustainability by optimizing the use of resources and at the same time minimizing the need to extract raw materials. Waste management significantly impacts the environment through the release of emissions and the use of resources such as electricity and fuel (Akesson, 2014). Implementing sustainable waste management strategies and technologies, such as waste-to-energy, can harness the energy potential of waste, reduce emissions as well as harmful pollutants, and reduce negative impacts on the environment and public health through the use of appropriate waste management practices.

World is grappling with a multitude of environmental and socioeconomic issues, with waste management and waste generation emerging as the primary worldwide concerns. Waste management practices vary between urban areas, rural areas and countries. Turkey, along with other countries, faces substantial difficulties in effectively managing waste production, reuse, collection, recycling, and disposal. The next part discusses Turkey's waste management practices.

## **III. Waste Management Applications**

The main institutions responsible for the management of solid waste in Turkey are municipalities, according to the 11<sup>th</sup> article of Environment Law No: 2872 (UAYEP, 2016). These municipalities are responsible for the transportation, collection and disposal of solid waste in their areas. Therefore, first of all, municipalities need to

raise public awareness about recycling activities, the importance of waste reduction and appropriate waste disposal methods.

In Turkey, there are 1397 municipalities, which include 30 metropolitan municipalities, 51 provincial municipalities, 919 district municipalities, and also 397 town municipalities as well (UAYEP, 2016). Each municipality has its institutional system for waste management. In Turkey, the Turkish Statistical Institute (TUIK) is responsible for analyzing and collecting environmental data, including waste management.

In 1991, Turkey's Ministry of Environment implemented solid waste control legislation to handle and manage solid waste. As a result, the regulation brings a variety of advances and plays a critical role in the features of storage, solid waste collection, disposal, and transport. In addition to solid waste, Turkey published and developed their regulation for medical waste in 1993, as well as hazardous waste in 1995.

Table 1 below shows data on Turkey's Turkey's total waste, hazardous waste, and non-hazardous waste amounts in 2018 and 2020. In this context, hazardous waste refers to materials that pose a substantial threat to human health or the environment due to their chemical or physical properties. These materials may be toxic, flammable, corrosive, or reactive. Proper disposal and management of hazardous waste are critical to prevent harm. Non-hazardous waste, on the other hand, does not pose the same level of threat to human health or the environment. It includes materials like household waste, paper, glass, and other common items. While non-hazardous waste still requires proper disposal, it generally has fewer strict regulations compared to hazardous waste.

Table 1 indicates that the total amount of waste in Turkey increased between 2018 and 2020. In both years, the largest total amount of waste belongs to household waste. While Thermal power plants followed households in 2018, mining establishments

followed them in 2020. While the most hazardous waste belonged to mining establishments in both years, non-hazardous waste belonged to households. According to Table 1, there is a remarkable decrease in non-hazardous waste created by mining establishments from 2018 to 2020. On the other hand, the total waste generation by health institutions increased in 2020 compared to 2018. This increase can be explained by the Corona epidemic that took over the whole world in 2020.

Tab	le 1	Waste	Generation,	Turkey,	, 2018,	2019
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	Amount of total waste		Amount of hazardous waste		Amount of non- hazardous waste	
-	2018	2020	2018	2020	2018	2020
Total	94 870 818	104 848 864	15 078 573	30 876 658	79 792 245	73 972 206
Manufacturing Industry establishments	22 881 144	23 867 866	3 677 320	4 597 274	19 203 824	19 270 593
Thermal Power Plants	26 127 134	24 375 356	13 805	10 012	26 113 329	24 365 343
Mining establishments <sup>1</sup>	17 387 029	27 581 875	11 176 581	26 044 730	6 210 448	1 537 144
Organized industrial zones	286 843	279 067	111 733	116 720	175 110	162 347
Health institutions	89 454	109 683	86 916	106 570	2538	3 113
Households <sup>2</sup>	28 099 214	28 635 018	12 218	1 352	28 086 996	28 633 665

*Source: TurkStat (2020). Figures in the table may not add up to totals due to rounding.* (1)*Amount of waste excluding overburden* 

(2) The amount of waste that originates from households has been estimated by using the Municipal Waste Statistics Survey results (TUIK, 2020)

Waste management has become a global challenge, with nations seeking innovative solutions to handle the ever-growing amount of waste generated. One aspect of this complex issue is the import and export of garbage, a practice that has raised environmental concerns and prompted regulatory responses. Figure 1 below shows the top 10 main destinations of waste from the EU in 2021.

According to Figure 1, Turkey serves as the primary recipient of garbage exported from the European Union, receiving over 14.7 million tonnes in 2021. This number is more than three times the amount recorded in 2004 and accounts for nearly half of the total waste exports. India was the second largest recipient of waste from the EU in 2021, with an intake of nearly 2.4 million tonnes. Following closely behind were Egypt (1.9 million tonnes), Switzerland (1.7 million tonnes), the United Kingdom (1.5 million tonnes), Norway (1.4 million tonnes), Pakistan (1.3 million tonnes), Indonesia (1.1 million tonnes), the United States (0.9 million tonnes), and Morocco (0.6 million tonnes).

Figure 1 Top 10 destinations of waste from the EU and waste quantities (in terms of million tonnes), 2021

Turkey	14.7
India	2.4
Egypt	1.9
Switzerland	1.7
Unite Kingdom	1.5
Norway	1.4
Pakistan	1.3
Indonesia	1.1
United States	0.9
Morocco	0.6

#### Source: Eurostat

Therefore, it can be claimed that in recent years Turkey has emerged as a significant player in the global waste trade, particularly concerning the import of plastic waste. This surge in imports has been attributed to the country's recycling industry, which, at times, has relied on external sources to meet the demand for recyclable materials. While the intention behind such imports is often centered on economic considerations and the promotion of recycling efforts, the environmental consequences have raised red flags.

In response to these environmental challenges, the Turkish government has taken regulatory measures to address the import and management of garbage. The surge in plastic waste imports prompted authorities to reassess existing regulations and consider new policies to ensure sustainable waste management practices. These regulatory responses are designed not only to protect the environment but also to foster a circular economy where resources are used efficiently, and waste is minimized.

The Turkish Ministry of Environment and Urbanization has played a crucial role in formulating and implementing regulations related to waste management. Efforts have been made to enhance monitoring and control mechanisms, ensuring that imported waste undergoes proper processing and adheres to environmental standards. The goal is to strike a balance between the economic benefits of waste imports for recycling industries and the need to safeguard the environment.

Moreover, international collaboration and adherence to global agreements have become integral components of Turkey's waste management strategy. The Basel Convention, an international treaty that aims to control the transboundary movement of hazardous waste, plays a significant role in shaping the regulatory framework. By aligning with international standards, Turkey aims to address the environmental concerns associated with waste imports and exports while fostering cooperation with other nations.

The primary strategies implemented by Turkey to reduce the impact of the waste sector until 2030 are outlined below (UNFCC, 2023)

- To minimize the amount of waste produced and to prevent the generation of waste within the framework of circular economy principles,
- To raise the recovery rate of methane gas from biodegradable wastes,
- To raise the recovery rate of municipal waste to 60 percent by 2035,
- To convert wastewater treatment facilities into bio-refinery facilities, increase the reuse percentage, and to expand the areas of use treated wastewater,
- To increase refuse-derived fuel (RDF) production from municipal waste,

• To decrease the percentage of landfilled waste to reach the target of zero municipal waste landfilling without pretreatment by 2053.

Turkey has also implemented a zero-waste management system in over 164,000 buildings and campuses since June 2017, with 19 million people being educated. The goal is to increase the recycling rate to 35% and lessen the landfill rate to 65%. Since 2017, the Ministry of Environment, Urbanization, and Climate Change processed 33.8 million tons of recyclable waste.

Municipalities are one of the main responsible for waste management in Turkey. They are responsible for implementing policies and regulations that encourage the proper disposal and recycling of waste, educating citizens about the negative consequences of improper waste disposal such as environmental pollution and resource depletion, and encouraging active participation in recycling initiatives. municipalities are responsible. and sustainable practices.

According to data by TURKSTAT in 2020, 1387 out of 1389 municipalities in Turkey provide waste services. Of the 32.3 million tons of waste collected in municipalities where waste services are provided, 69.4% was sent to regular landfill facilities, 17% to municipal dumps and 13.2% to recycling facilities, while 0.4% was sent to open burning and burial. was disposed of by pouring into streams or land. The average daily amount of waste collected per person in municipalities was calculated as 1.13 kg.

It's important to note that waste management practices and regulations can vary among municipalities in Turkey, and there may be ongoing efforts to improve waste management sustainability and efficiency at the national level.

The responsibilities of municipalities regarding waste management in Turkey can be summarized as follows.

• Collection and Transportation:

- Municipalities are typically responsible for the collection and transportation of municipal solid waste within their jurisdiction. This includes residential, commercial, and institutional waste.
- Establishment of Collection Systems:
  - Municipalities are expected to establish efficient waste collection systems, which may involve designing routes, scheduling collection activities, and providing bins or containers for residents and businesses.
- Recycling and Recovery:
  - Municipalities play a role in promoting recycling and recovery. They
    may establish recycling facilities or partner with private entities for the
    recovery of recyclable materials from the waste stream.
- Waste Disposal:
  - Municipalities are responsible for ensuring the proper disposal of nonrecyclable and non-recoverable waste. This may involve managing landfills or collaborating with other municipalities for regional waste disposal solutions.
- Public Awareness and Education:
  - Municipalities often have a responsibility to raise public awareness about proper waste disposal practices and the importance of recycling. Education campaigns and community outreach may be part of their initiatives.
- \*Monitoring and Reporting:
  - Municipalities may be required to monitor and report on their waste management activities. This includes data on waste generation, collection, recycling rates, and disposal methods.
- Compliance with Regulations:

- Municipalities must comply with national and local regulations related to waste management. This includes adhering to environmental standards, waste reduction targets, and other relevant laws.
- Collaboration with Other Authorities:
  - Collaboration between municipalities and other levels of government, as well as with private waste management companies, is essential for an effective waste management system.

In addition, the advancement of technological applications brings with it many developments in waste management. Technology has significantly improved waste management through waste-to-energy systems, modern and advanced recycling technologies, control and monitoring, all of which also impact the sustainable waste management system. For example, the GPS method enables the real-time monitoring of waste collection and transportation, enabling the management system to react quickly to status changes, leading to improved practices and environmental sustainability (Ion & Gheorghe, 2014).

Another technological method, which is called Information and Communication Technology (ICT), can also be applied as it has the task of offering convenient solutions for addressing municipal solid waste issues by providing access to information from any remote position (Akram, et al., 2021). Utilizing the ultrasonic sensor one of the best technological equipment which is used to manage the amount of waste material in containers.

Turkey has implemented smart city applications and initiatives in most of its cities, with Istanbul and Ankara emerging as the top adopting such technologies. These applications and initiatives primarily aim to mitigate the pollution pressure and adverse environmental effects of pollution. Key components encompass the creation of smart buildings that reduce carbon emissions, an emphasis on enhancing energy efficiency in large green spaces, and the implementation of intelligent transportation strategies. Additionally, smart environmental applications also incorporate renewable energy sources such as solar and wind power, prioritizing sustainability by reducing waste and efficient recycling practices, particularly within industrial symbiosis regions (Korkmaz & Ceylan, 2021). In general principle, smart cities effectively integrate technological advancement and environmental sustainability. A smart city prioritizes the primacy of sustainable utilization of limited resources through the optimization of processes and implementation of initiatives which promotes a positive environmental impact (Sureshkumar, 2021). A model of waste-to-energy, which is a component of a smart city, has been implemented all over the world. In Stockholm, Sweden, located the most extensive biofuel plant or production facility in the country is operated by utilizing residual materials from the sawmill industry. This smart city utilizes the collection of sawmill industry waste to create a valuable energy commodity called biofuel, which can power the city itself.

### **IV. Conclusion**

The significant expansion and growth of the human population, along with rapid urbanization and industrialization, has led to the generation of significant and huge waste. Understanding the factors influencing waste generation is crucial for accurate and effective planning of waste management programs before applying any management style.

Solid waste production directly correlates with economic activity, as an increase in a country's GDP or per capita consumption expenditure leads to an increase in waste production. Waste management has become complex and challenging due to changes in consumption patterns, limited resources, sector diversification, and producer insensitivity.

Waste management is a prominent issue in today's environmental landscape, requiring creative and sustainable methods to reduce the impact of growing waste volumes.

Throughout waste management practices, it is clear that a comprehensive approach is required, which includes trash minimization, effective collection, appropriate disposal, and strong recycling initiatives.

Efficient waste management plays a crucial role in upholding public health, safeguarding the environment, and promoting the development of sustainable communities. Municipalities in Turkey, as well as in numerous other nations, have substantial obligations to ensure the efficient and accountable management of waste. Municipalities in Turkey have a vital role in the collection and transportation of municipal solid waste. This includes a broad spectrum of waste sources, encompassing residential, commercial, and institutional garbage. Municipalities are responsible for devising effective garbage collection systems, organizing frequent pick-ups, and supplying suitable bins or containers to permit the appropriate disposal of waste by households and companies. They also create recycling facilities and implement programs to reclaim recyclable materials, to minimize the amount of garbage disposed in landfills and incinerators. Ensuring proper trash disposal is an essential obligation, requiring the use of ecologically conscious techniques for disposing of non-recyclable garbage. Municipalities play a crucial role in educating citizens about responsible waste practices and the environmental repercussions. Public awareness and education campaigns are essential in achieving this goal.

Despite these efforts, Turkish municipalities face obstacles such as scarce resources, insufficient infrastructure, and population expansion, which put pressure on waste management systems. Significant investments are necessary to modernize facilities, incorporate cutting-edge recycling technology, and react to evolving consumption patterns. Collaboration is identified as a vital remedy, involving the cooperation of municipalities, government entities, and private trash management firms. Collaboration at the regional level allows for the sharing of facilities and the implementation of standardized methods, which promotes a waste management system that is more cohesive and effective. Ultimately, Turkish municipalities have a

crucial role in the management of garbage, since they encounter obstacles that require innovative approaches, cooperation, and sustainable financial commitments in order to achieve a cleaner and healthier future.

The Turkish government also plays a crucial role in waste management practises, supervising and executing policies to tackle the environmental concerns linked to trash. Responsibilities encompass the oversight, implementation, and promotion of environmentally-friendly waste management techniques nationwide. The government formulates and implements policies regulating the collection, disposal, and recycling of garbage. Furthermore, the government actively encourages the establishment of modern waste management facilities and the implementation of cutting-edge recycling technology. Additionally, it promotes the creation of recycling facilities as a means to decrease dependence on landfills and incineration. The Turkish government also prioritizes public awareness and education, with the goal of fostering a culture of conscientious waste management among its residents. The organization conducts educational campaigns and community outreach initiatives to educate the public about appropriate waste disposal methods, the advantages of recycling, and the negative environmental consequences of inefficient waste management. The adoption of smart technologies has also emerged as a promising avenue in revolutionizing waste management. The government's approach emphasizes collaboration, which entails forming relationships with municipalities, other government institutions, and private waste management organizations. By engaging in collaborative endeavors, the sharing of resources, experience, and best practices leads to the advancement of a more cohesive and efficient waste management system.

However, as the world grapples with the complexities of waste management, the import and export of waste, particularly to countries like Turkey, have come under scrutiny. The surge in plastic waste imports, for instance, necessitates vigilant regulatory measures to ensure responsible waste management practices. The Turkish government's response through regulatory adjustments and international collaboration

demonstrates the commitment to striking a balance between economic considerations and environmental sustainability.

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Authors contributed equally to this work.

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Ethics Committee approval is not required for this article.

#### **Ethical Standards**

In all processes of the article, it was acted in accordance with the principles of research and publication ethics.