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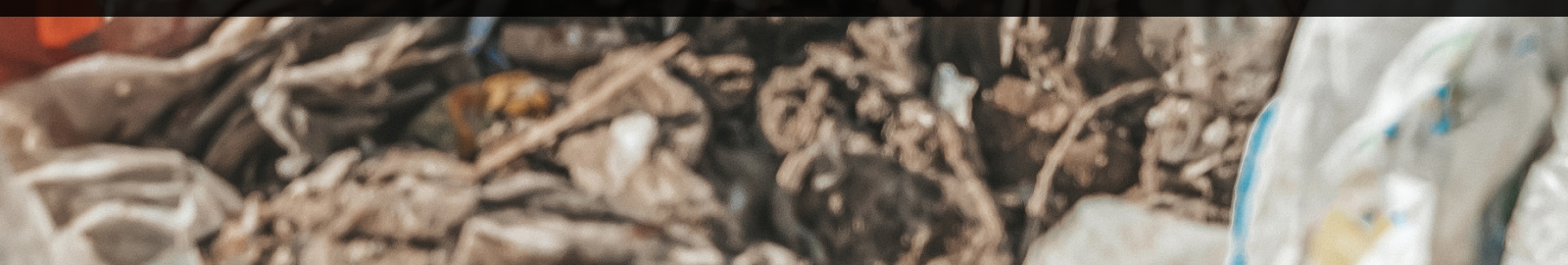
Urban Waste



CONTENT

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First of all, I would like to wish a belated happy new year to all IGLUS Quarterly readers. The year 2020 was a very tough year for all of us because of the pandemic, disasters and so on. We had to change our social lives to a new normal. However, I believe 2021 will bring us lots of new hopes and happiness, so that we can all leave the post-effects of 2020 behind.

In this first issue of the year, we will be discussing problems associated with urban waste with articles from experts from different parts of the world. We will try to understand what the previous mistakes were, what we must do to deal with the huge amount of wastes in cities, and what the current efforts of city governments are.

In the first article, Pedro Succar discusses the effects of recycling certificates on the increase of packaging recycling rates in the city of São Paulo. His article also touches on the government's waste policies and the current challenges confronted in Brazil. Seeing such a successful case of a city with 12 million people will absolutely inspire other cities around the world as well.

The second article focuses on solid waste management in Delhi. Lovelesh Sharma and Benjamin Mathews John give a deep discussion about the current practices of solid waste management in Delhi, where solid wastes are critical for the health of 20 million citizens. The article further illustrates the best examples from India and examines the applicability of a hybrid governance framework integrating centralized and decentralized governance mechanisms.

The third article is from Azerbaijan where petrochemical wastes are a very critical issue to be considered. In the article, Sevil Veysel and Prof. Amir Reza Vakhshouri first discuss the waste production and management in Azerbaijan cities. Then, they further analyze the impact of chemical and petrochemical wastes on the environmental pollution of the Absheron Peninsula. The case of Azerbaijan cities for reverting the previous mistakes with better policies in this article will be a good example for similar cases in other cities.

The fourth article is also from Delhi with a more specific case study. Different from the article of Lovelesh Sharma and Benjamin Mathews, Madhukar Varshney gives more focus on decentralized waste management systems with a case study of the Zero Waste Cooperative Group Housing Society (CGHS). The article shows the successes of Zero Waste CGHS in minimizing the amount of waste disposed of outside the CGHS boundaries. Madhukar Varshney's case study is critical to understanding citizen involvement in waste management.

In the last article, Fatih Hoşoğlu discusses the municipal waste management in İstanbul. Istanbul is the most populous city of Europe and Turkey. Therefore, the planning and the well-management of investments in such city are very critical. Through his article, Fatih Hoşoğlu focuses on these important points by also touching upon on the fates of the urban wastes. The article also shows us the importance of having a well-maintained legal framework for overcoming the challenges of urban waste management.

We sincerely hope that you can enjoy the articles on this urban waste issue in IGLUS Quarterly. We invite you to join the discussion at iglus.org. If you feel there are innovative practices underway in your city/region and you would like to contribute to an upcoming edition of IGLUS Quarterly, we encourage you to contact us at umut.tuncer@iglus.org

Editor of this issue: Numan Yanar

Case Study of the Influence of Recycling Certificates on the Increase In Recycling Rates in the City of São Paulo

Pedro Succar

Abstract: *Cities are places where population density problems are more challenging as more and more people live in ever-growing urban agglomerations, thereby increasing these challenges. Among these challenges, one of the most important is municipal solid waste management. As cities have grown so has the amount of waste generated. Municipal solid waste is expected to grow to 3.40 billion tons worldwide by 2050 under a business-as-usual scenario. The objective of this text is to understand if recycling certificates help increase the packaging recycling rates in urban areas. To this end, two assumptions were raised: 1) the increase in formalization of the recycling chain is a factor that increases recycling rates and 2) the increase in the income of waste pickers is a factor that increases recycling rates. To verify the assumptions and provide an answer to the question a case study was conducted in the megacity of São Paulo, the biggest city in Brazil, with more than 12 million inhabitants also the center of a metropolitan region, which has about 21.5 million inhabitants.*

Keywords: *São Paulo, Brazil, recycling certificate, packaging recycling, urban waste, waste management*

Author's Profile

Pedro Succar has a Bachelor's Degree in engineering from the Federal University of Rio de Janeiro (2007) and an Master of Business Administration (MBA) degree in real estate business management from Fundação Getúlio Vargas (2010) and a Master of Public Administration degree from École Polytechnique Fédérale de Lausanne (2020) through Innovative Governance of Large Urban Systems (IGLUS) program. Currently, he works as a consultant specialized in governance and organizational development projects.

Introduction

Cities are the engine of the world because of their capacity to concentrate people. They are leading hubs from which a great part of innovation emerges and also where cultural interaction and the richness are concentrated. They are also places where population density problems are more challenging as more and more people live in ever-growing urban agglomerations, thereby increasing these challenges. Cities, which represent 55% of the world's population, consume 75% of all primary energy produced and emit from 50 to 60% of the world's total greenhouse gases (UN-Habitat n.d.) and generated, in 2016, 2,01 billion tons of municipal solid waste. (World Bank 2018). Besides being the driving force of the world today, cities are also the place where the great challenges of humanity are concentrated in the fields of housing, infrastructure, transportation, energy, and employment, as well as in what concerns basic services such as education and health care. Among these challenges, one of the most important is municipal solid waste management. Cities have grown and so has the amount of waste generated. Municipal solid waste is expected to grow to 3.40 billion tons by 2050 under a business-as-usual scenario. The total quantity of waste generated in low-income countries is expected to increase by more than three times by 2050 (World Bank, 2018) and the management of it is becoming an urgent challenge.

The management of municipal solid waste is done locally, following national plans (often with internation-

ally committed goals). Ensuring the implementation of national solid waste policies in cities has several challenges, such as enabling financing schemes and inspections with governance between municipalities being the most post prevalent.

In 2010, Brazil approved the National Solid Waste Policy (NSWP), Law No. 12,305. It contains important instruments to allow much-needed progress in addressing the main environmental, social, and economic problems arising from the inadequate handling of solid waste. It envisions the avoidance and reduction of waste generation, with the proposal of practicing sustainable consumption habits and of implementing a set of instruments to increase the recycling and reuse of solid waste. It institutes the Extended Producer Responsibility (EPR) of waste generators: manufacturers, importers, distributors, traders, citizens, and holders of urban solid waste management services in the reverse logistics of waste and post-consumer packaging ("Brazilian Law 12,305", 2010). An innovation of NSWP, was the insertion of waste pickers in the reverse logistics process, differently from what happens in developed countries, which do not have this category of workers (Ferri, Diniz Chaves, and Ribeiro 2015; Guarnieri and Streit 2015)

Following the NSWP, in 2015, the Packaging Sectoral Agreement (SA) with the participation of packaging production companies and packaged product companies and the federal government, defined goals to ensure a reduction of packaging disposed of in landfills (MMA, 2012; "Sectoral Agreement - Packaging Sector", 2015).

The Extensive Producer Responsibility (EPR) instrument defined in the NSWP opened the way for the emergence of the Packing Recovery Organization whose aim is to ensure the recovery and recycling of packaging waste in the most economically efficient and ecologically sound manner(Costa, Costa, and Freitas 2017).

This scenario arises the Reverse Logistics Credits instrument. However, how do Reverse Logistic Credits work? A recycling certificate for a type of material is generated from the tracking of purchase and sales invoices for such material. Until it is recycled, the material passes through several actors, who participate in the recycling chain, for example, waste pickers, waste pickers' cooperatives, waste operators, intermediaries, and recyclers (Figure 1). A certificate is only generated when the material closes the loop and is sold to a recycling plant, which will transform the material into a recycled resin. Through the traceability of invoices of purchases and sales of material by the various actors in the recycling chain, the certifier company generates a certificate for the first link in the chain. Each certificate contains the quantity and type of material. Thus, only materials that generate invoices are certified. The informal recycling market is unable to participate in the certificate market, as it does not issue invoices. Periodically, the certifier makes bids to sell the certificates. The cooperatives and operators that hold the certificates and producers who need them participate in a bid as a way to prove that they have done reverse logistics and to comply with the legal goals or assumed sustainability commitments.

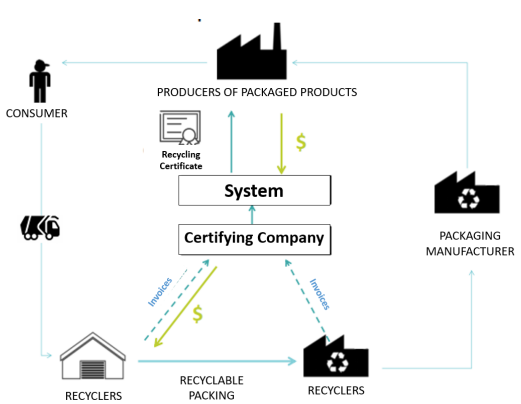

Figure 1. An example of how reverse logistic credits work

So, to understand if recycling certificates help increase the packaging recycling rates in urban areas, we raised two assumptions: 1) the increase in formalization of

the recycling chain and 2) the increase in the income of waste pickers are factors that increase recycling rates. A case study focused on the city of São Paulo was undertaken, based on the analysis of the available database and interviews with municipal solid waste experts, to validate the assumption and to verify if and how recycling certificates connect with formalization and income of waste picker.

Legal framework

In 2010, Brazil approved the National Solid Waste Policy (NSWP). Following it, in 2015 the Packaging Sectoral Agreement (SA) 2015 was signed and one of the most important items of the Sectoral Agreement is the definition of the goals: (i) creation of a structural system consistent with the improvement actions and improvements of structure and equipment, so that (ii) the joint actions of the Companies and other agents of the shared responsibility chain can provide a reduction target of packaging disposed of in landfills as shown in Table 1 below.

Reduction of recyclable dry waste disposed of in a landfill, based on national characterization in 2013					
Years	2015	2019	2023	2027	2031
Goal of Brazil	22%	28%	34%	40%	45%

Table 1. Goal Plan for reduction of the packaging disposed of in landfills Source: (MMA p. 3, 2012)

At the state level, in 2015, the São Paulo State Secretariat for the Environment (SMA) passed resolution SMA 45/2015 (SP-SMA 2015). This resolution defined that manufacturers, importers, distributors, and retailers of packaging are obliged to structure and implement reverse logistics systems, by returning products and packaging after use by the consumer, independently of the public service of urban cleaning and waste management. In other words, local governments are not responsible for the final disposal of this waste. Also, the Environmental Company of the State of São Paulo (CETESB), is responsible for issuing the operating license (license issued by the environmental agencies necessary for the operation of companies). To ensure compliance with federal law No. 12,305, State Law No. 12,300, and State Decree No. 54,645, CETESB requires compliance with SMA Resolution 45/2015 as a condition for the issuance or renewal of the operating license. In the specific case of this study, for example, manufacturers, importers, distributors, and packaging traders to obtain or renew the necessary license to operate, they need to structure, implement, guarantee and prove the reverse logistics of a minimum quantity of their products, defined as a goal in the Sectoral Agreement (CETESB 2018). Also, in 2018 SMA and CETESB by the government side and Federation of Industries of the State of São Paulo (FIESP), Center of Industries of the State of São Paulo (CIESP) and Brazilian Association of Public Cleaning and Special Waste Companies (ABRELPE) by the private sector side signed the General Packaging Reverse Logistics Commitment Term (TCLR) to commit with the improvement of packaging management after use by the consumer (State of São Paulo 2018).

Thus, the state of São Paulo complies with the resolutions imposed by federal law and federal decrees, as well as creating mechanisms that guarantee its implementation.

At the municipal level, the city of São Paulo prepared the "Integrated Solid Waste Management Plan for the City of São Paulo" (PGIRS - SP) and released it in 2014.

The general objectives of PGIRS do not differ from those outlined by the National Solid Waste Policy. Additionally, specific objectives have been defined, so that they progressively achieve the general objectives defined in the NSWP. For this purpose, goals were stipulated to be achieved by the public authorities and private generators.

The PGIRS also defines the implementation of a municipal environmental education plan, with a strong emphasis on waste.

To achieve the plan's guidelines and objectives, it is also extremely important to guarantee its economic and financial sustainability. It is a significant part of the

objectives of the PGIRS to provide the instruments for implementing a whole new management culture, both about the new structures that must be implemented at the Municipal Urban Cleaning Authority (Amlurb), as well as the necessary mechanisms for translating the PGIRS to the peculiarities of the 32 Subprefectures of the municipality of São Paulo (São Paulo City Hall 2014, 2019).

Analysis of the recycling chain database in general

The uncertainties of recycling data in Brazil, cited by the interviewed experts, are easily proven when trying to analyze official data. Despite having improved a lot in the last 10 years, the information is still incomplete, and gaps still exist. Analyzing only the city of São Paulo, it is observed that the data of recovered material from 2013 (2,1%) and 2016 (2%) were extremely low when compared to other years (average 48%), suggesting that there is an error in obtaining and/or disclosing these data (SINIR 2020).

Recycling certificates bring transparency and traceability to the material recycling process, especially when referring to data on the quantity and type of material recovered. However, the issue of certificates today is incipient and of as of yet little relevance. In 2019 certificates was equivalent to merely 0,5% of total MSW in the city of SP (SINIR 2020; "Sectoral Agreement - Packaging Sector" 2015; FIESP 2020).

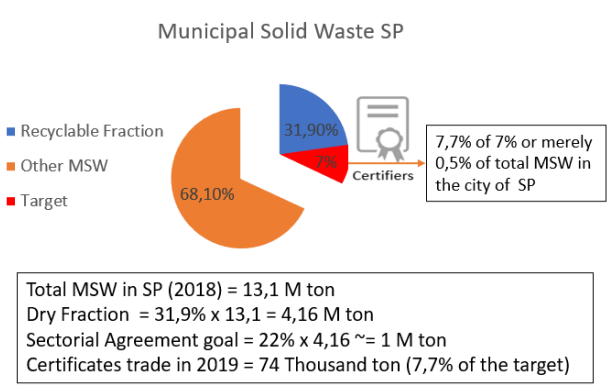

Figure 2. Amount of certificates issued in 2019 in São Paulo

Increasing formalization would increase recycling rates

The main obstacles to formalizing business in general in Brazil are bureaucracy and the tax burden. To open a company or issue a license in Brazil, it is necessary to go through public offices at the municipal, state, and federal levels, present a multitude of documents several times, register a series of documents with a notary public, and very rarely is it possible to do it online. This takes time, financial resources, and travel. Tax and tax legislation in Brazil are overly complex. There are municipal, state, and federal taxes, with different and complex rates to be understood and met. The rates may vary from place to place, a part is paid in the municipality/state that produces it, a part is paid in the municipality/state that receives the product or service. Also, there is double taxation. These are the two main reasons that small business owners avoid formalization.

During this study was mentioned by several interviewees that the recycling chain has a formal and informal part. The formal part is dominated by large companies, while the informal part is dominated by small companies and self-employed professionals, who for the reasons explained above do not want or are unable to formalize themselves.

The certificates are only sold in the formal part of the chain. Therefore, collectors' cooperatives and operators that work in informality do not benefit from the extra income from the certificate trade. The opportunity to have that extra income can be an incentive to formalize.

Comparing the values of the certificates sold in the State of São Paulo with the values of the recycled materials sold in the city of São Paulo, it can be observed that the glass certificate has the highest proportional value. The average price of glass certificates in 2019 was 85.21 BRL$ per ton. The sale price of recycled glass according to Business Commitment to Recycling Organization (CEMPRE) is 180 BRL$ per ton (CEMPRE 2020). In other words, glass certificates increase the

revenue from the sale of this material by almost 50%. This is a good incentive for cooperatives and informal operators to formalize.

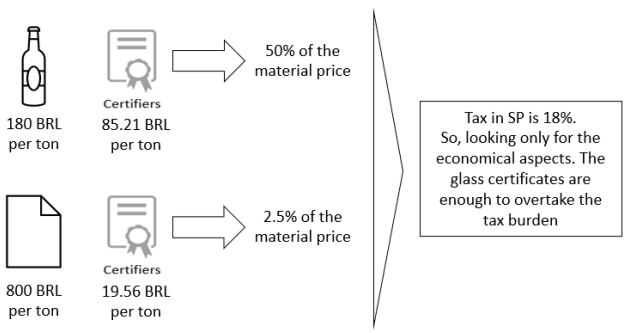

Figure 3. Comparison between glass and paper certificates

The gains from certificates must outweigh losses from tax burdens and bureaucracy so that certificates can be an engine of formalization. An interviewee who works primarily by recycling paper and said that he does not have so many advantages in the sale of certificates since the paper certificate is equivalent to only 2.5% of the value of the material. In this case, certificates alone do not encourage formalization, as the cost of formalizing exceeds the gain from the sale of certificates. For materials in which the financial gain from the sale of certificates alone does not exceed the tax or administrative and bureaucracy costs, the certificates will be just another inducer for formalization. Other inducers for formalization also need to be considered are the easing of receiving finance, easing of receiving support from the government, companies, and Non-Governmental Organizations (NGOs), and gains in scale which may all induce formalization, as would an increase in inspections that would entail higher risks for informal work.

Increasing the income of waste pickers would increase the recycling rate

A packaging producer company is required, by the EPR principle, to guarantee the reverse logistics of part of what was produced. This means that companies now have an extra cost to comply with legal obligations and they can fulfill this obligation in several ways. For this, producers usually create reverse logistics routes for their products, encourage outsourcing cooperatives of waste pickers, so that they can recycle to them and install points of voluntary delivery, etc. Another alternative is recycling certificates (Figure 1).

The purchase of certificates is the simplest investment that producers can make to meet the legal commitment. It is also a direct investment. So, the cost created by EPR becomes the revenue for the base of the recycling chain through the sale of certificates. Usually, the base of the chain is the operators and the cooperatives of collectors. The increase in the income of the cooperatives generates an increase in the earnings of its members. In this way, waste pickers increase their income.

Conclusion

São Paulo is the biggest, richest, and the most industrialized city in Brazil, it is also one of the most advanced city in the country regarding to Municipal Solid Waste. The waste collection serves 99,1% of the city's population and provide recycling collections in 80% of the city's area. It is the only city that has 2 mechanized plant for sorting recycling waste. São Paulo city is the capital of São Paulo state, that deployed an important policy, in which, the condition for the issuance or renewal of the operating licenses, a company must comply the reverse logistics targets. Another important fact that strengthens recycling certificates in the state is that the Federation of Industries of the State of São Paulo (FIESP), chose a certifier company for operate the certificates as an improvement committed in the General Packaging Reverse Logistics Commitment Term (TCLR).

Regarding the formalization, it can be concluded that recycling certificates are inducers to formalization only when the price of certificates for a given material is high compared to the price of selling the material itself. This occurs with the combination of two factors: i) when a given material has low recycling rates, generating few certificates, under the law of supply and demand, these

certificates end up rising in price and ii) when the selling price of the material itself is not high.

A certificate will only induce the formalization if the gain from the sale exceeds the tax, administrative and bureaucratic costs of issuing invoices, opening a company, and issuing a license. In São Paulo, for example, glass certificate credits generate significant gains that tend to induce the formalization of the chain for this material.

Currently, in Brazil, the goals of reverse logistics are divided into four types of material: metal, paper, glass, and plastic. That is, for a given company that produces Polystyrene (PS), High-Density Polyethylene (HDPE), or Expanded Polystyrene (EPS) plastics, which are more complex recycling plastics and have a lower market value, it can fulfill its legal recycling goal by recycling any type of plastic. This means that many companies end up meeting the goal with Polyethylene Terephthalate (PET), Polypropylene (PP), or Low-Density Polyethylene (LDPE) recycling, which has a higher market value and is easier to be recycled[1].

An indirect gain from increased formalization may be the gain in the reliability of recycling data. Refining the data will allow public policies and investments to be made more efficiently. Another important gain, which can function as a virtuous cycle, is the increase in tax revenue through increased formalization. Governments will be able to reinvest the resources collected from the recycling chain back into the chain itself.

Through the purchase of certificates, the producing company transfers financial resources to those who are carrying out the recycling work. So, regarding the increase in the remuneration of the waste collectors, it can be concluded that the certificates generate an increase in revenue for the base of the chain, that is, cooperatives of collectors and operators. An increase in the income of a cooperative implies more investments to increase capacity and increase the income of its members. As stated by the interviewees, this increase induces an increase in recycling rates.

Certificate prices follow the law of supply and demand. Thus, less recycled materials generate fewer certificates and consequently, they tend to be negotiated with higher prices. In this way, certificates induce more strongly to increase recycling rates for materials with a lower recycling rate and lower sales prices than those with a higher rate and higher market value. This regulatory attribute can be an important function of certificates for increasing recycling rates for low-recyclable materials.

The recycling certificate is just one of the possible solutions to the complex problem that is the management of municipal solid waste. There are several advantages and challenges for the growth of the reverse logistic credits market, which has the potential to boost the increase in recycling rates. I hope this study can serve as a basis for further studies and that we can move towards a more sustainable form of consumption and disposal.

[1] Styrofoam (EPS) is a material that has very low recycling rates, one of the reasons for this low recycling rate is because of the weight x volume ratio. Styrofoam is extremely light and bulky, this impacts a lot on the costs of transporting this material to a recycler. Currently, in Brazilian legislation, there is no differentiation between the different plastics in the reverse logistics goal. So, the recycling of Styrofoam ends up not happening. Styrofoam producers recycle the Styrofoam mass-produced in any plastic, in general PET, PP, or LDPE, which has a more developed recycling market. In this way, the legislation not only does not punish for the use of complex recycling materials, as in the case of Styrofoam, but it also encourages its use, since a Styrofoam packaging will be lighter than that of another type of plastic giving companies lower costs related to negative externalities.

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Need for Paradigm Shifts in Governance of Municipal Solid Waste Management (MSWM) in Delhi

Lovlesh Sharma* and Benjamin Mathews John**

Abstract: *Delhi today is a large metropolitan city housing close to 20 million people. The city is struggling to manage its MSW sustainably. This paper studies the current practises of solid waste management in Delhi and the possible shifts in governance mechanisms that could be adopted in order to efficiently manage solid waste in the city. The study uses the solid waste management process of Collection-Processing-Disposal as a framework to analyse the existing governance mechanisms in place. The lack of a decentralised system of managing MSW in Delhi and its related governance has led to various conflicts at the local level. Also best practises in MSW from cities such as Pune and Bengaluru point to the fact that MSW is best managed at the local level. Further considering Delhi's complex governance systems, the paper examines the need and applicability to adopt a hybrid governance framework which integrates centralised and decentralised governance mechanisms in order to effectively address and manage MSW in Delhi.*

Keywords: *decentralisation, centralisation, solid waste, management, challenges, prospects*

Authors' Profile

Lovlesh Sharma is the Sector Lead for Infrastructure for the Master Plan for Delhi-2041 project at the National Institute of Urban Affairs (NIUA), India. Lovlesh has 10+ years of experience as an Urban Infrastructure Planner, Architect and Academician in India and UAE. His areas of expertise include City master planning, infrastructure services including urban water supply, sanitation and waste management.

Benjamin Mathews John is a Project Associate for the Master Plan for Delhi-2041 project at the National Institute of Urban Affairs (NIUA), India. Benjamin has 8+ years of experience as an Architect, Urban & Regional Planner and Urban Designer with work spanning across Asia, Europe & Africa. His areas of expertise include City Planning and Design focused on the meaningful integration of people's needs with Ecological, Mobility, Physical Infrastructure and Cultural networks.

Introduction

Management of Municipal Solid Waste (MSW) in Indian cities is a big challenge today. Delhi, India's capital is no exception, the city produces the largest amount of MSW in the country (Economic Survey of Delhi 2018-19). As per the Census of India 2011, Delhi had a population of 16,787,941and is projected to house close to 20 million people today. The very scale of the metropolis adds to the complexity of managing MSW. The city generates 10,500 MT of solid waste daily with a collection efficiency of roughly 70-80% out which about 55% reaches the landfill (High Court of Delhi 2017). Currently, mixed waste is collected and transported to the dump-sites, compost plants and waste to energy (WtE) plants. Effective system of waste segregation is required at appropriate stages i.e. source of waste generation, collection, transportation, processing and disposal. Delhi has 3 large land-fill sites at Balaswa, Ghazipur and Okhla, all three have been long due for closure. What further adds to the complexity of managing MSW in Delhi, is the presence of Unauthorised Colonies (UACs) and Jhuggi Jhopdi Clusters

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(JJCs) which are areas developed without accordance to town planning norms. There are close to 1634 UACs and 675 JJCs or slums in Delhi (High Court of Delhi 2017) and managing collection/ transportation of waste in these areas is a huge challenge. In these areas there are no bins and limited access to dhalaos (waste collection centers at the local level). The Old City of Delhi which is characterised by narrow streets and limited space for collection facilities faces similar issues as UACs and JJCs. The more formal housing typologies like plotted and group housing have access to improved waste management practises. These areas also being from higher income groups, are in a position to pay the user fees and also engage in setting up decentralised treatment systems at the local level.

Union Ministry of Environment, Forests and Climate Change released the MSW Rules in 2016. The MSW Rules 2016 focusses on a decentralised system of waste management. The MSW Rule 2016 mandates source segregation of waste in order to channelize the waste to wealth by recovery, reuse and recycle. Waste generators require to segregate MSW into three streams namely Biodegradables, Dry (Plastic, Paper, metal, Wood, etc.) and Domestic Hazardous waste (diapers, napkins, mosquito repellents, cleaning agents etc.) before handing it over to the collector. MSW 2016 also proposes waste to energy plants. Delhi adopted the MSW Rule 2016 rules through the Solid Waste Management Bye-Laws 2018 which focussed on putting the onus on the individual to segregate and treat solid waste at source.

The objective of writing this paper is to study the current practises of solid waste management in Delhi and the possible shifts in governance mechanisms that could be adopted in order to efficiently manage solid waste in the city. The study uses the solid waste management process of Collection-Processing-Disposal as a framework to analyse the existing governance mechanisms in place. The study is restricted to only municipal solid waste i.e waste generated at house hold level.

Understanding Delhi's Governance Complexities

Governance has been defined to refer to structures and processes that are designed to ensure accountability, transparency, responsiveness, rule of law, stability, equity and inclusiveness, empowerment, and broad-based participation (International Bureau of Education, UNESCO).

Delhi being a Union Territory and the capital of India, it has a very unique governance structure. The urban development delivery structure of Delhi is characterised by 3 key players- the central government, the state government and the local governments. There are a number of overlaps between all there 3 forms of government in Delhi. The central government very strategically governs land and is responsible for law and order. While the state government has portfolios such as Power, Education, Health etc.

Delhi has four urban local bodies North, South, East Delhi Municipal Corporation and the New Delhi Municipal Committee (NDMC). The Muncipal Corporation of Delhi (MCD) has an elected mayor, while the NDMC has a government-appointed bureaucrat as its Chairman. At the local level, the MCDs deal with operations and maintenance of subjects such as Transport (street lighting and road repairs), Environment (parks), Utilities (drainage, sewage and solid waste), Education (Primary Education), Emergency (Disaster Management) and Health (Primary Health Care Centres, Disease and Vector Control).

To conclude, at any point of time Delhi can have 3 different political parties ruling at all 3 levels of government namely Central, State and ULB levels.

Governance Structure of Solid Waste Management in Delhi

During the early 90s as part of the economic liberalisation policy of the government of India, the government also brought in the 73rd and 74th Constitutional Amendment with the aim of devolutions of powers to the local bodies. The 73rd constitutional

amendment was for rural areas while the 74th constitutional amendment was for urban areas. Both the amendments proposed devolution of powers to the Gram Panchayaths and Urban Local Bodies (ULBs) respectively. As per mandates of the 74th constitutional amendment, a Metropolitan Planning Committee (MPC) shall be formed that would be responsible for development planning at the metropolitan scale while formation of ward committees at the ward level would prepare a local area plan. Solid Waste Management in India is a function of the ULB. According to the 12th Schedule of the 74th Constitution Amendment Act of 1992, Urban Local Bodies (ULBs) are responsible for keeping cities and towns clean.

In 1998, the Union Minister for Urban Development brought in a notification, which exempted Delhi from the 74th Amendment thus power to plan and develop still remains with the Union Ministry of Home Affairs and not with the local municipality or the elected state government. The participatory process brought in by the 74th amendment of the constitution known as the Nagara Palika Bill was subverted in Delhi (Ravindran 2013). Rendering the formation of MPC and ward committees null and void.

Devolution represents the most extensive form of administrative decentralisation; whereby the complete responsibility and decision-making authority for specified functions is relocated from the central government towards autonomous subnational bodies (Mulvaney, 2010). In India, many successful cases of solid waste management at the local level are attributed to the successful functioning of ward committees which are spearheaded by the ward councillor who is an elected representative.

Three forms of decentralisation exist namely planning, political, fiscal. The planning for solid waste management is still a very top down framework as the Delhi Development Authority (DDA) plans for it through its master plan and allocates land for MSW facilities. Local bodies at times also face issues with getting land for waste segregation at the local level. Also the bye-laws for solid waste are prepared by the central government and the adopted by the urban local bodies (MCDs). The financial segment is also top down where funds for development of solid waste management infrastructure mainly comes from the urban development fund operated by DDA and the Ministry of Housing and Urban Development.

In Delhi even though ward councillors exist for each of the 272 wards, they have very limited planning or fiscal powers. An alternative to the ward level planning committees are the Resident Welfare Associations (RWAs) and Market Trader Associations (MTAs) which exist in all areas of Delhi. RWAs are neighbourhood level area management organisations which are non-statutory in nature. Similarly, MTAs are market level management organisations. In the last decade there has been a rise in RWAs and federations of RWAs who have been able to mobilise funds, rally with the government and bring about changes at the local level. In recent times there has been a clarinet call to give RWAs legal powers to govern their local areas and prepare local area plans. Due to this lack of decentralisation of the solid waste management governance in Delhi, a number of conflicts arise which will be discussed in the following section.

Emergent Conflicts due to a Top Down Governance of SWM in Delhi

Like any top-down system, solid waste management in Delhi is characterised by privatisation of functions such as collection, transport and processing. The lack of a decentralised system of MSW governance has led to various conflicts at the local level which are discussed in detail below.

Collection

MCD makes formal contracts with private agencies to collect MSW at household level. Measurement and payment of collected and transported waste is based tonnage or weight. The terms of these contracts distort integrated waste management with the logic of "more waste, more money" because companies are compen-

sated for the amount (in tonnage) of waste they transport to landfills (regardless of whether or not it is recycled) (Schindler, Demaria and Pandit 2012). This gives no incentives to the private agencies to collect segregated waste at source. In fact, there have been complaints by citizens wherein on giving segregated waste to the private waste collectors, it is mixed back again at the Dhalao. By granting private companies the right to operate transfer stations, these contracts reduced the waste workers' access to waste as well as recycling rates (Gidwani and Reddy 2011)

About 60% of Delhi's population lives in informal settlements (UACs and JJCs) which constitute about 20% of the land share. Collection of solid waste from this 20% land share is a huge challenge for the MCDs; refer Figure 1 for details of existing system of solid waste management in Delhi. The private waste collecting companies collect a fees which in most cases is higher than the prescribed fees which makes it difficult for people living in UACs and JJCs to pay for formal waste collection. Thus they are excluded from formal collection system and mostly dump their waste in open grounds and burn them. There is an urgent need in Delhi's context to rationalise the collection fees based on areas characteristics and income levels.

Processing

To further process this waste and reduce waste from going to the landfill, various waste to energy plants has been set up in Delhi. These plants require waste at a very high calorific value. Thereby reducing the involvement of the informal sector to help in segregation and processing of waste. The focus on a centralised approach poses a major threat to the livelihoods of the waste workers because they must increasingly compete with private firms for ownership and control over recyclables at multiple stages (Schindler, Demaria and Pandit 2012).

Disposal

Further this waste is taken to the land fill sites of Delhi. With the growth of landfill sites in Delhi beyond its capacity, it has led to ground water contamination in various areas of East Delhi. This in turn has created health hazards for citizens living in areas surrounding the landfill.

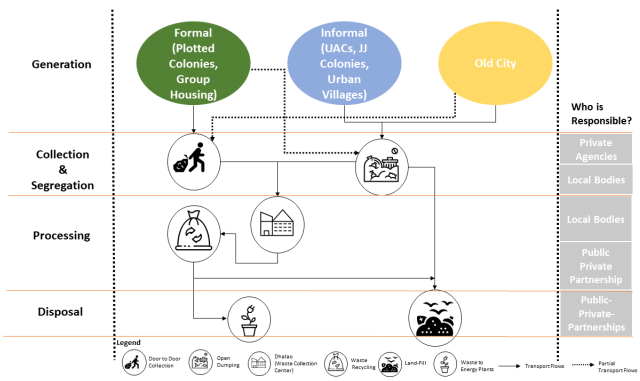

Figure 1. System of waste collection in Delhi (Source: Authors)

Case Studies

Pune, Maharashtra, India

Pune is the 8th largest city in India and the 2nd largest in the state of Maharashtra with a population of about 4 million, there are nearly 2.4 million households. There two municipal corporations in the city of Pune namely Pune Municipal Corporation (PMC) and Pimpri Chinchwad Municipal Corporation (PCMC) with an overall area of 244 sq. kms. 4 Zones: 15 Administrative, Ward Offices. Pune city is one of the fastest growing cities of India and experiencing an inorganic growth, it is considered to be the second largest IT hub of the nation. Pune generates 3000 tons of solid waste per day and 65% of households have door to door coverage. The ward wise average 500 gms per capita per day.

Pune is a peculiar example of organised involvement of the informal waste management sector. Pune municipal bodies has adopted the Public Private Partnership(PPP). Pune municipalities has joined hand with waste picker and forming SWaCH Cooperative. SWaCH Cooperative is a one of a kind cooperative in India which is fully owned by waste pickers. Kagad

Kach Patra Kashtakari Panchayat (KKPKP) formed the organization with support from Pune Municipal bodies and the waste picker trade union. At first municipalities signed a five-year Memorandum of Understanding in order for SWaCH members to work towards decentralization of door to door collection services for households, shops, offices and small commercial establishments. The Integration with informal sector has not only improved the condition of Pune but also the living standard of more than 3500 waste pickers who cover about 1.2 Million Households. Moreover, Pune municipalities pays for management and equipment cost and health insurance to workers of SWaCH. As a result, Pune has successfully implemented the waste management projects like – Zero Garbage Ward projects. On the other hand the initiatives like IEC (Information, Education and Communication), distribution of dry and wet waste bins to households and incentives & tax rebate for practicing eco-friendly methods. The bell ringing vehicles for separate collection of waste has become very famous in the communities and citizen received a good connect with the whole MSW management system. Pune has set an example of bottom up approach very successfully. The formal engagement of waste pickers is a win-win situation for all three – the ULB, citizen and waste pickers.

Bangalore, Karnataka, India

Bengaluru is known as a Garden City, Silicon City, Science City, and is the third most populous city in India. Spread across 1300sqkm of area, Bangalore has population of about 10.18 million. Bruhat Bengaluru Mahanagara Palike (BBMP) which is the City Corporation manages the solid waste of Bangalore. The city generates close to 5000 metric tons of waste per day, at an average generation rate of 0.5 kg per capita per day (kg/capita/d). The city has been facing major environmental and health issues due to unsustainable practises being adopted for waste management. This has led to high operating costs due to lack of proper infrastructural facilities. Also the establishment of new dumping areas outside the city has led to waste dumping in open areas posing severe problems to the structures constructed on these old dumps. In the meantime, groundwater quality has deteriorated due to improper leachate management etc.

In this context, Bangalore adopted a progressive has two tier waste management system. The City Corporation collects Solid waste in two phases. The first phase is a primary collection, in which the solid waste is collected on auto tipper and pushcarts. Auto tippers are provided for every 1000 households and a pushcart for every 200 homes. About 20,000 Pourakarmikas[1] are engaged (both Corporation and contractors) in the door to door collection, street sweeping, and transportation of MSW. The collected solid waste from houses are brought together at a common point, i.e., Dry Waste Collection Centers or Integrated Waste Management Units which are secondary locations from where the waste is transferred to landfill sites/treatment through tipper lorries and compactors. The City Corporation has a parallel scheme, "Swaccha Bengaluru", which levies mandatory collection fees for all households, businesses and educational institutions to increase its financial resources. The user fee directly puts the responsibility on the City Corporation to provide proper waste collection services. Thereby integrating citizens into the overall waste management strategy and helping to reduce the amount of waste going outside the locality. The levying of waste collection and disposal fees should is based on waste generation rates and according to the economic standard of the area, whilst considering the nature of the waste wherever necessary.

Also initiatives at the ward level such as Zero Waste Wards and Zero Plastic Wards are driven by the Ward Councillors garnering great success. This also creates competition among wards to achieve set targets.

[1] Pourakarmikas are civic workers employed in waste management of Bangalore

Therefore, this decentralised system of waste management adopted by Bangalore followed by strong tax collection system, including incentives and penalties has worked really well. There have also been improvements in the ranking of Bangalore under National Swatchta Sarvekshan listing in recent years. The MSW composition generated in Bengaluru has over time changed considerably during the last decade. Surprisingly the biodegradable waste increased by 1.5times in last five years indicating increased organic waste generation in the city. improper solid waste management, or accumulation of green waste.

New Possible Shifts in Governance of MSW in Delhi

The beneficence of a decentralised SWM system stems from the empowerment of local communities; incurring in the establishment of context-specific developmental programs based on the necessities and conditions of local populations (Massoud et all 2019). We need to acknowledge there is a huge informal sector working around scavenging and processing waste in Delhi. Some of the archaic practises we are still following today is in order to keep this informal sector afloat coupled with corruption. Unless plans and studies acknowledge this, we will not be able to come up with sustainable solutions to meaningfully integrate them into an efficient and equitable waste system. Reskilling of these informal workers along with reform in MSW recycling and disposal processes is the need of the hour. This will also require a deeper understanding and documentation of existing practises around waste management in Delhi.

Delhi being a mix of authorised and un-authorised settlements, the municipal bodies faces very distinct and context specific challenges. The issues faced by the municipal bodies managing their waste separately needs to be addressed through a mix of centralised and decentralised approaches.

At the decentralised level or ward level, MSW must be segregated and transported to integrated waste processing units. Existing Dhalaos must be augmented to function as integrated waste processing units. At the ward level, waste processing executive committees must be formed which will include Ward Councillors, MCD engineers, RWAs/ MTAs, Informal Workers or Safai Nigrani Samitiies and private agencies. These executive committees will be responsible for waste not leaving the wards and being processed within the ward- thereby bringing in the concept of Zero Waste Wards. They will be given fiscal powers to do so. The ensured segregation can only be achieved by door to door collection system ideally. Therefore, the market for processed waste will need to be evolved. The regional transaction of waste by-products like compost, methane gas and other recycled C&D products can only be enhanced with robust market strategies.

At the centralised level or sub-city level, a common body or board must be formed under the chairmanship of Chief Minister with necessary support from the State Government. The proposed body shall include the representative from all of the ULBs, Delhi pollution control committee (DPCC) and select representatives from Waste Processing Executive Committees. The board will be headed by the respective Commissioners. This common body's structure and functioning can be similar to other existing boards like Delhi Jal Board (DJB)– the body responsible for water supply and sanitation for Delhi. The board will play a regulatory role and shall focus on safe disposal of MSW that are unable to be processed within the ward.

The two tier proposal for Delhi's solid waste management is characterised by Waste Processing Executive Committees functioning at the local level responsible for collection and processing. At the Central level, the Waste Management Board shall play the role of a regulatory board at the sub-city level or individual MCD level and majorly responsible for safe disposal; Refer Figure 2. Facilitating these shifts will need amendments into existing legal frameworks to accommodate and empower localised governance.

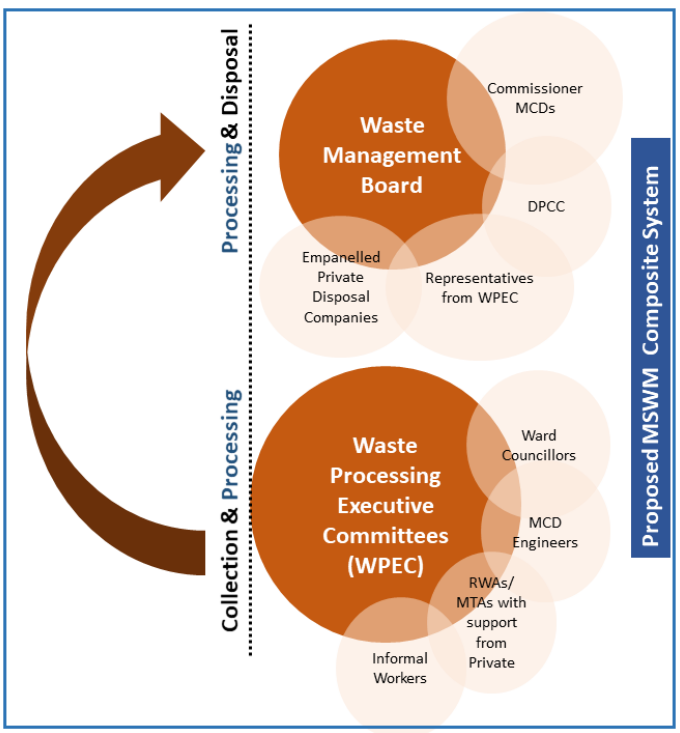

Figure 2. Proposed MSW Governance Mechanism (Source: Authors)

One of the fundamental shifts Delhi must make is the revision in payment and charges paid to the waste pickers, transporters in Delhi. The tonnage based system has failed the system completely. In the realm of high charges, it has been reported that transporters mix the segregated waste received from the localities. Payment method linked to a system of category wise segregated waste transported can be devised in this concerns.

Collection methods are in a dire need to be modernised with waste pickers being treated with respect and dignity. Basic collection gear like gloves, masks need to be provided. Waste collectors also need to be provided with health insurances and given monetary benefits on improved performances. Collection and transport vehicles also can be modernised by enabling them with GPS tracking devices and re-designing them so that they can be navigated through even the narrowest of lanes.

Lastly, nudging civic behaviour and bringing about citizen behaviour will bring about a paradigm shift in the way we think about MSW as a society. Aggressive campaigns by Ward Councillors and MLAs in association with local communities, RWAs/ MTAs, NGOs, students and other stakeholders needs to be planned to push for segregation of solid waste at the local level and communities taking responsibility for their own waste. The rules need to focus on making solid waste management a people's movement by taking the issues, concerns and management of solid waste to citizens at the grass-roots.

Conclusion

Delhi must adopt a vision which targets minimisation of waste going to landfills and the waste getting segregated and treated closest to the source. The reduction of very high per capita waste shall be done through various policies and projects. More over the overall efficiency of Delhi's MSW Management can only be materialized, if service delivery sector comes forward and enables the public sector stakeholders to devise appropriate frameworks that result in a win-win for both sides. An intelligent waste collection and transportation system with adoption of green processing methods will reduce the pressure on the landfill site which otherwise cause very high GHG emission and water pollution due to seeping leachate. Revised payment methods as suggested shall improve the overall segregation efficiency and only inert waste dumped at the landfill site.

The circularity of waste economy will also make a big difference. The MSW management board and GNCTD's together can acquire a regional approach to sell the waste by-products within the National Capital Region. The compulsory usage of C&D waste recycled products in all the new and re-generation projects is a must and shall be mandated by the State Government.

Finally, the bottom up approach by including informal waste picker- Safai Nigrani Samities with urban local bodies through formulation of waste processing executive committees at the ward level will change the whole governance system of Delhi. This would definitely take Delhi one step closer towards becoming a waste responsive and liveable city.

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Management of Chemical Wastes in Azerbaijan Cities

Sevil Veysel and Amir Reza Vakhshouri

Abstract: *The main purpose of this article is to briefly describe the urban waste and chemicals management in Azerbaijan, particularly in Absheron Peninsula. This paper first deals with the definition of urban waste management and their importance in modern life, and then discusses their impacts on different cities of Azerbaijan. In the following, the impact of chemical and petrochemical industries on the environmental pollution of the Absheron Peninsula is discussed and finally the necessary initiatives and plans to solve these problems in some areas of the peninsula are reviewed.*

Keywords: *Azerbaijan, urban waste management, Absheron Peninsula, petrochemical waste, Caspian Sea, Baku*

Authors' Profile

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Introduction

It is expected that approximately 70% of the world population will live in urban areas till 2050 (Tom Parsons, 2021). In these days, the main contributor of the high level of air pollution is the solid waste landfills in and around the cities that the health of millions of people around the world is affected negatively by this. In addition, the consumption of resources for material good is skyrocketing because of the rapid growth of global population which creates an urgent need for us to rethink the way that we dispose of waste in the cities.

Urban waste indicates a largely unused source of recyclable materials for production, reusable goods as well as a source of both heat and electricity when properly used in efficient waste to energy plants. Numerous health (cardiovascular diseases, cancers, diabetes, and chronic respiratory diseases etc.) and environmental issues (pollution of urban water, air and land etc.) occur for our consumption and disposal patterns which must be addressed to help shape the livable and sustainable cities of tomorrow.

Chemicals are important for the manufacture of many products and human health protection and a major contributor to the gross domestic product (GDP) and employment. However, human health and environment can face significant risks because of chemicals and their hazardous wastes without practices of good management. Generally, it creates higher risks on the poorest members of the global society. In urban areas, low-income communities are especially exposed to hazardous chemicals and associated with wastes in their jobs or because they live in polluted areas. In rural areas, exposure of most chemicals and pollution of environment is related with the

misuse of agricultural chemicals and pollution which brought by waterways. It impacts the natural resources which these populations depend.

Azerbaijan has developed rapidly in recent years; a good quality of life and rapid growth of economy are indicative of this progress. The country was the leader in the production of pesticides during the Soviet era, agricultural sector of the Azerbaijan extensively consumed chemicals. Azerbaijan was the leader as well in the production of compressors, air conditioners, and refrigerators which were relied on ozone depleting substances. Generally, the country is famous for the production of black gold (oil) which is the main reason of the pollution of land and shores of the Caspian Sea (Kamran M. 2020).

The urban waste and chemicals management in Azerbaijan

Azerbaijan is one of the oldest oil-producing nations in the world and during Soviet Era, it became one of the biggest manufacturers of petrochemicals and agricultural chemicals. Azerbaijan was almost producing half a million tons of dichlorodiphenyltrichloroethane (DDT)[1] and other pesticides (Alasgarova K., 2008). The country was a large consumer for ozone-depleting substances of air-cooling equipment and refrigerators and its chloro-alkali industry used mercury in its processing. By the end of the Soviet Era, the areas around Baku, the capital city, had become the pollution hotspot. Historically, three quarters of the industrial production and municipal waste generation of the country occurred on the Absheron Peninsula where Baku and many industries are located. This pattern continues today.

During the transition to the independence, the economic profile of the Azerbaijan began to change, and most industrial uses of hazardous chemicals were reduced or stopped. In recent years, the country has demonstrated a strong political will and has accumulated the resources necessary to clean up the legacy pollution.

Azerbaijan currently has an improved environmental safety in the areas of oil transportation and extraction and in the chemical industry. The Soviet practices of managing municipal waste and of discharging communal and industrial wastewater to the Caspian Sea are being replaced by new waste management systems which limit waste generation, sort waste by types and improve recycling efficiency and storage safety. Systems for sanitation, water supply and wastewater treatment are being upgraded in several urban centers. These improvements not only help to improve the quality of the environment, but they also reduce the amount greenhouse gas emissions, and improve the efficiency of energy, and recovery in the waste management.

There are approximately 70 landfills in Azerbaijan. Four of them, which are all located in greater area of Baku, receive over 70% of total municipal solid waste of the country (about 2 million tons per year) (Country FactSheet Azerbaijan, 2017). The largest site is Balakhani which occupies about an area of 200 ha. An improving quality of life and growth of population in Azerbaijan are driving up waste generation, particularly in Baku. Current initiatives in the waste management area are contributing to the decoupling of this trend.

As a result of the restructuring of Azerbaijan economy, the country generates less industrial waste than municipal solid waste per year. Additionally, more than half of the industrial waste which generated in the country is reused or recycled.

The generation of hazardous waste of the country has declined both relative to GDP (gross domestic product) and in absolute terms. By the end of Soviet

[1] In 1972, according to the order by EPA (Environmental Protection Agency), use of DDT was cancelled due to its toxic environmental effects and potential human health risks.

era, Azerbaijan had accumulated more than 3 million tons of hazardous waste, however in the transition to independence, many of the industries using or producing hazardous substances shrank. The hazardous waste generation has declined. In the past decade, with GDP of Azerbaijan going up and generation of waste going down, Azerbaijan now display one of the lowest ratios (1-10 kg/USD 1000) of hazardous waste to GDP in the region (UKEssays, 2018).

During the Soviet era, Azerbaijan relied heavily on pesticides and other agricultural chemicals to boost production like the republics of Central Asia. Previous levels for pesticide application exceeded 15-20 kg per hectare of cotton and were repeated several times in some districts. Agricultural chemical use has declined; however, the clean-up legacy waste has not been fully resolved yet, although remediation plans are in place, inventories are complete and initial urgent measures are being applied. Waste generation rate in Azerbaijan can be seen in Figure 1

On the Absheron Peninsula, some of the chemical industries are no longer in operation, and others have modified their practices. For example, mercury is no longer used in the processes of industry, as a result, historical mercury pollution has been cleaned up.

A general lack of efficient institutional arrangements in the past contributed to continuing non-compliance of Azerbaijan with the requirements of the Montreal Protocol[2] from 2001 through 2005. With the restructuring and strengthening of institutional responsibilities, Azerbaijan reported zero chlorofluorocarbon (CFC) consumption in 2006. However, the institutional capacity related to the monitoring and control of ozone-depleting substances (ODS) has not been sufficient yet to control ODS effectively. Now, the Global Environment Facility is supporting Azerbaijan for the improvement of the effectiveness of the registration, communication and control of ozone-depleting substances, and the operating practices of the responsible institutions and users. Resulting reduction in the consumptions of ozone depleting substances can be seen in Figure 2.

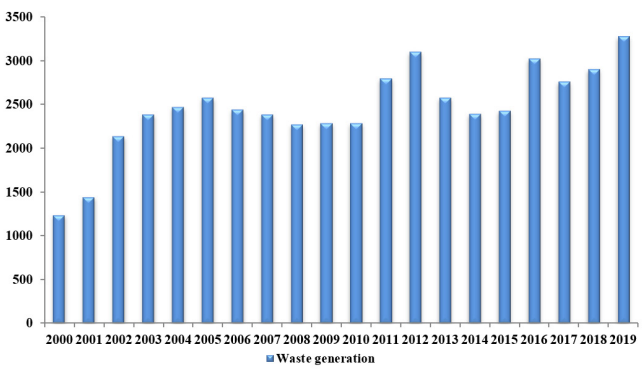

Figure 1. Waste Generation Rate (thsd.ton) In Azerbaijan, 2000-2019 (Source: Statistics of Azerbaijan, 2020)

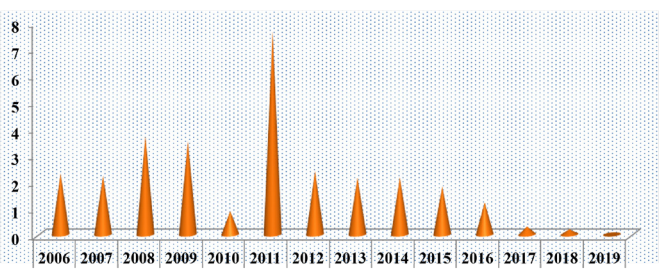

Figure 2. Consumptions of Ozone Depleting Substances, ODS tons, According to the data of the Ministry of Ecology and Natural Resources (Source: Statistics of Azerbaijan, 2020)

Special case for petrochemicals: Environmental clean-up and improvements of Absheron Peninsula

The clean-up in the Absheron Peninsula, which is the

[2] The Montreal Protocol on Substances that Deplete the Ozone Layer is an agreement signed in 1987 and enforced in 1989. It plans to prevent production and consumption of ozone layer depleting chemicals.

area with high concentrations of both pollution and people, is a special case, since the key achievements of the Azerbaijan here include the construction of a new national hazardous waste management site and modern hazardous waste sites of the oil industry.

During the last decade, the World Bank has financed several projects in which the main goal is to improve the environment in the Absheron Peninsula. Additionally, private sectors such as oil companies have invested in minimization of waste, clean-up, and recycling programs. These projects are helping to rehabilitate polluted land by the onshore oil production legacy on Absheron, to reduce environmental pressure from oil and gas extraction of today, to use of industrial waste from defunct enterprises safely, and to improve urban solid and liquid waste management in the metropolitan area of Baku.

Approximately 10000 ha area of Absheron Peninsula and surrounding lands are contaminated by oil and chemicals and its 20% has been done during Soviet-era oil production. For moderately polluted soil, we use bioremediation whereas mechanical methods are used for highly contaminated soil. Between 2009 and 2011, more than 800 ha of land have been remediated using one or the other of these methods at the oil extraction and storage fields of Bibi Heybat and Binagadi which are close to Baku. The area, which was pollution hotspot, now replaced with a park. In Bibi Heybat, 42000 square meters of area is replaced by Baku Higher Oil School.

The State Oil Company of the Azerbaijan Republic (SOCAR) has accepted responsibility for past oil pollution in other parts of country and is scaling up the clean-up efforts, setting priorities on the basis of the economic potential of the polluted areas. The wastewater facilities of refineries of Baku and Azerneftyag have been upgraded and nearly 35 million tons of oil-contaminated soils and sludge have been reprocessed. To minimize environmental and industrial impacts, both refineries are moved out of densely populated areas.

A low-level radioactive waste disposal project, which is the part of Absheron rehabilitation program, helps to reduce health risks by lowering the population's exposure to the radioactive contamination resulting from oil extraction and iodine production. The planned decontamination of former production plants of iodine will involve the removal, repackaging, and transport of transport of contaminated low level radioactive waste storage facility "Izotop"[3], which currently handles radioactive waste generated by medical, research and industrial applications. A survey program has determined the sites of low-level and medium-level radioactive contamination in the country and has helped to determine priorities for remediation or containment.

The Azerbaijan Government has invested USD 350 million to Waste-to-Energy Facility and a Sorting Plant which is located next to landfill of Balakhani. The main purpose of the government is to develop the Blakahani site as eco-industrial park for hosting numerous recycling and green energy industries including the principle recycling, recovery and waste management center for greater Baku. A project area of 120 ha at the Balakhani landfill has been rehabilitated and designed for long term disposal of waste from Baku region for the next 20 years. A highly efficient methane gas capture system is going to be installed to the landfill. This system will reduce greenhouse gas emissions by 670000 tonnes of carbon dioxide which is equivalent over of period of ten years (Tamiz Shahar).

The Balakhani eco-industrial park consists of the Material Recovery facility, with a capacity of 200000 per year and the Waste to Energy Plant has a capacity of 500000 tonnes of waste per year which generate 230 million kWh power. Both facilities are operating according to the environmental requirements of the European Union and Azerbaijan (Tamiz Shahar).

[3] Name of the waste storage facility

Sumgait chemical industry legacy and recent initiatives

Sumgait is in the third place for its area in Azerbaijan lies 30 km north of Baku with the population of 345,300 (Statistics of Azerbaijan, 2020). During Soviet Union era, it was the center of metal and chemical production and manufacturing of equipment. It had a lot of industrial plants and factories which were employing thousands of workers. About one third of the area of city is occupied by industrial facilities. Ten years later after Soviet Union, chemical related illness appeared on almost more than half of the population of Sumgait. Especially, children were so sensitive to environmental stress.

The main problem was related with the mercury sludge from chlor-alkali production which was solved with building the national hazardous waste management. It was financed by the World Bank according to the regulations of European Union. The landfill has started its operation from 2004 and its capacity is about 250000 cubic meters (World Bank, 2013).

Nowadays, Sumgait still has a number of industrial pollution hotspots, but at least majority of its hazardous industries has been closed and some positive clean-up measures have been successfully completed as well.

Caspian Sea

The main waste problem in the Caspian Sea is related with the drill cutting which is the broken bits of solid material removed from boreholes. This waste is generated by oil companies. Some drill cuttings are a non-toxic mixture of water based fluid and crushed rock which are then discharged to the Caspian Sea but there are the drill cuttings which are the mixture of potentially toxic synthetic mud as well. They are reinjected to the geological formation or transported to the shore related with the thermal treatment and disposal. Approximately more than 35000 tonnes of toxic drill cuttings is annually processed from offshore oil exploration and extraction by specialized oil industry hazardous waste facilities (BP 2019). State Oil Company of Azerbaijan Republic (SOCAR) and British Petrol (BP) agreed for the building of larger recycling center in the Gradagh Area which is located near Baku and the cost of the center is estimated about USD 60 million. It is for processing of the oil waste and drill cuttings from both BP and SOCAR.

Conclusion

Waste management is an urgent issue that should be tackled by the government quickly. Although, it poses great risks for today's and future generations, there is still little awareness among citizens regarding this issue.

In a short period of time, Azerbaijan and its cities has accomplished a lot by addressing the impacts of past environmental mismanagement and currently continues to overcome emerging chemical and waste management challenges. Every eligible organization together with citizens have responsibilities and ability to promote and implement effective strategies for managing current waste and chemical related challenges.

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Zero Waste CGHS (Cooperative Group Housing Society) of New Delhi, India – A Case Study

Madhukar Varshney

Abstract: *All metro cities in India are struggling today to manage city waste safely. With reference to the current waste management approach of centralized solutions of sending all waste to landfills is a failure solution as of now. This menace of landfill is reaching to smaller towns also in India. The paper is sharing the simple decentralized solution (Zero Waste) adopted and successfully implemented by one of the residential complex in Dwarka sub-city of Delhi in order to efficiently handle the 80% waste streams with in the complex.*

Keywords: *waste management, zero waste community, decentralization, comprehensive solution, residential waste solution*

Author's Profile

Madhukar Varshney is having 23+ years of corporate experience for handling large IT and Telecom projects in India and abroad. Founder of a non-profit organization: RISE Foundation (www.risefoundation.in) , having passion to work for betterment of cities by providing waste management consultancy services and afforestation using Miyawaki techniques.

Introduction

Mountains likes structure on the outskirts of capital city of India Delhi can attract anyone from distance, but these mountains are not made naturally. These are made of waste, generated by the city dwellers. The size of these mountains of waste in city are gaining an enormous size, as waste management becomes an acute problem. Waste is everywhere in Delhi. Delhi municipality is able to collect only 83% of the generated municipal solid waste. Out of this collected waste, 80% of waste is either compostable or recyclable, but only 29% of collected waste is disposed safely (Times, 2018). The projected average waste generation upto the year 2021 is approx. 0.68 kg per capita per day and total quantum of solid waste is 15,750 tons/day. Currently, it is centralized mechanism of waste disposal in Delhi, Rs.6500/ton (USD 90/ton approx.) is spent just on transportation collection and transportation. Total cost comes around INR 6.5 crore per day (65 million USD per day) is just spent on transportation this waste from collection locations to landfills (DowntoEarth, 2018).

Delhi has four operational landfills sites currently, however, three of them are supposed to be closed long time back (Figure 1). On an average day, thousands of tons of waste is dumped and distributed to each of these landfills. To understand the gravity of the issue, over 140 lakh tonnes of waste collected since 1984 lie in the Ghazipur landfill leading to hazardous living conditions especially to those residents who live nearby like Kaushambi, Khoda, Gharoli, Kalyanpuri, Ghazipur and Kondli with toxic air, contaminated water.

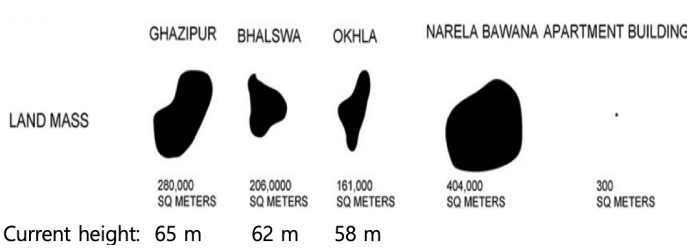

Figure 1. Delhi Primary Landfills (Virginia, 2018)

The current pathetic situation of city waste is primarily due to weak enforcement of Solid Waste Management

Rule (SWM) 2016 (CPHEEO, n.d.) in Delhi by municipal corporations and lack of political will due to the complex governance.

To combat this problem, the practical solution is proposed and established to make a Zero Waste Cooperative Group Housing Society (CGHS) in Dwarka. A cooperative housing society is a set-up formed through cooperation and consent of a number of members. The members have a sense of community spirit and camaraderie which most of the independent residents miss out on.

Dwarka is a planned sub-city of Delhi located in South West Delhi district located near to Indira Gandhi International Airport and Gurugram (called IT Hub in the state of Haryana). Sub-city generates 15000Kg approx. daily of solid waste (mix waste) as there is no waste segregation practices applied properly due to weak enforcement of SWM 2016. As per SWM 2016, CGHS comes under bulk generator categories and mandatory to have wet waste to compost within society premises otherwise municipality can fine Rs10,000/month (USD 140/month) (MOUD, 2016).

Zero Waste

To understand the term of Zero Waste, let us rewind a little in time. Some years back, newspapers carried reports about agitation by villagers at Urali Devachi, Pune's landfill site in the state of Maharashtra (Times of India, 2016). Villagers blocked city waste carrying trucks and stopped dumping the waste to landfills because of non-scientific disposal of waste on the landfill site. This leads to pollutes the air and water nearby village and creating health hazards. In Delhi too, there has been a lot of resistance from residents whenever the government plans for a new landfill site (Patil, 2021). The existing landfill sites are bursting at its seams and are potential disaster in near future.

Zero waste system aims to reduce the waste sent to landfills to the minimum. It can never be exactly zero as always there would be some non-usable material will remain (10-15%) which would need to go at the landfills.

How to reduce waste?

As per UN definition (UNStats, n.d.), any prime product produced for market for initial user has no further use in terms of his/her own purposes of production, transformation, or consumption, and of which he/she wants to dispose. Waste is thus any material at its 'wrong' place. If one can relocate the said material at some place or to some person who has a use for it, it no longer remains a waste. Thus, waste can be reduced bringing the concerned stakeholders in the value chain that can extract economic value out of waste and create a mechanism for sharing the said value amongst members in the chain.

Zero Waste CGHS

The Zero Waste CGHS Model, is a waste management system that aims to minimize the amount of waste disposed of outside the CGHS boundaries, i.e. in landfills, through more effective use of resources, time management and problem solving. Zero Waste is also a sustainable waste management system: it is economically and technically feasible, socially acceptable, and environmentally sound.

Typical waste categories in residential households areas are as follows:

1. Organic Wastes (60%): Vegetable peels, fruits peels, leftover food, egg shells, bones, garden leaves, flowers etc.
2. Recyclable Waste (20%): Newspapers, paper, cardboard, plastic, metal, bottles, biscuit/namkeen/toffee rappers etc
3. Hazardous Wastes (10%): Leftover paints & sprays, construction & demolition waste, e-waste etc.
4. Sanitary and Medical Wastes (10%): Sanitary pads, diapers, and other medical wastes.

Considering the above categorization, The CGHS Society under Zero Waste project of Brahma Apartments, Sec 7, Dwarka (New Delhi) with residential capacity of

250 households/flats is generating and handling all the following waste respectively within the society premises , giving the recyclable waste to recycler and only hazardous waste to municipality for landfill.

1. Wet Waste: There is almost 65-70 Kg wet waste is generated. This is treated thru Organic Waste Composter machine daily.

2. Dry Waste (Plastic, Paper, Glass etc.): It is collected every 3rd day and handed over to recyclers

3. Horticulture Waste: Cage composter is installed to handle this waste stream. Per cage composter can handle 100-150Kg of horticulture waste. 2 more such cage composter is planned to be installed.

4. Flower Waste: There was a special demand from many residents that to make a separate pit for floral waste which is used in daily rituals in the society in the absence of floating it in the river as old religious practice.

5. Small e-Waste: It is learnt from citizens that big size e-waste is usually collected by the recyclers, however e-waste of small size i.e. Alkaline batteries, Headphones and printer cartridge etc. are not picked usually due to low in volume or quantity There are collection boxes deployed in each blockto collect this waste stream and will be handed over to authorized e-waste recycler for safe disposal.

6. Small Size plastic Waste: Ecobricks (PET bottle packed solid with clean and dry used plastic) are created. Ecobrick is an environment conservation initiative, which is usually small in size and low in volume, not purchased by the recyclers in city area.

7. Domestic Hazardous Waste: They are like bulb and tube lights also collected and dispose of thru municipality.

8. Sanitary Pads and Medical Wastes: They are also handed over to municipality workers as there is no mechanism to handle this stream of waste

For handling these wastes following simple but effective solution of handle and safe disposal of wastes is suggested by Zero Waste CGHS as follows (Figure 2):

Figure 2. Residential Waste Management Solution (Proposed by author)

As can be seen from Figure 2, there is mandatory need to waste segregation i.e. wet waste and dry waste at source. In this case, 100% waste segregation of households are done at home to ease of handling the waste streams.

The following steps are implemented under this program:

1. Residents survey and awareness sessions conducted about the waste management rules and best practices.

2. Segregated wastes are collected from household daily

3. Wet wastes are treated using organic waste composter machine

4. Recyclable dry waste is collected by a recycler

5. Non-recyclable plastic wastes or small size plastic wastes are arrested in ecobricks

6. Small non-saleable e-wastes are collected using collection boxes to avoid mixing with any other category of waste and handed over to municipality worker for safe disposal

By above waste management practices, now, only waste like diapers, sanitary pads, medical waste etc. are going to landfill.

Figure 3 gives a summary of activities of Zero Waste Community for different composting systems (Figure 3)

Figure 3. Summary of activities for Zero Waste community

Conclusion

Waste reduction at landfill sites can take place by undertaking a small step by us at the homes. The largest portion of all waste: food wastes and garden wastes are all compostable to make manure and other useful products like bio gas etc. Furthermore, it should be considered that 20-30 % of our trash is dry waste compromising of plastics, paper, cardboard, cans, glass and metals. They are all recyclable and other small and less voluminous plastic waste for making ecobricks. Only the sanitary or non-recyclable rejects should reach the landfill sites which are only 10-15% of our waste.

In conclusion, segregation of our waste is no longer a choice, it is the need of the hour. This will also save huge cost on transportation of waste from collection sites to landfills and helping better environment of the city.

In this Zero Waste CGHS case, the Management Committee of Brahma Apartments and residents showed great participation for working on comprehensive solution to the acute problem of waste in the society and doing waste segregation at source. This study also indicated that a possible decentralized waste management solution can also curb waste problem in the city.

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Urban Waste Management in Istanbul

Fatih Hoşoğlu*

Abstract: *Waste management is a tip of the iceberg in terms of seeking a viable solution for cities. If cities do not treat waste in a safe and proper manner, air pollution, waste water pollution, land misuse, and greenhouse gas emissions are likely to occur. Istanbul is Turkey's and Europe's most populous city, generating nearly 19.000 tons of solid waste per day. Plans, estimates, and appropriate investments are needed for the management of such a large sum. The aim of this article is to represent Istanbul's current and future waste management. The laws and legal obligations for waste management in Turkey are presented. In addition, the entire process is clarified, from collection to final disposal, as well as waste characterization. Future waste management projections and action to help are also addressed.*

Keywords: *waste management, Turkish waste regulation, waste characterization, planning of waste management, economic tools for waste management*

Author's Profile

Fatih Hoşoğlu is an environmental engineer who has a Master's Degree from Missouri University of Science and Technology in U.S. Over the past 16 years, he has been involved in a variety of waste-related initiatives, especially on the topic of waste to energy and the preparation of waste management plans for local and international cities. He is currently the Deputy of General Manager at Istanbul Environmental Management Company.

Introduction

Population growth and rapid consumption of resources reveal the necessity of sustainable environmental management. From a global perspective, waste and resource management; product design should be carried out with a holistic approach covering the cycle of raw material creation, production, recycling and recovery, and should be carried out in accordance with the concept of "circular economy", which is bound by the European Union (hereinafter EU) to certain objectives (United Nations Development Program, 2017).

A single solution is not enough to solve the issue of waste entirely. Successful waste management can, however, be accomplished by integrating several approaches. The implementation of the "Integrated Waste Management" approach has contributed to this internationally agreed approach.

Solid waste transfer stations, sanitary landfill sites (I., II., and III. Class), landfill gas power plants, mechanical biological treatment plants are operated in accordance with the relevant legislation (Hosoglu, 2020). However, alternative treatment methods are required to overcome the challenges. For this purpose, in this article, the legal framework, the current and the future of waste management system, and the economic tools in Istanbul are described.

Legal Framework for Municipal Waste Management

The authorities and the responsibilities in waste management have been shared with many institutions and organizations in Turkey. Local administrations, especially the Ministry of Environment and Urbanization (hereinafter MoEU), some other ministries and many institutions in different fields are involved in the waste management procedure.

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One of the prior goal of the Government of Turkey's 11th Development Plan 2019-2023 is creating 'livable places, healthy climate,' which aims to increase the level of coverage of waste collection, treatment, and disposal facilities.

Turkey has established waste management regulations based on the environmental legislation enacted in 1983 and the legislation aligned with the European Union Waste Framework Directive in 2007 (On Birinci Kalkinma Plani, 2019). In July 2011, the Ministry of the Environment and Urbanization was reformed from an organizational standpoint to become a ministry which is responsible for waste management policies. Furthermore, under the "Metropolitan Municipality Law" and the "Municipality Law," municipalities have been held responsible for the waste management from collection to disposal.

The municipalities in Turkey are responsible for the control of urban waste, according to the Turkish Environment Law (Cevre Kanunu, 1983). For their administrative territory, Metropolitan Municipalities are responsible for the following things.

- Creating urban waste management plans
- Putting municipal waste treatment and disposal programs into action
- Building and operating municipal waste management facilities (i.e. transfer stations, treatment facilities, and disposal site)

District Municipalities (hereinafter DMs) are in charge of the following tasks for their administrative territory:

- Developing municipal waste collection plans
- Providing municipal waste collection services
- Supplying of urban waste collection equipment

Metropolitan municipalities are in charge of developing and implementing Solid Waste Management Plans that do not include waste collection and transportation to transfer stations, according to the statute. Istanbul Metropolitan Municipality (IMM) carries out the operation of solid waste management from transportation to final disposal or recycling in Istanbul.

Istanbul Metropolitan Municipality

General information

Istanbul is an ancient city that has hosted many cultures over its 8,000-year history. It has become an economic and cultural center and an intersection point as a result of its strategic position between Asia and Europe. Today, nearly 15 million people live in Istanbul, making it the most populous city in Europe and one of the world's megacities. Istanbul has 39 DMs and approximately 5,712 km2 territorial area (Istanbul. Governor Ship of Istanbul, 2021).

Current Municipal Waste Management in Istanbul

Collection and Transportation

It is the responsibility of the DMs to collect municipal solid waste, and DMs contract with private firms for the collection service. One district municipality can contract with either one collection company or multiple collection companies. Therefore, some collection companies contract with multiple district municipalities.

Municipal wastes brought to solid waste transfer stations by DMs, and then transported by Istanbul Metropolitan Municipality (hereinafter "IMM") to recovery and final disposal facilities, starting from the transfer stations. Currently, there are eight Transfer Stations, two Recycling Facilities and two Landfill Sites. In order to optimize transportation and reduce transportation costs, eight transfer stations have been operating throughout Istanbul since 1995. There are four in the European side and four in the Asian side. 220 semitrailers with a capacity 20-ton transport the waste and made 85,000 km/day with 600 round (Solid Waste Management Directorate [SWMD], 2020).

Recycling and Processing

DMs carry out recycling of packaging waste and made an agreement with licensed firms to collect and recycle the waste in sorting facilities. Unfortunately, there are still street pickers and unlicensed middlemen for packaging waste recycling sector in Istanbul despite of their high contribution the recycling rate.

A large amount of produced waste is currently disposed to the landfills located in Asian and European side. Other than landfills, there are Composting and Waste Recovery Facility with a 500 tones/day capacity in European side and a Mechanical Biological Treatment Plant with a 1,500 tones/day capacity in Asian side (SWMD, 2020).

Mixed waste first goes to the sorting unit for screening and hand picking to separate packaging waste. Then, organic part is sent to the fermentation unit to produce compost. The compost produced in the facility may not be used for agriculture, but only used for green spaces and for the cover soil of landfill sites. In the Mechanical Biological Treatment Facility, the recyclable parts of municipal waste are recycled; organic materials are sent to bio drying unit to produce solid recovered fuel (SRF) for using in the cement industry (Istanbul Environmental Management Company [ISTAC], 2020).

For the final disposal of wastes, the average amount of 10,000 tones daily wastes of European sides are located in Seymen landfill, whereas 6,500 tones of daily wastes are located in the Asian side: Kömürcüoda landfill. With the commissioning of Istanbul Airport, municipal wastes are not accepted to the Odayeri Landfill since 2018. Four new transfer stations were started to be built in different districts in order to optimize transportation of waste. There are three-biogas plants, which convert landfill gas to energy in Odayeri, Kömürcüoda and Seymen landfill sites. Total energy generation from these three sites is about 70 MW per hour. The leachate wastewater from landfill sites is treated in accordance with discharge standards in leachate treatment plants with Membrane Bioreactor - Nanofiltration (MBR + NF) technology (IMM, 2020).

Waste Characterization

Waste characterization is an important issue in terms of management and planning of waste management facilities. The regional waste characteristic of Istanbul was determined by ISTAC in 2017 as below on Figure 1.

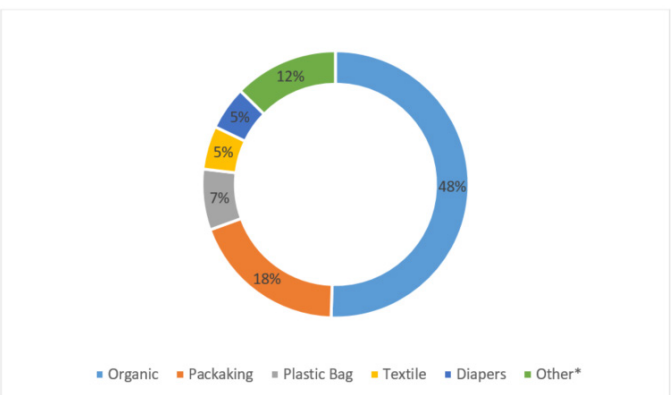

Figure 1. Waste ratios after characterization (2017)

Istanbul's future waste management plan, projection and necessary investments are discussed next.

Municipal Waste Management Planning (2024-2035)

The need for new landfill areas has also increased proportional to the same rate. This situation reveals the necessity to implement alternative waste management systems. Instead of disposing of wastes by storing them in line with the legislation targets, studies on different disposal facilities such as Thermal Treatment and Biomethanization are carried out in order to minimize the emissions to the environment, reduce the need for space and give an economic meaning to waste disposal.

In this context, a comprehensive planning has been made by ISTAC (2020), which includes increasing the efficiency of separating collections at the source of wastes, bringing resource efficiency to the fore and creating emission reduction actions in line with the waste

management strategy goals for 2024 - 2035.

With the "Regulation Amending the Regulation on the Landfill of Waste" (Atiklarin Depolanmasi, 2010) a target was set for the recovery of at least 60% of the amount of municipal waste collected in 2035.

Currently, 19,500 tones of daily municipal waste is generated in Istanbul. 6% of this waste is collected separately at its source by the DMs and given to the recycling system, 10% is recovered in the facilities (compost and bio-drying) of the Istanbul Metropolitan Municipality, and 84% is disposed of in landfills as seen on Figure 2 (Hosoglu, 2020).

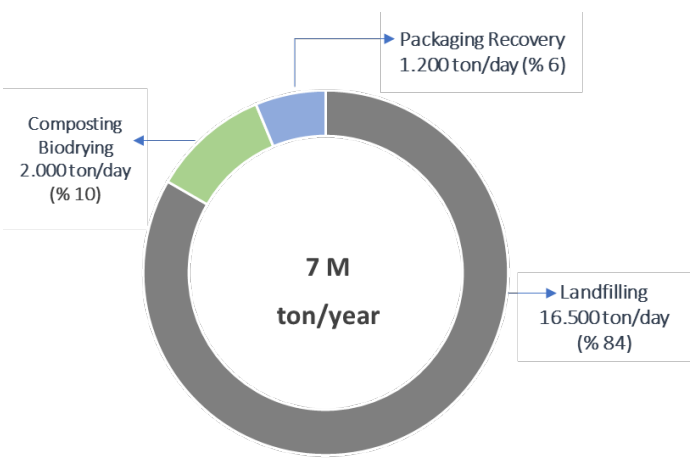

Figure 2. Current State of Municipal Waste Management (2018)

According to ISTAC report, it has been projected that the amount of waste will be 24,300 tones in 2024. In this context, in addition to the existing facilities, new Thermal Facilities tons/day and Biomethanization Plants are planned to establish facility with a total capacity of 6,000 tones/day and 300 tones/day, respectively. The construction of a incineration plant and a biomethanization facility are about to be completed and they are going to start operation by the mid of 2021. By increasing the efficiency of separating collection, the recycling ratio of packaging waste will be increased as well. The result of these investments, the landfill rate will be reduced from 84% to 53% as seen on Figure 3 (Hosoglu, 2020). Moreover, 231 MW of renewable energy capacity will be obtained with domestic waste thermal disposal, biomethanization investments and energy production from landfill gas in 2024.

In Istanbul, 31,000 tones daily amount of waste is expected to reach in 2035. In addition to the 2024 target, it is planned to establish a thermal disposal facility with a capacity of 3,000 tons/day and a Mechanical Biological Treatment Plant with a capacity of 2,500 tons/day. The landfill rate is predicted to be reduced from 53% to 39% with these activities.

In summary, planning has been made so that the recovery target of municipal wastes (including packaging wastes) will be 47% in 2024 and 61% in 2035.

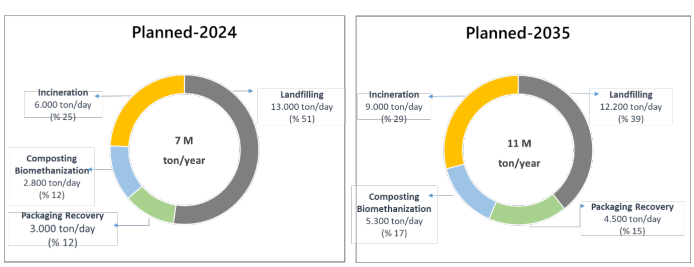

Figure 3. Municipal Waste Management Planning (2024-2035)

As additional information, to increase recycling patterns, the "Zero Waste Regulation" (Sifir Atik, 2019) supporting sustainable waste management was published . By mid of 2020, Public Institutions and Organizations, on December 31, 2020, Metropolitan District Municipalities with a population of 250,000 and above, Organized Industrial Zones, Airports, Shopping Centers, and Commercial Plazas, Educational Institutions, enterprises with 100 rooms, Health Institutions, Fuel Stations and Recreation Facilities, and Chain Markets need to apply zero waste management.

Economic Tools of Waste Management

In sustainable waste management, first, waste reduction should be provided in order to minimize the nega-

tive effects of waste on the environment and economy, and in cases where waste reduction is not possible, a new model (incentives, etc.) should be established to increase the recycling and recovery rates of waste.

Important steps were taken on the management of waste in Turkey recently. Pursuant to the "Regulation on Recycling Participation Share" published in 31.12.2019 (Geri Kazanim Katilim Payi, 2019); for the products listed in the Environmental Law No. 2872 (Annex-1), it has been imposed by the marketers or importers. With the publication of this regulation, it is expected that both the ratio of those who sell to the informal market will decrease and the amount of recycling will increase significantly.

The financial needs of waste management in Turkey are provided by several methods. The most important of these is environmental cleaning tax.

-Environmental Cleansing Tax (ECT)

ECT payers are specified in the Municipal Revenue Law, which was updated in 2003. Solid wastes created by offices and restaurants in the central area are collected by DMs in the same way that general household wastes are collected, and the waste generators are expected to pay ECT. The ECT tax is divided between the DMs and the MMs, with 80% going to the DMs and 20% to the MMs. The actual ECT is about 20-30% of what it should be, and local councils use a formula to calculate it. The actual ECT is just around 20-30% of what it should be, and local governments spend at least 40% of their revenue on waste management. As a result, unless a new financial model is developed, such as a solid waste management tariff, this mechanism would not be viable for waste management.

-Solid Waste Management Tariff

In 2010, the Ministry of the Environment released an ordinance on solid waste management tariffs. According to the ordinance, MMs are responsible for deciding the tariff rate and receiving approval from the municipal council. The MMs must obtain the agreement from all solid waste generators when determining the tariff limit. Since the ECT scheme could not be enforced because many residents would not pay ECT to cover solid waste management expenses, the solid waste management tariff was implemented.

Furthermore, the MoEU provides three forms of financial assistance to local governments (Japan International Cooperation Agency, 2015):

1. Budget from the MoEU: This is the the Ministry of the Environment's budget funding for urban solid waste management. This budget is solely dedicated to assisting financially needy municipalities, with no funds allocated to MMs with a higher financial capability,

2. EU Support Fund: This is for the Investment for Pre-Accession to the EU (IPA) program, which is handled by the MoEU's EU Investment Department. The beneficiaries of this fund, however, have already been chosen for the years 2020 and beyond.

3. Loan from Central Government or International Lending Agencies through Iller Bank (IB): The IB lends money to municipalities for capital construction programs that are sponsored by both the federal and state governments. Based on financial applications from municipalities, the IBs evaluate the financial and technical capacities of the municipalities before offering low-interest financing.

Lastly, the Ministry of Energy has also subsidiary for renewable energy using biomass as feedstock. For the period after July 1 2021, new prices per TL currency kilowatt-hour (kWh) will be 32 TL, 54 TL, and 50 TL for Landfill Gas to Electricity, Biomethanization, and Thermal Disposal (Municipal Solid Waste), respectively (YEK Belgeli Uretim Tesisleri, 2021).

Conclusion

Correct management of urban waste has an important place for a sustainable city management. Waste management in Istanbul, the largest city in Turkey's population while continuing operations in accordance with the legal requirements of future waste management

planning, is succeeded. In parallel, it is also aimed to increase the recovery rate from the wastes with the legal regulations made by the state in recent years. With the entry into enforcements of the new regulations, the municipalities have a great responsibility in complying with the desired targets in waste management. It is expected that the desired results will be achieved with the full coordination of both district municipalities and metropolitan municipalities.

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