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SOLID WASTE MANAGEMENT AND RECYCLING

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CHAPTER 1

AN OVERVIEW OF THE SOLID WASTE MANAGEMENT AND ITS RECYCLING

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ABSTRACT:

Recycling is the process of identifying parts of solid waste that may still be useful economically and recovering them for reuse. Recovering and using thermal energy is one sort of recycling; this process is covered separately under incineration. Since composting recovers the organic components of solid waste for reuse as mulch or soil conditioner, it may also be seen as a recycling process. Other waste products could be put to good use again. This article discusses the recovery of these materials, which include paper, metal, glass, plastic, and rubber. Any item that is to be recycled must first be processed and separated from the raw garbage. Separation may be carried out at the waste's origin or at a centralized processing plant. Curbside separation, also known as source separation, is carried out by private persons who separate newspapers, bottles, cans, and rubbish before setting them out for collection.

KEYWORDS:

Environment, Glass, Iron, Papers, Solid Waste

INTRODUCTION

International and national institutional frameworks underwent considerable changes as a result of the global economic crisis of the 1970s. Transnational businesses, the Bretton Woods's institutions, and important players on the world arena like the US and the UK all fervently supported the market's dominance and the state's retreat. Many nations in Africa, Asia, and Latin America were subjected to the imposition of such neo-liberal ideals of market liberalization and deregulation under the auspices of structural adjustment programs. Government in the South was strongly recommended to leave the direct delivery of essential services [1], [2].

The outcomes of these reform initiatives, however, fell short of expectations. Even if state governments cut down on expenditure and several nations saw economic recovery after an initial slowdown, the late 1980s were marked by widening wealth gaps. Urban poverty and the informalization of employment and economic activity expanded quickly in many southern states, posing enormous challenges for local authorities. To combat poverty and advance neighborhood and community development, new forms of collective organization among impoverished families and a variety of non-governmental organizations (NGOs) have begun to appear in many cities.

Even the most ardent supporters of the free-market philosophy began to acknowledge its limitations in the 1990s. Additionally, the fall of state communism and the Berlin Wall had ushered in a completely new political environment that was supportive of the democratic reform of state bureaucracy. Interest in the (democratic) institutions that support development processes has also grown as a result of the challenges that many nations in the south, as well as those in the former communist world, have faced in their transition to a market economy. Examining the function of institutions at the meso-level and how they affect economic development is one-way economists have shown this interest.

This is mirrored in the new understanding of poverty based on the asset-vulnerability approach that emphasizes the significance of institutions in mediating access in the field of poverty research. Political and social scientists now see the state as an "enabler," a coordinating body that collaborates with many other organizations in various types of partnerships with a view to fostering urban and regional development. The political procedures involved in partnership agreements and how they affect the efficiency of municipal and regional government have also attracted new focus.

The changes in the relationship between the state and the market or the state and civil society, and how their realignment influences future courses of growth, are at the heart of each of these discussions. Our primary goal in writing this book is to examine these processes and patterns of fundamental realignment between the market, civil society, and the state as they relate to the delivery of essential services in metropolitan areas. Historically, the state has seen urban basic services like water, sanitation, and solid waste management as being within the purview of municipal or national governments. In the last 20 years, there has been much discussion on how much of a role they should play in the restructuring of government, business, and community organizations.

The utilization of partnerships or alliances amongst various stakeholders has been suggested as a way to increase the efficacy and sustainability of urban solid waste management, which has sparked talks on new forms of urban government. Partnerships or alliances are being advocated as tools for more effective local government across a broad variety of issues, although local environmental management has developed particularly in poorer nations. This book's fundamental concept is that local communities' viewpoints, those of the organizations that work with them, and the backing of group efforts and small-scale economic players are just as significant as urban planners' and policymakers' opinions.

The authors involved in this study began with the premise that any changes to the way solid waste services are provided need to be evaluated not only in terms of cost effectiveness and service effectiveness, but also in terms of equality, widespread coverage, accessibility, and environmental considerations. These standards are included under the more general category of "sustainable development".

The fundamental query is: to what degree can improvements in solid waste management systems support sustainable urban development? In our opinion, rather than being based on broad theoretical generalizations, our thoughts on practical strategies for enhancing urban solid waste management should come from comparative analyses of both newly adopted practices and existing ones. This fundamental principle is shown in the use of comparative case studies in two places with a shared history of British colonial administrative practice but very different modern circumstances.

The study's objective is to conduct an integrated analysis of various waste management practices in order to evaluate how well they contribute to both the socioeconomic and environmental aspects of sustainable development. This comes after van der Klundert and Lardinois in the framework of the UWEP Programme proposed the notion of "integrated waste management" in international debates. They work to break down the idea of sustainable development into its several facets, looking at the actions taken by the various parties involved as well as the shifting alliances formed around such actions in the context of such facets. This makes it feasible to determine how component trade-offs influence the objectives advanced by various organizations.

The goal of the project is to build a framework that will help academics and practitioners weigh the trade-offs between different aspects of sustainable development when deciding on the consequences of future initiatives in urban SWM. At this point in our understanding, quantifying the many components is very difficult, hence the framework is based on empirical considerations. Local decisions could be influenced by politics. All the players engaged in such a decision may, however, base their decisions on an explicit analysis and awareness of the ramifications of their choices when socio-economic and environmental evaluation factors are integrated.

Changing Perspectives in Solid Waste Management Services

Research on urban SWM in developing nations has grown out of two main concerns: the concern for the environmental effects of expanding waste flows and the concern for the complexity and costs of waste management, which are becoming increasingly difficult for local authorities to manage effectively and efficiently. The latter viewpoint addresses three issues: issues with urban residents' environmental and public health, risks to workers' health and safety while handling solid waste, and issues with sustainable development in terms of resource recovery and waste material recycling. These are linked to the more traditional worries about properly disposing of garbage that may be disposed of in local and regional sinks.

The first difficulty has arisen from the viewpoint that local governments have main responsibility for SWM and conduct their operations primarily out of concern for public health concerns. Even while we now refer to "environmental health," many municipal governments have restricted that concept to actions involving "public health." Public health was the main viewpoint on SWM that was established during the nineteenth century in Europe and transferred to colonies all over the globe. Local government aimed to limit the health risks of solid waste accumulation in densely populated metropolitan areas by providing efficient collection, transport, and disposal services. Both the British and French administrative systems used local government and health ministries to organise these fundamental services. The efficient and unhindered evacuation of rubbish from residential neighbourhoods and from places for disposal outside of cities were the main goals.

In industrialised nations throughout the 1960s and 1970s, the limitations of this strategy became more obvious as consumption habits led to a large increase in waste flows, whose disposal exceeded the bounds of socially acceptable behaviour and the capacity of local and global sinks. Solid waste management practises have been impacted by a viewpoint that seeks to advance more sustainable resource usage, and this viewpoint is increasingly being applied via national policy guidelines in a number of industrialised nations. The "waste management hierarchy," in which waste avoidance, reuse, recycling, and energy recovery are meant to minimise the amount of trash remaining for ultimate, safe disposal, lays forth guidelines and directives to limit waste creation and enhance waste recovery [3].

In underdeveloped nations, the viewpoint that places public health concerns first has persisted to this day. How to cope with the rising expenses of handling greater waste flows, however, is receiving increasing attention. Privatisation and the implementation of cost recovery mechanisms are among the measures considered. The public sector has shown little interest in the debate over how such measures might be included into a viewpoint on sustainable development. Developing nations have made it abundantly apparent in international talks on sustainable development that environmental measures should reflect their own goals and not obstruct their genuine desire for economic expansion. They have prioritised pollution problems with a mostly urban emphasis and turned the environmental spotlight away from problems with resource management and resource depletion. The term "brown agenda" refers to the "immediate and most critical environmental problems which incur the greatest costs on current generations, particularly the urban poor in terms of poor health, low productivity, reduced income and quality of life: lack of safe drinking water, sanitation and drainage, inadequate solid and hazardous waste management, uncontrolled emissions from factories, cars and low grade domestic fuels, accidents linked to congestion and crowding, a lack of adequate solid and hazardous waste management, inadequate solid and hazardous waste management, and inadequate solid and hazardous waste management

A view of sustainable development, which integrates environmental considerations with efforts to fulfil human needs, is implied by the emphasis on pollution issues. According to this viewpoint, environmental concerns are taken into account alongside advances in urban quality of life brought about by modifications to the institutional structures that influence these places. Studies conducted under this paradigm often focus on the ways that different players help to enhance the environment and boost the efficacy of urban livelihood methods. Current policy views in developing nations currently place little emphasis on the 'green' goal of avoiding trash creation and lowering waste flows, but as waste flows grow, it will be crucial to pay greater attention to this issue in the future [4].

Actors And Activities: Public, Private and Civil Society Stakeholders

From the viewpoint of local authorities, urban solid waste management includes the operations of household solid waste collection, whether by door-to-door or neighborhood collection, transportation, and disposal of solid trash. The so-called waste hierarchy, which is shown below, is a more ecologically friendly approach to managing urban solid waste and it includes reuse, recycling, and recovery operations in addition to safe disposal of garbage in sanitary landfills or by burning. This research makes use of the latter paradigm for analysis, paying close attention to the reuse, recycling, and recovery procedures currently in use in the private sector in many developing nations. This enables us to present different scenarios to decision-makers, community-based organizations (CBOs), nongovernmental organizations (NGOs), local public bodies, and private businesses, outlining the kinds of contributions various activities can make to the sector's development towards a more environmentally sustainable future.

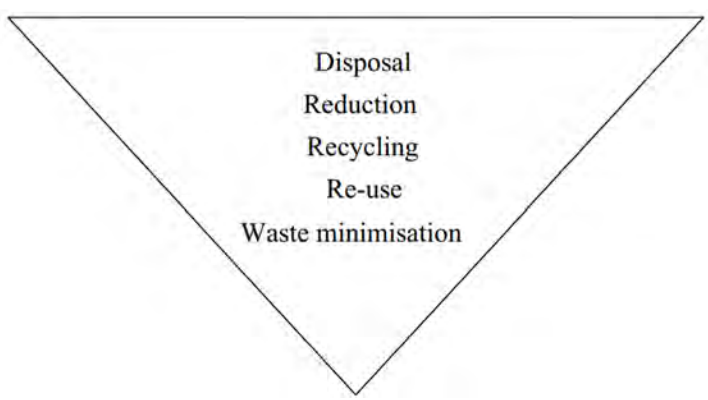

Figure 1: Illustrated the Waste Management Hierarchy.

The character of urban waste differs between developing and industrialized countries, and between larger and smaller towns. Cointreau-Levine has estimated that in developing countries the extent of organic waste is relatively high, constituting between 40%-70% of solid waste in developing countries. The increasing use of plastics as packaging material, and other inorganic materials has caused the character of solid waste to change composition in recent years. Therefore, because of the potential of organic waste also to be reused and recycled, it was decided to outline specifically what activities were carried out with respect to both inorganic and organic waste flows in the course of this study [5].

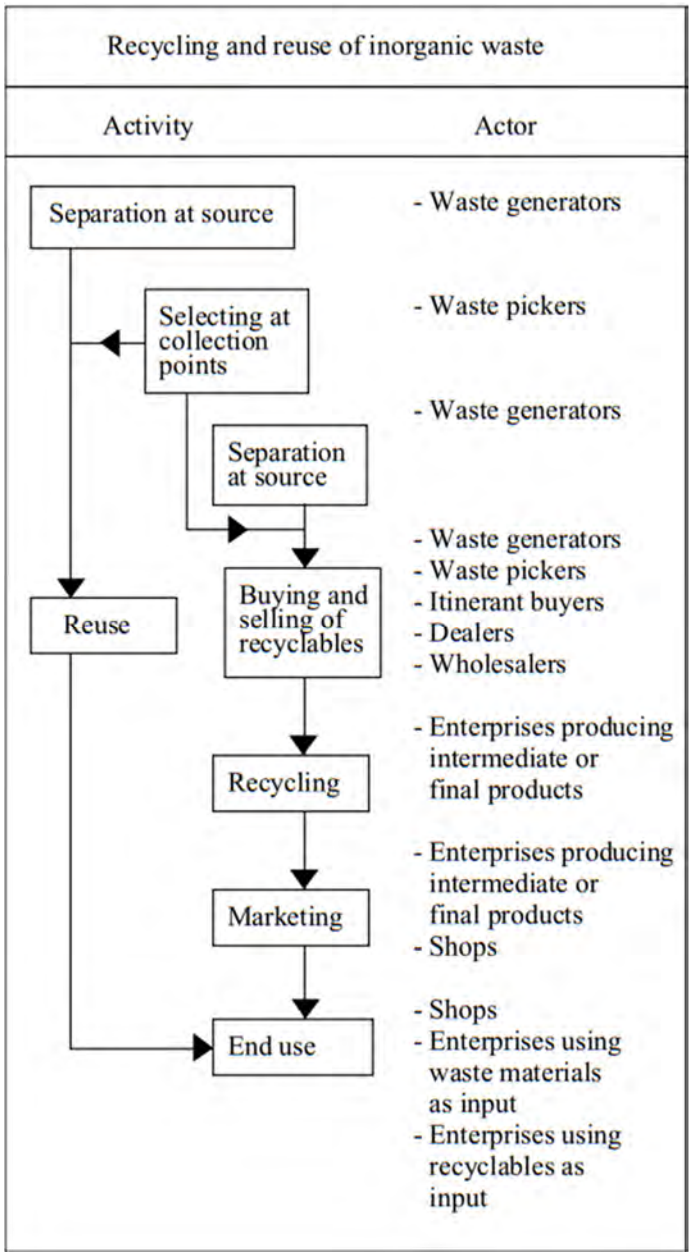

Figure 2: Illustrated the Recycling and Reuse of Inorganic Waste.

Based on earlier studies in India on inorganic waste and organic waste flows both within and outside the city, the different activities are believed to be related to one another in the aforementioned Figure 1. The primary benefit is that other actors' techniques for collecting, trading, and recycling waste fractions are presented alongside those used by the municipality to separate and sort waste fractions and perform other municipal operations. Figure 3 depicts, using the findings of the study reported in this book, the actions taken by municipal and non-municipal actors in the management of urban solid waste.

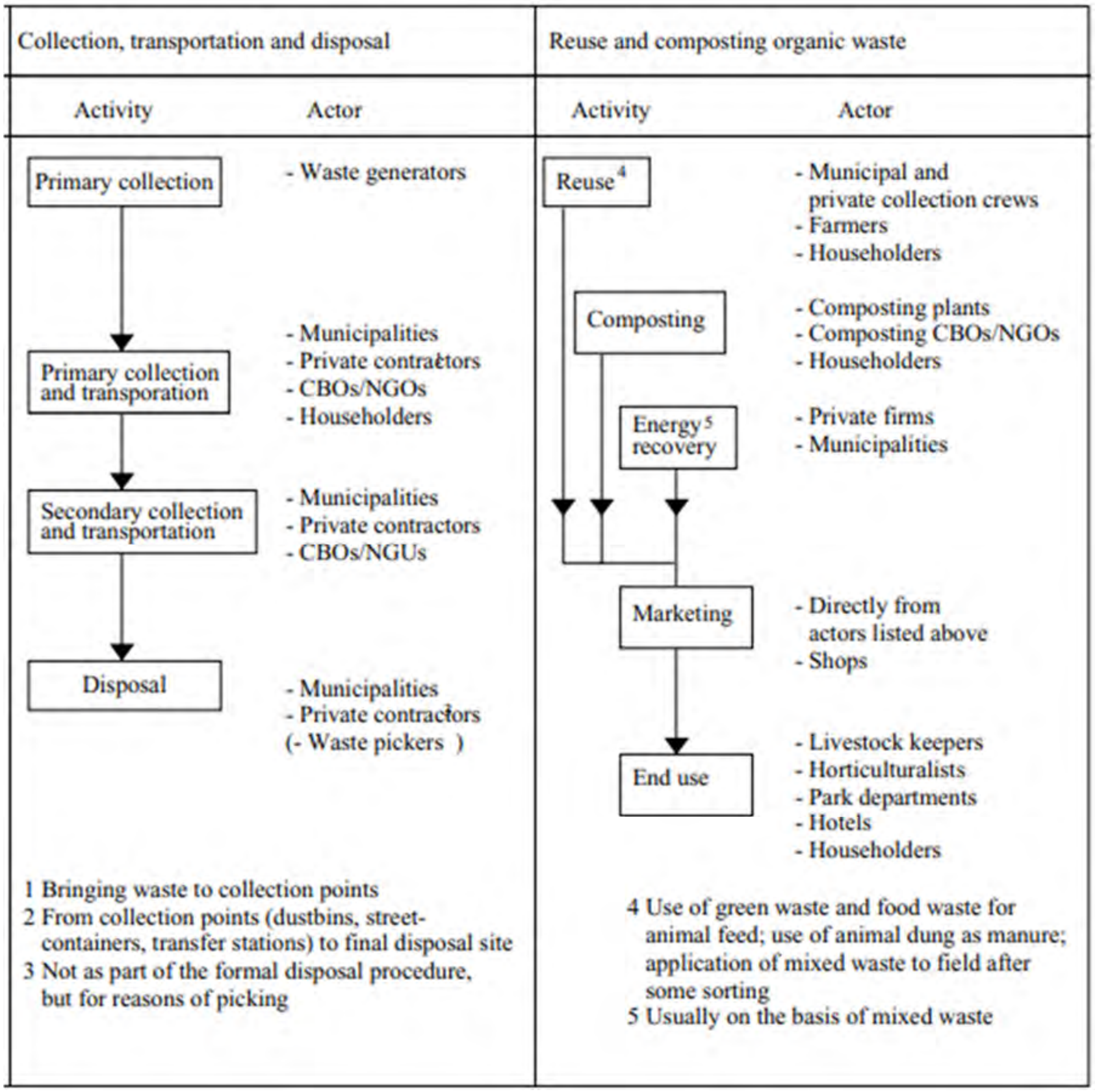

Figure 3: Illustrated the Process of the Collection and Reuse of Solid Waste.

The accompanying Figure 4 lists a variety of potential alliances in urban solid waste management based on prior research. It must be seen as a heuristic analytical framework, prepared to be put to the test against every city's particular empirical circumstances. It comes from models created for sustainable waste management rather than only public sector waste management as seen from a public health standpoint. Additionally, it incorporates the particular issues raised by the distinction between the parties engaged in removing organic waste and inorganic trash from municipal waterways.

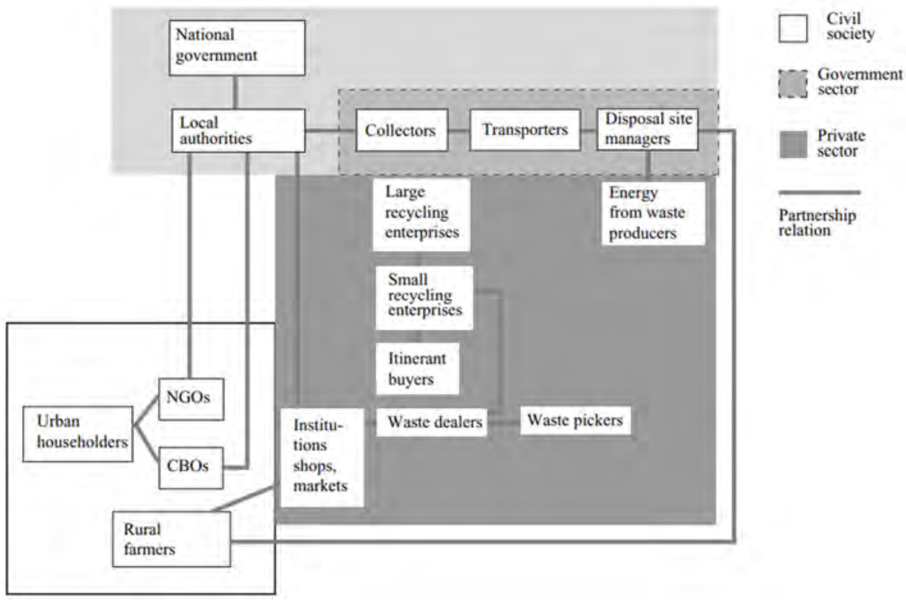

Figure 4: Represented the Actors and Several Possible Partnerships in Urban Solid Waste Management

Public Private Arrangements in SWM

International trends in public management reform have focused the greatest emphasis on public-private partnerships. Public interest and acceptability are raised when the private sector provides services [6]. Governments still need to uphold adequate standards, establish coordinated delivery, foster competition, prevent monopolistic control of critical services by unaccountable private providers, and reduce corruption and unfairness. Since both sides' obligations must be defined, privatization in service supply often means a kind of public-private agreement. Even if private businesses are hired to provide services, governments still have some control over the circumstances and standards that are established. They cut expenses, bureaucratic red tape, and degrees of coercion. They also reduce political meddling [7].

DISCUSSION

Local government officials' roles drastically shift in these institutional configurations from implementing agency to standard-setting and monitoring agency. In studies of these public-private partnerships, the degree to which government personnel can handle their increased obligations is a fundamental problem. The organizational and financial elements of such privatization projects should be evaluated as a second worry. Governments often outsource SWM operations to large, legally recognized businesses. The ability of small-scale, private businesses and CBOs to remove solid trash from residential areas receives little consideration. Despite their prior experience in this field, small-scale garbage dealers and recycling businesses of any size are not included in privatization plans. Local governments appreciate collaborating with established businesses. Strong contractual agreements are stressed, and unofficial enterprises and communities do not meet these requirements. Despite the growing recognition of their potential for trash separation and collection, only a few governments have begun to include them into their programs [8].

CONCLUSION

Studies on SWM pertaining to private-private partnerships place a strong emphasis on waste recovery, reuse, and trading within the system. Studies have demonstrated a great interest in labour contracts and working conditions, as well as the effects of government laws and regulations on private or community activities. These studies deal not only with contractual agreements between merchants and companies. Finally, qualitative environmental analyses are coupled with economic evaluations. The interest in the working circumstances and coping methods of garbage collectors and merchants led to the first investigations on the recovery, recycling, or repurposing of products from municipal refuse. In the 1990s, it became more commonly recognized that waste recovery not only gives money to large populations of urban poor people, but that its value as a commodity also aided in the ecological elements of the sustainable growth of SWM systems. The effects of international commerce and the usage of waste materials in manufacturing on the economy and environment have also been investigated. Cooperation between local authorities and urban poor groups engaged in "informal" economic activity is still far from becoming a reality at the local level. Since they contradict with their view of successful collection and disposal from a public health standpoint, local authorities often work to deliberately prevent such acts from occurring. Locals want to restrict street pickers' access to local rubbish sources because they see them as socially unacceptable.

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CHAPTER 2

AN OVERVIEW OF THE URBAN CONTRIBUTION TO SUSTAINABLE DEVELOPMENT

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ABSTRACT:

One of the services that may significantly advance urban sustainability is urban SWM. However, due of its ambiguity and widely divergent interpretations, the fundamental idea of sustainable development has given rise to contentious discussions and stirred up conflicting emotions in both academic and policy circles. We shall begin our research by adopting the perspective of sustainable development, which aims to unite the objectives of ecological sustainability with the concern for satisfying present-day human needs. In order to achieve ecological sustainability, it is necessary to reduce the use of non-renewable resources, guarantee the regeneration of renewable resources, and ensure that both local and global sink capacities are not surpassed.

KEYWORDS:

Environment, Glass, Iron, Papers, Solid Waste.

INTRODUCTION

The original model, which we adopted, focused on the relevant environmental challenges while leaving the particular institutional arrangements required and the best way to meet those requirements largely undetermined. The significance of institutional structures in regard to environmental challenges in cities is discussed in a more recent piece by Satterthwaite, who also suggests that urban managers should consider two areas for which they are not presently responsible. These consist of:

- **i.** Reducing the amount of environmental expenses that are passed on to city residents and the ecosystems that surround it;
- **ii.** Ensuring the development of "sustainable consumption."

It is crucial to explain how sustainability concepts relate to development objectives in terms of sectoral priorities across time. What constitutes a human need, how it is satisfied in relation to ecological sustainability, and what trade-offs are acceptable are all hotly debated topics. This is evident, for instance, in the discrepancy between those who support the green and the brown agendas for improving the urban environment. The former places a stronger emphasis on ecosystem health, the effects of cities on rural resources and neighbouring areas, and the danger that urban consumption poses to meeting the demands of coming generations. The latter pay greater attention to social justice issues and environmental dangers, and they are more focused on local issues that are now being experienced, particularly by the urban poor. Politically, nations of the South also emphasize the need to prioritise economic development right now above environmental sustainability. In this book, we'll start with a concept of sustainable development that blends an ecological viewpoint with developmental considerations and explicitly identifies the trade-offs present in each decision.

Analysing attempts to relate SWM to problems with sustainable development still has to be done. The idea of integrated sustainable waste management is one such effort. Based on existing research and the experiences of the network WASTE organised inside the UWEP Programme, their approach and associated model represent an early effort to link environmental challenges with socio-economic and technological delivery difficulties. It encompasses political, financial, social, economic, and environmental factors. The model is beneficial for including the wide range of factors required to determine how sustainable SWM systems are, but it has not yet been used in actual investigations.

By including the three main objectives of sustainable development into the model created in this book, we have connected the issue of solid waste management to that of sustainable development. environmental health improvement, socioeconomic equality, and ecological sustainability. The brown agenda often includes solid waste management, which mostly has local effects. The 'localised character' of the criteria we employed to analyse the contributions to sustainable development of diverse SWM activities and partnerships, both at the level of actors and the urban system, reflects this.

The following objectives should be pursued by SWM systems with regard to ecological sustainability:

- **i.** Reducing the quantity of garbage produced;
- **ii.** To increase recycling and reuse;
- **iii.** Should carefully dispose of any leftover garbage in order to keep neighborhood sinks from filling up.

The reduction of waste creation is essentially the duty of the national government and the private sector, and it may be accomplished by reducing the number of materials used in production and consumption, using those resources more effectively, and increasing closed-loop recycling. Whether or whether individuals, businesses, and institutions support this cause relies on how well-informed they are about the risks and rewards involved. Maximising trash reuse and recycling may be done at two different levels: at the primary level, which takes place inside homes, businesses, and institutions, or at the secondary level, which takes place after materials have entered the municipal waste stream. The degree to which source separation happens and is formally supported and encouraged is a crucial factor. The decrease of waste volumes to be disposed of and the utilization of virgin resources both contribute to sustainable development. Controlled disposal is included because it is crucial to determine how much municipal garbage really makes it to the designated dumpsites and, subsequently, how much is illegally dumped and pollutes the urban environment. Last but not least, how waste is finally disposed of in developing nations often through sanitary landfills or crude dumping determines how much ecological sustainability and environmental health are harmed by leaks that contaminate surface and groundwater or soils, air pollution from burning waste, and the spread of diseases through various vectors. Both effects on particular players and effects on the whole system are covered by the socio-economic aspects used to analyses SWM systems. Four standards are employed:

- **i.** Affordability and financial sustainability for the local governments, customers, and/or businesses engaged;
- **ii.** Employment that offers SWM employees a livable income and a certain amount of job stability;
- **iii.** Legitimacy from the viewpoints of the social and legal authorities;
- **iv.** Effective standards enforcement and monitoring.

The capacity of an activity to continue financially that is, the certainty that revenues will continue to equal costs is what determines whether it can do so. Authorities often have to tolerate a high level of subsidization because of the 'public benefit' aspect of SWM. The system's financial viability, nevertheless, is dependent on the government's capacity to pay for necessary maintenance out of its own resources or via grants, as well as its political resolve to do so. Contributions from residents can help make waste collection more financially viable. The idea of allocative efficiency shows how well fees cover the cost of the service, but if fees are too high, residents may decide not to use the service or may engage in free-riding. We also address the topic of productive efficiency within the context of this criteria, which relates to the operational performance of the service provider as shown by metrics like labour productivity and expenses per tonne [1].

One important component of our evaluation is how SWM contributes to gainful employment. It aims to determine if work in the industry offers a decent salary and some level of job stability. It also aims to examine how different socioeconomic groups' working circumstances differ. By using legitimacy as a criterion, we may discern between the legal status and societal perceptions. Access to finance and facilities; the lack of harassment; and the expenses of formalization are all potential benefits and drawbacks of legal registration of a partnership, and vice versa. Social legitimacy is the public's acceptance of something. The fourth criterion looks at whether there are systems in place to monitor performance across all three dimensions and if consequences are used when agreed-upon norms like production requirements, health regulations, labour laws, and environmental regulations are broken.

Contributions to environmental health are the subject of the third group of considerations. The objectives are:

- **i.** A cleaner urban environment with more efficiency;
- **ii.** Minimize risks to SWM employees' workplace health;
- **iii.** Reduce the risks to human and animal health from the use of waste in agriculture.

It is possible to look at how the activity affects the environment on two different scales: the neighborhood where it occurs and the city as a whole. According to SWM, the performance of the garbage collection service particularly its regularity and dependability determines how clean a neighborhood is. However, it is also necessary to consider the pollution created by nearby businesses that deal with trash (air, water, and soil) as well as by collection trucks (air). The contribution that partnerships provide to expanding the geographic reach of collection services is crucial at the municipal level. The objective of lowering workplace health risks is clear. It depends on the degree of exposure to garbage, particularly to hazardous waste components, and may be reduced by using the proper safety equipment. Finally, it is important to take into account any potential negative effects on the health of animals, the quality of the soil, and the yield of food crops when applying organic waste, whether it is composted or decomposed, or mixed trash, in peri-urban agriculture.

As was said in a previous part, a broad range of activities fall under the umbrella of SWM. The material that has already been written has often ignored the SWM system as a whole and concentrated on a single area of concern. However, we sought to go beyond such sectoral and topic analyses in our investigation. The objective has been to view three domains as components of a comprehensive system within the whole spectrum of activities that make up SWM, something that, to our knowledge, has seldom been done. The benefits of doing this include the ability to analyse the interactions across the various domains and the conflicts and trade-offs that may arise between the activities that are being improved across the many domains. The justification for doing this was that it would enable an integrated evaluation of contributions to sustainable development. These domains included the key criteria taken into account in the broader study topic, including social, economic, and environmental issues. The selected domains are:

- **i.** Measures for privatization in this sector, including collection and transportation;
- **ii.** Inorganic garbage collection, exchange, and recycling;
- **iii.** Recycling and avoiding using organic materials.

When attempts are made to make changes in the various domains, the combination of criteria inherent in the idea of sustainable development as it relates to SWM causes tensions and trade-offs. It may appear incongruous to the notion of lowering costs for SWM activities if, for example, promoting safe and healthy work raises expenses for local government or private sector companies. However, by explicitly articulating SWM activities in relation to practical components of sustainable development, policymakers, CBOs, and NGOs may analyse potential results in light of their own preferences and base their decisions on that information. These decisions may be political, but this way of analysis has the benefit of allowing them to be evaluated in terms of how much or little they contribute to various elements of sustainable development. This is currently feasible, but only qualitatively and experimentally, not statistically. The capacity for practitioners and academics to explicitly state the trade-offs between the various parts of SWM when certain decisions are taken is what contributes to enabling strategies [2], [3].

A multidisciplinary team, including workers from four universities, carried out a comparative fieldwork approach as part of the methodology, which consists of a number of components. They comprised environmental scientists, planners, economists, and human geographers. The International Institute of Environment and Development provided international comparative expertise, the Centre for Economic and Social Studies' staff coordinated fieldwork and analysis in Hyderabad, and the Kenyan team, which included researchers from Moi University and the Institute of Social Studies, were among the participating institutions. The University of Amsterdam provided coordination as well as participation in research.

Collaborative components were included into the research process in order to create a shared knowledge of the challenges at hand. The Nairobi and Hyderabad teams developed the fieldwork methodology, compared it, and finalized it in team workshops at each stage of the research, and the reporting and analysis of results was done on a comparative basis in joint workshops, where contrasts were brought out clearly.

This strategy resulted in the utilization of a variety of data sources, including background literature, fieldwork for primary data collecting via sample questionnaires, and a final workshop with stakeholders for input on evaluations of fieldwork findings in Nairobi. The original study strategy included physical and chemical analyses of soil and water samples with an analysis of socioeconomic data gathered via surveys and qualitative data gathered from persons with strategic expertise. However, due to the prohibitively expensive expenses of analyzing such materials in the relevant nations and the little significance that the particular inquiries were determined to have in the field of environmental health, the physical and chemical research was abandoned throughout the project. As opposed to tangible proof, environmental data thus focuses on how people perceive environmental issues.

In hindsight, the study's design included valuable insights for similar future research. First off, a single case study would have missed differences in the institutional and organizational environment that were highlighted by the comparative method. Second, the collaborative development of the study design fostered analytical unity and created vital team spirit across disciplinary and geographical boundaries. Finally, it was discovered that the utilization of both qualitative and quantitative data is crucial for enabling complementing discoveries; none would be feasible without the other.

Sustainable Development

The phrase "sustainable development" has been used to refer to a variety of ideas since its introduction in the 1970s, along with phrases like "sustainable cities" and "sustainable urbanization." Although the term "sustainable development" was originally used to emphasize the importance of directly addressing human needs while taking into account development's effects on the environment and the ecosystem, this is not always the case. For instance, many development assistance agencies have hijacked the term to describe the need to make their projects last so the roads, bridges, power plants, and irrigation schemes they funded do not fall into disrepair. When used in this manner, it has no direct bearing on satisfying needs and does not take environmental concerns into account.

However, if we return to the term's original definition, it boils down to whether two objectives can coexist when applied to cities. The ability of cities to meet the needs of the present without compromising the ability of future generations to meet their own needs by ensuring that the production and consumption of their populations and businesses do not have an excessive impact on local, regional, and global sinks of resources and there has long been disagreement about how to define the phrase "disproportionate." But at the very least, it calls for immediate action to halt and then drastically cut global emissions of greenhouse gases. Once again, there is disagreement on who should bear blame for this. Nevertheless, how cities do in terms of the two aforementioned objectives being desirable places to live and being hubs for production and consumption—clearly matters a lot. The remainder of this summary thus looks at cities that are or may become "good" development, environmental management, and low ecological footprint centres, which also includes centers for low-carbon lifestyles [4], [5].

They need to be taken into account jointly. Because there is little to no industry and consumption levels are so low, including a substantial percentage of the population that does not receive enough to eat, many cities in low-income countries have relatively tiny ecological footprints. With among the largest ecological footprints on the globe, many cities in high-income countries are also among the safest and healthiest. The question is whether having a low ecological impact and a high standard of living can coexist. In a world where more people are choosing to live and work in cities and towns, this problem is more important than ever [6], [7].

DISCUSSION

High density is often seen as one of the issues in cities, but how it affects housing in suburban or rural locations varies. The Boddington Zero Energy building in South London is one example of a new, high-density, low-rise building that reduces energy and water usage, carbon dioxide emissions, and the carbon footprints of the materials used in its construction. Cities are concentrated areas of people, businesses, automobiles, and rubbish. While this may make cities very unsafe places to live and work, it also has numerous potential benefits, including universal access to infrastructure and services, a reduction in trash levels, the ability to reuse waste streams, and the ability to delink a high-quality service. The cost of providing infrastructure, such as all-weather roads and paths, piped water, sewers, drains, electricity, and services like creche, all types of schools and health care, emergency services, and access to the rule of law and to government, is typically lower per household and per enterprise in areas with high densities and dense populations. The unit cost of conducting routine inspections of plant and equipment safety as well as occupational health and safety, pollution control, and the management of hazardous wastes is decreased due to the concentration of industries [8].

CONCLUSION

In order to lower the hazards of accommodations, there are also economies of scale or closeness. Four to six story terraces in European cities make up some of the most costly and coveted properties in the whole globe. These have greater population densities per hectare than the majority of one-story informal communities, but they also provide much more room per person. When compared to a life removed from high levels of resource use and greenhouse gas emissions, energy usage per home may be much lower. It is commonly recognized that cities provide economies of scale, proximity, and agglomeration that significantly benefit the majority of enterprises; in fact, this is one of the main reasons why the globe is urbanizing. The economies of scale and closeness for public goods and catastrophes, and typically a stronger ability among city people to pay for them, or at least to contribute towards the expenses, are less often highlighted. In well-managed cities, catastrophes happen significantly less often and when they do, the number of deaths is typically much fewer than in less prosperous and poorly controlled ones. For example, even though high-income countries like Japan and the US have a significant exposure to cyclones and even while there are outliers, like Hurricane Katrina's catastrophic effects on New Orleans, cyclone mortality are far greater in low- and middle-income countries than in high-income countries.

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CHAPTER 3

AN ANALYSIS OF COLLECTION AND DISPOSAL OF URBAN SOLID WASTE

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ABSTRACT:

A crucial function for preserving the health and wellbeing of urban populations is the collection and disposal of municipal solid waste. The procedure entails gathering garbage from industrial, commercial, and residential sources and then transporting it to a specified disposal place. Effective waste management is essential to decreasing environmental pollution, health risks, and natural resource depletion. The key problems, trends, and best practices surrounding the collection and disposal of urban solid waste are summarized in this abstract. It addresses a range of waste management topics, including garbage creation, collection techniques, transportation, disposal, and recycling. The study emphasizes the significance of public involvement, legislation, and technical advancements in developing effective and sustainable waste management systems. In order to handle the intricate problems of urban solid waste management, it also emphasizes the need of cooperation among many stakeholders, including governmental organizations, commercial waste management businesses, and the general people.

KEYWORDS:

Environment, Glass, Iron, Papers, Solid Waste.

INTRODUCTION

The main change that can be seen in the collection, transportation, and disposal of solid waste in many developing-nation cities, including Hyderabad and Nairobi, is the increased involvement of the private sector, either "spontaneously" in a free-market environment or encouraged through local authorities, NGOs, or CBOs. Solid waste management is becoming a field accessible to several forms of public-private cooperation rather than being a (local) government monopoly. The majority of studies on the topic begin by focusing on the shortcomings in public services, such as the overstaffing of jobs, the low labour productivity, the lack of incentives for higher performance, the ineffective cost recovery, the low levels of investment, and the poor maintenance of cars and other service-related equipment. Furthermore, for ethical, practical, or a combination of the two reasons, the authorities often disregard the servicing of informal neighbourhoods. Different privatisation strategies are then recommended in order to improve service effectiveness and efficiency. Evaluation of the organisational and financial elements of privatisation projects, as well as the readiness of government agencies and private contractors to take on their new responsibilities, are the main issues [1].

Although the general discussion of urban environmental management and urban sustainable development in the context of developing countries will serve as the starting point for this chapter, it will concentrate on the effects of policies and interventions with regard to the collection (partially including transportation and disposal) of urban solid waste, ignoring the implications for the other domains within the solid waste management system. The research acknowledges the presence of several institutional arrangements in solid waste collection and begins from a multi-actor approach. The debate will focus mostly on the privatization of solid waste collection, particularly on the recent rise in prominence of agreements between municipal governments and commercial garbage collection businesses. However, criticism will be levelled at the literature's and policy practice's fixation on the most prevalent arrangements, neglecting the presence and potential of others, often because of their informal character. Furthermore, it must be noted right away that global processes, like the promotion of privatization policies, result in various effects depending on the context. Case studies included in later chapters make this point very evident. Actually, local networks of political and social interactions have a significant impact on policies and initiatives. They influence the socioeconomic and environmental effects as well as the shape the privatization process takes. Because it aids in understanding the variety of experiences throughout Africa, Asia, and Latin America, the policy context will get a lot of attention in both this chapter and the ones that follow.

Urban Development in an Era of Reform

In reaction to the international economic crisis in the late 1970s and early 1980s, the neo-liberal paradigm was revived, which also led to a shift in perspectives on urban development in the developing world. The focus changed to the economically productive function of cities and the state as a facilitator or enabler of action by people, private businesses, and NGOs, particularly under the auspices of the World Bank. The key problem was to have everything organized in line with free market principles since cities were once again recognized as engines of progress.

Urban management became the buzzword and was largely intended to set up an acceptable division of tasks and responsibilities between public and private, as well as commercial and social players, so that each could perform their respective functions to the best of their abilities. The majority of governments in the developing world accepted the neo-liberal reform policies that form the cornerstone of the urban management method, even if they have not always made official commitments to the new convention. Through structural adjustment programs and aid conditionality, developing countries have been strongly advised not to say compelled to implement policies that will shrink the size of their civil services, decentralize administrative authority, boost public participation, and improve the effectiveness, accountability, and transparency of their administrations. Local resistance to the dominant authoritarian and centralist regime often strengthened these external forces. In the 1980s, the legitimacy of many nations in Africa, Asia, and Latin America was significantly weakened by their increasing incapacity to provide a socially important purpose for their population. Governments have attempted to reclaim some of this credibility by enacting decentralization, democracy, and participation programs.

As a result, the context for urban growth in Africa, Asia, and Latin America has changed as a result of both internal and foreign factors. It is not essential to delve deeply into the definition and characteristics of urban management or to analyses its ideological foundations for the objectives of the present investigation. It will do to briefly discuss the (local) government's emerging new role before focusing on the privatization discussion. But first, let's talk about how concepts for urban management relate to the discussion of sustainable development. In the South, interest for urban sustainable development grew during the 1980s. Due to its ambiguity and widely divergent interpretations, the fundamental idea of sustainable development has sparked intense discussion and stirred up conflicting emotions in academic and policy circles. Goals of environmental conservation and economic expansion are the main source of conflict. In an urban setting, these are more acute. Cities are seen as the wellspring of economic expansion and hubs of innovation, but they also use a significant number of natural resources and can put local and regional sinks at risk of overflow. We have attempted to adopt a stance within this framework of competing objectives. As previously stated, we will use a strategy that builds on the Brundtland study and was later developed, among other places, at the IIED by David Satterthwaite. It aims to reconcile the concern for human needs with the objectives of environmental sustainability. Drakakis-Smith has further developed the concept of sustainable development in the urban setting and makes distinctions between the economic component, the productive role of cities, and their capacity to reduce poverty, the environmental aspect, particularly the sustainable use of renewable resources, the minimization of the use of non-renewable resources, and the social dimension, satisfying basic human needs and respecting human rights. These are the key elements of a thorough and integrated urban sustainable development project. The realization that urban sustainable development, including sustainable methods of collection and disposal of urban solid waste, necessitates a multidisciplinary perspective as well as frameworks of governance and institutional design that enable a fruitful fusion of these perspectives is crucial for our discussion [2].

Unfortunately, environment and development have not made for a particularly happy marriage. An ecological vision is profoundly opposed to the utilitarian and exploitative worldview that is front and center in the views of the majority of modern governments and development organizations. Academics, policymakers, and activists often neglect the interconnection between the economic, social, political, and ecological systems and focus only on the dynamics of one system. Even if the events building up to the 1992 Earth Summit in Rio de Janeiro helped bring environmental issues to the attention of Southern decision-makers, this hasn't exactly resulted in a "greening" of their policies. Developing nations have made it very apparent that environmental policies should reflect their own goals and, more specifically, that they shouldn't obstruct their really desired economic growth. This stance is reflected in their efforts to shift the environmental focus away from concerns about greenhouse gas emissions, natural resource depletion, biodiversity preservation, and resource management, which are the main environmental concerns of the northern hemisphere, to concerns about the so-called "brown agenda," such as ways to mitigate the health and efficiency impacts of air and water pollution and to improve fundamental infrastructural services, particularly safe drinking water, These objectives are, in part, the 'traditional' concerns of leaders who are concerned with the fundamental requirements of their constituents.

A degraded urban environment is now widely acknowledged to have a substantial detrimental impact on urban productivity and efficiency as well as public health, with the urban poor being disproportionately affected. The spread of infectious and parasitic illnesses among people is facilitated by garbage piles in residential areas, which reduces residents' labor productivity or opportunities to find or keep employment. Illegal trash dumping into drainage canals may contaminate surface water or sometimes create floods, both of which have a negative impact on productive operations. It was generally acknowledged at the beginning of the 1990s that explicit urban environmental management was required to counteract these negative effects. The rationale used to support these measures, which were generally framed along neo-liberal lines, was that a combination of bad management, wrong economic policies, underinvestment in infrastructure, and weak institutional and regulatory frameworks was the primary cause of environmental ruin. The recommended policies often placed a significant emphasis on incentives and rules aimed at determining the actual price of environmental products and services. Breaking up inefficient and unproductive public sector monopolies that offered subsidized services at much below economic prices and involving the private sector in service delivery were prominent proposals [3], [4].

Urban management and urban sustainable development talks converge here since they center on the same set of legislative changes. Urban environmental management, as it is now applied in the majority of the developing world, is essentially a feeble effort to reconcile the need for increased urban production with the objective of environmental conservation. The latter is only added to the schedule; it is in no way the main objective. Although there are a few instances of municipal governments successfully reducing their environmental issues Porte Alegre and Curitiba in Brazil are two well-known examples this is more often the exception than the norm.

The majority of urban environmental management reports witness to the peripheral nature of environmental issues, especially those relating to ecological sustainability. The latter may have been overlooked since local governments often have little control over policies relating to environmental elements of sustainable development, such as the depletion or degradation of resources or eco-systems. The seeming lack of concern for the environmental dangers that many cities' (poor) citizens face, however, is largely a question of choice. Urban production and efficiency may be hampered by the negative consequences of a bad and unhealthy environment, although these effects are indirect and only partially resolved by the market. Urban entrepreneurs will face greater expenses and productivity suppression rather than an increase if environmental charges or laws are calculated or implemented, at least temporarily.

Strong political commitment is needed for the pricing of environmental capital, which is difficult to happen when the constituency is hardly exerting any political pressure in that direction. It is impossible to ignore the conflict between the requirement for government supervision and regulation of the private sector to successfully prevent environmental degradation and the urge for liberalization and deregulation to enable private operators to lead urban development. The market becomes an inadequate institution for the environment's management due to the environment's intrinsic characteristics, such as its public goods nature, externalities, and difficulties with common property. The investigation of the privatization of municipal solid waste collection reveals precisely these kinds of conflicts.

Decentralization and Its Limits

Not so much because privatization is one of its modalities as it is because privatization of public services places new, fundamentally different demands on local governments in particular, which is why attention must be given to the question of decentralization. They need to be empowered in order to meet these new expectations, and decentralization is meant to do this. Decentralization is the process through which planning, management, and resource agencies are transferred to lower levels of government or the private sector. Since authority functions and financial resources are genuinely transferred to sub-national political entities who in turn have real autonomy in many crucial respects devolution is often seen as the ultimate or "real" form of decentralization. This is how the term "decentralization" will be used in the study that follows.

Decentralization used to be primarily seen as a tool to increase the effectiveness of public administration. However, the desire for decentralization in the 1990s was mostly driven by shifting perspectives on the interactions between the state and society. In terms of the developing world, the crisis years had rendered many central regimes unable of carrying out their social obligations or, for that matter, of giving their main backers the benefits of holding political power. This condition reduced state authority and raised issues such as which organization, other than the federal government, is most qualified to provide public goods and services. Strong internal pressures were applied to governments in numerous nations, including Brazil, Columbia, Ghana, and most recently Indonesia, to decentralize and democratize governmental systems.

The neo-liberal doctrine's ascent to popularity and the fall of state-communism furthered the argument for decentralization. Decentralization was considered as being crucial to the goal of reversing the state and establishing a lean and effective form of government that would make the most use of community and private sector capabilities. It came to be more closely associated with the pursuit of "good governance," which was defined as greater accountability, better participation opportunities, and putting public officials under popular control. It was also defined as responsiveness, which is the recognition of the diversity of needs within the population in terms of policy responses, within a liberal-democratic framework. Decentralization is anticipated to result in more effective, practical, and locally tailored development policies by putting government closer to the people. It will contribute to the mobilization of important local energy and resources, increasing production. Finally, in an age of globalization when local governments are attempting to adapt to the restructuring of the global economy and the nation state's function as a policing or mediating force is losing relevance, devolution was increasingly seen as essential. Local governments must be given more authority in order to take full use of their unique geographic advantages and compete with other areas across the globe.

Although decentralization is clearly supported by the political and economic atmosphere as a whole, the process itself has no intrinsic virtue. It is true that it may aid in the empowerment of lower levels of government or even marginalized communities, but it can also serve to increase central authority or localized systems of political patronage and corruption. Decentralization may also lead to wider regional imbalances due to the uneven distribution of institutional resources and competitive advantages, even while it can narrow the gap between the state and civil society. Finally, it is yet unclear how decentralized governance affects urban production. By enhancing infrastructure and cutting red tape, a more effective and powerful local government may in fact be able to improve the business climate. However, it may also result in a decrease in the poor's access to urban property and even a reduction in the space for maneuvering for informal businesses due to more aggressive and systematic enforcement of rules and restrictions.

Despite their contribution to a cleaner environment and a decrease in trash quantities, garbage pickers and itinerant purchasers of recyclables, for instance, may face more severe harassment.

However, despite these factors, decentralization strategies have been adopted widely across the developing world. In actuality, both large contributors and members of civil society actively pushed for decentralization. Governments' political commitment to reforms that undermine their authority, however, often falls short of expectations. Since central ministries must be reorganized slowly, new processes must be developed slowly, the transfer of budgetary authority must be obstructed, etc., the execution of decentralization programs is complex and moves considerably more slowly than expected. Despite decentralization, many local governments still lack the tools they need to successfully promote community development, including the funding, power, mandates that are clear and consistent, and personnel that is well-trained and supported. These flaws contribute to the difficulties of public-private and public-community partnerships in providing urban basic services since local governments are not always able to fulfil their obligations under an agreement. Negative experiences may even inspire recentralization policies, like in Accra, where the central government stepped in and took control after local authorities failed to appropriately handle the issue of solid trash collection [5].

Privatizing Urban Solid Waste Collection

Services are privatized by governments for a variety of reasons. The Bretton Woods institutions' external demands as part of the wider structural adjustment reforms have been bolstered by internal developments, including a general unhappiness with the government's poor management of the economy and provision of adequate services. Private businesses are anticipated to take advantage of the possibility now that market concepts have been incorporated into the majority of national economies. According to the literature, the private sector has advantages over public sector company, including political independence, economic sanity, efficiency, dynamism, and innovation. It would be quite foolish to assume that privatization would always have these positive consequences. First off, there is still only a limited amount of empirical evidence to support the effectiveness of privatization, most of it is based on Western experiences. Additionally, the claim is somewhat supported by circumstantial evidence. The poor performance of many public sector operations instantly translates into suggestions to work in the other direction, turning policy into a type of 'trial and error' process. Second, there is no guarantee that the private sector will accept the task. Entrepreneurs may be reluctant to go forward because of concern about political unrest or simply because they do not believe that providing certain public services is lucrative. Third, organizations that stand to lose from the change often oppose privatization with strong political stances.

For instance, there is a significant risk that privatizations would result in a net loss of jobs and that working conditions in the private sector will be worse than those in the public sector. Furthermore, throughout time, intricate webs of advantageous connections between governmental officials and private interests have been created. Many may oppose change or look for new methods to preserve the status quo since they stand to lose when this superstructure of patronage and privilege is pulled down, which will undermine the presumed economic benefits of privatizations. Last but not least, privatizations based on the ability-to-pay premise is likely to exclude individuals who are not in high enough demand. Similar to this, detractors worry that private businesses may cut services that are unprofitable and provide subpar services in an effort to increase profits. When duties are transferred to the private sector, safeguards must be included to guarantee appropriate standards, achieve coordinated provision, ensure a competitive environment, prevent monopoly control of essential services by private providers who are not held accountable to the public, and to reduce corruption and inequity. Therefore, privatization in the context of service delivery often refers to a public-private partnership in which the government maintains some level of oversight while decreasing expenses, political interference, and bureaucracy .

Despite the consequences described above, privatization has emerged as the political tenet of the 1990s, and its significance as a tool for policymaking must be acknowledged. As a result, while searching for requirements that must be met in order to enjoy the benefits of privatization while avoiding the hazards, one must take a practical approach. When examining privatization, it is useful to distinguish between a number of factors, including the kind of privatization, the activities that will be privatized, the unique characteristics of public assets, and the key elements of the policy framework. We'll talk a little bit about these elements in the context of collecting urban solid garbage.

Starting with the first, contracting and franchising are the two techniques of garbage collection that are used the most often. Each kind of privatization, including divestment and open competition, has its own unique set of good and bad effects on the many stakeholders. In reality, there are both circumstances in which the private sector is unwilling to enter into a contract with the government, typically because of anticipated risks of non-payment or delays in payment, and circumstances in which business owners are wary of engaging in franchise operations because they worry about high default rates associated with widespread poverty, a lack of concern for public cleanliness, and the inability to penalize free riders by excluding them from service. Contracting is often seen as the strategy with the most promise for poor nations to reduce the cost of collecting solid trash. Governments who are keen to maintain a strict control over the collection of solid trash, often for reasons of public health, find it particularly alluring. The optimal conditions for this kind of privatization include reasonable contract durations, open competition, and cost-effectiveness-promoting contract parameters. Private operators are more inclined to invest in the proper equipment since time allows for the depreciation of their capital expenditures if contracts are longer in length. Long-term agreements also lower transaction costs and limit potential for political interference and corruption. Contract requirements that are excessively precise, such as those that include working techniques, equipment, labour input, and other factors as well as performance criteria, may inhibit initiative and drive-up monitoring expenses. Contracts have the risk of failing to adequately account for local variations, such as the distinction between planned and uncontrolled regions [6].

Many proponents of privatization are undoubtedly in support of the franchise system despite the widely acknowledged benefits of contracting since it moves risk to the private sector, "where it belongs," Franchise relieves local public administration of burdens and prevents widespread issues with inadequate local tax bases and ineffective revenue collection in many developing nations. This choice, however, won't work unless protections are included to guarantee that the private operation is both secure and appealing enough.

The privatization of state-owned businesses is entirely different from the privatization of urban services in terms of the second factor, the kind of activity. Urban services are typically under the control of local authorities, and their success is not only governed by economic returns but also by social and political factors. The former is typically under the jurisdiction of central government agencies, and their performance can be measured in strictly financial-economic terms. Solid trash collection raises issues of public interest and acceptability, suggesting that privatization often needs "the guiding hand of the state" to be successful. To guarantee compliance with health standards or environmental legislation, the authorities, for instance, must set up effective supervision of private garbage collectors. This managerial position is not only highly difficult and demanding, but also quite expensive.

Studies on privatized waste collection frequently draw the conclusion that services are provided more effectively than by municipal departments, but they frequently fail to account for the additional expenses incurred by the government for contract management and performance monitoring, as well as factors like the acquisition of land for disposal or transfer sites. Additionally, it is frequently necessary for the government to remain actively involved in service delivery, particularly when the private sector is only interested in providing services to 'profitable' high-income and accessible areas. This is due to the pragmatic desire to remain in touch with operational reality and to have a fallback position in case a private company fails.

The third point is that the kind of private sector arrangements that are possible are heavily influenced by the unique characteristics of public goods. The commonly used classification of public services ranges from strictly public goods that are consumed collectively and for which it is challenging to exclude people who do not pay to strictly private goods that can be consumed by individuals and from which it is simple to exclude people who cannot or do not want to pay. Concessions and contracts are the best ways for the private sector to participate in collective goods. Open competition, on the other hand, is the best choice for public commodities that may be handled as private products. The many processes that make up the solid waste management system may be divided into several groups. For instance, the selling of recyclables resembles a wholly private product, but the maintenance of significant highways and public spaces comes under the umbrella of community goods.

Waste collection from home to house falls somewhere in the middle of these two options. It has the characteristics of a so-called shared use or merit good, meaning that the service may be offered based on people's financial capacity. However, setting prices based on complete cost recovery may encourage many (poor) families to participate in free riding or to forego the service, which would be damaging to the general public's health. Therefore, municipal governments in many developing nations will be forced to continue allocating a large portion of their resources to garbage collection services, and they may even be obligated to continue being directly engaged in their management [7].

DISCUSSION

More consideration should be given to the policy context. The perception of privatization, the preferred type of public-private arrangement and the conditions that require the most attention managing capacities, limiting investment risks, community participation, etc. are all heavily influenced by the specific structure of political-economic forces and cultural attitudes. Even while privatization has great rhetorical backing, it generally proceeds relatively slowly in low-income nations. The prerequisites for successful privatization are frequently not met, including the absence of well-developed capital markets in the event that local businesses need to make sizable investments, inadequately adjusted legal and judicial frameworks, low per capita incomes, a dearth of a thriving private business class, and fierce internal opposition from the bureaucracy and labor unions. The broader backdrop in India and Kenya will be briefly described in the review that follows to highlight how crucial it is in understanding the ups and downs of privatization and partnerships [8].

CONCLUSION

Since independence, India's route to growth has been mostly state-directed, placing a strong focus on heavy industries and a quick industrialization via import substitution. A strong governmental apparatus made an effort to create an independent economy and guarantee the equitable distribution of the benefits of growth on both a geographical and social level. By the end of the 1980s, the nation's economy was in serious difficulties due to the overly complicated and intrusive system of macro- and micro-economic regulations that had been put in place. Early in the 1990s, the nation adopted a more market-driven approach in line with the global dominance of neo-liberal thought. Despite average GNP growth rates of over 6% per year in the second half of the 1990s, opponents assert that the New Economic Policy's effects have been underwhelming, particularly in a social sense. They make reference to the damaging effects of institutions and politics. Political whims, particularly politicians' desire to hold onto power, continue to have a significant influence on economic policies. This is a key factor in the failure of efforts to eliminate excessive regulation and dysfunctional economic governance laws. The language of equality has often been used as a justification for governmental involvement, but this has only served to increase the bureaucracy's power to regulate economic activity, hand out favors, and block progress.

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CHAPTER 4

AN ANALYSIS OF UNDER-UTILIZED POTENTIALS OF SOLID WASTE

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ABSTRACT:

Several aspects jump out when examining the prevalent tendencies, both in the research on the collection and disposal of urban solid waste and in policy practice. First and foremost, a concern for service efficacy and efficiency drives transformation in this area. The first is primarily economic, increasing output from a given input of resources and resulting in cost savings, whereas the second is concerned with the quality and coverage of services stemming from a desire to improve the overall public health situation, a concern that has always been high on (local) government agendas. As a result, effects on workers' working conditions have been of secondary consequence, while environmental concerns have been mostly absent. In actuality, the discussion of sustainable development has very little bearing on opinions and strategies for privatization and joint ventures in the collection and disposal of solid waste.

KEYWORDS:

Environment, Glass, Iron, Papers, Solid Waste.

INTRODUCTION

Relatively little consideration has been given to 'unofficial' practices by informal operators and/or community-based organizations, often sponsored by NGOs, when developing new rules for solid waste collection and disposal. Long before privatization ideas gained popularity, various types of 'unplanned' privatization often emerged in underserved urban areas. City administrations frequently ignore what has already been established on the ground because of the implicit bias in official policies towards large-scale solutions and formal businesses, which prevents them from realizing the contributions that these practices can and frequently do make to sustainable development. The literature on solid waste collection and disposal in poor nations typically misses connections with the other two key areas of solid waste management, namely the reuse and recycling of inorganic waste and the reuse of composted organic waste matter. This is a third, closely connected finding. Despite the fact that these activities might significantly decrease trash quantities, waste agencies are uninterested in them due to their focus on efficient and safe collection and disposal.

Additionally, a significant portion of these recycling and reuse operations occur beyond the jurisdiction of the government, and official attitudes often range from benign indifference to outright hostility. The likelihood of overlap or conflicts of interest between people operating across several fields is poorly understood. Finally, there is an evident propensity to consider urban solid waste collection and disposal in terms of conventional private sector involvement approaches. Official policy often places a lot of emphasis on a single approach, whereas in reality there are many players and actions that may be recognized, each with its own justification. This does not adequately reflect the wide range of situations and requirements that must be met, especially those of citizens who live in remote, sometimes underdeveloped locations. In the limited ways that the two situations permit, the present research attempts to partially address all of these flaws.

Regarding cooperation agreements, which (local) governments have hardly touched upon, a few additional words must be spoken. They often show a definite preference for outsourcing garbage collection services to big businesses in the event of privatization. Despite the fact that small-scale businesses and community-based organizations (CBOs) have previously shown their usefulness in a number of areas, most notably the supply and upgrading of housing, government entities are often hesitant to form partner ships with them. The majority of administrators and authorities believe that the presence of such small-scale, often informal or community activities, though not entirely, conflicts with their westernized beliefs about how to manage a contemporary city. The evasive nature of such operations is seen to pose a danger to the enforcement of governmental laws and ordinances (including sanitary codes and health standards) and may make it challenging to put in place appropriate punishments in cases of misconduct. In addition, the majority of local governments are unable to cover the transaction expenses associated with working with so many small businesses and community organizations. According to emerging concepts in urban management and local administration that acknowledge the potential of these players as well as the value of working with them, the mostly negative perspectives are beginning to give way to a more positive approach only very gradually.

Numerous studies indicate that micro and small businesses (MSEs) are capable of providing high-quality garbage collection services. Their benefits include lower costs due to the use of more appropriate technologies, like handcarts and donkey carts, higher flexibility, a stronger commitment to the job, closer ties to the community, and competition among MSEs. However, sometimes lower wages are achieved through severe underpayment of workers. The jobs "where there are no or few economies of scale, or where the effect of the economy of scale is easily compensated by increased efficiency" are best suited for these businesses. Sweeping and basic rubbish collection meet this criterion. These services might also be planned by community-based or cooperative organizations that include group effort. One benefit of such group action is intimate community engagement, which encourages responsiveness to local needs and increases the likelihood of active participation in the service, early payment of fees, and direct quality control. The initiative's sustainability may be threatened by its reliance on the knowledge and commitment of volunteers as well as the absence of a businesslike approach to service delivery. These "hidden" potentials are incorporated in the present research, and its contributions to sustainable development are evaluated.

The Importance of Local Governance

None of these possible benefits occur naturally. They rely on local government decision-making processes, relationships with the populace, and civil society organizations operating inside their borders. The demand for better local government is particularly apparent in cities in low- and middle-income countries, where there are several instances of innovation and better practice. Many come from more capable and democratic metropolitan administrations in countries like Brazil and Colombia where decentralization programs have given these municipalities greater authority and resources. Many others come from creative local civil-society groups, which are typically a mix of grassroots organizations and regional nongovernmental organizations (NGOs). These groups also increasingly work in partnerships with local governments, which helps create more transparent and democratic local governments [1].

Urban issues in the Global South are often attributed to urban expansion. However, some communities that have expanded quickly during the last 50 years have largely escaped the issues mentioned above. For instance, Porto Alegre, in Brazil, has had a rapid increase in population recently, going from having less than 500,000 residents in its metropolitan region in 1950 to over 3.5 million now. It boasts cutting-edge environmental regulations as well as a high-quality living environment. Indicators of environmental quality are comparable to those in Western European and North American cities, and its residents enjoy an average life expectancy. The city government was well-known in the 1990s for its dedication to promoting citizen participation, greater governmental accountability, good public health, and environmental management. Porto Alegre's participatory budgeting also included a comprehensive environmental management strategy, but it was founded on a thorough regional environmental study.

Sustainable city programs that address the backlog in infrastructure and services in the cities' poorest and worst-served neighborhoods and encourage methods for lower-income populations to get higher-quality homes are another innovation that is worth recognizing. This is referred to as "regeneration," "upgrading," and "community development," among other terms. The provision for water, sanitation, drainage, and trash collection in inner-city tenement areas and informal settlements has been significantly upgraded in many places where the backlog was greatest. These upgrades often included programs to enhance schools and health care as well. These were first thought of as one-time initiatives in "targeted" neighborhoods, but today it is understood that city and municipal governments need the capability and expertise to support ongoing upgrading programs throughout the city while collaborating with its residents [2].

This acceptance extends to the central government, as shown by the Community Organizations Development Institute (CODI) established by the Thai government, which provides direct access to housing loans and infrastructure subsidies to informal settlement residents who have organised savings organizations. These savings organizations decide on legal tenure, plan and carry out upgrades to their homes or create new ones, and collaborate with local governments or utilities to enhance infrastructure and services.

More than 700 projects totaling 80,200 homes were authorized by CODI between 2003 and June 2009 as part of the Baan Mankong (safe housing) programme. Within the next several years, the programme will see a considerable growth. The magnitude, the degree of community engagement, and the degree to which it strives to institutionalize community-driven solutions inside local governments all play a significant role in this. In order to enable urban poor networks of community organizations to collaborate with local government officials, other local players, and national agencies on citywide upgrading programs, CODI also offers assistance to these networks.

National organizations of slum and shack residents are growing in cities as well, and they are proposing innovative solutions to the problem of urban poverty. In more than 20 countries, there are national federations of slum/shack residents. The majority of savers and savings managers are women, and savings clubs serve as the basis for all of them. Slum/Shack Dwellers International, their own modest umbrella organization, serves as their communication and mutual assistance system. All of these federations are actively working to meet the requirements of their members, whether that means upgrading, supplying, or enhancing services or securing property on which to construct. Through the work of these federations, more than 150,000 families got land or a land tenure, and several million low-income individuals were given greater access to amenities like water and sanitation.

These federations are unique in that they understood that putting demands on governments that governments could not meet would not be very effective. The traditional methods of protest, strikes, barricades, and marches had been attempted by many, but they had not been particularly successful. They were aware that they needed to alter their interactions with public officials and elected officials. They needed to demonstrate to politicians and government officials that they were not "the problem" and that they could come up with solutions. Therefore, these federations gained the ability to act independently. When local governments collaborate with them, they can do much more on a much larger scale. They then offer partnerships to local governments. These federations have also shown that they are capable of doing the informal settlement enumerations and mapping required for planning upgrades [3].

This serves as a reminder that local reform is necessary to reduce poverty. Schools, healthcare, water and sanitation, land, social safety nets, the rule of law, and registration to vote are only a few of the necessities for the poor that must be secured through regional government organisations or local NGOs. Local power structures, patterns of property ownership, anti-poor politicians, bureaucracy, and rules and regulations within local governments are only a few of the local obstacles to poverty alleviation.

Cities' Contribution to Global Warming

The actions of specific individuals, companies, and institutions some of which are located in cities rather than cities, minor urban centers, or rural regions, are what cause human-induced greenhouse gas emissions. It is possible to divide the emissions from these activities among urban centers, smaller urban centers that can't be classified as cities, and rural regions, although this is not an easy task.

Large coal-fired power plants, for instance, would produce a lot of greenhouse gas emissions, but much of the energy they produce may be consumed elsewhere. For this reason, even when the power is produced elsewhere, cities are often assigned in greenhouse gas emission inventories the emissions created in delivering the electricity used inside their borders. This helps to explain why certain cities, such as those that rely on hydropower for their energy, have unexpectedly low emissions per capita.

Since consumption is the primary driver of practically all human-induced greenhouse gas emissions, shifting responsibility for greenhouse gas emissions to consumers reveals extremely significant differences between the top and lowest consumers. Although this is partially due to the fact that the contribution of the poorest people may be near to nil, the world's wealthiest high-consumption individuals are likely to be contributing to global warming hundreds of thousands of times more than many of the poorest individuals.

There may be as many as 1.2 billion urban and rural inhabitants who have consumption levels so low that they hardly make a dent in global warming.

Most of the time, they utilise wood, charcoal, or dung as fuel instead of fossil fuels, and they have no access to electricity. Most of these 1.2 billion "very low-carbon" individuals will travel by walking, biking, or using trains, buses, or minibuses with minimal emissions, which are often utilized at or near capacity [4].

Desirable Cities with Low Ecological Footprints

Theatre, music, museums, libraries, the visual arts, dance, festivals, the enjoyment of historic buildings and districts, a variety of dining options, particularly for local produce, or simply the enjoyment of living in a diverse and vibrant environment and being close to friends are just a few of the low-consumption characteristics of a high quality of life that are concentrated in cities. All of these are crucial if higher-income city inhabitants are to accomplish the considerable reductions in their lifestyle-related greenhouse gas emissions that are required to prevent disastrous climate change. In fact, in high-income countries, city leaders often show a stronger commitment to greenhouse gas reduction than national politicians. Cities have traditionally been centers of social, economic, and political innovation. The ability of cities to combine a high quality of life with low greenhouse gas emissions must be recognized and taken advantage of if we are to achieve the necessary decrease in world emissions. Considering cities to be "the problem" also fails to take into account the degree to which well-managed cities may separate good living standards from high greenhouse gas emissions. However, how a city is developed, run, and controlled has a significant influence on how it will respond to the effects of climate change [5].

Although many cities in Latin America, Africa, and Asia may have low greenhouse gas emissions per capita, the increased frequency and/or intensity of floods, storms, and heat waves, as well as water supply restrictions brought on by climate change, pose a threat to hundreds of millions of people living in these cities. Low-income populations are often more at danger because they live in unofficial settlements on landslip or flood-prone locations without drains or other protective equipment. This is often forgotten in discussions on climate change priority. As well as focusing on the problems that climate change is anticipated to bring, these debates neglect the dangers that a large portion of the urban population has long experienced due to inadequate infrastructure, services, and safe land locations for additional construction.

The management of solid waste disposal is often used to describe the procedure for gathering and handling solid wastes. It offers ways to recycle things that don't belong in the trash or rubbish. It is possible to define solid waste management as the process of transforming waste into a useful resource. Municipal solid waste that is disposed of improperly may lead to unhygienic circumstances that can pollute the environment. Rodents and insects may transmit diseases. The handling of solid waste presents difficult technological hurdles. They may also provide a broad range of administrative, social, and economic issues that need to be addressed [6].

Methods of Solid Waste Disposal and Management:

Here are the methods of solid waste disposal and management:

a) Solid Waste Open Burning

b) Sea dumping process

c) Solid wastes sanitary landfills

d) Incineration method

e) Composting process

f) Disposal by Ploughing into the fields

g) Disposal by hog feeding

h) Salvaging procedure

i) Fermentation/biological digestion

Solid Waste Open Burning: Solid waste open burning is not the perfect method in the present scenario.

Sea Dumping Process: This sea dumping process can be carried out only in coastal cities. This is very costly procedure and not environment friendly.

Solid Wastes Sanitary Landfills: Solid wastes sanitary landfills process is simple, clean and effective. In this procedure, layers are compressed with some mechanical equipment and covered with earth, leveled, and compacted. A deep trench of 3 to 5 m is excavated and micro-organisms act on the organic matter and degrade them. In this procedure, refuse depth is generally limited to 2m. Facultative bacteria hydrolyze complex organic matter into simpler water-soluble organics

Incineration Method: Incineration method is suitable for combustible refuse. High operation costs and construction are involved in this procedure. This method would be suited in crowded cities where sites for land filling are not available. It can be used to reduce the volume of solid wastes for land filling.

Composting Process: Composting process is similar to sanitary land-filling and it is popular in developing countries. Decomposable organic matter is separated and composted in this procedure. Yields are stable end products and good soil conditioners. They can be used as a base for fertilizers. Two methods have been used in this process:

i. Open Window Composting

ii. Mechanical Composting

Disposal by Ploughing into the Fields: Disposal by ploughing into the fields are not commonly used. These disposals are not environment friendly in general.

Disposal by Hog Feeding: Disposal by hog feeding is not general procedure in India. Garbage disposal into sewers including BOD and TSS increases by 20-30%. Refuse is ground well in grinders and then fed into sewers.

Salvaging Procedure: Materials such as metal, paper, glass, rags, certain types of plastic and so on can be salvaged, recycled, and reused.

Fermentation/biological Digestion: Biodegradable wastes are converted to compost and recycling can be done whenever possible. Hazardous wastes can be disposed using suitable methods [7].

DISCUSSION

The dangers involved are difficult to manage. The same ability, capacity, and desire of local governments to collaborate with people most at risk in enhancing living conditions and upgrading informal settlements are required to address these concerns. For instance, it won't happen if local governments continue to see everyone living in informal settlements as the issue rather than the outcome of the government's own shortcomings, particularly the inability to guarantee that there is enough legal land available for the construction of dwellings. Or if the local administration is blind to how very important the residents and businesses in informal settlements are to the prosperity of the city (albeit their contributions would be much increased if they received better treatment from local government). If adaptation to climate change is seen as a peripheral concern to local development and catastrophe risk reduction, it will not occur. And that won't happen if foreign assistance organizations ignore metropolitan regions (as is the situation right now). It requires a fundamental shift in how equipped and capable most aid organizations are to collaborate with local governments and organizations serving the urban poor. They too must recognize and comprehend how cities may support sustainable development [8].

CONCLUSION

In conclusion, efficient urban solid waste management is essential for protecting public health, the environment, and natural resources. The difficulties in managing this waste stream are complex, necessitating an all-encompassing strategy that takes into account factors including trash creation, collecting techniques, transportation, disposal, and recycling. As this study has shown, effective waste management requires cooperation and involvement from all stakeholders, including the public, trash management businesses, and government organizations. Improvements in waste management procedures and the achievement of sustainable results may be facilitated by technological advancements, legislation changes, and public awareness campaigns. Even if there is still much to be done in this area, it is obvious that creating thriving, resilient, and sustainable cities depend on the efficient management of urban solid waste.

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CHAPTER 5

AN OVERVIEW OF SOLID WASTE DISPOSAL AND COLLECTION PRACTICES IN VARIOUS CITIES

ABSTRACT:

The preservation of the environment's quality, public health, and safety, proper solid-waste collection is crucial. It is a labor-intensive operation, as it makes up around three-quarters of the overall cost of solid-waste management. Although, the task is frequently allocated to public personnel, there are occasions when it is more cost-effective for private businesses, to carry out the activity on the municipality's behalf, or for private collectors to be paid by individual property owners. There are several methods of collection of the solid waste. In this article, we will discuss some of the methods of solid waste collection**.**

KEYWORDS:

Biomass, Environment, Health Sector, Solid Waste, Waste Management.

INTRODUCTION

The Municipal Corporation of Hyderabad (MCH) has operated the 'Voluntary Garbage Disposal Scheme' (VGDS) since 1993. Around 175,000 families were served by the scheme in 1999, which was active in over 1,000 residential colonies. The scheme's main goal is to encourage individuals to participate in solid waste management via their charity organizations. The MCH offers free tricycles to communities so that waste may be collected from home to house. The MCH picks up the rubbish and transports it to one of the dumpsites while the welfare organizations hire waste pickers who are paid a monthly fee of Rs 10 per home to collect and carry the garbage to designated vantage points. In order to make it easier to separate organic and inorganic garbage at the source, households are given two trash cans. Further separating the inorganic debris, the garbage pickers sell precious items to waste dealers. The MCH has designated certain locations nearby for the organic waste to be transported to in order for CBOs and NGOs to use vermiculture to transform it into manure.

This programme demonstrates the local government's intention to enhance the effectiveness of the city's solid waste management1. Another indication of the MCH's proactive approach is the growing engagement of the private sector in sweeping and rubbish collecting activity since 1995. There were valid justifications for attempting to harness the abilities of other urban players in the provision of public services. Hyderabad's percentage of uncollected rubbish was reported to be between 25 and 35 percent in the middle of the 1990s. At that time, some regions had trash pickup once a day, every other day, and still others just once a week. However, after the adoption of the unit system and the deployment of private sweeping and garbage collection workers, the performance has significantly increased in terms of both coverage and frequency. Nevertheless, there are still issues, particularly in the city's low-income and unincorporated areas. For political reasons, serving the middle- and high-income neighborhoods is prioritized. This chapter examines the performance of the MCH's solid waste management system, often known as SWC, in terms of how it contributes to urban sustainable development. The organizational structure will be briefly described before the analysis begins. The main waste producers and waste collection players will then be identified. The performance of different institutional arrangements in SWC will then be systematically evaluated using the indicator system. Conclusions on the right policy responses may be reached on the basis of this assessment. The book's appendix contains a methodological remark on the research activities conducted in Hyderabad. The reports that served as the foundation for this overview include further information about the study.

Organizational Structure

The MCH functions under the control of an elected Commissioner who supervises the various departments charged to implement the municipality's statutory responsibilities. The task of SWC is discharged by the Health Department headed by the Chief Medical Officer of Health. The Health Department has two wings, viz. The Sanitary conservancy section as mention in Figure 1 and The Transport section. The sanitary wing takes care of street cleansing and collection of waste, while the transport wing sees to transportation and disposal of waste. The Engineering Department maintains transport vehicles such as tipper trucks, compactors, lorries etc.

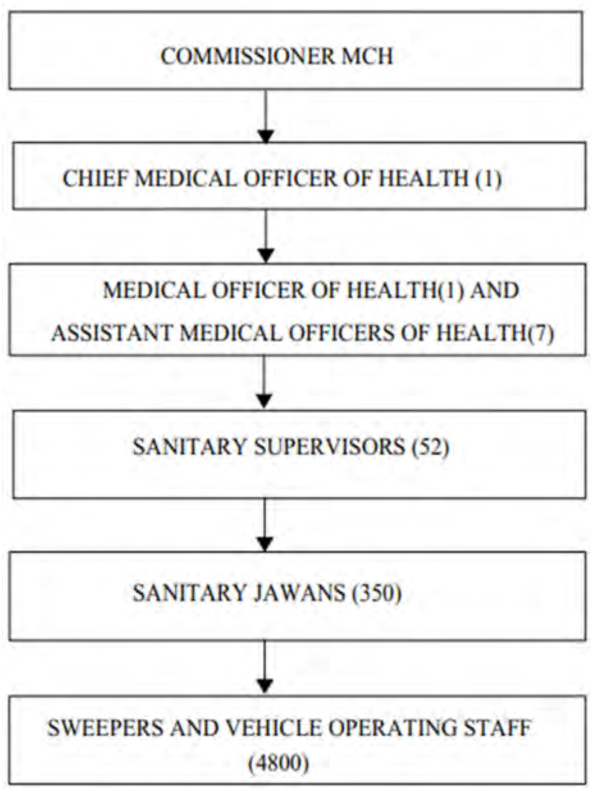

Figure 1: Illustrated the Management Chart for the Sanitary wing of the Health Department

As shown in Figure 2, the MCH is split into seven rings, each of which is overseen by an Assistant Medical Officer of Health and is staffed by sanitary supervisors who, in turn, are backed by the so-called sanitary jawans. In the middle of the 1990s, it was stated that the MCH had a personnel shortage of more than 50%. The latter oversee daily operations by the conservancy staff, which consists of drivers and sweepers (both men and women). The presence of commercial operators in SWC has in the meanwhile helped to somewhat counterbalance this issue [1], [2].

Since 2000, SWC in the city must adhere by the Municipal Solid Wastes Management and Handling Rules, which were established by the Central Government and published by the Ministry of Environment and Forests. The municipality is in charge of carrying out these regulations and any infrastructure improvements needed for proper SWC. In the event of violations, sanctions may be applied. Municipalities are being compelled by these regulations and their legal ramifications to take SWM seriously in their judicial domains.

Figure 2: Illustrate the Map of Hyderabad's Administrative Divisions and Location of Dumpsites

Organization Of SWC Services

i. Collection and Disposal

The production of solid waste occurs in both homes and institutions. A further differentiation between the high, medium, and low-income levels is often established among the households. Government institutions, such as schools, offices, and hospitals, may be further split into private institutions and public institutions, such as stores, marketplaces, offices, hotels, and private clinics. All of these generators (primary storage) keep their garbage on or close to their properties. From these basic storage places, office boys, servant maids, tricyclists participating in the VGDS programme, and shopkeepers remove some of this garbage, the amount of which is unclear. Following the separation of the waste by the aforementioned actors, part of the organic waste is delivered to cow farms by herders, while the remaining portion is transported to composting facilities by MCH, private vehicles, and tricycles (under the VGDS; see chapter 10). Urban farmers purchase compost from the composting facilities. Inorganic garbage is purchased at main collection sites by itinerant purchasers and small dealers who then sell the waste to retail and wholesale traders. Some garbage from the wholesale dealers is provided for local reusing, some is shipped to neighboring states, and the remaining is sent to recycling facilities. The majority of the amount of garbage created in the city is still generated from mixed and unsegregated municipal solid waste, which is deposited at secondary storage locations or dustbins [3].

Workers from the MCH and the private sector transport the garbage from the secondary storage stations, or roadside dustbins, to collecting points where it is discarded. The MCH has supplied 4,900 concrete cylinder trash bins (0.6 cum), 420 metal waste bins (1 m2), and 105 garbage houses (2.5 m2) spanning all the areas3. These communal waste bins are often found at street corners in the city. In order to identify materials with a potential financial value, both official waste workers and unofficial waste pickers sort waste at these intermediate locations. In practice, only recyclable materials are selected here because the majority of reusable materials have already been removed and the organic materials have become too contaminated. The MCH trucks bring the rubbish to one of the transfer stations and from there (in bigger vehicles) to dumpsites, while the private trucks straight go for the latter. there things are sold to itinerant purchasers, retail, and wholesale dealers from the secondary collecting locations. Some rubbish is gathered from the transfer stations and dumpsites and sold to retail and wholesale merchants by dumpsite waste pickers.

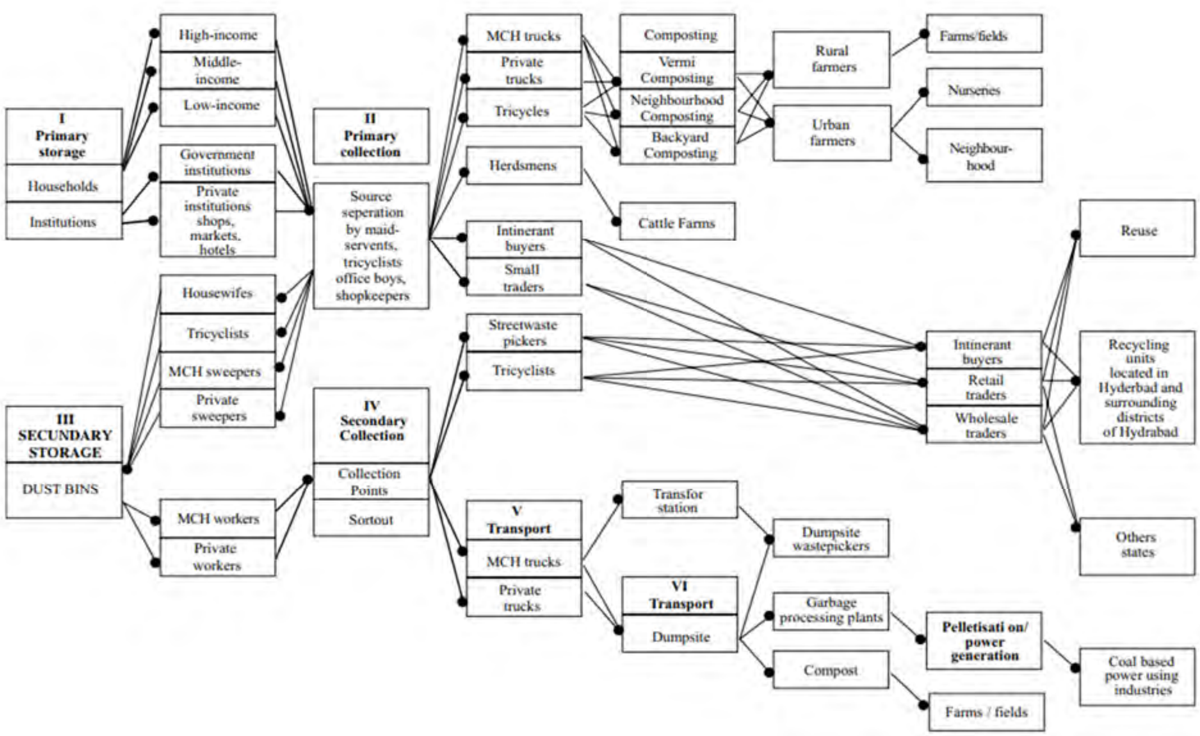

Figure 3: Illustrated the steps in the generation, collection and transportation of solid waste.

Currently, the MCH transports 200 tonnes of residual garbage daily to Selco International Limited, where it is converted into pellets (a replacement for coal). The industries that purchase the pellets on the market are those that generate electricity using coal4. Rural farmers used to transport some of the unsorted rubbish that was still present at the dumpsites to their farms and fields so that it might be composted. However, due to growing understanding of harmful externalities, this practise has been abandoned. Figure 3 provides a summary of the full generating, collecting, and transportation system [4].

183 trucks are now available for garbage transportation via the MCH. The fleet as a whole can remove about 1,700 tonnes per day with an average lifting capacity of 9 tonnes per day. However, in reality, only up to 900 tonnes are sent to one of the dumpsites each day. The fleet now has an average of 20% of its equipment out of commission. The MCH system is also split into two circuits: from secondary collection stations to a transfer station, when it is transferred into bigger trucks that take it to its final destination, the garbage is transported using smaller (open) vehicles [5].

Open dumping is the most popular way to dispose of trash in Hyderabad. There are three authorized waste sites inside the city: the 45-acre Mansoorabad dump site, which is situated 20 kilometers from the city centre; the 20-acre Jamalikunta (Golconda) dump site, which is located 8 kilometers from the centre; and the 22-acre Gandamguda trash site, which is located 10 kilometres from the core of the town. As the park's limits were being expanded in 1995, the Sanjivaiah dumpsite was shut down. Other unauthorised open dumpsites may be found across the city, including those at Hussiansagar. Some claim that the municipal staff once dumped trash in abandoned wells. However, the number of illicit dumping has undoubtedly decreased under the current unit system since payment to private service providers is based on trip registration [6].

Waste Characteristics

As shown in Table 1, the high decomposability of the material demands regular collection and disposal of municipal solid trash. Additionally, over time, the waste's properties have changed: although the organic (compostable) percentage is decreasing, the amount of inorganic material has been rising. The percentage of organic matter, however, is largest among low-income groups and decreases as income levels rise, while the inorganic fraction rises as household income levels do. The following are the primary components of household waste:

i. Combustibles (paper, plastics, rags);

ii. Non-combustibles (glass, metal);

iii. Compostables (vegetable/food, leaves);

iv. Toxic battery cells etc.

Table 1: Illustrated the Physical Composition of Fresh Urban Solid Waste

Sr. No.	Characteristics	Percentage
1.	Biomass	55.1
2.	Paper	7.2
3.	Rubber/leather	2.1
4.	Plastics	2.5

5.	Rags	8.0
6.	Metals	0.3
7.	Glass	0.3
8.	Sand/fine earth	13.1
9.	Stones etc.	12.2

Waste Generators

Based on the premise that the average production rate per individual is somewhere around 0.35 kg and that there are around 4 million people overall, the amount of solid waste created in the MCH is estimated to have been 1,500 tons/day in 1999. The amount of garbage produced varies depending on income level, ranging from 0.24 kg/day for the lowest income groups to 0.75 kg/day for the highest income groups. The waste producers may be roughly classified into two categories: large producers, both public and private, and small producers, particularly households. The former has 34 marketplaces, commercial hubs, and entertainment venues, 923 hotels and restaurants, 93 event spaces, 417 nursing homes and hospitals, as well as slaughterhouses and 30,000 livestock . There are also around a million households. Even while they alone produce a modest amount of trash, when combined, they make up roughly a quarter of the overall volume Table 2.

Table 2: Illustrated the Waste Generation.

Source	*Units (approx.)*	*Estimated volumes (tons per day) Abs*	*Estimated volumes (tons per day) percent*
Households	1.0 million	1050	75
Hotels and restaurants	923	80	5.7
Function halls	93	?	?
Markets	20	60	4.3
Hospitals and nursing homes	417	60	4.3
Slaughter houses	5	20	1.4
Recreation and community centres	35	80	5.7
Dairies etc.	30,000 (cattle)	50	3.6
All sources		1,400	100

DISCUSSION

Over the last 20 years, the twin city has seen a surge in the number of hospitals, nursing homes, and clinics. They produce garbage that contains toxins and infectious agents, which is dumped in either masonry bins constructed within the hospital's walls or street trash cans. Each hospital should have its own incinerator facility in accordance with national laws. In reality, only a few hospitals have such a facility since it is so expensive. Even when they have an incinerator, it may not always be able to utilize it because of routine maintenance or power outages. Hospital waste disposal methods have been looked at in the current research of eight hospitals. They include a private nursing home, corporate and philanthropic hospitals, and government hospitals. The majority of the hospitals in the sample have developed relationships with other hospitals for the provision of services. For instance, Vijaya Marie Hospital and Appollo Hospital collaborate on hospital waste disposal. All hospitals have payment agreements with the MCH, with the exception of Mendicity Hospital [7], [8].

CONCLUSION

Hospital trash may be disposed of via a variety of techniques. All of the public hospitals in our sample dispose of anatomical waste, such as human tissues, organs, and body parts, by burying it deeply. In other hospitals, after being covered, they are just thrown away in trash cans. The majority of hospital trash, including expired medications, blood-contaminated materials, and laboratory cultures, is disposed of in waste bins, however sometimes these products are autoclaved or cremated before being disposed of in waste bins. There are incinerators at just three hospitals. However, one of them (the Osmania hospital) does not have an incinerator because of limitations set by the Pollution Control Board. The remaining five hospitals in the sample don't have incinerators. Before being placed in trash cans, items are separated at each of the eight hospitals. In the end, just four hospitals offer products made of paper, plastic, and iron. All hospitals are happy with the MCH employees' work, which includes daily or sometimes every two to three days cleaning of the trash cans. Nevertheless, five of the eight hospitals in our sample intend to contract with private garbage collectors because they believe that their timeliness and reliability will enable them to perform more effectively than MCH employees. Additionally, they believe MCH is unqualified to handle biological waste in a competent way.

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CHAPTER 6

OVERVIEW OF THE COLLECTION THE SOLID WASTE FOR RESIDENTIAL AREA

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ABSTRACT:

Dumping mixed waste in landfills has been a key part of India's waste management strategy but landfills emit methane a greenhouse gas roughly 21 times more potent than CO_2. The fumes of landfill gas, when inhaled, cause respiratory problems, especially in children. Residents of areas surrounding landfills are forced to consume water poisoned with leachate and no water purification system can make the groundwater around such landfills potable. If we continue to dump garbage at the current rate, it is estimated that by 2047, India will need 1,400 square kilometers of landfill space or the combined area of Chennai and Hyderabad.

KEYWORDS:

Ecofriendly, Environment, Plastic, Residential Area, Solid Waste.

INTRODUCTION

Every structure, including residential, commercial, educational, lodging, and hospitality facilities, generates a significant quantity of garbage. Therefore, the facility management staff must concentrate on managing it in the best possible way. What steps therefore should be considered for managing garbage in business and residential buildings? The degree to which trash may be properly controlled relies on the building's architecture and the residents' objectives. Reducing waste depends on the occupant's actions. Through a variety of techniques, the Integrated Facilities Management services team is essential to successful waste management and recycling.

- **i.** Providing two distinct trash cans in each unit so that dry and moist waste can be stored separately.
- **ii.** Informing the building's residents of the need of separating wet and dry trash at the source.
- **iii.** Placing trash cans on each level and podium.
- **iv.** Daily collection of dry and wet trash from each unit, separation of the two types of waste, and efficient disposal of both.
- **v.** Keeping track of waste management data and performance.
- **vi.** Where necessary, the acquisition of suitable waste processing equipment, such as composting machines, sewage treatment facilities, etc.

The facilities services crew at the building has a number of waste management options at their disposal.

i. **Recycling and Reuse**

The facilities management services team must make it possible for users to effectively separate wet and dry trash at the source. While the local government's trash collection trucks and scrap dealers may be used to dispose of dry waste, a compost machine located on the property of the building can be used to transform wet waste into compost. The compost created in this way may be utilized in the building's garden or sold in the market.

ii. Renovation Initiatives

Ask your contractor to create a debris waste management strategy with an emphasis on repurposing materials while remodeling the space. Obtain receipts from the garbage haulers as well to keep track of the quantity of recycled and reused items. Additionally, this will be useful for future planning purposes if a refurbishment is required.

iii. Waste Assessment

A waste assessment or audit is a logical examination of your facility and its operational procedures to identify the volume and makeup of the components in your waste stream. Maintaining a record of what has been disposed of will enable you to tailor your waste reduction program appropriately.

iv. Donate

The local food banks that collect food and distribute it to the needy may accept donations of spare food or supplies from homes, workplaces, hotels, and restaurants. As it is totally free, you will be able to reduce your disposal and storage expenditures [1].

Types of household waste

1. **Organic Waste**

a. **Liquid Waste:** Food leftovers, fruit/vegetable peels, waste tea powder, coffee beans, landscape and pruning waste, other green waste, processed food, raw food materials, meat and bones, food-soiled paper, eggshells, leaf plates.

b. **Dry Waste:** Newspapers, magazines, brown paper, paper bags, paper packaging materials, ribbons, strings, leaflets, notebooks, wood, furniture.

2. **Non-organic Recyclable waste (solid rubbish)**

   a. **Plastic:** Plastic bags, containers, jars, bottles, covers, caps, milk pouches, food packets, soda bottles, wrappers.

   b. **Metals:** Utensils, batteries, pipes, nails, tools, aluminum foils, metal scraps, tetra packs, wires.

   c. **Glass:** Bottles, plates, cups, shards, mirrors, ceramics.

3. Hazardous waste

a. Insect sprays, syringes, diapers, sanitary napkins, cleaning chemicals, bleach containers, corrosives, flammable liquids, solvent-based paint, car batteries, e-waste, bio-medical waste.

4. Inert Waste

a. Sand, concrete, clay, subsoil, rubble

House-to-house Collection

To increase people's engagement in SWM, the MCH is also looking to form alliances with NGOs and community-based organizations. It first debuted the VGDS in 1993, and it is now used in more than 1000 residential areas, serving over 175,000 homes. The MCH provides assistance by making tricycles three-wheel bicycles with waste reservoirs freely accessible to citizens. The British government is sponsoring the expansion of the project into slum areas. home to home rubbish collection is done by waste pickers who are employed and compensated by neighborhood welfare organizations. Residents fund the system by paying a monthly charge that ranges from Rs 5 to Rs 20 depending on how much rubbish has to be removed from each residence, with combined families contributing more. People want value for their money, and welfare organizations enforce stringent oversight, thus the system is quite successful. In the colonies taking part in the program, there is no longer a need for trash cans since waste pickers collect the trash at doorsteps and take it to secondary collection locations outside the regions [2], [3].

Contributions to Socio-Economic Aspects of Sustainable Development

i. Economic efficiency and Viability

When it comes to the amount that charges are able to cover the cost of the service, Hyderabad's SWC system performs poorly in terms of allocative efficiency. Although SWC expenses are a significant portion of the municipal budget, user fees have not yet been attempted. It would be unusual by worldwide standards if cost recovery had been implemented with the emergence of the private sector. Even open discussion of the subject is discouraged due to the significant political costs associated with imposing a new tax on the populace. In a similar vein, the contractor interviews revealed a considerable aversion on their part to participating in a franchise structure since they think tenants would not pay their dues.

According to data collected for the years 1998–1999, it appears that the average labour productivity of workers in the private sector is slightly higher than that of MCH workers, with 0.24 and 0.19 tonnes of garbage lifted per day per worker, respectively. This is in terms of the operational performance of the service providers (productive efficiency). Additionally, the MCH always pays more to clean the streets and move a tonne of rubbish than the private sector does. Additionally, as a consequence of advancements in the privatization process, local contractors have been able to lift rubbish for less money over time.

But the contract requirements established by the government account for a significant portion of the private sector's competitive advantage. Due to this, private contractors are compelled to use relatively outdated cars to save transportation expenses while also paying very low rates [4].

The levels of satisfaction among local contractors were astonishingly high, despite the fact that their entrepreneurship had been curtailed and their profit margins had been adjusted lower. They have a reliable source of income via SWC. However, the present privatization strategy has two significant shortcomings from the standpoint of productive efficiency. First off, the contract's stipulations prevent the entrepreneur from freely choosing the combination of manufacturing components. The system prohibits innovations that could result in cost savings. Second, the contracts only last 10 months, with a 5-month pre- and 5-month post-monsoon term each, leaving the business owner and his or her employees with little job security. These factors account for why private contractors seldom make investments in their business, as is shown from the fact that the majority hire rather than purchase their cars.

The Hyderabad contracting system's drawback is that new technology hasn’t been included into SWC as a result. Of course, this has something to do with the contractors' obligation to employ a certain number of employees. They further assert that since contracts are often short-term, they are unable to recoup their investment in trucks or mechanized sweeping equipment [5].

Employment and Labor Conditions

Since the implementation of privatization initiatives, there are considerably more workers employed by SWC overall. A total of 3,650 additional employees were hired under the unit system. How their working circumstances compare to those of MCH-workers is a crucial subject. The latter's average net pay is three times more than that of a worker in the private sector. Additionally, government workers get a number of non-wage perks, such as cleaning supplies, leave days, health insurance, pensions, and vacation days. Most employees in the private sector are forced to live without these perks. Contractors often disregard clauses in contracts pertaining to the wellbeing of their employees. They very never make contributions to the Provident Fund (PF) or Employees State Insurance (ESI). While the contract stipulates payment of the minimum salary of Rs. 1,300, the average monthly income of a worker is Rs. 1,100. In order to shield them from harassment, female employees are not meant to work nights, however the majority of all-night employees are female. Another area where private sector employees fall short of their counterparts in government service is job security. MCH employees are employees for life, while contract workers in the private sector are subject to termination at any moment. The short term of the service agreements suggests that their employment is only secure for that time frame. In reality, as a consequence of MCH engagement, the situation of contract labour has even become more precarious. The municipality modified the contract requirements at the expense of the workers, who were forced to label their work as "non-permanent," drop the requirement for ESI and PF facilities, and remove the requirement to wear uniforms in an effort to prevent the elimination of the financially advantageous labour contracting system adopted by the contractors. However, it must be noted that despite these apparent discriminations, the affected workers are generally content with their employment, which compare positively in terms of pay and job security to roles they had held earlier in their careers [6], [7]. The majority of SWC employees believe their workload is very high and complain that their employment is harming their health. The MCH employees may, however, utilise their vacation days to remain at home if they are ill. Employees in the private sector find it difficult to disclose illnesses, and over half of them admitted to working for more than one day while unwell. The percentage for MCH workers was 4%.

Domestic waste management system in India Rules

The standard procedure in apartments and societies also known as large producers of waste is for the housekeeping staff to collect trash door to door, which the municipal corporation or a designated waste collection firm would subsequently pick up from the curbsides. Some people's "dump it all in one garbage bag" philosophy makes sorting waste a huge task. garbage collectors can hardly physically separate dry, moist, and poisonous garbage without harming themselves, not to mention the many hours lost sifting through the massive amounts of rubbish that are collected every day.

The Ministry of Environment updated the Solid trash Management Rules in 2016, mandating trash separation at the source in order to "recover, reuse, and recycle" garbage in order to transform it into money. The new regulation places responsibility for trash management with the waste producer so that it may be managed effectively and decentralized without taxing the infrastructure and resources of the government. Additionally, they required local authorities to develop a thorough waste management plan in accordance with state law within six months of the Rules' notice. As a result, the specific bye-laws created by each Indian city's urban local authorities regulate its solid waste management strategy. Many of the bye-laws' clauses are shared by all states [8], [9].

Contributions to Public Health and Environmental Aspects of Sustainable Development

Cleanliness of Neighborhoods

On paper at least, sweeping, rubbish collection and transportation occur regularly and every day in all units. However, the study of residents in neighborhoods served by the MCH and private contractors found that the frequency of sweeping, collection, and cleaning of trash cans in their neighborhoods is widely regarded to be less than once per day. In privately run facilities, where frequency and cleanliness have increased since the MCH completed the work five years ago, levels of satisfaction are marginally higher. The municipal labour force, which was around half the normative needed strength prior to privatization, could be deployed in a considerably more constrained area of the city, which has resulted in an increase in service levels in the MCH-serviced units as well.

Residents generally have a favorable opinion of SWC's privatization. Due to rigorous oversight and more job insecurity, the majority of individuals believe that private employees would provide superior results. As a result, SWC has a high level of social credibility among private businesses. It is also possible to see advances on a city-wide scale. Following privatization, the geographic reach of basic collection services has been increased. This is mostly due to the city's increased expenditure in solid waste management. However, partially as a consequence of the uniform package, privatization is only applied in regions with high accessibility and planned design. Slum neighborhoods still get appallingly inadequate services. More than half of the chosen respondents said that residents in these unlawful areas of the city often lack trash cans in their neighborhood, which leads to many of them engaging in random dumping practices [10].

Health of Workers

The system of SWC in Hyderabad continues to rely heavily on manual labour. Sweeping and lifting is usually done manually and this is extremely demanding. The labor-intensive nature of the work derives at least partially from the strength of labor interests in (local) politics discouraging the replacement of labor by capital. Anyway, laborer's are in continuous contact with the garbage and, hence, stand a good chance of being infected or hurt. Although the employers are obliged to provide protective clothing and safety equipment to their workers, both parties often contravene these requirements. There is some reason to believe that private workers, on average, are slightly worse off than their MCH colleagues. In the private sector, loading and unloading of vehicles, for example, is almost exclusively done by manual labour because contractors rarely use trucks with hydraulic lifting devices. The current contracting system does not encourage investment in equipment that will make work easier. Furthermore, contractors are more likely to save on protective gear.

Environmental Impact

The MCH's SWC policy is largely focused on lowering urgent risks to public health. The major objective is to maintain neighborhood cleanliness and to have managed garbage removal from these locations. The reduction of trash, the promotion of recycling, and the avoidance of waste creation get little attention. Therefore, any repercussions of the policy in these areas are unintended. There may be a few unintended negative effects on the ecosystem. The first issue is that the private contractors often use extremely old vehicles, which typically generate significant levels of pollutants. The contractors' trucks must comply with the contract's requirements and be less than 15 years old. The actual age of the vehicles being used by the contractors is 27 years; 52% of the trucks are over 25 years old12. Additionally, the MCH mandates that the private contractors' vehicles unload their contents at the specified dumpsites rather than one of the intermediate transfer stations. As they go to and from the disposal sites, which are located far from their unit areas, the trucks are often stopped in traffic. Due to improper packaging without a top cover, littering of garbage during transit is extremely prevalent. Rather than the MCH vehicles, this appears to relate more to the trucks utilized by private operators. The privatization of SWC most likely only has a little influence on trash recycling and reuse.

On the one hand, the actions allowed garbage pickers to separate valuable items by making more mixed rubbish accessible at secondary collection stations and dumpsites. However, those formally in charge of SWC will try to prevent waste pickers from having unfettered access to the trash since this hinders their job and can result in littering. The amount of waste that is being collected and disposed of in a controlled manner has increased significantly, which has a clear positive effect on the privatization campaign. This reduces environmental hazards for people living in residential areas risk of contracting an infectious or parasitic disease due to waste exposure and for environmental degradation (water pollution or soil degradation due to leakage). However, additional garbage will also be brought to the dumpsites, causing their capacity to be used up sooner. The environmental issues related to this sort of disposal will undoubtedly become worse when the open dumping technique rather than the sanitary landfill is used [11].

DISCUSSION

The gathered wastes pile up as a result of poor solid waste disposal, notably by waste management organisations, and they start to pose a concern for the environment as well as for the general population. Biodegradable materials are forced to decay and breakdown under abnormal, unregulated, and unsanitary circumstances by the dumping of massive amounts of rubbish. It becomes a breeding habitat for many pathogenic organisms and disease-causing insects after a few days of decomposition. The region produces a bad odor and loses some of its visual appeal. Toxic metals, chemicals, and other dangerous pollutants are among the solid wastes gathered from many businesses. When these wastes are discharged into the environment, they may cause biological and physicochemical issues; the chemicals may seep into the soil and contaminate the groundwater; they may also affect the soil productivity in that specific location. In a few rare instances, hazardous wastes may mix with regular trash and other flammable wastes, making disposal more difficult and dangerous. Dioxins and other harmful gases are created and discharged into the air as a consequence of burning hazardous wastes and scrap paper, which also causes other ailments including cancer, skin infections, and chronic disorders.

CONCLUSION

By generating, using, and squandering natural resources, human lifestyles have put strain on the ecosystem and thrown eco systems out of equilibrium. Due to SW production and economic growth, the most of nations obovately have significant environmental impacts since natural resources are utilized and waste and pollution are generated. As a result, there is now more concern about solid waste management as a component of sustainable development. This research looked at the value of SWM for sustainable development in the context of India's new HMC development process. With the study, four research goals were to be attained. Studying the characteristics of Hyderabad Municipal Council's solid waste management practices was the initial goal. The researcher analyzed how waste management practices may help to support the development processes in Hyderabad District and looked into the environmental effects of solid waste management practices in Hyderabad Municipal Council. It was also important to learn how local populations felt about solid waste management in order to promote sustainable environmental development.

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CHAPTER 7

OVERVIEW OF THE WASTE GENERATION AND MANAGEMENT

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ABSTRACT:

Until recently, the production and consumption model were primarily linear, i.e. it consisted of a sequence of stages from resource extraction, production and consumption to the discarding of waste. This system is highly inefficient and unsustainable in time. We live on a finite planet in which consumables fuels, materials are limited for a demanding and growing population. Also, both productive processes and waste generated very often have a high impact on the environment and living beings. The way to combat these effects is to change our model of production and consumption, changing from a linear economic model to a circular economy, which emulates nature by converting waste into resources. This type of economy promotes, right from stage one, the reduction of consumption, taking into account a product's useful life and, at the end of that, its reuse or recycling.

KEYWORDS:

Ecofriendly, Environment, Plastic, Residential Area, Solid Waste.

INTRODUCTION

In the past, waste management was a job for engineers. It has to do with how society has changed as a result of technology, which has led to both advantages and drawbacks that need solid waste disposal. Diagrammatic representations of the material flow in a technological society and the waste production that results are provided. Wastes are produced during the mining and manufacture of raw resources, such as the abandoned maize husks from a field or mine tailings. More waste is produced throughout later stages of the processes that create things for society to consume out of these raw materials after they have been mined, harvested, or otherwise obtained. The diagram shown in Figure 1 makes it clear that the best way to solve the issue of solid waste disposal is to reduce the quantity and toxicity of waste produced. However, as people strive for a better life and a higher standard of living, they tend to consume more goods and produce more waste. In order to limit the quantity of garbage that has to be landfilled, society is looking for better waste management techniques [1], [2].

Solid waste generation in a community is often influenced by zoning and land use. Although there are many possible source categorization schemes, the following groups have shown to be helpful:

- **i.** Residential,
- **ii.** Commercial,
- **iii.** Institutional,

iv. Construction and demolition,

v. Municipal services,

vi. Treatment plant sites,

vii. Industrial,

viii. Agricultural.

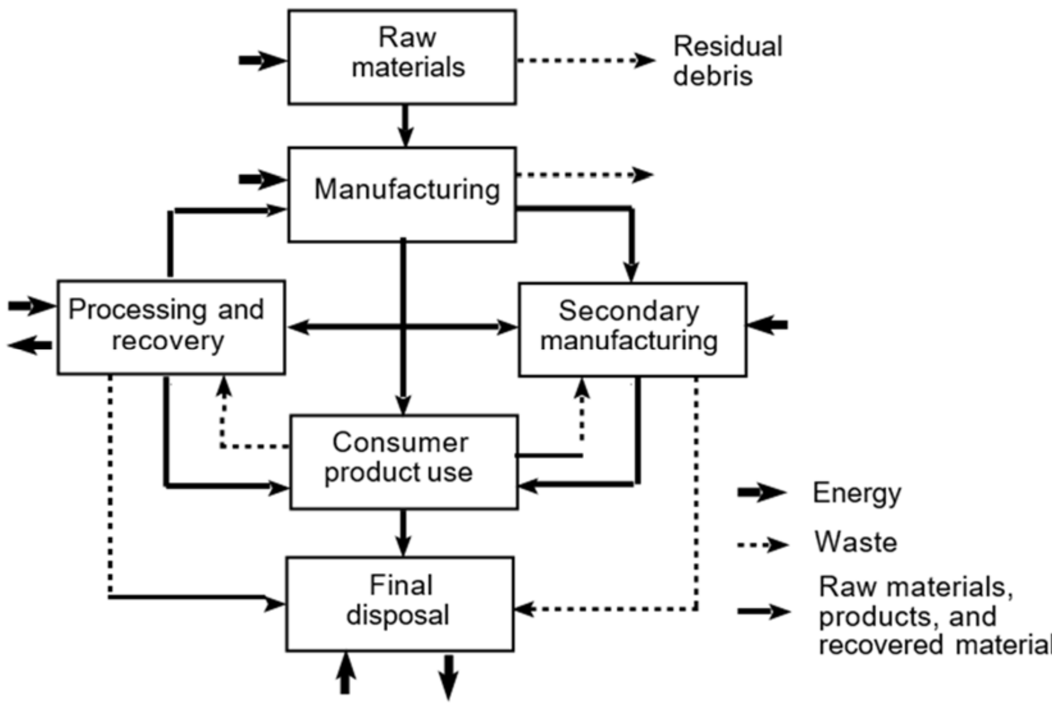

Figure 1: Represented the Flow of materials and waste in an industrial society.

Table 1 lists typical places, activities, or buildings connected to each of these waste sources. With the exclusion of wastes produced by municipal services, water and waste water treatment facilities, industrial activities, and agricultural operations, as shown in Table 1, MSW is often understood to comprise all community wastes. It is crucial to be aware of how differently terminology are defined and solid waste is categorized in the literature and in the profession. As a result, using public data needs a lot of caution, wisdom, and common sense. Because it incorporates so many different technologies and academic fields, solid waste management is a complicated procedure [3], [4]. These are those that deal with the management of solid waste creation, handling, storage, collection, transfer, transportation, processing, and disposal. All of these procedures must be carried out in accordance with current legal and societal norms that safeguard public health and the environment and are also aesthetically and environmentally sound. Administrative, financial, legal, architectural, planning, and engineering disciplines must be taken into account for the disposal process to be responsive to public sentiments. An integrated solid waste management strategy has to engage all of these disciplines in constructive multidisciplinary dialogue and interaction if it is to be effective. The purpose of this manual is to make this procedure easier [5].

Table 1: Illustrated the Sources of Solid Wastes in a Community.

Source	**Typical facilities, activities, or locations where wastes are generated**	**Types of solid wastes**
Residential	Single-family and multifamily dwellings; low-, medium-, and high-density apartments; etc.	Food wastes, paper, cardboard, plastics, textiles, leather, yard wastes, wood, glass, tin cans, aluminum, other metal, ashes, street leaves, special wastes (including bulky items, consumer electronics, white goods, yard wastes collected separately, batteries, oil, and tires), and household hazardous wastes
Commercial	Stores, restaurants, markets, office buildings, hotels, motels, print shops, service stations, auto repair shops, etc.	Paper, cardboard, plastics, wood, food wastes, glass, metal wastes, ashes, special wastes (see preceding), hazardous wastes, etc.
Institutional	Schools, hospitals, prisons, governmental centers, etc.	Same as for commercial
Industrial (nonprocess wastes)	Construction, fabrication, light and heavy manufacturing, refineries, chemical plants, power plants, demolition, etc.	Paper, cardboard, plastics, wood, food wastes, glass, metal wastes, ashes, special wastes (see preceding), hazardous wastes, etc.
Municipal solid waste*	All of the preceding	All of the preceding
Construction and demolition	New construction sites, road repair, renovation sites, razing of buildings, broken pavement, etc.	Wood, steel, concrete, dirt, etc.
Municipal services (excluding	Street cleaning, landscaping,	Special wastes, rubbish, street sweepings, treatment facilities)
Treatment facilities	Water, wastewater, industrial	Treatment plant wastes, principally
Industrial	Construction, fabrication, light	Industrial process wastes, scrap

Agricultural	Field and row crops, orchards,	Spoiled food wastes, agricultural vineyards, dairies, feedlots, farms, etc.

Increasing Waste Quantities

As of 2000, the United States produced roughly 226 million tonnes of MSW annually. This sum is more than 1600 pounds per person per year (or 4.5 lb per person per day). On a per capita and total production rate basis, the volume of MSW produced each year has been rising. About 2.7 lbs. per person per day and 88 million tonnes per year were produced per capita in 1960. By 1986, the amount produced daily per person had increased to 4.2 lb. By 2005, it is anticipated that the trash production rate will have risen over its present level to reach a per capita rate of roughly 4.6 lb per person per day and an annual rate of 240 million tonnes.

Even while trash reduction and recycling are increasingly crucial components of waste management, the issue with solid waste cannot be resolved with only these management techniques. More than 120 million tonnes of solid waste would still need to be processed by other methods, such as combustion (waste-to-energy) and landfilling, even if it were feasible to achieve a recycling (diversion) rate of around 50%. The following list of functional elements includes:

i. Waste Generation:

Waste production includes all of the actions taken when items are deemed to be no longer valuable and are either thrown away or collected for disposal. It's crucial to understand that trash creation involves an identification stage, and that this process differs for every person. Waste generation is now an activity that is difficult to regulate [1].

ii. Waste Handling and Separation:

The processes involved in managing storage and processing wastes at the source before they are put in storage containers for collection are referred to as waste handling and separation. Moving loaded containers to the point of collection is included in the definition of handling. The treatment and storage of solid waste at the source involves several steps, including the separation of waste components. Due of concerns about the general public's health and aesthetics, on-site storage is quite important [6].

iii. Collection:

The term "collection" refers to both the collecting of recyclables and solid trash as well as the transportation of these items to the point where the collection vehicle is emptied, such as a materials-processing plant, a transfer station, or a landfill, once they have been collected.

iv. Transfer and Transport:

The two stages that make up the functional aspect of transfer and transport are (1) the transfer of wastes from the smaller collecting vehicle to the larger transport equipment, and (2) the subsequent transport of the wastes often over considerable distances to a processing or disposal location. A transfer station is often where the transfer happens. The most popular method of moving rubbish is by motor vehicle, although rail trains and barges are also employed [7].

v. Separation, processing, and transformation of solid waste:

Curbside collection, drop-off locations, and buyback facilities are some of the methods and resources now being utilized for the recovery of waste items that have been separated at the source. At materials recovery facilities, transfer stations, combustion facilities, and disposal sites, the separation and processing of wastes that have already been separated at the source as well as the separation of mixed wastes often take place.

Processes for transformation are used to recover conversion products and energy while lowering the amount and weight of trash that has to be disposed of. Numerous chemical and biological techniques may be used to change the organic portion of MSW. Combustion is the most often employed chemical transformation process when energy is also being recovered. Aerobic composting is the biological transformation method that is most often utilized.

vi. Disposal:

All solid wastes today are ultimately disposed of by landfilling or land spreading, regardless of whether they are residential wastes that are collected and transported directly to a landfill site, leftover materials from MRFs, residue from the combustion of solid waste, compost, or other materials from different solid waste processing facilities. A sanitary landfill of today is not a dump. It is a way of disposing of solid waste that does not endanger public health or cause annoyances on land or in the earth's mantle.

DISCUSSION

Larger amounts of solid waste are not included in the national totals in addition to the high volumes of MSW that are produced and reported nationwide. For instance, garbage that is not designated as MSW may be treated in the same facilities as MSW in certain jurisdictions. These wastes might include mining wastes, oil and gas wastes, contaminated soil, building and demolition wastes, agricultural wastes, municipal sludge, combustion ash, including cement kiln dust and boiler ash, and industrial process wastes that are not considered hazardous waste. These wastes are produced at an astoundingly high rate throughout the country, at a rate of 7 to 10 billion tonnes annually. The majority of these wastes are handled on the production site. However, managing even 1% or 2% of these wastes in MSW facilities has a significant impact on MSW capacity. A acceptable estimate is probably one or two percent [8].

Waste generation and management are essential aspects of sustainable development, focusing on the responsible handling and disposal of various types of waste materials. This overview provides a comprehensive understanding of waste generation, its sources, types, and the strategies employed for waste management.

Waste Generation:

Waste generation refers to the production of unwanted or discarded materials that are no longer useful or have reached the end of their lifecycle. Waste can originate from residential, commercial, industrial, and institutional sources. The factors influencing waste generation include population growth, urbanization, consumption patterns, industrial activities, and economic development.

Sources of Waste:

Waste can be categorized into various sources, including:

a) **Municipal Solid Waste (MSW):** MSW refers to the waste generated from households, institutions, and commercial establishments. It includes organic waste, paper, plastics, glass, metals, and other materials.

b) **Industrial Waste:** Industrial waste arises from manufacturing processes, power generation, construction activities, and other industrial operations. It may contain hazardous materials that require special handling and treatment.

c) **Hazardous Waste:** Hazardous waste is generated from industrial processes, healthcare facilities, laboratories, and other sources. It poses potential risks to human health and the environment due to its toxic, flammable, or corrosive nature.

d) **Electronic Waste (e-waste):** E-waste comprises discarded electronic devices such as computers, smartphones, televisions, and appliances. These items contain hazardous substances and require specific disposal methods.

e) **Construction and Demolition Waste:** Construction and demolition activities produce large volumes of waste materials, including concrete, wood, metals, and other construction debris.

Waste Management Strategies:

Waste management aims to minimize waste generation, promote recycling and reuse, and ensure safe disposal of waste. The following strategies are employed for effective waste management:

a) **Waste Minimization:** Waste minimization involves reducing the amount of waste generated at the source through measures such as product redesign, material substitution, and process optimization.

b) **Recycling and Reuse:** Recycling involves collecting and processing waste materials to produce new products. Reuse involves finding alternative uses for items to extend their lifespan and reduce waste.

c) **Composting:** Composting is the process of decomposing organic waste, such as food scraps and yard waste, to produce nutrient-rich compost that can be used for soil enrichment.

d) **Waste-to-Energy:** Waste-to-energy technologies convert non-recyclable waste into energy, such as electricity or heat, through processes like incineration, gasification, or anaerobic digestion.

e) **Landfilling:** Landfilling is the final disposal option for non-recyclable waste. It involves burying waste in landfills engineered to prevent environmental contamination and methane gas emissions.

f) **Hazardous Waste Management:** Hazardous waste requires specialized treatment and disposal methods to prevent harm to human health and the environment. Techniques include recycling, chemical treatment, secure landfills, and incineration.

Sustainable Waste Management:

Sustainable waste management focuses on a holistic approach that minimizes waste generation, maximizes resource recovery, and reduces environmental impacts. It involves adopting integrated waste management systems, promoting circular economy principles, and encouraging public participation and awareness.

Challenges and Future Outlook:

Waste management faces challenges such as inadequate infrastructure, limited resources, insufficient waste management policies, and inadequate awareness and education. To address these challenges, governments, industries, and communities must work together to develop efficient waste management systems, implement proper regulations, promote recycling and resource recovery, and foster sustainable consumption patterns.

CONCLUSION

Currently, there is not much awareness of this issue in our culture. The practice of producing rubbish is extremely risky for not only the current generation but also for the generations to come. People must be informed and inspired to exercise recycling, reusing, and waste reduction rather than creating garbage. The management of waste should be a top concern for local governments. Individual participation is crucial. Due to India's two decades of economic growth, the country's waste has changed from 1990. The quantity of MSW produced in India is continuously rising as a result of a growing population and changing lifestyles. Land is scarce, and environmental and public health resources are priceless. The present SWM conundrum in India should be approached holistically; although long-term solutions should be taken into consideration, the immediate issues must first be solved.

In conclusion, waste generation and management are critical components of sustainable development. By implementing effective waste management strategies and promoting waste reduction, recycling, and safe disposal practices, societies can minimize environmental impacts, conserve resources, and create a cleaner and healthier environment for present and future generations.

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CHAPTER 8

AN ANALYSIS OF THE NOT REPORTED WASTE GENERATION

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ABSTRACT:

The world generates 2.01 billion tonnes of municipal solid waste annually, with at least 33 percent of that extremely conservatively not managed in an environmentally safe manner. Worldwide, waste generated per person per day averages 0.74 kilogram but ranges widely, from 0.11 to 4.54 kilograms. Though they only account for 16 percent of the world's population, high-income countries generate about 34 percent, or 683 million tonnes, of the world's waste. When looking forward, global waste is expected to grow to 3.40 billion tonnes by 2050, more than double population growth over the same period. Overall, there is a positive correlation between waste generation and income level. Daily per capita waste generation in high-income countries is projected to increase by 19 percent by 2050, compared to low- and middle-income countries where it is expected to increase by approximately 40% or more. Waste generation initially decreases at the lowest income levels and then increases at a faster rate for incremental income changes at low-income levels than at high income levels.

KEYWORDS:

Ecofriendly, Environment, Plastic, Residential Area, Solid Waste.

INTRODUCTION

Larger amounts of solid waste are not included in the national totals in addition to the high volumes of MSW that are produced and reported nationwide. For instance, garbage that is not designated as MSW may be treated in the same facilities as MSW in certain jurisdictions. These wastes could be mining wastes, oil and gas wastes, contaminated soil, construction and demolition wastes, agricultural wastes, municipal sludge, combustion ash (including cement kiln dust and boiler ash), medical wastes, and industrial process wastes that are not considered hazardous waste. These wastes are produced at an astoundingly high rate throughout the country, at a rate of 7 to 10 billion tonnes annually. The majority of these wastes are handled on the production site. However, even a small percentage of these wastes processed in MSW facilities may have a significant impact on MSW capacity. A acceptable estimate is probably one or two percent [1], [2].

Lack of Clear Definitions

Sound waste management strategies have so far been significantly hampered by the absence of precise definitions in the area of solid waste management (SWM). It has led to uncertainty over what constitutes MSW and what processing capability is available to handle it on a fundamental level. A valid measuring system is built on consistent definitions. They enable an entity to monitor its advancement and assess it against that of other entities. They encourage fruitful communication with all parties involved. Furthermore, what is measured is managed, therefore waste products are unlikely to get significant management attention if they are not measured. Definitions must get a lot of consideration from waste management decision-makers early in the planning process. Decision-makers should take into account an open public comment process to define acceptable definitions early in the strategy creation (planning) phase since all future legislation, regulations, and public discourse will be dependent on these definitions [3].

Lack of Quality Data

Without reliable data, it is difficult to create strong integrated MSW management plans. Without these statistics, it is much more challenging to engage the public in a discussion on the best course of action. Although the federal government and several states have concentrated on gathering better statistics on garbage creation and capacity, these data are still less reliable than they should be. Knowing who creates the garbage is sometimes just as important as knowing how much waste is created.

Another data issue is the prices of alternatives to burning and landfilling as well as the effects on the environment, health, and safety (EHS). Although dangers and costs are often very site-specific, landfilling and combustion have both been extensively examined. Composting, recycling, and source reduction have gotten far less attention. While compared to landfilling, these operations often have less of an effect on the environment, health, and safety. Once again, the solution is often site- and/or product-specific [4].

Without accurate information on the risks and costs of every alternative under consideration, MSW management systems are unlikely to optimize decision-making and may, in certain situations, produce incorrect judgements. Decision-makers should prepare for an active data gathering stage before making crucial strategic decisions since data are sometimes expensive and difficult to get. While this strategy would seem to slow down development in the short run, it will really lead to real long-term success marked by techniques that are both cost-effective and ecologically friendly.

Need for Clear Roles and Leadership in Federal, State, and Local Government

MSW has always been seen as a municipal government problem. Over the last ten years, as EHS concerns have grown and more garbage has left the areas where it is created, the situation has become more complicated. The development of site, construction, and operational criteria for waste management facilities is now being done by the federal, state, and municipal governments. In addition to solid waste management, state and local governments often regulate facility licenses for a variety of other concerns, including as air pollutants, stormwater runoff, and surface and groundwater discharges. Numerous authorities and approvals are often required to meet these criteria. While federal law has typically governed product labelling and design, state and local governments have begun to pay more attention to these issues as they work to cut down on trash creation at the source and boost municipal garbage recycling.

Understandably, the existing regulatory environment is becoming less effective, and current trends will persist until more coordination across all levels of government occurs. But if responsibilities are defined and leadership is valued, a more logical and economical waste management system may emerge. Federal leadership is crucial, particularly when it comes to product regulations and labelling. Multinational corporations will find it more unrealistic to create goods for every state. Small states and nationally functioning small firms will be particularly hard hit. State leadership will be essential in permit streamlining, as well as federal leadership on items. The lengthy duration of the permitting procedure has a significant influence on the cost of facility permits, even while it has no positive impact on the level of environmental protection. Furthermore, if waste management facilities and facilities employing secondary materials as feedstocks cannot be created or expanded, the finest waste management systems become outmoded and impractical. Even source reduction programmes sometimes need significant permission changes for already-existing industrial plants [5].

DISCUSSION

Need for Even and Predictable Enforcement of Regulations and Standards

The general public still has mistrust for both the people who run the waste facilities and the regulators who make sure they are run properly. The perception of underfunded or ineffective state and federal enforcement programs is a significant factor in this phenomenon. The public does not have faith that a strong permission will be upheld, despite the fact that it may be written. Governments' reluctance to enforce laws against other government-owned or -operated establishments has also raised concerns. Whether or whether these views are accurate, it is essential to address them if a solid waste management plan is to be agreed upon.

Decision-makers might take a number of different techniques into consideration. They may create internal, fully staffed, cutting-edge enforcement programs that provide equal access to all facilities, regardless of their nature, scale, or ownership. Public confidence will grow if decision-makers include the public in the overall design of the enforcement program and report on inspections and outcomes. If internal resources are limited, decision-makers might consider more creative strategies, such as the employment of outside inspectors, facility disclosure laws, or separate performance assurance agreements between the facility and the host community [6].

Resolution of Intercounty, Interstate, and Intercountry Waste Issues

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i. The majority of towns and states export some of their wastes, such as radioactive, hazardous, and medical wastes.

ii. New, cutting-edge waste facilities are expensive to construct and maintain, and they need more rubbish than the neighborhood can normally provide to justify their expenses.

iii. The environmental impacts of waste facilities are often comparable to those of manufacturing and recycling operations. Why should one community produce chemicals or other items that are eventually needed by another community if that community won't manage the trash from that community?

iv. Shorter interstate movements (less than 50 mi) may provide the groundwork for a strong waste management plan, but long-distance transport of MSW (above 200 mi) often reflects the inability to build a local waste management strategy. In order to avoid overly limiting possibilities, Congress should exercise caution.

Integrated Waste Management

To accomplish specified waste management objectives and goals, integrated waste management (IWM) is the selection and deployment of appropriate methods, technologies, and management programs. IWM is changing as a result of the rules created to execute the many states and federal legislation that have been approved. Four fundamental management choices (strategies) for IWM have been recognized by the U.S. Environmental Protection Agency (EPA):

i. Source reduction,

ii. Recycling and composting,

iii. Combustion (waste-to-energy facilities),

iv. Landfills.

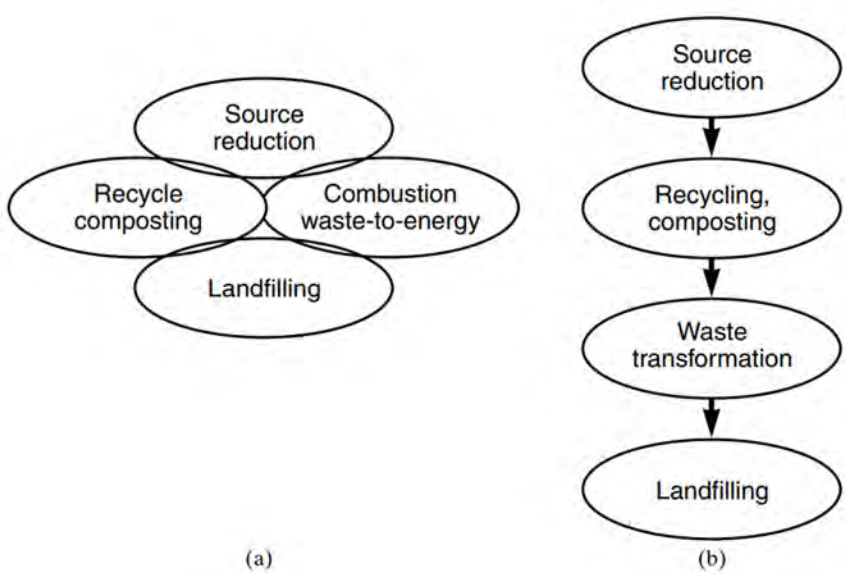

Figure 1: Relationships between the management options comprising integrated waste management: (a) interactive, and (b) hierarchical.

These tactics, as suggested by the U.S. EPA, are designed to be interactive, as seen in Figure 1(a). As shown in Figure 1b, the state of California has decided to explore the management choices in a hierarchical manner. For instance, recycling should only be considered after all possible measures to decrease trash production at the source have been taken. Similar to recycling, waste transformation is only taken into account when the maximum quantity has been recycled. Additionally, waste transformation has taken the place of the combustion (waste-to-energy) option in California and other states. The IWM hierarchy will most certainly continue to be interpreted differently by states. In the discussion that follows, the management choices that make up the IWM are taken into account. The next three parts discuss the adoption of integrated waste management methods [7].

Source Reduction

The goal of source reduction is to lessen the amount and/or toxicity of created waste. Source reduction involves switching to reusable goods and packaging, with returnable bottles serving as the most well-known example. However, the bottle bill law only reduces the source of pollution if bottles are recycled after being returned. Grass clippings that are not cleaned up after being dropped on the lawn and modified yard plants that do not produce leaf and yard trash are two more excellent instances of source reduction. When a product or process is being designed, source reduction should be taken into account. Everyone may engage in source reduction. Customers may take part by utilizing things more effectively or by making fewer purchases. The public sector, which includes all tiers of government (local, state, and federal), as well as the private sector, may be more effective consumers. They may review practices that wastefully produce and distribute paper (reducing the number of copies of documents), implement practices that call for the procurement of durable goods, and reduce the use of disposable goods. To minimize the amount of waste produced in production, the private sector might restructure its manufacturing procedures. Utilizing closed-loop manufacturing procedures, alternative raw materials, and/or other production techniques may be necessary to reduce the quantity of waste. The private sector may also modify goods by making them more effective, more durable, or using dangerous components less often. Although anybody may take part in source reduction, doing so requires a profound understanding of how people conduct their daily lives, which is difficult to impose via legislation without becoming bogged down in the enormous complexity of commerce [8].

The greatest way to promote source reduction is to make sure that the expense of waste management is completely internalized. Cost internalization refers to pricing the service in a way that includes all expenses. Pickup and transport, site and construction, administrative and payroll expenses, as well as environmental controls and monitoring are costs associated with waste management that need to be internalized. It is essential to remember that these expenses must be taken into account regardless of whether the product is eventually handled in a facility for disposal, burning, recycling, or composting. By compelling product makers to publicly disclose the costs related to various areas of product usage and development, regulations may help with cost internalization.

Recycling and Composting

Of all the waste management strategies, recycling is perhaps the most widely accepted and practicable. Recycling separates useful items from the rest of the municipal trash stream, bringing raw materials back to the market. There are several advantages to recycling. Recycling conserves limited resources, minimizes the need for virgin material extraction, which diminishes the environmental effect of mining and processing, and uses less energy. Recycling may also increase the capacity of landfills. By eliminating noncombustible elements like metals and glass from recycling, incinerators and composting plants may operate more effectively and produce higher-quality ash.

If recycling is not done in an ecologically appropriate way, it may potentially lead to issues. What's left of badly run recycling facilities may be found at many Superfund sites. Examples include activities for deinking newspaper, recycling waste oil, recycling solvents, and recycling metal. All of these procedures eliminate dangerous pollutants that must be handled carefully. Another recycling practice that may have issues is composting in the absence of sufficient site controls. If grass clippings, leaves or other yard wastes with pesticide or fertilizer residues are composted on sandy or other porous soils, for instance, groundwater may get polluted. Volatile compounds may potentially contaminate the air.

Recycling will thrive in areas with favorable economic circumstances, not only those where it is mandated. This requires that the price of resource recovery or landfilling be at least $40 per tonne greater than its actual cost. Stable markets for recovered products are essential for the success of recycling programs. It is not difficult to find examples of issues in this area; from 1984 to 1986, Germany had a surplus of paper as a result of a discrepancy between the grades of paper collected and the grades needed by the German paper mills. To determine if the mills had the capacity and tools required to handle low-grade domestic newspaper, the government had not collaborated with the private sector sufficiently. Similar market losses for paper have happened in the United States, particularly between 1994 and 1997. In certain areas of the nation, disposal of collected newspapers now actually costs money due to falling prices. Stable supply must also be produced in order to maintain stable markets. Metals and plastics recycling are two sectors where this supply-side issue has caused issues. To handle the market condition, government and business must collaborate. Making ensuring that mandatory recycling programs do not outpace the marketplace is vital.

CONCLUSION

Recycling and composting will only succeed, even in a favorable market environment, if they are made easy. Examples include curbside collection for homes on a regular basis and simple drop-off locations in remote areas and for more specialized items. Product mail-back initiatives have been successful for several electronics and appliances. Public education is a key element for raising the quantity of recycling, even with stable markets and practical programs. As was done during the energy crises of the 1970s, the US must now adopt a conservation ethic rather than a throwaway one. The next chance for cultural transformation is recycling. It will be necessary to go beyond only being willing to gather trash for recycling. Customers will be required by this cultural shift to buy recyclable goods and goods created with recycled materials. Businesses will need to use secondary materials in the production of goods and create new items that are simple to disassemble and separate into their component parts.

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CHAPTER 9

AN OVERVIEW OF THE WASTE DISPOSAL

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ABSTRACT:

We observe heaps of garbage lying along the roads while passing through a highway. Open dumping is the most common method of waste disposal in India. The trash heaps are usually left open to the environment and the elements. These seldom have a sparse covering which can often attract pests or vermin. Sometimes, these dumps are subjected to open burning, which can release toxic fumes and smokes. There have also been instances where enough heat has been generated to trigger a spontaneous combustion Sometimes, wastes are illegally dumped into rivers and canals or used to fill land depressions without proper consultations. These practices cause a lot of problems in the long run. These can range from the degradation of the soil quality to leaching toxic chemicals into underground water sources. Therefore, to prevent such scenarios, proper waste disposal methods should be adopted.

KEYWORDS:

Eco Friendly, Waste Management, Waste Disposal, Waste Hierarchy, Waste Recycle.

INTRODUCTION

In affluent nations, municipal liquid waste is routed via sewage systems and processed as wastewater or sewage. This process removes the majority or all of the toxins before wastewater, or sewage, may reach groundwater aquifers or surface waterways like rivers, lakes, estuaries, and oceans. For further details on sewage networks and treatment, see wastewater treatment. Refuse is non-hazardous junk that has to be collected and transported to a processing or disposal facility. Municipal solid waste (MSW) is often referred to as garbage. Some examples of refuse include waste and garbage. Food scraps that can be composted and dry items like glass, paper, linen, or wood make up the majority of garbage. Trash is not garbage; on the other hand, garbage is very putrescible and decomposable. Trash includes large items that need special collection and processing, such as old refrigerators, sofas and enormous tree trunks, as well as construction and demolition debris (such as wood, plasterboard, bricks, concrete and rebar, a steel rod with ridges for use in reinforced concrete). Refuse is typically disposed of in sanitary landfill pits or other locations where rubbish is kept apart from the environment and covered with impermeable synthetic bottom liners.

Waste disposal refers to the removal, disposal, recycling, or destruction of undesired materials, sometimes referred to as waste, that are created by industrial, residential, or agricultural goods. Less pollution and environmental risks will result from using the proper disposal techniques for garbage. The correct collection of garbage and scientific treatments that may reduce air, water, and soil contamination are all vital stages in good waste management.

Wastes come in many different forms, and non-biodegradable garbage makes up a large portion of the waste produced today. Industrialization and globalization have made significant contributions to this. Toxic gases and smoke may be released by trash dumps that contain dangerous compounds. The proper disposal of each kind of trash is thus required; for instance, burning all wastes may result in the aforementioned issue and damage to persons. Additionally, it is not advised to dump into rivers or fill soil depressions without competent supervision. Wastes, especially those made of plastic, batteries, sanitary items, and oil, should be disposed of correctly. A dangerous environment and a contaminated atmosphere might follow from doing so.

trash management is a crucial concept related to trash disposal, and both are essential for keeping the environment clean. Consequently, a waste management system should be included in the concept of trash disposal. Refuse, Repurpose, Reduce, Reuse, Rot, Recycle, and Rethink are the seven R's of garbage management. Following each of these trash disposal processes will make it much easier to live hygienically and healthily. Not only for us, but also for future generations, it is essential. Additionally, it protects those who handle garbage improperly, such as those who work in landfills and other similar occupations. Blood infections, lung issues, growth issues, skin irritations, etc. might all result from it. Therefore, it should not be the responsibility of the employees to dispose of garbage; rather, this responsibility should begin at home. Segregating biodegradable, non-biodegradable, and hazardous waste should be practiced everywhere, especially in residential and business settings. Let's explore the numerous garbage disposal techniques used throughout the cleanup procedure.

Methods of Waste Disposal

The various methods of waste disposal given in Figure 1, as follows:

- **a)** Landfill
- **b)** Incineration
- **c)** Biogas Generation
- **d)** Composting
- **e)** Waste compaction
- **f)** Vermicomposting

Figure 1: Illustrated the Illustrated the Methods of Waste Disposal

i. Landfill

The debris that cannot be recycled or reused is filtered out during this procedure and then distributed as a thin layer in low-lying regions all across a metropolis. Each layer of trash is followed by a layer of dirt. However, when this procedure is finished, the region is deemed inappropriate for building development for the next 20 years. It can only be utilized as a park or a playground instead [1].

ii. Incineration

Incineration is the process of burning trash under controlled conditions to turn it into incombustible materials like ash and waste gas. The exhaust fumes from this process are treated before being discharged into the environment since they might be hazardous. This approach is one of the most sanitary ways to dispose of trash since it minimizes the amount of waste by 90%. Occasionally, the heat produced is utilized to create power. However, since this process produces greenhouse gases like carbon dioxide and carbon monoxide, some people believe it is not entirely ecologically beneficial.

iii. Waste Compaction

Cans and plastic bottles that are garbage are compressed into blocks and shipped to be recycled. This method makes transportation and placement simple by preventing metal oxidation and lowering the demand for airspace [2].

iv. Biogas Generation

Waste that decomposes over time is transferred to biodegradation facilities, including food waste, animal waste, and organic industrial waste from the food packaging sector. They are degraded at bio-degradation facilities with the aid of bacteria, fungus, or other microorganisms before being transformed to biogas. In this instance, the organic matter provides the microorganisms with sustenance. Either aerobic (with oxygen) or anaerobic (without oxygen) deterioration may take place. This procedure produces biogas, which is utilized as fuel, and the leftover material is turned into manure [3].

v. Composting

With time, all biological materials deteriorate. One of the main organic wastes we discard each day includes food leftovers, yard garbage, and other things. These organic wastes are first buried under several layers of soil, where they are then allowed to decompose due to the activity of bacteria and fungus. As a consequence, nutrient-rich manure is produced. Additionally, this procedure makes sure that the soil's nutrients are restored. Composting improves the soil's ability to retain water in addition to nourishing it. It is the finest substitute for chemical fertilisers in agriculture.

vi. Vermicomposting

Vermicomposting is the process of turning organic materials into nutrient-rich manure by employing worms. The organic stuff is consumed and digested by worms. By-products of digestion that the worms excrete into the soil make it rich in nutrients, which promotes the development of bacteria and fungus. Additionally, it is a lot more efficient than conventional composting [4], [5].

Combustion (Waste-to-Energy)

Combustion (waste-to-energy) is the third IWM option. Combustion facilities are desirable because they excel at one task dramatically, up to ninefold, reducing the amount of trash. Utilizable energy may also be recovered by combustion facilities, either in the form of steam or electricity. This may either be lucrative or unjustifiable, depending on the energy economics of the area. When landfill space is at a premium or when the dump is far from the source of production, the high initial cost of incinerators might become appealing just by virtue of the volume reduction they provide. New landfills must be positioned more and farther from the population centre in many large urban areas. Additionally, the potential for recycling furnace bottom ash as a construction material is promising. It's possible to use incinerator ash to produce cement or concrete products.

Incinerators are severely constrained by their expense, the relatively high level of sophistication required to run them safely and profitably, and the public's strong scepticism about their safety. The public is worried about incinerator stack emissions as well as the toxicity of the ash they create. Through the creation of new rules for solid waste combustion waste-to-energy facilities and enhanced landfill requirements for ash, the U.S. EPA has addressed both of these problems. These rules will guarantee that properly planned, constructed, and run facilities will be completely safe for human health and the environment.

Landfills

The one kind of waste management that no one likes but that everyone needs is landfills. There are just no combinations of waste management practises that are effective without landfilling. The only management strategy that is both essential and adequate among the four fundamental management alternatives is landfilling. Some wastes simply cannot be recycled since, with time, they lose all of their inherent value and can no longer be recovered, and recycling itself results in residuals.

Protection of the environment and human health may be achieved via the technology and management of a contemporary landfill. Making ensuring that all landfills that are currently in use are properly planned and are being monitored when they are closed is a difficulty. It is important to understand that contemporary landfills do not resemble the outdated landfills that are now included on the Superfund list. Hazardous materials are no longer accepted in landfills that are currently in operation. Furthermore, they don't get bulk liquids. They have elaborate ground-water monitoring systems, leachate collecting systems, gas-control systems, liners, and possibly most importantly are better sited and situated in the first place to benefit from the local geological conditions.

Debris piles may also be used as resources. Many landfills currently recover methane gas, and recovering carbon dioxide is also being thought about. Landfills may be converted into parks, golf courses, or ski resorts when they are closed. Landfills may one day be mined if economic circumstances allow, according to certain organizations and businesspeople who see them as storehouse of resources for the future. This may be especially true for monofils, which concentrate on a single kind of waste product, such combustion ash or shredded tires [6].

Status of Integrated Waste Management

The US EPA has established a voluntary national target of 25% source-reduction and recycling reduction in MSW production. Note that other states have more ambitious recycling targets. As an example, California established targets of 25% by 1995 and 50% by 2000. Source reduction is now thought to be responsible for somewhere between 2% and 6% of the trash that has been reduced. The term "recycling" has no universally recognized meaning, and estimates of the amount of MSW that is recycled vary greatly. Estimates between 15% and 20% have been released by the Office of Technology Assessment (OTA) and the U.S. EPA. About 5 to 10 percent of the overall waste stream is now composted, according to estimates. 50% to 70% of MSW is currently landfilled. More than 100 of the biggest landfills in the country recover landfill gas for energy, and the majority of it is burnt for burning.

Importance of Effective Waste Disposal

It is well known that landfills are terrible for the environment and that there is a shortage of landfill space in the UK. garbage disposal strategies are continuously reviewed for these reasons as well as the growing push to recycle garbage. Effective waste management benefits not only the environment but also human health and welfare. Effective garbage disposal may be as simple as people depositing their trash in a container and avoiding littering. Effective waste management can take many different forms depending on the volume or situation of waste generation. Effective trash disposal on a bigger scale may be achieved by major waste producers making sure their garbage is disposed of in an ethical or sustainable manner. Due to the controversy surrounding trash disposal, regulations have been created, the most well-known of which being The Environmental Protection Act of 1990.

The main benefits of effective waste disposal include:

- **i.** Environmental protection from pollution or contamination.
- **ii.** Money generation companies may buy recyclable materials due to their value. Additionally, the waste management industry creates employment opportunities.
- **iii.** Safety irresponsibly disposed of waste can harm people.
- **iv.** Exploring alternatives where innovative solutions to waste disposal have been found, great strides have been made that is composting.
- **v.** Business philosophy as consumers become more environmentally conscious, it is important for businesses to promote their ‘green’ strategies and environmental promise.

The Waste Hierarchy

The trash Hierarchy is a vital concept that trash processors must use. It lists landfill-free alternatives to waste management and ranks them in order of environmental value. The triangle's top point, waste prevention, emphasizes the necessity for action even before trash is produced. This highlights the need for waste production to be reduced overall wherever feasible. This can include, for instance, reducing product packaging. Reuse is the next step, in which waste products like plastic water bottles are put to new use. An analogous idea is upcycling, in which materials are given a fresh but different application, like a playground swing made out of a tyre. Even repurposed items like topsoil and aggregates are offered by ETM. Recycle is the next step after reuse, and it involves turning trash into new materials or goods. Since incinerating waste is not a very popular technique of disposal, it lies towards the bottom of the triangle. It is controversial because harmful gases may be emitted into the atmosphere if garbage is burned for energy instead of only for heat [7].

DISCUSSION

Human garbage has been produced throughout the years, and trash disposal techniques have evolved. For instance, waste from millennia ago would have been crudely buried since the population was tiny and the waste was extremely biodegradable. Similar to this archaic disposal technique is landfill. Today, however, this is not an option since contemporary trash is sometimes difficult to biodegrade, the volume is too great, and ecosystems are harmed. Reuse and recycling are strategies to address the aforementioned problems since they lessen the quantity of garbage that ends up in landfills, hence lowering the detrimental impacts of waste. Recycling preserves natural resources and lowers the energy required to produce new products. Many materials, such as plastic and oil, may be recycled, making it a popular and efficient form of waste disposal. Some materials, such as glass or paper, can also be recycled indefinitely [8].

CONCLUSION

The trash Hierarchy is a vital concept that trash processors must use. It lists landfill-free alternatives to waste management and ranks them in order of environmental value. The triangle's top point, waste prevention, emphasizes the necessity for action even before trash is produced. This highlights the need for waste production to be reduced overall wherever feasible. This can include, for instance, reducing product packaging. Reuse is the next step, in which waste products like plastic water bottles are put to new use. Upcycling, where materials are given a new but different use, such the kind used for a swing at a playground, is a related idea. Even repurposed items like topsoil and aggregates are offered by ETM. Recycle is the next step after reuse, and it involves turning trash into new materials or goods. Since incinerating waste is not a very preferred disposal option, it lies towards the bottom of the triangle. It is controversial because harmful gases may be emitted into the atmosphere if garbage is burned for energy instead of only for heat.

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CHAPTER 10

AN INTRODUCTION TO IMPLEMENTING INTEGRATED WASTE MANAGEMENT STRATEGIES

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ABSTRACT:

In order to overcome the difficulties in effectively and sustainably managing various waste streams, integrated waste management solutions are being used more often. To reduce the quantity of garbage that ends up in landfills, these methods combine several waste management practices, such as waste reduction, recycling, composting, and energy recovery. The advantages, difficulties, and best practices of adopting integrated waste management techniques are briefly discussed in this abstract. It discusses how crucial infrastructure development, policy, and stakeholder involvement are to the effective use of these solutions. The report also looks at some of the cutting-edge waste management technologies, such material recovery facilities and waste-to-energy conversion. The abstract also emphasizes the need of continuing assessment and monitoring to guarantee the viability and efficacy of integrated waste management methods. Communities may lessen their environmental impact, preserve resources, and build a more sustainable future by implementing a comprehensive waste management strategy.

KEYWORDS:

Energy Recovery, Solid Waste, Waste Management, Waste Energy, Waste Transformation.

INTRODUCTION

In order to apply IWM for residential solid waste, as shown in Figure 1, many technologies and all of the previously covered and indicated management choices are often used. There have been very few cases when a properly integrated and optimized waste management strategy has been produced, even though the majority of communities now employ two or more of the MSW management alternatives to dispose of their garbage. It is necessary to undertake an optimization study that incorporates all of the possibilities accessible in order to establish an integrated strategy for managing municipal garbage. However, there isn't yet a tested way for carrying out such an optimization study.

Figure 2 shows the most typical technological combinations utilized to complete IWM. The most popular in the US is likely Strategy 4, which entails curbside recycling and landfilling the remainder of the garbage. Strategy 3, which consists of landfilling and composting, is popular in rural areas. The most common combination of Strategies 5 is curbside recycling with the aid of a materials recovery facility (MRF), followed by mass burning or combustion at a refuse-derived fuel (RDF) facility and landfilling of the nonrecyclable materials from the MRF and ash from the incinerator. In large cities, tipping fees for landfilling can sometimes reach and exceed \$100 per tonne. However, as previously said, each issue should be evaluated separately, and the management choice and technology combination that best suits the circumstance should be chosen. The needed volume of landfill per tonne of MSW produced for each of the nine combinations of alternatives is shown in Figure 3 as a pointer to the possible impact of any of the nine solutions in Figure 2 on the landfill space and its lifespan. The cost of the alternative combinations is of the utmost importance to the development of an integrated waste management system, apart from the availability of landfill volume and space. In the section that follows, costs are covered.

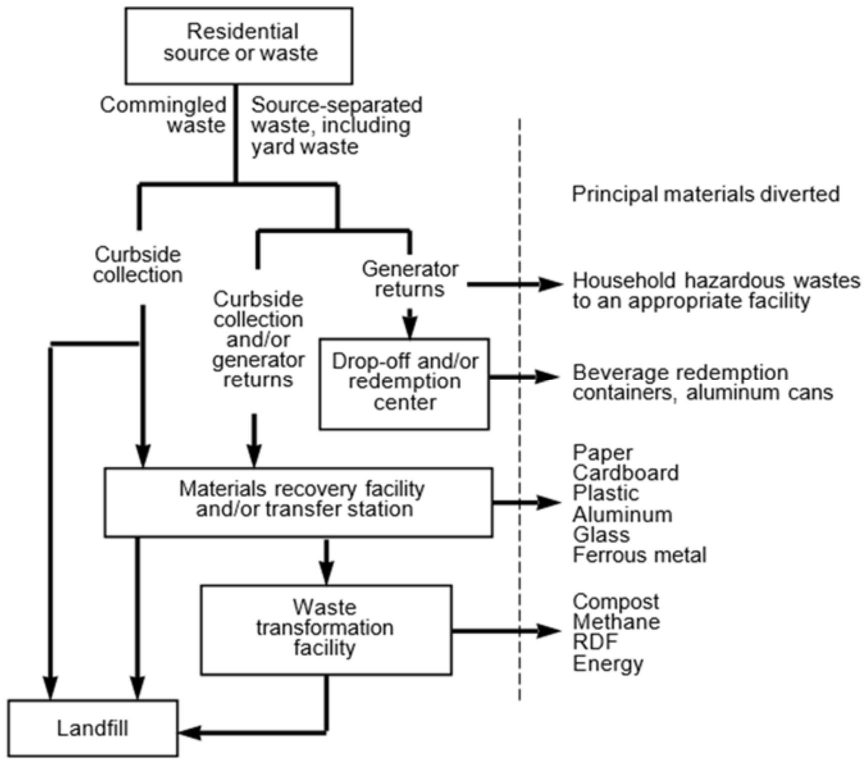

Figure 1: Illustrated the Flow Diagram for Residential Integrated Waste Management

Typical Costs for Major Waste Management Options

The section on the installation of IWM for domestic solid waste gives an idea of what the different waste management technologies typically cost. Chap. 16 provides more thorough cost details, such as the price of specific parts, labour, land, and finance. It should be emphasized right away that getting site-specific quotes from knowledgeable contractors is the only accurate approach to evaluate the prices of waste management alternatives. When constructing an integrated waste management system, it is often essential to establish some rough calculations.

To aid in this preliminary costing, cost data from the literature were examined for many regions of the nation, and published estimates of the capital costs and operating costs for the four most popular municipal solid waste disposal options materials recycling, composting, waste-to-energy combustion, and landfilling were correlated. In order to offer a uniform baseline for cost comparisons, all of the cost information for the different choices was translated to January 2002 USD. Engineering News Record Construction Cost Index (ENRCCI) value of 6500 was used to modify the cost data [1].

Each of the waste management solutions has social costs in addition to the externalized costs discussed in this chapter. For instance, the vehicles needed to pick up, collect, and transport the items for recycling would produce air pollution. In many recycling procedures, such as the deinking of newspapers, pollution is produced that must be paid for by society since it is not included in the recycling cost. Waste-to-energy combustion pollutes the air from stack emissions and the water from ash disposal, especially if there are heavy metals present. Landfilling has an impact on the environment because it causes leachates to flow into aquifers and produces gases like methane. During the first 20 years of a landfill's operation, it is predicted that between 60 and 110 lb of methane will be produced for every tonne of wet municipal garbage. Due to constraints in the collecting mechanism and the permeability of the cover, 9 to 16 lb of that gas will not be collected but instead leak into the atmosphere. According to the U.S. EPA, landfills in the country produce roughly 12 million tonnes of methane annually. However, future landfilling will have a smaller negative influence on the environment because to new rules [2].

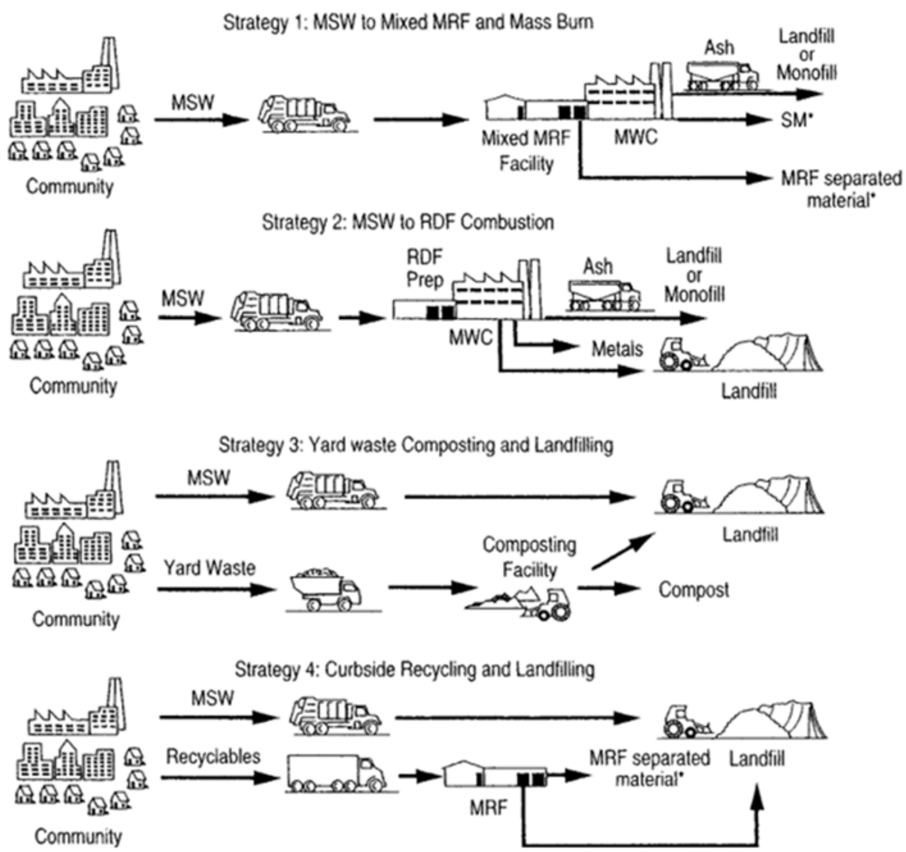

Figure 2: Illustrated the Typical Examples of Waste Management

Capital Costs

It should be emphasized that the quality, accuracy, and dependability of the capital cost data accessible in the literature varies. As a consequence, the cost data's range is wide. The year that a facility was constructed, the interest rate paid on the capital, the regulations in effect at the time of construction, the method of funding a project (privately or publicly), and the location of the facility are all variables that will impact the costs stated. The outcomes are also significantly impacted by the expenditures related to auxiliary operations like land acquisition, pollution control, and road improvement. Cost information on sorting, recycling, and composting is hard to get and sometimes suspect. Therefore, it is advised that costs for all systems be built up from system components, using a consistent set of assumptions and accurate cost estimates at the time and location of operation, while evaluating alternative techniques to control MSW. The statistics for the combustion option seem to be the most extensive and trustworthy ones.

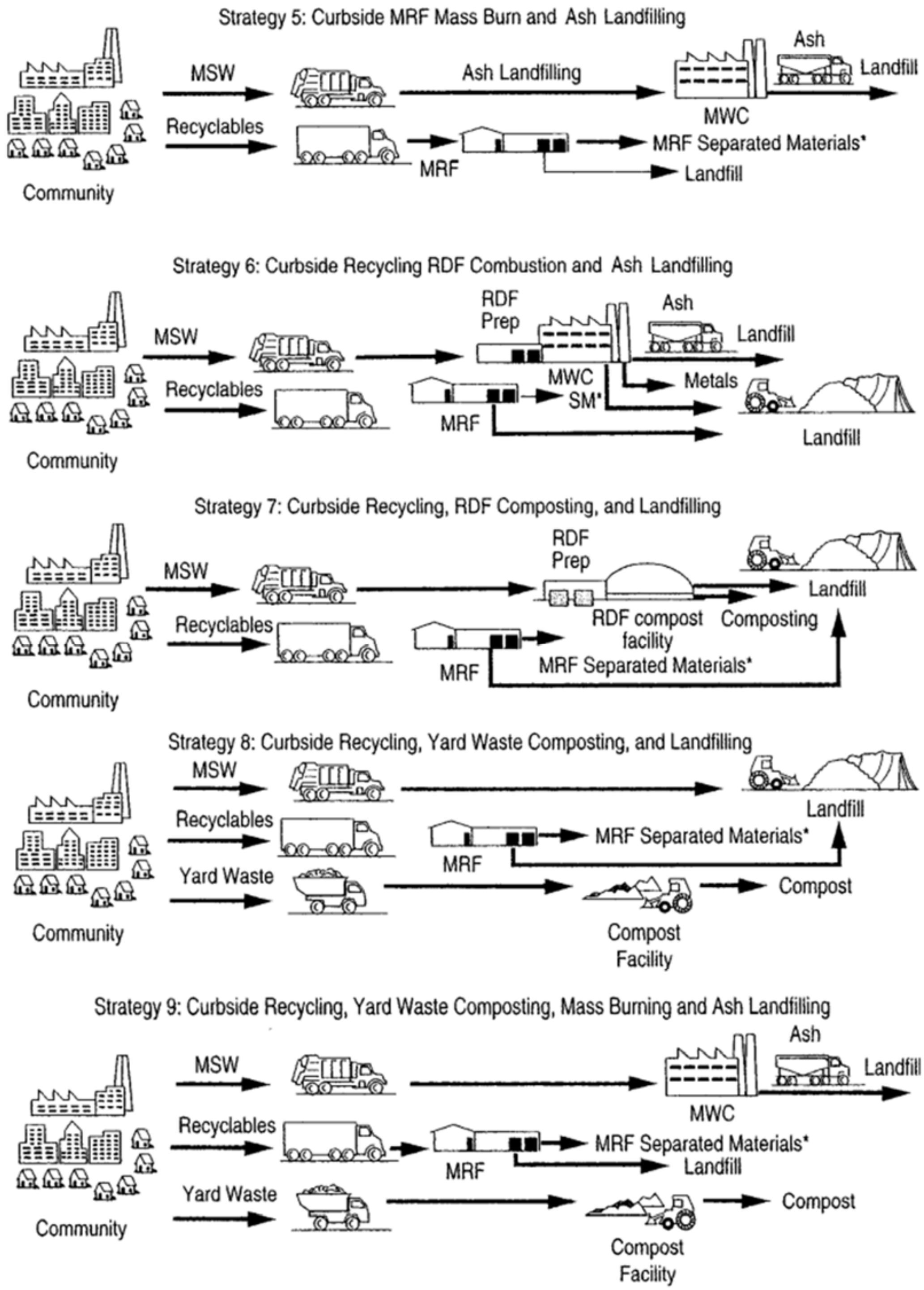

Figure 3: Illustrated the Typical Examples of Waste Management

There is a great number of documented experiences with combustion, which is a regulated process that is finished quickly. Additionally, methods that have been utilized successfully in fossil fuel combustion facilities may be employed to measure inputs and outputs [3], [4].

i. Collection:

Capital expenditures are required for collecting trucks, and depending on their capacities and roles, vehicles may cost anywhere between $100,000 and $140,000.

ii. Materials Recovery Facilities (MRFs):

For current low-tech and high-tech MRFs that separate recyclables, whether they are mixed or source-separated, the capital expenditures vary from around $10,000 to $40,000 per tonne of design capacity per day [5].

iii. Composting:

There are few published capital cost statistics for MSW composting operations. According to reports, the capital expenses for MSW composting plants vary from $10,000 to $50,000 per day tonne of capacity. Additionally, there are no scale effects in investment costs; investment is a linear function of capacity between 10 and 1000 tonnes per day.

iv. Mass Burn: Field-Erected:

Electricity is produced by the majority of mass burn facilities that are field-erected. With a range of 750 to 3000 ton/d, the average size for which usable data are available is 1200 tons/day of design capacity. The capital cost per tonne per day ranges from $80,000 to $120,000. The kind of energy generated did not distinguish the mass burn facilities [6], [7].

v. Mass-Burn:

The usual ton/day range for modular mass-burn steam and power producing units is 100 to 300. The capital expenses per tonne per day vary from $80,000 to $120,000.

vi. Refuse-Derived Fuel (RDF) Facilities:

For running RDF production plants with a processing capacity between 100 and 300 tonnes per day, the capital expenses vary from $20,000 to $30,000 per tonne per day.

vii. Landfilling

Because construction often doesn't end at the start of operations but rather continues throughout the life of the landfill, it may be challenging to estimate capital expenses. As a result, capital expenses are included to operational costs and reported as such. Cost models may be used to predict the capital and operational costs of landfills; however these models are only applicable to a specific area. The given cost range represents the start-up expenses for a brand-new, contemporary landfill that complies with all applicable federal standards and has a capacity of more than 100 tonnes per day [8].

viii. Operation And Maintenance (O&M) Costs*:*

When analyzing integrated waste management systems, operation and maintenance (O&M) expenses are just as crucial as capital expenditure. Again, it should be emphasized that there are significant differences in the O&M expense statistics. An analysis of the circumstances at the project's period and location is necessary for a trustworthy estimate. Local variations in wage rates, employment agreements, safety regulations, and crew numbers have an impact on operating expenses. O&M expenses may be significantly impacted by accounting systems, particularly those utilized by cities and private owners, as well as the age of landfills or incinerators. Tables 1.5 and 1.6, respectively, provide typical O&M expenses for collection trucks and materials recovery facilities, as well as for composting, burning, and landfilling.

ix. Collection O&M Costs:

Both the quantity collected and the number of stops made have an impact on the collection O&M expenses, which are stated in dollars per tonne. The average O&M cost per tonne for the collection of mixed trash without source separation is between $50 and $70. After the source separation of recyclable items, the average O&M expenses for the collection of the commingled trash vary from $60 to $100 per tonne. Source-separated material curbside collection costs range from $100 to $140 per tonne.

x. MRF O&M Costs:

O&M expenses for MRFs vary from $20 to $60 per tonne of segregated material, with an average cost of $40 to $50/ton. Not predictable variances based on the kind of technology or the size of the facility, but rather discrepancies in the techniques of reporting cost data, are mostly to blame for the wide range in O&M costs. Due to the increased labour intensity of the former, low-technology MRFs often have higher running expenses than high-technology MRFs.

xi. Composting O&M Costs:

Composting processed MSW has O&M expenses that vary from $30 to $70 per tonne. While O&M costs show some drop with plant capacity, the link between them and scale is relatively low, whilst capital costs show little to no influence with size.

xii. Mass Burn: Field-Erected O&M Costs:

For field-erected mass burn combustion plants, typical O&M cost estimates are shown in Table 1. Six are for large-scale power plants. Costs for O&M per tonne vary from $60 to $80. The O&M expenses for facilities that generate both steam and electricity are comparable.

xiii. RDF Facility O&M Costs

The typical O&M expenditures for RDF plants vary from $20 to $40 per tonne of processed MSW, or around $40 per tonne. Keep in mind that the averages previously mentioned are based on large ranges and have few data points. The expenses of future RDF facilities may thus only be roughly estimated using these averages [9].

xiv. Landfilling O&M Costs:

The few statistics that are available show that local factors greatly influence landfill costs. Cost information varies in how much it accounts for capital recovery expenses. MSW landfill O&M expenses vary from $10 to more than $120 per tonne. Monofils vary in price from $10 to $80 per tonne of ash.

DISCUSSION

The four methods of waste management source reduction, recycling, waste-to-energy, and landfilling are covered in the parts that came before. In light of such information, we must create a framework for making choices. In a world without economic restrictions, the waste management technologies may be ranked according to how desirable they seem to be for the environment. Source reduction would undoubtedly rank highest since it eliminates the need for waste management altogether. The next-best management option would be recycling, which includes composting, since it may bring resources back into use after the original product has fulfilled its intended function. Waste to energy occurs as a result of the ability to recover energy that would otherwise be lost and squandered. Last but not least, landfilling is truly neither better nor worse than incineration since it too may recover energy, despite often being put last. Additionally, the ash from waste-to-energy operations still has to be managed by landfills [10].

CONCLUSION

In practice, each town and area will have to modify its integrated management system to fit its unique environmental circumstances and financial limitations. There isn't much of an option for a tiny, isolated community like Nome, Alaska, other than to depend completely on an efficient landfill. On the other hand, New York City is able to combine all the components of the waste management hierarchy with ease and effectiveness. Long Island, New York, and many Florida municipalities that depend significantly on groundwater that is fragile often need to reduce their landfilling and instead look at incineration, recycling, and residual disposal in areas where groundwater is less vulnerable. Communities with poor air quality often steer clear of incineration to reduce the number of pollutants in the atmosphere. By first removing metals and other undesirable waste components from the garbage stream, these communities may sometimes go above and beyond to guarantee that incineration is acceptable. In any community, the profitability of recycling certain waste stream constituents is dependent on waste stream volume, collection costs, market accessibility, and the environmental effects of recycling and reuse processes.

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CHAPTER 11

AN ELABORATION OF THE PLANNING FOR SOLID WASTE MANAGEMENT

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ABSTRACT:

Implementing a Waste Management Plan is evidently a best practice approach to new development where proponents can improve waste outcomes throughout the planning, construction and operational phases of the development. A well-executed Waste Management Plan at the construction stage will help avoid excessive noise, odour, security, and vermin issues which may potentially arise due to poorly planned waste processing. Sustainable ongoing waste management can result in cost efficiencies for developers and building management through integration of suitable bin sizing and collection frequencies. Overall, Waste Management Plans provide an optimal and thorough approach to managing waste through consideration of both the environmental and social benefits of reducing waste generation.

KEYWORDS:

Earth, Environment, Economic Analysis, Industrial Waste, Solid Waste Management.

INTRODUCTION

The only way to create a strong combination of management tools is via long-term planning at the local, state, and even regional levels. It must take into account both financial limitations and environmental considerations. As was previously said, planning needs reliable data. In disciplines like planning for health care and transportation, this reality has long been acknowledged. However, solid waste planning databases were not accessible until recently, and even today, they are inadequate. There are certain rules that planners need to follow:

- **i.** To start, it's important to consider the long run. Current spot market price volatility is a sign of the economic crisis, when it is unable to find a location for new facilities. Examples of places where current prices are much lower than their peak levels currently exist due to the emergence of additional capacity choices.
- **ii.** Next, planners need to make sure that each alternative accounts for all expenses. Municipal accounting procedures may sometimes conceal expenses. For instance, the department of transportation may buy cars, while another department would buy real estate, and so on. Accounting accuracy is crucial.
- **iii.** Third, cutting corners on environmental controls results in immediate cost savings but may result in longer-term liabilities. It is always preferable to do things properly the first time, particularly when it comes to landfills, incinerators, recycling centres, and composting farms.

- **iv.** Fourth, planners should take market volatility for recyclables into consideration. Can a recycling program endure the peaks and troughs of recycling markets in a certain place for a specific product without going bankrupt in between?
- **v.** Fifth, when locating waste facilities that use recycled materials as inputs and facilities that need permit adjustments to execute source reduction, planners must take into account the availability of efficient facility permitting and siting.

Finally, planners need to consider more than just local possibilities. Different management combinations may be affordable when political borders are not taken into account. Potential savings might be made in the areas of funding, administration, simplicity of use, and environmental protection. Public authorities, nonprofit public enterprises, special districts, and multicommodity cooperatives are examples of regional models.

Formulating an Integrated Solid Management Waste Strategy

It takes time and effort to create a successful integrated solid waste management plan. The system must ultimately be comprehensive; each component must serve a distinct function and coordinate with the others like beautifully honed, highly effective equipment. A single design team that is aware of its goal and collaborates with suppliers and customers to build the design is unlikely to provide an effective and well-functioning result, much like a piece of equipment. law does not drive the effective integrated waste strategy; rather, law drives it. Source reduction and recycling efforts may not always increase when laws are passed. Contradictory laws or regulations might really conflict with one another. In addition, the free-market system operates best when there is a feeling of stability and predictability, which fosters risk-taking since it is simpler to anticipate anticipated market reaction. The sooner a comprehensive framework for waste management is stabilized, the more probable it is that critical corporate investment will be obtained for public decision-making. Planning begins with carefully defining language, such as what types of garbage are included and which are not, as well as what constitutes recycling and posting. Additionally, it necessitates the formulation of precise policy objectives for the entire waste management plan. Is it more important to maximize landfill diversion or to implement the ecologically protective, most cost-effective strategy? There are no unequivocally correct or incorrect responses. However, the public should be informed of the definitions, fundamental presuppositions, and objectives for evaluation and discussion [1].

The identification of all feasible solutions and the systematic gathering of the environmental risks and costs related to each option constitute the second step. The optimal time to collect data is before choosing a plan. Depending on the assumptions made regarding market demand and the steps taken to boost markets, cost estimates for recycling and composting might vary greatly. Since certain kinds of reuse scenarios have more severe environmental implications than others, these varying market assumptions may also have an influence on the assumptions about environmental hazards. The cost and environmental risks associated with various options will also depend on how strict the regulatory permitting and enforcement programs are that set and enforce standards for each type of waste management facility, including recycling facilities and facilities that use recycled material inputs in the manufacturing process. Finally, the costs and hazards of different recycling and composting solutions will be impacted by the availability of product standards for recycled materials. All management techniques will have different costs depending on the volume. After this data is gathered, the general public need to be given the chance to provide insightful feedback on the veracity of the presumptions. Acceptance of the public at this level may eventually lead to a procedure that is quicker and more fluid.

In order to choose an option or set of alternatives, the last stage is comparing the tradeoffs between the possibilities that are now accessible. These tradeoffs primarily entail comparing costs and risks. But they also include carefully taking into account implementation concerns including funding, trash quantities, enforcement, permit timeframes, site challenges, and potential future behaviour changes. It helps to provide some instances of implementation problems. Pay-by-the-bag waste disposal programs could lead to less trash since individuals tend to produce less waste when they can save money. On the other side, there have been some signs that pay-by-the-bag systems have actually led to a decrease in legal dumping and an increase in private burning of trash. Another example is the need to determine the true impact of bottle bill. If the collected bottles are recycled or if markets exist for their reuse, bottle bills may be highly successful. Because there is no effective market strategy in place, bottle bills in certain places lead to a double payment once for the collection of the bottles and again for their disposal. The last example involves flow control. Flow control is a means of ensuring that each of the different solid waste facilities has a enough supply of garbage to operate effectively. The government may be tampering with the generator's Superfund liability or increasing the amount of waste going to an environmentally subpar facility if it uses flow control to send a private generator's waste to a poorly designed or operated solid waste facility.

The costs of alternative solutions may be compared using several computerized decision models. These, however, often need a lot of customizing before they perfectly match a local circumstance. It is often helpful to create a final strategy iteratively by choosing one or two plausible options initially, and then defining the precise characteristics of the chosen method in a subsequent iteration. Participation of the public is essential throughout the selecting process.

Creating a number of generator-specific methods in order to create an integrated waste management plan may also be beneficial. One category of MSW generators is residential generators. The public sector, which produces its own waste streams and comprises towns and counties, is another significant category.

The hotel and restaurant industries, petrochemical companies, the pulp and paper sector, and the supermarket industry are just a few examples of the many particular industrial groupings. Each time, the kind of solid waste produced will be different. For certain organizations, all garbage will be included in the general MSW category. Industrial, agricultural, or other non-MSW waste will make up a large portion of the garbage for other groups. There may be substantial diversity within the generator category in certain instances.

The within-group waste characterization is likely to be very consistent in other situations. Industry-specific methods that concentrate on the major waste generation classes might provide more workable and affordable solutions [2].

Key Factors for Success

Arriving at successful solid waste management solutions requires more than just good planning. The best technical solution may fail if politicians and government officials do not consider a series of other important points. This section attempts to identify some of these points.

i. Credibility for Decision Makers

The integrity of those who must eventually make the tough siting and permitting choices must be protected at all costs. Environmentally sound guidelines for all kinds of facilities, including recycling facilities, may provide the required backing for decision-makers. Additionally important is credible enforcement that acts on an even playing field. Public satisfaction with solid waste management facilities may also be increased through operator certification programs, company-run environmental audit programs, company-run environmental excellence programs, government reward programs for exemplary facilities, and financial assurance clauses. Last but not least, precise siting procedures and conflict resolution processes may provide decision-makers a critical support system [3].

ii. Efficient Implementation Mechanisms Including Market Incentives

There are many things that may be done to make programme implementation easier. It may be beneficial to use accelerated permitting procedures for both new construction and current facility permit modifications. Examples of strategies include class permits or varying standards depending on how sophisticated the facilities are. Pilot programs may be very useful in figuring out if a programme that seems excellent on paper will really perform successfully.

The majority of current federal and state law and regulation has a command-and-control system at its core. Such a plan is predicated on clear directives that apply to all stakeholders equally. Because these rules are created independently of market principles and other fundamental economic motivations, they are often more difficult and costly for both the regulated and the regulators to put into practice.

The consideration of market incentives is a component of some of the most effective implementation techniques. When compared to the conventional command-and-control strategy, market alternatives may dramatically reduce the cost of accomplishing a set quantity of environmental protection, energy reduction, or resource conservation. The idea behind this strategy is straightforward. Find out what the overall objective is. Then, allow those who can accomplish the objective in the most efficient manner. To those who struggle harder to reach the objective, they may sell more credits. Other market strategies depend on leveraging market price to actively promote desired behaviors [4].

The Federal Emergency Planning and Community Right-to-Know Act (1986) emissions reporting programme is another incentive-style programme that has produced significant environmental advantages in a cost-effective manner. Specific reductions in emissions to the air, water, and land are not mandated by the legislation. It does, however, mandate that the impacted facilities disclose the amount of chemicals discharged in public. The simple need to publicly disclose has led to a significant decrease in emissions.

The following programme categories might be examined by decision-makers at the state or federal levels:

i. A comprehensive programme that uses a marketable permit system to lower average per capita trash production rates. This kind of programme might be implemented in a variety of ways. In a state, a set per capita amount might be determined. Any towns (or counties) who could do so most effectively may sell additional credits to other municipalities that were impacted. Another option would be to base the per capita rate on the size of the municipality or mandate a specific percent decrease from baseline prices for all municipalities.

ii. A sellable permit programme to carry out recycling objectives. Allow the municipalities and counties that can accomplish recycling rates most affordably to sell any excess credits to other impacted parties rather than requiring all towns, municipalities, and counties to achieve the same levels of recycling.

iii. A programme that would create various corporate tax rates depending on how much recycling (or source reduction) the firm does. The tax rates might be determined by percentage increases over a base year or set rate criteria (such as a source reduction of 10% or recycling of 25%).

iv. A plan to provide various property taxes for residences who recycle or cut their garbage disposal by a certain proportion. To keep the tax benefit, the percentage might be raised progressively each year.

v. Giving favor to businesses who recycle a lot overall or use a lot of secondary materials in their products and services.

vi. Differential business tax rates or permit preferences for businesses that employ recycled material inputs in manufacturing processes or that purchase significant amounts of recycled materials for consumption.

vii. Differential water rates are offered to businesses who use a lot of compost or cut down on their green waste.

viii. Requirements for information disclosure that mandate certain kinds and sizes of organizations to divulge data to the public on their rates of waste production, recycling, acquisition of secondary materials, and waste management practices. Hotels and other consumer enterprises are good examples. Additionally, the state might gather industry-specific state average values and mandate that these prices be disclosed alongside company-specific rates.

Significant Attention on Recycling Markets

Recycling won't be long-term viable unless it is driven by the market, where there is a market for secondary materials. The subject of market incentives offers some suggestions for how market incentives may be used generally to motivate effective integrated waste management plans by influencing the behaviors of those who would be impacted. Some of these actions could cause a market demand for certain secondary materials. But it's also critical to look at secondary material markets on a commodity-by-commodity basis, especially for the group of commodities that make up a significant portion of the MSW stream [5].

There are many different policy options that might affect market demand. These include requirements for recycled content in certain commodities, manufacturer take-back programs, virgin material fees, lab testing fees, equipment tax credits, tax credits for users of secondary materials, mandated use of secondary materials for certain government-controlled projects like landfill covers or mine reclamation projects, use of market development mechanisms in enforcement settlements, and more. Only after a thorough examination of each commodity can it be established if any of these activities are required and, if so, which ones.

Two warnings are in order if such steps are required. First, before dictating a certain outcome, it is often preferable to address the need for market strengthening with concerned parties. A controlled result may be automatically imposed if the market does not improve after a certain amount of time. That hammer often gives people the push they need to take action without involving the government. The latter four instances of market demand methods are best implemented at the federal level, despite the fact that the first six programme examples of market demand approaches may be implemented at either the federal or state level [6].

Public Involvement

Since the public must actively participate in making the ultimate decision, even the finest technological solution may not be successful. Public participation must really engage both sides of a conversation; it cannot be a one-way street. In order to reach a consensus, there must be mutual concessions. This conversation must include a meaningful consideration of the trade-off between cost and risk reductions. Multiple chances for formal and informal feedback are preferable for this public participation.

Continuous Commitment to High-Quality Operations for All Facilities

A dedication to high-quality operations is necessary for today's solid waste solutions. As with many other government services in the past, solid waste management contracts were often given to the lowest bidder. Given the environmental risks connected to improperly managed solid waste, this strategy has to be carefully evaluated.

Evaluation of the Effectiveness of the Chosen Strategy

It is crucial to consider the complete effect of each legislative or regulatory provision when creating a given piece of legislation or set of rules. Planning for MSW is a process, not a job. That procedure must continuously guarantee that the plan accurately reflects reality and that implementation challenges are quickly resolved.

DISCUSSION

There will be waste produced by every facility. Managing a facility's waste stream is an everyday need, regardless of the size of the company, the size of the building (such as a hospital or college), or the size of the stadium. Basically, some of the material that enters your facility will be disposed away as garbage. The only method to control this inflow-outflow process is to create a practical, expert waste management strategy. Unfortunately, this procedure, which occurs every day at every institution, is sometimes not given the serious consideration it deserves. As a consequence, the organization running the facility will have greater operational costs and a bigger environmental impact. Every organization's fundamental operation should include an effective and affordable waste management strategy. Any sizable facility should have a well-designed waste management system in place, just as no business should function without well-tuned, effective, and thoroughly vetted accounts payable and payroll systems processes designed with specific goals in mind that are routinely examined for errors and inefficiencies. Controlling the input and outflow of materials is a fundamental need of doing business in the modern world, much as controlling the inflow and outflow of finances. A workable waste management strategy is the best approach to do it [7], [8].

CONCLUSION

Uncontrolled waste disposal has serious negative effects on the environment and public health, including contaminating surface and groundwater through leachate, soil contamination from direct contact with waste or contaminated liquid waste percolation, air pollution from burning waste, disease transmission by various vectors like birds, insects, and rodents, causing discomfort due to unpleasant landfill odours, and uncontrolled release of hazardous substances. Planning for waste management involves accurate information on waste creation, variables that affect trash generation, and fact-based projections of waste volumes. It is urgently necessary to raise public awareness, professional knowledge, facilities, and financing from government or non-governmental organizations in order to increase the sustainability of solid waste management. It is important to emphasize capacity enhancements to the current system for managing solid waste, especially with regard to collection and disposal.

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CHAPTER 12

AN ELABORATION OF PRINCIPLES OF MUNICIPAL SOLID WASTE MANAGEMENT

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ABSTRACT:

The management of municipal solid waste is a major problem that affects metropolitan areas all over the globe. Solid waste management encompasses a variety of tasks, such as garbage collection, transportation, disposal, and recycling. To reduce garbage's harmful effects on the environment, public health, and sustainable development, it is crucial to manage municipal solid waste effectively. This summary gives a general overview of the difficulties that come with managing municipal solid waste, including the necessity for better garbage collection and disposal methods, the significance of raising public awareness and education, and the contribution of technology to better waste management practises. In order to preserve a cleaner, healthier environment for both the present and future generations, the abstract also emphasizes the need of international collaboration and the necessity for sustainable waste management regulations.

KEYWORDS:

Environment, Earth, Ecofriendly, Pollution, Solid Waste**.**

INTRODUCTION

There are several methods to classify a nation's level of development. In this publication, the stage of development is categorized in relation to its effects on solid waste management based on the availability of economic resources and the level of industrialization. Economic development status is a better indicator of the long-term economic landscape than it is of the current state of the economy (recession vs. prosperity). The management of solid waste in an environment that is predominantly non-industrial is the focus of this publication. Such management is tailored to the types and amounts of waste produced as well as the accessibility of handling and processing equipment typical of non-industrial environments. The level of mechanization and the accessibility of technical resources are used to gauge industrialization. Whether it is justified or not, the words "developed" and "industrialized" are often used interchangeably.

It is challenging to apply a single developmental category to solid waste management because to localized fluctuations in degree of development within each nation. A big metropolitan region, such as the capital city and its surroundings in a developing country, could be at a level of development that is significantly advanced compared to the rest of the country. On the other hand, these communities are not totally protected from the constraints placed on them by the nation's position.

The authors of this document have made an effort to avoid using repetitive descriptions of technologies that do not significantly change with scale of operation or degree of sophistication in order to include in each section a range of coverage that encompasses the range of development that is typically found in economically developing nations. Although the material offered in this article is largely relevant to developing nations, it is crucial to keep in mind that some of it may also be relevant to a country in transition or even a developed or industrialized country.

Characteristics of Solid Waste in Developing Countries

The phrase "solid waste" is often used to describe a diverse range of wastes generated in metropolitan settings, the nature of which differs from region to region. The kind and volume of solid waste produced in a region depend on the residents' lifestyle and way of living as well as the variety and amount of the area's natural resources. Organic and inorganic wastes are the two main categories into which urban wastes may be separated. Urban solid waste's organic components may be broadly divided into three groups: putrescible, fermentable, and non-fermentable. Putrescible wastes often degrade quickly and, if not well regulated, produce offensive smells and bad visual conditions. Wastes that are fermentable tend to disintegrate quickly without the unpleasant side effects of putrefaction. Non-fermentable wastes decompose slowly because they often resist microbial deterioration. The preparation and consumption of food is a significant source of putrescible waste. As a result, its nature changes depending on a person's lifestyle, way of living, and food season. Crop and market detritus are examples of fermentable wastes.

The main distinction between wastes produced in industrialized countries and those produced in underdeveloped countries is the former's greater organic content. The information in Table 1 on the volume and makeup of municipal solid wastes produced in various nations provides an indication of the size of the discrepancy [1], [2].

Table 1: Illustrated the Comparison of Solid Waste Characterization Worldwide (% wet wt)

Location	Putres -cibles	Paper	Metals	Glass	Plastics, Rubber, Leather	Tex-tiles	Ceramics, Dust, Stones	Wt (g)/ cap/ day
Bangalore, India [1]	75.2	1.5	0.1	0.2	0.9	3.1	19.0	400
Manila, Philippines [2]	45.5	14.5	4.9	2.7	8.6	1.3	27.5	400
Asunción, Paraguay [2]	60.8	12.2	2.3	4.6	4.4	2.5	13.2	460
Seoul, Korea [3]	22.3	16.2	4.1	10.6	9.6	3.8	33.4[a]	2,000[a]
Vienna, Austria [4]	23.3	33.6	3.7	10.4	7.0	3.1	18.9[b]	1,180
Mexico City, Mexico [5]	59.8[c]	11.9	1.1	3.3	3.5	0.4	20.0	680
Paris, France [4]	16.3	40.9	3.2	9.4	8.4	4.4	17.4	1,430
Australia [7]	23.6	39.1	6.6	10.2	9.9		9.0	1,870
Sunnyvale, California, USA [6]	39.4[d]	40.8	3.5	4.4	9.6	1.0	1.3	2,000
Bexar County, Texas, USA [6]	43.8[d]	34.0	4.3	5.5	7.5	2.0	2.9	1,816

While wastes produced in regions subject to seasonal temperature changes or where coal or wood are used for cooking and heating may contain a lot of ash, those produced in humid, tropical, and semitropical areas are typically characterized by a high concentration of plant debris. During the winter, the ash content might be much greater. Regardless of climate variations, the wastes often include some nightsoil contamination. These variations are still present in the trash produced in large cities in emerging nations.

Solid trash should ideally not include faces or urine, and combining these substances with home garbage should be illegal. However, there has to be some leniency in this situation due to enforcement challenges and lifestyle differences. Human excretory wastes combined with home garbage make it difficult to collect solid waste in a way that is acceptable in terms of environmental health. It should also be prohibited to handle domestic garbage in conjunction with pathological wastes, slaughterhouse wastes, industrial wastes, and similar materials. Nevertheless, it's important to remember that certain microorganisms and chemical residues will unavoidably be present in the garbage despite all safety measures.

Importance of a Sound Solid Waste Management Program

An economically growing country may neglect solid waste management in an effort to hasten the speed of its industrial growth. Such a failure results in a heavy consequence later on, including the wasteful loss of resources and a staggeringly negative effect on the environment, public health, and safety. By deciding to address the waste later, when the nation may be in a better position to take the necessary actions, the punishment is neither avoided nor alleviated. This is true because, as shown by the information in Table 1, the rate of waste creation often rises in direct proportion to the level of development achieved by a country. The incorrect justification that improvements in developmental status take precedence over the preservation of a welcoming atmosphere does not decrease the penalty either. The work needed to restore the environment to its original state increases with environmental deterioration. In conclusion, efforts to maintain or improve environmental quality should at the very least be comparable to those made to progress development.

i. Environmental and Health Impacts

The organic component of MSW is a crucial component due to its potential negative effects on public health and environmental quality as well as the fact that it makes up a significant portion of the solid waste stream in a developing nation. Its attraction of rodents and vector insects, for whom it supplies food and shelter, has a significant negative effect. A negative impact on environmental quality is shown as offensive odours and ugliness. These effects are not limited to the disposal location alone. On the contrary, they are present whenever the trash is produced, dispersed, or accumulates around the site. Without proper management, an organic waste's negative effects will last until it has completely broken down or somehow stabilized. Resources such as soil, water, and air may be contaminated by unmanaged or poorly regulated intermediate decomposition products.

ii. Epidemiological Studies

According to studies, a significant portion of people who deal with waste and those who live close to or on disposal sites are infected with gastrointestinal parasites, worms, and other associated species. This form of contamination is probably present everywhere garbage is handled. Even though it is known that rodents and insects can act as carriers of a number of pathogenic diseases, including cholera, yellow fever, the plague, typhoid fever, salmonellosis, and others, it can frequently be challenging to pinpoint how such transmission affects a particular population [3].

Modern solid waste management techniques have a direct and significant positive impact on the environment's quality as well as public health. For a fair price, a cutting-edge solid waste management programme may be put into place. This is a crucial truth since there are several instances when developing nations' solid waste management expenses are high and the quality of service is subpar. However, if the underlying causes of these circumstances are examined, it becomes clear that, in many instances, cost-effective waste management systems would be produced if the systems' discovered flaws were fixed.

For instance, municipalities in certain poor nations allocate an excessive number of financial resources to specific solid waste services, particularly garbage collection and sweeping. In the past, it was typical to simply spend more money to improve poor service delivery, such as via the purchase of new equipment, the design and building of facilities, etc., without also addressing and resolving systemic inefficiencies. Unfortunately, substantial capital expenditures in the solid waste management industry in many developing nations do not always translate into higher levels of service quality. On the other side, by implementing low-cost, or sometimes no-cost, alterations to the current system, with the emphasis being on boosting system efficiency, significant gains may often be obtained. The effective planning of collection routes, changes to the collection trucks, decreases in equipment downtime, and public education, such as education and communication leading to the generation of less waste and the reduction of litter, are examples of such improvements [4], [5].

Recovery and Utilization of Resources

Resource recovery is a key component of solid waste management in developing countries for a number of reasons. Metals, glass, plastic, textiles, and other reclaimable inorganic components have historically been retrieved mostly by uncontrolled manual scavenging by private persons (often referred to as the "informal" sector). By establishing material recovery facilities (MRFs), scavenging has been formalized and mechanized during the last several years. An essential component of waste management is the reuse and recovery of the inorganic parts of the waste stream.

Since organic (biodegradable) residues account for at least 50% of the garbage (by weight) in the majority of developing nations, special attention is paid to these residues. The organic component's resource recovery includes three aspects:

i. The element may be composted and utilized in agriculture as a soil additive.

ii. ii. Its energy content is recoverable thermally or biologically. Methane is produced via biological energy recovery through anaerobic digestion. Combustion is used in thermal recovery to generate heat.

iii. iii. To create sugar, the organic material might be hydrolyzed chemically or enzymatically. The sugar may be utilised to produce single-cell proteins or as a substrate for the fermentation of ethanol.

The usage in agriculture is the most useful of the three uses. Despite being a long-standing practice, "bio-gasification" or the creation of methane has only lately started to get significant interest as a viable alternative energy source. Before either ethanol fermentation or the manufacturing of single-celled proteins becomes a practical reality, there are several obstacles to be overcome, mostly of an economic character.

A resource recovery project's effectiveness depends on having a precise understanding of the amount and makeup of the waste input. It is necessary to guarantee the composition and consistency of the input's volume. It is obvious that trying to run a business of any real magnitude without a reliable raw material supply would be a complete waste of time. Not only must the supply be consistent, but it must also always be accessible at a fair price. Ample financial resources and competent human resources are further prerequisites.

With few exceptions, substantial economic resources would prevent operations like hydrolysis and maybe large-scale anaerobic digestion in a reactor in economically poor countries. These procedures rely on rather pricey advanced equipment. On the other hand, there are many different types of composting, from that done by private households to that done by communities. Composting equipment does not need to be complicated. Last but not least, in order to prevent recycling from turning into a precursor to landfilling, it is necessary to identify the existence, scope, and sustainability of a market or other kind of demand for the recovered resource [6].

Scope and Organization of the Book

There are two volumes to the book. It is further broken down into four sections, four appendices, a bibliography, and a glossary in Volume I. Below is a summary of what each of the four components contain:

- **i.** The fundamentals of solid waste management are covered in Part I. It has five chapters total, including the introduction, covering topics including the framework for managing solid waste, the amount and types of garbage, storage and collection, and street cleaning.
- **ii.** The processing and treatment are covered in Part II. The eight chapters include topics including recycling, using organic materials in agriculture, and recovering energy via biological and thermal processes. Composting is well discussed.
- **iii.** The ultimate disposition is covered in Part III. Sanitary landfilling is covered in its own chapter.
- **iv.** Part IV is made up of four chapters that include non-technical topics such as management information systems (MIS), financial considerations, policy choices, and regulatory and economic tools.

The publication's appendices provide further data and information on public health, the features of compost, performance metrics, and the costs of solid waste treatment methods.

DISCUSSION

I this section the author discusses the key components of solid waste management strategy and execution that apply to developing countries. Since the design and execution of solid waste management systems requires an awareness of both sets of difficulties, both non-technical and technical topics are treated in depth. Since organic waste makes up a major portion of the waste stream in developing nations, composting and the use of organic waste in agriculture are given a lot of consideration. The management of solid waste in an urban environment is the main focus of this work. A tiny municipality, a town of any size in the middle, or a large metropolitan region might all be considered urban settings. In certain circumstances, technology features might be used to rural areas. The publication is intended for those who oversee or play a key part in solid waste management. The goal is to make them aware of their possibilities and provide them with the background knowledge they need to make decisions that are in line with the country's cultural, economic, and technical realities. As a result, the information is more focused on helping people make decisions than on providing exact technical designs for facilities at particular locations. A thorough engineering design requires input from qualified experts who are knowledgeable about solid waste management and sensitive to the unique requirements of the community seeking their professional assistance. This is especially true when a project's scope requires more than a few tonnes of garbage every day. Although the book does not concentrate on particular engineering design, many of the technical topics discussed in the publication include descriptions of basic scientific and engineering concepts [7], [8].

CONCLUSION

As a result, the reader is made aware of the fundamental connections between operation and performance, and they may utilize these fundamentals to examine solid waste management systems in light of a specific set of circumstances. The authors want to emphasize as the Introduction draws to a conclusion that managing solid wastes is a challenging issue that doesn't need to be made more challenging by needlessly using complicated (expensive) technology. In the low-tech economy of developing countries, effective solid waste management depends on avoiding superfluous high technology. A limited amount of sophisticated machinery and technology should be imported. A technology that is generally seen as low-tech and easily implementable in one nation may 5 6 be too advanced and otherwise unsuitable in the nation that is importing it. This assertion is true not just for trash disposal procedures but also for waste collecting and even waste storage equipment.

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CHAPTER 13

AN ANALYSIS OF SOLID WASTE MANAGEMENT FRAMEWORK

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ABSTRACT:

Solid waste management (SWM) is a growing concern for governments and communities worldwide due to its environmental and health impacts. A comprehensive framework for SWM is essential to address the challenges posed by the increasing amount of waste generated by growing populations and urbanization. This abstract presents an overview of the key components of an effective SWM framework, including waste minimization, segregation, collection, transportation, treatment, and disposal. It also emphasizes the need for public education and awareness campaigns to encourage waste reduction and behavior change, as well as the importance of stakeholder engagement and collaboration in developing and implementing SWM policies and programs. Furthermore, the abstract highlights the role of technology in optimizing waste management processes and creating opportunities for resource recovery and circular economy initiatives. Finally, the abstract underscores the significance of incorporating sustainable and environmentally-friendly practices into SWM frameworks to promote a healthier, cleaner, and more resilient environment.

KEYWORDS:

Environment, Pollution, Solid Waste, Waste Management, Waste Framework.

INTRODUCTION

Waste management issues such as waste characteristics, collection, landfilling, public awareness campaigns, and information management are included under integrated waste management. Some of these subjects are also mentioned generically in this chapter in the context of their significance and applicability to supporting the fundamental framework for solid waste management, even though they are covered in fully later in the book. This section specifically addresses the connections between the major subjects addressed in this book. Understanding these connections is essential to implementing integrated waste management, a single, comprehensive strategy for handling garbage in a city, town, or region.

a) Elements of a Waste Management System

A comprehensive municipal solid waste management (MSWM) system includes some or all of the following activities:

i. Setting policies;

ii. Developing and enforcing regulations;

iii. Planning and evaluating municipal MSWM activities by system designers, users, and other stakeholders;

- **iv.** Using waste characterization studies to adjust systems to the types of waste generated;
- **v.** Physically handling waste and recoverable materials, including separation, collection, composting, incineration, and landfilling;
- **vi.** Marketing recovered materials to brokers or to end-users for industrial, commercial, or small-scale manufacturing purposes;
- **vii.** Establishing training programs for MSWM workers;
- **viii.** Carrying out public information and education programs;
- **ix.** Identifying financial mechanisms and cost recovery systems;
- **x.** Establishing prices for services, and creating incentives;
- **xi.** Managing public sector administrative and operations units;
- **xii.** Incorporating private sector businesses, including informal sector collectors, processors, and entrepreneurs.

b) Integrated Waste Management

A framework for building and implementing new waste management systems as well as for evaluating and improving current systems is integrated waste management. Integrated waste management is founded on the idea that all technical and non-technical parts of a waste management system should be examined together since they are in reality interconnected and changes in one area often have an impact on procedures or activities in another [1].

c) Importance of an Integrated Approach

Sound practice must have an integrated approach because:

- **i.** Some issues can be treated more quickly and effectively when they are combined with other waste system components. Additionally, unless changes are managed in a coordinated way, the construction of new or enhanced waste processing in one location might interrupt ongoing activity in another area.
- **ii.** Integration enables capacity or resources to be optimized and hence fully used; there are usually equipment or management infrastructure economies of scale that can only be attained when all garbage in an area is handled as part of a single system.
- **iii.** An integrated strategy enables engagement from players in the public, private, and informal sectors, in roles suitable for each.
- **iv.** Since certain waste management techniques are more expensive than others, integrated methods make it easier to find and choose affordable solutions. Some waste management initiatives won't ever be able to generate any revenue; others will always be net costs; and yet others could. A variety of practises that complement one another in this respect might emerge from an integrated system.

v. The absence of an integrated system might result in revenue-generating activities being "skimmed off" and viewed as lucrative while operations connected to protecting public health and safety are not adequately funded and are run at low or inadequate levels.

d) Methods for Integrating a Waste System

There are several methods that planners might strive towards integrated systems. The first step is to put all the formal components of the waste system into one framework and then create a strategy based on the system's overall goals. The solid waste management hierarchy, which outlines the priority that should be given to important waste management activities that impact waste creation, treatment, and disposal, is one of the pillars of the framework for contemporary, integrated solid waste management systems. The next part goes into more information about the hierarchy [2].

Putting all waste-related operations under the same division or agency, which is a crucial step towards achieving integration, comes in second in terms of jurisdictional and staffing difficulties. Developing integrated financial systems that, for instance, employ disposal fees to pay materials recovery or public education, is a third technique to facilitate coordination and weighing trade-offs across all components of a waste management system. In a broader sense, it's critical to evaluate all MSWM system expenses and locate chances for income generation.

e) Waste Management Hierarchy as a Key Element of Integrated Solid Waste Management

The waste management hierarchy is a common component of national and local policy and is often regarded as the cornerstone of contemporary MSWM practice. The hierarchy places waste management procedures in order of their positive effects on the environment or the use of energy. The hierarchy is similar to that in Figure 1 in almost all nations, with the initial items having more importance than those below them [3].

The hierarchy of waste management is designed to ensure that waste management procedures are as ecologically friendly as possible. The majority of industrialized nations have embraced the waste management hierarchy in different versions. Its key components are also included in regional efforts to create a coordinated strategy on the reuse of different waste management process byproducts as well as international treaties and protocols, notably those that deal with the management of toxic or hazardous wastes.

The hierarchy is a practical tool for policymakers to save resources, address landfill shortages, reduce air and water pollution, and safeguard public health and safety. Since traditional waste avoidance, reuse, and recycling practices are commonplace in many poor nations, certain elements of this hierarchy are already in place [4].

Nevertheless, it is important to acknowledge that all waste management techniques have advantages and disadvantages. since of this, the hierarchy cannot be strictly followed since, in certain cases, the costs of a recommended activity may outweigh the benefits when all financial, social, and environmental factors are taken into account.

Stakeholders

Clear definition of authority and responsibility, participation of all stakeholders in system design, and awareness of the lines of accountability among those impacted at all levels are requirements for appropriate practice in waste management systems. Whether or whether the government itself is undertaking the waste management duties, governments will often have ultimate authority and responsibility for overarching policy as well as for administration of the MSWM system. The parties listed below each have a substantial connection to waste management and, in certain circumstances, have a large amount of responsibility for operations or policy.

i. Residential Waste Generators:

The whole waste system is impacted by local inhabitants' preferences for specific trash services, their desire to find separate recyclable items, their willingness to pay for the service, and their ability to transport garbage to public collection locations. Residents' choices and actions may be influenced by incentives.

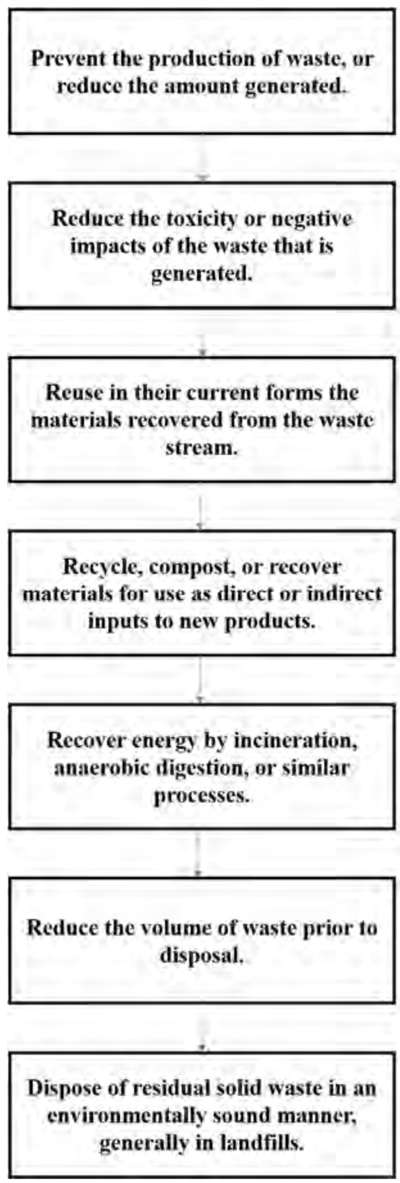

Figure 1: Illustrated the Key Element of Integrated Solid Waste Management

ii. Business Waste Generators:

Businesses create garbage as well, and they have the potential to play a big role in the waste management system, especially when they are required to pay for their waste services directly, as is increasingly the case. Similar to inhabitants, incentives may have a significant impact on behavior.

iii. Public Health and Sanitation Departments

An essential public duty is to maintain public health and sanitation, and in most developing and transitional nations, this task falls within the purview of the local public health department. This agency often oversees inspection and enforcement in an integrated system but is not actively engaged in collecting or disposal activities [5].

iv. Public Works Departments

The majority of the time, these local governments are in charge of managing garbage collection, transport, treatment, and disposal. However, it is often the job of a separate department to collect recyclable items or manage independent contractors, which frequently results in competing objectives and actions.

v. Natural Resource Management Agencies

These organizations often oversee local or regional initiatives related to material recovery or composting. As a consequence, there is inadequate integration between these activities and waste management operations. Putting all the functions under the same agency or department is often considered to be good practice.

vi. National or State/provincial Environmental Ministries

In general, these levels are where waste management policy is created. In underdeveloped nations, little policy is made at this level with regard to materials recovery. In order to develop integration that complies with the policies, programs must also be put in place in addition to the policies themselves.

vii. Municipal Governments

In the majority of nations, local or municipal governments are in charge of managing garbage, making sure that it is collected and transported to processing plants, markets, or disposal sites. Typically, the city government which is ultimately in charge of the whole process will finance the trucks, teams, and other equipment.

viii. Regional Governments

In nations where there is a scarcity of local disposal space, regional agencies or big city governments may have responsibility for landfills, incinerators, composting facilities, or the like. Typically, the regional governments in charge of these facilities have access to a source of income from the disposal fees collected by garbage collection businesses.

ix. Private Sector Companies

As concessionaires or contractors for the appropriate government authority, private sector businesses often participate in the collection of garbage, street sweeping, material recovery, and increasingly, the building and operation of landfills, incinerators, and composting facilities. Private firms, unlike governments, are only involved in activities that allow them to gain money since they do not directly manage public health or sanitation. It is unreasonable to anticipate engagement from the business sector if there is no source of income. However, the required funding source may come from direct fees or grants from the government.

x. Informal Sector Workers and Enterprises

Individual workers and unregistered, small businesses recover materials from the waste stream in developing nations, but they also do so to a significant extent in industrialized and transitional nations. They do this through segregated or specialized collection, purchasing recyclable materials, or picking through waste. These individuals and businesses improve and/or clean the recovered materials before selling them to either a manufacturer, a broker, or an intermediate processor. Workers in the informal sector may create brand-new products using recovered materials; they could create gaskets and shoe soles from used tyres, for instance [6].

xi. Non-governmental Organizations

In the subject of waste management, non-governmental organizations (NGOs) constitute yet another group of players. NGOs often have the goal of improving the environment or the standard of living for underprivileged or marginalized people; as part of this goal, they could encourage small businesses and other initiatives. These organizations usually focus their efforts on the extraction of certain elements that aren't presently being recovered and processing them to add value and generate money since waste materials sometimes constitute the only stream of resources that is expanding. Many composting initiatives in Latin America were launched in this manner.

xii. Community-Based Organization's

Community-based organizations actively participate in trash management activities in a number of places when there is inadequate collection or the neighborhood is underserved. These smaller-scale or local NGOs may start out as self-help or self-reliance units, but they may eventually develop into service businesses that charge customers for collection and profit from the sale of recycled materials. NGOs that engage with community-based businesses and informal employees often seek recognition for these groups as components of the waste management system.

xiii. Poor and Residents of Marginal and Squatter Areas

Similar to other public services, waste collection frequently lags behind political influence and clout, leaving residents of underserved and marginalized communities with unsatisfactory (or nonexistent) service, filthy streets, and an ongoing buildup of trash and human waste in public spaces. These folks often have the greatest need for better or more extensive garbage services.

xiv. Women

Waste handling disproportionately touches the lives of women, particularly in some developing and transitioning countries. Women often collect the waste and set it out or move it to community transfer areas. Women are far more likely to be involved in materials recovery than in other comparable types of physical work. This is perhaps because they are in daily contact with the waste in their homes, and perhaps because women tend to be among the most marginalised groups of some societies.

Cost and Cost Recovery

These services are advantageous to the generators as well as the community at large since efficient trash collection and disposal are required to preserve the cleanliness and public health of a town. Proper trash collection in this sense entails both routine collection services and remediation of wastes that producers have disposed of improperly. But not everyone agrees that all "waste" is indeed waste. Small-scale recyclers and scavengers are effective in recovering value from other people's rubbish. It may be possible to manage this process such that it enhances existing institutionalized garbage collection rather than interfering with it by using the informal sector, which is often engaged in such operations. Scavenging poses major health and societal issues, as explained in this paper, but the point is that a lot of what is considered "waste" is really valuable to someone. The expenses of garbage disposal for the whole community are decreased by those who remove recoverable elements from the waste stream. Sorting the recyclable and reusable parts of the solid waste stream is becoming more and more important in industrialized nations. However, some garbage must ultimately be collected and disposed of, and some kind of payment must be made for this service. Additionally, and depending on local conditions, various waste management services, such as public education and the processing of garbage for the recovery and reuse of recyclable materials, may need support in some form [7].

i. Fees and Charges

Prior until recently, the majority of nations, particularly developing nations, nations in transition, and European social democrats, believed that waste management fell within the purview of the government and was paid for with general resources. Governments have increasingly focused on establishing particular income streams for waste management in recent years, partially due to austerity and structural adjustment policies, pressure from international financial institutions, and pressure to restrict taxes. A number of developments in terms of fees and charges for garbage collection and disposal have resulted from this.

a. Charging Directly for Waste Service

Getting money from the people who use the service is one method of funding waste systems. On the most basic level, trash producers profit from collection services. However, there have been initiatives, especially in North America, to persuade households to pay directly for their own garbage disposal based on the amount of rubbish they are producing. When people want to get rid of their garbage and can pay the costs, the unit charge system for waste collection works effectively and is a good idea. It fails when there are no controls over trash disposal or when there are no easy alternatives, such as when individuals are too poor to pay fees or when the rates are just too costly. Fees may be used to pay for garbage collection or other waste system components. Fees may also be used to encourage waste reduction among generators.

b. Indirect Charges

Waste disposal fees are often connected to other publicly provided services, like water or electricity, for which people are ready to pay. Studies have shown that water and electrical energy usage are approximate indications of waste creation, therefore including waste costs in water and (if existing) sewage rates allows for some cost recovery.

c. Incentives and Penalties

Charges and fees may also be used as rewards for "good behavior" and punishments for "bad behavior." To encourage individuals to source separately, for instance, the cost of disposal may be raised and the cost of materials recovery could be subsidized. Fines may sometimes be applied to deter unlawful dumping.

ii. Structuring Financing for Waste Management Systems

Sound financial management of waste management systems often involves treating fixed expenses and variable costs differently. General tax income may be used to cover fixed expenditures that create the capacity for collecting, processing, or disposing of trash or materials. The justification for this is that having a comprehensive solid waste management system in place has advantages for all societal members. Societies may be able to recoup a part of fixed costs through commercialized collection, processing, and disposal operations if they achieve a certain degree of expertise and stop relying entirely on general tax revenues to pay for these operations. Variable expenses may be properly covered by direct or indirect fees since they are tied to the actions that initially caused them. Accurate cost tracking is a crucial component in creating solid cost recovery systems. Unbelievably many local governments lack the information necessary to determine or justify rates because they are unaware of the true expenses associated with collection or disposal. Wherever they are not now in place, establishing effective, open, full-cost accounting systems should be a top priority [8].

iii. Strategies for Cost Containment and Enhanced Efficiency

The practices that may lead to better cost recovery and financial management are discussed in this section.

a. Privatization

Government pressure to lower taxes while boosting and enhancing service levels is prompting an examination of privatization as a possibility for waste management operations. Privatization may take many different shapes. A government can grant a private company a license to carry out MSWM activities and recover its costs directly from those it serves, award a contract to a private company for specific MSWM services, contract with a private company to build a waste management facility that the company may later own or operate, or allow qualified companies to participate in an open competition.

Municipal solid waste management involves a variety of tasks that may sometimes be privatized and other tasks that nearly always need government oversight and execution. The following areas are where privatization often succeeds:

a) Collection of waste or recyclables payment to the private contractor is based either on total waste collected or on number of households in the service area;

b) Construction of waste facilities;

c) Operation of transfer stations, compost facilities, incinerators, or landfills under contract to a public-sector entity;

d) Development of private waste facilities, once the price for landfilling has risen to a level where other strategies become cost competitive;

In circumstances where there is sufficient government infrastructure to manage a competitive bidding process, to contract with the private firm, to monitor its work, and to hold the private firm accountable for adequate performance of tasks.

DISCUSSION

When the government entity with jurisdiction is too small or too politically weak to be able to manage the contracting processes effectively and when poorly designed, such as if there is little no monitoring and enforcement of contract terms, privatization does not usually work well in small or sparsely populated areas because there usually is insufficient earning potential due to low waste volumes. The role and management of competition are important considerations in the privatization of municipal solid waste management. This is crucial in developing nations because the official and informal private sectors may not be developed enough to provide efficient competition. A privatized waste function may be enhanced through competition. Private contractors are encouraged to perform effectively by competition since there is a strong incentive for them to keep their contracts. In order to guarantee that the complete range of services is accessible, to ensure that the competition is well-managed via contracting, the awarding of concessions, or franchising, and to avoid the establishment of monopolies, competition is healthy at the time of bidding or contract negotiation [9].

CONCLUSION

Sound practice includes acknowledging and assisting small-scale and unorganized sector waste-related businesses, particularly in developing nations, albeit to a lesser degree in transitional and industrialized nations as well. These companies often remove waste-stream products at little or no cost, saving the government money. The financial load on public works and sanitation budgets might dramatically rise if their operations are disrupted. Numerous initiatives have tried to institutionalize these businesses' market niches, secure government recognition for them, and protect their operations from disturbance during waste system modernization and upkeep in recent years. In order to achieve this, contracts have been awarded or arranged between informal sector businesses and the city or formal private sector collection firms; cooperatives have been formed; equipment, supplies, clothing, gloves, and shoes, or even vehicles, have been provided to improve working conditions; and new waste facilities have been designed to include rather than exclude these businesses. By sustaining subsistence activities and an essential economic niche, assisting small and informal businesses often increases efficiency and cost effectiveness.

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CHAPTER 14

AN ANALYSIS OF THE IMPORTANT ISSUES AND STRATEGIES FOR SOLID WASTE MARTIAL

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ABSTRACT:

Poor waste management ranging from non-existing collection systems to ineffective disposal - causes air pollution, water and soil contamination. Open and unsanitary landfills contribute to contamination of drinking water and can cause infection and transmit diseases. Recycling reduces the need of natural resource exploitation for raw materials, but it also allows waste materials to be recovered and utilized as valuable resource materials. We can significantly reduce the amount of solid waste by following some basic principles of reducing the amount of waste that is created, reusing materials that would otherwise be discarded, by recycling materials and by using recycled materials.

KEYWORDS:

Environment, Glass, Iron, Papers, Solid Waste, Waste Management.

INTRODUCTION

An important element in improving waste management systems is the need to attune chosen technologies to the character of the waste that is generated in a particular location. If wastes are wet and dense, as they are in most developing countries, buying compactor trucks will often be a waste of money. If wastes have low calorific value, it will not be possible to incinerate them without using supplementary fuel. If considerable amounts of toxic waste have entered the general municipal solid waste (MSW) stream, leachate from dumps will be particularly dangerous. On the other hand, if a portion of the waste stream consists of organics or can be easily separated into organics and non-organics, composting may become a viable waste management strategy.

Major differences between Industrialized and Developing Countries

One theme that appears consistently throughout this book is the enormously different conditions in which industrialized and developing countries must work to solve MSWM problems. Developing countries often have:

- **i.** Low labour costs and extreme shortages of capital, which together call for low-tech solutions to MSWM problems;
- **ii.** A waste stream dominated by organic waste, which means that: a) incineration is difficult unless undertaken in conjunction with a program that achieves source separation of organics, and b) composting is especially important if large amounts of waste are to be diverted from landfills;

iii. A complex informal sector that is very active in the collection, separation, and recycling of waste;

iv. Significant mixing of industrial hazardous wastes with MSW;

v. Few people who are adequately trained in solid waste management activities, and a high proportion of the urban population with low levels of education;

vi. Inadequate physical infrastructure in urban areas, which makes collection of waste particularly difficult.

At the same time, it should be recognized that there are also similarities between industrialized and developing countries with regard to MSWM issues. In neither case does the public want MSWM facilities near residential areas and, in both cases, the amount of waste being generated is increasing. In both industrialized and developing countries, adopting an integrated approach to waste management is important. Related to this, people throughout the world are recognizing the importance of waste reduction as the first stage of the waste management hierarchy and as an essential element of MSWM. Methods of waste reduction are described in more detail in the last part of this chapter.

Improving Management Capabilities

In many instances, particularly in developing countries, the greatest impediments to efficient and environmentally sound handling of MSWM issues are managerial, rather than technical. Improving the operational and management capabilities of individuals and institutions involved in MSWM at the local level is therefore extremely important. For this reason, this book considers these issues in two of the topics addressed: management and planning, and training. Even with new efforts to make funds available for MSWM activities, it is certain that funds will at least appear to be insufficient for the foreseeable future. Managers must therefore be attuned to every opportunity to use their resources more efficiently [1].

Public Involvement

The public can play a role in promoting efficient, financially sound, technically competent management of waste issues by demanding accountability from the MSWM system. Although in many countries the public has long grown accustomed to having low expectations of government, the pressing and very visible problems brought about by the absence of effective MSWM systems may inspire stronger demands for good performance from public managers and any private companies with whom they work. Public education is important in achieving the goal of public involvement. This book includes a section on public education for each of the regions [2].

Special Wastes

Special wastes are those types of solid waste that require special handling, treatment, and/or disposal. The reasons for separate consideration include: tye first one is their characteristics and quantities (either or both may render them difficult to manage if they are combined with "typical" municipal solid waste); or second is their presence will or may pose a significant danger to the health and safety of workers and/or the public, to the environment, or both. These wastes are very different from each other, so they should be managed and handled separately if feasible. Typically, in developing countries, special wastes are set out for collection, collected, and/or disposed along with wastes from commercial businesses and residential generators. Ideally, these wastes should not enter the municipal solid waste stream, but quite frequently they do, particularly in developing countries. Examples of types of special wastes are given below:

i. Pathological or infectious medical waste from hospitals, clinics, and laboratories.

ii. Hazardous waste in the household waste stream (e.g., oil-based paints, paint thinners, wood preservatives, pesticides, household cleaners, used motor oil, antifreeze, batteries)

iii. Discarded tires

iv. Used oils

v. Electronic waste (e-waste)

vi. Wet batteries

vii. Construction and demolition debris

viii. Municipal wastewater treatment (sewage) sludge, septage, and slaughterhouse wastes

ix. Industrial hazardous waste, and some types of industrial solid waste (e.g., metal cuttings from metal processors or cannery waste)

Special wastes can cause significant health and environmental impacts when managed inadequately. Persons that may come into direct contact with the wastes, such as waste collectors and scavengers, may be subject to significant health and safety risks when exposed to some types of special wastes, e.g., industrial hazardous waste. Toxic components of these wastes can enter the environment, for example, poisoning surface and groundwater bodies. Hazardous wastes can also degrade MSW equipment used to manage solid waste (e.g., collection vehicles), or the performance of the equipment [3], [4].

Special wastes are discussed in this document because of the potential negative effect that they can have on the MSWM system. Still, it is important to point out that this section only superficially reviews the topic of special wastes. If the reader is involved in any part of the management process for special wastes, further additional reference materials and training are extremely important[5].

Proper management of special wastes is quite difficult in most developing countries, particularly in those countries where regular MSW is not managed adequately. Three issues are usually always relevant:

i. The party or organization responsible for managing special wastes is seldom clearly identified and the necessary entity may not even be in existence;

ii. Available resources to manage solid waste are scant and priorities have to be set;

iii. The technology and trained personnel needed to manage special wastes are seldom available.

In the absence of countervailing reasons, the development of sound practices in the management of special wastes should follow the integrated waste management hierarchy applied in other areas of MSWM, i.e. waste reduction, minimization, resource recovery, recycling, treatment (including incineration), and final disposal. As with the management of other types of MSW, the proper application and programmatic emphasis of this hierarchy to special wastes depends on local circumstances (e.g., available technologies, waste quantities and properties, and available human and financial resources) [6].

Effective management of special wastes begins with an assessment of their potential impacts on human health and safety and on the environment. The environmental benefits of properly handling hazardous wastes can be very large, since in some cases small quantities of hazardous wastes can cause significant damage. However, even though all hazardous wastes present some risks, the quantities are not always sufficient to warrant separate collection and disposal. As points of reference, Organization for Economic Co-operation and Development (OECD) guidelines and US environmental regulations specify minimum quantities of material that need special treatment as "hazardous waste". Obviously, specific decisions regarding the management of special wastes will necessarily depend on the capabilities of individual countries to carry out such programs. A number of alternatives for handling of special wastes have been or are in the process of being devised in response to the various needs of developing and industrialized countries. These practices are summarized in this section for the most frequently encountered special wastes [7].

Medical Waste

Medical waste is one of the most problematic types of wastes for a municipality or a solid waste authority. When such wastes enter the MSW stream, pathogens in the wastes pose a great hazard to the environment and to those who come in contact with the wastes. Wastes generated within health care facilities have three main components:

i. Common (general) wastes (for example, administrative office waste, garden waste and kitchen waste);
ii. Pathogenic or infectious wastes (these types also include "sharps");
iii. Hazardous wastes (mainly those originating in the laboratories containing toxic substances).
iv. The quantity of the first type of general wastes tends to be much larger than that for the second and third types. Segregation of medical waste types is recommended as a basic waste management practice, as indicated in Table 1. However, thorough separation is possible only when there is significant management commitment, in-depth and continuous training of personnel, and permanent supervision to ensure that the prescribed practices are being followed. Otherwise, there is always a risk that infectious and hazardous materials will enter the general MSW stream [8].

DISCUSSION

Households generate small quantities of hazardous wastes such as oil-based paints, paint thinners, wood preservatives, pesticides, insecticides, household cleaners, used motor oil, antifreeze, and batteries. It has been estimated that household hazardous waste in industrialized countries such as the United States accounts for a total of about 0.5% (by weight) of all waste generated at home. In most developing countries, the percentage probably is even lower. There are no specific, cost-effective, sound practices that can be recommended for the management of household hazardous wastes in developing countries. Rather, since concentrated hazardous wastes tend to create more of a hazard, it is best to dispose of household hazardous wastes jointly with the MSW stream in a landfill, where the biological processes tend to exert a fixating effect on small amounts of toxic metals, while other toxic substances are diluted by the presence of MSW or are broken down into less toxic intermediates during the process of decomposition in the fill [9], [10].

Table 1: Represented the Recommended Methods for Managing Medical Waste

Source separation within the health care facility	• Isolates infectious and hazardous wastes from non-infectious and non-hazardous ones, through colour coding of bags or containers • Source separates and recycles the relatively large quantities of non-infectious cardboard, paper, plastic, and metal • Source separates compostable food and grounds the major fraction of organic wastes and directs them to a composting facility if available • Includes and is characterised by thorough management monitoring program
Take-back systems	• Where vendors or manufacturers take back unused or out-of-date medications for controlled disposal
Tight inventory control over medications	• To avoid wastage due to expiration dates (a form of waste reduction)
Piggy-back systems for nursing homes, clinics, and doctors' offices	• Can send respective wastes for treatment to proper health care waste treatment facilities using health care waste collection and transport systems located in the vicinity
Treatment of infectious waste through incineration, or by disinfection	• Includes autoclaving, chemical reaction, microwaves, and irradiation • In the case of incineration, the processing may be performed within the premises of the health care facility (onsite) or in a centralised facility (offsite). An incinerator is difficult and expensive to maintain, so it should be installed in a health care facility only when the facility has sufficient resources to properly manage the unit. Otherwise, a centralised incinerator that provides services to health care facilities in one region or city may be more appropriate. Regardless of location, the incinerator must be equipped with the proper air pollution control devices and operated and maintained properly, and the ash must be disposed in a secure disposal site. In the case of disinfection, residues from these processes should still be treated as special wastes, unless a detailed bacteriological analysis is carried out.
Proper disposal of hospital wastes	• In many developing countries, none of the treatment systems discussed in this table are widely available, so final disposal of infectious and hazardous components of the wastes is necessary. Since in many developing countries there are no landfills specifically designed to receive special wastes, infectious and hazardous health care wastes normally are disposed at the local MSW landfill or dump. In this case, close supervision of the disposal process is critical in order to avoid exposure of scavengers to the waste. Final disposal should preferably be conducted in a cell or an area specially designated for that purpose. The health care waste should be covered with a layer of lime and at least 50 cm of soil. When no other alternative is available for final disposal, health care wastes may be disposed jointly with regular MSW waste. In this case, however, the health care wastes should be covered immediately by a 1 m thickness of ordinary MSW and always be placed more than 2 m from the edge of the deposited waste.

CONCLUSION

The management of used tires poses a potential problem for even the more modern MSWM systems, for reasons related both to the tires' physical properties and their shape. Tires are composed primarily of complex natural and synthetic rubber compounds, both of which have substantial heating value, and various other materials. The recovery of rubber from used tires can be very energy-intensive, and such processing may generate hazardous substances and other types of process residues. Illegal stockpiles of used tires can create substantial land use problems, harm the environment, and serve as breeding grounds for insects and other small animals that harbour pathogens that are detrimental to human health. Stockpiles can self-ignite and cause fires that are very difficult to control, resulting in negative human health and environmental impacts.

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CHAPTER 15

AN ANALYSIS OF THE SEPARATION OF HOUSE HOLD WASTE

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ABSTRACT:

The practice of separating and classifying home garbage into several categories is known as domestic waste separation. Its goals are to reduce the quantity of waste that is dumped in landfills, improve the effectiveness of recycling, and encourage sustainability. Due to the rising concern about waste's effects on the environment, notably in terms of greenhouse gas emissions and pollution, this practice has received a lot of attention recently. This abstract's goal is to provide a general overview of the idea of home trash separation, along with its advantages and implementation strategies. We will discuss the several types of home garbage, including organic, recyclable, and hazardous waste, as well as the correct methods of disposal. We will also go through the difficulties and impediments to adopting domestic trash separation as well as possible solutions. In the end, home trash separation is a crucial practice that may aid in our transition to a future that is more ecologically friendly and sustainable.

KEYWORDS:

Class, Household Waste, Heavy Waste, Papers, Solid Waste.

INTRODUCTION

According to the potential harm they may cause if released into the environment and the form of disposal that would be accessible if the waste were not separated, the priority waste streams for separation are determined. A priority may be the separate collection of mercury-based batteries, for instance, if burning was the main method of trash disposal and it was difficult to regulate mercury emissions. Successful household hazardous source-separation programmes need frequent public education and a convenient collection service. Warning consumers that some consumer products include harmful or hazardous elements that call for particular handling and disposal procedures at the moment of purchase or on the box. Usage of point-of-purchase take-back programmes for products that may be collected via these programmes, such as spent oil, batteries, and pharmaceuticals. At the policy and programme levels, there is a focus on redesigning consumer goods to make them less hazardous or harmful (for example, reducing the mercury content in batteries). Handling of personnel HHW should just complete initial and ongoing training; they are not required to be certified or qualified chemical technicians.

Whole tyres that are disposed of in a landfill often rise to the top and make it challenging to keep the soil layer over the trash in place. Tires that have been unlawfully abandoned may serve as a breeding ground for mosquitoes and other insects that cause diseases like dengue. The following is a description of some suitable practices for handling worn tires. Reusing or recycling old tyres often takes place in the unofficial sector.

i. Reuse by cutting them into pieces for playground padding and railway track buffers, retreading them for longer service or shredding and grinding them for use as road paving material. It should be mentioned that processing tire materials must be done under regulated circumstances since it produces dust and buffing's that might be harmful if discharged or carcinogenic to employees.

ii. Thermal destruction in cement kilns followed by energy recuperation. Cement kilns that are designed to take solid fuels are needed for this procedure. Both developed and developing nations have shown that this method of tyre disposal is workable.

iii. Processing in pyrolytic reactors is option for reducing emissions are essential since organic vapors are produced. As a consequence, the operation may be rather expensive, and it often only becomes profitable when the buildup of tyres becomes hazardous owing to the possibility of fires or costly due to competing land uses.

Also, there is some recommended methods of managing used oils are described in below:

i. Refining one more to create lubricating oil. An effective way to handle spent oil is to process it for re-use as a lubricant. But one risk of this procedure is that the leftovers from the re-refining can end up in the MSW stream or in drains. To clarify the issues brought on by this careless, incorrect disposal practice, education must be employed. The best scenario would be to burn wastes in a cement kiln that has the right kind of pollution control equipment. Residues should be stored in sealed containers and put in a specific location at the landfill disposal site if this is not practicable.

ii. Apply as fuel. Because it contains a high amount of specific energy, used oil has significant utility as a fuel. However, if the combustion system doesn't have the proper environmental control equipment, burning old oil might release heavy metals into the environment. The use of spent oil as a fuel for cement kilns results in an additional level of pollution management since the heavy metals in the oil are absorbed into the cement matrix [1], [2].

Electronic Waste (E-waste)

A range of electronic items have seen significant price drops over the last several years, along with corresponding increases in availability and use. Although there are many goods that are very new, some of the more popular ones include personal computers, printers, monitors, television sets, and mobile phones. These and related goods are used more often, thus every year, many of them are replaced and thrown away. These materials were improperly handled and disposed of, which led to a number of issues with far-reaching effects. One major issue is that many electrical items contain various dangerous substances, including mercury, arsenic, lead, cadmium, and others. The hazardous elements included in the items might be discharged if they are not handled correctly or disposed of with other types of municipal solid waste, endangering the environment and the public's health. The adoption of separated collection and proper processing is one realistic approach to managing e-waste. The elimination and/or reduction of the toxicity of the residue is accomplished by mechanical and chemical processing of the products in order to recover valuable components [3].

Wet Batteries

The majority of the time, auto repair shops and battery manufacturers produce used wet batteries. This kind of battery includes lead and acid, both of which, if handled improperly, pose risks to both people and the environment. Wet batteries must be processed in a way that is environmentally friendly for the materials to be recovered. In order to recycle batteries, the acidic liquid is normally drained and neutralized. The lead is then recovered in a non-ferrous foundry [4].

Construction and Demolition Debris

Urban regions often produce construction and demolition (C&D) waste as a consequence of new development, the destruction of outdated buildings and roads, and routine building maintenance. These wastes include inert building materials including cement, bricks, asphalt, wood, and metal. Because C&D waste is biologically inert, it may often be disposed of in landfills with less limitations than MSW, which has a far greater biodegradable content and environmental pollution potential. Although this is more likely to occur in industrialized nations, it must be noted that C&D waste may include certain dangerous elements, such as asbestos and PCBs. During wars and natural catastrophes (such as earthquakes, floods, typhoons, and others), very enormous amounts of demolition trash are produced. City officials must take precautions to prevent the dumping of these wastes in public areas and on unused property, since doing so might turn them into unregulated, illegal dumps with a host of unfavorable effects. However, disposing of C&D waste in MSW landfills may be expensive and a waste of landfill space. Other options to C&D disposal may thus be necessary and need to be taken into account in any case. Alternatives include processing and recycling, as seen in Figure 1.

Figure 1: Illustrated the Storage of Construction and Demolition Debris at a Processing Facility.

The idea of waste avoidance, reuse, and recycling is the foundation of good C&D waste management practises. When these procedures can't be followed, suitable disposal must be taken into account. These wastes may be utilised as fill in old quarries, as road base, in coastal communities to acquire land at the ocean front, or for the building of levees since they are mostly inert or because they can be treated to become so in certain situations. The following is a list of good methods for keeping C&D waste out of landfills. There is also the option of using specialised landfills for the disposal of building and demolition waste. Since the majority of the time the potential environmental effect is quite minimal, these landfills are easier to site than normal MSW landfills [5], [6].

- **i.** Inventory management and construction material return privileges may help encourage waste avoidance. By doing this, it is ensured that resources won't be thrown away needlessly.
- **ii.** Selected destruction. Before beginning the primary demolition (wrecking) process, this practice entails the removal of a few chosen building and road components, often for the purpose of recovery.
- **iii.** On-site separation systems, which keep sorted recyclable materials in a number of smaller containers at a construction or demolition site as opposed to disposing of mixed materials in a single roll-off or compactor.
- **iv.** Reusing secondary stone, asphalt, and concrete materials after crushing, milling, and grinding them. These materials may be treated to meet various building material requirements. The availability of authorized standards for materials used in road building and government procurement regulations that encourage or stimulate the acquisition of recyclable materials enable the recovery and reuse of these kinds of materials.

Bulky Metallic Waste

Bulky metallic trash is made up of metallic items that, whether found alone or in combination, are constituted of high-density material and occupy huge volumes (e.g., larger than 1 or 2 m^3). Old automobile bodies, structural steel, huge metallic appliances, and abandoned fabrication tools are a few examples of bulky metallic trash. Steel is the most common building material for massive metallic trash, while other forms, such aluminum, are also sometimes seen. Because it is challenging to handle, treat, and dispose of this sort of garbage using more typical and ordinary municipal solid waste management equipment, it is referred to as a unique waste. Bulky metallic garbage must often be collected, processed, and disposed of using specialized, large-capacity equipment. Furthermore, a significant amount of bulky metallic garbage may be recycled. The affordability of recycling, however, depends on factors like processing costs, market accessibility, transportation expenses, etc. Figure 2 presents a case of heavy metallic trash.

Management of bulky metallic waste is a particularly difficult problem for rural and isolated communities (e.g., remote islands) because of limited space for storage and/or disposal, limited financial resources, and long distances to recycling markets [7].

Municipal Wastewater Treatment (sewage) Sludge, Septage, and Slaughterhouse Wastes

Sewage sludge (biosolids) is produced during municipal wastewater treatment (MWWT) in order to safely release wastewater into the environment. The solid or semi-solid waste products left over after wastewater treatments make up the 24 sludge. Contrarily, septage is the substance drained from septic tanks that serve homes. If liquid discharges at the source are not pre-treated before dumping into the sewer, MWWT sludges and septage both include significant amounts of pathogenic organisms and often chemical pollutants, too. Therefore, these materials need to be handled and disposed of properly [8].

Figure 2: Illustrated the Bulky Metallic Waste being loaded for Transport to Market

Wastes from slaughterhouses may be utilized to make materials for glue, animal feed, and soil amendment. Traditional practices including steam digestion, manual bone-crunching, manual bone-crunching, pit composting (often with home organics added), and sun-drying pose too many health concerns to be regarded appropriate. Small-scale aerobic composting of animal wastes, such as manures, hide scrapings, and tannery and abattoir wastes, may also result in a soil amendment, although there are potential health hazards if the wastes are not sufficiently sterilized in terms of the transmission of germs. All of these activities produce leachate and the disagreeable scents that go along with it. They are often linked to unsafe working conditions and health concerns for workers, but they may also be lucrative and a source of subsistence income. Instead of completely removing the activities themselves, appropriate means of managing these sorts of materials might entail making technological and health improvements. The following list of other suitable management techniques is provided:

- **i.** Preventing the creation of huge amounts of sludge by separating the storm drainage and sewage systems.
- **ii.** When practical, installing onsite treatment facilities for home waste and human waste to reduce dependency on centralized sewage systems.
- **iii.** Land application, but only if very regular sludge testing reveals that the levels of metal, salt, nitrogen, etc. are below acceptable limits and the administering authority has the means and dedication to maintain strict monitoring and testing criteria. In actuality, this will imply that the viability and suitability of land application as a management strategy is often called into question.
- **iv.** Treatment such as liming, composting, co-composting, or drying, followed by the application of the treated soil. These techniques are intended to replenish the soil with the organic material in the trash. However, as was already said, certain sludge

components might make land application undesirable.

v. Dewatering and landfill disposal. It is crucial to remember that sludges should be as thoroughly de-watered as possible before being disposed of in a landfill to prevent the creation of huge amounts of leachate.

Industrial Waste

In industrialized nations, local authorities often have little authority over the collection of industrial trash. However, such garbage often enters the MSW municipal solid waste stream in poorer nations where effective industrial waste management systems are lacking. Hazardous and non-hazardous waste may both be produced by industrial sources, with non-hazardous waste often making up the majority of the amount. Despite often being of relatively modest volume, the hazardous part of this waste may cause serious issues for the environment and public health.

Depending on the precise amounts and characteristics of the waste, the cost of treatment, local laws, and other criteria, there are a wide range of appropriate solutions for the correct management of hazardous industrial wastes. Beyond the scope of this article, techniques and facilities for handling industrial hazardous waste must be planned and designed. However, a helpful book by Batstone, et al., which may be used as a general reference, is included in the Bibliography. Best waste management techniques, in any event, include separating hazardous industrial waste from MSW. Specially constructed cells should be available inside the municipal landfill in those circumstances when municipal authorities are required to provide a temporary solution for the disposal of hazardous waste. In order to prevent scavengers from coming into touch with the hazardous waste, these cells must be segregated [9].

DISCUSSION

Reducing the quantity of garbage that has to be managed either informally on the generator's property or officially by another entity after the waste is disposed by the generator is the natural first step in good solid waste management. As a result, there is no need to collect or handle the decreased waste volumes. The word "waste reduction" as used in this text refers to reducing, limiting, or preventing waste at its source or its potential for development. Reusing wastes at a generator's location or nearby locations, such as using industrial refuse to make goods or reusing things by a comparable group in practically their present state such as reusing secondhand clothing), are all included in waste reduction. Reducing garbage's quantity or toxicity is a kind of waste reduction. One way to reduce waste is to stop garbage from ever being created in the first place. A number of international, regional, and national authorities or organizations have emphasized waste reduction as a key component of solid waste management systems. In a number of economically developing nations, the hierarchy of solid waste management places waste reduction at the top of the list of general approaches to managing solid waste. Recycling and land disposal are two further general approaches [10].

CONCLUSION

The high cost and lack of appropriate locations connected with the development of new landfills, as well as the environmental damage brought on by harmful elements in the deposited trash, are typically the primary drivers for waste reduction in wealthy nations. The same factors apply to remote, tiny towns such island villages and major urban centers in emerging nations that are often bordered by more populated jurisdictions. However, promoting trash reduction may nonetheless have a large positive impact in communities that do not already face considerable challenges related to the ultimate dispositions of their waste's disposal demands. If not otherwise managed, as consumption levels grow and urban wastes alter, their solid waste management departments, which are already overworked, would be ill-equipped to spend more money and resources on the larger amounts of wastes that will unavoidably be created.

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CHAPTER 16

AN ANALYSIS OF KEY CONCEPTS IN MUNICIPAL WASTE REDUCTION

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ABSTRACT:

Waste reduction is anything that reduces waste by using less material in the first place. Reducing waste can be as simple as using both sides of a sheet of paper, using ceramic mugs instead of disposable cups, or buying in bulk rather than individually packaged items. What is the concept of municipal waste. It covers waste from households, including bulky waste, similar waste from commerce and trade, office buildings, institutions and small businesses, as well as yard and garden waste, street sweepings, the contents of litter containers, and market cleansing waste if managed as household waste.

KEYWORDS:

Economy, Environment, Heavy Material, Solid Waste, Waste Reduction.

INTRODUCTION

Both local and national levels of government may take part in trash reduction initiatives. Redesigning goods or packaging, raising consumer knowledge, and promoting producer accountability for post-consumer wastes are a few waste reduction initiatives being used nationally. The primary strategies for reducing waste at the local level include: diverting materials from the waste stream through source separation and trading; recovering materials from mixed waste; putting pressure on national or regional governments to enact legislation on redesigning packaging or products; and encouraging small- or large-scale home composting.

Enhancing what is already their People in many underdeveloped nations currently practise major waste reduction practices, as indicated in the paragraphs that follow. The first rule in developing ideas for further waste reduction should be to build on what already exists and seems to be effective. In general, the majority of cities and towns in the developing world base sound practises on:

- **i.** Assisting the present private sector (formal and informal), where current practises are appropriate, in waste reduction and resolving issues faced by all key players by providing access to capacity-building, funding, and education;
- **ii.** Creating such support as a crucial element of the municipal solid waste management strategy.

Understanding and evaluating regional waste reduction, waste recovery, and recycling practises are necessary for creating a workable strategic plan.

Systems of Waste Reduction

i. Industrialized Countries

Waste reduction and materials recovery are perhaps the areas of municipal solid waste management where the disparities between industrialized and developing nations are most apparent. However, in the majority of the economically developing nations, the traditional labor-intensive practices of repair, reuse, waste trading, and recycling have persisted. In the affluent countries, rising overall living standards and the introduction of mass production have reduced markets for many used materials and goods. As a result, there is a lot of room for waste reduction in growing economies, and emphasis is now being placed on the recovery of synthetic or processed resources. Several wealthy industrialized nations use public or consumer funding of the whole spectrum of programs for waste reduction from changes in production and packaging to waste reduction audits to discover waste reduction possibilities. Reducing the amount of waste that must be gathered and dumped in landfills is one of the primary goals, in the eyes of municipal authorities. Governments have established frameworks and agreements aimed at reducing waste output at the national level under the idea of producer responsibility. For instance, industry is tasked with meeting a set of packaging reduction targets of a certain % within a specific time frame [1].

ii. Developing Countries

Due to the great value that people put on material resources in many developing nations, among other things, waste reduction happens organically as a matter of everyday practice. Reusing a range of materials is thus common. The scarcity or high cost of virgin materials, the level of utter poverty, the availability of workers willing to accept subsistence wages, the thrifty values of even relatively well-off households, the sizeable markets for used goods, and the products made from recycled plastics and metals are some of the factors that encourage the reuse of materials in developing countries. In underdeveloped nations, wastes that would not be useful or economically feasible to recycle such as coconut shells and dung used as fuel have value. The majority of municipal trash of all types are finally used in nations like India, Vietnam, and China if one considers the usage of compost from dump sites as well as materials recovery. Even if some of these nations are now headed in this direction, reducing waste that might be accomplished by laws and procedures (such as agreements to alter packaging) is not now a top concern in these nations. Due to the cheap cost of unskilled labour and the huge demand for produced goods, businesses may easily trade trash for leftovers or utilize leftovers as feedstock. Older equipment and leftovers are sold to less developed, smaller enterprises. Plastic and boxboard packaging that prevents food contamination benefits public health, and a large portion of the improved packaging is recovered and recycled.

Cleaners and caretakers organize the sale of paper, plastics, etc. at workplaces and institutions. Giving clothing and other items to loved ones, charities, and home staff still plays a big role in reducing waste at the household level. Markets for old products may be found in all cities and towns. However, networks of roving buyers, small- and medium-sized merchants, and wholesale brokers provide the highest amount of materials recovery. The level of formalization of trash trading firms varies throughout emerging areas; Asia and Latin America have higher levels of formalization than Africa. The system can adjust to changes in the market because the lowest-level employees serve as a disposable labour cushion. When there is less demand for the products they sell, they must, if possible, find other employment. The ancient practices of repairing and reusing items, as well as the trade, sale, or gifting of excess materials and old items, benefit the less developed nations in terms of reducing waste. If these methods of waste reduction did not exist, there would be larger amounts of inorganic post-consumer waste entering the MSW stream [2].

iii. Priorities for Cities of Developing Countries

For the majority of populations in less developed countries, the hierarchy that is promoted in many industrialized nations with high standards of living—in which waste minimization is given top priority may not be suitable. Instead, finding ways to prevent organic waste from entering the municipal solid waste stream, which therefore necessitates organized collection and other types of treatment, should be the first focus in the majority of situations. The rationale is that because organics are often the biggest component of MSW, redirecting this waste stream would result in the greatest decrease in wastes that need to be collected and disposed of. Waste reduction in that industry is not as significant as it is in industrialized countries due to the lack of growth of manufacturing capacity in the majority of developing nations. Nevertheless, emerging nations must be aware of the expansion of wasteful behaviors that may be caused by contemporary industrial processes and novel consumption patterns. In relation to the latter, for instance, growing use and dependence on thin plastic film for packaging might result in more of this material being dumped in the environment. If this situation is not regulated, the thin plastic film can ultimately block surface drainage systems and contaminate rivers and other bodies of water. One way to deal with materials that may present unique issues linked to litter management and negative environmental effects of disposal is to implement regulations and incentives at the national level [3].

Even for planners with ample resources, the variety of concerns to be taken into account while creating a well-functioning MSWM system may be intimidating. MSWM problems are significantly more challenging to tackle in the majority of the globe, where such resources and knowledge are limited. Despite being an important urban issue, there are other issues vying for urban managers' attention in addition to MSWM. Due of their poor standing as a topic of study, MSWM concerns frequently get less attention than other urban challenges. The following are the keys to developing in this field:

- **i.** Careful planning and development of an integrated MSWM system, which aims to lessen waste production and treat trash in a coordinated manner. Understanding the kind of trash produced is crucial to this.
- **ii.** The use of fresh revenue-generating tactics that do not only rely on a government-owned and -operated MSWM system. In many instances, a well-balanced combination of public and private systems may result in a waste management system that is more adaptable and effective than a system that is entirely owned and run by the government.
- **iii.** Including small businesses and the unorganized sector in the MSWM system;
- **iv.** Establishing a structure of local accountability and responsibility. Businesses and residents may be encouraged to take responsible action in MSWM situations. The managers and planners in charge of the MSWM system need to greatly improve their knowledge and skills, and that is the most crucial aspect of responsibility [4].

Environmental Impact of Solid Waste Disposal on Land

When solid waste is disposed of on land in open dumps or in improperly designed landfills like in low lying areas, it causes the following impact on the environment.

a) Ground water contamination by the leachate generated by the waste dump,

b) Surface water contamination by the run-off from the waste dump

c) Bad odour, pests, rodents and wind-blown litter in and around the waste dump

d) Generation of inflammable gas within the waste dump

e) Bird menace above the waste dump which affects flight of aircraft

f) Fires within the waste dump

g) Erosion and stability problems relating to slopes of the waste dump

h) Epidemics through stray animals

i) Acidity to surrounding soil

j) Release of greenhouse gas

Principles of Municipal Solid Waste Management

Municipal Solid garbage Management (MSWM) is the process of managing municipal garbage according to the principles of Integrated Solid Waste Management (ISWM). In order to fulfil the dual goals of (a) waste reduction and (b) efficient management of waste remaining created after waste reduction, ISWM is the application of relevant methods, technologies, and management programs to all forms of solid wastes from all sources [5].

i. Waste Reduction

It is now widely acknowledged that sustainable development cannot be accomplished until society in general and business in particular are able to generate "more with less," or more products and services with less use of the world's resources (raw materials and energy), pollution, and waste. As part of solid waste reduction strategies, production as well as product improvements have been implemented in several nations employing internal material recycling or on-site energy recovery.

ii. Effective Management of Solid Waste

Better human health and safety depend on effective solid management systems. They must protect public health by halting the spread of illness while also being safe for employees. A solid waste management system also has to be economically and ecologically sustainable in addition to these requirements [6].

iii. Environmentally sustainable: It must minimize the negative effects of waste management on the environment.

iv. Economically sustainable: It must run at a price the community can afford.

It is evidently challenging to simultaneously reduce cost and environmental effect. A tradeoff will always be present. The balance that must be struck is to limit the waste management system's total environmental consequences as much as feasible while keeping costs to a reasonable level [7].

An integrated strategy, which deals with all forms of solid waste materials and all sources of solid waste, is necessary for a solid waste management system to be both economically and ecologically sustainable. In terms of the environment and the economy, a multi-material, multi-source management strategy often outperforms a material- and source-specific approach. Such a system should handle certain wastes, but in different streams. One or more of the following alternatives are part of an efficient waste management system:

- **i.** Transportation and waste collection.
- **ii.** Resource recovery by sorting and recycling, that is, the recovery of resources (such paper, glass, metals, etc.) via separation.
- **iii.** Resource recovery via waste processing, which includes the recovery of energy through biological, thermal, or other processes, or the recovery of materials (such as compost).
- **iv.** Trash transformation (without resource recovery), which includes decreasing the volume, toxicity, or other physical/chemical characteristics of trash to make it appropriate for disposal at the end of its useful life.
- **v.** Land-based disposal, or the sustainable and ecologically safe disposal in landfills.

Functional Elements of Municipal Solid Waste Management

Six functional elements can be used to categories the activities involved in managing municipal solid waste, from generation to disposal: generation, handling, sorting, storage, and processing of waste at the source, collection, sorting, processing, and transformation, transfer and transport, and disposal.

i. **Waste Generation:**

Waste production includes processes that identify items as being worthless (in their current condition) and either discard them or collect them for disposal. The creation of waste is now an activity that is difficult to manage. The development of wastes is expected to be under better control in the future, however. Even though it is not within the control of solid waste managers, waste reduction at the source is now taken into account in system assessments as a way to regulate the amount of trash produced [8].

ii. **Waste Handling, Sorting, Storage, and Processing at the Source:**

The handling, sorting, storing, and processing of trash at the source is the second of the solid waste management system's six functional components. The processes involved in managing wastes up until they are put in storage containers for collection are referred to as waste handling and sorting. Moving loaded containers to the location of collection is included in handling. An essential stage in the treatment and storage of solid waste at the source is the sorting of waste components. For instance, at the point of generation is the ideal location to segregate waste materials for recycling and reuse. Newspaper and cardboard, bottles and glass, kitchen garbage, and ferrous and non-ferrous items all need separate handling by households.

Due of public health issues and aesthetic considerations, on-site storage is crucial. At many residential and commercial locations, it's common to see unsightly improvised containers or even open ground storage, both of which are unpleasant. In the case of people, the home will often bear the expense of providing storage for solid wastes at the source, as will the management of commercial and industrial premises. Processing at the source includes chores like composting garden trash.

iii. **Collection:**

The collection process' functional component involves both the collecting of recyclables and solid garbage as well as the transportation of these commodities from the collection site to the place where the collection vehicle is emptied. This place might be a facility for processing resources, a transfer point, or a dumping site for waste. Solid waste classification, processing, and transformation: The fourth functional element is the sorting, processing, and transformation of solid waste materials. This functional part includes the recovery of sorted elements, processing of solid waste, and transformation of solid waste that takes place mostly at sites far from the source of trash production. Composting plants, transfer stations, combustion facilities, and disposal sites are the typical locations where mixed wastes are sorted. Bulky products are often divided, waste components are manually divided, waste components are divided by size using screens, and ferrous and non-ferrous metals are divided [9], [10].

DISCUSSION

To recover conversion products and energy, waste is processed. Numerous biological and thermal techniques may be used to change the municipal solid waste (MSW)'s organic component. Aerobic composting is the biological transformation method that is most often utilized. Incineration is the thermal transformation technique that is most often utilized. Without resource recovery, waste transformation is done to lessen the quantity, weight, size, or toxicity of waste. Different mechanical, thermal that is, incineration without energy recovery or chemical procedures may be used to transform things. Transferring and moving: There are two processes involved in the functional aspect of transfer and conveyance. The first involves moving garbage from the smaller collecting vehicle to the bigger transport equipment, and the second is moving the material further often over considerable distances to a facility for processing or disposal. A transfer station is often where the transfer happens [11].

CONCLUSION

Disposal is the solid waste management system's last functional component. All solid wastes today, whether they are residential wastes collected and transported directly to a landfill site, residual materials from Materials Recovery Facilities (MRFs), residue from the combustion of solid waste, rejects of composting, or other materials from various solid waste-processing facilities, ultimately end up being disposed of by landfilling or uncontrolled dumping. An designed facility called a municipal solid waste landfill plant is used to dispose of solid wastes on land or deep under the earth's mantle without endangering public safety or generating a nuisance, such as rodent and insect breeding or groundwater pollution.

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CHAPTER 17

AN ANALYSIS OF HIERARCHY OF WASTE MANAGEMENT OPTIONS

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ABSTRACT:

The Hierarchy of Waste Management Options is a framework that outlines the preferred waste management practices in order of priority. The hierarchy is based on the principles of waste reduction, resource conservation, and environmental protection. The top priority is waste reduction, which includes source reduction, reuse, and recycling. The next level is energy recovery, which includes incineration and other methods that convert waste into energy. The lowest priority is disposal, which includes landfilling and other methods that permanently remove waste from the environment. The hierarchy of waste management options is a useful tool for policymakers, waste management professionals, and individuals to prioritize waste management practices that are more sustainable and environmentally friendly.

KEYWORDS:

Economy, Environment, Heavy Material, Solid Waste, Waste Reduction.

INTRODUCTION

Waste minimization or reduction at source, which entails lowering the quantity (and/or toxicity) of wastes generated, occupies the highest level in the ISWM hierarchy. Because it is the most efficient technique to decrease waste volume, processing costs, and environmental effects, reduction at source is first in the hierarchy. Recycling, which occupies the second-highest position in the hierarchy, entails the following steps: (a) separating and sorting waste materials; (b) preparing these materials for reuse or reprocessing; and (c) actually reusing and reprocessing these materials. Recycling is a crucial component in lowering the demand for resources and the volume of garbage that must be disposed of in landfills.

Waste processing, which is ranked third in the ISWM hierarchy, entails modifying wastes to recover conversion products (such as compost) and energy. The capacity of landfills is often used less when waste materials are processed. It could be necessary to transform garbage without recovering any goods or energy in order to minimise waste volume (by shredding and baling, for example) or toxicity.

Typically, this falls under the ISWM hierarchy's fourth position. The solid wastes that cannot be recycled and are no longer useful, the residual matter left over after solid wastes have been pre-sorted at a materials recovery facility, and the residual matter left over after the recovery of conversion products or energy must all eventually be dealt with. The regulated disposal of garbage on or in the earth's mantle is what constitutes landfilling, the fifth rung in the ISWM hierarchy. It is by far the most typical technique for finally getting rid of trash residuals. Because landfilling is the least preferable method of disposing of society's wastes, it occupies the lowest position in the ISWM hierarchy. It is crucial to remember that the waste management hierarchy is merely a suggestion [1].

Waste Minimization

The best course of action is to minimize or reduce trash at the source so that it does not enter the waste management system and the community does not have to pay for waste processing, recycling, and disposal. However, since it was not a part of prior waste management systems, it is a strange practice. The most practical and effective ways to reduce the amount of waste produced at the source seem to be (i) adopting industry standards for product manufacturing and packaging that use less material, (ii) passing laws that limit the use of virgin materials in consumer products, and (iii) levying (by communities) cess/fees for waste management services that penalize generators in the event of an increase in waste quantities.

Changes to product packaging regulations may reduce waste packaging or increase the usage of recyclable materials. Recycling of materials is encouraged in place of virgin raw resources by the industrial sector. Waste reduction is aided by sorting at the source, recycling at the source, and processing at the source (such yard composting). Charging a variable fee per can (or tonne) of rubbish is one waste management approach employed in certain communities in industrialized nations, which provides producers with a financial incentive to decrease the quantity of waste disposed of for collection. The ability to generate the funds necessary to cover facility costs, the management of a sophisticated monitoring and reporting network for service, and the extent to which wastes are being disposed of elsewhere by the generator rather than being reduced at source are all concerns related to the use of variable rates.

Resource Recovery through Material Recycling

Material recycling can occur through sorting of waste into different streams at the source or at a centralised facility. Sorting at source is more economical than sorting at a centralised facility [2].

Sorting at Source

Sorting at source (home sorting) is driven by the existing markets for recyclable materials and the link between the house holder and the waste collector. The desirable home sorting streams are:

- **i.** Dry recyclable materials e.g., glass, paper, plastics, cans etc.,
- **ii.** Bio-waste and garden waste,
- **iii.** Bulky waste,
- **iv.** Hazardous material in household waste,
- **v.** Construction and Demolition waste,
- **vi.** Commingled MSW (mixed waste).

At present recycling of dry recyclables does take place at the household level in India. However, source separation and collection of waste in streams of (b), (c), (d) and (e) has to be developed in most cities.

Centralized Sorting

Everywhere recyclable materials are gathered in a commingled (mixed) form, centralized sorting is required. In several nations, hand sorting using an elevated picking belt is widely used. Some industrialized nations have mechanized sorting facilities that use magnetic and electric field separation, density separation, pneumatic separation, size separation, and other approaches. In compared to manual sorting, such facilities are often costly. Centralized sorting is not used in India. However, when household rubbish is collected by ragpickers and placed in kerbside collection bins (dhalaos), some intermediate sorting does take place. To reduce the number of recyclable items that end up in a waste processing plant or landfill, it is necessary to formalize this intermediate sorting system or create a centralized sorting facility.

Sorting Prior to Waste Processing or Landfilling

The majority of recyclable materials are typically recovered for reuse via home sorting and centralized sorting operations. A tiny portion of these items might, however, escape the sorting procedure. To recover recyclable materials, sorting is also done right before garbage processing, waste transformation, or landfilling. Ragpickers may carry out sorting at a landfill just after laying a layer of trash. Manual sorting or size separation is often done in waste processing or transformation facilities. Wherever hand sorting is used, it is important to take precautions to keep sorters safe from all disease paths and working in clean environments [3].

Resource Recovery through Waste Processing

Biological or thermal treatment of waste can result in recovery of useful products such as compost or energy.

Biological Processes

Biological treatment involves using micro-organisms to decompose the biodegradable components of waste. Two types of processes are used, namely:

- **a.** Aerobic processes: Windrow composting, aerated static pile composting and in-vessel composting; vermi-culture etc.
- **b.** Anaerobic processes: Low-solids anaerobic digestion (wet process), high solids anaerobic digestion (dry process) and combined processes.

In the aerobic process the utilizable product is compost. In the anaerobic process the utilizable product is methane gas (for energy recovery). Both processes have been used for waste processing in different countries a majority of the biological treatment process adopted world-wide are aerobic composting; the use of anaerobic treatment has been more limited.

In India, aerobic composting plants have been used to process up to 500 tons per day of waste.

Thermal Processes

Thermal treatment involves conversion of waste into gaseous, liquid and solid conversion products with concurrent or subsequent release of heat energy. Three types of systems can be adopted, namely:

- **i.** Combustion systems (Incinerators): Thermal processing with excess amounts of air.

- **ii.** Pyrolysis systems: Thermal processing in complete absence of oxygen (low temperature).
- **iii.** Gasification systems: Thermal processing with less amount of air (high temperature).

The most extensively used thermal treatment method for MSW worldwide is combustion systems. The pyrolysis of municipal solid waste has not proven particularly effective, despite the fact that it is a frequently used industrial technique. A similar lack of success has been seen with mass fired gasifiers. Pyrolysis and gasification, however, may possibly turn out to be worthwhile options in the future [4].

Mass-fired combustion systems (MASS) are one of three kinds of combustion systems that have been widely employed for energy recovery in many nations. Municipal solid waste must have a reasonably high calorific value in order to be economically feasible for energy recovery via thermal processing. The inclusion of a sizable amount of paper and plastics in MSW produced in industrialized nations results in a high calorific value of the MSW (usually over 2000 kcal/kg), making it ideal for thermal processing. The low calorific value of Indian MSW (usually less than 1000 kcal/kg) results from the materials near lack of paper and plastics, as well as their high concentrations. Such trash may not be acceptable for thermal processing in its mixed condition. In the future, however, this situation could change due to the removal of inserts from Indian MSW and the development of combustion systems for low-calorific value wastes.

Other Processes

New biological and chemical processes which are being developed for resource recovery from MSW are:

- **i.** Fluidised bed bio-reactors for cellulose production and ethanol production.
- **ii.** Hydrolysis processes to recover organic acids.
- **iii.** Chemical processes to recover oil, gas and cellulose.
- **iv.** Others. The economic viability of these processes is yet to be established.

Waste Transformation (Without Resource Recovery) Prior To Disposal

At the end of all sorting processes, biological processes and thermal processes, the non-utilizable waste has to be disposed of on land. Prior to this disposal, waste may need to be subjected to transformation by mechanical treatment, thermal treatment or other methods to make it suitable for landfilling.

i. **Mechanical Transformation**

Sorting of waste may be undertaken to remove bulky items from the waste. Shredding of waste may be undertaken for size reduction to enable better compaction of waste.

ii. **Thermal Transformation**

In regions where land space is very scarce (e.g. islands), waste with low calorific value may be subjected to combustion without heat recovery to reduce the volume of waste requiring disposal on land.

iii. **Other Methods**

To reduce toxicity of wastes e.g. hazardous wastes or biomedical wastes, special detoxification transformations may be undertaken. Some methods used are autoclaving, hydroclaving, microwaving, chemical fixation, encapsulation and solidification. These methods are usually not applied to MSW [5].

iv. **Disposal On Land**

Waste is disposed of on land in units called landfills which are designed to minimise the impact of the waste on the environment by containment of the waste. Usually, three types of landfills are adopted. Landfills in which municipal waste is placed are designated as “MSW Landfills” or “Sanitary Landfills”. Landfills in which hazardous waste is placed are designated as “Hazardous Waste landfills”. Landfills in which a single type of waste is placed (e.g., only construction waste) are designated as “Monofills”.

Components Of Municipal Solid Waste Management System

the precise components and application to municipal solid waste of an integrated solid waste management system.

Source separation and collection of dry recyclables are now pretty well established in India at the home, commercial, and institutional levels. At different intermediary phases, ragpickers take additional possession of these recyclables. Neither manual nor automated central sorting is used.

Bio-waste, building and demolition trash, and hazardous waste are seldom source separated; as a result, the majority of garbage collected is a combination of these elements. Due to its high inert material concentration, poor calorific value, and unpredictable mixing of hazardous components (such as pesticides, paints, batteries, etc.) at the microscopic level, such mixed trash is seldom suited for biological processing or thermal processing.

In certain places, compost is created by the biological processing (aerobic) of high-quality bio-waste that is gathered from fruit and vegetable markets. These processing facilities aid in lowering the amount of garbage dumped in landfills. In India, mixed municipal garbage has not been successfully thermally processed. Compost that has undergone biological processing and may include pollutants in excess of allowable limits is of poor quality [6].

Once hazardous waste streams and garbage from building and demolition are separated from the bio-waste stream, biological processing becomes feasible. Only when enough high calorific value components (such as paper and plastic) are present in the garbage can thermally processing of waste become economically feasible. An integrated municipal waste management system often does not include waste transformation as a main component. However, some sorting and shredding may be done as transformation operations before landfilling at the disposal site.

Linkages Between Municipal Solid Waste Management System and Other Types Of Wastes Generated In An Urban Centre

Other than municipal solid waste, the following types of waste may also be generated in urban centers:

a. Industrial Waste – hazardous and non-hazardous waste from industrial areas within municipal limits.

b. Biomedical Waste – waste from hospitals, slaughter houses etc.

c. Thermal Power Plant Waste – Flyash from coal-based electricity generating plant within municipal limits.

d. Effluent Treatment Plant Waste – Sludge from sewage treatment plants and industrial effluent treatment plants.

e. Other Wastes – Special wastes from non-conforming areas or special units. All waste streams must be managed by their own waste management system. However, the following aspects of inter-linkages between different waste streams are considered important.

(a) Different waste streams should not be managed in isolation. Inter-linkages between various streams should be encouraged if these lead to more efficient and economical recovery of the two important resources from solid waste – material and energy. For example, in some countries solid biodegradable waste and sewage are mixed to improve biological processing of solid waste.

(b) Different types of solid waste eventually reach any one of the following three types of landfills – MSW landfills, hazardous waste landfill or monofills for designated waste. Some important observations are:

i. All hazardous waste – whether from MSW stream, industrial waste stream or any other waste stream – should be disposed off in "Hazardous Waste Landfills".

ii. Large quantity non-hazardous waste (e.g. construction and demolition waste or flyash) should be disposed off in monofills (i.e. "Construction Waste Landfills" or "Ash Disposal Sites").

iii. Municipal solid waste after waste processing as well as nonhazardous, small quantity waste (typically less than 15% of the MSW quantity) from non-municipal sources can also be disposed off in MSW landfills, if the compatibility of such wastes with municipal waste is ascertained. Non-hazardous sludge (small quantity) can also be accommodated in a MSW landfill provided it has been dewatered and dried prior to disposal [7].

(c) At present, the solid waste management practices are to comply with the following sets of regulations:

i. Section dealing with conservancy and sanitation in the Municipal Acts of each state.

ii. Hazardous Waste Management and Handling Rules (1989), The Ministry of Environment & Forests (MoEF).

iii. Biomedical Waste Management and Handling Rules (1998), MoEF.

iv. Municipal Solid Waste Management and Handling Rules (Draft) (1998), MoEF.

v. Special notifications for other wastes from time to time, MoEF.

The inter-linkages between different waste streams are not clearly identified in these rules and regulations. The municipal solid waste managing authority should ensure that small-quantity waste from other streams is accepted for landfilling only after certification that the waste is non-hazardous by a regulatory authority (e.g. State Pollution Control Board) [8].

DISCUSSION

In this section the author discussed that the following five phases are needed to build a solid waste management system for municipal solid waste: (a) Problem Definition and Objective Statement (b) Inventory and data gathering (c) Alternative development System selection (d) and implementation strategy (e) Declaring the present issue and the accompanying goals of the decision-makers is the first step. The second phase is creating an inventory and gathering information about both the current system and that needed for the new system. This would include information on trash creation, waste characteristics, travel routes, collection methods, disposal locations, markets for recovered products, etc. The third phase involves evaluating the data and assessing the viability of various technologies. Since there may be more than one solution to a problem, many alternatives are devised. The planners and decision-makers evaluate the possibilities before choosing a final set of technologies or plans. The final management system is made up of this collection of technologies and programmers.

CONCLUSION

In conclusion, the Hierarchy of Waste Management Options provides a framework for prioritizing waste management practices in a sustainable and environmentally friendly manner. By focusing on waste reduction, resource conservation, and environmental protection, the hierarchy encourages the adoption of practices that minimize the negative impact of waste on the environment. The hierarchy provides guidance to policymakers, waste management professionals, and individuals to make informed decisions about waste management practices that will ultimately lead to a cleaner, healthier, and more sustainable future. As the world continues to grapple with mounting waste and environmental challenges, the adoption of the Hierarchy of Waste Management Options will play an important role in creating a more sustainable future.

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CHAPTER 18

AN OVERVIEWS OF THE WASTE MANAGEMENT IN RURAL AREA

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ABSTRACT:

The province of Bushehr is located in southern area of Iran and north of Persian Gulf. Solid waste management in Bushehr's villages was the aim of this research. For the sake of this study, 21 villages scattered all over the province were selected. Field studies showed that about 646 grams of residential solid waste per capita is generated in selected villages every day. There are 322 shops in chosen villages and total amount of commercial waste is about 3565 kilograms per day. The average amount of medical waste is about 7.8 kilograms per hygienic unit. Waste Composition in selected villages is: putrescible materials: 42.49%, construction and demolition: 11.7%, paper and cardboard: 8.77%, plastics: 8.24%, wood: 6.90%, metal: 6.08%, glass: 5.89%, rubber and leather: 5.1% and textile: 4.83%. According to this study, the main obstacle to recycling program is the unbiased collection of waste in rural area.

KEYWORDS:

Economy, Environment, Heavy Material, Solid Waste, Waste Reduction.

INTRODUCTION

The contemporary world operates as a "throw away" civilization. In a world that produces almost 450 million tonnes of garbage each year, the phrase "reduce, re-use, re-cycle" is still just empty words. The notion of waste management has become one of the main themes of sustainable development concepts, which are based on policies and practices. This is due to the growing concern about the vast amount of trash being created in both the form of solid and liquid waste. Solid waste production is rising, and if it is disposed of properly, Rural Solid Waste Management: Issues and Action Uncontrolled behaviors like those of Pravash Chandra Moharana may have a negative influence on the environment and public health.

Solid waste generation in rural areas of India

Waste poses a serious danger to public health concerns and hygiene, particularly in rural parts of India. Even while the waste (both solid and liquid) produced in rural regions is mostly organic and biodegradable, it has grown to be a serious threat to the long-term viability of the ecological balance. According to estimates, India's rural residents produce 0.3 to 0.4 million metric tonnes of solid trash (organic/recyclable) per day.

According to estimates based on crop output, India's ten main crops (rice, wheat, sorghum, pearl millet, barley, finger millet, sugarcane, potato tubers, and pluses) produce roughly 312.5 Mt of crop leftovers with a nutritional potential of about 6.46 Mt of plant nutrients. India yearly produces 50 million tonnes of vegetables and around 33 million tonnes of fruits. Approximately 10 to 15%

of the total yield is thought to be accessible as residues or biodegradable trash for recycling in agriculture. Including the dung present in Union Territories, the total dung output is expected to reach 450 Mt. Recently, the amount of trash that don't decompose quickly, such bottles, cans, plastics, and polythene, has been progressively growing in rural areas, which makes management very difficult.

Impact on Rural Health

i. Insect/mosquito breeding in stagnant water pools on waste sites and in canals and waterways blocked or constricted with waste resulting in the spread of disease.

ii. There are significant health risks due to the existence of vermin, insects, flies and scavenging animals particularly to workers and neighbouring residents.

iii. Nuisance caused to the neighborhood due to odour and flies

iv. Pollution of rivers and streams with consequent contamination of potable water supply downstream.

Objectives of Waste Management in Rural Areas

i. To protect human health and improve quality of life among people living in rural areas,

ii. To reduce environment pollution and make rural areas clean,

iii. To promote recycling and reuse of solid waste,

iv. To convert bio waste into organic manure which is nutrient source of agricultural and horticultural crop,

v. To generate employment for rural poor by offering new opportunities in waste management by adopting cost effective and environmentally sound solid waste treatment technologies

Types of Solid Waste

Organic and inorganic waste products created by homes and agricultural farms that are not economically valuable to the owner are also referred to as solid waste. As shown in Figure 1, solid trash in rural regions often consists of household cleaning supplies, kitchen and garden garbage, bovine dung and waste from cattle barns, agricultural wastes, broken glass, metal, waste paper, plastic, textiles, and rubber, as well as waste from markets and retail spaces. Solid waste may be categorized according to its biodegradability as follows:

Biodegradable: Waste that are completely decomposed by biological processes either in presence or in absence of air are called biodegradable e.g., kitchen waste, animal dung, agricultural waste etc.

Non-biodegradable: Waste which cannot be decomposed by biological processes is called nonbiodegradable waste. These are of two types: the first one is Recyclable: Wastes having economic values but destined for disposal can be recovered and reused along with their energy value e.g. plastic, paper, old cloth etc. and other is Non-recyclable: Waste which do not have economic value of recovery e.g. tetra packs, carbon paper, thermo coal etc [1], [2].

Figure 1: Illustrated the Rural Solid Wastes

Approaches for Solid Waste Management

The solid waste management is the collection, transport, processing, recycling or disposal of waste materials, usually ones produced by human activity, in an effort to reduce their effect on human health or local aesthetics or amenity. For effective management of solid waste in rural areas, focus should be on management at household level. That which cannot be managed at household level should be managed at the community level. In general, the following approach should be followed:

i. Segregation of solid waste at the household level (Biodegradable and non-biodegradable)

ii. Reuse of non-biodegradable waste at the household level to the extent possible

iii. Household level treatment of bio degradable waste

iv. Collection and transportation of segregated waste at the household level to a place identified at the community level (in cases where household level treatment is not possible)

v. Community level treatment or recycling/ reuse of waste

vi. All the biodegradable waste should be composted at the community level

vii. Non-biodegradable waste may be further segregated and sold or recycled

viii. Waste which cannot be composted, reused or recycled may be disposed at the landfill sites following appropriate procedure, (such waste may usually be construction waste, debris etc).

Composting as Technology option for Treatment of Biodegradable Waste

One method for the treatment of organic waste is composting. Figure 2 shows that throughout the composting process, organic material decomposes due to bacterial activity, culminating in the development of compost, which resembles humus. The amount and quality of feed ingredients thrown into the compost pit determine the usefulness of compost as manure. Farmers get a higher yield from composted manure, and it is also environmentally benign. Both compost pits and vermicompost pits may be used to decompose biodegradable solid waste. The following list of composting techniques suited for rural locations includes:

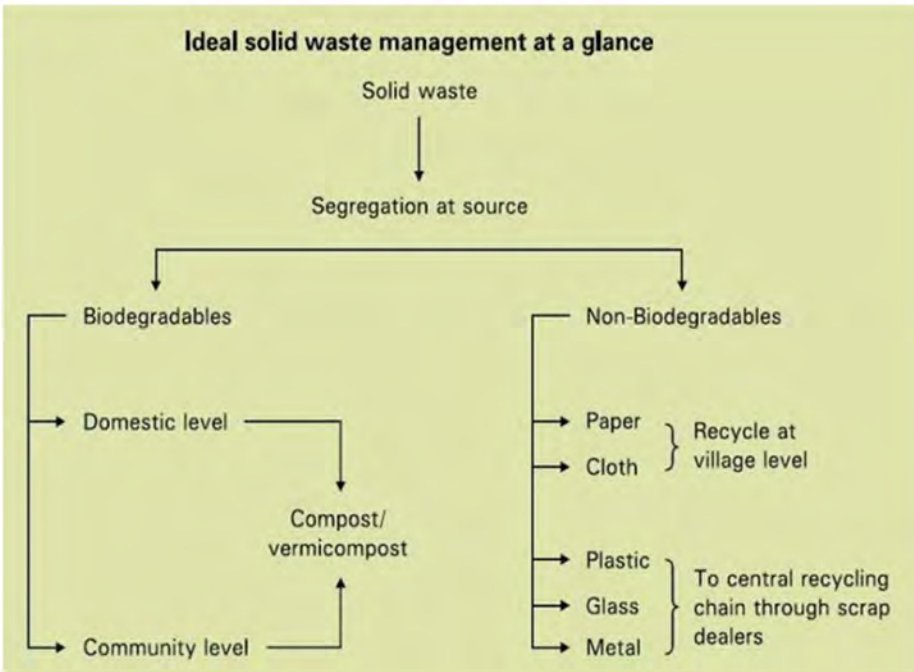

Figure 2: Represented the Ideal Solid Waste Management at a Glance

i. Pit method

The location of the compost pit should be close to a water supply and at a high elevation to prevent rainwater intrusion during the monsoon season. It might be covered with a temporary shelter to shield the compost from severe downpours. The pit should be any reasonable length, 1.5–2.0 m broad, and about 1 m deep. The material from the cow shed is distributed, and then a slurry of dung produced with 4.5 kg of urine soil and 4.5 kg of inoculums from a 15-day-old composting pit is deposited on top of each layer. The material in the pit is sprinkled with enough water (almost 90%) to sufficiently moisten it. This method of layer-by-layer filling the hole shouldn't take more than a week. To prevent compacting the material in any manner, caution should be used. During the whole composting process, the material is rotated three times: once after 15 days after filling the pit, once again after another 15 days, and once more after another 30 days. Each time the material is turned, it is completely mixed, water is added, and the pit is then added in its place [3].

ii. Heap method

Composting may be done in heaps above ground during rainy seasons or in areas with a lot of rainfall. The heap should be about 2 m long, 1.5 m high, and 2 m broad at the base. The top is roughly 0.5 m smaller in width than the base because to the tapering edges. Sometimes a small bund is constructed around the pile to shield it from the wind, which might cause the heap to dry out. A 20 cm layer of carbonaceous material, such as leaves, hay straw, sawdust, wood chips and chopped maize stalks, is often added to the heap at the beginning. Then, 10 cm of nitrogenous material, such as new grass, weeds, or leftover garden plant material, trash, or fresh or dried manure, is spread over the area. The pile is typically wetted so that the materials feel moist but not soggy, and the pattern of 20 cm of carbonaceous material and 10 cm of nitrogenous material is continued until the pile is 1.5 m high. In order to maintain heat, the pile may sometimes be covered with dirt or hay and stirred every six to twelve weeks. The material's decay is sped up significantly by shredding. You may shred organic trash by repeatedly passing it through a rotary mower. When there is not enough nitrogenous material available, seeds are sown after the first turning of the fermenting heap to develop green manure or a leguminous crop like sun hemp. At the second mixing, the green material is subsequently added. The whole procedure lasts roughly four months.

iii. Vermicomposting

Vermicomposting is the process of making compost using earthworms. Animal waste, household garbage, agricultural waste, and forest litter are all examples of decomposable organic wastes that are often utilised as composting ingredients. The main basic sources are often dried chopped agricultural wastes and animal manure, mostly cow dung. The quality of vermicompost is enhanced by the mixture of leguminous and non-leguminous agricultural leftovers. Vermicomposting uses a variety of earthworm species, including Eisenia foetida (Red earthworm), Eudrilus eugeniae (night crawler), Perionyx excavatus, etc. Due to its rapid reproduction rate, Eisenia foetida (Red earthworm), which turns organic waste into vermicompost in 45–50 days, is often selected [4], [5].

Reuse and Recycling of Nonbiodegradable Solid Waste

As previously stated, efforts should be taken to separate recyclable and non-recyclable non-biodegradable solid waste at the home and community levels. The women's self-help organizations may do sorting or segregation of items including paper, plastic, fabric, metal, and glass at the community level. Waste that has been separated must be packaged and kept in a secure location. When sufficient amounts have accumulated, the recyclable wastes are sold to the neighborhood recyclers.

i. Paper recycling, item 1. Waste paper may be turned into a valuable recyclable product. It's an age-old craft to turn waste paper into pulp. The method has now been improved. The pulp may be used to create a variety of items, including showpieces. The items are so durable that they serve as a partial substitute for wood. This is why it is also known as Pep wood.

ii. Plastic recycling, second. Plastics have become a significant source for worry in all sorts of solid waste in rural regions owing to: i) Non-biodegradability, Nuisance Value in Waste Stream, and Blockage of Drainage Channels Surface water contamination, haphazard burning that contributes to air pollution, and a lack of an effective system for collecting and disposing of plastic trash are the other three problems. These wastes should be separated at the household level by each home owner. Separated plastic garbage must be packaged, kept secure, and sold to nearby recyclers.

Landfill

Despite composting, reuse, and recycling, some trash cannot be properly handled or processed and must be disposed of in a landfill or by burning. with an incinerator, a specifically designed machine, garbage is burned with this technique. Incineration is full combustion, not only burning. Air pollution is said to be caused by incinerators. This is not a practical waste management solution. Non-biodegradable and non-recyclable inorganic solid waste are disposed of at a landfill, which is a place that has been specifically designated for this purpose. Landfill is seen as a workable solution. Secured land filling operations might be used to dispose of non-recyclable inorganic waste [6], [7].

DISCUSSION

Entrepreneurship can be summed up as a business discipline that aims to comprehend how opportunities to create something new, such as new goods or services, markets, production methods, raw materials, or ways to organize existing technologies, emerge and are found, or created, by specific individuals who then use various strategies to exploit or develop them, producing a variety of outcomes. It is a method for creatively offering answers to the serious issues facing society. One such issue or issue with management in India is garbage. Understanding the waste value chain and identifying a market niche where a start-up can make a difference are essential for every aspiring entrepreneur interested in working in the field of waste management. When the concept is prepared, it needs a framework to function. Clear frameworks promote easy decision-making, identify roles and duties for members, and clearly define the scope of the job. There are several configurations that may be used for a construction. The choice of how to spend or use the finances may be one of the important elements. The businesses established with the main goal of earning profits or not making profits are both a part of the Indian economy and sometimes even work well together. Both have benefits and drawbacks of their own [8].

CONCLUSION

In conclusion, waste management in rural regions is an important problem that has to be addressed. Despite being distinct from those in metropolitan regions, waste management difficulties in rural communities are no less pressing. It is often challenging to adopt waste management practices in rural locations due to a lack of infrastructure, a lack of resources, and a low population density. However, it is feasible to put into practice efficient waste management techniques by taking a complete strategy that considers the particular difficulties faced by rural communities. All stakeholders, including local governments, communities, and people, must actively participate and engage in order for waste management in rural regions to be successful. The detrimental effects of trash on the environment and human health may be greatly reduced by implementing waste reduction, reuse, and recycling practices together with suitable waste disposal techniques. Additionally, encouraging people to adopt more sustainable waste management practices may be accomplished through promoting public awareness of and education about trash management.

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CHAPTER 19

AN OVERVIEW OF THE SOLID WASTES OF EATABLE PRODUCTS

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ABSTRACT:

Solid wastes of edible products, also known as food waste, have become a critical environmental and social problem in many parts of the world. This waste comprises a significant portion of municipal solid waste and can lead to environmental pollution, greenhouse gas emissions, and other negative impacts on the ecosystem. In recent years, various efforts have been made to reduce food waste and divert it from landfills, including composting, recycling, and donation programs. This paper aims to provide an overview of the causes and impacts of food waste, as well as the various strategies being used to manage it. The paper discusses the economic, environmental, and social benefits of reducing food waste, as well as the challenges and opportunities associated with its management. Ultimately, this paper highlights the importance of reducing food waste to achieve sustainable development and ensure food security for present and future generations.

KEYWORDS:

Environment, Ecofriendly, Eatable Products, Rural Area, Solid Waste.

INTRODUCTION

The equatorial and sub-equatorial regions of Africa, Asia, and South America are where coffee is mostly grown in rural settings. Guatemala, Mexico, Uganda, Honduras, India, Ethiopia, Indonesia, Colombia, Vietnam, and Brazil round up the top 10 producers. Over 20 million tonnes of liquid and solid waste are produced each year by the cultivation and processing of coffee, with the latter phase sometimes taking place far from the sites where the beans are produced. Farmers and processing facilities must dispose of this trash [1]. Coffee is frequently farmed alongside other cash and food crops, such as maize, as well as livestock on farms that normally have a size of 1-2 hectares (ha), despite the fact that the farms in these regions may vary in size from 0.5 to 6 ha. An illustration is given by the higher-than-average farm plot sizes of Ugandan coffee farmers (2.69 ha compared to 1.86 ha, respectively), who also tend to have bigger farm plots than coffee growers without maize. Therefore, the cultivation of coffee and maize is a significant factor in determining family incomes and poverty, and some land is set aside for growing traditional staple foods with minimal added value. Indeed, compared to coffee farmers who do not plant maize, those who produce both coffee and maize have much lower poverty rates. In general, we may infer that the economics of coffee farms rely on a broad range of variables, including productivity, quality, production costs, waste disposal expenses, and price premiums, the latter of which is necessary to meet sustainability or quality criteria. Without concentrating on waste management in rural regions, the alternatives for the valorization of coffee residues have lately been explored.

The majority of the rural regions where olive trees are grown are in the Mediterranean basin, where the northernmost countries Spain, Italy, Greece, Portugal, France, Cyprus, Slovenia, and Malta produce almost 82.5% of the world's olive oil, or 2.34 out of 2.84 million tonnes. If the nations on the southern side of the Mediterranean basin are included (Morocco, Algeria, Tunisia, Lybia, Egypt, Jordan, Israel, Lebanon, Syria, and Turkey), this number increases to 94.1% of the total olive oil output in the world, or 2.63 million tonnes. Olive tree farming and the processing of olive oil, which often takes place far from the olive producing sites, produce an average of 6.01 million m3 of liquid waste and 8.06 million tonnes of solid trash per year in the northern Mediterranean basin. If the southern part of the Mediterranean basin is taken into account, this quantity increases to 30 million m3 of olive mill effluent and 20 million tonnes of solid trash, also known as wet husks. In Italy, for example, 60% of olive farms are less than 2 ha, and fewer than 10% are larger than 10 ha. Olive trees are often farmed alongside other cash and food crops, with cattle being raised only occasionally. Farm economics as a whole depends on a broad range of variables, including productivity, quality, production costs, and waste disposal. Costs associated with meeting quality and sustainability criteria are borne by the farmers, with premiums only going to bigger agro-industrial facilities that convert waste into power. Recently, strategies for valuing solid olive oil extraction leftovers were evaluated, concentrating less on waste disposal in rural regions.

In addition to their enormous annual availability, the chemical composition and end-of-use of the two manufacturing chains' solid leftovers have a lot of commonalities. Both types of solid waste—coffee husks, damaged coffee beans, and used coffee grounds on the one hand, and olive wet husks and stones on the other—are difficult to dispose of because they have similar environmental effects, decontamination requirements, potential uses, and chemical characteristics, such as a high concentration of ligno-cellulosic materials, a low concentration of fat and protein, and the presence of (poly)phenols that are resistant to degradation. In the poorer and less accessible rural regions, the primary final applications are the creation of heat and the recycling of organic waste into crops. The end-of-use of the solid residues in regions with more intensive agriculture is characterised by the production of heat for home heaters, electricity, recycling into agriculture after modest composting, and minor uses for the production of commodities with high added-value (such as cosmetics, mushrooms, and fodder). In this chapter, the two categories of solid waste are critically examined independently and evaluated for how well they are used in rural regions to produce coffee and olive oil.

The Management of Residues of Production and Transformation in Rural Areas

Developing nations produce more than 90% of the world's coffee (Coffea arabica, Coffea canephor, and the native C. arabica cultivar Harrar from Ethiopia). The economy of these nations is mostly reliant on agriculture, with coffee being one of the most significant crops. In fact, as a national economic policy, nations like Vietnam, India, Kenya, Nicaragua, Ecuador, and Mexico supported the growth of coffee in rural regions. Approximately 70% of the world's coffee crop is grown on tiny farms with less than 6 acres in rural locations. The environment has been severely impacted by the imposed policies, subsidies, and incentive programs that encouraged the conversion of land to intensive, high-tech monocrop coffee growing. In fact, some of the world's most ecologically varied and endangered places are where you'll find coffee fields [2], [3].

Extreme poverty abounds in the remote rural regions where the greatest coffee is cultivated. Access roads are in poor shape, there are few or no basic amenities available, and farmers get little or no basic education. Coffee production is a family business and the only source of income for coffee producers in many nations. Despite having comparatively weak trading positions, farmers must maintain the same high production standards as large-scale producers that have access to more resources for investments and technical advancements. Marginalized farmers established cooperatives or beneficious, which are gathering hubs where they gather the crops and process the fruit till they receive the coffee beans, in order to pool their resources and increase the selling of coffee. Huge amounts of pulp, leftover water, and parchment trash are produced during the process of separating the commercial product (beans) from coffee cherries. Nearly all of these wastes are dumped in the environment, which results in unpleasant smells, an unpleasant appearance, the attraction of harmful insects, and soil and water contamination. In fact, they are the main cause of river pollution in northern Latin America and Ethiopia. The proper use of coffee byproducts would aid in avoiding these issues, and the valuing of the residues would contribute to the value in terms of protecting the environment. Table 1 provides a summary of the key chemical characteristics of the coffee processing wastes at the farm level that are important for their valuation. Due to the resistance of polyphenols and complex glaucids, the breakdown process under natural circumstances is exceedingly sluggish and imperfect despite a favorable C/N mass ratio of 40, leading to toxicity issues [4].

Table1: Illustrated the Main Chemical Components in Productions.

Component	Spent coffee grounds	Coffee pulp	Coffee husk
	$g \times 100\ g^{-1}$ d.w.	$g \times 100\ g^{-1}$ d.w.	$g \times 100\ g^{-1}$ d.w.
Proteins	6.7–13.6	10.1	5.2–11
Total lignin	33.6	–	–
Cellulose	8.6–13.8	–	16.0–43.0
Carbohydrates	–	63.2	35.0–85.0
Reduced sugars	–	12.4	0.71
Ash	0.43–1.6	8.3	0.7–6.2
Fat	6.3–28.3	–	0.3–3.0
Tannins	1–9	1.80–8.56	
Caffein	1–2	1.3	1.0–1.3
Organic carbon	–	–	50.8
N	–	–	1.27
Polyphenols	–	–	1.22

Various efforts have been undertaken to get around these environmental issues and reduce the levels of toxicity, such as enhancing industrial processes, cutting down on wastewater output, or recycling trash to produce valuable substances like enzymes and caffeine. Due to the expenses and lack of technology in these little towns, only a handful of the options have been adopted in rural regions. The most alluring use to partially address the issues faced by people in these regions is still the valorization of coffee leftovers in agriculture, as animal feed, and for energy generation.

Encouraged by the expansion of certified coffee markets and development initiatives, several farmers began a switch to organic coffee cultivation. New fertilization techniques were used throughout this period. From this perspective, such organic growers have access to significant amounts of coffee pulp. The pulp contains around three-quarters of the nutrients that were taken out of the coffee beans. The most popular method for reducing the residue's environmental effect is co-composting it with animal manure. To guarantee its stabilization and sanitization, the compost is often not obtained under controlled circumstances. Typically, pulp is allowed to decompose in heaps without any treatment, producing an organic substance that is mistakenly referred to as "compost." Crop output has suffered as a result of adding non-stabilized organic matter to the soil. Vermicomposting is an option that is popular in Ethiopia and Colombia and produces superior outcomes for organic fertilization [5].

Some significant regions of Africa and Central America have also established small programs to obtain bioethanol and biogas. The energy demands in rural regions are partly met by the energy produced from coffee trash. In addition, the technology has to be improved further before it can be used in the most isolated or underdeveloped areas. Due to the high caffeine concentration, which has an adverse effect on ruminants, the use of pulp as animal feed has been rather seldom. It has been utilized as a nutritious addition to sheep diet in Ethiopia.

Finally, due to ignorance and government policy, there is still a lot of pollution. The proper use of coffee byproducts must be done in order to balance out this output. From an environmental standpoint, the valorization of the liquid and solid leftovers should be seen as a value addition. However, in order to maintain sustainability, decent living conditions for the populations engaged in coffee production, and the preservation of quality, it is crucial that coffee production and processing take into consideration environmental demands. One of the goals of the International Coffee Agreement of 2007 is to urge members to create a coffee industry that is sustainable in terms of its impact on the economy, society, and environment.

The Management of Residues of Olive Oil Extraction Process in Rural Areas

The olive oil extraction process is carried out in approximately 12,000 olive mills, the majority of which are small and medium enterprises (SMEs), involving 800,000 jobs. The olive tree cultivation in the Mediterranean countries of the EU (approximately 400 cultivars in Italy, 150 in Spain, and 40 in Greece) takes place on 4.8 million ha. Traditional pressing (TP), two-phase decanter process (PDP), and three-phase decanter process (PDP) are the main methods used to get olive oil; Table 2 lists the wastes produced by each method. In southern Europe, there is a disparity in the types of extraction processes used: 99% of the technology is 2PDP in Spain, 55% in Italy is 3PDP, 15% is 2PDP, and 15% is TP. In Greece, 82% of olive mills are using 3PDP, while 18% are using 2PDP. However, there is growing interest in the two-phase technique in these latter two nations, maybe in conjunction with the depicting of the olive wet husks (also known as crude cake or pomace). The stones may be split in this manner and utilized for heating, especially in small communities and for home heaters.

Regarding the leftovers from olive tree agriculture, the burning of agricultural wastes in open fields and the burning of wood as a home fuel are the two primary biomass burning practises in rural southern European locations. The contribution from the burning of these two forms of biomass also tends to grow as the population in the African portion of the Mediterranean basin rises. Due to their potential to increase greenhouse gas emissions (GHG), burning olive branches and leaves in open fields is permitted in the northern part of the Mediterranean basin. Once the agro-residues are used for environmentally friendly, cost-effective, and sustainable solutions like composting and subsequent ploughing of the compost, these burnings may be avoided. Although an attempt has been made to quantify the spatial distribution of biofuel and open-field burning in order to assess the effect of this burning on the budgets of trace gases, there are currently no significant efforts being made to discourage burnings on the basis of ongoing educational programmes for small olive farmers. Therefore, the most typical end-of-use practise in rural regions is still open field burning of olive crop remains. Only when the content of soil organic matter and organic nitrogen at plough depth is high, which is uncommon in both the northern and southern sides of the Mediterranean basin, would the delivery of ashes in cropped agriculture be meaningful for fertilisation purposes.

Table 2: Illustrated the Solid and liquid waste generated using different olive extraction technology.

Extraction process	Input	Amount of input	Output
Traditional pressing	Olives	1 tonne	Oil
	Washing water	0.1–0.12 m^3	Solid waste (*ca.*.25% water + 6% oil)
	Energy	40–63 kWh	Waste water (*ca.* 88% water)
3-Phase decanter (3-PDP)	Olives	1 tonne	Oil
	Washing water	0.1–0.12 m^3	Solid waste (*ca.* 50% water + 4% oil)
	Fresh water	0.5–1 m^3	
	Water to wash the impure oil	10 kg	Waste water (*ca*.94% water + 1% oil)
	Energy	40–63 kWh	
2-Phase decanter (2-PDP)	Olives	1 tonne	Oil
	Washing water	0.1–0.12 m^3	Solid waste (*ca.* 60% water + 3% oil)
	Energy	<90–117 kWh	

Small farms no longer employ in-house pressing, or the extraction of olives using giant stone wheels or stone cones, and this practise is typically restricted to demonstration farms for educational or historical reasons. The use of conventional pressing methods is dwindling in favour of decanter centrifugation systems, which may separate olive oil from wet husks or olive oil from wastewater and husks in three steps. Small olive mills in rural regions often use 3PDP, but as 2PDP decanter extractors with lower energy use become more readily available, new options are opening up. In contrast, 2PDPs with enormous working capacities or the most recent generation of decanter extractors, which combine batch processing with current extraction technology without the need of water, are the favoured technologies in agriculturally intensive regions. The waste in the latter method is represented by a dehydrated husk that resembles the one from the three-phase decanter, together with the pulp from the husk, or "pâté," which are moist husks within the bowl that have completely lost all signs of the kernel. This pâté may be combined with other biomass to produce biogas or utilised for a variety of agronomic or animal feeding applications [6], [7].

DISCUSSION

The biochemical and physical-chemical characteristics of the "wet husks" of solid waste are described. For convenience, these characteristics are contrasted with those of the wet husks after microbially enhanced composting in mechanically rotated static heaps. The re-uses at the small farm level include additional oil extraction because the wet husk still contains 2-4% oil, delivery by soil treatment into the permitted soil acreage, sale to larger companies, and re-use as animal feed, which necessitates pre-treatment with the right enzymes and process. Delivery into the soil after composting, as a green (i.e. only plant materials) or mixed (i.e. plant materials plus manure) fertilizer. Small farmers don't view any of the first three options as being particularly profitable because pomace oil has a low price with very little profit, direct soil application necessitates a lot of red tape and pollutes the soil, and selling husks as fuel is unprofitable and requires the transportation of a material with a 70% humidity level. The volatile phenolics might pollute the air if they are air dried before shipping. If the farmer had access to the technology, the fourth alternative would be conceivable. In-house, the final alternative is perhaps the most practical if the farm has a tractor for rotating the piles mechanically [8].

CONCLUSION

It has been shown that using agricultural leftovers as organic amendments and fertilizers is a sensible option for recycling residues and enhancing soil fertility. The second objective may be accomplished within the framework of contemporary agronomic management, including agricultural practices that are conservative and regenerative. The three pillars of conservative agriculture crop rotation, reduced tillage, retention of sufficient levels of crop residues and soil surface cover, as well as preservation of the soil carbon sink support regenerative agriculture. The carbon content of soil may significantly rise as a result of all these management techniques. The increase in soil richness and variety of bacteria is thus correlated with increases in organic matter and humic fractions. Therefore, it is incorrect to equate the use of leftovers from coffee and olive cultivation with their disposal. The same is true for the use of residues from the first stage of processing, which are viable at the level of small farms in rural regions. Instead, it is recommended to utilise these leftovers, especially if benefits to crops and soil are anticipated, either in the short- or medium-term.

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CHAPTER 20

AN OVERVIEW OF THE WASTE OPERATIONAL EQUIPMENT AND FACILITIES

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ABSTRACT:

The inputs for the SWM system are provided by a waste collecting system. Waste collection serves the purpose of removing waste streams from their source and transporting the gathered garbage to the intermediate treatment facility and ultimate disposal locations. However, the environmental effects of transporting waste streams also include traffic congestion, odour, noise, and leaching from wastes. It is necessary to compare the transport vehicle selection to the state of the roads. The collection method used to empty the waste container, the type of container used paper and plastic bags, different types and sizes of metal or plastic cans the location of the container surface/street, underground/buried or semi-underground and the container capacity can all be used to describe the container system. The kind of trucks utilized to collect rubbish is influenced by all these factors.

KEYWORDS:

Disposal, Equipment, Facilities, Hazardous, Management, Operations.

INTRODUCTION

In the SWM system, collection is crucial. Waste collecting containers may be emptied via pneumatic transfer, one-way exchange, or simple emptying. As shown in Figure 1, containers may be positioned on the street's surface, underground, or semi-underground. The easy emptying technique, which is often used, involves manually emptying the trash containers into the collection truck before driving back to the starting point. This technique is often used for small-scale commercial trash, biodegradable garbage, residual MSW, and mixed MSW. The term "one-way collection method" describes the removal of garbage bags from the collection location by carrying them to a vehicle; the waste container is not returned in this approach. The one-way collection approach is simpler and quicker, but it requires more staff to pick up the trash bags. Exchange of containers during operation is considered a potential substitute for removing a full container and replacing it with an empty one. Such an exchange strategy is used, for instance, for disposing of hazardous trash, such as used cooking oil, and other inert garbage, such as glass, close to eateries. In either one-way or exchange networks, the entire container is delivered to a temporary storage location or a final destination for processing. Vacuum and/or positive pressure conveying equipment is required for pneumatic transfer, when trash is gathered and delivered via the air.

In addition to form, material, and capacity, container systems may be classified. Small containers constructed of plastic or galvanized steel may hold up to 100 L of liquid, however 50 to 70 L are more typical. Small-medium containers typically consist of plastic or metal with a round or square base and wheels, and have a volume between 100 and 1,100 L. By turning the container into the vehicle, these containers are emptied. Larger containers with capacities exceeding 1,100 L, such the igloo, prismatic, and Cyclea, are specifically designed to release garbage through the bottom. Between 2,000 and 12,000 L are the capacity of other bigger containers.

Figure 1: Represented the Underground Waste Containers.

The truck, the container loading mechanism, and the vehicle body that houses the rubbish are all parts of a waste collecting vehicle system. They are further separated by the container loader system, which can be manual, semi-automated, or automated; automated when the driver does not need to exit the truck to position the container, semi-automated when the driver does, and manual when the operator must roll out and return the container by using its force. Cranes, side loaders, rear loaders, or front loaders may all be included into a vehicle's design. Utilizing automatic prongs to grasp the garbage container and hoist it over the truck, front loaders are used in vehicles that can empty the waste container into the hopper of the vehicle. Similar to a front loader, a side loader often has an automated system, but the lift apparatus is mounted on the truck's side. When compared to back loaders, which are called automated systems but need two or three employees to operate, side loader systems have the benefit of just requiring one person. The drawback of side loaders is that, as seen in Figure 2, they need specially made containers.

A compaction system is used by contemporary garbage collection trucks to minimize waste volume and boost collecting capacity. The body opening of a crane vehicle system is located on the top of the car. The truck's crane can handle anything from packaging debris to multigene containers, including specially made bottom-opening containers like the Cyclea, Igloo, and Prisma, which are raised and emptied within the vehicle. Pneumatic and hydraulic systems, which don't need a container or a vehicle, are possible additional unique collecting techniques. Pneumatic systems use tubes to draw trash bags into a certain space below the surface, where they are collected by a vehicle. Food waste that has been ground and flushed with tap water may be handled by hydraulic systems. These techniques are often used in the kitchen sink where, after grinding, food waste is released together with domestic wastewater [1].

Figure 2: Represented the Vehicles with a side loader and a rear loader.

The transfer station is a crucial part of solid waste collection systems because it provides the infrastructure required to increase waste collection's economic efficiency when intermediate treatment facilities or the network's final destination of waste streams are located far from the source of the waste and there is a significant amount of waste that needs to be transported. To reduce transportation costs for MSW collection, a transfer station might be positioned halfway between the places of generation and shipment. Waste is moved from collection trucks to bigger vehicles at a transfer station so they may be transported by road, rail, or ship. Direct load, storage load, and combined direct and discharge load are the three different kinds of transfer stations. In storage-load transfer stations, waste from a storage pit is pushed into open-top transport trailers, compaction facilities, or a moving conveyor for transport to processing facilities or compaction facilities; in combined transfer stations, when other uses for waste exist, waste is discharged directly into an open-top trailer, into compaction facilities, or onto a moving conveyor for transport to processing facilities or compaction facilities.

The hydraulic hook lift hoist, which uses hydraulic arms to hook, lift, and hoist the container onto the truck, is another transport method that might be used to move garbage from transfer stations to their ultimate location. The order of the lifting procedure, including the container. Several vendors provide hooklifts under a variety of brand names: Bennes Marrel uses Ampliroll, Cargotec Finland Oy uses Multilift Hooklif, and Zetterbergs Industri AB uses LIVAB Load Exchanger. garbage collecting practises may be categorised into two groups in order to properly describe the collection schemes: those that collect and transport commingled garbage and those that execute source separation to recycle partial waste fractions. Waste bins may be placed close to homes, such as for curbside pickup, or they may be positioned to serve a specific neighbourhood or community [2], [3].

The management styles for MSW collection vary across the globe, ranging from complete managerial control for the collection of 10 distinct recyclables at the doorstep utilising multi-compartment trucks to no discernible managerial supervision. Waste materials that have already been sorted at the source may either be collected individually or commingled, which can be designed for either human sorting or mechanical sorting at the MRF. The necessity for source separation in residential settings is related to later waste treatment techniques. For different waste fractions, shifting from a commingled to a source-separation practise relies on residents' recycling habits, but when no policy-driven incentives are provided, it may be challenging to adopt a routine that necessitates more labour. Age, education, income, and family size are the primary demographic variables influencing participation. The availability of opportunities, facilities, and understanding of waste separation at the source, in addition to strongly held values and contextual variables like storage convenience and collection schedules, are additional elements that are extremely significant to the public's engagement and, as a result, the participation rate.

The placement of containers identifies several collecting strategies. Containers, often referred to as curbside or door-to-door containers, may be placed close to homes, one container for each residence. Neighbourhood containers are collecting containers that are placed at a public collection location where locals may leave their mixed/residual garbage, with recyclables being placed in bring stations or dropoff sites, which are also referred to as neighbourhood containers. All waste fractions may be placed separately in zone containers. Although both collection systems are often positioned in open spaces with easy access for collection vehicles, some homeowners still find them hard to use, regardless of where the containers are. Clean points, also known as recycling centres or stations, are specialised locations, often on the outskirts of cities, where locals may drop off waste fractions that are not collected by any of the systems previously mentioned for a reasonable fee or for nothing at all. Containers of various shapes and sizes are utilised at curbsides and drop-off locations for buildings since these locations are in a common area for residents. For homes that are curbside, a mix of containers, racks, and bags that are either inside or outside may be employed [4], [5].

Mechanical Treatment

A strategic MSW management strategy must include the separation or sorting of solid waste by various components. This step may also be justified in reference to any phase of the waste management life cycle. Source separation, which takes place prior to garbage collection, is addressed in the first step of waste separation. Then, residual waste and waste components from source separation may be mechanically handled in sorting facilities, mechanical treatment facilities, RDF production facilities, energy recovery facilities, or even landfills.

Several European nations, particularly Germany, pioneered mechanical processing in the 1970s. At that time, the three major objectives of waste management in Germany were to create compost from MSW, recover the high calorific waste fraction to create RDF, and recycle the economically valuable waste fraction. The preparation and/or recovery of targeted fractions in the wholly or partly commingled waste streams was made possible by the use of significant mechanical equipment, such as sieves, air classifiers, trommels, magnetic separators, eddy current separators, and other devices. However, challenges with quality assurance and quality control continue to be difficult [6], [7].

A need of an integrated SWM system is the mechanical sorting or processing of trash, which has gained popularity globally, particularly in Western Europe and certain Asian nations. Sorting and preparing garbage for use in later processing, including recycling, biological treatment, energy recovery, and even landfilling, is the goal. The unit operating techniques and tools covered in this chapter include:

- **i.** Comminution,
- **ii.** Classification/separation/segregation,
- **iii.** Compaction/densification,

iv. Internal transportation.

Comminution

Comminution is the process that reduces the size of solid materials by crushing, grinding, and other methods to provide homogeneous waste streams with higher density. In fact, comminution can promote a higher ratio of surface to volume, improving the efficiency of both biological treatment and incineration . There are three primary purposes for size reduction :

A. Production of smaller particles that can be more easily manipulated than bulky parts;

B. Production of regular sized and well-shaped particles which can be sorted effectively in downstream processes;

C. Release of divergent materials from one another.

Classification/Separation/Segregation

According to size, magnetism, density, electric conductivity, form, colour, high-calorific percentage, organic waste, and removal of unwanted particles, classification has resulted in the segregation of numerous waste fractions. Sieving/screening, densiometric separation, inertial separation, magnetic separation, detection, and removal/automated separation are some of the several categorization methods [8].

Using one or more sieving surfaces or screens, sieving involves dividing trash into two or more fractions according to its size, a process known as size classification. Sieving may be done dry or wet, and the waste fractions are either small or bigger as a consequence. Vibrating screens, trommel screens, and disc screens are a few examples of potential gadgets.

In order to collect fragmented garbage with many size fractions, more than one kind of grate may be utilized. Vibrating screens are made up of a grate or perforated plate that can separate two distinct size fractions. The vibrating movement oscillates the materials to keep them moving through the screen to retain oversized materials and sieve undersized materials, according to Tchobanoglous et al. A motor induces an oscillating movement, which induces particle movement to improve screening. Wastes are fed into the upper side onto the angled plates.

As shown in Figure 3, the drum sieve, also known as a rotary screen or trommel, is one of the most often used SWM equipment. It is made up of a perforated cylindrical grate that rotates on an inclined horizontal axis. By using different mesh-size screening surfaces in different regions of the cylinder, these machines may divide waste materials into a number of size fractions. They could provide ripping tools that double as bag openers.

DISCUSSION

Densiometric separation divides waste fractions into two fractions light and heavy based on various weight-to-volume ratios. Both wet and dry densiometric separation, like sieving, are often used in SWM systems. There are several densiometric separation tools. The most common types of separators include aqueous flotation with air bubbles and sink/float separation, as well as dry separators such air classifiers and densiometric tables. Waste is separated using air as a separation support in air classifiers, producing light and heavy fractions. While the heavy percentage lowers, the lighter elements are caught in an upward air flow and subsequently trapped in a cyclone. A horizontal air stream is used in an air knife, which is similar to an air classifier in that the light fraction is dragged through the stream and the heavy fraction falls to the bottom. You may also get a fraction in the middle [9], [10].

Figure 3: Illustrated the Drum Sieve with Start Ripper Devices.

CONCLUSION

A frequent use of flotation is the separation of glass from ceramics and other waste products. Selected fine-size particles float to the top of the slurry by connecting to bubbles. The hydrophobic portion of the waste that needs to be separated leaves, and air bubbles integrate with the substance, causing it to float to the top. Meanwhile, the hydrophilic portion of the waste will saturate and deposit at the tank's bottom. The light and heavy fractions are separated via sink/float separation, which is dependent on the liquid density. Calcium nitrate, calcium chloride, sodium chloride, and potassium carbonate, to name a few compounds used in plastic separation, are added to water to vary its density since the liquid has to have an intermediate density to separate both portions.

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CHAPTER 21

AN OVERVIEW OF THE THERMAL TREATMENT FOR SWM

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ABSTRACT:

Thermal treatment means the treatment of hazardous waste in a device which uses elevated temperatures as the primary means to change the chemical, physical, or biological character or composition of the hazardous waste. Thermal treatment can reduce the amount of MSW dumped in landfills, thus prolonging the life of the existing landfills. Compared to landfills, thermal treatment plants require relatively small amount of land. Thermal treatment plants do not produce methane emissions or leachates. Incineration is the high-temperature burning of a waste. It is also known as controlled–flame combustion or calcination and is a technology that destroys organic constituents in waste materials. New techniques are developed for this burning process, used as energy-generating methods.

KEYWORDA:

Greenery, Pollution, Solid Waste, Thermal Treatment, Waste Material.

INTRODUCTION

In contemporary civilizations, waste production is inextricably linked to human existence. In 2006, the 27 Member-States of the European Union produced over 255 million tonnes of municipal solid trash, an increase of 13% from 1995. This was an increase of 9% over 1995 and represented an average of 517 kg of municipal garbage per person. Therefore, it is not surprising that waste management has emerged as a vital topic of rising interest for researchers, local government officials, businesses, and regular individuals. The use of numerous treatment techniques, technologies, and procedures is necessary for the efficient management of solid waste. The public's health and the environment must be protected by all used technology and systems. In addition to sanitary landfills, mechanical recycling, and standard recycling routes for various target materials, technologies like composting, anaerobic digestion, and thermal treatment methods like incineration, pyrolysis, gasification, and plasma technology are also used for the management of household solid waste, as shown in Figure 1.

The discussion of various thermal practices for managing municipal solid waste is the main topic of this chapter. Thermal waste management techniques strive to reduce the amount of garbage, transform waste into innocuous materials, and use the energy that is concealed inside waste as heat, steam, electrical energy, or combustible material. They include any procedures that transform waste materials into gases, liquids, and solids while simultaneously releasing thermal energy or doing so as a result. The New Waste Framework Directive 2008/98/EC divides waste treatment into two categories: "Disposal" and "Recovery," with the "Recovery" category including thermal management practices that involve considerable energy recovery. Additionally, the waste management industry's pyramid of priorities, which is shown in Figure 2, demonstrates that energy recovery is a more popular choice than ultimate disposal [1].

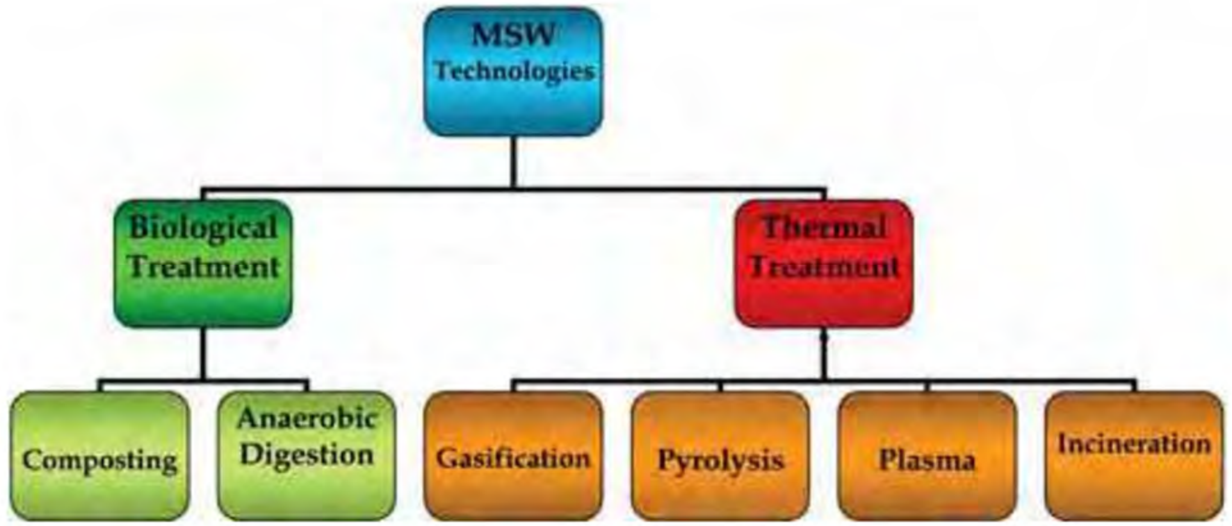

Figure 1: Illustrated the different biological and thermal methods for solid waste management

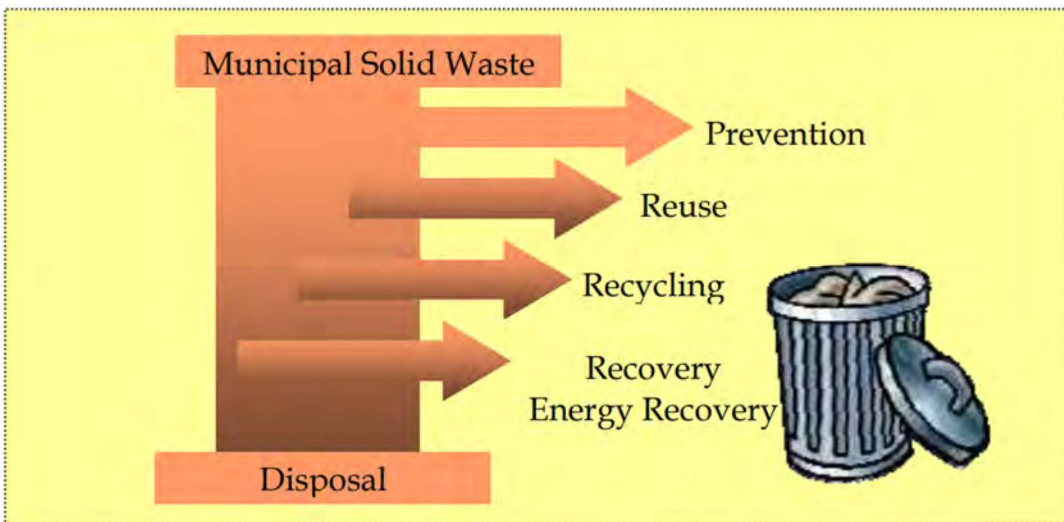

Figure 2: Illustrated the pyramid of the priorities in the waste management sector

Because of this, a growing number of nations worldwide are creating and using waste-to-energy systems to manage the steadily rising amounts of municipal garbage production. Increased recycling rates and the operation of a large number of Waste-to-Energy plants are characteristics of waste management systems in technologically sophisticated nations. More precisely, according to Eurostat statistics, 53%, 47%, 47%, 38%, 36%, 35%, 34%, and 28% of municipal garbage was handled using thermal technologies in 2007, respectively, in Denmark, Sweden, Luxembourg, Netherlands, France, Germany, Belgium, and Austria. However, certain Member States continue to use non-thermal methods to manage the produced municipal garbage, particularly in southern Europe and the Baltic Sea. Bulgaria, Estonia, Iceland, Cyprus, Latvia, Lithuania, Slovenia, Malta, Poland, Romania, and Greece are a few examples of such nations.

The utilization of thermal technology for solid waste management in Europe and other parts of the globe is generally described. The presentation of information on incineration includes pyrolysis, gasification, plasma technology, and mass burn combustion. Each technology's many features, representative reactions, and outputs from each thermal process are all discussed. Air emissions and solid residues are described, and the needs for cleaning systems are also covered for each situation. The first gasification/vitrification effort to treat municipal trash in Greece is detailed towards the end [2], [3].

Incineration

i. General

When carbon-based materials are burned in an oxygen-rich atmosphere, usually at temperatures over 850o, a waste gas predominantly made of carbon dioxide and water is produced. Other air emissions include sulphone, nitrogen oxides, and others. Ash is created from the waste's inorganic component. The most widespread and tested thermal process that uses a broad range of fuels is this one. Since there is surplus oxygen during complete combustion, the stoichiometric coefficient of oxygen in the combustion process is greater than "1". Theoretically, no carbon monoxide is created and the average gas temperature is 1,200°C if the coefficient is equal to "1". This thermal treatment method's goal is to reduce the amount of the treated trash while also using the stored energy. The recuperated energy could be put to use for:

- **i.** Heating,
- **ii.** Steam production,
- **iii.** Electric energy production

For every tonne of household garbage, an average of 0.7 MWh of electricity and 2 MWh of district heating may be generated. Thus, it is possible to generate around 17 MW of electrical power and 1,200 MWh of district heating per day by incinerating roughly 600 tonnes of garbage each day. Both mixed solid trash and garbage that has been specifically chosen for treatment may be treated using this procedure. Municipal solid waste may be reduced in weight and volume by 75% and 90%, respectively. For the thermal treatment of large volumes of solid waste, more than 100,000 tonnes annually, incineration technology is practical.

To ensure that the treated solid waste is completely burned, a number of prerequisites must be met:

- **i.** Adequate fuel material and oxidation means at the combustion heart,
- **ii.** Achievable ignition temperature,
- **iii.** Suitable mixture proportion,
- **iv.** Continuous removal of the gases that are produced during combustion,
- **v.** Continuous removal of the combustion residues,
- **vi.** Maintenance of suitable temperature within the furnace,
- **vii.** Turbulent flow of gases,
- **viii.** Adequate residence time of waste at the combustion area .

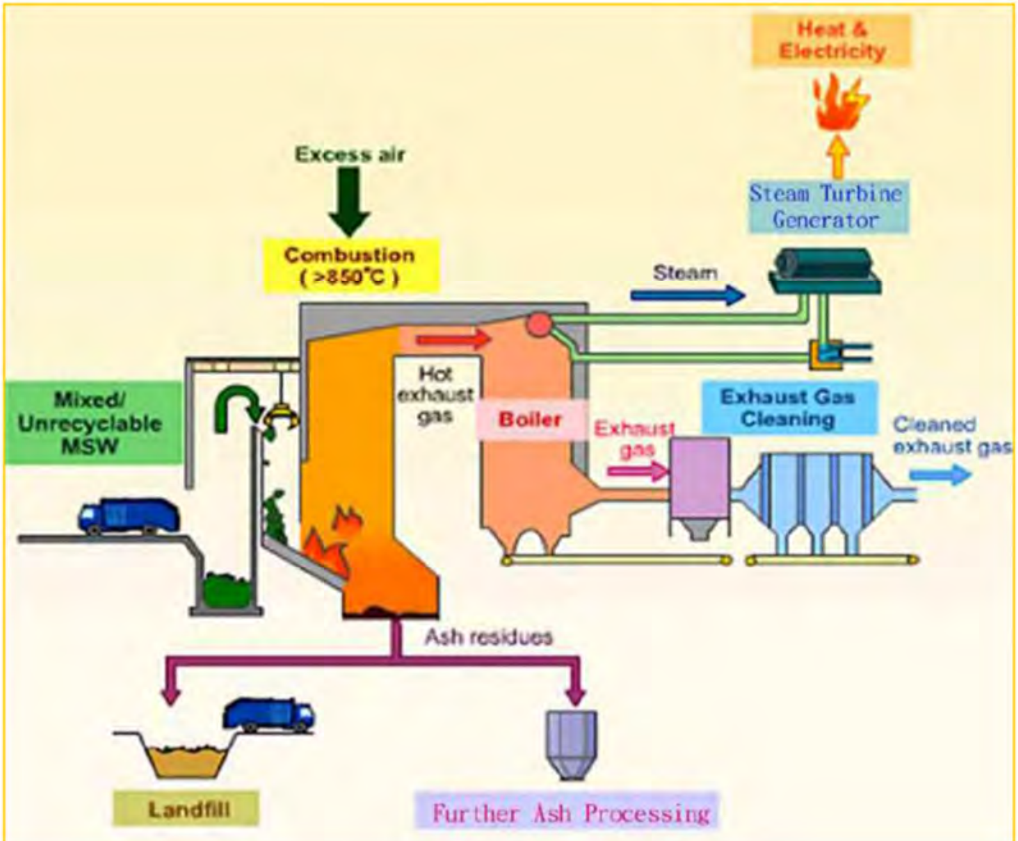

Figure 3: Illustrated the schematic diagram of incineration process

The existing European legislative framework via the Directive 2000/76/EC prevents and limits as far as practicable negative effects on the environment, in particular pollution by emissions into air, soil, surface water and groundwater, and the resulting risks to human health, from the incineration and co-incineration of waste, as display in Figure 3.

Typical Incineration plant

A typical incineration plant includes:

i. Weighing System

The system for weighing solid waste aims at the control and recording of the incoming loads and it has to be practical so as to minimize the time that vehicles remain at this point.

ii. Reception Site

Due to the fact that waste does not arrive on continuous basis , the existence of waste reception and temporary storage site is considered necessary. The design of the site is made in a way that the following are ensured:

i. The unloading time is as little as possible,

ii. All transferred waste is received,

iii. The homogeneity of the waste that will be used as feeding material is achieved,

iv. The smooth feeding of the facility is ensured

Moreover, the design of the reception site should be based on the minimization of the environmental consequences. For instance, the solid waste should remain for maximum two days so as to avoid odours, while the bottom of the site has to be characterised by weathering to allow the leachates and washing wastewater to go away [4].

Feeding System

The feeding system has to be adapted to the rate and feeding velocity of the installation.

Combustion Hearths

The ignition of solid waste at incineration facilities is achieved through the use of specific burner, which operates with secondary fuel. Basic parameters for the appropriate operation of the combustion hearths are:

i. achievement of the minimum desired temperature

ii. adequate combustion time

iii. achievement of turbulence conditions / homogenous waste incineration

Boiler

The boiler is the apparatus that produces steam in a manner that best makes use of the energy present in the fuel. Molecules or substances made of carbon and oxygen are referred to as furan or dioxin. These chemicals develop hazardous qualities when they interact with halogens like chlorine or bromine. The chlorinated species of halogenated dioxin and furan have been the focus of the majority of study. It is well acknowledged that dioxin and furan are byproducts of combustion processes, particularly those that burn or incinerate household and medical waste. Furans or/and dioxins are produced during combustion processes when hydrocarbon precursors interact with chlorinated chemicals or molecules. Due to the existence of precursor chemicals, free chlorine, or unburned carbon and copper species in the fly ash particles, they may also be produced in a post-combustion flue gas cooling system. Dioxins and furans have a harmful effect, however this was not understood until the 1980s. The TEQ-Toxic equivalent of the dioxin emissions was significantly reduced as a result of the MACT Regulations' adoption. As a consequence, the dioxin emissions have been constrained to a thousandth of what they were in 1987, reaching levels below 10 gr TEQ annually. The unregulated burning of garbage, which produces around 600 gr of dioxins yearly, is believed to be the largest source of the chemical, according to statistics published by the US EPA. Almost all combustion processes create dioxins and furans in the gas phase, while the precise method by which they are formed is unknown. It is known that the temperature at which they develop is 300C, a temperature at which both production and breakdown are feasible responses. Their development is aided by the presence of chlorinated organic materials in trash and the rise in their oxygen content [5], [6].

DISCUSSION

A moving grate incinerator is the usual facility for the burning of home solid waste. The movable grate makes it possible to optimise the flow of waste through the combustion chamber for more complete and efficient burning. A single moving grate boiler may work for up to 8,000 hours a year with only one planned pause for inspection and maintenance, which lasts roughly one month and can handle up to 35 tonnes of trash per hour. Municipal Solid Waste Incinerators are another name for moving grate incinerators. A waste crane inserts the trash into the "throat" at one end of the grate, at which point the waste descends over the falling grate to the ash pit at the other end. A water lock is used to remove the ash in this instance. A portion of the combustion air is supplied from below via the grate. The grate itself is meant to be cooled by this air flow. The mechanical strength of the grate must be cooled, and many moving grates additionally include internal water cooling [7], [8].

CONCLUSION

As a result, incinerator operating conditions have a greater impact on the generation of dioxin than waste composition or PVC content. Given the evidence linking dioxins and furans to human malignancies, it is imperative to adopt both primary and secondary steps to reduce these emissions. Different cleaning procedures may be used to get rid of the suspended debris and the gas pollutants. Deposition chambers, which remove 40% of suspended particles, cyclones, wet cleaning towers, electrostatic precipitators, and bag filters are mentioned in this context. When gas pollutants such as HCl produced during the burning of PVC and oxides of nitrogen, Sulphur, and phosphorus exceed the limit values, it is often essential to remove these in addition to suspended particles.

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CHAPTER 22

AN ANALYSIS OF TECHNOLOGY MATRIX FOR MULTIPLE SOLID WASTE STREAMS

ABSTRACT:

The range of technological options for handling waste streams ranges from small-scale operations like waste recycling bins and shipping vehicles to large-scale municipal solid waste (MSW) incinerators and landfills, each of which has special characteristics for any possible solid waste management (SWM) system. Technology matrix is methodically described in this chapter in relation to different waste stream kinds. It is presented singly with highlighted operational units as well as collectively with synergistic processes running simultaneously or sequentially. With the help of this body of knowledge, waste streams may be seen as flows linking different system parts in urban, man-made networks that support urban sustainability by recovering materials and energy and minimizing pollution consequences both directly and indirectly over the long term. Such an occurrence might be seen as an essential component of urban metabolism.

KEYWORDS:

Environment, Ecology, Pollution, Hard Material, Solid Waste.

INTRODUCTION

The key design question is how all waste treatment options can be seamlessly integrated to provide a complete solution based on risk informed, cost-effective, environmentally benign, and forward-looking criteria, taking into account the treatment technologies for handling solid waste streams introduced in previous sections. Several case studies shown in this section highlight various technological matrices that may reach a balanced choice over the aforementioned criteria in order to demonstrate various sorts of SWM systems. Unit processes, process flow diagrams, mass balance diagrams, layout, and configuration are all part of the fundamental technology matrix evaluation tools.

The key design question is how all waste treatment options can be seamlessly integrated to provide a comprehensive solution based on risk-informed, cost-effective, environmentally friendly, and futuristic criteria, taking into account the treatment technologies for handling solid waste streams introduced in previous sections. Several case studies shown in this section highlight various technological matrices that may reach a balanced choice over the aforementioned criteria in order to demonstrate various sorts of SWM systems. Unit processes, process flow diagrams, mass balance diagrams, layout, and configuration are all part of the fundamental technology matrix evaluation tools. Technical planning and unit layouts often consist of three steps:

i. **Feasibility analysis:** analyzes the possibilities for the SWM unit to be built. It should provide decision-makers with clear recommendations on technical and economic aspects of the planned unit;

- **ii.** **Configuration preview:** studies the equipment to be selected, flow charts of treatment procedures, rates of recovered materials, the mass balance, the environmental and safety aspects, and the staff;
- **iii.** **Setting end:** provides the final preparation of the plans and specifications used in construction with respect to estimated costs and legal documentation.

The goal and function of the unit must be established before beginning the technical planning. Functions, according to the author, rely on the unit's role in the SWM system, the kinds of materials to be processed, how the waste will be disposed of in the transportation system, and the kinds of containers needed to transport processed commodities to the final consumer. To achieve the holistic processing objective using system thinking, a process flow diagram made up of the accumulation of various operational units is required. The following are the primary objectives to be covered in the creation of a process flow diagram:

- **i.** Identify the characteristics of the waste to be processed;
- **ii.** Specify current and future materials to recover;
- **iii.** Identify available equipment and facilities.

For instance, bulky garbage must be removed or shredded before certain waste categories may be effectively separated from commingled waste. A bag opening equipment must be put at the start of the processing line because bags must be opened in order to expose trash for sorting and recycling. The mass balance, which determines the amount of material to be recovered, treated, and disposed of sequentially given the feed rates to each operational unit and the entire process, is one of the most crucial components during capacity design and equipment selection; as a result, if the design engineers fully understand the characteristics of the waste streams, the functionality of each unit operation, and the project goals, proper selection of various unit operations and their adequacy will be made.

- **i.** Phase 1 establishes the system's perimeter. This perimeter may be established for either the whole unit or a specific unit action;
- **ii.** Phase 2 determines the quantity of material in the system and residues that enter and exit the system border;
- **iii.** Phase 3 encourages the use of the material balance discovered throughout the process that will take place within the restrictions of the system.
- **iv.** Phase 4 uses the mass balance data to calculate the capacity (loading rate) of the unit activities and processing stages. Waste entering these facilities is often indicated in tonnes per day. The activities or separation of the transport unit must be described in tonnes per hour. Therefore, depending on the actual hours of operation per day, the capacity of tonnes per day must be adjusted to tonnes per hour.

The layout and configuration of waste treatment units depends on the type of waste and amounts to be processed. The factors to be considered in the configuration and layout include:

- **i.** Methods and means by which the waste must be delivered to the unit;
- **ii.** Estimated rates of delivery of materials;

iii. Definition of capacity;

iv. Development of performance criteria for the selection of equipment;

v. Space requirements for maintenance and repair.

Due to the vast number of devices available in the market and their possible combinations, several possible technological configurations are possible. The following sections present some layout examples for residues from the main processing units when handling MSW [1].

Mixed Municipal Solid Waste and Process Residues

Processing mixed MSW and industrial wastes often involves combining mechanical, biological, and thermal treatment methods. MBT facilities minimise waste volume and quantity, process organic waste fractions, and recover certain fractions for industrial reuse, such as metals, plastics, and RDF as a fuel alternative in industrial facilities (like cement factories). MBT plants are seen as an alternative to incineration in the context of a technology matrix because of their essential roles. MBT plants may be run in one of two ways, depending on the real objective: mechanically followed by a biological process, or biologically followed by a mechanical process. In order to provide the best material recovery and to enable flexibility in response to market trends for recyclables, several equipment types with various functionalities are incorporated [2].

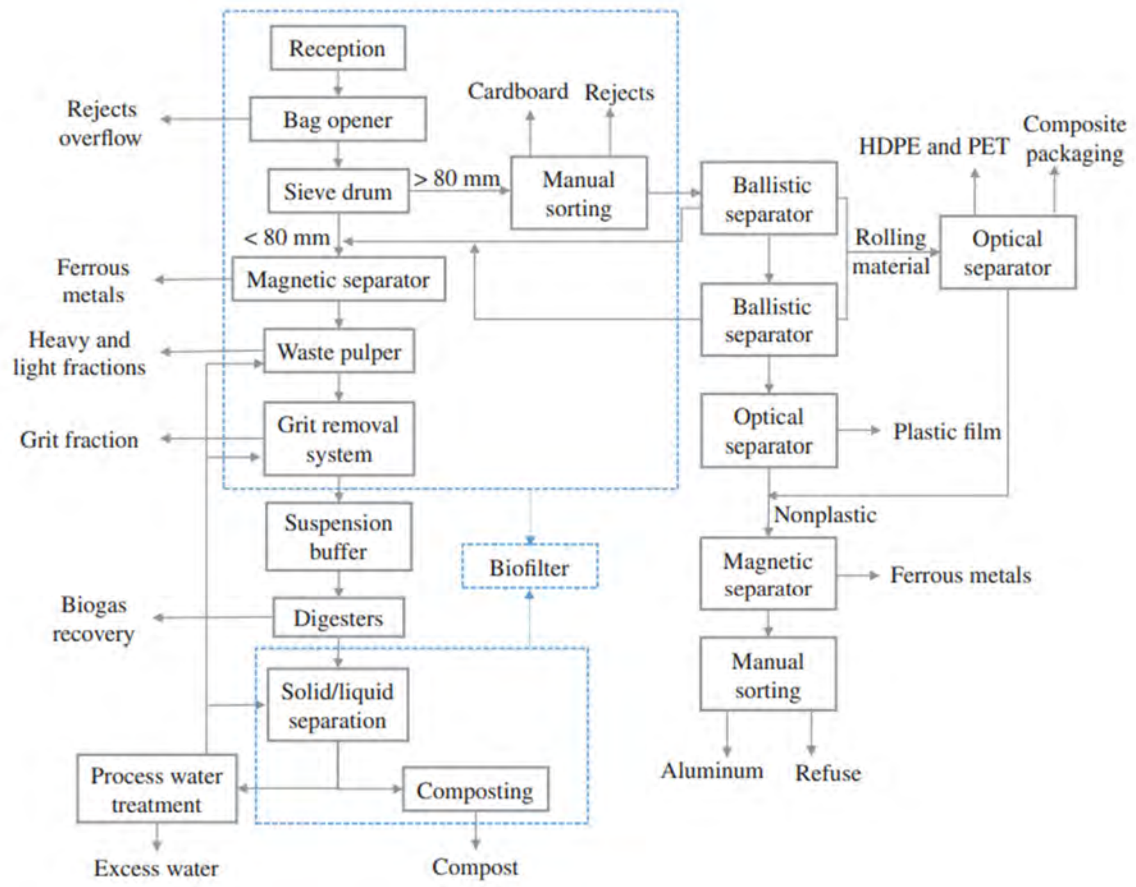

Figure 1: Illustrated the Anaerobic digestion MBT plant located at Leiria

For instance, in the case of the MBT shown in Figure 1, the outputs include compost, electric energy (such as biogas from anaerobic digestion), recyclable materials (such as metals, cardboard, high-density polyethylene (HDPE), and low-density polyethylene (LDPE) primarily plastic film). The same MBT idea may be utilized to create RDF from waste materials with high heating value, such as paper, plastic, and wood, if RDF is preferred by the market. The proportion with a low heating value may be treated in a landfill using aerobic treatment and a stabilized biological process. Figure 2 shows an illustration from a unit in Italy. MBT, in which biological treatment comes first, is a special technique utilized in facilities where the goal is to employ microorganisms to dry the material rather than let it totally destroy the organic materials. The bio-drying method used in this unit reduces moisture, increasing the calorific value of the waste and improving its suitability for energy recovery, i.e., the production of RDF. The mechanical procedure is intended to remove certain waste materials and recover RDF [3], [4].

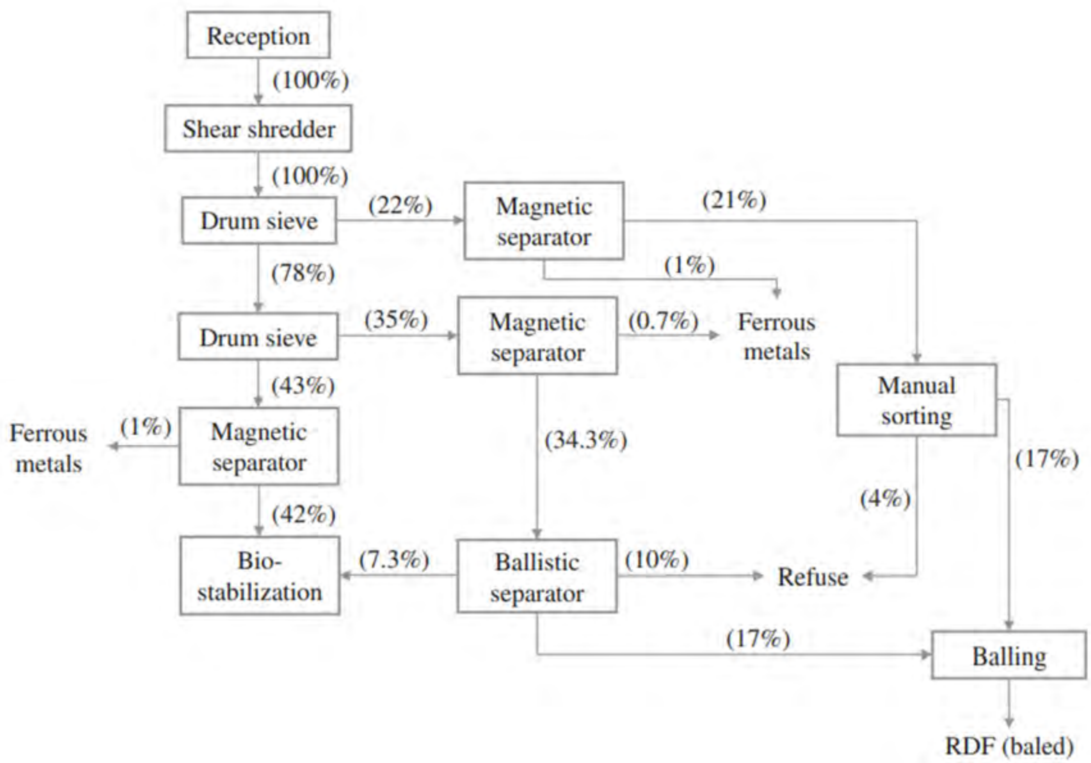

Figure 2: Illustrated the Aerobic MBT plant with RDF production.

Refuse-derived fuel production

RDF may be created independently in specialized units, in addition to aerobic MBT units, using waste components with high calorific contents from various sources, including urban, industrial, and commercial sources, as well as other recycling procedures. As shown in Figure 3, a typical RDF processing line contains several mechanical devices to remove waste materials like metals and low calorific fractions and to conform to final RDF criteria. RDF produced in these units with high calorific contents might come from industrial waste, MSW, and CDW. Understanding waste composition and projecting how to adjust equipment size and functionalities to fit changing demand will be crucial for the future sustainable growth of RDF production [5].

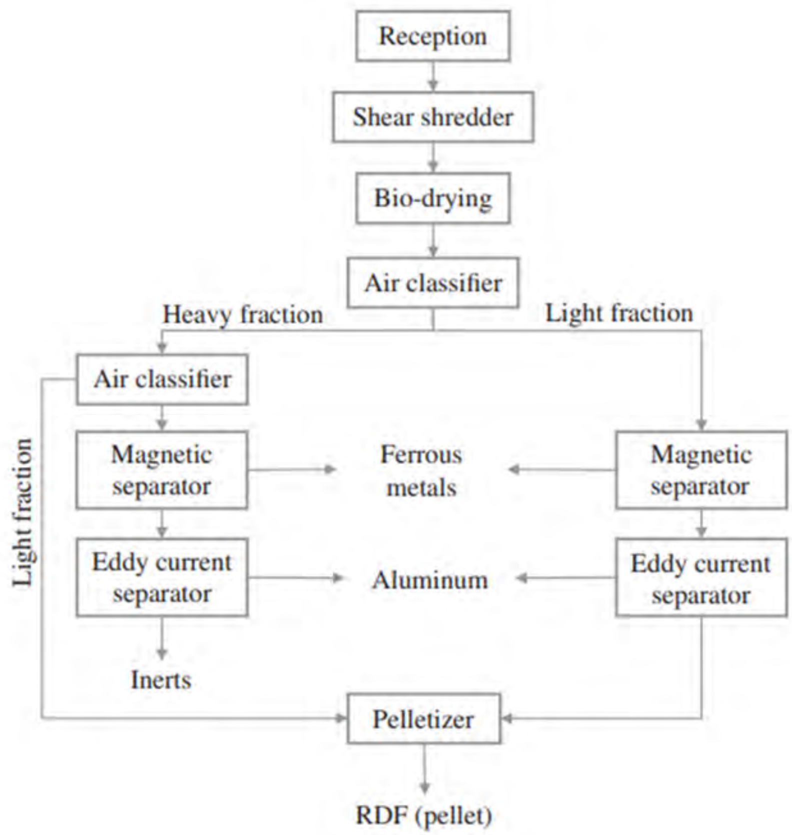

Figure 3: Illustrated the Aerobic MBT for RDF production

Incineration Plant

An incineration plant is made up of many phases to make sure that full combustion takes place in conditions that are technically sound, ecologically friendly, and professionally safe. As shown in Figure 4, an incineration unit begins with a discharge platform where garbage is gathered by a crane to feed the furnace. The boiler's water may be heated using the waste heat recovered during combustion, and the heated water can then be utilized to generate steam or electricity. The gaseous emissions are scrubbed in the gas scrubber, then filtered in the bag house, and ultimately released via the stack [6].

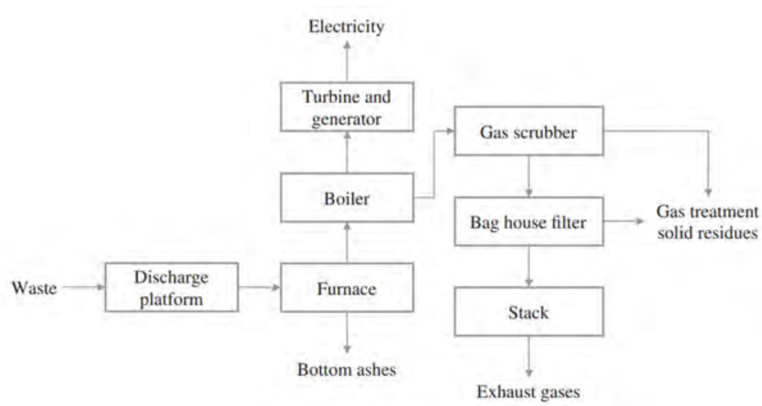

Figure 4: Represented the Incineration Plant from Lisbon Metropolitan Area

Biodegradable Waste

Composting and anaerobic digestion are the two main technologies now available to handle biodegradable waste. These alternatives are distinct from MBT since the material is beginning to degrade. It would have been better to separate the organic trash to avoid having to set up so many mechanical sorting devices. Figure 5 shows how a typical composting facility handles garbage from source-separated collections. These concatenated units often start with a refining stage to improve the compost's appearance for the final composting unit. This step is typically automated using a drum sieve, vibrating sieves, and a densiometric table. These first treatment facilities guarantee that the ultimate biological composting procedure yields top-notch compost. Lisbon, Portugal's metropolitan region, has a real-world anaerobic digestion facility. Vegetable markets, restaurants, and hotels are the two major sources from which source-separated BMW are gathered. The treatment schematic resembles the one at the facility in Portugal's Madeira Autonomous Region. Take note that a manual sorting unit in the centre of the treatment diagram is always necessary to ensure the creation of high-quality compost [7].

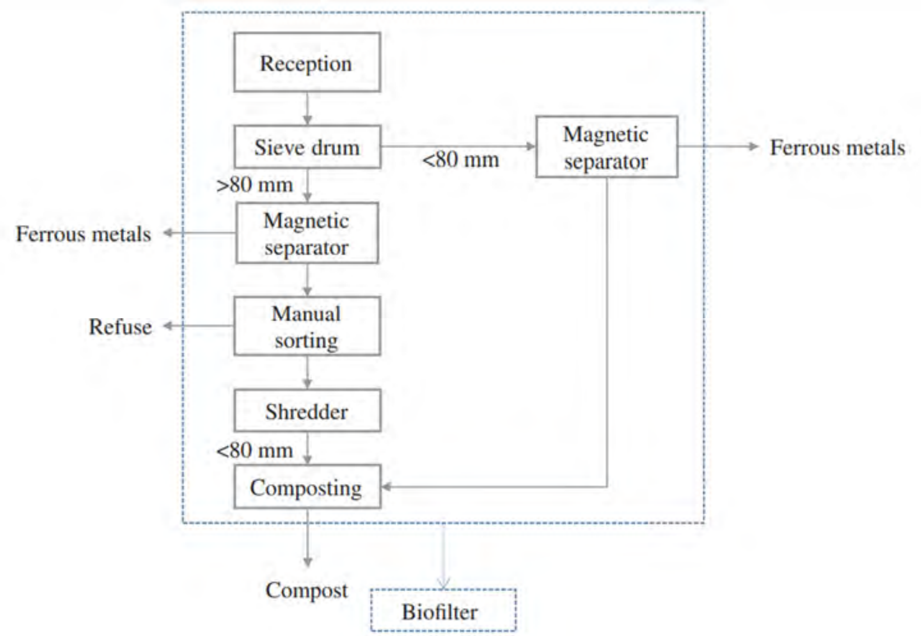

Figure 5: Illustrated the Composting plant from source-separated biodegradable municipal waste collected

Thereby lowering the need for the installation of several mechanical sorting devices. Typical composting facilities handle garbage from collections that are source-separated. These concatenated units often start with a refining stage to improve the compost's appearance for the final composting unit. This step is typically automated using a drum sieve, vibrating sieves, and a densiometric table. These first treatment facilities guarantee that the ultimate biological composting procedure yields top-notch compost.

DISCUSSION

The homogeneity of the MSW streams is the first step in the packaging waste process. Then, separation is aided by manual or automated devices, depending on the type of packaging used. Examples of these materials include paper and cardboard, liquid packaging board, ferrous and nonferrous metals, plastics like expandable polystyrene, HDPE, LDPE, PET, and polypropylene (PP), and laminated packaging. Each recovered material is pressed and balled after sorting to facilitate storage and delivery to the next recycling facility. The kind of MRF is determined by how the separation units are arranged. According to the degree of equipment automation, MRFs may be thought of as manual, semi-automated, or automated/automatic facilities. Package sorting takes place in a manual MRF facility using labor-intensive procedures. The garbage is transferred from the manual sorting section onto a conveyor in this kind of MRF facility using a wheel loader. The employees separate the packing onto the conveyor belt either by positively sorting the desired material or negatively sorting the items that are unsuitable for recycling. Along the operating line, the chosen materials discharge from the conveyor into the proper storage silos. Despite the fact that batch mode may also be built for various objectives, the majority of manual MRF plants operate on a continuous model along the sorting conveyor [8].

CONCLUSION

This device often includes a magnetic separator to better separate ferrous packaging and is located at the end of the sorting conveyor. Any garbage that is not separated at the end of the conveyor is released as refuse and often goes to a landfill or an incinerator facility for ultimate disposal. Materials that have been sorted are then fed into a balling line to be sent to recyclers. When compared to equipment for plastic sorting in particular, a manual sorting plant offers various benefits in terms of separation efficiency, including less contamination and lower investment costs; nevertheless, operating expenses might be considerable owing to employee pay and health insurance. Automatic equipment might be an effective way to sort packaging trash in nations where human interaction with garbage is restricted by human health regulations. The only mechanical tools used in an automated or semi-automatic MRF are for process control and quality assurance; manual labour is only supplementary in these kinds of plants. Semi-automated units, where packing is sorted using both mechanical technology and hand sorting, have been popular in various nations recently. Before using mechanical treatment to separate out a certain proportion of various kinds of plastic packaging trash, a semi-automatic MRF uses manual sorting to homogenise package waste.

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CHAPTER 23

AN OVERVIEW OF THE SOCIAL AND ECONOMIC CONCERNS OF SWM

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ABSTRACT:

Modern urban life requires effective solid waste management (SWM), which has a big social and economic impact. Socially, poor SWM may have a detrimental impact on inhabitants' health, safety, and quality of life. On the other side, efficient and effective SWM may boost a region's economic development by generating income, creating jobs, and protecting the environment. This abstract examines the social and economic issues with SWM, such as its effects on environmental protection, public health, and safety, as well as the financial effects of waste management regulations. An examination of the difficulties that SWM faces in developing nations is included in the debate. In these nations, a lack of resources, infrastructure, and knowledge significantly hinders efficient waste management. The abstract also explores how the public, business sector, and government might work together to solve the social and economic issues surrounding SWM. The debate emphasizes the need of various stakeholders working together and participating in order to create and execute sustainable waste management strategies that are advantageous to society and the economy.

KEYWORDS:

Economic, Hard Material, Pollution, Soild Waste, Social Concern.

INTRODUCTION

A sustainable solid waste management system must take into account not just technical aspects but also economic motivations and societal restraints. For each urban SWM planning scenario, for example, amortized costs and benefits over the planning horizon must be calculated. To define an affordable fee system in terms of family income and consumption patterns, it is also necessary to understand consumer willingness to pay. The administrative team of a SWM project must evaluate the utility's financial viability with such execution plans, as well as its political and public acceptability, and if required, must make the appropriate adjustments to increase the project's responsibility. The planning, design, and administration of a SWM system are discussed in this chapter in connection to financial, economic, and social considerations. These factors may be tailored for various initiatives, plans, and programs that may be adaptably applied to SWM systems of all kinds. While financial planning is necessary throughout the project planning stage, economic assessment must be connected to other facets of a SWM project's environmental, resource, and welfare economics. However, while executing these SWM initiatives, social issues are linked to the legal considerations in decision-making as well as to community views and input.

Financial Concerns

i. Financial Concepts

The main concern with any kind of SWM is determining if the fee structure is reasonable, workable, or sustainable in the area where the service is being provided. Costs and advantages of the SWM system must be balanced in order for it to operate properly and adhere to rules and policies. Investment expenses, operation and maintenance costs, administrative costs, and potential revenues are the primary components of a cost-benefit analysis that waste managers are concerned with. Four elements are examined in a financial analysis that is necessary to balance cash flows and maintain operations: net present value, discount rate, internal rate of return, and amortized costs/benefits. There are three other methods to determine if a project is financially viable: NPV, IRR, and amortized expenses. The discount rate is a crucial variable required for NPV, IRR, and amortized costs/benefits calculations. The net present value (NPV) of a project determines the current worth of all project-related expenses. The most valuable project may be identified by comparing the NPV of several projects, which is stated as "value today" in terms of required revenues and expenses.

When comparing income and expenditure that take place at various times in time, the discount rate is a kind of interest rate that is employed. Inflation-adjusted standards for the social discount rate might be 6-8% in rich nations and 10-12% in developing ones annually. The discount rate, in theory, reflects the rate of compound interest assuming there is no worry about inflation. For each individual, business, and society with different time periods and financial patterns, this discount rate may be determined. Generally speaking, a project may be suggested if its net present value (NPV) is positive; nevertheless, the decision-maker is also concerned with the sum required for the project's start-up and the time required until it is fully operational. It is therefore important to rank projects according to their "earning power," with the one that earns the highest NPV per dollar invested at the top. It may be calculated using the profitability index, which measures how much cash inflows are worth now compared to the original investment. The greater the number, the better [1].

IRR is an economic method for project appraisal that determines the discount rate that, when used to compute NPV, will result in the project's NPV being equal to zero. The IRR is normally determined by an iterative process where several discount rates are inserted into the NPV calculation until the NPV converges to zero. The cost of capital may thus be directly compared to a project's IRR. When the IRR exceeds the cost of capital, a project is considered financially feasible. Total amortized expenses are created by adding yearly operating and maintenance costs to the amortized capital investment. The capital investment must be amortised in order to integrate these expenditures on the same basis as O&M costs are calculated annually. The conventional amortization formula is used to determine amortized costs:

Total amortized costs = Amortized capital investment + Annual O&M cost.

Waste Management Costs

Throughputs, design capacity, solid waste stream creation rates, recycling possibilities, and facility locations are all factors that might determine the costs and advantages when designing a SWM system. It is often required to be aware of certain extra indirect elements that affect the costs and benefits. Cost management for SWM has been considered in a variety of ways, and thorough economic modelling might benefit from emphasizing economies of scale. Economies of scale are the savings in output unit costs that businesses get as a result of a bigger operation or process, such as a larger facility, when fixed costs are spread over a greater number of output units. Wilkinson defines economies of scale as characteristics of growing size that result in decreasing long-term unit costs. However, it is not an indefinite benefit. In fact, if an item or service is offered on a higher scale than what the top management limit allows, cost advantage will actually evaporate. The term for it is diseconomy of scale. For all unit activities in a SWM system, the idea of a cost benefit that materializes with greater production of a product is essential [2].

As a result, all SWM unit activities may be examined from the standpoint of size or the economies of scale. The inclusion of nearby municipalities in a regionalization plan, where their responsibilities for SWM is bound together, is one way to put an economies of scale effect into practice.

The argument for promoting centralized waste management systems, which unite an increasing number of local governments to establish a consortium for SWM, is economies of scale. In industrialized nations where the management competence is established and creating a consortium via a democratic process won't be problematic, centralized SWM systems may really be advocated. Economies of scale may still be encouraged in poor nations with low rates of solid waste output and strict financial restrictions to cut average costs over the long run. When it comes to early applicability and viability in these developing nations confronting administrative and technological challenges, conventional low-tech solutions like neighborhood composting through a decentralized SWM system that doesn't generate any economies of scale are more practical and workable. Other socioeconomic factors, however, may result in more agreeable decentralized SWM systems.

Decentralized Waste Management Systems

In rural regions, composting which has a long history in India is quite common. Only a few installations are now in use since administrative and technological challenges in the 1970s shown that centralized, large-scale composting operations in metropolitan areas were unprofitable. Expected revenues have been lowered due to high operation and shipping expenses, underdeveloped markets for compost, and poor quality mixed-waste compost.

Since the 1990s, there has been a trend towards more compact, manually run composting facilities at the local level, driven mostly by citizen initiatives or voluntary organizations with funding from international agencies. The decentralized strategy is expected to provide the following key benefits:

i. Composting, when combined with primary garbage collection, helps communities' fragile waste situations and reduces citizens' reliance on the subpar municipal waste collection service;

ii. With the right technology, decentralized composting may be conducted with lower startup and ongoing expenses;

iii. Because manual composting in small, decentralized plants necessitates labor-intensive procedures, it is more readily integrated at the community level with shared socioeconomic backgrounds. It also provides the poor sections in Indian society with new work options and a source of income;

iv. Decentralized composting enables organic waste to be recycled where it is produced, cutting down on the amount of trash that has to be transported and associated expenditures, which benefits SWM total costs.

In the Indian community, where there are less than 1000 participating families, there are a variety of composting plants accessible at the local level. According to the interviews with the main people in charge of community planning and the initiators, scaling up to a decentralized composting model run by citizens and communities is difficult. Benefits of decentralized composting, such as better environmental conditions in residential areas, are provided by several instances of community efforts with the help of a working waste collecting system [3].

Waste Collection Costs at An Island

Wherever practicable, an integrated SWM system must be put into place on Sardinia Island in order to meet the target of reaching a 50% average efficiency for waste separation and recycling during the collection phase on a regional scale. If waste is collected twice a week for residual municipal solid waste, three times a week for biodegradable fractions, and once a week for packaging waste, the collection costs for each waste component could range from US$69 per tonne in 2006 for residual MSW to US$603 per tonne in 2006 for plastic packaging waste.

If the financial assistance of the national recyclers' network is taken into account, the total average collection cost, which includes the operation of a waste collection centre, may be reduced to 2006 US$133 per tonne of the produced MSW. In Sardinia, the cost of collecting is now at US$75 per inhabitant per year [4].

There is always a trade-off from a system analysis viewpoint since the collecting phase is interconnected with the processing and disposal phases in a SWM plan. This suggests reduced pretreatment costs because of a lower service level, which might result in cheaper collecting expenses. For instance, the cost of sorting or pretreating waste fractions to be transported for recycling at the material recovery plant will increase if the separate collecting system is separated into a small number of waste streams. The collection cost is also impacted by the mode of collection selected. Kind of vehicles, shipping distance, manpower and administrative expenditures, and kind of waste transfer are all elements that impact transportation costs. Using transfer stations helps save expenses. Smaller capacity trucks may carry waste to a transfer point in between, where it can be unloaded onto bigger capacity vehicles and sent to the ultimate location. Because the overall shipping strategy would result in a reduced cost per unit of mass and shipping distance, this intermediate garbage station may cut the average transportation expense.

Numerous additional factors exist, including but not limited to the generation of revenues such as power from biogas, the price of electricity, and the digestate market price. This is true even if the procedures used for anaerobic digestion might alter the investment and operating expenses. Reduced economies of scale are the outcome of these difficulties. The revenue generated from the selling of compost is not included into the investment and operating expenses of biological treatments like composting. WTE facilities need a lot more money than composting or anaerobic digestion facilities do. Where there are not great operating cost economies of scale, WTE is the treatment option of choice; nonetheless, there are considerable diseconomies when using small-scale WTE facilities. WTE facilities need a constant supply of waste throughout their useful lives in order to be cost-effective, and life cycle cost would reflect this. the calorific value or the quantity of waste input is reduced Numerous additional factors exist, including but not limited to the generation of revenues such as power from biogas, the price of electricity, and the digestate market price. This is true even if the procedures used for anaerobic digestion might alter the investment and operating expenses. Reduced economies of scale are the outcome of these difficulties. The revenue generated from the selling of compost is not included into the investment and operating expenses of biological treatments like composting. WTE facilities need a lot more money than composting or anaerobic digestion facilities do. Where there are not great operating cost economies of scale, WTE is the treatment option of choice; nonetheless, there are considerable diseconomies when using small-scale WTE facilities. WTE facilities need a constant supply of waste throughout their useful lives in order to be cost-effective, and life cycle cost would reflect this. the calorific value or the quantity of waste input is reduced [5].

The majority of the expenses associated with landfilling are capital expenditures, such as those connected to land, equipment, labour, materials, and resources. Prices associated with landfills vary depending on the sort of trash disposed of since different sites have different needs for liners, top covers, and other consumables, all of which have an impact on prices. Tsilemou and Panagiotakopoulos claim that while a biogas collecting system is not required for small landfills, whether or not one is included in the cost-effectiveness analysis is also an important consideration.

Waste Management Revenues

An SWM system makes money by selling waste products like compost, recyclables, electric energy, or heat. As in the case of packaging waste managed in response to extended producer responsibility, where collection and sorting are funded by the tax that is paid by packaging producers, recyclables obtained from the SWM system can be financed by the producer in many nations with an established polluter pays principle. However, it might be challenging to predict recyclables income at the design stage. Due to problems with the market's fluctuating supply and demand, which have an impact on the business framework of a SWM strategy, the recyclables market is extremely uncertain:

i. In direct competition with equivalent virgin resources, recycling is under pressure on the supply side due to rising costs for trash collection and processing. Under these circumstances, structural complexity and technological shortcomings significantly limit the recycling industry's ability to compete. Ultimately, by making sure that product design takes into consideration the needs of post-consumption collection, sorting, and recycling, recycling efficiency might be increased. Additionally, the market value of recyclables may vary depending on their quality.

ii. On the demand side, the competitiveness of recycling is constrained by the processing industries' lack of enthusiasm for recyclables as a result of their technical characteristics, restricted use, and/or unfavorable reputation. Furthermore, the absence of essential industry standards or even the propensity for certain standards or specifications to disregard or treat recycled materials or products differently are likely to hinder recycling. Additionally, there is a fundamental distinction in vocabulary between "waste" and "standards" based on subpar quality criteria.

iii. The investment needed to strengthen the industrial structure, advance methods for handling recyclable trash, and create new markets for recycled goods is severely hampered by the lack of transparency in recycling markets.

iv. Usability restrictions are linked to technological limitations that lower the market value of recyclable materials. For instance, the use of multilayer plastics for food packaging is not mechanically recyclable; the use of multiple colours in glass bottles necessitates expensive separation from recyclable materials; the use of ink technologies in paper printing requires better technical solutions to recycle paper; and the use of metal applications, such as pigments in paints and constituents, is limited by technological limitations [6], [7].

DISCUSSION

These problems together cause secondary recyclable trade prices to fluctuate. The biggest shift over the last ten years has been the steep decline in secondary material prices that occurred during the 2008–2009 financial crisis. Anecdotal evidence from this time period indicates that some waste management authorities experienced short-term sales difficulties with the materials they had gathered for recycling; however, average annual trade data for the 27 member countries of the European Union suggests that the markets for the majority of secondary materials were not significantly impacted.

The statistics also demonstrate that following a significant decline recorded during 2008, the price of commodities often exported from the EU for recycling rebounds well. Despite the price drop, trade volumes in plastics within the EU-27 have rapidly increased to levels greater than before 2008. This finding implies that the trash industry is strong enough to withstand momentary crises in the secondary material markets. However, persistent price declines will have an impact on the economics of recycling collection, which might ultimately result in higher implementation costs for Europe's trash and recycling policy [8].

CONCLUSION

If biological treatments are available, a SWM system may also generate additional outputs or byproducts, such as compost, in addition to the collection of recyclables. The compost market is mostly impacted by regional considerations. The contribution of compost as a SWM income may be determined by the quality of the compost, the availability of a large agricultural market for compost, subsidies, and the presence of rival goods like manure. Europe's position is highly varied. Compost sales to agriculture in Belgium and the Netherlands have become challenging due to fierce competition with manure; however, high prices from US$113 to US$377 per tonne can be reached when the compost is sold in small quantities, such as for blends, to hobby gardeners, or to wholesalers. In central Europe, bulk compost for agricultural use is rarely higher than US$6.3 per tonne. Although there is no standardized rule to govern it, compost is also exported. In the United States, compost is one of the most popular and useful garden supplements, and the price of compost, whether purchased in bulk or bags, varies greatly from state to state. SWM-derived electric energy, comprising biogas gathered from landfills and anaerobic digestion facilities as well as energy recovered from incinerators and the burning of refuse-derived fuel, is regarded as a renewable source of energy. In certain nations, a subsidy is available to encourage this type of energy; when used in the waste industry, this subsidy may significantly boost SWM's earnings.

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