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Markets, Partnerships and Sustainable Development in Solid Waste Management

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ABSTRACT: ***This chapter examines how markets, collaborations, and sustainable development relate to solid waste management. With ramifications for the environment, society, and the economy, solid waste management is a crucial problem on a worldwide scale. In order to promote sustainable practices and innovation within the solid waste management industry, this research investigates the role that markets and partnerships play. It evaluates different market-based strategies, including recycling programs and waste-to-energy technologies, and looks at the value of public-private partnerships in enhancing waste management systems. The results show that solid waste management sustainable development objectives need effective stakeholder engagement, including public agencies, private businesses, and local communities. Market mechanisms may also encourage trash reduction and recycling activities, promoting both economic development and environmental preservation. Overall, this research emphasizes the value of integrated approaches to solid waste management that use market forces and promote collaborations.***

KEYWORDS: ***Markets, Partnerships, Sustainable Development, Solid Waste Management (SWM).***

INTRODUCTION

International and national institutional frameworks underwent considerable changes as a result of the global economic crisis of the 1970s. Major players on the global arena, including the US and the UK, multinational businesses, and the Bretton Woods institutions, 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. The direct delivery of essential services was one area where governments in the South were aggressively urged to leave. The outcomes of these reform initiatives, however, fell short of expectations. The late 1980s were marked by widening wealth inequality, even while state governments cut expenditure and several nations saw economic recovery following an early slowdown. Urban poverty and the in formalization 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 [1]–[3].

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 conducive to the democratic reform of state bureaucracies. An interest in the (democratic) institutions that support development processes has also grown as a result of the challenges that many developing nations, including those in the south and the former communist world, have had in making the shift 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 evident in the new conceptualization of poverty in poverty research that emphasizes the significance of institutions in mediating access and is based on the asset-vulnerability approach. Political and social scientists now see the state as an "enabler," a coordinating body that collaborates with a number of other organizations in various sorts of partnerships targeted at urban and regional development. The 1990s saw a major focus on the significance of what later came to be known as civil society organizations and how they could collaborate with both public and private sector organizations. The political procedures involved in partnership agreements and how they affect the efficiency of local and regional government have also attracted new research. 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

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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 nonprofit organizations. There have been significant differences between rhetoric and practice, with expectations often outpacing improvements in practice.

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. Alliances and partnerships are being advocated as tools for more efficient local government across a broad variety of issues, but local environmental management is one area where they have particularly developed in developing nations. This book's fundamental concept is that local communities' viewpoints, those of the organizations that work with them, and the encouragement 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 accessibility, affordability, and environmental considerations. These standards are included under the more general category of "sustainable development". To what degree can modifications to solid waste management (SWM) systems support (aspects of) sustainable development in urban settings. Our opinions on how to most effectively improve urban solid waste management should, in our opinion, not be based on broad theoretical generalizations but rather should result from comparison examinations of both newly adopted procedures and already used practices. 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 quite 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 (1995) introduced the concept of "integrated waste management" in international talks around the UWEP Program. They work to break down the idea of sustainable development into its numerous 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 [4]–[6].

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. However, by including socio-economic and environmental evaluation components, all parties engaged in making this decision are able to base their choices on an explicit analysis and understanding of the consequences of their actions. Materials that no longer have value to their original owners are considered waste. Only garbage that enters the municipal stream is the subject of this book. This may include garbage produced by businesses, homes, and institutions. Municipal trash streams do not accurately represent the patterns of waste creation since waste components have already been separated by businesses and families and sold for reuse and recycling.

Changing Perspectives in the Provision of Urban Services: The Case of SWM

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 traditional worries about properly disposing of garbage that local and regional sinks can handle. The first difficulty has arisen from the viewpoint that local government has main responsibility for SWM and conducts its operations primarily out of a concern for public health concerns. Even while we now

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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 organize these fundamental services. The efficient and unhindered evacuation of garbage from residential neighborhoods and from places for disposal outside of cities were the main goals.

DISCUSSION

Implementing policies and tactics that reduce the detrimental effects of waste creation, disposal, and treatment on the environment, society, and the economy while fostering long-term sustainability is referred to as sustainable development in solid waste management. It entails using a comprehensive strategy that takes into account the full waste life cycle, from creation to disposal. The following are important sustainable development concepts for solid waste management:

Waste Reduction: The main goal is to reduce the production of trash at its source by using techniques including waste avoidance, reuse, and recycling. This saves resources and lowers the total amount of garbage that has to be disposed of.

Resource Recovery: Stressing the recycling, composting, and energy recovery of valuable resources from trash. This encourages a circular economy, lessens the demand for raw material extraction, and helps preserve natural resources.

Environmentally Sound Disposal: It is crucial to use environmentally friendly disposal techniques for garbage that cannot be repurposed or reclaimed. This entails using correct landfill design and operating techniques, adding safeguards to reduce leachate and gas production, and avoiding soil and water pollution.

Waste-to-Energy: Using trash as a resource to produce energy via procedures like anaerobic digestion and incineration. This lessens reliance on fossil fuels, promotes the generation of renewable energy, and may decrease greenhouse gas emissions.

Public Participation and Education: Promoting ethical trash disposal methods, encouraging people and communities to adopt sustainable waste management techniques, and raising public understanding of waste management procedures.

Collaboration and Stakeholder Engagement: Involving everyone who has a stake in the development and implementation of waste management programs, including government agencies, waste management organizations, businesses, communities, and people. Collaboration makes it possible to share information, tools, and sustainable waste management best practices.

Monitoring and Evaluation: Establishing reliable monitoring methods to evaluate the efficacy of waste management procedures and identify areas for development. Regular review aids in strategy adjustment, goal creation, and tracking progress towards sustainable waste management objectives.

Communities may achieve more sustainable waste management practices that support environmental preservation, resource conservation, and social well-being by incorporating these concepts into their solid waste management systems. During the 1960s and 1970s, industrialized nations began to see the limitations of this strategy as rising waste flows from changing consumption patterns exceeded the socially acceptable level and the capability of regional and global sinks to absorb them. Solid waste management procedures have been impacted by a viewpoint that seeks to advance more sustainable resource usage, and this approach is progressively being adopted via national policy guidelines in a number of industrialized nations. The "waste management hierarchy," in which waste avoidance, reuse, recycling, and energy recovery are aimed to minimize the amount of trash remaining for ultimate, safe disposal, lays forth guidelines and directions to limit waste creation and enhance waste recovery. 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. Privatization 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 shifted the environmental focus away from issues of natural resource depletion and resource management and given priority to pollution-related

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issues (the so-called "brown agenda") with a predominately urban focus (UNCHS, 1996). The term "brown agenda" refers to the "immediate and most critical environmental problems which incur the heaviest costs on current generations, particularly the urban poor, in terms of poor health, low productivity, reduced income, and decreased 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 crop failure."

Focusing on pollution issues implies a view of sustainable development that integrates considerations of the environment with efforts to address human needs. 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 such 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. The 'green' agenda, which focuses on avoiding waste creation and decreasing waste flows, is currently underemphasized in present policy views in developing nations, but as trash flows rise, it will be crucial to pay greater attention to this issue in the future [7]–[9].

Actors and activities include members of the public, private, and civil society.

When seen from the standpoint of local authorities, urban solid waste management includes the operations of residential garbage collection, either by door-to-door or neighborhood collection, transportation, and disposal of solid waste (often in dumpsites). 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 provide policy makers, community-based organizations (CBOs), nongovernmental organizations (NGOs), local public bodies, and private businesses with alternative scenarios that illustrate the kinds of contributions various activities can make in the direction of more environmentally sustainable development in the sector. The so-called waste hierarchy, is a more ecologically friendly approach to managing urban solid waste and it includes reuse, recycling, and recovery operations as well as safe disposal of garbage in sanitary landfills or by incineration which is shown below in Figure 1.

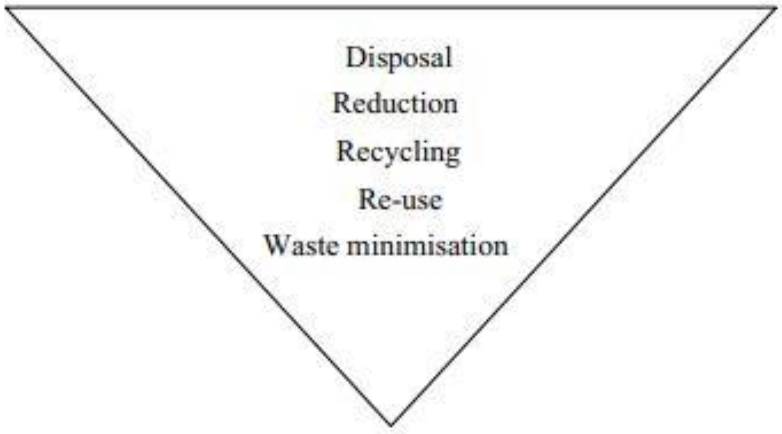

Figure 1: Illustarte the Waste management hierarchy.

Urban garbage has different characteristics in industrialized and developing nations, as well as in bigger and smaller municipalities. According to Cointreau-Levine's (1998) estimate, between 40 and 70 percent of the solid waste in developing nations is made up of organic waste, which is a pretty large amount. The composition of solid waste has changed recently due to the growing use of plastics and other inorganic materials as packaging materials. It was determined to detail explicitly what actions were carried out with regard to both inorganic and organic waste flows in the course of this research since organic waste has the potential to be recycled and repurposed.

Partnerships in SWM: Liabilities and Potentials

A new permanent position for the government as a facilitator of other players, who should be the direct suppliers of services, has been proposed by new concepts about the relationships between the local government and other actors in public services,

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which first focused heavily on privatization. This sparked a strong interest in "partnerships" as a crucial strategy for delivering services that are both effective and efficient according to World Bank standards and fairly distributed. A few points will be derived from the extensive debate on what constitutes partnerships and under what circumstances partnerships operate as such in order to properly examine urban SWM. The examination of partnerships may be done on several levels, including politically as "institutions" of governance, at the planning level as tools for public policy, sociologically as forms of social capital, and economically as a means of lowering transaction costs. Values, procedures, and institutions are three factors that must be considered in order to comprehend how partnerships work. The regularized patterns of interaction amongst the participating players are referred to as the institutional dimension.

Process refers to the interactions that occur across time between the actors, while value refers to the larger system of standards, assumptions, and goals that guides engagement. Such models need to include a fourth dimension since, in the end, how well and widely accessible urban services are is how urban residents evaluate 'partnerships' in the provision of services. Different definitions of partnerships exist in relation to urban government. Here, we highlight the key components of these definitions that serve our needs. According to Peters, a partnership is defined as at least two primary players, one of whom is public, who have ongoing contacts and interactions, each of whom contributes resources, and who are jointly responsible for the activities' results. This last component might be difficult to implement in collaboration with a partner from the government, and it also lessens responsibility for common people. Based on our prior discussion of the word alliance, we employ the term partnership8 for our research on SWM, but in a broader meaning of the idea. In this research, established connections between participants in the SWM-system (which will be outlined in the following section) are referred to as partnerships.

The characteristics of a partnership are:

1. There are two or more players involved, although not always one from the public sector;
2. It alludes to a more or less long-lasting connection between the parties involved in the supply of public goods (based on a written or oral agreement);
3. All parties to the connection get something from it (without implying equality or mutual gain);
4. It manifests in actual (physical) actions in which each actor makes a tangible or immaterial investment;
5. Potential points of friction and conflict, as well as areas of cooperation, may be discussed during negotiations;
6. The partnership must take public goods into consideration (or have a spin-off that relates to a public benefit).

In theory, partnerships benefit all parties involved, but this does not indicate that they are equally important since concerns of power are often at play in these kinds of interactions. Although partnerships imply some permanence, they should nevertheless be seen as manifestations of people's behaviors, which have a built-in propensity to change, adapt, and cease in reaction to shifting conditions. An example of this is the growth of private trash contractors in a field that was previously thought to belong to the public sector. Finally, it's critical to map out the different waste collection and disposal partnerships in order to avoid being fixated on the most dominating ones and to see the potential of the others [10].

Urban planners and economists often use the word partnership to refer to public-private partnerships when significant commercial businesses are engaged in a variety of service-related activities. Due to the worldwide literature on partnerships, where there is some enthusiasm about the possibility of partnerships, alliance was utilized in the essay published in Cities as an alternative to partnerships. There is no assumption of actor equality in our definition, similar to the other political science literature listed above, and there may be unequal allocations of time, money, and rewards as well. As there are many partnerships between the private sector and communities for essential services, where the public sector is not directly engaged, we do not wish to impose the restriction of having at least one player from the public sector.

CONCLUSION

The examination of solid waste management markets, partnerships, and sustainable development emphasizes the necessity for teamwork and market-driven strategies to meet the complex difficulties related to waste management. We may promote sustainable habits and provide financial incentives for trash reduction and recycling by using market mechanisms, such as waste-to-energy systems and

recycling programs. Public-private partnerships are essential for bringing together the necessary funds, knowledge, and tools to enhance waste management practices and foster innovation. To achieve sustainable development objectives in solid waste management, players from the public and commercial sectors as well as local communities must work together effectively. The development of a circular economy, the mitigation of environmental effects, and the promotion of economic growth all have a great deal of promise when integrated methods that mix market forces and partnership models are used. To create sustainable and resilient waste management systems in the future, politicians, companies, and communities must continue to work together and innovate while using the strength of markets and partnerships.

REFERENCES:

[1] L. Rodić and D. C. Wilson, "Resolving governance issues to achieve priority sustainable development goals related to solid waste management in developing countries," *Sustain.*, 2017, doi: 10.3390/su9030404.

[2] P. Agamuthu and J. A. Hansen, "Universities in capacity building in sustainable development: Focus on solid waste management and technology," *Waste Manag. Res.*, 2007, doi: 10.1177/0734242X07079155.

[3] M. A. Abas and S. T. Wee, "Municipal Solid Waste Management in Malaysia: An Insight Towards Sustainability," *SSRN Electron. J.*, 2016, doi: 10.2139/ssrn.2714755.

[4] D. V. Asiri, "Solid waste management for sustainable development," *SWM Sustain. Dev. Jiae*, 2017.

[5] S. Adipah and O. N. Kwame, "A Novel Introduction of Municipal Solid Waste Management," *J. Environ. Sci. Public Heal.*, 2018, doi: 10.26502/jesph.96120055.

[6] S. Kruljac, "Public-Private Partnerships in Solid Waste Management: Sustainable Development Strategies for Brazil," *Bull. Lat. Am. Res.*, 2012, doi: 10.1111/j.1470-9856.2011.00659.x.

[7] T. Farrelly, P. Schneider, and P. Stupples, "Trading in waste: Integrating sustainable development goals and environmental policies in trade negotiations toward enhanced solid waste management in Pacific Islands countries and territories," *Asia Pac. Viewp.*, 2016, doi: 10.1111/apv.12110.

[8] B. Samiha, "The importance of the 3R principle of municipal solid waste management for achieving sustainable development," *Mediterr. J. Soc. Sci.*, 2013, doi: 10.5901/mjss.2013.v4n3p129.

[9] M. A. Abas, "Understanding the Concept of Sustainable Development for Effective Solid Waste Management: Malaysia Perspective," *Open Access J. Waste Manag. Xenobiotics*, 2018, doi: 10.23880/oajwx-16000107.

[10] V. E. David, J. Wenchao, Y. John, and D. Mmereki, "Solid waste management in Monrovia, Liberia: Implications for sustainable development," *J. Solid Waste Technol. Manag.*, 2019, doi: 10.5276/JSWTM.2019.102.

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Introduction of Arrangement in Solid Waste Management

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ABSTRACT: ***The management of solid waste is essential to both public health and environmental sustainability. Solid waste management systems must be set up correctly in order to enable efficient garbage collection, disposal, and recycling. In order to reduce waste and save resources, this study intends to examine the significance of organization in solid waste management. It highlights important factors, such as infrastructure, logistics, community involvement, and legislative frameworks, in the planning of solid waste management systems. The study highlights the need for integrated strategies that include trash reduction tactics, effective collecting techniques, cutting-edge disposal technology, and recycling campaigns. Cities and communities may reduce environmental damage, advance circular economies, and nurture a healthier and more sustainable future by putting in place well-organized arrangements.***

KEYWORDS: ***Arrangement, Disposal, Management, Solid Waste Management, Sustainable.***

INTRODUCTION

The organization and coordination of numerous tasks and elements involved in solid waste management are referred to as arrangement. It entails creating a productive system that integrates trash collection, transportation, treatment, and disposal in an orderly and methodical way. Solid waste management plans aim to minimize harmful effects on the environment and public health while ensuring the efficient and sustainable processing of garbage [1]–[3].

The following elements are often included in the arrangement for solid waste management:

1. **Waste Collection:** rubbish collection is the activity of collecting rubbish from public, private, and industrial sites. This entails creating a collection schedule, routes, and techniques, such as curbside pickup, public drop-off places, or garbage containers at predetermined locations.

2. **Waste Transportation:** After being collected, trash has to be delivered to the proper facilities for treatment or disposal. In order to reduce trip distance and maximize fuel consumption, this entails managing a fleet of vehicles, such as trash trucks, and developing effective transportation routes.

3. **Waste Treatment:** The reduction of solid waste volume, resource recovery, and environmental impact are the primary goals of solid waste treatment. Recycling, composting, anaerobic digestion, and waste-to-energy conversion are all examples of treatment techniques. The agreement should call for the creation and management of suitable treatment facilities or collaborations with specialist institutions.

4. **Waste Disposal:** Proper disposal is required for trash that cannot be processed or reclaimed. This might include running sanitary landfills where garbage is securely handled and confined to avoid contaminating soil and water resources. The agreement should call for the construction of properly designed landfills and the use of waste disposal techniques that adhere to environmental rules.

5. **Monitoring and Enforcement:** To make sure that waste management techniques adhere to rules and standards, regular monitoring and enforcement measures are necessary. Inspections, audits, and enforcement actions against unethical waste management or dumping techniques may be part of this. The agreement should call for the creation of monitoring mechanisms and the participation of appropriate enforcement and oversight bodies.

6. **Public Awareness and Participation:** The effectiveness of solid waste management depends on including the public via awareness campaigns, educational initiatives, and community engagement. Initiatives to

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increase public knowledge of waste reduction, appropriate waste segregation, and ethical waste disposal procedures should be a part of the arrangement. Public involvement may aid in enhancing waste management practices and encouraging a feeling of community ownership and responsibility.

Coordination between several stakeholders, including government agencies, waste management authorities, private sector organizations, communities, and people, is necessary for effective solid waste management arrangements. Designing and executing an integrated waste management system that meets the unique demands and problems of the local region requires collaboration and cooperation among various stakeholders.

DISCUSSION

The following diagram shows 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 Furedy's investigations about the distinction between the players engaged in removing organic waste and inorganic waste flows from urban waterways. Figure 1 depicts many potential alliances in the management of municipal solid waste.

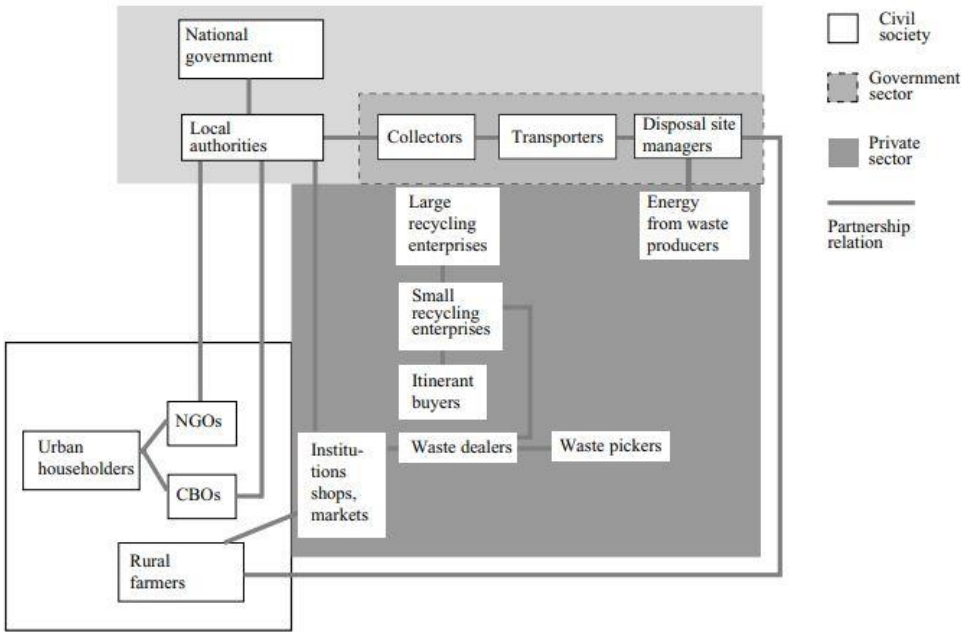

Figure 1: Several Possible Partnerships in Urban Solid Waste Management

1. 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. According to Rondinelli and Iacono (1996) and Burgess et al. (1997), governments must continue to uphold adequate standards, accomplish coordinated provision, foster competition, prevent monopolistic control of critical services by unaccountable private providers, and reduce corruption and unfairness. As a result, privatization of service provision often entails a kind of public-private partnership where the roles of both sides must be defined. Although private companies are hired to carry out services (see Dillinger, 1994), governments nevertheless have some control over the circumstances and standards that are imposed.

They minimize expenses, political involvement, bureaucracy, and coercion (SWM research by Bartone et al. (1991), Ali (1993), Fernandez (1993), Lee (1997), and Post (1999) are examples of studies in this area). Local government officials' roles drastically shift in these institutional configurations from implementing agency to

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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. Assessing the organizational and financial elements of such privatization projects is a second issue to consider [4]–[6].

Typically, governments outsource their SWM operations to big, 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 trash dealers and recycling businesses of any size are not included in privatization attempts. Local governments favor collaborating with established businesses. Strong contractual agreements are stressed, and unofficial enterprises and communities do not meet these requirements. Few governments have begun to include them in their strategies, despite the fact that their potential for trash separation and collection is becoming more widely recognized.

2. Private-private arrangements

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 labor contracts and working conditions, as well as the effects of government laws and regulations on private or community undertakings. These studies deal not only with (semi-) 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 research on the recovery, recycling, or reuse of items from municipal refuse. The value of waste recovery as a commodity was increasingly recognized during the 1990s, contributing to the ecological aspects of the sustainable development of SWM systems in addition to providing income to sizable groups of the urban poor. The effects of global commerce and the utilization of waste materials in manufacturing have also been explored. Cooperation between local governments 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.

The operations of garbage collectors, itinerant buyers, merchants, and small-scale recyclers of waste products are carried out in close cooperation and competition. They rely on one another for loans and informal social security systems, but this dependence also enables for "free rider" behavior to go unchecked. All of these operations take place in partly legal settings, with many businesses operating without registration or merely completing a portion of the registration procedure. Last but not least, impromptu private-private agreements come up during collection, transport, and disposal. These are mostly a response to the ineffectiveness of the public sector's offerings. They struggle with local authorities not taking notice of their actions, and they could also not adhere to accepted public norms for disposal and transportation.

3. Community-private and public sector-community arrangements

The literature has covered the function of NGOs and CBOs extensively, focusing mostly on initiatives that are started at the neighborhood level. Residents of a given region form community-based organizations to enhance local garbage collection (e.g., clean-up campaigns), and they may also incorporate composting in their activities to emphasize the "green" components of sustainable development. They often only engage in activities at the neighborhood level, which may reduce their influence. Outside NGOs often target socially disadvantaged target groups, such mothers and children picking up trash on the streets (, and focus their efforts on enhancing their socioeconomic capacities. This includes encouraging rubbish pickers to form co-operatives, offering housing and alternative training, and setting up savings plans. According to Furedy (1992) and Schenk, Bhuvaneswari, and Baud (1998, respectively), NGOs may also engage in more general activities aimed at increasing public awareness of sustainable development issues or contribute to the development of alternative technology to support recycling and composting activities in a decentralized manner. A well-known example of this kind of project is SEWA in India.

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Urban Services and Contributions to Sustainable Development: Making An Operational Framework

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 integrate ecological sustainability objectives with the concern for addressing present-day human needs. In order to achieve ecological sustainability, it is necessary to minimize the use of non-renewable resources, guarantee the regeneration of renewable resources, and ensure that the capacity of both local and global sinks is not surpassed. The initial model we used highlighted the relevant environmental challenges but gave no guidance on what precise institutional structures are required and how to meet those needs. 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. Making sure progress is made toward "sustainable consumption" is one of them, as is minimizing the transfer of environmental costs to city dwellers and the ecosystems that surround.

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 disparity between the proponents of the green and the brown agendas for improving the urban environment. The former place a greater emphasis on ecosystem health, the effects of cities on rural resources and neighboring 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 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 prioritize economic development at this time 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. By operationalizing the three overarching objectives of sustainable development ecological sustainability, socioeconomic equality, and enhancing environmental health we have connected the subject of solid waste management to that of sustainable development. The brown agenda often includes solid waste management, which mostly has local effects. The "localized nature" of the criteria we employed to examine the contributions to sustainable development of diverse SWM activities and partnerships, both at the level of actors and the urban system, reflects this [7]–[9].

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

i. Reduce the quantity of garbage produced;
ii. To increase recycling and reuse; and
iii. To dispose of any leftover garbage in a regulated manner to avoid filling up nearby sinks.

Reduced material intake, more effective material usage, and more closed-loop recycling are ways to minimize waste output. This objective may be achieved via production and consumption policies that are essentially the responsibility of the national government and the business sector. Whether or whether individuals, businesses, and institutions support this cause relies on how well-informed they are about the risks and rewards involved. Maximizing trash reuse and recycling may be done at two different levels: at the primary level, which occurs inside homes, businesses, and institutions; and at the secondary level, which occurs 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 since it's a key sign of a SWM system's effectiveness how much municipal garbage really makes it to the designated landfills and, therefore, how much gets dumped illegally and pollutes the city.

Last but not least, the method of final disposal in developing nations, mainly through crude dumping or sanitary landfills determines how much ecological sustainability and environmental health are harmed by contamination of surface and groundwater or soils by leakage, air pollution from waste burning, and disease transmission by various vectors The socio-economic factors included in the analysis of SWM systems cover both effects on

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particular players and systemic effects at the city level. Four standards are employed:

i. Financial feasibility and affordability for the concerned local governments, consumers, and/or businesses these may cause conflict amongst parties;
ii. Jobs that pay a decent wage and provide SWM employees a certain amount of employment stability;
iii. legitimacy from the viewpoints of the public (social) and the authorities (legal);
iv. Effective standards enforcement and monitoring.

An activity's capacity to continue ultimately hinges on its financial viability, or the certainty that revenues will continue to offset expenses. Authorities often have to tolerate a high level of subsidization because of the 'public benefit' character of SWM. However, the capacity of the authorities to pay for proper service (via their own income or grants) and the political will to do so are what determine the system's financial viability. The concept of allocative efficiency indicates the extent to which charges cover the cost of the service. However, if the charges are too high, residents may choose not to use the service or may engage in free-rider behavior. Contributions from residents can help make waste collection more financially viable. 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 labor productivity and expenses per ton.

One of the most important aspects of our evaluation is the impact SWM brings to meaningful 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 criteria, we may discern between the legal situation and societal perceptions. A partnership's legal status may have benefits access to financing and facilities; lack of harassment; but, it may also have drawbacks costs of formalization. Social legitimacy is the public's acceptance of something. The fourth criterion attempts to ascertain if systems are established to monitor performances in all three dimensions and whether punishments are used in the event that agreed-upon norms, such as output objectives, health standards, labor regulations, and environmental rules are broken.

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

i. Increased efficiency in creating a pristine urban environment;
ii. Reduce risks to employees' occupational health in SWM;
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 community 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 toxic waste components, and may be reduced by using the proper safety equipment. Finally, when trash is used in peri-urban agriculture, whether it be organic waste that has been decomposed or composted, or mixed garbage, potential negative effects on animal health, soil quality, and food crop quality must also be taken into account [10]–[12].

Several key aspects:

An arrangement in the context of solid waste management refers to the structuring and organization of different parts and activities involved in managing solid waste. In order to achieve effective and efficient waste management methods, it entails coordination of many stakeholders, resources, and processes. The arrangement in solid waste management includes the following crucial elements:

1. **Collection Systems:** This entails the development and execution of procedures for the collection of solid trash from private residences, public buildings, and commercial establishments. It involves choosing the best collection strategies, such as curbside pickup, drop-off locations, or container-based systems, as well as collection schedules and routes.
2. **Transfer and Transportation:** Waste must be transferred from collection locations to transfer stations or disposal facilities after it has been collected. Making plans for the effective transfer of

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garbage using appropriate vehicles and transportation techniques is necessary, taking into account variables including distance, volume, and safety standards.

3. **Treatment and processing facilities**: To decrease its volume, recover resources, or lessen its negative effects on the environment, solid waste often has to be treated or processed. Depending on the waste composition and local laws, plans are established for the construction and operation of facilities such recycling plants, composting facilities, waste-to-energy plants, or specialized treatment centers.
4. **Disposal Sites:** Plans must be developed for the ultimate disposal of trash that cannot be successfully processed or repurposed. This involves selecting suitable landfill sites or other disposal facilities, designing them appropriately, and managing them while adhering to environmental standards and reducing any possible risks to the environment and public health.
5. **Regulatory Framework:** Establishing rules, standards, and guidelines to control waste management practices is a crucial component of waste management systems. This entails establishing roles and duties for different stakeholders, permitting procedures, and enforcement mechanisms, as well as standards for waste management, treatment, and disposal.
6. **Financial and Institutional Arrangements:** In order to control and manage waste management operations, sustainable solid waste management has to be adequately funded. The establishment of financial sources, cost recovery procedures, institutional frameworks, and the participation of public or private organizations in waste management activities are some examples of arrangements.

In order to guarantee that solid waste is handled, treated, and disposed of in a way that is effective, ecologically sound, and socially responsible, solid waste management arrangements require the strategic planning, organization, and execution of several components.

CONCLUSION

Solid waste management depends heavily on organization, and efficient waste reduction, resource conservation, and environmental sustainability depend on well-organized systems. For the establishment of trash collection locations, treatment facilities, and disposal sites, infrastructure planning and development are essential. Logistics that are effective provide prompt and correct garbage collection, reducing the chance of contamination and health risks. In order to encourage recycling and promote proper trash disposal methods, community involvement and public awareness initiatives are required. Regulations must be upheld, trash minimization must be encouraged, and recycling programs must be supported. Cities and communities may improve their waste management systems, decrease landfill trash, save resources, and support the growth of circular economies by establishing integrated arrangements that take these factors into account. For a cleaner and healthier future, it is crucial that stakeholders work together and invest in sustainable solutions to the mounting problems with solid waste management.

REFERENCES:

[1] R. C. Ancog, N. D. Archival, and C. M. Rebancos, “Institutional arrangements for solid waste management in Cebu City, Philippines,” *J. Environ. Sci. Manag.*, 2012.

[2] E. Pinheiro and A. C. de Francisco, “Management and characterization of textile solid waste in a local productive arrangement,” *Fibres Text. East. Eur.*, 2016, doi: 10.5604/12303666.1201128.

[3] E. S. Siagian, A. Sumaryana, I. Widianingsih, and H. Nurasa, “Public-private partnerships in solid waste management: arrangements in Indonesia,” *Asia Pacific J. Public Adm.*, 2019, doi: 10.1080/23276665.2019.1592845.

[4] S. Towolioe, A. S. Permana, N. A. Aziz, C. S. Ho, and D. G. Pampanga, “The Rukun Warga-based 3Rs and waste bank as sustainable solid waste management strategy,” *Plan. Malaysia*, 2016, doi: 10.21837/pmjournal.v14.i4.157.

[5] S. D. Joardar, “Urban residential solid waste management in india: Issues Related to Institutional Arrangements,” *Public Work. Manag. Policy*, 2000, doi: 10.1177/1087724X0044006.

[6] A. B. N. and A. MUSTAPHA, “INSTITUTIONAL CONSTRAINTS TO MUNICIPAL SOLID WASTE MANAGEMENT IN KANO METROPOLIS, NIGERIA,” *IInternational J. Innov. Environ. Stud. Res.*, 2015.

ISSN (Online) 2456-1290

International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)

Vol 9, Issue 6S, June 2022

[7] WaterAid, "Solid Waste Management Arrangements and its Challenges in Kampala: A case Study of Bwaise II Parish, Kawempe Division, October 2011," *Brief. Pap.*, 2011.

[8] R. Yeboah and D. Odoom, "Examining the Institutional Arrangements Regarding Public Private Partnership in Solid Waste Management in Ghana: From the Perspective of Sunyani Municipality," *Int. J. Manag. Soc. Sci.*, 2018.

[9] A. A. Moruf, F. K. Oluwasinaayomi, and O. L. Mubarak, "Public-Private Partnership (PPP) in residential solid waste management in Ibadan: Challenges and opportunities," *J. Geogr. Reg. Plan.*, 2020, doi: 10.5897/jgrp2019.0721.

[10] A. D. Ablo and E. E. Yekple, "Urban water stress and poor sanitation in Ghana: perception and experiences of residents in the Ashaiman Municipality," *GeoJournal*, 2018, doi: 10.1007/s10708-017-9787-6.

[11] A. Nandan, B. P. Yadav, S. Baksi, and D. Bose, "Recent Scenario of Solid Waste Management in India," *WSN World Sci. News*, 2017.

[12] R. Martins and C. V. B. Martins, "Arrangements for urban solid waste dimensions management among cities consortia," *Rev. Bras. Gest. e Desenvolv. Reg.*, 2015.

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Evolving Partnerships in the Collection of Urban Solid Waste in the Developing World

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ABSTRACT: ***The fast urbanization and population increase in the developing nations makes managing urban solid waste a considerable concern. This chapter intends to investigate the main problems and possible remedies surrounding urban solid waste in emerging nations. It examines the root causes and effects of poor waste management techniques, focusing on the effects on the environment, society, and health. The research also looks at different technologies and tactics that may be used to further sustainable development and waste management. Policymakers, communities, and stakeholders may collaborate to build cleaner, healthier, and more livable urban environments by tackling this urgent problem. In the end, strengthening public health, protecting natural resources, and promoting sustainable urban development depend on developing countries' ability to manage their urban solid waste better. To produce cleaner, healthier, and more resilient communities, a comprehensive strategy integrating technical breakthroughs, community involvement, and legislative interventions is needed.***

KEYWORDS: ***Environmental, Health, Sustainable Development, Urban Solid Waste, Waste Management.***

INTRODUCTION

The primary 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 labor 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 neighborhoods. Different privatization strategies are then recommended in order to improve service effectiveness and efficiency. Evaluation of the organizational and financial elements of privatization projects, as well as the ability of government agencies and private contractors to carry out their new responsibilities, are the main areas of concern [1]–[3].

Although the general discussion of urban (environmental) management and urban sustainable development in the context of the developing world will serve as the starting point for this chapter, it will concentrate on the implications for policies and interventions related to the collection (partially including transportation and disposal) of urban solid waste, ignoring those for the other domains within the solid waste management system (see chapters 6 and 9). The research acknowledges the presence of several institutional arrangements in solid waste collection and begins from a multi-actor approach. Such 'partnerships' have previously been defined in terms of their core elements in chapter.

The focus of the conversation will mostly be on the privatization of solid waste collection, particularly on the recent rise in prominence of agreements between municipal governments and private garbage collection businesses. However, criticism will be leveled 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. Additionally, it must be noted right away that global processes, such as the promotion of privatization policies, result in various effects depending on the context. The case material discussed in the following chapters makes this point very clearly. Actually, local networks of political and social interactions have a significant impact on policies and interventions. They influence the socioeconomic and environmental effects as well as the shape the privatization exercise takes. Because it aids in understanding the

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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 main problem was getting things organized in line with free market principles since cities were once again recognized as engines of progress. Urban management, which quickly became popular, was largely intended to set up an adequate division of tasks and responsibilities between public and private actors (both commercial and social), so that each could focus on what they are said to be best at. 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 pressed to implement policies that will shrink their civil services, decentralize administrative authority, boost public participation, and improve the effectiveness, accountability, and transparency of their government operations.

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 made an effort to reclaim some of this credibility by implementing decentralization, democracy, and participation initiatives. The promotion of enablement may be considered as an imperfect effort to carry prior theories about self-help housing, community-based settlement upgrading, and informal sector promotion to their logical end. The whole system of institutions, laws, practices, and attitudes must be designed to operate with these concepts. To achieve successful enabling, democratic and participatory government institutions must be established [4]–[6].

So, throughout Africa, Asia, and Latin America, both internal and foreign influences have changed the context for urban development. It is not required to linger on the definition and characteristics of urban management or to critically analyze its ideological foundations for the objectives of the present study. It will do to briefly discuss the (local) government's emerging new position before focusing on the privatization discussion. But first, let's talk about how concepts for urban management relate to the discussion of sustainable development. Throughout the 1980s, the South's interest for urban sustainable development grew. 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 up a lot of natural resources and can put local and regional sinks at risk of overflow. We sought to adopt a stance within this framework of competing objectives. As previously stated, we will use a methodology that builds on the Brundtland study and was later developed, among others, at the IIED by David Satterthwaite.

It aims to blend the concern for human needs with the objectives of environmental elements of sustainable development. 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 its capacity to provide employment and reduce poverty, the environmental aspect particularly the sustainable use of renewable resources, minimization of the use of non-renewable resources, and appropriate physical planning, 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 program. The realization that urban sustainable development, including sustainable methods of collecting and disposing of urban solid waste, requires 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.

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DISCUSSION

In the developing world, the process of collecting and eliminating garbage produced in urban areas of nations with developing economies or weak infrastructure is referred to as "collection of urban solid waste." Many developing nations have major difficulties in successfully managing their solid waste because of the fast urbanization and population increase. The collecting phase, which is an essential part of the total waste management system, comprises numerous vital elements, including:

Waste Collection Infrastructure: Developing nations may have little infrastructure for collecting waste. This includes the accessibility of the tools, equipment, and trucks required for effective garbage collection. Waste collection services that are sporadic or insufficient might be caused by inadequate infrastructure.

Collection Techniques: Various collection techniques are used based on the degree of urbanization, the resources at hand, and the local circumstances. One of the most popular methods is manual collection, in which garbage pickers or unofficial laborers physically gather trash from residences or specified collection locations. There are times when it is necessary to use mechanical collection systems with garbage collecting trucks and containers.

Collection Frequency: The frequency of garbage collection is dependent on a number of variables, including population density, waste creation rates, and the availability of resources. Daily or frequent collection may be required in heavily inhabited areas, although collection may take place less often in less populated areas.

Waste Segregation: To enable efficient waste management, waste segregation at the source is a crucial step. rubbish pickers or unofficial employees sort rubbish during collection in certain underdeveloped nations to separate recyclables from non-recyclable waste. This method improves resource recovery while lowering the amount of garbage that is disposed of.

Inclusion of Informal Sector: The informal sector contributes significantly to rubbish collection in many developing nations. Informal garbage collectors and recyclers often work alone, removing trash from homes, streets, or landfills. Enhancing waste management procedures, creating chances for employment, and increasing the effectiveness of garbage collection may all be accomplished by integrating and formalizing the operations of the informal sector.

Public Awareness and Participation: Public Education on correct garbage Disposal methods and Active Public Participation in Waste Separation and Collection Initiatives: These factors may greatly enhance the efficacy of garbage collection systems by educating the public about correct waste disposal methods. Campaigns for proper trash management, community involvement efforts, and educational programs all support this cause.

Urban solid waste collection in underdeveloped countries has difficulties due to a lack of funding, poor infrastructure, institutional capacity issues, and the need for efficient stakeholder cooperation. The integration of the official and informal waste management sectors, as well as investments in infrastructure development, capacity building, and technology adoption are all crucial for addressing these issues. The application of sustainable waste management methods, information exchange, and cooperation with international organizations may all help to enhance garbage collecting systems in developing countries.

Unfortunately, environment and development have not made for a particularly happy marriage. An ecological vision is fundamentally at conflict with the utilitarian and exploitative worldview that is front and center in the views of the majority of modern governments and development organizations. Academics, policy-makers, and activists often neglect the interdependence between the economic, social, political, and ecological systems and focus primarily 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. Environmental policies should reflect developing countries' interests and, more importantly, should not obstruct their legitimate efforts to grow their economies, as has been made abundantly apparent by these nations. Their efforts to shift the environmental focus away from the main environmental concerns of the northern hemisphere, such as greenhouse gas emissions, natural resource depletion, biodiversity preservation, and resource management, and toward issues on the so-called "brown agenda," such as ways to mitigate the health and efficiency effects of air and water pollution and to improve basic infrastructural services, particularly safe drinking water, reflect this position. These objectives are, in part, the 'traditional' concerns of (urban) administrators who are concerned with the fundamental needs of their inhabitants [7]–[9].

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Urban poor people are disproportionately affected by the consequences of a degraded urban environment, which has a considerable detrimental impact on urban production and efficiency as well as public health. 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 costs and involving the private sector in service delivery were two of the main recommendations.

Urban management and urban sustainable development discourses converge here since they are both based on the same (neo-liberal) policy changes. In reality, urban environmental management as it is now done across the majority of the developing world is barely more than a valiant 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 sporadic success stories of municipal governments successfully reducing their environmental problems Curitiba and Porte Alegre in Brazil are well-known examples this is the exception rather than the norm. The marginal status of environmental concerns, especially those related to ecological sustainability, is shown by the majority of descriptions of urban environmental management.

The latter may have been neglected since local governments often have little control over laws pertaining to environmental elements of sustainable development 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. There is a conflict between the desire for liberalization and deregulation to enable private operators to lead urban growth and the necessity for (government) control and regulation of the private sector to successfully halt environmental deterioration, which cannot be denied. 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.

Underused Resources

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 effectiveness and efficiency drives transformation in this area. The former is primarily economic, resulting in cost savings by producing more output from a given input of resources, while the latter is concerned with the quality and coverage of services, stemming from a desire to improve the general state of public health a concern that has always ranked highly 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 reality, the discussion around sustainable development has little to no impact on opinions and policies about privatization and joint ventures in the collection and disposal of solid waste. Second, 'unofficial' activities by informal businesses and/or community-based organizations, often with the assistance of NGOs, have received very little consideration in the drafting of new rules for solid waste collection and disposal. Long before privatization strategies gained popularity, various types of 'unplanned' privatization often emerged in

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underserved urban areas (Baud, 2000). City administrations frequently ignore what has already been established on the ground because of the implicit bias in official policies toward large-scale solutions and formal businesses, and as a result, they are unaware of the contributions that these practices can (and frequently do) make to sustainable development. The literature on solid waste collection and disposal in developing nations mainly misses connections with the other two primary fields in solid waste management, the reuse and recycling of inorganic waste and the reuse of (composted) organic waste matter, which is a third, closely linked observation. 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 [10], [11].

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. Even while there are many players and actions that may be recognized, each with their own justification, official policy often concentrates on a single technique. 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 businesses and community-based organizations (CBOs) have previously shown their usefulness in a number of areas, including the supply and upgrading of shelter, government organizations are often hesitant to form agreements with them (UNCHS, 1996). The majority of administrators and officials believe that the inclusion of such small-scale (sometimes informal, but not always) or community activities is in conflict 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. Additionally, the majority of local governments are unable to cover the transaction expenses associated with working with so many small businesses and community organizations. In line with new theories on urban management and local governance that acknowledge the potential of these actors as well as the value of working with them, the predominately negative viewpoints are starting to give way to a more positive outlook only very slowly (Anschütz, 1996; Haan et al., 1998; Baud, 2000).

According to various research, micro and small businesses (MSEs) are capable of providing high-quality garbage collection services. Their benefits include cost savings due to the use of more cost-effective technologies like handcarts and donkey carts, lower wages even if it sometimes results in severe underpayment of workers, higher flexibility, a stronger sense of commitment to the job, stronger ties to the community, and competition among MSEs (Haan et al., 1998: 12-6). According to ibid. "tasks 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 handled by these businesses. Sweeping and basic rubbish collection meet this criteria. These services might also be planned by a group of people working together (cooperatives, community-based organizations). 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 reliance on the abilities and commitment of volunteers, as well as the absence of a businesslike approach to service delivery, are weaknesses that may jeopardize the initiative's long-term viability (Anschütz, 1996). These "hidden" potentials are incorporated in the present research, and its contributions to sustainable development are evaluated. Public sector organizations are no longer solely responsible for the collection, transportation, and disposal of urban solid waste. Numerous new alliances have developed, either directly from the (local) government or "spontaneously" in the (business or non-commercial) private sector. There are now many cities in emerging nations that show the presence of pluralistic service delivery systems [12], [13]. This system's appearance, functionality, and coordination are heavily influenced by the sociocultural setting.

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CONCLUSION

Urban solid waste management in developing countries is a complex issue that calls for all-encompassing and long-lasting solutions. Poor waste management techniques lead to serious environmental deterioration, threats to the public's health, and social injustices. However, it is feasible to change waste management systems and accomplish sustainable development objectives by putting the right policies and technology into place. The main goals of efficient waste management should be to minimize trash creation, encourage recycling and composting, and put in place effective collection and disposal methods. Success also depends on educating the public and integrating local communities in trash management programs. More sustainable waste management techniques may also be achieved by using cutting-edge technology like waste-to-energy conversion and decentralized waste management systems. To solve the financial, infrastructural, and institutional issues related to urban solid waste management, cooperation between governments, communities, the corporate sector, and international organizations is also crucial. Stakeholders may create financing sources, rules, and policies to assist the development of effective waste management systems by cooperating.

REFERENCES:

[1] S. ElSaid and E. H. Aghezzaf, "A progress indicator-based assessment guide for integrated municipal solid-waste management systems," *J. Mater. Cycles Waste Manag.*, 2018, doi: 10.1007/s10163-017-0647-8.

[2] A. K. Nartey and P. Nyarko, "Solid Waste Management Practices in Ghana: Challenges and Prospects," *African J. Curr. Med. Res.*, 2020, doi: 10.31191/afrijcmr.v4i1.45.

[3] D. G. l. Parvathamma, "An Analytical Study on Problems and Policies of Solid Waste Management in India –Special Reference to Bangalore City," *IOSR J. Environ. Sci. Toxicol. Food Technol.*, 2014, doi: 10.9790/2402-081010615.

[4] F. A. S. Islam, "Solid Waste Management System in Dhaka City of Bangladesh," *J. Mod. Sci. Technol.*, 2016.

[5] S. M. Kassim and M. Ali, "Solid waste collection by the private sector: Households' perspective-Findings from a study in Dar es Salaam city, Tanzania," *Habitat Int.*, 2006, doi: 10.1016/j.habitatint.2005.09.003.

[6] A. AKTHER, T. AHAMED, T. TAKIGAWA, and R. NOGUCHI, "GIS-based Multi-criteria Analysis for Urban Waste Management," *J. Japan Inst. Energy*, 2016, doi: 10.3775/jie.95.457.

[7] J. Cavé, "Who owns urban waste? Appropriation conflicts in emerging countries," *Waste Manag. Res.*, 2014, doi: 10.1177/0734242X14540978.

[8] H. A. Aziz and S. Abu Amr, "Introduction to solid waste and its management," *Waste Management: Concepts, Methodologies, Tools, and Applications*. 2019. doi: 10.4018/978-1-7998-1210-4.ch001.

[9] S. J. Cointreau, "Environmental management of urban solid wastes in developing countries : a project guide," *Urban Dev. Tech. Pap. 5*, 1982.

[10] Sourabh Manuja, "An Audit of Municipal Solid Waste Management System in Selected Wards of Varanasi - A Case Study," *Int. J. Eng. Res.*, 2020, doi: 10.17577/ijertv9is050541.

[11] R. K. Kazungu, "Improving Governance for Sustainable Waste Management in Nairobi," *46th ISOCARP Congr.*, 2010.

[12] I. M. R. Gidde and V. V. T. K. K. Kokate, "Municipal Solid Waste Management in Emerging Mega Cities : A case study of Pune City," *Indo Ital. Conf. Green Clean Environ.*, 2008.

[13] C. Zurbrügg, S. Drescher, I. Rytz, A. H. M. M. Sinha, and I. Enayetullah, "Decentralised composting in Bangladesh, a win-win situation for all stakeholders," *Resour. Conserv. Recycl.*, 2005, doi: 10.1016/j.resconrec.2004.06.005.

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Decentralisation and Its Limits

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ABSTRACT: ***The idea of decentralization has drawn a lot of interest in a number of fields, including politics, finance, and technology. Power, responsibility, and decision-making are transferred from central authorities to local or scattered institutions. This study examines the idea of decentralization and its limitations, examining the advantages and difficulties it presents in various situations. This study explores the possible benefits and constraints of decentralization by looking at case examples and previous research. Decentralized systems must be implemented well in order to be sustainable over the long term. This requires an understanding of the constraints of decentralization. A more sophisticated strategy may be offered by hybrid models that mix aspects of centralization and decentralization. Decentralization-related problems may also be addressed by putting in place clear accountability systems, investing in infrastructure, and using technology breakthroughs.***

KEYWORDS: ***Decentralization, Government, Political, Private Sector.***

INTRODUCTION

Not so much because privatization is one of the modes of decentralization that it requires attention, but rather because it places new, fundamentally distinct demands on local governments in particular. They need to be empowered in order to meet these new expectations, and decentralization is intended to do this. Decentralization is the process of giving lower levels of government or the private sector control over planning, management, and resource agency. 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" type 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 institution, other than the central 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 [1]–[3].

The neo-liberal doctrine's ascent to popularity and the fall of state-communism furthered the argument for decentralization. Decentralization was seen as essential to the goal of reversing the state's expansion and building a lean, effective style of government that would make the most use of community and private sector potentials. It became more closely linked to the pursuit of "good governance," which came to be understood within a liberal-democratic framework as greater accountability better opportunities for participation and subjecting public officials to popular control, transparency (i.e. a clear demarcation of tasks and responsibilities and more insight into the allocation of resources), and responsiveness (i.e. acknowledging the diversity of needs among the population in terms of policy responses). Decentralization is anticipated to result in more effective, practical, and locally tailored development initiatives by putting government closer to the people. It will aid in mobilizing important local energy and resources and boost production as a resul. Finally, in an age of globalization when the nation state's function as a policing or mediating power is waning and local governments are attempting to adapt to the restructuring of the global economy, devolution was increasingly seen as essential. Local governments need to be given more authority in order to take full use of their unique geographic advantages and compete with other regions across the globe.

Although there is no doubt that the overall political and economic environment is in favor of decentralization, 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

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groups, but it can also serve to promote local corruption and patronage networks or to further entrench the authority of the central government. Decentralization may also result in increased regional inequalities due to the uneven distribution of institutional capabilities and competitive advantages, even while it can reduce the gap between the state and civil society. Finally, it is still not quite obvious how decentralized administration 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, at the same time, it may very likely result in a decrease in the poor's access to urban property and may even, as a consequence of more forceful and systematic application of laws and restrictions, limit the flexibility of informal businesses. 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.

Decentralization is being debated as a potential regulatory improvement for the majority of emerging nations. The majority of these nations, according to Schuurman, have never undergone a change to the Fordist regime of accumulation (mass production) and the corresponding welfarist style of social control. Because current Post-Fordist neo-liberal reasoning supports this prescription for the North, it is thus premature to hollow down the state in Third World nations. However, despite these factors, decentralization plans have been adopted widely across the developing world. In reality, the decentralization concept was vigorously pushed by significant contributors as well as by members of civil society. Governments' political commitment to reforms that undermine their authority, however, often falls short of expectations. As a result, decentralization policies are difficult to implement and move much more slowly than expected. These challenges include the slow reorganization of central ministries, the creation of new processes, and the obstruction of the transfer of fiscal authority, among others. 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 fulfill their obligations under an agreement. Negative experiences may even inspire recentralization policies, as was the case in Accra (Ghana), where the central government stepped in and took control of local authorities after they failed to appropriately manage the issue of solid trash collection [4]–[6].

DISCUSSION

Privatizing the Collection of Urban Solid Waste

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 the chance now that market principles have been (re-)installed in the majority of national economies. According to the literature, the private sector has advantages over public sector industry, including political independence, economic sanity, efficiency, dynamism, and innovation. It would be incredibly foolish to assume that these positive impacts of privatization would continue. First off, the empirical evidence for privatization's effectiveness is still fairly few and mostly based on Western experiences. Additionally, the claim is somewhat supported by circumstantial evidence. Since many public sector initiatives have a bad track record, suggestions to move in the other direction are immediately made, 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 resistance. For instance, there is a serious risk that privatization would result in a net loss of jobs and that working conditions in the private sector will be subpar compared to those in the public sector. Additionally, throughout time, intricate webs of advantageous ties have developed between governmental officials and private interests. 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 broken down, which will undermine the presumed economic benefits of privatization.

Last but not least, privatization based on the ability-to-pay premise is likely to exclude those who are not in high demand. Similar to this, detractors worry that private businesses may cut

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out unprofitable services 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 minimize 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 goods, 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.

First, each kind of privatization contracting, concession, franchise, and open competition has a unique set of both good and bad effects on the many stakeholders. The two approaches used in garbage collecting the most often are franchising and contracting. In reality, there are instances where businesses are reluctant to operate under a franchise due to high default rates (related to widespread poverty, a lack of concern for public cleanliness, and the inability to penalize free riders by excluding them from service), as well as instances where the private sector is unwilling to work with the government under contract, typically because of expected risks of non-payment or delays in payment. 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. This kind of privatization functions best when contract terms are not too short and when the bidding process and contract requirements promote competition and cost efficiency. Private operators are more likely to invest in suitable (cost-saving) equipment the longer the contract's life, since this gives their capital investments time to depreciate. Long-term agreements also lower transaction costs and limit potential for political interference and corruption. There is also a risk that contracts do not sufficiently account for local variations in circumstances, such as the distinction between planned and unplanned areas, if contract specifications are overly detailed, for example, not only on performance standards, but also on working methods, equipment, labor input, etc., and control is too tight [7]–[9].

Many proponents of privatization are undoubtedly in favor 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 approach will only be effective, however, if protections are included to guarantee that the privatized operation is both secure and sufficiently alluring (ibid: 27). 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, unlike the former, which are typically under the jurisdiction of central government agencies and whose performance can be measured in strictly financial-economic terms. Solid waste collection raises issues of public interest and acceptability, suggesting that privatization often needs "the guiding hand of the state" to be successful. To guarantee that private garbage collectors are following environmental or health norms, for instance, the authorities will need to set up sufficient monitoring.

This managerial position is not only highly difficult and demanding, but also quite expensive. Studies on the privatization of waste collection frequently draw the conclusion that services are provided more effectively than by municipal departments, but they frequently overlook the additional expenses incurred by the authorities for contract management and performance monitoring, not to mention factors like the acquisition of land for disposal or transfer sites. Furthermore, it is frequently necessary for the government to remain actively involved in service delivery, particularly when the (commercial) private sector is only interested in serving 'profitable' high-income and easily accessible areas. This is because the

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commercial private sector only cares about serving 'profitable' high-income and accessible areas. In the event of a franchise, the local government grants a private company the authority and duty to provide garbage collection services to clients within a certain zone. The owner is permitted to set a predetermined price for each family or property in order to pay his costs and generate a modest profit.

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 accepted division of public services ranges from purely public goods also known as collective goods that are consumed collectively and for which it is difficult to exclude people who do not pay police, fire brigade to purely private goods that can be consumed by individuals and from which people who cannot or do not want to pay for them can be easily excluded. Concessions and contracts are the best ways for the private sector to participate in collective goods. But for public products that may also be viewed as private commodities, free competition is the best choice. 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 tariffs based on full cost recovery may encourage many (poor) families to participate in free riding or to refuse the service with negative implications on the general public's health. Therefore, municipal governments in many developing nations will be forced to continue allocating a significant portion of their resources to garbage collection services, and they may even be obligated to continue being directly engaged in their management.

Policy context

More consideration should be given to the fourth dimension, the policy environment. The preferred type of public-private arrangement (more or less control by the government), the perception of privatization (favorable or unfavorable), and the conditions that need the most attention (managerial capacities, limitation of investment risks, community participation, etc.) are all largely determined by the specific structure of political-economic forces and cultural attitudes. The privatization process develops relatively slowly in most low-income nations, despite significant rhetorical support. 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 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.

1. India

Since independence, India's route to development has been mostly state-directed and has placed a significant emphasis on fast industrialization (via import substitution and with a focus on heavy industries). 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% yearly throughout the second half of the 1990s, opponents assert that the New Economic Policy's effects have been underwhelming, particularly in a social sense. They highlight how (national) institutions and politics have a negative influence. 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. According to Drèze and Sen, the language of "equity" has often been used to justify governmental interference, but this has simply served to expand the bureaucracy's authority to regulate economic activities, hand out favors, or create obstacles. The impoverished Indians who were supposed to benefit from such action received nothing from it, whilst those with strong access to the bureaucracy profited well.

The review of the challenges and potential outcomes of privatizing solid waste collection services in the nation's towns and cities reflects the uniqueness of recent growth in India. It goes without saying that there was a lot of resistance to

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outsourcing this duty. The bureaucracy was primarily opposed because it believed that government authority was being reduced. Many of its leaders insist that the only way to ensure equal service is through the public sector. This explains why, despite indications of significant cost savings, solid waste management duties have only been privatized on a small scale to yet. However, it seems as if there has been greater success in recent years in putting private sector involvement ideas into action. This is because municipalities are not permitted to hire more workers even while their service duties expand to accommodate growing populations and geographic areas. The idea of broader participation of informal actors and community-based organizations in service delivery has not yet advanced much beyond the stage of experiments, which is also explained by the inheritance of state-led development and the power of officials with a traditional "law and order" mentality.

To some degree, the firmly ingrained notion that the state should run and oversee all public activities may prove to be advantageous since, in the opinion of many analysts, the success of privatization rests on the local government's provision of a suitable framework. Local governments must, however, have the resources and administrative capabilities to carry this out. In reality, the Seventy-fourth Constitutional Amendment of 1992 still governs the devolution of functional and budgetary authority to local organizations. Critics assert, for instance, that progress has been made in terms of 'democratic' improvements in the organization of local administrative units, but that these improvements are not commensurate with a clearly mandated functional agenda that will enable them to function as units of self-government. Decentralization is undoubtedly a difficult endeavor that won't provide results right away [10], [11].

The persistent reliance of local organizations on financing from the federal and state governments represents a significant barrier. Few efforts have been made to link money and functions, and decisions regarding the allocation of fiscal resources between the State governments and the municipality tend to be fairly arbitrary the majority of significant income still went to the States. In reality, many States have quite distinct methods, which may partially be ascribed to their individuality but also reflects the absence of central supervision. The majority of local authorities, particularly the smaller ones, nevertheless lack the institutional and personnel resources needed to carry out their new duties. Greater autonomy is significantly hampered by the ineffectiveness of the municipal tax imposition and collection system. Last but not least, the State governments continue to do a number of tasks that are the responsibility of local entities, which causes confusion and conflicts of authority. This is particularly problematic in large metropolitan areas, like Hyderabad, where municipal governments and metropolitan corporations fiercely defend their respective spheres of influence while the local state or federal governments simultaneously try to exert control.

Solid waste management is hampered by the decentralisation exercise's flaws. Municipalities sacrifice their own discretionary authority to rely on regional or central state levels to pay for investments in landfills, composting businesses, or incinerator facilities. They may need to make a formal request to the State government to guarantee payment to private companies who collect municipal solid garbage. This interferes with long-term planning and effective service delivery by introducing political issues into the talks that are beyond the purview of local politics. Additionally, contract managers, performance monitors, information campaigners, and public health inspectors must work closely together and in concert to meet the notion of tight oversight inherent in contracting out public services. The majority of metropolitan governments are not really equipped to handle all of this in a suitable manner. Therefore, in the research of privatized garbage collection services in Indian cities, incidents of contractors disobeying contract clauses, engaging in unscrupulous behavior, managing complaints improperly, and maintaining subpar working conditions keep cropping up.

2. Kenya

The three main objectives of Kenya's long-term development strategy have been to Africanize the economy, accelerate industrialization, and weaken the influence of the foreign capitalist class that dominated a sizable portion of the post-independence economy. The government got actively engaged in directing the economy in the desired direction, and the government executive, particularly the president and the cabinet, was granted significant regulatory powers. Actually, until the 1980s, the nation's favorable resource endowment enabled a reasonably solid economic performance. The economy, however, began to rapidly decline in the early 1990s as a result of both internal and foreign problems global recession, Gulf War, inadequate rainfall. It pushed the

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Kenyan government into the Bretton Woods institutions' hands, where they were forced to implement a structural adjustment program. The economy was anticipated to be revived by the well-known combination of market deregulation and liberalization, privatization of parastatals, and decrease of government expenditure. However, despite some hints of improvement, the performance as a whole was poor.

The idiosyncrasies of Kenya's political structure are primarily to blame for the country's economic issues. State power is the primary concern of politics due to the state's strong hold on the economy and position as the primary provider of resources. The deeply ingrained system of patronage and corruption has been effectively utilised by the KANU administration of president Arap Moi to forge an alliance of minority ethnic elites that serves as its basis of power. However, the present political system is very shaky. Along with continued struggle between pro- and anti-reform factions within KANU, there are continual conflicts between the government and opposing organizations that sometimes result in outbreaks of ethnic violence. The public's increasing outrage over the unequal distribution of basic services, the escalating political repression, and the administration's inability to stem the economic tide all pose a danger to the legitimacy of the government. Therefore, forces of change that aim to further democratize society and downplay the significance of ethnicity are slowly gaining traction.

The Kenyan government is infamous for being both unaccountable and insensitive to the demands of the vast majority of its population. It seems sense that the majority of state officials are hesitant to enact changes that would jeopardize current advantages. One example is the lack of commitment to the notion of reducing the state's direct engagement in commercial endeavors and service delivery, which is one of the objectives of Kenya's National Development Plan. There is tension and mistrust in the relationships between the Kenyan government and civic society. Since the 1980s, NGOs and people's organizations have increasingly complemented the dwindling governmental funding for essential services. The state, however, is uneasy about this growth and has tried to exert control over these organizations from above by subjecting them to the system of political patronage.

When it comes to solid waste collection, the majority of local governments lack explicit policy in this area, and genuine support for the notion is generally limited to the odd trial (UNCHS, 1998). Nevertheless, a great number of small and big businesses have emerged in an effort to fill the void created by the subpar operation of the majority of state cleaning agencies. They are serving the requirements of upper- and middle-class populations who can afford to pay market pricing. However, there is no institutional or legal oversight of this spontaneous privatization. Similar to this, garbage disposal in low-income communities, particularly slums and squatter settlements, relies in significant part on volunteer efforts to burn it or deliver it to the closest official collection station.

The seeming indifference of local governments to the service requirements of their (poor) residents is related, in part, to their weak and inferior status within the administrative structure. Kenya is one of a rapidly dwindling number of developing nations that have not yet taken the path toward decentralization seriously. Local councils still need government approval for the majority of their actions. Furthermore, the province administration's persistent meddling via state-appointed district commissioners, district officers, and chiefs who are essentially loyal to the president and the party gravely undermines the discretionary authority of local authorities. In terms of local financing, Kenya currently lacks a system of centralized grants or income sharing, which is unusual from a global standpoint. Local governments nearly solely depend on land rates, service fees, and licensing fees to fund their operations. However, poor resource mobilization and financial management are well known. The majority of municipal councils struggle with a lack of financial accountability discipline, nepotism and patronage in hiring procedures, dishonest revenue collectors, political pressure on officers to be less aggressive in revenue collection, and high staff turnover. Numerous of these issues are recognized by the government, which has prompted it to launch a program of local government reform based on more devolution. However, the policy declarations still need to be followed by concrete action.

CONCLUSION

Decentralization has several benefits, including boosting participation, efficiency improvements, and creativity. It does, however, have its limitations. This essay has emphasized a few of the major drawbacks of decentralization. First, it might be difficult to strike a balance between decentralization and coordination. While decentralization gives local organizations more authority, it may also cause fragmentation and a

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lack of cooperation on a larger scale. Decentralization may also have trouble guaranteeing accountability and resolving issues with collaborative action. Decentralized systems are susceptible to corruption, inefficiency, and the neglect of public goods in the absence of appropriate controls and monitoring. Third, infrastructural shortcomings and technology constraints may make it difficult to deploy decentralized systems successfully, especially in underdeveloped areas. Fourth, achieving the ideal balance between local autonomy and central control is a difficult issue since hazards might arise from either too centralization or much decentralized systems. Policymakers and practitioners should carefully evaluate the context-specific issues and create suitable governance frameworks to get around these constraints. This will be further explained for our two example cities, Nairobi and Hyderabad, in the three chapters that follow.

REFERENCES:

[1] J. Mihálik, P. Horváth, and M. Švikruha, "Give me liberty or give me money: The fiscal decentralization and autonomy of regional governance in Slovakia," *Eur. J. Gov. Econ.*, 2019, doi: 10.17979/ejge.2019.8.1.4573.

[2] M. Y. Lee and A. C. Edmondson, "Self-managing organizations: Exploring the limits of less-hierarchical organizing," *Research in Organizational Behavior*. 2017. doi: 10.1016/j.riob.2017.10.002.

[3] S. Berman, "Tocqueville's Revenge: State, Society and Economy in Contemporary France," *Polit. Sci. Q.*, 2000, doi: 10.2307/2657921.

[4] S. Hamati, "Is Divorce a Solution? Decentralization Effect on Economic Growth in Post-Civil Conflict Countries," *Peace Econ. Peace Sci. Public Policy*, 2019, doi: 10.1515/peps-2018-0055.

[5] R. P. Kotorov, "Virtual organization: conceptual analysis of the limits of its decentralization," *Knowl. Process Manag.*, 2001, doi: 10.1002/kpm.93.

[6] N. Argyres, L. A. Rios, and B. S. Silverman, "Organizational change and the dynamics of innovation: Formal R&D structure and intrafirm inventor networks," *Strateg. Manag. J.*, 2020, doi: 10.1002/smj.3217.

[7] B. Chemouni, "Explaining the design of the Rwandan decentralization: elite vulnerability and the territorial repartition of power," *J. East. African Stud.*, 2014, doi: 10.1080/17531055.2014.891800.

[8] Woo Sik Kee, "Fiscal decentralization and economic development," *Public Financ. Rev.*, 1977, doi: 10.1177/109114217700500106.

[9] R. C. Sanchez, "Regulation of official degrees as a limit to decentralization in higher education," *Rev. Educ.*, 2014.

[10] M. Y. Lee and A. C. Edmondson, "Research in organizational Behavior self-managing organizations : Exploring the limits of," *Res. Organ. Behav.*, 2017.

[11] G. Crawford, "Decentralization and the limits to poverty reduction: Findings from Ghana," *Oxford Dev. Stud.*, 2008, doi: 10.1080/13600810701702002.

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Collection, Transportation and Disposal of Urban Solid Waste in Hyderabad

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ABSTRACT: ***Municipalities all around the globe have enormous difficulties in managing urban solid garbage. Systems for collection, transportation, and disposal must be efficient if public health, the environment, and sustainable development are to be maintained. This chapter explores the fundamental elements of urban solid waste collection, transportation, and disposal while examining the numerous approaches and technology used to improve garbage management. The research sheds light on the value of good waste management and emphasizes the need for comprehensive strategies to deal with the rising trash creation in metropolitan areas. Efficient urban solid waste collection, transportation, and disposal need a comprehensive and integrated strategy that incorporates technical advancement, public involvement, and governmental support. Cities may reduce the negative environmental effects of solid waste, save resources, and improve the quality of life for their citizens by implementing sustainable waste management strategies.***

KEYWORDS: ***Disposal, Garbage, Management, 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 program 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 from designated vantage points and transports it to one of the dumpsites while the welfare organizations hire waste pickers who are paid Rs 10 per month per home. In order to assist the separation of 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 program demonstrates the local government's intention to enhance the effectiveness of the city's solid waste management. 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 use 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, some every other day, and still others just once a week. The 1998-launched Clean and Green Andhra Pradesh Campaign is another project worth mentioning. Every second Saturday of the month will be recognized as Clean and Green Day by the State administration, according to decrees. The plan is for locals, governments, businesses, and non-profit organizations to work together voluntarily to clean up the city [1]–[3].

It is unclear whether or not this number takes illegal colonies within municipal limits into account. 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 collecting players will then be identified, and using the proposed indicator system, the performance of different institutional arrangements in SWC will be systematically evaluated. Conclusions on the right policy

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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. An efficient waste management system in urban settings must include the collection, transportation, and disposal of urban solid waste. Let's examine each phase in more detail:

Collection:

Collection is the methodical collecting of solid trash from a variety of sources, including homes, businesses, and public spaces. Various techniques may be used to carry out the gathering process:

1. **Door-to-door Collection:** rubbish management workers or authorized collectors go door-to-door to pick up rubbish from specific homes or businesses. With this approach, convenience for locals is guaranteed, and trash separation at the source is encouraged.
2. **Community Collection sites:** Waste collection may be consolidated at designated community collection sites in regions with limited resources or lower population densities. Residents dispose of their trash at these places for later pickup by waste management vehicles or employees.
3. **Participation of the Informal Sector:** In many metropolitan areas, scavengers or informal garbage pickers play a critical role in gathering recyclable items. They often operate alone, collecting trash from homes, businesses, and landfills to aid in resource recovery.

Appropriate planning, adherence to collection routes, and coordination amongst collection crews are necessary for effective garbage collection systems. To ensure efficient collection operations, adequate equipment, such as garbage collection trucks, bins, and containers, is required.

Transportation:

The garbage must be delivered from the authorized collection sites to the appropriate disposal facilities or treatment plants once it has been collected. Various forms of transportation may be used, depending on the distance and infrastructure available:

1. **Waste Collection Vehicles:** The hauling of the gathered garbage involves the employment of specialized trucks or vehicles. These vehicles might be specialist vehicles for the transportation of hazardous waste, open-bed trucks for bulkier materials, or compactor trucks for compacting rubbish.
2. **Transfer Stations:** On occasion, transit routes include intermediate transfer stations. The garbage from smaller collecting trucks is transferred to bigger transport vehicles at these stations for long-distance transportation to disposal locations.

Transportation systems that are efficient take into account things like route optimization, vehicle upkeep, and compliance with safety and environmental requirements [4]–[6].

Disposal:

The ultimate treatment or disposal of solid waste is referred to as disposal. Depending on environmental laws, available infrastructure, and waste properties, there are many waste disposal techniques:

1. **Landfilling:** The most typical means of disposing of trash are landfills. The gathered garbage is dumped in specific locations, where it eventually decomposes. To reduce environmental effects, proper landfill design, trash compaction, and environmental protections are required.
2. **Incineration:** Incineration is the process of burning waste under controlled conditions at high temperatures. This method may be used to convert waste into energy, minimize the amount of garbage, and produce energy via heat recovery. To reduce emissions, effective air pollution control techniques are essential.
3. **Composting:** Organic waste may be processed through composting, which uses biological breakdown to create compost that is nutrient-rich. Composting is an environmentally friendly process that decreases waste volume and produces an important soil nutrient.
4. **Recycling and Resource Recovery:** Materials including paper, plastic, glass, and metals are separated and processed for recycling in order to reduce the quantity of garbage sent for disposal. Recycling lessens the demands on energy, resources, and the environment resulting from the extraction of raw materials.

Disposal procedures should adhere to environmental laws, take into account regional circumstances, and give sustainability and resource

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preservation first priority. Effective waste management strategies, proper infrastructure, stakeholder participation, public awareness, and constant monitoring and assessment are necessary for effective collection, transportation, and disposal systems. Sustainable urban waste management techniques are aided by integrated waste management strategies that place a high priority on resource recovery, recycling, and trash reduction.

DISCUSSION

Structure of Organizations

An elected Commissioner who is in charge of the MCH manages the numerous departments tasked with carrying out the statutory obligations of the municipality. The Health Department, which is managed by the Chief Medical Officer of Health, is in responsibility of carrying out SWC's duties. The Sanitary Conservancy Section and The Transport Section are the two divisions that make up the Health Department. While the transport wing is in charge of garbage transportation and disposal, the sanitary wing is responsible for street cleaning and rubbish collection. Transport equipment such tipper trucks, compactors, Lorries, and other vehicles are maintained by the engineering department. Each of the seven circles that make up the MCH is overseen by an Assistant Medical Officer of Health and backed by a team of sanitary supervisors, who in turn are helped by the so-called sanitary jawans. The latter oversee daily activities carried out by drivers and male and female sweepers who work for the conservancy. It was said that the MCH had a personnel shortage of more than 50% in the middle of the 1990s. The presence of commercial operators in SWC has in the meanwhile helped to somewhat counterbalance this issue. 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 State Warehousing Corporation (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.

Organisation of SWC Services

1. 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 (schools, offices, hospitals, etc.) and private institutions (stores, marketplaces, offices, hotels, private clinics, etc.) may be further split into these categories. All of these generators (primary storage) keep their garbage on or close to their properties. Unfortunately, the amount of this garbage that is segregated from these principal storage places by office boys, tricyclists (part of the VGDS plan), and shopkeepers is unclear. Following the separation of the trash by the aforementioned actors, part of the organic waste is brought by heardsmen to cow farms, and the remaining portion is transferred to composting facilities by MCH and private vehicles as well as tricycles. Urban farmers buy 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 [7]–[9].

Workers from MCH and the private sector transport rubbish from secondary storage stations (such as roadside dustbins) to collecting points where it is discarded. These public trash cans are often seen at street corners. 4,900 concrete cylinder trash bins (0.6 cum), 420 metal waste bins (1 m2), and 105 garbage homes (2.5 m2) have been given by the MCH to cover all the locations 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. These products are offered to traveling consumers, retail, and wholesale dealers. The and the organic compounds have been too heavily polluted by the secondary collecting stations. These products are offered to traveling consumers, retail, and wholesale dealers. The MCH trucks convey the garbage from the secondary collection locations to one of the transfer stations and from there (in

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bigger trucks) to dumpsites, whilst the private trucks go straight to the latter.

Currently, the MCH transports 200 tons of residual garbage daily to Selco International Limited, where it is converted into pellets (a replacement for coal). Industries that use coal-based power generation are the target market for the pellets offered on the market4. 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 practice has been abandoned. The current collection centers have a combined capacity to handle 2,170 tons or 3,623 m2 of waste. Therefore, the rubbish holding capacity exceeds the amount of waste produced daily. However, variables other than the trash holding capacity are more crucial, such as the distribution of these waste bins around the population and the frequency of pickup. Poor facilities are present, for instance, in unauthorized colonies. For comparison's sake, each trash can in the MCH serves 737 people, but there are, on average, 270 people per can in the nine neighboring municipalities. 183 trucks are now available for garbage transportation via the MCH. The fleet as a whole can remove about 1,700 tons per day with an average lifting capacity of 9 tons per day. However, in practice, only up to 900 tons 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.

Open dumping is the most popular way to dispose of trash in Hyderabad. There are three authorized dump sites within the city: the 45-acre Mansoorabad (Autonagar) dump site, which is located 20 kilometers from the city center, the 20-acre Jamalikunta (Golconda) dump site, which is located 8 kilometers from the center, and the 22-acre Gandamguda dump site, which is situated 10 kilometers from the center of the town. The Sanjivaiah dumpsite was shut down in 1995 when the park's perimeter was expanded. Other unauthorized 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 amount of illicit dumping has likely decreased under the current unit system since payment for private service providers is based on trip registration [10], [11].

2. Waste characteristics

Municipal solid trash must be regularly collected and hauled away due to the high decomposable content (approximately 55 percent). 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. Most often found in household garbage are the following items: Paper, plastics, and rags are combustibles. Glass and metal are non-combustibles. Vegetables and food are compostables. Toxic battery cells and other materials are also combustible.

3. Waste generators

Based on the premise that the average production rate per person is about 0.35 kg and that there are around 4 million people overall, the amount of solid waste created in the MCH is projected to be 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 includes 30,000 livestock, 5 slaughterhouses, 417 hospitals and nursing homes, 93 function rooms, 34 marketplaces, commercial centers, and leisure areas. There are also around a million households. Even though they alone produce just a little amount of garbage, when combined, they account for around 75% of the overall volume.

4. Hospitals

The twin metropolis of Hyderabad-Sekunderabad has seen a surge in the number of hospitals, nursing homes, and clinics during the last 20 years. 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. Every hospital is required by national legislation to have a separate incineration facility. In reality, only a few hospitals have such a facility since it is so expensive. Even when they do have an incinerator, frequent maintenance or power outages prevent them from using it all the time. 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

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of services. For instance, Vijaya Marie Hospital and Appollo Hospital collaborate on hospital waste disposal. With the exception of Medicine City Hospital, every hospital has collecting agreements with the MCH.

Hospital trash may be disposed of in a number of ways. Anatomical waste, including as human tissues, organs, and body parts, are buried deeply in every government hospital in our sample. In other hospitals, they are simply disposed of in trash cans after being covered. All other hospital trash, including laboratory cultures, biological poisons, old medications, and objects tainted with blood, is often disposed of in waste bins, however sometimes these products are autoclaved or cremated before being disposed of in waste bins. The only hospitals with incinerators are three The Pollution Control Board's limitations, however, prevent incineration from taking place in one of them (the Osmania hospital). The other five hospitals in the sample do not have incinerators. Materials are separated in each of the eight hospitals before being disposed of in trash cans. Following that, just four hospitals will sell things made of paper, plastic, and iron. All hospitals are pleased with the work of MCH employees who clean the trash cans on a daily basis or sometimes every two to three days. Nevertheless, five of the eight hospitals in our sample intend to contract with private garbage collectors because they believe they would perform more efficiently than MCH employees due to their regularity and timeliness. They also believe that MCH is unqualified to handle biological waste in a responsible way.

5. Educational institutions and offices

Three high schools, three junior colleges, three degree colleges, two engineering institutions, and four offices were chosen for the current study's investigation of their waste management procedures. Osmania General Hospital, Gandhi Hospital, Government General and Chest Hospital, Medicity Hospital, Medwin Hospital, St. Theresa's Hospital, Vijaya Marie Hospital, and Vijaya Krishna Nursing Home are the hospitals chosen for the current in-depth investigation. The oldest and largest hospitals in the sample are Osmania and Gandhi Hospitals, with 2,400 and 1,500 employees, respectively. Both of them were founded in 1866 and 1851, respectively. The Government General and Chest Hospital opened its doors in 1971 with 400 employees and 200 beds. In 1992, Medicity Hospital opened its doors with 350 employees and 150 beds. 350 beds and 750 employees made up Medwin Hospital, a corporate hospital, when it first opened its doors in 1989. With 425 and 60 employees, respectively, St. Theresa's and Vijaya Marie Hospitals are managed by Charitable Trusts founded in 1973 and 1942. In 1987, Vijaya Krishna Nursing Home opened its doors with 40 beds and 12 employees.

Among the sample institutions, Osmania University College for Women is the oldest, having been founded in 1924 and employing 480 people. Siddhartha College and Annie Besent College, which were founded in 1995 and 1994, respectively, are the other degree-granting institutions chosen. Jawaharlal Nehru Technological University College and DVR College of Engineering and Technology, both founded in 1985 and 1998, respectively, are the engineering institutions chosen for the current research. Office of the Municipal Corporation of Hyderabad (800 employees), ITC Badrachlam Paper Boards Limited (300 employees), Institute of Health Systems (60 employees), and Office of the Accountant General (1,650 employees) are the offices chosen for the current research.

The sample institutions keep their garbage in plastic bins, gunny bags, or polythene cement bags, which they afterwards deposit on their property or into the closest MCH dustbin. In the latter scenario, this is done by their own team. Public institutions like public schools and municipal buildings often enlist the aid of MCH employees to dispose of their own garbage. Only paper garbage is removed from the waste produced at the sample institutions by some of them to be sold. Rarely are other materials sold. The majority of the sample institutions remove their trash bins every day, while at the other institutions, it only happens seldom, sometimes once a week, and sometimes a month. The amount of garbage created in the researched universities is typically rather little and can be readily disposed of by their own workers, hence almost none of them have plans to outsource waste collection on their campus to private companies. Only two colleges intend to use outside companies to handle their garbage. However, the majority of them agree that private contractors perform better than the MCH because they believe they are held to higher standards of accountability and supervision.

6. Hotels

The primary producers of garbage are hotels. Twelve hotels have been chosen for this research in order to evaluate the amount of garbage produced and the method of waste disposal. Most hotels keep their trash in plastic containers, although some also utilize polythene coverings. Additionally, this trash is initially deposited within the boundaries of the hotel. Every day, each hotel disposes of its garbage,

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which might weigh up to 100 kilograms each day. Many hotels separate the trash, removing items like paper, glass, and liquor bottles that have been sold. On occasion, food waste is distributed to beggars. The hotels often have some form of agreement with cow farms or pig farms that allows them to collect food and vegetable waste for free to feed their animals. Most hotels, particularly the smaller and medium sized ones, continue to employ the MCH service. However, several hotels (Golconda, Paradise-Percis) have farmed out their garbage collection to the private sector. The latter have no intentions to hire a commercial company to collect rubbish.

7. Markets

The city of Hyderabad contains 34 marketplaces and 5 slaughterhouses, including the neighboring towns. All of these significant generators struggle with the issue of waste buildup that results in unsanitary conditions on the property. To evaluate waste collection and disposal techniques, two slaughterhouses and eight markets have been chosen from the study population. These facilities produce anything from 20 tons (at the Monda vegetable market) and 200 kg (at the Ramnagar fish market) of garbage per day. The majority of marketplaces put their trash in RCC bins or metal containers, but others just dump it everywhere. While all other markets rely on the MCH to remove the debris, two markets Gudimalkapur Vegetable Market and Gaddiannaram Fruit Market have delegated the task of rubbish collection to private contractors. Trucks carry out all of this on a daily basis. Many markets and slaughterhouses are thinking about handing over trash collection to private contractors, who they believe will provide more dependable and consistent service than the MCH. Only the fruit market in Gaddiannaram has a composting unit out of all the marketplaces. The SPEQL provides technological know-how for the vermin-composting unit, which has been given one acre of land by the fruit market's management. It is one of Andhra Pradesh's premier composting facilities. The compost produced by this facility is also purchased by farmers and horticulturists from the neighboring villages and districts. Except for paper, none of the marketplaces sell any inorganic trash.

CONCLUSION

Maintaining the wellbeing of urban populations depends on the effective and sustainable management of urban solid waste. The importance of appropriate collection, transportation, and disposal methods in waste management has been underlined by this research. It is clear that integrated strategies that include resource recovery, waste reduction, and recycling are essential for reducing the environmental effect of solid waste disposal. A key part of improving waste management techniques is played by technical developments including waste-to-energy conversion, intelligent waste management systems, and enhanced transportation infrastructure. Collaboration between governmental institutions, businesses, and other organizations in the private sector is essential for effective waste management. Promoting sustainable waste management techniques requires community participation in garbage segregation efforts, recycling programs, and awareness campaigns. Additionally, it is essential to put laws and rules into place that encourage recycling, encourage trash minimization, and deter inappropriate disposal.

REFERENCES:

[1] B. A. Khan, A. A. Khan, M. Ali, and L. Cheng, “Greenhouse gas emission from small clinics solid waste management scenarios in an urban area of an underdeveloping country: A life cycle perspective,” *J. Air Waste Manag. Assoc.*, 2019, doi: 10.1080/10962247.2019.1578297.

[2] S. S. Asadi, Y. Sree Ramulu, M. V. Raju, and P. J. Ratnakar, “Optimal route analysis for the transportation of solid waste using remote sensing and GiS: A model study,” *Int. J. Appl. Eng. Res.*, 2015.

[3] S. Godura, A. K. Aggarwal, and P. Bhatia, “Municipal solid waste management index in urban areas: Delphi validated tool,” *Int. J. Environ. Waste Manag.*, 2017, doi: 10.1504/IJEWM.2017.087150.

[4] S. Jampala, A. Gellu, and D. S. Kala, “Current Scenario on Urban Solid Waste with Respect to Hyderabad City,” 2016.

[5] D. P. S. R. Nalla Naresh, “Limnological Study of Hasmathpet Lake Situated in Hyderabad Region of Telangana,” *Int. J. Eng. Res. Technol.*, 2014.

[6] S. S. Asadi, Y. Sree Ramulu, M. V. Raju, and D. Satish Chandra, “Creation of remote sensing and Gis based risk area mapping for ground water pollution prevention: A case study,” *Int. J. Appl. Eng. Res.*, 2015.

[7] D. W. M. Chan and T. N. Y. Choi, “Critical analysis of the application of the Safe Working Cycle (SWC): Interview findings from Hong Kong,” *J. Facil. Manag.*, 2015, doi: 10.1108/JFM-09-2014-0029.

[8] M. Knight and K. Rodgers, “‘The Government Is Operationalizing Neo-liberalism’: Women’s Organizations, Status of Women Canada, and the Struggle for Progressive Social Change in Canada,” *NORA - Nord. J. Fem. Gend. Res.*,

2012, doi: 10.1080/08038740.2012.747786.

[9] C. Hatton and E. Emerson, "THE DEVELOPMENT OF A SHORTENED 'WAYS OF COPING' QUESTIONNAIRE FOR USE WITH DIRECT CARE STAFF IN LEARNING DISABILITY SERVICES," *Ment. Handicap Res.*, 1995, doi: 10.1111/j.1468-3148.1995.tb00160.x.

[10] L. S. Bixler, "Educational services in health sciences libraries. Volume 2: Current practice in health sciences librarianship," *J. Am. Soc. Inf. Sci.*, 1996, doi: 10.1002/(sici)1097-4571(199612)47:12<955::aid-asi11>3.0.co;2-r.

[11] A. A. Natividad, J. Timoneda, J. Batlle-Sales, V. Bordas, and A. Murgui, "New Method for MEaduring Dehydrogenase Activity in Soils," 1997.

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Sustainable Development in the Basic State Warehousing Corporation (SWC) System

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ABSTRACT: ***The Basic State Warehousing Corporation (SWC) system is examined in this chapter's examination of the notion of sustainable development. A development strategy known as "sustainable development" tries to satisfy the requirements of the current generation without endangering the capacity of future generations to satisfy their own needs. In order to reduce post-harvest losses and ensure food security, the SWC system is essential. But it also has substantial effects on the social and environmental spheres. This chapter explores the SWC system's core sustainable development elements and makes recommendations for ways to make it more sustainable. The SWC system may help accomplish sustainable development objectives by putting these ideas into practice, establishing a balance between economic progress, environmental preservation, and social well-being.***

KEYWORDS: ***Contractors, Employees, Sustainable development, State Warehousing Corporation, SWC***

INTRODUCTION

A crucial part of the infrastructure for storage in many nations is the State storage Corporation (SWC) system. Government-owned organizations called SWCs were created to provide warehousing and storage facilities for items including agricultural commodities. SWCs' main goal is to aid farmers, dealers, and other stakeholders in keeping their goods stored and preserved so that food security is maintained and post-harvest losses are kept to a minimum. The Basic State Warehousing Corporation (SWC) System has the following salient characteristics and features:

1. **Infrastructure Development:** SWCs concentrate on the creation and upkeep of silos, cold stores, and other forms of storage infrastructure. In order to promote effective storage and distribution of commodities, these facilities are strategically situated close to manufacturing facilities, marketplaces, and transportation hubs.
2. **Storage Services:** SWCs provide storage services to individuals, farmers, businesses, cooperatives, and governmental organizations. They provide standardized, safe storage facilities with the required ventilation, pest control, temperature control, and other elements to preserve the quality of the goods being kept.
3. **Quality Control and Grading:** SWCs often contain quality control labs and grading facilities to evaluate the caliber and grade of agricultural goods. This aids in establishing the value in the market, guaranteeing fair trade, and upholding standards of quality.
4. **Warehouse Receipt System (WRS):** SWCs employ a financial tool called a Warehouse Receipt System (WRS), which gives the commodities that are being stored collateral value. Farmers and merchants may utilize the warehouse receipts provided by SWCs to apply for loans from financial institutions, making it easier for them to access financing and reducing post-harvest risks.
5. **Risk Management:** SWCs are essential to the management of hazards related to the storage of commodities. They take action to stop losses brought on by things like spoilage, pests, theft, and natural calamities. Additionally, sufficient insurance protection is offered to protect the commodities being held from any dangers.
6. **Support for Marketing:** SWCs often help with the marketing of agricultural products by providing market knowledge, pricing data, and supporting fair trade practices. They could also work for the government or other organizations, doing

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things like purchasing, distributing, and marketing goods.

7. **Capacity Building and Training:** SWCs engage in capacity development and training programs to improve the abilities and expertise of its employees and stakeholders. The topics covered in training programs include correct handling and storage methods, quality control, commodity grading, and warehouse management procedures.
8. **Integration with Agricultural Supply Chain:** To guarantee efficient transportation and storage of commodities, SWCs work with a variety of agricultural supply chain players, including farmers, dealers, transporters, and governmental organizations. This integration increases the effectiveness of the supply chain, lowers post-harvest losses, and encourages prompt availability of goods on the market.
9. **Government Support:** The government provides capital investment, a regulatory framework, and regulatory monitoring for SWCs. To encourage the creation and operation of SWCs, the government may provide grants, subsidies, financial aid, and other forms of encouragement.

In general, the Basic State Warehousing Corporation (SWC) System is essential for promoting fair trade, maintaining food security, and assisting in agricultural output. SWCs support the smooth operation of agricultural supply chains and the overall growth of the agricultural industry by offering dependable storage facilities, quality control, financial instruments, and risk management measures. The emphasis of the remaining section of this chapter will be on domestic garbage management [1]–[3].

DISCUSSION

One may distinguish between the fundamental SWC system provided by the MCH or its authorized private-sector agents and the VGDS, which can be considered as an improvement over the fundamental service.

1. Basic service

Regardless of the region's status, the MCH uses a consistent SWC system in theory. In reality, however, routine service is only permitted in officially recognized residential zones. People living in slums and illegal colonies are not completely disregarded for public health reasons, but service levels are much lower in terms of trash bin availability and collection frequency. It is anticipated that individuals carry their trash to collection places, such as dustbins, garbage homes, containers, or open disposal sites. Sweepers take care of cleaning the streets and transport the collected rubbish to the same public collection sites. The garbage is then physically transferred from there onto trucks that either take it straight to one of the three municipal landfills or to a transfer facility. In order to save on fuel, vehicle maintenance, and time lost due to escalating traffic congestion, the MCH plans to establish twelve of these transfer stations, of which three are now operational. The whole system is very labor-intensive, and salaries make up the majority of the budget for solid waste management.

The MCH began the process of privatization in SWC in 1995. Both the bureaucracy which feared a loss of government control and labor unions which defended the interests of the highly organized MCH-workers opposed the idea of outsourcing this role to the private sector vigorously. Municipalities have little choice but to go on with the private sector involvement initiative since they are not permitted to hire new workers even as their service needs increase along with their populations. Additionally, assurances were given that current employees wouldn't face layoffs. Initially, only approximately 10% of the MCH region particularly the outlying, newly constructed colonies was subjected to privatization; but, as additional areas were progressively turned over to the private sector, by 1998, about 25% of the MCH area was receiving privatized services. Contractors first worked under two distinct systems. The lowest bidder approach required private contractors to submit bids for sweeping and lifting rubbish in a specific region on a daily basis. The second technique included paying contractors based on the amount of trash they had removed, with the idea being that this would encourage them to do so.

Contractors might provide a price per ton that included sweeping expenses. Both systems had significant flaws, which were mostly brought on by the MCH's inadequate monitoring and management. Because there were no defined output standards in the first system, contractors used to get their payments even when they weren't performing well. In the second system, contractors resorted to loading stones, building waste, etc. into their trucks to boost weight. Additionally, it was claimed that

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the contractors formed syndicates with MCH representatives to provide costs that were far higher than the going rates. In 1998, the MCH implemented a new organizational structure and a more thorough monitoring system in an effort to address these issues. The MCH region was split into 266 units, each with a sweepable length of 7-8 km and a liftable volume of 7-8 tons per day of garbage. Each unit consists of a sweeping unit and a lifting unit, each with a set number of workers and tools. Under this so-called unit system, contactors are paid based on a consistent calculation that includes a predefined profit margin of 10% (which was decreased to 8% in 1999). 146 of the 266 units were privatized, while 120 were still managed by MCH. Contractors were welcomed to apply as long as they met certain regulatory standards and contributed a Rs 25,000 (US$ 625) deposit. A maximum of three units were permitted per contractor (after 1999, only two). A final decision was reached by drawing lots since the MCH received more applications than there were available units [4]–[6].

2. 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 providing citizens with free access to tricycles, which are three-wheeled bicycles with waste reservoirs. 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 joint families paying more. The program is highly successful because consumers expect value for their money and welfare organizations enforce stringent oversight. 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 settlements.

Assessing Sustainable Development in The Basic SWC System

Despite some overlap, the contributions of the two SWC systems to many facets of urban sustainable development will each be assessed. Although adaptable to accommodate the unique conditions in Hyderabad and the data at our disposal, the collection of indicators described has been employed to frame the research. The fundamental service's attributes will be evaluated first, with a focus on how the MCH and private contractors provide their services differently.

Contributions to socio-economic aspects of sustainable development

1. Economic viability and effectiveness

In terms of allocative efficiency the degree to which charges cover the cost of the service, the SWC system in Hyderabad performs poorly. 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 believe tenants would not pay their dues. The average labor productivity of workers in the private sector appears to be slightly higher than that of MCH employees in terms of operational performance (productive efficiency) (0.24 and 0.19 tons of garbage lifted per worker, respectively; data taken for the year 1998–1999).

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 garbage for less money over time. However, the contract requirements established by the government account for a major 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. The Hyderabad contracting system's drawback is that new technology haven'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 automated sweeping equipment.

2. 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

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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 that the minimum salary of Rs. 1,300 must be paid, the average monthly income of a worker is Rs. 1,100. In order to protect them from harassment, female employees are not meant to work nights, however the majority of night workers 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 hired by the private sector are subject to termination at any moment.

The brief term of the service contracts suggests that their employment is only assured for that time frame. In reality, as a consequence of MCH action, the situation of contract laborers has even become more precarious. The municipality modified contract requirements at the expense of the workers in an effort to prevent the elimination of the financially advantageous labor contracting system used by the contractors (labeling their work as "non-permanent," dropping the requirement for ESI and PF facilities, and eliminating the requirement to wear uniforms). However, it must be noted that despite these apparent discriminations, the affected workers are generally content with their employment, which compare well in terms of pay and security to jobs they had earlier in their careers. 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, utilize 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. This percentage was 4% for MCH laborers.

3. Monitoring

Local governments are considered to be able to implement a stricter enforcement approach thanks to private sector cooperation. It is likely true that local governments in India have more control over private agents than they do over their own (very organized and politically assertive) labor force. Nevertheless, the private sector is strictly regulated, although more so in terms of service quality and less so in terms of the welfare of its employees. The high quality of services offered by neighborhood contractors shows that monitoring is mostly successful. Sanitary supervisors (52) and sanitary jawans (350) are significant participants in performance evaluation. They monitor the contractors' work every day and note any eventual shortfalls, which eventually lead to reductions in the agreed-upon sum. However, reports of contractors disobeying contract terms, unscrupulous business practices, inadequate complaint management, and subpar working conditions are widespread in Hyderabad and other Indian cities (cf. Ali et al., 1999).

The community's participation in the monitoring system is a plus. A citizen committee with 10–15 members had been established in each unit. Before their invoices are approved for payment, contractors must have at least three members sign their performance sheets to show gratitude for the job. However, it is unknown if this innovation has really raised the standard of monitoring or whether it has just become a formality or even opened up new opportunities for manipulation. Although it is difficult to estimate the extra expenses associated with contract management and performance monitoring, it is true that the MCH now employs a much larger number of staff members than it did before, while the number of laborers has reduced. Privatization incurs significant transaction costs, no doubt.

4. System viability

Although precise information on the entire cost of SWC inside the MCH is lacking, it is probable that this has significantly grown. Since the most recent reform in 1998, total spending on privatized SWC has practically quadrupled, although overall spending on the remaining MCH service and monitoring the whole sector has probably not decreased much, if at all. At least 20% of the approximately Rs 300 crores total MCH budget for the 2000–2001 fiscal year is allocated to SWM. Officials in charge claim that the MCH has enough income to cover all of its expenses, including SWM. The town does, however, have trouble funding significant purchases. In 1999, the MCH was able to get a loan from the Mega City Fund for the building of infrastructure totaling Rs 28 crores under the Mega City Scheme. A portion of this funding will be used to build transfer stations and replace SWC vehicles. 25 percent of the Rs 28 crores come from the Government of India's revolving fund, and 25 percent is a matching grant from the State Government. The MCH's own

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money make up the remaining 50%. However, it seems that the MCH is unable to meet the repayment obligations, which might compel the authorities to apply for a new Housing and Urban Development Corporation (HUDCO) loan. This shows that the SWC system's financial sustainability is somewhat unsettling. Until some kind of cost recovery is implemented, it is likely to remain a weakness. However, there are no intentions at this time to impose user fees on residents.

Contributions to public health and environmental aspects of sustainable development

1. Cleanliness of communities

On paper at least, sweeping, rubbish collection, and transportation occur regularly and every day in all units. However, the poll 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 largely 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 labor force, which was roughly 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. Most individuals believe that because of rigorous oversight and increased job insecurity, private employees will perform better. As a result, SWC has a high level of social credibility among private businesses [7]–[9].

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, privatization is only used in places that have well-planned layouts and easy access partly as a consequence of the uniform package. Slum neighborhoods still get appallingly inadequate services. More than half of the chosen respondents noted that residents in these unauthorized areas of the city often lack trash cans, which leads to many of them engaging in arbitrary dumping behaviors.

2. Worker health

Hyderabad's SWC system still mainly relies on physical labor. Manual sweeping and lifting is the norm, and it is quite taxing. The works labor-intensive character results, at least in part, from the power of labor interests in local politics, which discourage the use of capital to replace labor. However, since they often come into touch with the trash, workers have a high risk of infection or injury. Despite the fact that employers are required to supply their employees with safety gear and protective apparel, this obligation is often broken by both sides. There is some evidence to suggest that private employees have a little worse situation than their MCH counterparts. Because contractors seldom ever employ trucks with hydraulic lifting equipment, loading and unloading vehicles, for instance, is nearly solely done by human labor in the private sector. The existing contracting structure does not promote spending on equipment that will facilitate work. Additionally, contractors are more likely to spend less on safety equipment.

3. 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 regulated garbage removal from these locations. The minimization of trash, the promotion of recycling, and the prevention 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

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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 connected to this sort of disposal will likely become worse when the open dumping technique rather than the sanitary land fill is used.

Contributions to public health and environmental aspects of sustainable development

1. **Cleanliness**

The majority of residents who take part in the program express satisfaction. The great majority of people think the neighborhood is now cleaner. The respondents said that rubbish pickers passed by their home daily in 87 percent of cases, with the remaining 13 percent reporting that collection occurred four to five times each week. The fact that rubbish was now being collected at doorsteps instead of needing to be brought to public bins some distance from homes made many quite happy. They also valued the lack of trash cans in their localities and the resulting littering.

2. **Environmental impacts**

The VGDS has a generally good effect on the environment. Although there are no impacts on ultimate disposal procedures or trash minimization, the program does support recycling and reuse. At the home level, waste is meant to be divided into organic and inorganic elements. In reality, it doesn't seem that this is presently a common practice. On the trash market, the garbage pickers attempt to sell precious goods. Vermicomposting is a method for recycling organic waste so that it may be transformed into manure. However, despite the assistance of various NGOs, neighborhood composting has not consistently shown to be a practical solution (see chapter 10). In this regard, the plan's promised advantages have not materialized. The amount of garbage that must be transported to the dumpsites is considerably decreased, which means the capacity of the dumps will last a bit longer, which is another favorable environmental consequence. Additionally, collecting is done manually up to the vantage points on the outside of the neighborhoods. Truck use is reduced thanks to the system.

SYSTEM-WIDE CONCERNS

Investigations of the SWC's functioning in Hyderabad also revealed a number of issues that affect the whole city and obstruct or frustrate appropriate service. Large portions of the city's subpar physical infrastructure, particularly in low-income and slum regions, create a significant bottleneck. For instance, the fundamental collecting system necessitates that vehicles have adequate access to residential areas. Residents, who are mostly housewives or maids, are compelled to carry their trash to viewing places that are somewhat distant from their homes when it is difficult for cars to access the region. This leads to careless disposal techniques. By implementing a VGDS in the region, the issue may be partially solved. To achieve this, nevertheless, calls on the existence of a community welfare organization that can plan this service, or, in the absence of such an institution, community mobilization. It is a well-known fact that middle class communities are more likely to have CBOs actively involved in community sanitation. The MCH presently uses a very tight unit structure for the delivery of fundamental services. It implies that the physical layout of the region must meet minimal standards, particularly in terms of road width and locations for installing trash cans or garbage houses. There seem to be solid justifications for adjusting the labor and equipment input needs to the kind of arrangement. It is likely that a more adaptable strategy would aid in meeting the demands of city dwellers in the less affluent areas.

The government is having a lot of trouble with ultimate disposal as a result of Hyderabad's fast expansion and immense size. The Golgonda facility was shut down in January 2000 after being in service for 20 years. The area became overpopulated, and the State Tourism Department made the decision to turn the property into a golf course. The Andhra Pradesh Pollution Control Board gave Gandamgooda a partial closure order in 2001 when it surpassed its capacity. Selco International has already received 10 acres for its pelletization facility. Even though Mansurabad has long since reached saturation, the location is still utilized for dumping. Due to the remoteness of the site, transportation expenses are a significant concern, particularly for the private contractors with their stringent contract requirements. The public continues to protest against the site's continuing usage, and trucks now need police escorts to approach the area securely. There are now studies being done on potential new sites.

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However, even if the authorities are able to find locations that are theoretically appropriate for use as dump yards, fierce public resistance is anticipated, hence names of probable locations were withheld. Another issue is that fresh dumps are probably going to be beyond of MCH's purview. Two of the three are currently situated outside the MCH region. Collaboration with other governmental entities, including neighboring municipalities and the state government, each bringing in their own political demands, is consequently necessary in order to reach decisions about the city's SWC. It is anticipated that the placement of dumpsites in the future would spark lengthy discussion. Future sites are almost certainly going to be rather far from Hyderabad, and travel expenses will just becoming more and more of a hassle [10], [11].

Local politics are a system-wide issue of altogether different magnitude. Early SWC privatization initiatives were badly hampered by corruption and nepotism. Fortunately, local civil society has the authority necessary to reveal the repercussions of these violations. However, it is well known that officials are bought to be tolerant, for instance, when private contractors violate contract terms. Such behaviors, which are prevalent across the local bureaucracy, continue to have a detrimental impact on the efficacy and efficiency of services. For instance, the unit system's rigidity is partly the product of efforts to reduce opportunities for exploitation. In addition, it prohibits the MCH from gaining more from the praised dynamism and flexibility of the private sector. The repeated intervention of the strong labor unions, the majority of which have attempted to hinder SWC's privatization, has had a similar impact. They have succeeded in defending the rights of organized (municipal) labor, but they haven't done much to aid newcomers to the industry. Additionally, they require the MCH to use its own, very costly labor force, which drives up the price of SWM significantly above what it would be in a free market. Obviously, this shouldn't be seen as an implied defense of the low wages paid to employees in the private sector. However, it must be noted that the MCH does not seem to have the freedom to weigh the interests of its employees against those of the general taxpayer.

CONCLUSION

To ensure long-term food security and reduce negative environmental and social effects, the Basic State Warehousing Corporation (SWC) system must include sustainable development concepts. This research emphasizes the value of implementing sustainable practices such trash reduction, effective waste storage and distribution, the use of renewable energy, and stakeholder involvement. It is advised that stakeholders, SWC management, and policymakers work together to make sustainability a system priority and to create a more resilient and sustainable agriculture supply chain. By fostering responsible resource management and meeting the requirements of both current and future generations, the SWC system may act as a model for sustainable growth in the larger agricultural sector.

REFERENCES:

[1] M. A. Hannan *et al.*, "Solid waste collection optimization objectives, constraints, modeling approaches, and their challenges toward achieving sustainable development goals," *Journal of Cleaner Production*. 2020. doi: 10.1016/j.jclepro.2020.123557.

[2] M. A. Hannan *et al.*, "Waste collection route optimisation model for linking cost saving and emission reduction to achieve sustainable development goals," *Sustain. Cities Soc.*, 2020, doi: 10.1016/j.scs.2020.102393.

[3] H. J. König *et al.*, "Participatory impact assessment of soil and water conservation scenarios in Oum Zessar watershed, Tunisia," *Environ. Manage.*, 2012, doi: 10.1007/s00267-012-9865-y.

[4] J. Jakobi, J. A. Huisman, H. Vereecken, B. Diekkrüger, and H. R. Bogena, "Cosmic Ray Neutron Sensing for Simultaneous Soil Water Content and Biomass Quantification in Drought Conditions," *Water Resour. Res.*, 2018, doi: 10.1029/2018WR022692.

[5] M. G. Wordofa, E. N. Okoyo, and E. Erkalo, "Factors influencing adoption of improved structural soil and water conservation measures in Eastern Ethiopia," *Environ. Syst. Res.*, 2020, doi: 10.1186/s40068-020-00175-4.

[6] S. Lamptey, L. Li, J. Xie, and J. A. Coulter, "Tillage system affects soil water and photosynthesis of plastic-mulched maize on the semiarid Loess Plateau of China," *Soil Tillage Res.*, 2020, doi: 10.1016/j.still.2019.104479.

[7] J. Mensah, "Sustainable development: Meaning, history, principles, pillars, and implications for human action: Literature review," *Cogent Soc. Sci.*, 2019, doi: 10.1080/23311886.2019.1653531.

[8] L. M. Fonseca, J. P. Domingues, and A. M. Dima, "Mapping the sustainable development goals relationships," *Sustain.*, 2020, doi: 10.3390/SU12083359.

[9] R. Bali Swain and F. Yang-Wallentin, "Achieving sustainable development goals: predicaments and strategies," *Int. J. Sustain. Dev. World Ecol.*, 2020, doi: 10.1080/13504509.2019.1692316.

ISSN (Online) 2456-1290

International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)

Vol 9, Issue 6S, June 2022

[10] L. Shi, L. Han, F. Yang, and L. Gao, "The Evolution of Sustainable Development Theory: Types, Goals, and Research Prospects," *Sustain.*, 2019, doi: 10.3390/su11247158.

[11] A. V. Agbedahin, "Sustainable development, Education for Sustainable Development, and the 2030 Agenda for Sustainable Development: Emergence, efficacy, eminence, and future," *Sustain. Dev.*, 2019, doi: 10.1002/sd.1931.

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Collection, Transportation and Disposal of Urban Solid Waste in Nairobi

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ABSTRACT: ***Nairobi, like other cities, has a considerable issue when it comes to managing urban solid garbage. This research attempts to examine Nairobi's urban solid waste collection, transportation, and disposal processes. The infrastructure, policies, and stakeholder engagement of the waste management system, among other things, are evaluated. This study outlines the main problems and possible fixes for enhancing Nairobi's waste management's efficacy and efficiency. Nairobi can greatly improve its waste management system, promote environmental sustainability, and raise inhabitants' standard of living by addressing these problems and putting sustainable policies into place.***

KEYWORDS: ***Garbage, Management, Services, Solid Waste, Waste.***

INTRODUCTION

Literally, Nairobi is covered with trash. Only around 25% of the city's daily solid waste production, which is estimated to be 1,500 tons, is collected. The remainder is dumped in open areas, marketplaces, bus stations, sewers, and on the sides of highways, where it builds up into mountains of decaying, foul-smelling rubbish. The cityscape is adorned with discarded polythene sheets in a wide variety of colors and sizes. Thus, the collection, transportation, and disposal of solid waste are often chaotic. But it hasn't always been that way. The Nairobi City Council (NCC) collected practically all of the rubbish produced as recently as 1977. Poor performance dates back to the late 1970s and is still present. The introduction of community and private sector players into the solid waste collection industry was encouraged by the NCC's subpar performance. However, they lack control or direction and are acting in an unruly way. For instance, while garbage is transported to the dumpsite, waste pickers board open waste trucks, pick on top of the moving vehicles, discard everything they can't utilize, and litter the whole path carelessly. Additionally, illegal garbage pickers and dealers dominate the NCC-owned and -operated dumpsite, making it necessary for the NCC and private businesses to pay a "bribe" to get access. Utilizing the full potential of private sector and civil society engagement is hampered by a lack of control and direction [1]–[3].

The societal support for the current solid waste collection services is further diminished by a notable skewness in the regional service distribution. Residential neighborhoods with high incomes and certain middle-income neighborhoods, as well as commercial neighborhoods, are well-served by private businesses and even the NCC. The core low-income neighborhoods (slums and other unplanned settlements), where 55 to 60 percent of Nairobi inhabitants dwell, do not, however, get rubbish collection service, with the exception of localized initiatives by CBOs. Small private enterprises are also increasingly providing services to some of the comparatively better low-income regions. In general, private businesses and the NCC provide good service to the Western half of the city while providing less service to the Eastern section. The collection of solid trash in Nairobi is examined in this chapter along with its implications for urban sustainable development. It focuses especially on the importance of long-term growth of the initiatives of newer entrants into garbage CTD, the corporate sector, and civic society. Among the questions addressed are:

i. Who are the participants and how are their activities coordinated in Nairobi's solid trash collection?
ii. What is the significance of these activities, both relative and absolute?
iii. What are the major solid waste collection activities' contributions to urban sustainable development?
iv. According to stakeholders, what are the drawbacks and opportunities of different methods of collecting solid waste?

The literature and secondary and primary data gathered in 1998 and 1999 are used in the debate. In this volume's chapter 1 and the methodological appendix, specifics of the technique and data utilized, including the template used in the study of sustainable development, are described.

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Institutional Framework and History

Nairobi has traditionally had solid waste management services supplied by the NCC, a municipal government under the Ministry of municipal Government (MOLG). Local authorities (LAs) held monopolistic authority over sanitation and solid waste management services prior to the Environmental Management and Coordination Act (1999) (Mulei and Bokea, 1999). Other organizations needed the appropriate LA's written consent in order to manage solid waste or handle waste products. When a private business was hired to rake and clean city streets, collect trash, and provide street lighting in 1906, the NCC conducted an experiment in the privatization of solid waste management (UNCHS, Undated). Privatization was abandoned because the private business was unable to fulfill the contract in a satisfactory manner. Up until the late 1970s, the NCC offered acceptable solid trash collection services. Performance began to decline in the late 1970s, and it became worse in the 1980s and 1990s. Bins (Nairobi) Services Limited and Domestic Refuse Disposal Services Limited (DRDS), which were registered under the Companies Act to provide solid waste collection services to industries, institutions, commercial establishments, and high-income residential areas in 1986–1987, were drawn to the private sector due to the NCC's appalling performance beginning in the middle of the 1980s and the demand for solid waste collection services. In the 1990s, private sector enterprises kept entering the market.

The NCC began a trial solid waste management privatization scheme1 in 1997 after doing research that was funded by the Japanese government. The plan took the form of a management contract with a private company. It has not been renewed since the contract's expiration in 1999. In accordance with the Local Government Act (CAP 265) and Public Health Act (CAP 242), LAs provide solid waste collection services. While the latter mandates that LAs offer the services, the former gives LAs the authority to develop and maintain solid waste collection services. The Acts, however, neither specify requirements for collecting solid waste nor make any mention of recycling or waste reduction. The Acts also do not assign responsibilities for different categories of garbage, such as hazardous, industrial, or municipal trash. In accordance with the Local Government Act, the NCC has passed bylaws that prohibit the unlawful dumping of garbage, outline the storage and collection obligations of waste generators, and state the Council's authority to levy fees for the removal of solid waste. However, they are not carried out properly. As a result, Kenya lacks a comprehensive national solid waste management law. Despite being constituted as self-sufficient, independent business organizations, the Central Government weakens LAs. The NCC serves as the greatest illustration of how LAs function in Kenya. The NCC is led by a mayor who is supported by a deputy mayor and is made up of 73 council members, 55 of whom are chosen by the general public and the others are proposed by the MOLG. Twelve committees (made up of council members) oversee the Council's business, and they make decisions by consensus. The mayor and council members lack executive authority. Chief Officers, who report to MOLG, are in charge of carrying out the policies established by the committees and are led by the City Clerk. The Public Service Commission (PSC) hires these officials. Without PSC permission, the LAs are not permitted to punish or remove such employees from their positions. As a result, the staff has less responsibility to the LAs. The council members and the top officers have experienced extreme conflict as a result of this structure [4]–[6].

According to Gathru and Shaw (1998), the Local Government Act gives the Minister for Local Government the authority to create, dissolve, and regulate LAs unilaterally. Additionally, it gives the minister the authority to fire all council members, disband the council, and name a commission to manage the LA. Many commissions have been appointed throughout the NCC's history as a result of the use of this authority, sometimes to the organization's detriment and typically in reaction to political problems. Even though councillors are in charge of policy, even little actions need ministerial approval. Furthermore, it happens often for the Provincial Administration to disregard a decision made by the NCC. While the ministry has overstepped its bounds in certain areas in its monitoring of LAs, it has usually fallen short in this regard (NCC, 2000). Thus, it did little to stop the theft of NCC assets, and some of its senior staff members actively took part. Political parties fight for the opportunity to form the government, including municipal administration, ever since the nation established a multiparty political system in 1992. As a result, LAs often include council members from both the government and opposition parties. The political party with the most council members often elects the mayor, who is chosen by the other council members. Since 1992, the NCC has a majority of council members who are members of national opposition parties. This, together with the authority given to MOLG

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(controlled by the governing party) over LAs, and the fact that LA decisions are determined by consensus rather than majority voting, have provided for an environment that is ripe for sabotage.

The NCC has also been hampered by ongoing rivalry among councilor groupings for the coveted mayoral position. Once elected, the mayor is held captive by the council members, whose demands are often anything but altruistic. Since the middle of the 1980s, strengthening and empowering LAs has been a recurrent governmental goal. Recent policy documents (such as Budget Speeches and the "Interim Poverty Reduction Paper for the period 2000-2003"), among others, outline a number of reforms, including a reduction in the role of the central government, streamlining of financial management including revenue sharing programs and the improvement of local revenue mobilization capacity, and increased community involvement in project planning, service delivery, and project implementation. The political will is still insufficient, yet these policies are at various levels of execution. The Road Maintenance Levy Fund is currently distributed to LAs. Additionally, the first quarterly payments to the LAs were made in January 2000 after the implementation of the Local Authority Transfer Fund (LATF) Act in July 1999. In the first year, LATF got 2% of income tax receipts, or around Ksh 1.2 billion, although it is anticipated that this would increase to 5% in coming years.

DISCUSSION

Additionally, fresh attempts have been made in the legal field. The first effort at a national solid waste management legislation is the Environmental Management and Coordination Act (1999). The Act grants Kenyans the right to a clean and healthy environment and gives them the right to legal action if incorrect solid waste disposal occurs. The new environmental law's provisions for solid waste management are as follows:

i. Forbids the unlawful disposal and discharge of trash;
ii. Demands permits (from the National Environmental Management Authority, or NEMA) for the creation of waste disposal facilities, the transportation of garbage, and the production of hazardous waste;
iii. Requires waste producers to use practices including treatment, reclamation, and recycling in an effort to reduce waste.

The maximum punishment for breaking the new solid waste management rules is a maximum fine of Kshs 1 million (US$ 132,000), which is a reasonably deterrent sentence. The new legislation is commendable in that it gives private companies who compete with the NCC for solid trash collection the chance to be licensed. The effectiveness of the new legislation, however, won't be known for some time as implementation hasn't started yet. Even though there is currently no legislation in place to direct, monitor, and control the process of privatizing solid waste collection services, government attitudes are supportive in this regard (Republic of Kenya, 2000). However, the Environmental Management and Coordination Act (1999) establishes an organization (NEMA) to license trash transportation, the development of waste disposal facilities, and the production of hazardous waste, and the Local Government Act (Section 143) gives LAs the authority to contract out services.

ORGANISATION OF SOLID WASTE COLLECTION SERVICES

Nairobi's solid waste management system involves a wide range of participants. According to the figure, the actors may be broadly divided into those who create policy and those who carry it out or have an impact on it. The roles and performances of many performers are clarified in the analysis that follows.

1. Policy-makers

The MOLG is tasked with developing policies, provide technical support to LAs, and giving supervision and direction to supervisors. Additionally, the City Clerk, who is in charge of carrying out executive tasks and implementing policies, is answerable to the MOLG. Through the Environment Committee, NCC council members create regulations for the collection of solid waste. Roles and authority between MOLG and NCC are not clearly separated, as the previous section made obvious. When it comes to supervisory control, direction, and capacity development, MOLG has done a bad job. For instance, it usurps NCC's authority when it comes to repairing urban roadways (NCC, 2000). Policy decisions pertaining to the collection of solid trash are also made by the Ministry of Environment and Natural Resources (MENR). It is in charge of managing the environment overall, including trash and pollution. For instance, MENR is expected to, among other things, implement environmental standards on air, water, and land over the period 2000–2003, promote community-based waste management initiatives, offer incentives for informal sector waste management, and create environmental partnerships with stakeholders like NGOs and

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CBOs. The results of its policies, nevertheless, are still insignificant.

New institutions for environmental management have been created under the Environmental Management and Coordination Act (1999). A NEMA is envisioned for general oversight, coordination, and implementation of all environmental matters and policies, while a National Environment Council (NEC) is envisioned for policy formulation, setting of national environmental goals and objectives, and promotion of environmental cooperation. In addition, NEMA plans to establish a regulations and Enforcement Review Committee to provide guidance on environmental regulations, such as those governing waste disposal techniques and means. Additionally, the committee will publish rules for the treatment, storage, transportation, segregation, and destruction of trash. It is still too early to say if these institutional improvements will have any appreciable impact [7]–[9].

2. Waste generators

i. Households

Nairobi produced 1,530 tons of municipal (waste) per day in 1998, with families producing 82.8 percent of the city's total, followed by businesses (6.5 percent), markets (5.8 percent), and roadways (4.9 percent) (JICA, 1998). The greatest generation rates were seen in markets, roadways, and establishments like restaurants. JICA (1998) discovered per capita generation rates for high, medium, and low income residential areas to be 0.65, 0.60, and 0.54 kg/day, respectively. According to earlier estimates from the years 1985 to 1992, for example, per capita solid waste production rates were between 0.35 and 0.46 kg per day, depending on the socioeconomic class of the families (Mwangi, 1990; Syagga, 1992). The JICA (1998) statistics, however, are seen to be superior since the research was so thorough and included unplanned developments, while the others either utilized subpar NCC data or limited their surveys to serviced areas. Estimates of waste production are often calculated excluding the items that homeowners remove for recycling and trading.

In addition to producing garbage, households also take part in waste minimization or avoidance. Approximately 70% of the homes we spoke with segregate materials for reusing and/or selling. About 15% of the homes in the tested population exchanged the segregated commodities. Plastics, textiles for clothes and shoes, wood from furniture, and other items are consumed directly or indirectly by the household or by household staff. Food waste is fed to hens, pigs, and dogs while vegetable waste is utilized to fertilize/mulch kitchen gardens and, increasingly, for animal fodder. Households may turn to indiscriminate dumping and littering, rubbish burning and/or burying, and some of them even publicly admit to engaging in such behaviors as a result of the inadequate solid waste collection services.

ii. Institutions

Institutions including schools, hospitals, lodging facilities, dining establishments, retail stores, and marketplaces are also engaged in trash creation and material separation at the source. For the collection of solid trash, they hire private businesses, and they sell or give away the garbage to farmers and waste collectors. Esho (1997) conducted interviews with 19 institutions, and found that around 47% of them managed rubbish themselves, 45% burned it, and the remainder sold it to waste pickers. The majority of the 18 businesses surveyed (around 67%) sold their rubbish to pickers. According to our 1998 study, part of the organic waste gathered from 43% of Nairobi's marketplaces and institutions is utilized as animal feed. With its own burning plant, Kenyatta National Hospital is preparing to provide incineration services to other institutions. Industrial garbage is not regarded as municipal waste, and its disposal is the generator's responsibility. Industries may either transport and dispose of garbage on their own, hire private organizations or the NCC to do it, sell or donate the waste to recycling businesses, or recycle it themselves. Esho (1997) discovered that half of the businesses she surveyed hired the private sector to manage their garbage, while the other half managed it themselves, 60% of them by recycling it, and the other half by open dumping it or selling it to waste pickers.

Actors In Solid Waste Collection

The NCC and private businesses are Nairobi's main solid trash collection service providers, while there are other, smaller players. Some businesses and bulk producers, such as Nairobi Airport Services (NAS), store and transport their own garbage to the disposal facility. Kenya Refuse Handlers Limited, a private company hired by the NCC to provide solid waste management services in the CBD, accounted for 46% of the 360 tonnes of solid waste collected in the city per day in 1998, while the NCC accounted for 22% (JICA, 1998).

Additionally, many homes aren't serviced. The JICA study found that 74 percent of the surrounding area and 26 percent of high-income, 16 percent of middle-income, and 75 percent of low-income areas were not served. Approximately 48 percent of the households we surveyed had no solid

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waste collection service. The two main garbage collection techniques used in Nairobi are communal (or station) and door-to-door, with the former being employed primarily by the NCC and the latter by private businesses. According to JICA (1998), the community approach was responsible for 91 and 48 percent, respectively, of the total garbage collected by NCC and private businesses in 1998. The percentages for the door-to-door strategy were 9% for NCC and 52% for private businesses. Door-to-door collection is preferred by private collectors since it makes charges easier to collect. The community technique is placing residential garbage in a specified location or sizable container before pickup. Block and kerbside rubbish collection systems are also employed on a modest basis, despite not being included in the JICA study. In estates with block-shaped buildings and a shared entrance for several families, block collection is employed. In business districts, apartment buildings, and housing complexes where massive amounts of rubbish are produced, the kerbside approach is employed.

NCC

1. Collection performance

The NCC continues to play a prominent role in the SW collection and transportation sector and only offers street sweeping and waste disposal services. The NCC employs 2,416 persons to provide solid waste collection services under the Department of Environment's (DOE) cleaning division (1998). The DOE's duties include putting into practice the solid waste management policies created by the Environment Committee, maintaining public order, safeguarding the environment and public health, upholding aesthetic standards, offering solid waste collection and treatment services, regulating and monitoring waste generators, regulating and monitoring private sector participation, and enforcing all solid waste management laws and regulations. The city is split into two divisions for operational reasons, each having three districts. Each district offers services for SW collection, transportation, and street sweeping. In addition to these duties, the Dandora dumpsite is also managed by the Embakasi district. The greatest staff sizes are found in the Central and Western districts, which have varying district sizes.

Solid garbage collection services provided by NCC have been appalling over the last 20 years. When opposed to 270–350 tons per day as recently as 1992 (Syagga, 1992), NCC was only collecting 80 tons per day by 1998 (JICA, 1998). The NCC no longer schedules services; instead, it merely offers them when and where they are most required. It primarily serves important locations including airports, the central business district, hospitals, and politically sensitive residential districts. NCC services are thus concentrated in the same places as commercial providers are, i.e., those places and organizations that can afford private service at the cost of places where the poor live (JICA, 1998). NCC solid waste collection service is seldom ever provided to the eastern boundary. Low-income regions only get service when there is a "health hazard" from the rubbish, when there is a public uproar, or on days when the environment has to be cleaned up. Despite adding a fee on all water bills, the NCC no longer provides storage bins. The NCC's clients utilize any and all containers, including sisal bags and plastic buckets, for storage.

2. Vehicles and equipment

The quantity and caliber of the garbage transport equipment and other vehicles owned by NCC have drastically decreased. For example, the number of refuse trucks decreased from 60 in 1969 to just 21 by 1992, while the number of monitoring vehicles decreased from 35 to 4 over the same time period (Kibwage, 1996). By 1998, there were just 15 functioning trash transportation vehicles left (JICA, 1998). The Deputy Mayor of NCC notified the media in February 2001 that only 22 of the 202 garbage collection trucks out of a necessary 235 were in service. Additionally, the majority of the vehicles utilized by the NCC are in poor condition. The imported, highly mechanized vehicles are difficult to maintain and inappropriate for Nairobi and its waste characteristics, whilst the open trucks of the country have a poor capacity and significantly increase littering. These vehicles cost a lot, need a lot of labor, and pricey imported replacement parts (Syagga 1992; Otieno 1992). The main reasons for the poor condition of NCC's waste collection vehicles are a lack of funding, technical issues brought on by bad roads, overloading and improper handling by employees, poor servicing and a lack of replacement parts, and frequent accidents. While the Council's process for purchasing replacement components is drawn out and time-consuming, maintenance is sometimes not planned for sufficiently. The usage of the cars for private transportation is also illegal.

3. Disposal

The NCC is solely responsible for waste disposal. The sole authorized dumpsite in the city is an open landfill. The landfill, which is about 26.5 hectares in size and lies near Dandora, about 7.5 kilometers east of the CBD, was filled with over 1.3 million cubic meters of trash after being in service for

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almost 14 years (JICA, 1998). The NCC owns and operates the landfill, and depending on vehicle capacity, levies dumping fees ranging from Kshs 30 to Kshs 100 (US$ 0.4 to 1.35) per ton. The NCC loses a significant amount of cash due to corruption, in addition to the cheap costs. However, because of its remote location, the absence of citywide rubbish transport infrastructure, and security, disposal at the official landfill is relatively expensive. The control of the dump by gangs of rubbish merchants and pickers is linked to insecurity. The waste has been split into areas by many gangs. Each gang patrols its region to ensure that trash deposited there belongs to them. Similar to this, the vehicles that often carry rubbish into the dump are "owned" by certain gangs and are typically directed to the proper area for disposal. Cooperation is required from all truck drivers, especially NCC drivers, to prevent vandalism to the vehicles. The cops are often paid for to accompany them to the landfill. However, the authorities are often powerless in the face of the gangs, some of whom are headed by hardened criminals who pose as garbage merchants and are highly armed.

The environment for indiscriminate dumping by private firms is created by insecurity, the high expense of SW transportation and disposal, and the absence of effective supervision of the operations of private companies. As a result, illegal dumps used even by NCC have cropped up everywhere. Some private landowners who have abandoned quarries on their property are now offering them for rubbish disposal in exchange for small fees due to the increased demand for dumpsites. One of the major private solid waste collection businesses has been unsuccessfully attempting to get a permit from the NCC to run its own sanitary dumping site. Once the new environmental law is put into effect, this will be achievable [10]–[12].

CONCLUSION

In Nairobi, there are a number of issues with transportation and disposal of municipal solid garbage that must be resolved right now. The city's ineffective waste management techniques are a result of poor infrastructure, weak regulations, and little stakeholder participation. The report emphasizes the need for enhanced garbage collecting systems, which would include the use of contemporary technology and more resources. Strong transportation strategies are also required to guarantee timely and secure trash disposal. The report also underlines the significance of including pertinent parties, including local communities and waste management agencies, in the development of thorough waste management programs.

REFERENCES:

[1] J. Muiruri, R. Wahome, and K. Karatu, “Assessment of methods practiced in the disposal of solid waste in Eastleigh Nairobi County, Kenya,” *AIMS Environ. Sci.*, 2020, doi: 10.3934/environsci.2020028.

[2] M. M. Ikiara, A. M. Karanja, and T. C. Davies, “Collection, transportation and disposal of urban solid waste in Nairobi,” 2004. doi: 10.1007/1-4020-2529-7_4.

[3] K. Junglen *et al.*, “Characterization and prediction of fecal sludge parameters and settling behavior in informal settlements in Nairobi, Kenya,” *Sustain.*, 2020, doi: 10.3390/su12219040.

[4] World Bank, “Kenya - Development of Housing, Water Supply and Sanitation in Nairobi,” *World Dev. Sources, Rep. No. 15586*, 1996.

[5] M. Nthambi, “Determinats of Households’ Choice of Solid Waste Management Options in Kibera Slum, Kenya,” *J. Int. Real Estate Constr. Stud.*, 2013.

[6] R. K. Kazungu, “Improving Governance for Sustainable Waste Management in Nairobi,” *46th ISOCARP Congr.*, 2010.

[7] M. A. Mwanthi, L. O. Nyabola, and E. Tenambergen, “International perspectives. Solid waste management in Nairobi City: knowledge and attitudes,” *J. Environ. Health*, 1997.

[8] G. Mulaku, “ACCURATE MAPPING: THE FIRST STEP TO BETTER SPATIAL INFORMATION MANAGEMENT BY AFRICAN UTILITIES,” *African J. Sci. Technol.*, 2005, doi: 10.4314/ajst.v5i1.15316.

[9] O. Zedadra and Guerrieri, “EFFECT OF INTERNAL CONTROLS ON FINANCIAL PERFORMANCE OF SMALL AND MEDIUM ENTERPRISES IN NAIROBI COUNTY,” *Sustain.*, 2019.

[10] I. Baud, C. Furedy, and J. Post, *Solid waste management and recycling actors, partnerships, and policies in Hyderabad, India and Nairobi, Kenya*. 2004.

[11] R. K. Henry *et al.*, “State of the World’s Cities 2010/2011 Bridging The Urban Divide Nairobi | Kenya Design and Layout by MJS London,” 2008.

[12] R. A. Obudho, R. A. Obudho, and O. K. Mairura, “Urban environmental problems,” in *Infrastructure, Environment, Water and People: Proceedings of the 17th WEDC Conference*, 1991.

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Assessing Sustainable Development in Solid Waste Collection in Nairobi

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ABSTRACT: ***In this chapter, the role played by different players in Nairobi's solid waste collection in promoting urban sustainability is examined. To the greatest extent feasible, the framework established. The remainder of the research compares the two main service providers, the NCC and private businesses, in terms of sustainable development. For metropolitan areas to remain clean and healthy, solid waste management and collection are essential. However, there are several issues with Nairobi's present waste management procedures, including poor infrastructure, a lack of funding, and inefficient regulations. In order to assess the sustainability of solid waste collection in Nairobi, this study takes a multifaceted approach that takes into account social, economic, and environmental variables. Surveys, interviews, and site visits to recycling centres and garbage pickup locations are all used to gather data. The results will provide insightful information on the benefits and drawbacks of Nairobi's present waste management system, as well as suggestions for attaining sustainable growth in solid waste collection.***

KEYWORDS: ***Management, Sustainable Development, Solid Waste, Waste Collection, Waste Management.***

INTRODUCTION

Contributions to socio-economic components of sustainable development

1. User fees and financial sustainability

If an activity can support itself, it may be viewed as economically viable. Unfortunately, it was difficult to do a cost-benefit analysis in this situation that would have allowed for the drawing of clear conclusions. The information does, however, provide us some hints about the topic. Larger private sector organizations often have more profitable solid waste collection operations than the NCC does. However, the strong rivalry brought on by unrestricted entrance and a lack of regulation in the market also poses a severe danger to the financial survival of private solid waste collection companies, especially smaller ones. The municipality's ongoing solid waste collection operations have steadily become worse, and this is intimately tied to the ongoing financial problems at the NCC. Operations for collecting solid garbage are negatively impacted by bad financial management, an overworked staff, corruption, ineffective revenue collection, and indebtedness. For instance, the Interim Oversight Board calculates that the NCC now owes Kshs 7.5 billion in obligations and earnings [1]–[3].

The feasibility and profitability of solid waste collection operations are mostly determined by user fees. Private solid waste collection businesses vary in size from very big ones with fewer than 100 customers to very small ones with up to 5,000 clients. For instance, our study revealed that there are just 60 Urban Waste Management Services. Even 'brief case' firms, made up of only one or two people and operating without permanent offices or contact addresses, exist. These businesses lease or borrow cars to carry rubbish. They provide sporadic service and levie a low cost. They may take a while before returning to the same region since they choose the places they serve somewhat randomly. They also take part in a wide range of other business endeavours.

Larger businesses often have greater rates and turnover. The average monthly fee for a service provided by medium and big businesses is around Kshs 500 (US$ 6.70), while their monthly revenue ranges from Kshs 700,000 to Kshs 2.5 million (US$ 9,350-35,000). Larger businesses focus on clientele including businesses and institutions, as well as high- and some middle-class residential neighbourhoods, who pay higher fees. The cost of the service has been significantly impacted by the fact that households are not required to hire the private company providing solid trash collection to other nearby residents. Due to this, private businesses often have a small number of dispersed clientele in various residential regions. To secure profitability, the businesses charge their few dispersed clientele as much as Kshs 800 per month. Potential customers are put off by the exorbitant cost, and certain neighbourhoods are left without services. These pricey service providers are able to hold onto the upstream market by providing

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services that are constantly of a high calibre. Households in these upscale neighbourhoods revealed during the fieldwork that the private solid waste collection services were reasonably priced. Large companies are consequently able to charge high prices and maintain their services due to effective demand.

Small and some medium-sized businesses use competitive pricing, which means that the costs are based on the size of the bulk load for big generators, the degree of local competition, and sometimes the distance of the region from the service provider's facilities. Small businesses often charge 60% less for their services than do bigger businesses due to more competition. Due to fierce competition, monthly fees in the lower income sectors that small businesses are rapidly entering have dropped to as little as Kshs 100 (US$ 1.3). 'Brief case' businesses actually charge as little as Kshs 50 per month for a service, despite the fact that people are often prepared to pay much greater costs. According to a recent poll, for instance, 50% of those who were paying between Kshs 300 and 400 per month were prepared to spend up to Kshs 800 (US$ 10.6), while 47% of residents who were paying less than Kshs 100 per month were willing to pay more than Kshs 200. Private companies, especially the smaller ones, are prevented from fully using this opportunity in the absence of government rate fixing due to the fierce open competition, which lowers their economic viability.

Another issue that private solid waste collection companies face again, the smaller companies more so than the bigger ones is non-payment by certain customers and the widespread perception among Kenyans that the NCC is responsible for handling solid trash collection. Residents become reluctant to work with private providers as a result of the latter, particularly in less wealthy neighbourhoods. Furthermore, NCC continues to be politically opposed to privatizing the solid waste collection business because to concerns that doing so could result in job losses. Numerous businesses and organizations are among the NCC's numerous clients. Additionally, despite the fact that the service is seldom ever done, every family with a water connection pays an average monthly garbage collection price of Kshs 60. But given its poor performance, the NCC is unable to raise the solid waste collection service prices to keep up with rising service costs. One of the areas that needs improvement is this one. The clean-up division lacks fiscal independence and has no influence over the waste charges added to the water bill. In comparison to places like Bangkok (15.3%) and Penang (24.7%), it barely gets 10 percent of the NCC funding (JICA, 1998). The political struggle over limited local government resources is the basis for allocations rather than the demand for services. As a result, DOE consistently receives inadequate money [4]–[6].

2. Equipment and shipping costs

Large private enterprises' bigger, well-maintained equipment and facility inventories are another indication of the solid waste collection service's economic success. Bins (Nairobi) Ltd., for instance, has 11 collection vans, compared to City Bins Ltd.'s 15. Smaller businesses with 2 to 6 vehicles are Tacentac Enterprises and Urban Waste Management Services. A typical small business has one vehicle, often a pick-up (weighing around 1 tonne) or 7-tonne truck, which is either family-owned or rented from the open market. The car is usually an old family pick-up that serves several purposes and has no other use. In a 1997 Esho study of small businesses, leased automobiles were utilized by around 60% of the respondents. Small businesses transport rubbish using little trucks with very little capacity. Due to the expensive cost of renting vehicles, it is difficult for businesses to make a profit. Transportation expenditures are increased by the poor condition of the roads and ongoing gridlock. The dispersion of each company's customers around the city is another factor driving up transportation expenses. For a voyage carrying 4 tons, for example, private collectors go 50 kilometres as opposed to 35 km for NCC (JICA, 1998). High travel costs are an issue that is made worse by rising fuel prices and a lack of transfer facilities. Thus, Nairobi's haphazard solid waste collection system results in ineffective service delivery, which has a severe impact on the financial health of private businesses. More cars than any private company are in the NCC's fleet, however due to poor maintenance and repair, the majority of them are not in use.

3. Workforce and productivity

The NCC's overstaffed personnel is one of the primary reasons for the ongoing financial crisis. In order to justify employing additional employees, mostly family, friends, and supporters of council members and politicians, the city's population expansion is often made the scapegoat (NCC, 2000). However, there hasn't been a parallel rise in the performance of municipal services with the labour growth. For instance, the NCC's staff rose from 17,000 to 20,048 between 1995 and 2000, yet the Council's solid waste collection performance did not improve as a result. Around 2,324 people were employed in the cleaning area in 1998, with

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22% of them working in solid trash collection and the remainder in street cleaning (JICA, 1998). 7.3 employees would be needed to collect 1 ton of SW at the time the NCC was collecting about 70 tons each day. However, a smaller corporation like Tacentac Enterprises required 0.84 personnel while a private company like Bins (Nairobi) Services Ltd. only needed 0.62. In addition, the NCC had 4.8 crew members on average per collection truck vs 4.0 for private collectors (JICA, 1998). The results of the pilot public-private partnership between the NCC and KRH serve as a convincing example of how private businesses are better in terms of labour productivity. The private company was able to do far better job than NCC was able to accomplish with greater resources with Kshs 1.3 million (US$ 20,000) every month. The municipal authorities was able to save Kshs 2.6 million per month by redeploying 525 garbage personnel and vehicles to other locations.

The NCC's excessively large personnel has had a significant impact on the pay bill. Less than 10% of NCC's yearly revenue is utilized for operations and maintenance, with more than 90% going toward paying employees' salaries and benefits (NCC, 2000). The Interim Oversight Board claims that a substantial part of NCC personnel are "ghost" employees (those who just exist on the payroll), and that only 12,000 are really necessary. This behaviour is undoubtedly another factor in the relatively poor labour productivity of NCC activities. Sadly, suggestions to cut the staff to 12,000 in order to improve the NCC's income situation encounter ferocious opposition. For instance, when 273 employees who were hired improperly were fired in January 2001, NCC council members expressed outrage.

DISCUSSION

Contributions to public health and environmental components of sustainable development

1. Cleanliness of communities

Many Nairobi neighborhoods, particularly the unplanned, low-income sections, could need some cleaning up. Due to the near collapse of regular service, the NCC's contribution to the promotion of public health via adequate solid waste collection is minimal. Additionally, the NCC rarely ever supplies storage containers, which, according to the houses surveyed, results in an infestation of mosquitoes and other flies, odor, and the spreading of waste by animals. Since they often provide their customers consistent (1-2 times weekly) and dependable services, private businesses make a significantly more favorable contribution to the objective of clean neighborhoods. As an added benefit, several private companies provide their customers with street/compound cleaning and/or sweeping services. The majority of homes who employ private solid waste collection services reported having little storage issues. However, some homes have complained that the private businesses don't always collect trash on time. Stray dogs and cats destroy the uncollected trash, leaving streets and surrounding areas littered. 'Brief-case' rubbish pickup companies are particularly prone to this issue.

The absence of government backing is the main issue preventing the private sector from playing a more ecologically responsible role. There are no bylaws requiring locals to take part in a solid waste collection service provided by a commercial company in their community. Because of this, they are unable to maximize the collecting potential in the region and appropriately lower their charges, which would increase participation and, in turn, improve cleanliness. Furthermore, the NCC does not enforce compliance with public health and service standards in the private sector. Private business owners are hesitant to abide with environmental standards since they are primarily driven by the desire to generate money. For instance, ineffective supervision usually leads to garbage being dumped carelessly, particularly by "brief case" private enterprises. Last but not least, the private sector is unable to expand solid waste collection services to all previously serviced regions. The public health conditions in the serviced regions are adversely impacted by the external consequences of the pollution in these places. However, certain low-income residential neighborhoods, especially those close to the city's dumpsite, now have access to private solid waste collection services thanks to the advent of smaller businesses with cheap operating costs. As a result, Esho (1997) discovered that the middle-class and some low-income neighborhoods were primarily supplied by 70% of the small private enterprises in his sample. Additionally, in low-income and slum regions, 11% of the families we surveyed in 1998 received solid waste collection services from private businesses.

2. Worker health

Both NCC and private sector employees' health situations are concerning. About 80% of the employees who were questioned reported dealing with health risks at work, which is a larger rate than that seen among rubbish pickers at dumps. Simple collection systems are used, and physical labor is

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often used to load rubbish into the trucks. The health and welfare of the trash crew are affected by this. The most frequent illnesses experienced by the employees are injury/cuts, headaches, stomach problems, skin problems, respiratory difficulties, pains and aches, eye issues, and burns (30 percent), in that order of importance. The only "protective gear" used by the employees consists of overalls, boots, and sometimes gloves. Additionally, lower tier employees in the private sector are not protected by medical plans and do not get routine checkups.

3. Environment and transportation

Transportation is a challenging part of solid waste collection in Nairobi since there is only one official dumpsite and no transfer facilities, which adds to the environmental and financial implications. The affordability of private solid waste collection services is mostly influenced by user charges, which are a key determinant of these expenses. The implications are especially severe in low-income regions that are far from the Dandora dumpsite. Another issue with collecting trucks' environmental impact is air pollution. It specifically applies to smaller businesses that serve low-income neighborhoods and rely on the usage of outdated cars to stay afloat. Last but not least, it's important to note that NCC and private handling company employees have encountered issues with garbage pickers hopping on their trucks and utilizing the journey to sift out usable waste stuff. They often leave a trail of trash on the highways after their hurried labor.

4. Recycling, reuse and composting

Even though Nairobi's solid waste management system has large sub-sectors for recycling, reusing, and composting, the NCC and private companies' collection activities are in no way focused on these issues. For source separation, recycling, reuse, and the reduction/prevention of waste creation, there is no formal policy or assistance. Any connections that do exist are unintentional and the consequence of actions taken by organizations outside of government (NGOs, CBOs, international organizations, and certain private handling firms). For instance, our study found that 5% of them are active in trash separation.

5. Environmental effects of disposal

Despite being the sole agency permitted to provide disposal services, the NCC has no control over the disposal of garbage. Due to harmful material leaks, the technique of crude dumping used at Dandora a former quarry causes serious ecological hazards. Due to the lack of a solid waste management program, the site's ability to absorb wastes has been severely compromised, shortening its lifespan. Due to a lack of transfer facilities, the NCC now utilizes illegal dumping, which has had a significant impact on the city's cleanliness. Because of the official dump's poor management, the nearby neighbors have severe health issues. All of these issues are made worse by the disturbing security situation at the dump, which seems to be completely out of government control. Despite the fact that private firms collect substantial amounts of garbage from neighborhoods and other regions of the city, only some of it gets dumped at the authorized dumpsite. There are regular accusations that in an effort to reduce operating costs, the majority of commercial companies particularly "brief case" ones dump rubbish in public areas rather than at the designated dumpsite. Additionally, excessive usage of plastic bags for garbage storage has been pushed by private suppliers, creating additional environmental issues. However, the fact that some private businesses are supporting environmental awareness programs is positive.

The official dumpsite will move from Dandora to Ruai as planned, which should enhance environmental effects of ultimate disposal but might also negatively influence other aspects of sustainable development. The new location will be a sanitary landfill7 and as its capacity remains unaltered, it will digest garbage more efficiently. In the long run, the effectiveness of the new dump's administration and the pace of trash deposition will decide environmental elements of sustainable growth. However, because of the dump's further distance from the CBD and the absence of transfer facilities, more solid waste collection organizations would dump garbage carelessly, endangering the public's health. The decision is also likely to have a significant impact on the viability of private businesses. In locations where such lengthy transportation distances must be covered, fewer businesses will be able to function. The employees of these businesses may lose their jobs as a result, but probably more crucially, the estimated 2,000 dump garbage pickers and dealers who operate at the old dumpsite may lose their source of income. Significant internal and external resistance to the planned move exists in LA [7]–[9].

OTHER ACTORS' CONTRIBUTIONS TO SUSTAINABLE DEVELOPMENT

The before mentioned additional players only have a very little and often indirect impact on the collection of solid trash. The comments that follow are limited to those areas where they most strongly support the objectives of urban sustainable development.

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1. **Informal actors**

By lowering the amount of garbage that has to be disposed of, informal actors support the environmental aspects of the city's solid waste collection service. Additionally, they improve social justice in service delivery by reducing waste in crucial locations (non-serviced low-income communities). However, garbage pickers and dealers indiscriminately discard non-saleable products, polluting the locations where they work, and enraging the NCC and private firm employees who must clear up the scattered rubbish. Their impact on public health is so detrimental. Theft of garbage storage containers is another charge leveled against unofficial actors.

2. **NGO's and CBO's**

By composting organic wastes, recovering inorganic waste materials, conducting routine environmental clean-ups, and educating the public on environmental and waste management issues, CBOs (and the NGOs that support them) have made individual and localized contributions to the sustainable development of the city's solid waste collection service. JICA (1998) lists the localized effects of composting groups in Nairobi as enhanced public health, a cleaner environment, and more money. Weekly clean-ups in the slums of Mathare are organized by the Mathare Youth Sports Association. The community was successfully made aware of the need of waste separation at the place of creation by the Kitui Pumwani Integrated Project CBO (JICA, 1998). However, the overall contribution of CBOs is still modest. Only 15 community-based solid waste organizations with a combined membership of 10,300 process less than 0.1 percent of the entire municipal garbage produced, or roughly 1 ton of waste per day (JICA, 1998).

Undugu Society of Kenya, a humanitarian NGO engaged in plastic recycling and composting operations since 1981, has helped low-income garbage collectors and street children by providing work and revenue production opportunities (Davis-Cole, 1996). Numerous variables, including those covered in one of the preceding sections, limit the impact of CBOs and NGOs. Residential associations, together with its umbrella group "We Can Do It," are increasingly playing a crucial role in keeping the NCC and the Central Government on their toes by calling for better services and more accountability. Additionally, they are organizing self-provision of not just solid waste collection but also additional services (including security and infrastructure) in addition to evaluating the quality of private solid waste collection services. Since the organizations were born out of need and are run by highly educated and forward-thinking individuals, they are emerging as important change agents for sustainable solid waste collection.

3. **Urban farmers**

Urban agricultural practices, such as kitchen gardening, are absorbing a significant portion of the organic waste that could otherwise have ended up at the dumpsite, contributing increasingly more to the financial sustainability of the city's solid waste collection efforts.

Views of stakeholders on a potential solid waste collection strategy

On August 16, 2000, a stakeholder workshop took place. Representatives of the NCC, private solid waste collection firms, recycling businesses, unofficial players including garbage pickers and dealers, the Ministry of Health, and the University of Nairobi were among the 31 attendees. Stakeholders discussed a range of problems and voiced their worries and perspectives. Of course, they did not always share the same opinions. But in the end, regarding solid waste collection, the following findings were made:

1. The NCC was given the task of organizing regular stakeholder meetings and discussions.
2. Solid trash collection was becoming worse despite the constructive efforts of the corporate sector and civil society organizations. Reuse and recycling of garbage were assessed insufficient, the Dandora dump's conditions were rated appalling, and the issue of indiscriminate dumping was seen as posing a major danger to public health. However, it was questioned if the intended waste transfer to Ruai would be implemented quickly. The operating expenses of private businesses and trash recycling organizations were significantly rising due to inadequate infrastructure, such as bad roads, traffic congestion, and power and water shortages, endangering their ability to continue contributing to a more sustainable solid waste collection system. The NCC's main responsibility was to provide a fair playing field for the other parties by facilitating, regulating, and overseeing them. Additionally, since it charges homeowners for trash disposal, the NCC was required to provide a reliable solid waste collection service either directly or via private suppliers.

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3. Private businesses had a significant influence. However, because of their participation, effective regulation was needed to both facilitate their activities and safeguard the general welfare. They were charged with indiscriminate dumping even though they were already making a significant contribution. Private businesses themselves were not pleased with the chaotic free competition. They said it caused the emergence of several "brief case" businesses that provided very cheap costs but carelessly discarded rubbish, harming the reputation of the whole private solid waste collection industry. There was broad consensus about the need of creating and putting into place norms and criteria for private solid waste collection services. Additionally, private businesses complained about non-payment. Participants came to the conclusion that formalizing and organizing private sector engagement was necessary to enable private enterprises to more easily utilize the legal system for the settlement of such issues. Additionally, it was thought that trash disposal services should only be offered by the commercial sector with a license.
4. Although the importance of the civil society (CBOs and RAs) was recognised, there was also a need to support and develop its participation.
5. In order to support the design of efficient solid waste collection initiatives, it was necessary to increase public knowledge of solid waste concerns and examine the role of culture on trash creation and management.

System-Wide Concerns

Although not entirely, the aforementioned research was structured in accordance with how solid waste collection operations affect the participants or the customers they serve. However, it's also critical to consider issues at a systemic level and go beyond the micro level. From the standpoint of urban sustainable development, this is particularly justified. Several issues come to mind. First off, due to their 'illegal' status, poor accessibility, weak political voice, and lack of purchasing power, low-income areas, primarily slums and other unplanned settlements, where about 60% of Nairobi residents live, hardly or never receive any solid waste collection service. The NCC seems to be oblivious to the demands of the majority of its inhabitants and overlooks the external consequences of poor public health in these places by focusing its limited resources there. The greatest significant impediment to more sustainable solid waste management is likely the disturbing lack of equality in service.

If the authorities want to achieve any significant progress in the city as a whole, they must acknowledge the phenomena of illegal settlement. Second, the Central Government and the NCC often disagree, overlap, and create uncertainty in Nairobi's administration. In addition, decision-makers (NCC council members) often lack education and authority to punish NCC employees and officials. The councillors who elect the mayor are more loyal to their hungry demands than to the people of Nairobi. Consequently, the NCC has developed a reputation for poor administration, fraud, indifference, and overall disorder. The collapse of direct public services as well as the lack of system-wide coordination and regulation of other players in solid waste collection (the NCC's indirect provision role) are the results of this local administration system's failure [10].

Uncontrolled private sector participation in solid waste collection has a negative impact on effectiveness. Its impulsive character suggests that it is only motivated by commercial concerns at the cost of social and governmental objectives. Third, Nairobi lacks either a "integrated" solid waste management system or any policies that would go in that direction. Activities like collecting, recycling, and composting don't always relate to one another structurally. They are the product of “spontaneous” initiatives in civil society rather than any coordinated NCC operation. Therefore, the potential for producing beneficial spin-offs is not realized. Additionally, the concept of collaborations amongst several performers, each contributing their own unique features, has not yet been thoroughly considered. For instance, residential associations might efficiently oversee and monitor private solid waste collection companies and ensure that they uphold service requirements. The fact that different trash types are jumbled together is another upsetting feature of this lack of integration. Therefore, relatively safe garbage is polluted with hazardous and poisonous compounds, making collection locations and dumpsites environmental and public health risks. Whether the Environmental Management and Coordination Act (1999), which calls for a more integrated approach to solid waste management, will really aid in the solution of these issues is still up in the air.

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CONCLUSION

Several important conclusions are drawn from the evaluation of sustainable development in Nairobi's solid waste collection. First off, the city's current waste management procedures are insufficient, posing a threat to the environment and public health. These problems are exacerbated by limited resources, poor infrastructure, and inefficient policies. To achieve sustainable waste management, social variables including public knowledge, community engagement, and behavior modification are essential. Public involvement may be increased and proper trash disposal methods can be promoted via educational campaigns and community engagement initiatives. Thirdly, finance and investments in waste management infrastructure are important economic determinants for sustainable growth. Waste collection and disposal procedures may be greatly enhanced by wise resource allocation, cost-effective technology, and public-private collaborations. Last but not least, reducing the environmental effect of solid waste requires consideration of environmental variables including recycling and waste reduction techniques. Promoting energy recovery, composting, and recycling practices may help create a waste management system that is more sustainable. These results suggest that in order to enhance solid waste collection and ensure sustainable growth in the city, Nairobi authorities should give priority to infrastructure development, raise public knowledge and engagement, allot enough budget, and put appropriate laws in place.

REFERENCES:

[1] M. A. Hannan *et al.*, "Solid waste collection optimization objectives, constraints, modeling approaches, and their challenges toward achieving sustainable development goals," *Journal of Cleaner Production*. 2020. doi: 10.1016/j.jclepro.2020.123557.

[2] L. Rodić and D. C. Wilson, "Resolving governance issues to achieve priority sustainable development goals related to solid waste management in developing countries," *Sustain.*, 2017, doi: 10.3390/su9030404.

[3] N. Ferronato and V. Torretta, "Waste mismanagement in developing countries: A review of global issues," *International Journal of Environmental Research and Public Health*. 2019. doi: 10.3390/ijerph16061060.

[4] N. H. Hoang and C. Fogarassy, "Sustainability evaluation of municipal solid waste management system for hanoi (Vietnam)-why to choose the 'waste-to-energy' concept," *Sustain.*, 2020, doi: 10.3390/su12031085.

[5] N. Ferronato, M. Ragazzi, M. A. Gorritty Portillo, E. G. Guisbert Lizarazu, P. Viotti, and V. Torretta, "How to improve recycling rate in developing big cities: An integrated approach for assessing municipal solid waste collection and treatment scenarios," *Environ. Dev.*, 2019, doi: 10.1016/j.envdev.2019.01.002.

[6] M. A. Hannan *et al.*, "Waste collection route optimisation model for linking cost saving and emission reduction to achieve sustainable development goals," *Sustain. Cities Soc.*, 2020, doi: 10.1016/j.scs.2020.102393.

[7] E. Bahçelioğlu, E. S. Buğdaycı, N. B. Doğan, N. Şimşek, S. Kaya, and E. Alp, "Integrated solid waste management strategy of a large campus: A comprehensive study on METU campus, Turkey," *J. Clean. Prod.*, 2020, doi: 10.1016/j.jclepro.2020.121715.

[8] S. Adipah and O. N. Kwame, "A Novel Introduction of Municipal Solid Waste Management," *J. Environ. Sci. Public Heal.*, 2018, doi: 10.26502/jesph.96120055.

[9] A. M. Troschinetz and J. R. Mihelcic, "Sustainable recycling of municipal solid waste in developing countries," *Waste Manag.*, 2009, doi: 10.1016/j.wasman.2008.04.016.

[10] N. Parvez, A. Agrawal, and A. Kumar, "Solid waste management on a campus in a developing country: A study of the Indian institute of technology Roorkee," *Recycling*, 2019, doi: 10.3390/recycling4030028.

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Trial and Error in Privatisation; The Case of Hyderabad's Solid Waste Management

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ABSTRACT: ***In India's busy city of Hyderabad, managing solid waste present's substantial difficulties. This case study investigates the situation of Hyderabad's solid waste management, outlining the major problems, prevalent procedures, and prospective remedies. The study uses information from academic studies, government publications, and interviews with pertinent parties. It is possible to learn important lessons about the wider problems of solid waste management in rapidly expanding metropolitan regions by studying the instance of Hyderabad. Hyderabad's situation offers other fast developing metropolitan regions struggling with solid waste management a significant lesson. Cities may work toward efficient waste management systems that contribute to a more sustainable and livable future by comprehending the local environment, adopting creative solutions, and putting sustainable principles into reality.***

KEYWORDS: Hyderabad, Management, Solid Waste, Urban Areas.

INTRODUCTION

With a population of more than 4.5 million, Hyderabad, the state capital of Andhra Pradesh in Southern India, is the fifth-largest metropolis in the country. The Municipal corporate of Hyderabad (MCH) is in charge of collecting and disposing of municipal garbage across the corporate region, as specified in The Hyderabad Municipal Corporation Act. The Health Section and the Transportation Section are in charge of these activities overall, much as other Indian Municipal Corporations. There are 12,590 permanent workers at the MCH, 7,150 of whom work in the health section. Out of them, sanitation work is performed by over 5,700 personnel (MCH, 1998a). The MCH is structured administratively into seven "circles" that each include 56 wards. Each circle is led by an Assistant Medical Officer of Health (AMOH). Sanitary Supervisors, who are in control at the ward level and oversee a group of Sanitary Jawans, provide assistance to this individual. The day-to-day oversight of the kamatans, kamatees, and truck employees is the responsibility of the Jawans. While the kamatees (males) dispose of the rubbish at the collection locations, the kamatans (females) sweep the streets and collect the trash. Based on fieldwork conducted from January through July 1999, this chapter [1].

The study's purpose was to evaluate the kind and level of private sector involvement in Hyderabad's solid trash collection as well as the degree to which it was successful in achieving different objectives. I made an effort in the evaluation to incorporate the social and political aspects of the privatization process in addition to the more common concerns with service efficacy and efficiency. The research was led by the following set of queries:

1. Why did the MCH decide to privatize a significant portion of its solid waste collection services, and what are the features of the privatization model that was chosen?
2. What socioeconomic effects will this specific kind of solid waste collection privatization have on the contractors and workers involved?
3. What are the advantages and disadvantages of the existing system for privatizing the collection of solid waste?

The primary public-private partnership in solid waste collection is the outsourcing of sweeping services and solid trash collection in the MCH's planned residential districts to private companies1. Property tax income covers all of the service's expenses. There are plans to impose "user-based garbage collection charges." However, there are rumors that for political reasons, residents will once again be spared from paying.

Terms of Reference for the Collection of Private Solid Waste

The MCH's decision to outsource some of its solid trash collection duties to the private sector was primarily motivated by the difficulty it had in hiring more employees despite the city's ongoing growth. There were more considerations at play. For instance, the Supreme Court ruled that major highways should be thoroughly cleaned before the

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morning opening of businesses. The MCH was forced to start night sweeping as a result. However, owing to their strong legal position and the opposition from the labor unions, MCH workers who were vehemently opposed to working night hours were unable to do this task. When 10% of the MCH regions were privatized in 1994, the first serious effort to privatize the solid waste collection services was made (MCH, 1998a). More portions were turned over to the private sector in 1996, and by 1998, about 25% of the MCH region had been privatized (MCH, 1998a). At first, either the set volume method or the lowest bidder system was used by the contractors. According to the lowest bid methodology, the MCH identified the locations and issued a request for proposals from private contractors. Entrepreneurs were invited to provide daily estimates for the cost of cleaning and lifting waste for the whole region. The second approach included paying according to how much trash was removed. The lowest bidder received the contract for sweeping and rubbish lifting in a specific region after the contractors were requested to submit their estimates for one Mt. of waste [2], [3].

The participation of the community via a tricycle program is a distinctive aspect of Hyderabad's solid trash collecting system. The house-to-house collection is handled by community-appointed rubbish pickers in around 1,200 colonies, each of which has 100–200 families. The MCH is covering the cost of the tricycle, and the inhabitants pay a monthly charge of Rs 10–20 (approximately Rs 40 for 1 US$ in 1999). The MCH stated in 1998 that the current privatization attempts had not been successful. Three factors were cited as the cause of the private sector's poor performance: the first was the inability of the private operators to assure accountability; the second was the absence of an effective monitoring system; and the third was the absence of established production criteria (MCH, 1998a). For instance, a local newspaper at the time claimed that private contractors and numerous MCH officials had formed a covert syndicate, which caused the bids to soar by about 200 percent above the prices offered in the prior bidding process (Deccan Chronicle, 3/31/98). In an effort to address these issues, the MCH unveiled a totally new organizational structure and logical monitoring system in September 1998. The municipal wards were split into 266 so-called units of about comparable size to add consistency to the system.

120 of these units were given to MCH employees, while the remaining 146 were given to the private sector. The remaining MCH units received the workers who had previously worked in the privatized MCH units. Additionally, several new, hitherto unserviced regions were occupied by private contractors. Each unit generates around 7 to 8 Mt per day and has a total sweep length of about 8 km. One sweeping unit and one lifting unit make up each unit. The MCH has established the following labor needs for each unit. Contractors were asked to submit their thoughts once the unit pricing was set via advertising in three daily publications (a prestigious Telugu, Urdu, and English newspaper). Only two weeks passed between the request for bids and the commencement of the job, which was quite little time. The MCH did indicate its preference for companies satisfying the following requirements: having their own vehicles, labor license, Profident Fund (PF) and Employees State Insurance (ESI) code number, and good record of previous performance. There were no requirements regarding the type of company, so both proprietary firms, partnership firms, registered companies, Labour Contract Societies, as well as individuals, were invited to respond. Labor Contract Societies were singled out as a kind of contractor and prompted to think.

The MCH also gave precedence to businesses or individuals ready to finance the purchase of Dumper Placer trucks. The most that any one contractor could have was three units. Even with all of these requests, the MCH received more applications than it had units to fill. Therefore, a drawing for lots was used to make the final decision. For each unit, the applicants were required to put down Rs 25,000 ($625). The Earnest Money Deposit (EMD), which is equal to 2.5% of the yearly contractual sum, serves as a guarantee for the MCH. The MCH is authorized to cancel the contract, lose the EMD, and blacklist the contractor if, after many warnings, the contractor continues to exhibit poor performance. Regarding the contract criteria, it is important to draw attention to one episode in particular that had a significant impact on the MCH's method of contracting. Because they had been discovered to be "state employees in disguise," the Supreme Court of India granted a motion for the integration of contract laborers employed by a private contractor into government service in its ruling from March 30, 1999. Although it was unknown whether this decision would also apply to Hyderabad's unit-system, the MCH prepared for it by making certain changes to the contracts' terms of reference. These "little manipulations," as one MCH official called it, were done to keep the contract system in place. However, these changes

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have decreased the security of contracting out governmental services, particularly for contract workers [4]–[6].

DISCUSSION

Implications of Privatisation For the MCH

Money channeled to the private sector has significantly grown since the unit system was implemented in September 1998. Prior to the implementation of the unit system, the revised budget projections for 1997–1998 indicated that 57,39 lakh rupees per month were spent on privatizing solid waste collection services. After the most recent reform, the overall cost of privatized solid waste collection almost quadrupled. Unfortunately, it was hard to determine how the increase in spending was covered. The reorganization and modernization of the supervision and monitoring system was another significant result of the privatization of solid waste collection for the MCH, particularly in light of the implementation of the unit system. The performance of private operators can be checked more easily than that of public institutions, according to proponents of privatization. Sanitary Supervisors are in charge of overseeing the daily operations of the private contractors in Hyderabad. However, there are a number of problems with their work. First off, there is a huge variation in the workload of the sanitary inspectors, with some covering just a small number of units and others considerably more. Second, any deficiencies in the service provided by the contractor must be reported by the supervisors to the Circle Office. Depending on the nature and frequency of the violations, the Commissioner of the MCH may determine the deductions from the contractual amount owed to the business owners based on these reports. However, the supervisors primarily focus on job completion - correct street cleaning and removal of garbage from the collection locations - while neglecting regulations with regard to labor conditions, in part because they believe this is outside their scope of duty. Thirdly, records of the violations committed by specific contractors are not maintained. As a result, when issuing new contracts, the MCH is unable to distinguish between contractors who perform well and those who don't. Finally, corruption may affect the whole system. It is well known that agreements are struck between sanitation supervisors and contractors to suppress the reporting of deficiencies. It's noteworthy to observe that the existing approach also assigns the community a monitoring responsibility. In practically every unit, a citizen committee with 10–15 members was formed. After the contractors have completed their job, they must get the signatures of at least three members to show that the work has been approved. Without these signatures, the contractor's invoices will not be accepted. Although these standards undoubtedly help employees perform better, they are also subject to manipulation.

Contractors' Position in the New Unit System

This section summarizes the findings of a brief survey conducted among independent contractors. A total of 28 interviews were conducted, 10 of which were deep in nature. On the basis of a list supplied by the MCH, the contractors were first contacted. Following that, appointments were established, often with the help of the Sanitary Supervisors. Most often, the contractor's home was the location of the interviews.

1. **Sociocultural upbringing**

Ninety percent (90%) of the contractors surveyed identify as Hindu, and many of them are Reddys. They are a part of indigenous agricultural groups that fall under the forward communities' category, along with the Kammas and Velamas. Muslims make up the last 10% of the contractors. Three of the contractors that were questioned are female. A women's cooperative society serves as the umbrella organization for all of these. The other contractors were born in one of the nearby districts, while over one third of the contractors were born in Hyderabad. The contractors, however, were all born in Andhra Pradesh. Most contractors have a college degree. 52 percent of them have at least a bachelor's degree, compared to just 15% who have no education or only a few years of elementary schooling. It seems that they often participate in truck-related activities like transportation and building work, according to the literature outlining the antecedents of contractors in solid waste collection services.

However, in Hyderabad, the contractors are a pretty diverse group that carry out a wide range of various tasks with varying degrees of dependency on solid waste collecting operations. For instance, small-scale industries, real estate brokers, and labor contractors were among the contractors that were questioned. Given that some of the contractors are Labor Contract Societies, they may be described as "unconventional."3. These organizations were allowed to submit applications for many contracts thanks to the MCH, at the state government's request. The majority of them are women's cooperative societies, although other labor union welfare organizations also participate. Even though they are referred to be cooperative societies, these

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organizations really function under the exact same regulations as the fully private contractors.

2. Labor Welfare Organization of the MCH Employees Union

A labor organization called the MCH Employees Union is a member of the CITU, which is politically associated with the CPI (M), the communist (Marxist) party. Since 1998, its labor welfare organization has been engaged in solid garbage collection. It is free from paying EMD since it is a Labor Contract Society. Children of retired and current MCH workers are allegedly given jobs by the organization since they are no longer able to sign up for MCH-service. With regard to the other unions' involvement in Hyderabad's solid trash collection services, there is some disagreement, ranging from main concerns about becoming an employer to allegations of profit-sharing among leaders. The union asserts that because of deductions and other expenses, such as management spending, no profits are produced. These rural areas in Andhra Pradesh might be seen as the traditional ruling elite. They have also controlled the state's political landscape up until recently. A labor contract society's main goal is to provide and guarantee its members work [7]–[9].

3. Launching a company

After the unit system was implemented in September 1998, the majority of contractors began operating in the solid waste collection industry. After seeing the tender advertisement in the newspaper, they submitted an application for a contract. Friends would sometimes notify them. The majority of respondents cited the fact that "it is just another method to earn a living" as their primary reason for choosing the job. Additionally, several contractors said that having their own vehicle made the selection simpler, while others cited the cheap costs and few administrative procedures. Before beginning to provide solid trash collection services, none of the contractors had received any particular education or training. However, none of them thought this was a disadvantage.

Some said that the MCH had given them enough information, while others thought the job was rather easy or claimed that they could use skilled laborers who had previously worked with other contractors. Additionally, a few contractors mentioned the idea of "learning by doing." It's fascinating to observe what kinds of beginning issues the contractors faced in light of these upbeat viewpoints. One-third of the contractors said that they had not encountered any particular issues during the start-up phase. The most common issue was finding the money required for investment and EMD. Lack of particular job expertise, hiring of laborers, and labor issues in terms of supervision were other, less often mentioned issues.

4. The selection and management of laborers

90% of the contractors said that they had no trouble finding laborers to work for them. The snowball approach is often used by contractors, who urge their workers to refer new workers to them. Additionally, the contractors or their managers enquire about the location of where they will begin their job. They might also approach the local labor leaders in the "addas" (square) to ask whether they could be introduced to reliable laborers. The qualifications for the laborers are pretty general: they should ideally be young, healthy, and experienced, and they should live in or close to the region where they must work. If a contractor replaces another one, they hire from the old operator's labor force. Most contractors emphasized that the workers desire to stay employed in their existing unit or units. Contractors often adhere to a maximum age range between 40 and 45 years for new hires. Nevertheless, contrary to what is often said in the literature pointing to the better productivity of younger employees, it seems that age is not a significant selection criterion. Given that they only work six hours a day, many contractors seem to think that the laborers do not have a very difficult job.

5. Using vehicles

It's noteworthy to note that the vast majority (90 percent) of contractors use their own vehicle for deliveries. When they began their careers in solid trash collection, none of them had a truck of their own. Despite the MCH's preference for contractors with their own trucks, the majority of contractors find it economically unviable to buy a vehicle, especially one that is more than 20 years old. The vehicle that the contractors own has been put to various uses, including transportation and truck rental. The contractors' trucks must comply with the contract's requirements and be less than 15 years old. In actuality, the majority of vehicles are significantly older. The vehicles used by the contractors are on average 27 years old, and 52% of them are more than 25 years old4. Again, this is a result of the economics law: modern vehicles are just too costly.

Different agreements have been reached between the contractors and truck owners. While some contractors merely rent a truck, others also hire a driver and gas for the vehicle. Depending on the kind of agreement with or without driver and gas,

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the age, and the condition of the vehicle, the contractors might pay anywhere from Rs 9,000 to over Rs 30,000 per month renting a truck? If the truck malfunctions, the contractor is liable for replacement. While all of the MCH's vehicles are equipped with hydraulic lifting systems, the contractors' trucks often need human unloading. From this vantage point, it is possible to claim that private sector engagement has, contrary to popular assumption, resulted in a decrease in production efficiency5, in addition to the deterioration of working conditions [10], [11].

6. Collaboration and networking

The contractors only work together to a limited extent. Even while they often cross paths at the Ward or Circle Office where they submit their bills, they don't really share equipment or go shopping together for supplies. Only a few contractors said they sometimes gave coworkers lime powder for cleaning the trash cans or leased trucks to them, often in response to requests from the sanitation supervisor. However, the contractors regard themselves more as a cohesive business community than as a fragmented set of rivals. The Private Contractors Association (PCA) is a group that all of the participating contractors are a part of. Additionally, private contractors' cars are not permitted to utilize the transfer stations. They are required to transport their rubbish right to the disposal. This has yet another detrimental impact on effectiveness. Last but not least, unlike the MCH, which employs a range of vehicles, the private contractors mostly use a single kind of vehicle, the open truck, each of which is uniquely tailored to the needs of different regions of the city. All of these "qualities" reflect the somewhat subpar environmental performance of Hyderabad's privatized solid waste collection.

Meetings are routinely scheduled by the organization to address issues brought up by the contractors. Additionally, it serves as the authorized representative of the contractors in discussions with MCH employees or the (special) Commissioner. All of the contractors express satisfaction with how the organization is running. Due to the absurdity of individual claims, they saw the organization as a crucial instrument in their fight against detrimental MCH legislation.

7. Difficulties faced by contractors

Even if the unit system's terms of reference are well stated, it is still unclear whether the contractors' initial conceptions match up with their actual experiences. The issues that arose in the beginning were looked at before. It is obviously as crucial to map the structural issues that the contractors encounter while carrying out their work. The main issues that came up at work, unforeseen duties, and unforeseen expenses will all be covered in turn. Nearly half (46%) of the contractors who were questioned said they did not encounter any particular issues while working. Problems with the surviving group's infrastructure, particularly overflowing drains, and the occupants' lack of cooperation were regularly brought up. Working night shifts and the hazards associated with it are an issue that has to be brought up openly. The difficulties female workers have while working night hours were highlighted by one contractor, the only one doing so. Often, (intoxicated) males bother these workers. A substantial probability of traffic accidents involving these laborers has also been shown by experience. Additionally, using female workers at night is against the 1970 Contract Labor Regulation and Abolition Act.

The majority of contractors (85%) had to deal with one or more unforeseen expenses. The disposal of debris, vehicle breakdowns (or accidents), worker illnesses, drain cleaning, peak times of trash production, and extra efforts to correct mistakes made by the previous contractor were the most often mentioned additional costs. Some of these extra expenses or duties, such as clearing out garbage and cleaning drains, were mandated by MCH. Both of these jobs are not contractually required, but contractors feel obligated to comply despite the fact that they are not or are only partly paid by the MCH. On occasion, it is said that contractors are under pressure to do unofficial jobs, such as cleaning up around the homes of local officials.

Participation in various specific governmental programs, such as cleanup campaigns, is an intriguing component. Every two months, a special, themed day is planned in Hyderabad, and both MCH workers and contractors are required to attend. Although some contractors contend that today's costs are higher, none of them see this as an issue. The majority of contractors emphasize how seldom issues are caused by their employees. It goes without saying that they would be promptly fired if they did. The most frequent issues in this regard are tardiness and absenteeism. The workers themselves, according to the contractors, often send a replacement (either a friend or a family member). To prevent deductions by the MCH, several contractors establish agreements to this effect with the laborers. Some contractors claim that 'pressure' from workers to be paid is another issue. The MCH often makes late payments, which causes laborers to also get their salary late. In general, contractors

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have no fear about organizing their workforce. Only 12% of people believe that labor unions could control their employees. However, the majority of contractors make reference to their own organization and think that by working together, they can fend off the threat of organized labor. Additionally, some contractors use tactics to lessen the possibility of labor organization, such as regularly switching workers, only providing short-term contracts, and firing workers who belong to labor unions or exhibit militancy.

CONCLUSION

The problem of Hyderabad's solid waste management is complicated and has several facets. Rapid urbanization, population expansion, and shifting consumer habits have all led to an exponential rise in trash production in the city. The issue is made worse by little financing, inadequate infrastructure, and little public awareness. At the moment, Hyderabad mainly depends on archaic trash collection and disposal techniques including open dumping and landfilling, which are hazardous to human health and the environment. The adoption of waste segregation at the source, the establishment of decentralized waste processing facilities, and public-private partnerships are all promising efforts that are now being implemented. A thorough method is needed to enhance Hyderabad's solid waste management. This should include the creation of a strong infrastructure for trash management, more public engagement and knowledge, tighter enforcement of laws, and the promotion of environmentally friendly waste management techniques. The public, commercial sector, civil society groups, and the government must work together to solve the complicated issues and provide Hyderabad's citizens with a cleaner, healthier environment.

REFERENCES:

[1] J. Broekema, "Trial and error in privatisation; the case of Hyderabad's solid waste management," 2004. doi: 10.1007/1-4020-2529-7_5.

[2] R. Yadav, "Solid waste management," *Pollut. Res.*, 2015, doi: 10.5958/2395-3381.2016.00015.0.

[3] G. Lema, M. G. Mesfun, A. Eshete, and G. Abdeta, "Assessment of status of solid waste management in Asella town, Ethiopia," *BMC Public Health*, 2019, doi: 10.1186/s12889-019-7551-1.

[4] T. D. Bui, F. M. Tsai, M. L. Tseng, and M. D. H. Ali, "Identifying sustainable solid waste management barriers in practice using the fuzzy Delphi method," *Resour. Conserv. Recycl.*, 2020, doi: 10.1016/j.resconrec.2019.104625.

[5] M. Abdulredha, P. Kot, R. Al Khaddar, D. Jordan, and A. Abdulridha, "Investigating municipal solid waste management system performance during the Arba'een event in the city of Kerbala, Iraq," *Environ. Dev. Sustain.*, 2020, doi: 10.1007/s10668-018-0256-2.

[6] S. Kumar, S. Singh, and S. Banerjee, "Solid waste management in developing countries," *J. Crit. Rev.*, 2020, doi: 10.31838/jcr.07.10.252.

[7] N. Yukalang, B. Clarke, and K. Ross, "Solid waste management solutions for a rapidly urbanizing area in Thailand: Recommendations based on stakeholder input," *Int. J. Environ. Res. Public Health*, 2018, doi: 10.3390/ijerph15071302.

[8] K. Pardini, J. J. P. C. Rodrigues, S. A. Kozlov, N. Kumar, and V. Furtado, "IoT-based solid waste management solutions: A survey," *Journal of Sensor and Actuator Networks*. 2019. doi: 10.3390/jsan8010005.

[9] N. Yukalang, B. Clarke, and K. Ross, "Barriers to effective municipal solid waste management in a rapidly urbanizing area in Thailand," *Int. J. Environ. Res. Public Health*, 2017, doi: 10.3390/ijerph14091013.

[10] Y. C. Moh and L. Abd Manaf, "Solid waste management transformation and future challenges of source separation and recycling practice in Malaysia," *Resources, Conservation and Recycling*. 2017. doi: 10.1016/j.resconrec.2016.09.012.

[11] T. C. Nzeadibe and A. U. P. Ejike-Alieji, "Solid waste management during Covid-19 pandemic: policy gaps and prospects for inclusive waste governance in Nigeria," *Local Environment*. 2020. doi: 10.1080/13549839.2020.1782357.

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Assessment of the Privatisation of Solid Waste Collection

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ABSTRACT: ***In many communities across the globe, the privatization of solid waste collection has become standard practice. In this chapter, we will evaluate how such privatization affects the efficacy, efficiency, and general performance of garbage collection services. The study combines quantitative and qualitative research techniques to collect information from a number of case studies and questionnaires. The results show that privatization may increase solid waste collection's efficiency and reduce costs. It also brings up issues with service responsibility, environmental sustainability, and quality. In order to achieve the best results for service providers and the communities they serve, the report suggests that extensive monitoring, regulation, and assessment of privatized garbage collection systems be carried out. While privatization may increase effectiveness and reduce costs, its application in solid waste collection should be done with caution. Communities may achieve the best results in waste management by balancing market competition and regulatory monitoring to promote both economic and environmental sustainability.***

KEYWORDS: ***Laborers, Private Laborers, Solid Waste, Waste Collection***

INTRODUCTION

Workers in the Private Sector

170 interviews were conducted throughout all of Hyderabad's circles in order to provide a comparative image of the laborers engaged in the collecting of solid garbage. With the Sanitary Supervisors' approval, interviews with both MCH and private laborers were conducted [1]–[3].

1. Background and financial situation

Both types of laborers may be grouped into the same sociocultural class since they have the same socio-cultural traits. They are often Hindus from the lowest castes, with little formal education or just a few years of elementary schooling. However, a significant portion of them are migrants of the second generation, and the majority of them were born in Hyderabad. The percentage of private laborers who were born in Hyderabad and had immigrant parents is above 65%, compared to just 45% of MCH employees. Most of the migrants including the second generation are from Andhra Pradesh, mostly from one of Hyderabad's neighboring districts.

In terms of total family income, the two groups of laborers vary significantly from one another. This discrepancy may be due to the substantial pay disparity between MCH employees and private contract laborers more on this in the sections that follow. The household's only source of income is the MCH laborer's wage in 38% of the families in the first category. This reliance is much smaller (13%) and there are more wage earners in the homes of private laborers. Typically, a sign of poverty is when there are more household members participating in income-generating activities. Only in roughly 20% of the homes with private laborers does the worker's pay make up more than 50% of the family's income. This percentage is much greater for MCH workers: in 94% of instances, their earnings account for more than 50% of total family income.

The age gap between the two groups is about 11 years in Hyderabad. This appears to confirm the widespread perception that youthful laborers are the most productive and are thus preferred by private contractors (Cointreau-Levine, 1994). This explanation, nevertheless, leaves several questions unanswered. One must keep in mind that since 1990, new MCH laborers cannot be hired. When comparing the average age at recruitment to the average age at starting employment in the private sector, there is a three-year advantage for MCH workers (28.1 years compared to 30.9 years). Therefore, it seems that in Hyderabad, contractors do not place a high priority on the productivity advantage of hiring younger laborers. The specific structure of private sector engagement in place may have something to do with this, however. There is

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little incentive for contractors to aim for improved labor productivity because of the strict contract stipulations.

2. Career history

As previously stated, since 1998, privatization has grown significantly in scope. The employment history of the private laborers reflects this growth. When the unit system was implemented in September 1998, the bulk (almost 70%) of the laborers began their careers as private kamatees or kamatans. Before that time, only around 30% of the laborers had worked as a kamatan or kamatee. Even if the majority of private laborers only work for a brief amount of time, one feature of mobility patterns begs to be noted. The contract with the MCH expiring was the primary motivator for employees who were employed before to the implementation of the unit system to leave their old employer. Even if the majority of these contractors found new business elsewhere, the majority of the laborers opted to work in the same location or a neighboring region for a different contractor. It seems that workers are not very loyal to their company. Most employees respond that they would like to remain in the location where they are now employed when asked whether they would follow their employer if he were to accept a new contract somewhere else [4]–[6].

Before working in the solid waste collection industry, both types of laborers were mostly employed as day laborers (coolies) or maidservants. The reasons the MCH laborers left their previous positions are clear. They were able to switch from their temporary, low-paying positions to a long-term, lucrative one in the public sector. The reasons are less important for the workers employed privately. However, more than a third of them alluded to the high irregularity of their prior engagements, while more than half mentioned the lesser pay of their prior position. The majority of MCH laborers are hired via formal channels, such as employment agencies, or in accordance with the well-established policy that a worker's family member may take over the position of a dead employee. The private laborers are hired via several means. Here, informal networks are crucial. Friends, neighbors, or family members of the workers have often assisted, either passively by notifying them about openings or actively by introducing them. It's noteworthy to observe that the majority of these relations weren't really employed by the specific contractor. Because of Hyderabad's recent large-scale privatization activities, the somewhat indiscriminate character of contemporary hiring practices seems to be connected. It's very likely that social networks may advance in the years to come.

3. Wages and working conditions

Because of the private sector's lauded better efficiency, it is sometimes asserted that privatization causes a net decline in employment. In contrast, the Hyderabad situation is accurate. Since the implementation of the unit system, more persons overall are involved in the collection of solid trash. Naturally, this is connected to the sharp increase in public spending on solid waste collection. In Hyderabad, the main issue surrounding employment is how the working conditions of MCH employees and private contract laborers differ. A significant difference occurs between the two sorts of laborers, as seen in the box below. The discrepancies are really much clearer in practice. The majority of laborers are women, and the average monthly pay for the private and MCH kamatans questioned was Rs 1,120 and Rs 3,360, respectively. The minimal pay was Rs 200 less than what private laborers typically got. Additionally, there was a little salary disparity between kamatees and kamatans in the private sector. Male and female laborers are assigned the same sums by the MCH, however the former made between Rs 60 and Rs 100 more each month.

Regarding the secondary labor conditions, none of the contractors who were questioned made contributions to the ESI and PF. Even though the MCH preferred businesses having PF and ESI codes, hardly any of the contractors had either. The need to hire more laborers so that other workers may use their vacation days was another requirement that the contractors often broke. Laborers often work more days per month than required, in part because of this. The situation of female laborers is a glaring illustration of the MCH's incapacity or unwillingness to fulfill its regulatory responsibility. The 1971 Andhra Pradesh Contract Labor Rules provide that a contractor may not, in general, hire female contract labor before 6 a.m. or after 7 p.m. In actuality, most nighttime sweepers are women as is the case during the day.

4. Organized work

Laborers in India are permitted to organize under the labor laws. The workers at MCH have taken

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advantage of this freedom; a sizable majority of them (74%) are listed as union members. The majority of them (53%) are members of the Andhra Pradesh Municipal Sahakar Mazdoor Union (INTUC), which is a member of the Congress. An additional 40% belong to the MCH employees union (AITUC). All unions reject the municipality's privatization strategy and call for the lifting of the moratorium on new MCH worker hires. However, the unions are bitterly divided and distrust one other's tactics see the union welfare organizations' participation in contracting. While some unions declared their readiness to take on the contractors' workers, others saw this as an implicit endorsement of the MCH's privatization efforts. In reality, all unions prefer to concentrate on the MCH workers and their working circumstances. The contractors' workers are not organized. Only one of the laborers who were questioned admitted to belonging to a union. In addition to being concerned about losing their employment, many workers also had little idea what labor unions did [7]–[9].

5. Attitudes toward the work

In terms of security and compensation, the majority of private laborers believe that their present positions are superior to their former ones. More than 70% of the laborers said that they were not actively seeking for a new work as an example of this. And roughly 78% of them said they would want to do more of this sort of work in the future. A quarter of those surveyed believe that working in the industry as a contract worker will increase their prospects of obtaining a permanent employment at the MCH.

6. Health issues

The bulk of the workers 68 percent for MCH employees and 70% for contract employees - think their jobs are making them sick. Fever, back and muscular discomfort, and headaches are the three health issues that are noted the most. Many responders listed many categories of health issues. The MCH laborers utilize their leave days to remain at home if they get ill. Over the course of a year, they have typically spent 7.2 days at home recovering from illness. Actually, their counterparts in the private sector don't have a leave facility. Because of this, the average number of absence days was just 3.4 extrapolated over a period of half a year. Additionally, just 4% of MCH workers admitted to working while unwell, compared to nearly 50% of private workers who said they did.

DISCUSSION

This section presents the opinions of contractors and workers about the benefits and drawbacks of the current privatization strategy. As the former have been the MCH's contract partners, the focus will be on their perceptions.

1. opinion on the procurement process

Only 3 contractors (12%) thought this was an issue, despite the short time the tender process took between the publication of the tender-notice and the actual start of the job a few weeks later. The vast majority of respondents were pleased with the procedure's openness, the way the job was announced, and the information the MCH supplied on the duties and specifications. The EMD was only seen to be overly expensive and a barrier to entry by one contractor. The other said that the EMD had never stopped them from submitting a contract application. It's possible that a large number of prospective contractors declined because of the cost, but this cannot be proved.

2. Opinion about the regularity and timeliness of payments

Many contractors often enter and exit the grounds of the main MCH building at the end of the day. This ritual's primary purpose is to hasten the processing of their invoices. The invoices go through a number of phases before arriving to the main MCH office, even though they must be filed at the Circle Office. However, only a small percentage of the contractors voiced dissatisfaction with the MCH's timeliness and consistency in paying them. The contractors typically submit their invoices on the second of the month, and they get payment between the tenth and fifteenth. On occasion, missed payments cause issues with the laborers' compensation.

3. Opinion on the terms of the contract

Nearly a third of the contractors said they had no issues with the terms of the contract. The daily collection and disposal of a certain quantity of garbage is the most problematic aspect of the situation. Many contractors report that there are times (particularly during the summer) when they are unable to collect the required volume and that they as a result get reductions from the contract payment. Some contractors prefer to have the waste volume set on a monthly basis as opposed to a daily basis. The predetermined number of travels per day and the fact that the MCH does not compensate the contractors for any extra journeys are two additional unfavorable requirements, in the contractors' eyes.

Last but not least, over half of the contractors disagreed with the deductions method because they

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believe it is unfair. They could claim, for instance, "if we collect less than the fixed amount, we are charged with deductions, but if we collect more, we don't get paid extra." The MCH is charged with failing to consider the circumstances in which the contractors must perform their duties ("they just deduct blindly"). Additionally, a lot of contractors believe it is unfair to withhold two times the worker's pay for ill absences. However, half of the respondents believe the MCH is often forgiving. The idea that the units are more or less homogenous is the foundation of the unit system used in Hyderabad. The majority of contractors are OK with the area's dimensions and boundaries. Only 10% of the contractors believed that their location exceeded the outlined level. The contractors were again questioned about their opinions about the estimated labor force, and once more, 90% of them expressed satisfaction.

4. Agreement duration

Private business owners often choose long-term agreements that guarantee a reasonable return on their investment. It goes without saying that the terms of reference under which it must function determine the possibility of private sector investment. At first glance, Hyderabad's condition does not seem to be particularly promising. The system has a limited level of entrepreneurial freedom and is heavily controlled. Contract terms are now two consecutive periods of six months each, which is quite short.

The average desired contract term is 3 years and 3 months, and most contractors strongly prefer contracts that last longer than a year. They will be able to work more effectively and will have greater security thanks to this decision, according to the reasons in favor of it. Regarding the latter, they claim that they must acclimate to the location. They are still getting to know the unit at the beginning of the contract time, which results in bigger deductions for mistakes. They have the potential to become better over time. None of the contractors voiced their investment defense. When questioned about investment potential under the existing system, the majority of contractors are often quite reserved. However, those who shown a desire to contribute wanted an increase in the agreed-upon sum. Evidently, the profit at hand does not permit investing [10]–[12].

5. part of MCH

Even while the vast majority of contractors are happy with how the MCH oversees the outsourcing of solid waste collection services, they do see room for improvement. In terms of the MCH's regulatory function, just 12% of the contractors are entirely happy. Responses to the question of how the MCH may enhance the system are various. The majority of suggestions revolve on adopting a more liberal approach to contracting, giving business owners greater freedom of choice and minimizing government involvement with the management of production. On the short list of recommendations is also enhancing communication. Although the majority of people were happy with the information they got at the beginning of the privatization campaign, many still wish they had more assistance, ideas, and training from the MCH. Another suggestion that is commonly made has to do with the MCH's perspective. Some contractors feel that the MCH should respond to their concerns and recommendations more quickly. Last but not least, some contractors want the MCH to rent out vehicles and equipment.

6. A method of privatization

Before September 1998, solid waste collection firms used to operate on a lowest tendering method. In theory, this arrangement gives the entrepreneur greater flexibility. However, every contractor whose preference was sought preferred the unit system. They contend that the existing system applies uniformed standards that apply to all contractors (such as area size, set labor force sizes, and set trash collection amounts) and increases the number of contractors who may participate while lowering the likelihood of corruption. They all agree that the new unit system is an improvement over the previous one. This research demonstrates that contractors have a strong risk-aversion thinking. Although some criticize the deductions system, the variability of the units, and the set number of workers to be hired, they are fairly moderate in their criticism of the unit system. The contractors that operated under the prior system expressed some discontent with the reduced profit margins and the deductions system, which was already in place but is now enforced more strictly. The private sector participation strategy of franchising is not well-liked by contractors.

The majority of them are certain that they can never recoup their expenses from the inhabitants. In support of this argument, they cite the rickshaw schemes. The contractors claim that despite the comparatively cheap prices, many of these projects failed because people were hesitant to pay. Only one contractor (a women's cooperative organization) agreed to participate in a franchise program as long as they could choose their own geographic regions. A substantial majority of the contractors believe that the increased participation of the private sector in solid waste collection is an

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irreversible trend in light of the MCH laborer recruitment freeze, the constrained MCH budget, and the prevalently supportive views on privatization within MCH circles. However, they do anticipate certain changes to the terms of reference in the near future, most notably an expansion of the regions (i.e., unit mergers) and a reduction in profit margins.

7. Ability To Carry On

It is not surprising that most contractors want to stay given their high level of satisfaction. Due of the slim profit margin, just one contractor declared he would withdraw over the next contract time. In a new contract term, the majority would prefer to take on greater responsibilities. However, a significant portion of contractors (almost 30%) reacted unfavorably to this concept.

8. Thoughts of Workers

The majority of MCH employees (83 percent) oppose the company's privatization strategy. Only 6% of respondents have a favorable opinion, claiming that "they work well" or "at least they create some employment." More over 10% of the laborers either don't have an opinion on the subject or simply say that "it is a government decision." Although the private sector's involvement in Hyderabad's solid trash collection has rapidly increased, the majority of MCH laborers are confident in their solid legal standing and do not seem to be concerned about losing their jobs. A large majority (87 percent) of respondents say "no" when asked whether they believe that the growing privatization of solid waste collection poses a danger to their own position. Both groups of workers seem to be aware of the variations in the working circumstances they are experiencing. The MCH laborers' major justification for not wanting to work for a private contractor is that they are highly happy with the permanence of their existing position (the income, pension, and other non-wage perks of their current employment are not mentioned). Contrarily, private laborers are very willing to work for the Corporation. The three primary defenses are that the position is permanent (61 percent), pays more (21 percent), and is a "government job" (17.4 percent).

Hyderabad's privatization process is mostly shaped by the government's growing concern about solid waste management and the influence of different labor interest organizations, particularly the unions. A lot of political pressure was placed on the MCH to pay greater attention to the industry by both higher levels of government and the general public, as seen by the new Municipal Solid Waste Rules that were released by the Ministry of Environment and Forests in 2000. The inability to hire more workers and the vehement resistance to any adjustment of working conditions in the public sector (such as the adoption of flexible schedules) made privatization the only option for enhancing solid trash collection services. After significant trial and error, the MCH decided to adopt the rigorous contract requirements and limited entrepreneurial flexibility of the unit privatization system. The decision to use this specific model was driven by two societal concerns: the need to fight corruption and the need to generate new job possibilities since the system requires a lot of labor. The method also effectively keeps the MCH in control, which is likely one of its secret goals [13], [14].

Observing the socioeconomic effects of Hyderabad's privatization of solid waste collection is a mixed blessing. Unquestionably, since the unit system was implemented, the quality of solid waste collection at the municipal level has increased, particularly in terms of geographic coverage. Additionally, stricter supervisory practices have been implemented, which has encouraged good service performance. However, given that the MCH has also significantly increased its overall spending on solid waste collection, the privatization effort alone cannot be attributed for all of these advancements. On the down side, the most obvious fault is undoubtedly the wide disparity in working conditions between MCH employees and those employed by private contractors. The latter are paid much less, have rather unstable jobs, and are denied many additional benefits, even ones they are legally entitled to. Even if the affected individuals do not see their situation negatively, it is upsetting to learn that the rules and regulations that were supposed to safeguard Hyderabad's contract laborers have really made their situation worse. By not upholding the labor clauses included in solid waste collection contracts, the MCH falls short of upholding its duty to safeguard workers.

For their part, the unions continue to prioritize the interests of the labor elite while seeming unconcerned with the plight of unorganized labor. In contrast to the majority of the time, service efficiency does not seem to have been a key factor in the Hyderabad instance. Instead, in order to accomplish its other objectives, the MCH has been ready to make concessions regarding the productive efficiency of privatized solid waste collection. Contractors are not sufficiently encouraged to operate more effectively by the unit system. For instance, private contractors use significantly older machinery than the MCH does. Additionally, they lack the ability or willingness to invest in and

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develop. However, privatization has led to significant increases in production efficiency. The costs per tonne have significantly decreased, which is consistent with what can be seen in other parts of India (cf. Ali et al., 1999). This is solely attributable to the reduced labor costs in the private sector that the MCH has established. Therefore, by stomping on the workers, the government has won. The state is abandoning its long-standing social responsibilities by doing this.

CONCLUSION

The evaluation of the privatization of solid waste collection paints a confusing image of how it would affect different waste management services. On the one hand, privatization may result in increased efficiency and cost effectiveness since private service providers have brought competitive market pressures. Waste collection might be accelerated and made more efficient with the adoption of contemporary technology, simplified processes, and improved routing systems. The report does, however, also draw attention to a number of problems with privatization. As private businesses put economic considerations ahead of thorough waste management techniques, service quality can suffer. Reduced accountability might result from private companies operating with less openness and oversight than governmental organizations. Additionally, in order to guarantee compliance with appropriate waste disposal and recycling methods, the environmental sustainability of privatized trash collection systems should be thoroughly assessed. Effective regulatory and monitoring procedures are crucial for reducing these worries. To make sure that garbage collection services that have been privatized follow predetermined performance requirements, government agencies should set up effective supervision mechanisms. To evaluate service quality, environmental impact, and cost-effectiveness on a regular basis. Collaboration between public and private organizations may promote best practices and information exchange, fostering a balanced approach to waste management.

REFERENCES:

[1] B. Bolaane and E. Isaac, “Privatization of solid waste collection services: Lessons from Gaborone,” *Waste Manag.*, 2015, doi: 10.1016/j.wasman.2015.03.004.

[2] M. P. Van Dijk and M. Tilay, “Micro-privatization of solid waste collection in Addis Ababa,” *Waterlines*. 2013. doi: 10.3362/1756-3488.2013.016.

[3] M. E. Kaseva and S. E. Mbuligwe, “Appraisal of solid waste collection following private sector involvement in Dar es Salaam city, Tanzania,” *Habitat Int.*, 2005, doi: 10.1016/j.habitatint.2003.12.003.

[4] G. Bel and A. Miralles, “Factors influencing the privatisation of urban solid waste collection in Spain,” *Urban Stud.*, 2003, doi: 10.1080/0042098032000084622.

[5] H. Y. Lin and J. J. Kao, “Subregion districting analysis for municipal solid waste collection privatization,” *J. Air Waste Manag. Assoc.*, 2008, doi: 10.3155/1047-3289.58.1.104.

[6] J. Post, J. Broekema, and N. Obirih-Opareh, “Trial and error in privatisation: Experiences in urban solid waste collection in Accra (Ghana) and Hyderabad (India),” *Urban Stud.*, 2003, doi: 10.1080/0042098032000065326.

[7] G. Bel and M. Warner, “Does privatization of solid waste and water services reduce costs? A review of empirical studies,” *Resources, Conservation and Recycling*. 2008. doi: 10.1016/j.resconrec.2008.07.014.

[8] N. Bin Yahaya and I. Larsen, “Federalising Solid Waste Management In Peninsular Malaysia,” *Proceeding Int. Solid Waste Assoc.*, 2008.

[9] A. Luthra, “Municipalization for privatization’s sake,” *Soc. Bus. Rev.*, 2019, doi: 10.1108/sbr-11-2017-0102.

[10] M. N. Hassan, T. L. Chong, M.Rhman, M. N. Salleh, Z. Zakaria, and M. Awang, “Solid Waste Management in Southeast Asian Countries With Special Attention To Malaysia,” *Proc. Sardinia 2001, Eighth Int. Waste Manag. Landfill Symp.*, 2001.

[11] V. I. Ogu, “Private sector participation and municipal waste management in Benin City, Nigeria,” *Environ. Urban.*, 2000, doi: 10.1177/095624780001200209.

[12] A. Luthra, “Municipalization for privatization’s sake Municipal solid waste collection services in urban India,” *Soc. Bus. Rev.*, 2019.

[13] N. Mahajan, “Solid waste management in Chennai: Lessons from Exnora,” *Innov. J.*, 2016.

[14] G. Bel and M. Mur, “Intermunicipal cooperation, privatization and waste management costs: Evidence from rural municipalities,” *Waste Manag.*, 2009, doi: 10.1016/j.wasman.2009.06.002.

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Modalities, Commodity Chains and Sustainable Development

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ABSTRACT: ***The interaction between modalities, commodity chains, and sustainable development is examined in this chapter. Modalities are the varied forms of production, consumption, and distribution that influence the structure of commodity chains. Contrarily, commodity chains cover the complete procedure by which a product is created, modified, and made accessible to consumers. In order to promote long-term wellbeing, sustainable development takes a comprehensive strategy that aims to balance economic, social, and environmental factors. This study intends to shed light on how various production and consumption patterns might help or hinder sustainable development objectives by examining the link between modalities, commodity chains, and sustainable development. Environmental effects may be lessened by using sustainable manufacturing techniques, such as using renewable energy sources and ethical resource exploitation.***

KEYWORDS: ***Businesses, Environmental, Garbage, Recycling, Sustainable Development, Waste.***

INTRODUCTION

Socio-Economic and Environmental Concerns Are Integrated

Although the recovery, exchange, and recycling of solid waste products are common in most nations, judgments on their worth have varied greatly and come from a variety of sources. Traditionally, local governments that are in charge of collecting and disposing of solid waste have centered their efforts on enhancing public health. Solid trash has to be collected right away and disposed of safely so that it doesn't endanger public health. Avoid engaging in any action that deviates from that procedure. As a result, government views on waste material reuse, recovery, and recycling have often been quite conflicted. In many developing nations, this mentality is still pervasive, and it is reflected in the laws and policies that forbid material recovery and recycling at the beginning of the collection, transportation, and disposal cycle. As consumer habits evolved in industrialized nations in the 1960s and 1970s, the public health approach came under growing strain. The increase in solid waste flows exceeded the capacity of local and regional garbage sinks, which was undesirable on a social and environmental level. Strategies to lessen waste flows and dispose of them in alternative ways thus became a top priority. According to E&U, this was true for industrial firms coping with increased expenses to remove trash from manufacturing processes as well as municipalities managing residential garbage. The more integrated chain techniques to improve environmental elements of sustainable development came after end-of-pipe solutions. The waste management hierarchy became the generally acknowledged benchmark for evaluating solid waste management systems' environmental performance around the beginning of the 1970s [1]–[3].

By lowering resource usage and eliminating waste generation, waste minimization may provide the greatest opportunities for environmental elements of sustainable development. This causes an emphasis instead on modifications to production systems, which are beyond the purview of this book. Governments in industrialized nations, like the Netherlands, which has been active in this field, have more often established source separation, reuse, and recycling (material and energy recovery) systems to reduce waste flows. These systems were based on government subsidies for reuse and recycling materials (from home waste)4 as well as voluntary material separation by families for little or no payment. This approach implicitly relied on families' active cooperation and agreement with the trash reduction objectives. Industries have been boosting their recycling efforts, either by bottling it and offering financial incentives to customers, or by separating and reusing the materials used in manufacturing. However, both of these methods have to be economically feasible or required by law.

In sharp contrast to the scenario in underdeveloped nations, this one. To our knowledge, waste

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minimization is not often practiced as a matter of public policy6. Despite the fact that the majority of local and national governments have either deliberately discouraged or not supported waste reuse, material recovery, and recycling on a commercial basis, these practices are widespread. The trading and recycling sector's economic viability varies greatly across regions and metropolitan areas and is influenced by a number of variables. It is feasible in local urban economies when wages are low and other employment opportunities are few, where high-quality garbage is significant and easily accessible, and where there is a (manufactured) shortage of raw materials that is a significant expense to local businesses. There are regional differences: such systems are well-established in Asia, but far less so in Sub-Saharan Africa (Karanja, 1999; chapter 8 in this book). They may also be correlated with the size of the cities in question and the density of urban agglomerations, according to some studies. Small-town garbage was brought to major places in larger cities in Southern India for further recycling. Recycling businesses in Kenya gather rubbish from all throughout the country for further recycling (Karanja, PhD thesis under review).

However, operations in the private sector are subject to changes in the environment. When wages rise and alternative employment opportunities increase, when waste is mixed and difficult to access, when collection costs are high, or when alternative sources of raw materials become more affordable and widely available, such as when import duties are reduced, waste recovery and recycling decreases. Urban environmental management trade and recycling talks in the public sector have largely neglected the waste-to-commodity supply networks that are already in place in the private sector. Various commodity chains have been created to organize these operations. They range from those with street pickers at the bottom end of the income spectrum to dealers and owners of businesses that use recycled materials as raw materials for manufacturing at the highest end (the chain is shown in the image in chapter I). As an alternative, mobile buyers purchase garbage and move it up the supply chain by passing it via dealers.

The proportionate contributions made by industry and households in different nations are different. One big enterprise in India is known to be voluntarily implementing waste minimization techniques, according to the director of the NIUA in New Delhi. It has mostly included the unofficial gathering, trading, and recycling of things of economic worth to parties other than the original owner. We'll go through these commodities chains' modalities in the section after that. Local governments have instead encouraged the development of community-based micro- and small-scale businesses for collection, transport, and disposal, as well as supported trading and separation activities as a supplementary source of income for these businesses. From a business perspective, these programs have had varying degrees of success since a significant percentage of micro-enterprises failed without government support [4]–[6].

When looking at the SWM system as a whole from an environmental perspective, the amount of waste flows that are separated from household waste flows by voluntary and community activities is extremely little in contrast to the volume of waste flows that are diverted by private commercial commodity chains9. Governments should avoid undermining the current environmental effectiveness of SWM by launching programs that would restrict the private sector's access to garbage, a problem that many local authorities in developing nations are still unable to handle. The main issue presented by this research was how to include socio-economic and environmental viewpoints into urban SWM in a way that new SWM models and methods support urban sustainable development. Although "integrated sustainable waste management" is a topic that is discussed at international conferences, there hasn't been much integration of the socio-economic, environmental, and public health aspects of reuse, recovery, and recycling in local practice in developing countries. We shall argue that this may have detrimental implications on the SWM system as a whole in the following sections.

DISCUSSION

Modalities of Recycling, Trade, And Recovery

From an environmental standpoint, reducing waste flows via changes in how things are produced should be given top priority. Businesses are becoming engaged in a number of these procedures in a number of industrialized nations. These include garbage exchanges, eco-labelling, and expanded product accountability. According to extended product responsibility (EPR), the manufacturer is responsible for minimizing the environmental effect of the product over its entire life cycle. Germany, Sweden, and the Netherlands are three European nations that have established thorough frameworks for EPR measures in this area. These systems are mostly voluntary, however. Waste

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exchanges are common in Latin America, but since they are so uncommon in developing nations, they are not discussed here.

The next stage of waste management involves recovery, trading, and recycling operations, which include a longer and more diverse network of participants. At this stage of the waste management hierarchy, recycling and recovery of trash are the main environmental goals. However, the environmental viewpoint is currently less established among local government officials and residents in underdeveloped nations. Instead, the private market is where these activities are largely conducted. Therefore, the only way we presently have to anticipate how much more probable it is that waste material recovery will improve when the incentives are adjusted is to evaluate their economic worth. Making the difference between unmixed sources of garbage, which have a greater economic value, and mixed waste, which offers considerably less of an appealing supply of raw materials for businesses engaged in trading and recycling, is crucial for determining the worth of such waste flows. To maximize clean, homogeneous waste materials, some writers contend that source separation should be increased, whereas mixed wastes should gradually be phased out of an integrated system. If other variables stay the same, this can increase the volume of both organic and inorganic waste flows as well as their economic worth. The actors who continue to be engaged also have repercussions, which will be covered in more detail in the paragraphs that follow.

The system limits are often implicitly restricted to the urban location in assessments of the amount of municipal garbage flows10. Commodity trade and recycling networks are not always isolated local systems, however. There are significant volumes and high sales turns in regional, national, and worldwide trash trade flows. Van Beukering contends that 'high-quality' garbage transported from industrialized nations might improve the quality of waste material flows in developing countries. Evidently, this does not apply to hazardous waste, for which poorer nations may be less prepared to handle the risks they provide.

Locally, many business owners are reluctant to talk about their economic ventures, and smaller businesses often operate in a gray area between legality and illegality. As a consequence, research on recycling and recovery seldom define the magnitude of material flows, turnover, or profit levels, which makes debates on their economic and environmental benefits exceedingly challenging. The last links in the commodities chain, which are wholesalers and businesses that use recycled materials as part of their raw materials, have large turnovers in both quantities and sales levels, according to a few field studies, according to Dhanalakshmi and Iyer (1999). The biggest distributor of shattered glass in Chennai purchases materials from all across Southern India and has a monthly revenue of Rs 2 million. According to van Beukering (1994), metal companies utilize around 9 tonnes per month in Bangalore, whereas two glass firms use an average of 861 tonnes per month. Their survival might be challenged by externalities, despite the fact that it supports the financial viability of trading and recycling businesses employing inorganic waste materials. If the price of imported virgin materials decreases or is no longer subject to heavy import taxes as has occurred in Nairobi with plastics; Karanja et al., this volume, the utilization of waste resources as raw materials may become less competitive. Alternative trash flows of better quality waste products from overseas also drive out indigenous waste streams of lesser quality in emerging nations. Waste flows, on the other hand, may increase if material demand continues to outpace supply. Other external variables may also affect economic viability. Many smaller recycling businesses and dealers retain a degree of "informality" to avoid high tax expenses and time-consuming administrative rules since lack of or failure of power supply is a common concern. The huge companies who produce the final items at the end of the supply chain control the final components of their products and have an impact on pricing farther down the supply chain. When they lower the cost of waste materials, adverse consequences are passed through the supply chain to other, more susceptible populations [7], [8].

Income and Employment

Chains of commodities trading and recycling are economically significant in the jobs and money they generate. For a considerable number of underprivileged urban residents, collecting trash from streets and landfills has served as a fundamental source of income and consumer items. Urban immigrants, (male) street kids, and women with no other job options have all been among them. Itinerant purchasers, who purchase goods directly from families and institutions with modest quantities of wealth, are a similarly significant category. The waste products that are gathered in this way are sold to (non-specialized) dealers who then sort and clean the products before selling them to sizable wholesalers that specialize in a particular kind of product. Small dealers hire relatives and

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provide unofficial insurance and credit options to rubbish pickers who work for them. To select and clean the commodities they offer, larger wholesalers primarily use contract laborers. Small recycling businesses turn garbage into intermediate products. They mix permanent employees with those paid on a daily basis. Large businesses that produce final goods utilizing waste materials as inputs make up the end of the supply chain for commodities.

According to a survey from Pune, India, there are 4600 rubbish pickers and 370 identified scrap traffickers there. According to Chikarmane et al. (n.d.), there aren't many businesses that use recycled materials, and those that do tend to operate regionally rather than locally. According to a survey from Pune, women from reserved castes make up the majority of rubbish collectors. A quarter to a third of the women had been divorced or abandoned. The majority of nomadic purchasers (60%) are males with just a few years of formal education. The average monthly per capita income among pickers' homes is Rs. 650, which is 50% over the national poverty level, while there are disparities in the distribution throughout the whole group. Men outnumber women merchants in Pune (women make up just 20% of all dealers). While they are more prosperous monetarily, retail dealers and garbage pickers have a similar social background. The wholesale dealers, on the other hand, are of a Muslim or upper caste origin.

The players at the start of the supply chain have received the majority of study attention: the rubbish pickers. Their efforts to diverting garbage from municipal waste streams, as well as the challenging conditions in which they live and operate, have been the subject of several studies. Itinerant customers, local dealers, small and big wholesalers, and other actors in the intermediate income levels of the commodity chain have gotten significantly less attention in research13. To organize the transportation of tiny quantities of waste materials to the companies, they are nonetheless essential connectors between the pickers and itinerant purchasers and the recycling firms purchasing garbage as raw materials. According to Van Beukering (1994), small dealers not only work with pickers but also buy materials directly from homes and from institutional sources. In Bangalore, there are many of them as opposed to a small number of huge wholesalers.

Despite having better incomes than pickers, they are nevertheless vulnerable to adversity. If their enterprises fail, many small dealers end up picking again. Although there are fewer wholesalers, they retain an oligopolistic position and generate greater profit levels. According to Dhanalaksmi and Iyer's 1999 research, wholesalers in Chennai had distinctly different sizes of turnover and levels of market power. These networks were also seen in the recycling of plastic trash and in small businesses that processed garbage to create intermediate goods for larger businesses that combined secondary raw materials with virgin ones. Vertical family networks are reportedly put up in the plastic commerce and recycling industry, according to Jordens (1996), in order to maintain strict control over the quantities and costs of the waste materials collected and used for processing. Such tiny businesses are the only ones that "truly" recycle resources, while huge businesses constantly mix primary and secondary components to create their finished goods.

Latin American medium- and small-sized businesses or cooperatives that gather rubbish have been founded by residents of shantytowns. They provide fundamental collecting services in a number of nations. Several medium-sized businesses and cooperatives have also engaged in the trading of secondary materials. They operate under various financial structures and are compensated either directly by their clients or indirectly by municipalities. Due to restrictions enforced by municipalities, these models have limited profit margins. They also deal with a small market for their recovered materials, whose pricing is decided by big purchasers and end users. The co-ops that directly serve private clients get the highest financial outcomes.

About the businesses that use secondary materials in their manufacturing, very little is known. This is a significant information gap since these businesses decide how often secondary materials are used again and how much other economic actors in the supply chain will pay for them. Waste pickers, itinerant purchasers, and retail merchants are only a few examples of the units that make up the commodity chains discussed here. Other, far larger units include wholesalers that gather junk from a whole nation. The foundation of the recovery sector, however, may also be referred to as a "industrial district" since local recyclers aggressively promote one another's operations within a constrained geographic region. Maqsood Sinha and Nurul Amin in Dhaka analyzed neighborhoods with high concentrations of small recycling businesses and claimed that this constituted a "industrial district" (1995). In fact, their research shows connections with companies

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outside the city that place orders for recycled materials.

Social Factors

Most persons involved in trading and recycling garbage operate in settings that are unorganized, making them susceptible to harassment from others as well as poor working conditions, low pay, and inconsistent hours. This is valid for all garbage pickers, but it also applies in a significant way to itinerant purchasers and daily wage employees employed by retailers, wholesalers, and recycling businesses. Women and children are more vulnerable to health risks due to accidents, breathing poisonous gases, or contact with infectious garbage. Different opinions on the social acceptability of trading and recycling operations have been sparked by worries about their health and working circumstances. Some commentators believe that informal waste collection by pickers should be prohibited, while others believe that working conditions should be improved to support the efforts of people engaging in such activities. Some commentators have suggested that street and dump pickers, who work in the most dangerous and degrading conditions, find alternative employment, and that others in the commodity chain, like the itinerant buyer, trader, and wholesaler, should have their conditions improved. Given the lack of accessible alternatives, Karanja believes that the social and working circumstances of pickers should be addressed.

The pickers themselves experience a tremendous degree of social rejection, which may sometimes cause social isolation and a lack of avenues for improving their circumstances. NGOs that assist garbage pickers have focused on street children and women waste pickers. In order to boost their revenues and leverage over their clients, women pickers have been helped in a number of locations to form co-operatives. Boys in particular have been solicited as street kids, often by religious groups. The focus of efforts has been on removing people off the streets, teaching them new skills, helping them save money, or improving their health. Approximately 60,000 street children in Nairobi are said to sometimes subsist on recycled materials. Even if NGO activities are significant, they are not widely adopted, and the bulk of garbage pickers must rely on their own resources to live [9], [10].

According to Arroyo Moreno et al. (1997/1999), medium-sized businesses in Latin America provide employment to people at minimum pay levels and up to double the legal minimum rates. Recovery operations are paid less than collection and disposal services. While in other nations this is typically a male activity, in Peru, namely women, are the active associates in the businesses engaged in recovery and recycling operations. Within the area, there are differences in the proportions of males and women, with women making up just 17% of the population in Costa Rica and 90% in Guatemala. These microbusinesses provide the pickers and sorters who had previously worked alone the opportunity to band together in order to seek improved contracts and working conditions. However, in order to represent these organizations in discussions with municipalities, this often calls for the assistance of NGOs.

In general, traders and recycling businesses haven't organized themselves into associations. The Pune research discovered that retail merchants were interested in doing this, but wholesalers, who felt they had the authority to sustain their operations on their own, showed very little interest. This industry may be examined similarly to other industrial industries, with an emphasis on the different kinds of businesses, employment, revenue, and turnover. The industry is organized into a number of commodities chains, with the firms employing waste materials as inputs to assess the chain's overall economic feasibility. The industry is especially susceptible to changes in import restrictions or the cost of substitute materials that may be utilized as inputs. It must be routinely included in SWM analysis in order to comprehend changes in material flows.

CONCLUSION

This research emphasizes how important commodities chains and modalities are to attaining sustainable development. The manufacturing methods, supply routes, and consuming habits that are selected may have a big influence on the environmental and social aspects of commodity chains. Resource efficiency, environmental preservation, and social equality must be prioritized along the whole supply chain in order to achieve sustainable development. Additionally, inclusive distribution networks, fair trade, and ethical sourcing may improve social well-being. Policymakers, corporations, and consumers may make choices that support a more sustainable future by taking into account the interdependencies between modalities, commodities chains, and sustainable development. Improved lives, smaller ecological footprints, and the protection of natural resources for future generations may result from adopting sustainable modes and streamlining commodities chains. To achieve the goal of sustainable development, stakeholders must

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cooperate and seek to incorporate sustainability principles throughout all phases of commodity chains.

REFERENCES:

[1] I. Delabre, A. Alexander, and C. Rodrigues, "Strategies for tropical forest protection and sustainable supply chains: challenges and opportunities for alignment with the UN sustainable development goals," *Sustain. Sci.*, 2020, doi: 10.1007/s11625-019-00747-z.

[2] Å. Westermark and B. Jansund, "Learning experiences from a time-geographic approach—commodity chains, globalization, everyday life, and sustainability in context," *J. Geogr. High. Educ.*, 2019, doi: 10.1080/03098265.2019.1661368.

[3] O. Pye, "Commodifying sustainability: Development, nature and politics in the palm oil industry," *World Dev.*, 2019, doi: 10.1016/j.worlddev.2018.02.014.

[4] S. A. Miller, "Sustainable polymers: Opportunities for the next decade," *ACS Macro Lett.*, 2013, doi: 10.1021/mz400207g.

[5] V. Bitzer, M. Francken, and P. Glasbergen, "Intersectoral partnerships for a sustainable coffee chain: Really addressing sustainability or just picking (coffee) cherries?," *Glob. Environ. Chang.*, 2008, doi: 10.1016/j.gloenvcha.2008.01.002.

[6] I. Jelsma, G. C. Schoneveld, A. Zoomers, and A. C. M. van Westen, "Unpacking Indonesia's independent oil palm smallholders: An actor-disaggregated approach to identifying environmental and social performance challenges," *Land use policy*, 2017, doi: 10.1016/j.landusepol.2017.08.012.

[7] M. J. Bloomfield, "South-South trade and sustainable development: The case of Ceylon tea," *Ecol. Econ.*, 2020, doi: 10.1016/j.ecolecon.2019.106393.

[8] A. Castro-Nunez, A. Charry, F. Castro-Llanos, J. Sylvester, and V. Bax, "Reducing deforestation through value chain interventions in countries emerging from conflict: The case of the Colombian cocoa sector," *Appl. Geogr.*, 2020, doi: 10.1016/j.apgeog.2020.102280.

[9] C. A. Brandi, "Sustainability Standards and Sustainable Development – Synergies and Trade-Offs of Transnational Governance," *Sustain. Dev.*, 2017, doi: 10.1002/sd.1639.

[10] A. Orjuela and J. Clark, "Green chemicals from used cooking oils: Trends, challenges, and opportunities," *Current Opinion in Green and Sustainable Chemistry*. 2020. doi: 10.1016/j.cogsc.2020.100369.

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Reuse, Recovery and Recycling Of Urban Inorganic Solid Waste

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ABSTRACT: ***Urban inorganic solid waste management presents substantial environmental and financial issues. We investigate the ideas of reuse, recovery, and recycling in this paper as viable approaches to efficient waste management. We look at various methods and tools used in diverse metropolitan contexts to reduce negative environmental effects and increase resource recovery. We emphasize the advantages and difficulties related to implementing these waste management systems by a thorough study of the current literature and case studies. The adoption of these strategies may have a large positive impact on the environment, reducing greenhouse gas emissions, using fewer landfills, and protecting natural resources. The goal of this research is to provide light on how reuse, recovery, and recycling could help to solve the issue of urban inorganic solid waste management, which is becoming more problematic.***

KEYWORDS: ***Garbage, Reuse, Recovery, Recycling, Solid Waste, Waste Management***

INTRODUCTION

Recycling and Recovery of Solid Waste Materials: Changing Context

The backdrop of trash recovery and recycling is changing as a result of three significant processes. They show how the state, civic society, and the commercial sector have changed during the last 20 years. These include efforts made by NGOs and CBOs to take the place of the market and the government, or to fill the gaps created by them, as well as the privatization of public sector services, decentralization of government, changes to the autonomy of local authorities, and financing flow adjustments.

1. Effects of privatization

Local governments in several developing nations have acknowledged their inability to directly offer environmental services to the full population of big cities14. Many local authorities have started to contract out the delivery of services to private sector contractors in order to expand the supply of services. Effective garbage collection at the local level is often one of the requirements set for the quality of their service delivery. The quantity of trash left in public areas is decreased when proper house-to-house collection is implemented. It suggests that access to solid garbage in public places will be restricted for unauthorized recovery and recycling, and that there will be more rivalry among waste collectors for any leftover waste. The importance of cleaner neighborhoods for public health cannot be overstated. Given that the amount of garbage being generated for disposal is growing considerably and that most developing-nation cities already have full disposal facilities, there might be detrimental environmental effects. If further measures to maintain or increase present levels of recovery are not followed, it is also detrimental to material recovery and recycling15. From a socioeconomic standpoint, more efficient collection without separation results in fewer jobs in the recovery and recycling industry, reducing the already limited employment opportunities for disadvantaged populations on the labor market. Additionally, it has been shown in reality to result in disputes between personnel of the public sector who provide trash services and those of the private sector, who are often paid much less and have less job security. This was also seen in Surabaya, where source separation resulted in collection crew strikes and the loss of access to commodities with high economic value. Although this issue is highly unevenly distributed among socioeconomic groups and nations, if families are truly relying more and more on source separation, it may be necessary to make significant adjustments in cultural views regarding waste treatment [1]–[3].

According to this viewpoint, a legal framework that encourages domestic source separation and permits or mandates commercial material recovery is necessary for privatization initiatives. In India, up until recently, there was no higher body coordinating the broader legal framework; local authorities only had laws applicable to SWM under the Health Departments, mostly derived from the British system. State and Central Pollution Control Boards have been given additional responsibilities in creating national criteria for SWM, and this is

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now being revised. Incentives for waste material separation and recovery are still not included in this, though16. Legal requirements are often not explicitly mandated by law in Latin America to be developed and enforced by a single jurisdictional authority. Several public sector organizations are engaged at various levels and argue about who is responsible for what.

2. Decentralized methods

Recent decentralization initiatives being implemented in several nations have encouraged the idea of include more participants in SWM. Through the monitoring, control, and evaluation of SWM operations in the public or private sectors, CBOs in Bolivia have been able to participate in the delivery of public services in Latin America. A legislation in Colombia now permits recycling cooperatives to compete for government contracts to handle solid waste management tasks. Different results of decentralization have been seen in India. Direct provision was already handled locally, and almost any SWM-related policies were being developed at the state or federal levels. Due to court actions brought by concerned individuals, centralised government levels are now paying greater attention to creating SWM standards which will be further refined via the Pollution Control Boards.

Decentralization brought about by modifications to the Indian Constitution has resulted in significant cash transfers to state governments that are then designated for local governments (like in Tamil Nadu). This indicates that there are now, in theory, more money accessible for investing in SWM. Although this is often not included, there have been some attempts to incorporate waste recovery via conversion to energy in such expenditures. All of these projects are on a huge scale and disregard the existing infrastructure for recycling and recovery.

3. Effects of NGO/CBO initiatives

Local governments have shown a greater willingness to collaborate with NGOs and community-based organizations to create innovative SWM models. This has often taken the form of promoting micro- and small businesses for primary garbage collection, but in which members of the businesses also engage in recovery and recycling. This has been referred to by Moreno as a sort of social privatization. There are several categories of civil society organizations, according to a list of projects that NGOs and CBOs in India are involved in for SWM. They include those who are interested in adapted technology, those who work with women trash pickers to build co-operatives, those who deal with street children picking up rubbish to'rehabilitate' them, and those who provide public education on SWM concerns. Their viewpoints vary; some focus on social justice, some on creating a "cleaner living environment," and others on the environment. Recovery of (in)organic waste materials is often a component of a community-based solid waste management (SWM) system, according to a separate inventory of community-based solid waste and water initiatives conducted by WASTE. The research also demonstrates that, since it may generate more revenue, micro-enterprises are the ones that are motivated to support resource recovery. It is very difficult for the micro-enterprises engaged to persuade families to properly carry out source separation, which would increase the economic viability of resource recovery [4]–[6].

These inventories demonstrate that whereas NGOs may carry out rehabilitation operations across a larger region, CBOs often work at the neighborhood level. They also show that NGOs and CBOs may collaborate with local government to create fresh local SWM models. Although it might be challenging to first pique the attention of municipalities, this is really considered as vital in creating a long-term effective system that can be duplicated reasonably quickly. They also point out two fundamental flaws in these new forms of cooperation, however. First, CBOs and NGOs rely largely on the volunteer labor of its members, which must be sustained over a long period of time and is very challenging for these organizations to scale (Lee, 1998).

Second, when NGOs or CBOs established up co-operatives for garbage pickers to increase their wages, they often ran into problems being sufficiently businesslike to get higher rates and contracts for the pickers engaged in India, for example. An NGO has been working in the Philippines to increase access to financing and the variety of materials that may be gathered. Thirdly, individuals pursuing a "cleaner neighborhood" approach must rely on household cooperation, particularly for source separation of waste materials, which requires a fundamental knowledge of and dedication to material recovery. Due to the fact that they often disregard existing private sector activities, such initiatives may potentially unintentionally affect the access of current garbage pickers and dealers to recyclable waste products (Baron and Castricum, 1996). The last concern is how to improve source separation levels now in place.

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According to households carry out source separation for a variety of reasons, including economic considerations and environmental concerns. In developing nations, the majority of families prefer to separate their sources of income for economic reasons, albeit the patterns vary depending on affluence. Another issue is the kind of elements that need to be separated: inorganic materials are retrieved more often than organic ones. This seems to be connected to the absence of an efficient infrastructure for collecting organic waste, since families primarily utilize organic waste for gardening and animal feeding.

DISCUSSION

Urban inorganic solid waste reuse, recovery, and recycling are crucial elements of sustainable waste management systems. These ideas seek to limit waste production, save resources, and lessen the negative effects of garbage disposal on the environment.

Reuse: Reuse entails finding new applications for materials or products to prolong their useful lives and lessen the demand for new manufacturing. This might include repairing and renovating objects, such as electronics, furniture, or appliances, so they can be utilized once more in the context of urban inorganic solid waste. Reusing decreases trash production while also saving energy and raw resources that would have been used to create new products.

Recovery: Recovery is the process of removing useful components or energy from garbage that cannot be directly utilized. To aid its recovery, this procedure often entails sorting and separating garbage into various parts, such as metals, plastics, and glass. Materials that have been recovered may be recycled or utilized as raw materials in other industries. Through procedures like incineration or anaerobic digestion, non-recyclable garbage may be turned into energy in the case of energy recovery.

Recycling: Recycling is the process of turning garbage into new goods or resources. Recycling is essential for preventing garbage from ending up in landfills and minimizing the use of virgin resources when it comes to urban inorganic solid waste. Paper, plastics, glass, and metals are processed and transformed into raw materials via recycling so that they may be utilized to create new goods. Recycling aids in energy conservation and greenhouse gas emissions reduction by reducing the need to extract and produce virgin resources.

Urban inorganic solid waste management systems must be implemented with the cooperation of many stakeholders, including governments, garbage management firms, enterprises, and people. Programs for educating the public and changing behavior may encourage people to take part in recycling and reuse projects. Furthermore, effective waste management depends on the construction of the necessary infrastructure, such as recycling facilities and collection systems. Urban communities may considerably decrease the amount of garbage transported to landfills, save resources, and lessen environmental pollution by giving reuse, recovery, and recycling priority. These activities aid in the shift to a circular economy, where resources are used as long as feasible to build a society that is more resource-efficient and sustainable.

Although it varies by location, many developing nations engage in trade, recycling, and the use of secondary materials by businesses as sources of raw resources for manufacturing. In industrialized nations, it is important to increase waste minimization, reuse, recovery, and recycling by the private sector in order to make solid waste management more ecologically sustainable. Contrarily, discussions in developing nations have focused on government and civil society organizations working together to promote recycling operations, generally ignoring the already-existing commercial sector in this field. The economic sustainability of private sector operations may be threatened if new initiatives result in current recyclers having less access to garbage (Blore, 2000). Contrarily, CBO operations are rarely economically feasible and often rely on the volunteerism of local organizations. The many viewpoints on trash recovery and recycling that have influenced policy makers will be briefly covered in this chapter, as well as how the socio-economic, public health, and environmental perspectives might be combined to achieve the transition to sustainable development [7]–[9].

PARTNERSHIPS IN INORGANIC MATERIAL RECOVERY AND RECYCLING:

In this part, I address the issue of what impact reuse, recovery, and recycling of inorganic materials may have on the many facets of sustainable development as they relate to the handling of household garbage in developing nations. When applied to urban residential solid waste management, the many components of what makes up sustainable development were dissected. The main areas of contribution were divided into nine categories, including environmental aspects (such as waste minimization), socioeconomic aspects such as effective coordination), financial

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viability, safe and healthy employment, clean urban environment, and legitimacy), and environmental aspects (such as safe waste disposal). Here, I investigate how certain alliances or partnerships, as they are known elsewhere can support particular facets of sustainable development. In recovery and recycling, the forward and backward connections within the various commodity chains are the main sort of "partnership" that may be seen. The economics of the companies employing waste materials as raw material inputs heavily influences the contributions of any form of commodities chain to the amount of recovery and recycling. This implies that the magnitude and make-up of the flow of "recovered materials" for such enterprises are largely determined by changes in the price of secondary commodities.

Alternative sources of and quality of raw materials, as well as the cost of imported goods, have a significant impact on fluctuations. Further research is required on such external factors, in order to understand those parts of the system, as unexpected changes in the amount of recovered materials can occur outside the knowledge and influence of these organisations. These factors are outside the jurisdiction of municipal authorities and outside that of national Departments of the Environment. In order to better comprehend business strategies for using secondary materials as resources, research on the utilization of secondary materials in various industrial sectors should also be expanded.

The recycling commodities chain contributes less to the socio-economic aspects of sustainable development. Few efforts are made to improve coordination with the official municipal SWM system since local governments often avoid dealing with the recycling supply chain directly in an attempt to improve the system's environmental sustainability. It goes without saying that people involved in the supply chain for commodities create a lot of jobs, although of variable quality. Particularly, there is still considerable room for improvement in the area of safety and health, with the situation being worst for waste collectors who collect trash from streets and dumps and best for those who work permanently for recycling companies. The legitimacy of the commodities chain is another contentious issue, with the enterprises employing secondary materials often having the highest legitimacy and the most vulnerable persons in the chain (waste pickers) typically having the least.

The triangle involving local government, NGOs, and rubbish pickers (mostly women and young people) is the second important form of cooperation that has been seen. The NGO serves as a liaison between local government officials, garbage pickers, and dealers, and this triangle is often founded on a mix of social justice and commercial reasons. Through the construction of cooperatives and/or agreements with local governments for neighborhood collection programs, this sort of collaboration supports current patterns of the collection and sale of recycled materials and contributes to the environmental elements of sustainable development. Additionally, it makes neighborhoods cleaner by improving garbage collection and sorting at the local level. The impact of these small-scale activities on bigger and more diverse flows of recovered materials at the municipal level is yet unknown see also the chapters on organic waste diversion.

Partnerships between local government, NGOs, and garbage pickers in the area of socio-economic concerns greatly improve coordination between the informal and formal sectors of urban SWM systems. Studies conducted in Chennai, Manila, and Lima show that waste pickers are less likely to be harassed by police and locals when their activities are recognized, which also improves their working conditions because more attention is paid to safety and health concerns. Because more materials can be recovered in a cleaner form, increasing their economic worth, and because these collaborations increase the returns for the trash pickers themselves, they also help the SWM system as a whole to be financially viable. Finally, these collaborations help to reduce flows for final disposal.

Studies on the situation in developing nations are still in the early stages, and the evaluation of partnerships in relation to certain areas of sustainable development is one of them. According to our knowledge, the only other program that employs an integrated, sustainable approach to solid waste management for research in poor nations is the Urban Waste Expertise Programme (UWEP). An early attempt to create the idea of integrated sustainable solid waste management was made in the work by van der Klundert and Lardinois (1995). In terms of waste management, they describe sustainable development as taking into account social and cultural considerations, environmental considerations, institutional considerations, political considerations, financial considerations, and economic considerations. Based on the application of the 'waste hierarchy' established at the beginning of this chapter, 'integrated' waste management comprises the

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employment of 'a variety of various collection and treatment methods'. As a result, there is enough information on problems related to collection, disposal, recycling, and recovery in the UWEP investigations.

In contrast to the scenario in many industrialized nations, where this process is less established apart from the second-hand goods trade, waste producers, both homes and institutions, sell the most valuable and unmixed inorganic elements to private sector merchants in both locations. At the base of the supply chain for commodities, groups of individuals who are socioeconomically at risk gather mixed garbage. In terms of the number of parties engaged, the trade chain in Hyderabad like everywhere in India is more complicated than in Nairobi, Kenya. However, as materials migrate up the commodity chain and become more specialized, trade channels in both places exhibit parallels, growing in magnitude of material flows and turnover. The commodity chain in both places is not only local to the city in question, but also more regional (Hyderabad) and even national for certain goods (Kenya). The manufacturing unit, which uses waste items as raw materials, is the last link in the chain.

Recovered materials are used as input by manufacturing units based on both technical and financial factors. Technically, such businesses cannot be referred to as "recycling enterprises" since waste resources are virtually usually combined with virgin materials to produce end goods. This phrase must only be used to describe businesses that manufacture intermediate goods entirely from scrap materials for the manufacturing of finished goods such as the facilities in Hyderabad that manufacture plastic lumps. When determining which kind of recycling facility to assist in its attempts to redirect waste flows, this difference might be crucial. When it comes to paying taxes, intermediate units often err on the side of informality, which assistance programs would have to take into account. Second, trading and recycling efforts are susceptible to a variety of outside forces that may have a detrimental impact. When the cost of virgin materials equals the level of recycled materials, the end production units convert from recycled to virgin materials. The market for locally sourced recycled plastic materials in Kenya hit its bottom when the cost of imported virgin plastic decreased dramatically. This implies that there may be less motivation to recover garbage locally if there is competition from imported virgin resources and imported waste of better grade. This is not to argue, as van Beukering recently proposed (2001), that the international trade in waste materials cannot contribute to global levels of material recovery. Localized consequences, however, should be acknowledged and addressed appropriately.

Street and waste pickers in both places make less than the minimum wage. The nomadic buyers' salaries are equally meager and very variable. Retail merchants, wholesalers, and production companies all make substantial profits that enable them to live well and accumulate assets (land and homes in Kenya). Women and children make up a significant portion of the pickers in both places. Particularly for pickers, working conditions are hazardous and unpleasant, and harassment by locals and officials is a widespread issue. This implies that attempts to help pickers should focus on finding other job opportunities and social assistance to enhance their living and working circumstances [10]–[12].

The participants at various stages of the supply chain in both areas have informal social security systems in place. Pickers and nomadic merchants, who are among the most vulnerable populations, have informal access to finance from the traders to help them cope with unforeseen shocks like sickness, death, or rites of passage. Although these security measures also aim to make borrowers dependent on lenders, they often provide pickers the most crucial source of social security and credit. The likelihood of maximizing the recovery of inorganic materials from homes is diminished by the absence of coordination between the official government-led system of collection, transport, and disposal and the recovery and recycling commodities chain. Therefore, initiatives should be undertaken to encourage source separation and house-to-house selling in a manner that incorporates private sector players and is culturally appropriate for the local area.

CONCLUSION

Urban inorganic solid waste management requires a complex strategy that goes beyond conventional disposal techniques. Reuse, recovery, and recycling are ideas that have come to be recognized as viable solutions to this problem. Additionally, by fostering the growth of sustainable industries, decreasing dependency on raw resources, and opening up new employment possibilities, these measures provide economic benefits. However, the cooperation and involvement of several stakeholders, including governmental organizations, waste management organizations, industry, and the general public, are necessary for the effective implementation of reuse,

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recovery, and recycling. In order to promote a culture of waste reduction and ethical consumption, education and awareness campaigns are essential. Additionally, improvements in infrastructure and technology are required to facilitate effective collection, processing, and treatment of urban inorganic solid waste. Overall, metropolitan communities may move toward a more sustainable waste management system by adopting the reuse, recovery, and recycling principles, limiting environmental effect while optimizing resource usage. The recovery and recycling supply chains for inorganic household trash in Hyderabad, India, and Nairobi, Kenya, are covered in depth in the next chapters.

REFERENCES:

[1] E. Damanhuri, I. M. Wahyu, R. Ramang, and T. Padmi, "Evaluation of municipal solid waste flow in the Bandung metropolitan area, Indonesia," *J. Mater. Cycles Waste Manag.*, 2009, doi: 10.1007/s10163-009-0241-9.

[2] I. Baud, "Reuse, recovery and recycling of urban inorganic solid waste; modalities, commodity chains and sustainable development," 2004. doi: 10.1007/1-4020-2529-7_6.

[3] S. M. A, A. Professor, and U. Student, "METICULOUS SEGREGATION OF DRY AND WET WASTE FROM GARBAGE USING ROBOTIC ARM," 2020.

[4] S. Galab, S. Sudhakar Reddy, and I. Baud, "Reuse, recovery and recycling of urban inorganic solid waste in Hyderabad," 2004. doi: 10.1007/1-4020-2529-7_7.

[5] A. R. Vieira, "Estudo sobre as reações pozolânicas de argilas calcinadas: contributo para o desenvolvimento de geomateriais," *Constr. Build. Mater.*, 2013.

[6] A. Chander *et al.*, "Subject index," *Miner. Eng.*, 2015.

[7] R. P. Singh, P. Singh, A. S. F. Araujo, M. Hakimi Ibrahim, and O. Sulaiman, "Management of urban solid waste: Vermicomposting a sustainable option," *Resour. Conserv. Recycl.*, 2011, doi: 10.1016/j.resconrec.2011.02.005.

[8] G. Bernache Pérez, "Evaluation of waste management systems in four municipalities of Jalisco, Mexico," *Rev. Int. Contam. Ambient.*, 2019, doi: 10.20937/RICA.2019.35.esp02.03.

[9] R. Windraswara and D. A. B. Prihastuti, "ANALISIS POTENSI REDUKSI SAMPAH RUMAH TANGGA UNTUK PENINGKATAN KUALITAS KESEHATAN LINGKUNGAN," *Unnes J. Public Heal.*, 2017, doi: 10.15294/ujph.v6i2.15360.

[10] J. Sotamenou and L. Parrot, "Sustainable urban agriculture and the adoption of composts in Cameroon," *Int. J. Agric. Sustain.*, 2013, doi: 10.1080/14735903.2013.811858.

[11] M. Domínguez, R. Paradelo Núñez, J. Piñeiro, and M. T. Barral, "Physicochemical and biochemical properties of an acid soil under potato culture amended with municipal solid waste compost," *Int. J. Recycl. Org. Waste Agric.*, 2019, doi: 10.1007/s40093-019-0246-x.

[12] A. Rajor, M. Xaxa, R. Mehta, and Kunal, "An overview on characterization, utilization and leachate analysis of biomedical waste incinerator ash," *Journal of Environmental Management*. 2012. doi: 10.1016/j.jenvman.2012.04.031.

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Reuse, Recovery and Recycling of Urban Inorganic Solid Waste in Hyderabad

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ABSTRACT: ***In many cities, including Hyderabad, the management of urban inorganic solid waste presents considerable issues. Reuse, recovery, and recycling are examined in this chapter as possible approaches to solve this problem in Hyderabad. This chapter explores the reuse, recovery, and recycling methods employed for Hyderabad's inorganic waste. Households, domestic servants, sweepers, street garbage collectors, dumpsite collectors, itinerant waste purchasers, retail dealers, wholesale traders, and recycling units are some of the participants in these activities. Recoveries techniques like waste-to-energy production help lessen our dependency on non-renewable energy sources. Recycling encourages a circular economy and lessens the demand for virgin resources by turning garbage into raw materials or new goods.***

KEYWORDS: Dealers, Garbage, Retail, Recycling, Solid Waste, Wholesalers

INTRODUCTION

The chapter's main goal is:

1. Illustrating the movement of various waste components (paper, plastic, metal, and glass) via trade and recycling channels as they are collected, reused, and recycled;
2. To examine how recycling businesses are structured, their potential to make a profit, and their relationships with garbage collectors, merchants, and wholesalers;
3. To investigate the kind of work that the various employees in the industry are doing; and
4. To determine the contribution of recycling inorganic waste to urban sustainable development from a socioeconomic and environmental perspective.

Inorganic trash is produced by households and institutions and, in theory, is disposed of in the municipal waste stream. In India, servants, family members, or lower-level staff in institutions have the most access to the inorganic trash that is separated for sale. The rest is added to the municipal stream where it is combined with other garbage after inorganic waste has been separated at the source. At this stage, trash becomes into a public benefit (or 'evil'), and access becomes more widespread. Waste that is no longer uncontaminated is further separated. Tricyclists, MCH workers, street garbage pickers, and municipal crews all have access to and participate in the separation of waste at dustbins, collection sites, and transfer stations. Inorganic garbage is segregated and sold at the dumpsite by refuse pickers [1].

Waste is mostly sold to itinerant customers and retail dealers by household members, household staff, office boys, and tricyclists. Street rubbish collectors, waste collectors from dumpsites, certain tricyclists, itinerant customers, and small vendors sell to retail and wholesale vendors. Retailers sell some rubbish to recycling facilities in Hyderabad and the surrounding areas as well as to wholesalers in other states. Recycled materials are utilized in certain retail and wholesale waste. Additionally, garbage is sold by wholesale dealers to recycling facilities and other states. Although this is the typical scenario in Hyderabad, the intricacy of the flows varies depending on the materials used. According on the kind of waste material, Hyderabad produces several waste flows. The diagrams may be compared to identify many discrepancies. First, since reuse and recycling are involved in the flow of metal scrap and glass bottles, it is more complicated than the flow of paper, plastic, and glass trash [2]–[4].

Second, neither the creation of garbage nor the recycling facilities to which waste is ultimately sold are restricted to the Hyderabad Corporation area and the adjacent municipalities5. This makes it quite evident that, in terms of recycling flows, the city is not a closed system. Because neither the total amount of garbage created in Hyderabad nor the quantities the recycling businesses buy from outside the city, it is extremely difficult to determine the contribution that waste removed from the municipal stream contributes to lowering

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city waste flows. The last links in the recycling supply chain are the recycling businesses. As shown in the preceding figures, their economic viability influences the profitability of the whole chain of suppliers connected to them. They set the pricing for their goods as well as the costs associated with purchasing the secondary resources utilized as inputs in such manufacturing. Price variations are then transferred through the supply chain. As the last units in the value-added chain, these private sector recycling facilities serve as the starting point for the study. The entrepreneurs are often classified as belonging to a "other caste," i.e., they do not belong to an underprivileged or reserved caste. They have good education; half of them have bachelor's degrees in engineering or business, while the other half hold master's degrees in related fields.

In the 1990s, recycling units gained in popularity. Only one was established in the 1970s, while six were in the 1990s. The recent addition of more units is a sign of the recycling units' potential. The fact that there are recycling units with both modest and big capital investments shows that recycling operations may be effectively conducted by units of various sizes. Larger units are equipped to complete all manufacturing and processing steps. Smaller facilities create intermediate items since it would be too expensive to purchase more machinery. The units are able to achieve fair to significant profit margins, on average close to 10% (based on turnover/costs). Companies recycling plastic may achieve larger profit margins than businesses recycling other kinds of materials.

There are contract positions available at the recycling facilities, as well as casual employment (daily hiring). But employees often stay with the same unit for a longer amount of time. Nearly 40% of all employed employees were women on average. The average number of workers per unit was fifty, with the smallest unit having only nineteen employees and the biggest having 120. Men's monthly salaries ranged from Rs. 1,400 to Rs. 3,000, while women's salaries stayed between Rs. 900 and Rs. 1,900 at the most. This shows that in this industry, women make between 66 and 75 percent of what men make. Men work overtime but women often do not, and their hourly salaries are typically lower. An annual bonus and a pay credit are often the sole sorts of fringe benefits provided to the employees. A few units additionally provide reimbursement for medical expenses. Back and chest aches, as well as respiratory illnesses, are common complaints among the personnel in the units.

According to the profit margins discovered, these units are currently feasible. This viability is based on a number of cost-cutting strategies. To start, the laborers do not do formal wage job and get nothing in the way of social security benefits. Second, since the units are situated in industrial districts, neither locals nor environmentalists are likely to object to them. Some businesses are situated in the rural regions around Hyderabad because the government has provided tax breaks and other benefits to encourage non-agricultural businesses there. Finally, the profit margins of these recycling units in rural regions are now maintained by the lack of trade unions and a lack of knowledge about the consequences of these units on the environment. However, these units risk losing their economic viability if the costs of the environmental externalities they produce are absorbed or if they begin to abide by labor laws [5]–[7].

DISCUSSION

Wholesale Traders

Businesses or people that purchase and sell items or commodities in big numbers are known as wholesale traders. They serve as a bridge between producers or manufacturers and retailers or other companies that sell goods directly to customers. Due to the enormous numbers involved, wholesale dealers sometimes buy items in bulk from producers or distributors at reduced costs. They then earn a profit by selling these products to merchants or other companies at a little higher price. The products might include a wide variety, including electronics, apparel, food, home goods, and more. In the supply chain, wholesale merchants are essential because they make it easier for producers to distribute their products to retailers. They often run distribution facilities or warehouses where they keep stock and handle inventory. This makes it possible for shops to get a large range of goods from several producers without having to deal with each source individually.

Additionally, wholesalers help both manufacturers and retailers. The distribution of a manufacturer's goods to numerous retail establishments is handled by wholesale merchants, who assist producers in accessing a bigger market. It enables companies to concentrate on manufacturing while leaving the responsibilities for marketing and sales to wholesalers. Conversely, retailers profit from the ease of obtaining goods in large quantities from a single wholesale seller, saving them time and effort. Additionally, wholesale dealers could provide their customers with transportation,

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packaging, and even financing solutions. With manufacturers and retailers, they often develop long-term partnerships based on loyalty, dependability, and effective supply chain management. In general, wholesale merchants are essential to the supply and distribution of commodities, ensuring that things are delivered to the market quickly and effectively.

The primary suppliers of secondary materials to the recycling plants are wholesalers. Although 20% of them are from scheduled or backward castes, their background is still mostly that of advanced castes. Nearly half have completed postsecondary education. 20% of the merchants only have an elementary education, while the remaining 80% have a secondary education. 60% of the wholesale units were founded in the 1970s or earlier, therefore they are mostly well-established. A second group (24% of the group) began operations in the 1990s. Since they deal with higher volumes of mostly uncontaminated garbage, wholesale dealers often specialize on a specific waste. However, 40% additionally trade in a different material, accounting for up to 10% of their total turnover. There are 9 wholesalers of paper, 9 for metal, 4 for bottles, and 2 for plastics. They operate from commercial spaces; 60% of wholesalers own their spaces themselves, while 40% rent them. Their primary function is to separate garbage, store it, and transfer it to recycling facilities that purchase it.

They either sell the garbage to other regional wholesalers and recycling facilities, or they sell it directly to facilities in Maharastra, Tamil Nadu, and Karnataka. Other states pay comparatively more for recycling units. Since they deal in huge quantities of materials, wholesale dealers are less impacted by price variations in waste products than retailers are. However, they are at danger from shady providers and purchasers. Wholesalers must provide their suppliers prompt payment as well as loans when necessary. The recycling businesses who purchase the materials demand that they provide the materials on credit at intervals of between 15 and 90 days. As a result, the amount of working capital invested in the company may be substantial.

Weekly garbage purchases typically cost Rs 133,125. After subtracting the expenses of property, infrastructure, non-wage perks, labor, and transportation, the wholesalers have an average weekly net revenue of Rs 30,269. The statistics clearly show that dealers' incomes vary greatly. The magnitude of the turnover dictates the size of the units' net income since profit margins are very modest. The average number of employees employed by units built during the previous 20 years is 5, compared to seven for older units. Men are engaged in hauling and transporting debris, while women and children do the bulk of the sorting. In these units, there is no shift system. Secondary materials are bought by wholesalers from a range of suppliers. Waste pickers, itinerant purchasers, retail workers, government agencies, and others are among them. The majority of materials acquired for the four waste fractions examined by the field study (varying from 63 percent for metal and paper, 68 percent for bottles, to 95 percent for plastic) are from retail dealers. The secondary products that have previously passed the sorting and cleaning performed by retail dealers are obviously preferred by wholesalers.

Depending on the features of their units, wholesalers may purchase materials from various trash providers to varying degrees. While big units purchase 50% from stores, 35% from itinerant buyers, and 15% from garbage pickers, small units prefer to buy paper completely from retail dealers. Only 4% of plastic waste units buy from itinerant buyers and rubbish pickers combined (mostly small units), who buy virtually entirely from retail sellers. Wholesalers that purchase scrap metal purchase 60–70% from retail merchants, 15–25% from roving purchasers, and fewer than 5% from pickers. Government agencies are another significant source (15%) for bigger units. Retail merchants are the primary source for small units (85%) and smaller units (65%) among wholesalers that purchase bottles. Additionally, 27% of their purchases come from transient consumers. The data support prior research by Furedy (1992) on this sort of dealer and show that itinerant purchasers are a more significant source of secondary materials than is often recognized. Additionally, it is made evident that trash pickers do not have much direct access to wholesalers in order to sell rubbish, with garbage making up just 1-3 percent of the goods supplied to wholesalers.

RETAIL TRADERS

Individuals or small enterprises that purchase and sell products or services directly to customers are referred to as retail traders. They usually work on a lesser scale than manufacturers or wholesalers but are nevertheless very important in the distribution and sale of goods to the general population. Retail traders may be found in a variety of locations, such as brick-and-mortar shops, online marketplaces, or a mix of both. They provide a huge selection of consumer products, including food, home goods, electronics, apparel, and more. By delivering items

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in small amounts and at convenient places, retail traders function as a middleman between manufacturers or wholesalers and the final consumers, affording clients convenience and accessibility. These merchants purchase their products from manufacturers or wholesalers, often buying them at wholesale costs and reselling them at higher retail prices in order to make a profit. By providing customers with a range of options, individualized customer care, and an easy shopping experience, they increase the value of the items.

Retail business owners have a significant role in economic development and employment creation. They are essential in helping customers with their different wants and preferences by providing a broad range of goods and services. Retail traders also act as a crucial conduit between manufacturers and customers, offering insightful consumer and market data that may affect product development and marketing plans. Retail merchants have increased their online presence as e-commerce has grown, accessing a wider client base and adjusting to changing consumer behavior. As internet shopping involves efficient digital marketing techniques, logistics management, and upkeep of an online presence to draw consumers, this move has offered both possibilities and obstacles. Retail traders contribute significantly to economic activity and the molding of customers' shopping experiences in both real-world and online markets by distributing and selling products and services to consumers.

In Hyderabad, 'backward' castes make up a majority of retail merchants (71%). Another 24% of people identify as belonging to "other castes." This implies that under the Hindu caste system, the lower down the value chain, the lower the social background. Their educational levels are lower than those of wholesalers: just a tiny percentage (55%) of them have a tertiary degree. Only 4% of the merchants were determined to be women, making males the overwhelming majority. The merchants, who are a part of a wider family and caste group network of persons operating in this area, already had some business experience before opening these shops. They get both material and spiritual assistance from this. The late 1980s and early 1990s saw the establishment of retail trading units. 32 of the 55 projects began after 1995, which is more than half. They are mostly housed in privately owned or leased residences. Despite having a license from the MCH, they often face harassment from the property owners. Instead of spending money on purchasing real estate or vehicles, they instead hire it as needed. In order to save expenses, they do not use paid outside labor but rather use unpaid family work from both male and female relatives. Over time, the units do succeed in increasing both the scope of their operations and the personnel employed there [8]–[10].

Before selling the garbage, retail dealers usually sort it and clean it before stocking enough of it. Cars or rickshaws are their primary modes of transportation for selling the rubbish. They sell the garbage to wholesale buyers, but retail buyers are responsible for covering transportation expenses. Retail traders don't focus on a single material and buy a variety of wastes, including paper, bottles, plastic, broken glass, metal scrap, aluminum, and copper. All of the study's waste components are purchased by 64% of respondents. Another 25% purchase three of the four different kinds of supplies. Only 11% of people specialize more than they do. Itinerant customers, government agencies, homes, and street and dumpsite pickers are just a few of the sources that traders buy from. Who the retail merchants purchase from is determined by the quality and accessibility of waste items. Itinerant purchasers provide 60–80% of the materials that retail dealers purchase.

Metal is an exception, which they also acquire from other retail purchasers. This implies that the most significant type of suppliers for small- and medium-sized retailers is nomadic purchasers. Additionally, it implies that since there is a shortage of metal scrap, small-scale retailers must buy it from their peers in order to have enough to sell economically. Pickers are purchased by retail dealers; between 12 and 33% of their resources originate from them. In contrast to plastic trash, this is least true for paper waste. By giving them loans and advantages in kind, traders do strive to tie rubbish pickers and nomadic purchasers to them as suppliers. For retail dealers, there are obvious seasonal fluctuations in their operations. Due to a reduction in garbage supply from itinerant purchasers and other sorts of pickers, company productivity decreases by 25 to 50 percent during the wet season. Retail merchants are aware of the government's import regulations. Additionally, they have waste permits, which are advantageous for them while purchasing and selling rubbish as well as to keep away from any issues with the Municipal Corporation of Hyderabad.

The average weekly net income for retail dealers is Rs 817, after deducting expenses for renting a storage facility, transportation, energy, and water. In calculating revenue, the degree of turnover is more significant than levels of profit margin for

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both this group and wholesalers. The units made purchases worth an average of Rs 4,045 each week during the most recent week of the field survey in 1999. The kind of garbage that is bought affects the degree of revenue as well. Paper makes up 34% of the entire cost of waste materials acquired, followed by plastic (12%), metal (28%), and bottles (26%).

ITINERANT BUYERS

Itinerant traders, or peddlers, are people or organizations who move from one location to another to offer products or services. They depend on traveling from one place to another to contact their consumers rather than having a set site for their commercial activities. The practice of itinerant buying and selling has a long history and has been embraced by many different civilizations. Mobile buyers often bring their goods with them, either by utilizing carts or portable displays or by carrying them in vehicles. They often stock a wide range of goods, including anything from food and minor appliances to apparel, accessories, and home goods. Itinerant purchasers may sometimes specialize in certain categories of goods or services. These merchants often go for densely populated regions like metropolitan cores, marketplaces, or gathering places for prospective clients. They may simply exhibit their items on the sidewalks or in public areas, or they might erect temporary booths or kiosks. Itinerant buyers utilize a variety of sales strategies to draw in clients, including bargaining, providing discounts, and highlighting the distinction or excellence of their goods.

Itinerant purchasing may be a versatile and dynamic style of trading that enables dealers to adjust to various environments and client preferences. Customers who may not have easy access to conventional retail establishments or who value the customized and direct relationship with the vendor may take advantage of its ease. Additionally, it offers chances for company owners with little resources or those that choose a mobile business approach. Itinerant purchasing, nevertheless, might often be difficult. Itinerant merchants may be required to abide by local laws and get the required licences in order to do business lawfully since regulations and licensing standards may differ from one jurisdiction to the next. Itinerant buyers may also face commercial risks due to variations in demand, competition from well-established merchants, and the have to continually look for new clients and markets. The nature of nomadic purchasing has changed as a result of the growth of e-commerce and internet shopping. While still being flexible and adaptable, some itinerant merchants today use technology to contact clients via internet platforms, social media, or smartphone applications [11]–[13].

Throughout the day, itinerant rubbish buyers purchase 'dry' waste from homes and domestic staff as they travel from door to door. High income neighborhoods produce waste products of a higher grade from the perspective of nomadic waste purchasers, although domestic employees often gather and sell them. They claim that middle-class neighborhoods, where women of the family are more inclined to sell themselves than residents of high-income neighborhoods, where garbage is provided to domestic helpers and maids, are better for them. The mobile rubbish collectors also service homes, businesses, and workplaces. They don't operate in groups; they work alone, and they stay in the same places throughout time. This promotes consistency and a higher level of confidence in their clientele's connection. The majority of itinerant purchasers (73%) are from scheduled castes or scheduled tribes. The remainder are members of "backward" castes. Only 3% of them are women, making them primarily male. They are generally uneducated, have roots in rural Andhra Pradesh, and moved to Hyderabad in quest of employment. When there is no employment in the rural regions, the seasonal nomadic buyers go back and forth to them and only work in "buying waste."

The nomadic garbage purchasers often have bicycles, which they use as a mode of transportation while scouring locations for rubbish to buy and transport. They often commute 10 to 11 kilometers from their place of residence to work each day, putting in 10 to 11 hours on average. They relax on Sundays after working for six days straight collecting trash. They only labor 3 to 4 hours each day during the wet season, and their revenue plummets. They borrow and repay the loans during the busiest season as a last option to tame the revenue variations. While working, itinerant buyers face health hazards. They express complaints about aches and pains, cuts from sharp objects, skin conditions, and headaches. Since none of the garbage is readily accessible in sufficient numbers, the itinerant waste buyer acquires all forms of waste and does not specialize. On the day when the trash is picked up, they sell it. Before selling the garbage to the merchant, they sort it there. As a result, there are no storage or sorting expenses. Because of this, the itinerant buyer's sole expense is the bicycle he rides, and the remaining value of the garbage is money.

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Permanent relationships with their retail merchants are common for itinerant purchasers who operate year-round in the industry (according to 77% of the dealers surveyed). These linkages are reflected in two different ways. In the first, the dealer offers daily operating money as well as interest-free loans. The payment given to the itinerant purchasers for the garbage supplied to the merchant is regularly subtracted in the evening from the operating capital granted in the morning. They are eligible for loans up to Rs 5,000 at a time. Accounts must be resolved on Diwali (an annual event), and that sum must be paid back in two payments. On Diwali, the traveling vendors also give them presents on a yearly basis. The only approach to encourage long-lasting relationships is to provide interest-free loans with the same payback terms as the first technique. With these techniques, the nomadic garbage buyer is forced to sell their waste to only one dealer over an extended period of time.

Seasonal roving purchasers (23 percent of the dealers) often do not use daily working capital or interest-free loans. Any dealer is welcome to purchase their trash. The tethered technique benefits nomadic garbage purchasers by allowing them to acquire interest-free loans and operating capital, save expenses, and provide a bare minimum of financial assurance against unanticipated disasters. The dealers benefit because it guarantees a steady supply of goods to sell. In 1999, the average weekly revenue for all roving dealers was close to Rs 1,223. The difference was between dealers who had long-standing relationships with their retail customers, who made Rs. 1,152, and those who did not, who made Rs. 1,456. The fluctuations in revenue between the slow and busy seasons show that nomadic merchants with solid links to retail traders are more flexible than those with short-term relationships. They strive to maintain their income by purchasing as much as they can since they are unable to acquire loans from these vendors.

CONCLUSION

In the context of urban inorganic solid waste in Hyderabad, the research emphasizes the significance of implementing sustainable waste management techniques, with an emphasis on the ideas of reuse, recovery, and recycling. These tactics may have a big positive impact on the environment and the economy. To lessen the load on landfills and conserve natural resources, reuse entails finding other applications for waste materials. Establishing the necessary infrastructure, increasing public awareness, and fostering cooperation amongst stakeholders, such as local government, waste management businesses, and the community, are essential for the successful implementation of these policies. Hyderabad's waste management system can be successfully integrated with reuse, recovery, and recycling activities to create a cleaner, more environmentally friendly city that will benefit both its citizens and the environment.

REFERENCES:

[1] S. Galab, S. Sudhakar Reddy, and I. Baud, “Reuse, recovery and recycling of urban inorganic solid waste in Hyderabad,” 2004. doi: 10.1007/1-4020-2529-7_7.

[2] O. K. M. Ouda, S. A. Raza, R. Al-Waked, J. F. Al-Asad, and A. S. Nizami, “Waste-to-energy potential in the Western Province of Saudi Arabia,” *J. King Saud Univ. - Eng. Sci.*, 2017, doi: 10.1016/j.jksues.2015.02.002.

[3] R. P. Singh, P. Singh, A. S. F. Araujo, M. Hakimi Ibrahim, and O. Sulaiman, “Management of urban solid waste: Vermicomposting a sustainable option,” *Resour. Conserv. Recycl.*, 2011, doi: 10.1016/j.resconrec.2011.02.005.

[4] G. Bernache Pérez, “Evaluation of waste management systems in four municipalities of Jalisco, Mexico,” *Rev. Int. Contam. Ambient.*, 2019, doi: 10.20937/RICA.2019.35.esp02.03.

[5] E. Damanhuri, I. M. Wahyu, R. Ramang, and T. Padmi, “Evaluation of municipal solid waste flow in the Bandung metropolitan area, Indonesia,” *J. Mater. Cycles Waste Manag.*, 2009, doi: 10.1007/s10163-009-0241-9.

[6] M. Vicent, M. Criado, and J. García-Ten, “Alkali-activated materials obtained from asphalt fillers and fluorescent lamps wastes,” *J. Clean. Prod.*, 2019, doi: 10.1016/j.jclepro.2018.12.291.

[7] J. Sotamenou and L. Parrot, “Sustainable urban agriculture and the adoption of composts in Cameroon,” *Int. J. Agric. Sustain.*, 2013, doi: 10.1080/14735903.2013.811858.

[8] A. Jain, R. Goyal, S. Singh, and L. Pradhan, “Municipal solid waste management in India: A case study of post consumed tetra pak cartons in Delhi NCR,” *IIOAB J.*, 2016.

[9] R. Pratap, P. Singh, A. S. F. Araujo, M. H. Ibrahim, and O. Sulaiman, “Resources , Conservation and Recycling Management of urban solid waste : Vermicomposting a sustainable option,” *"Resources, Conserv. Recycl.*, 2011.

[10] B. M. Verstappen *et al.*, “Market-driven Upcycling of Urban Organic Solid Waste in Indonesia,” *SANDEC News*, 2016.

[11] A. Aragón Cruz and A. Córdova, “Separation of recyclable inorganic waste in tijuana,” *Rev. Int.*

ISSN (Online) 2456-1290

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Contam. Ambient., 2019, doi: 10.20937/RICA.2019.35.04.19.

[12] S. Martins, M. M. Barros, P. S. D. C. Pereira, and D. C. Bastos, "Use of manufacture residue of fluidized-bed catalyst-cracking catalyzers as flame retardant in recycled high density polyethylene," *J. Mater. Res. Technol.*, 2019, doi: 10.1016/j.jmrt.2018.11.015.

[13] S. M. Rola, E. G. Vasquez, L. F. B. Carvalho, I. C. Leite da Fonseca, M. A. Vasconcelos de Freitas, and L. Pinguelli Rosa, "The sustainability of construction: Techniques and technologies for energy efficiency and the reduction of greenhouse gases - methodological aspects," *WIT Trans. Ecol. Environ.*, 2012, doi: 10.2495/ARC120371.

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Street and Dump Site Waste Pickers in Hyderabad

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ABSTRACT: ***This research focuses on rubbish pickers in Hyderabad, a significant Indian metropolis. Waste pickers are essential to the informal waste management industry, helping to preserve the environment and fight poverty. However, they have a number of difficulties, including as health hazards, societal stigma, and a lack of official recognition. This study tries to comprehend the working circumstances, socioeconomic situation, and difficulties experienced by Hyderabad's rubbish pickers on the streets and at dump sites. Waste pickers were the subjects of surveys and interviews, and the results shed light on their ambitions, living arrangements, and modes of subsistence. In order to improve the lives of garbage pickers and include them in official waste management systems, the research underlines the necessity for governmental initiatives. In order to manage garbage sustainably and improve the lives of waste pickers, it is crucial to acknowledge the contributions of Hyderabad's street and dump site waste pickers and to put the right regulations and interventions in place. Waste pickers' socioeconomic situations may be improved by incorporating them into official procedures, resulting in a cleaner environment for all Hyderabad residents.***

KEYWORDS: ***Garbage, Health, Recycling, Street Pickers, Waste.***

INTRODUCTION

Social background

The street- and dumpsite garbage pickers are the primary categories of non-household and non-institutional collectors of rubbish for trade and recycling. Younger men, women, and kids are among them. The majority of Hyderabad's rubbish pickers are recent rural migrants who moved to the city with their families for primarily economic reasons. Both groups have a predominance of scheduled caste and, to a lesser degree, scheduled tribal heritage. In comparison to other working groups in the trash chain, they are more likely to be female: 42% of dump pickers and 28% of street pickers are women. Children are more prevalent among garbage pickers than among street pickers, where they make up just 4% of the persons questioned. 80 percent of the population in each group lacks literacy, and most of their kids don't attend school either.

The pickers endure a difficult way of life. They don't have much access to government services. They receive water from public water taps or bore wells since the great majority (88–90%) do not have ration cards. 65 percent of waste pickers and 53 percent of street pickers in Hyderabad had resided there for less than five years, respectively. The rubbish pickers at the Mansurabad location are linked, originate from the same rural region, and reside in the same neighborhood of Hyderabad. The socioeconomic and geographic origins of waste pickers in Golconda and Gandamguda are diverse. This implies that when migrants stay longer in the region, they may advance up the value chain and have access to garbage with a greater unit value [1].

Economic activities

The primary places where street pickers focus their picking efforts include slums, industrial zones, residential neighborhoods, and institutions. Six of them work six days a week, while the other three-quarters work seven days a week. The amount of time they labor varies significantly depending on the season since selecting is more difficult and the products are less valued during the wetter months. Each day, they transport their materials to a retail merchant so they may be sorted and sold. Dump pickers focus on one location, to which they get access by making a daily payment of Rs. 10 to municipal representatives at the dumpsite. They gather a variety of waste items, sort them, and sell them to retail dealers that same day. They cannot use public transit with their supplies, thus transportation costs are another significant expense. Some people walk, others cadge a ride from the municipal rubbish collection staff, while still others rent rickshaws collectively. 'Tied' and 'untied' procedures are used by both sets of pickers to sell to their retail dealers.

In contrast to linked selling, which gives them access to a sizable loan (up to Rs 5,000) but forces them to sell to the retail dealers who are giving this

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loan7, untied selling enables them to sell to any trader they want. The bulk of each group continues to be unaffiliated with any specific trader. However, compared to just 10% of street pickers, more over 20% of trash pickers take out loans from dealers. Some members of both groups may get loans via their connections in the rural communities from where they hail, which is the preferred choice. Paper, plastic, polythene bags, metal debris, pads, broken glass, and bottles are among the rubbish that both teams of garbage pickers have managed to gather. Between 70 and 75 percent of the materials obtained during the peak season are collected during the quiet season.

The pickers themselves utilize fuel wood, bottles, and some of the clothes and other things they gather. Similar garbage is gathered by dumpsite pickers in greater quantities than it is by street pickers. Paper makes up the biggest portion, followed by scraps of polythene, plastic, and metal. The levels are 60 percent of peak season for the majority of materials that are influenced by rain. The two groups of pickers' average salaries differ from one another. When they are "tied" to a dealer, street pickers make an average of Rs 274 per week, and when they sell on the open market, they make Rs 247. They make, on average, 68 percent of what they did during the peak season. Untied pickers earn 73% of their peak salaries, compared to tied pickers' 63%. This shows that working for different customers enhances revenue for street pickers, while tethered pickers earn less but have some access to loans to help them get through the lean season.

When working in a "tied" relationship with a merchant, dump pickers make an average of Rs 391; but, when selling on the open market, they make an average of Rs 388. Tied dump pickers make around 68 percent of what untied pickers make during the lean season, compared to the latter's 60 percent. This implies that for dump workers, a stable relationship with a dealer decreases income swings and gives them access to a fundamental type of social security. However, just 22% of the pickers have this kind of connection [2]–[4].

Working hazards

Nearly all of the street pickers expressed health concerns, namely headaches, cuts from sharp items, and vision issues. Similar issues were reported by garbage pickers, but they also acknowledged having respiratory disorders, indicating that the air quality at the dump is an additional issue. For medical care, street pickers pay Rs. 21 per week, while dump pickers Rs. Both groups mostly make use of private medical facilities. The police and the general people often harass street pickers, preventing them from entering certain locations. Unmarried girls and women who pick up trash are subjected to sexual harassment by municipal employees, and their belongings are sometimes taken. They cannot board buses under the current public transportation system, which drives up the cost of transportation for them.

DISCUSSION

Evaluating The Inorganic Recycling System's Sustainability

The assessment of the inorganic waste recycling system's impact on several facets of sustainable development in Hyderabad's urban area is the topic of the concluding part. The indicators from chapter 1 are employed, however somewhat flexibly, depending on the amount of data that is available for the research. The three areas of contribution that are highlighted are the socio-economic, public health, and environmental elements.

1. **Contributions to socio-economic aspects of sustainable development**

   i. **Economic viability and effectiveness**

The recycling industry is distinguished by its entirely private nature; no player or firm along the value chain receives government funding. This indicates that the system's present allocative efficiency is high enough to make it lucrative for the different players in the commodity chain to engage in their sorting, trading, and recycling operations. The recycling operations' profit margins have been seen to range from 5% to 22%, with an average of 10%. Wholesalers' weekly net income is around Rs30,000. It was shown that retail dealers and itinerant purchasers earn an average of Rs. 817 and Rs. 1,222 per week, respectively. Street and garbage pickers earned, on average, Rs250 and Rs389 per week, respectively. According to this data, the majority of the organizations involved in the commodity chain are able to support a livable standard of life. There were no overt signs that prices were falling throughout the supply chain in the Hyderabad region, despite the fact that different players claim there is greater competition presently inside their groupings. Materials were mostly sourced from the city and surrounding area and marketed there. Little to no relationship has yet been established between trash from foreign sources outside of India.

The businesses, merchants, and pickers in the chain have operational performance that is well suited to

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the fine-mesh network required to successfully gather mixed debris from homes, streets, and dumpsites. The lowest-paid pickers and itinerant purchasers are dispersed across the city and sell to neighborhood-level retail dealers. Recycling facilities primarily purchase from wholesalers, who in turn purchase from retail dealers. 550 tons of paper, 39 tons of plastic, 63 tons of metal scrap, and 14,000 bottles are collected each week at the wholesaler level. The MCH gathers 6,800 tons on average each week; the recycling chain's operations increase that total by 10%.

The commodities chain is not particularly interested in boosting its productivity via technical advancements or purchases of new equipment. This is seen in recycling facilities, as larger facilities produce end goods while smaller ones only produce intermediate ones. Both wholesalers and retailers want to make as little investment as possible, as shown by their preference for renting storage space and for leasing both real estate and transportation as and when required. Increasing productive efficiency is mostly accomplished on the "low road" by lowering costs throughout the whole supply chain. For wholesalers and recycling facilities that operate in part on an informal basis, the main approach to save expenses is to not pay taxes as required. The units, merchants, and pickers also do not adhere in any manner to labor law standards, as I will further explain in the next section.

ii. Labor and employment circumstances

The amount of employment generated by the commodities chain is extremely significant. 500 persons, including about 40% of women, were employed by the 10 recycling facilities that were covered. There were 143 persons employed by the 25 wholesalers we studied. The 110 workers employed by the 55 stores each have two family members working for free. With 60 individuals identified in just one sample, itinerant buyers represent a significant group in Hyderabad's supply chain for commodities. This indicates that, with the exception of Furedy, who has highlighted its significance, this group may likely be greater than often claimed in the literature. Without including the family members that assisted the responders, there were about 200 pickers in the area covered. These figures represent samples from populations whose sizes are unknown, therefore extrapolating them to the whole city is not possible. All employees in the industry have poor job security. Employees with longer-term contracts are only to be found in the recycling units. However, those without formal contracts who work in the wholesale and recycling facilities often stay there for a longer amount of time. Fringe benefits are not provided in accordance with official regulations across the whole supply chain, although annual bonuses, presents in kind, and often some kind of loan from the employer (or buyer of products) is feasible to cover significant costs or disasters. Retail retailers provide their pickers informal social security via the loans they give them. Only 10 to 20% of the pickers have access to this kind of social security, however [5], [6].

The aforementioned list of types of business owners, independent contractors, traders, and pickers includes their respective incomes. The recycling units' pay workers make between Rs 900 and 2,600 a month. Women make up 40% of the workforce and earn around 60% of what males do in terms of wages. Once again, the data indicates that for the various categories of persons engaged, salary levels in the industry are not less than those of similar employment. However, compared to equivalent occupations in the construction sector, for example, the social standing of the work is far lower. The workforce's gender breakdown reveals that women are more concentrated in wage labor in less secure recycling and wholesaling units than men are, as well as in the risky street picking and dump picking. They do not belong to the group of dealers, who generate a medium level of revenue. This gendered architecture of public space, which prevents women of certain castes from moving from home to home to purchase goods, is the cause of this skewed pattern. Women from designated castes and tribes who work as street pickers are not required to follow the traditions of higher caste groups. The majority of street and waste pickers complain of health issues they attribute to their labor, and working conditions are poor. They spend a considerable amount of money on private health care since it is more costly but also more readily available than public health care (which is free but has hours that clash with the pickers' working hours).

iii. Regulation of the sector

From recycling operations to pickers, the players and businesses in the supply chain decrease in terms of legality. The majority of the time, recycling units are single-owner or proprietorship registered businesses. They have legal access to power and land tenure, and they pay taxes. However, they often do not adhere to the labor laws that apply to permanent employees. In order to circumvent stringent environmental laws, wholesalers in the sample opted to be situated in

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industrial parks or outside of the city. The bulk of retail merchants rent homes where they conduct most of their business. Due of the waste's negative environmental effects, these features leave them open to harassment from the property owner and neighbors. Additionally, it indicates that they are a part of Hyderabad's "informal economy" and are not legally regulated as enterprises. Due to this, they are vulnerable to harassment from police and municipal officials, and they often have to pay bribes to avoid having their businesses closed or their items seized.

Mobile purchasers are considered to be a component of the "informal economy" but are not recognized as official collectors. They must earn the confidence of the homes from whom they buy their products over a longer length of time in order to establish their own legitimacy. Pickers are seen as wholly unlawful and are even less trusted by locals, government workers, and the police. They have to pay police and municipal officials to get access to the rubbish (particularly at the dumpsite) since they are hounded by the numerous organizations listed. Local and national authorities have been prohibited from acknowledging the economic and environmental benefits the recycling industry contributes to recovering inorganic waste materials because of the air of illegality that lingers over small-scale and "informal" trade operations. Surprisingly, this also holds true for international organizations (like the World Bank) that support safer and more efficient solid waste management. Their policy interventions are mostly focused on safer disposal and more effective collection (see WB SWM Roadshow in India in 2000; new SWM Rules by GOI), which hinders them from creating new programs like recycling and recovery efforts [7]–[9].

iv. System resiliency

The garbage recycling system is now financially sustainable due to its "informality," lower labor costs, and unpaid taxes. The system might become less viable if it were to become formalized and integrated into the urban SWM system with a recognized contribution to lowering waste volumes for disposal and the environmental contribution of lowering use of virgin resources. This is because higher taxes and labor costs will lower profits in recycling units. These units push expenses farther up the supply chain, which reduces or eliminates the financial viability of trash picking.

2. Contributions to public health and environmental aspects of sustainable development

Reduction in the amount of garbage disposed of at the dumpsite and the perceived influence on environmental health conditions, often known as public health in India, have been used to analyze the environmental impact of reuse and recycling operations.

i. Cleanliness of neighborhoods

At the neighborhood level, trash recovery and recycling are thought to have a detrimental influence on the environment or public health. This is connected to the fact that waste products are removed from the trash bins to be sorted by the pickers, and it is more applicable to street pickers than itinerant buyers. Residents are highly wary of them being in their neighborhood since they are thought to be potential robbers. Since they remove unmixed garbage from the neighborhood before selling it, itinerant buyers do not constitute a threat to the environment or public health. Because they keep materials in their own properties in residential areas and have pickers coming and going with the rubbish they sell, retail merchants are seen as a negative environmental health danger. Wholesalers are often found outside of residential areas and are not seen as a danger by locals.

ii. Worker health

The supply chain for recycled goods is dependent on labor-intensive recovery and transformation processes, and the majority of employees are always at risk for accidents and potential diseases from contaminated trash. Women and children who sort rubbish in recycling and trade facilities as well as street and dumpsite pickers who look for waste in their local places are the employees most at danger. The amount of money practically everyone in these categories spends each week on health to offset the harmful impacts of their work risks reflects this. They don't wear any safety gear, and the only thing they have to search among rubbish heaps is a long stick.

iii. Impact on the environment - decrease in waste quantities

The decrease in trash volumes accomplished in the trade and recycling sector was estimated in the preceding section to be 10% of the weekly waste collected by the MCH. This makes a significant contribution to SWM that is more sustainable. This is particularly true when new dumpsites have not yet been put to use and old dumpsites are filling up. In reality, this would support the introduction of more and stricter recycling regulations, allowing for the continued use of current disposal sites. The likelihood is that the opposite tendency will develop. Garbage pickers and itinerant purchasers have less access to garbage at the neighborhood

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level as a result of SWC's privatization, and it is yet unclear if alternative collection stations can provide a replacement with the same degree of recovery.

System Wide Concerns

The fact that neither Hyderabad's government nor its citizens see the recycling industry as a crucial component of a SWM system that integrates concerns about environmental impact and environmental health is a key cause for concern. Instead, the emphasis on public health is still at the forefront of attempts to enhance the system, and this focus is reflected in the new national SWM rules that were established in 2001. As access to garbage is more effectively barred and the quantity of waste collected decreases, the situation will worsen before it can get better in terms of contributions to environmental elements of sustainable development in SWM.

The option used in European nations is to force families to supply their labor for free in order to recoup costs through private sector initiative. They must either transfer the sorted rubbish to secondary collection locations or provide it to the public authorities in designated containers after sorting it. This is a choice that, for a variety of reasons, would face strong opposition in India. At the moment, families separate items that may be sold to wandering customers or other dealers. Due to the 'unclean' connotation of garbage, providing free labor would be unpopular with middle-class and high-income homes. As a result, this would force houses to rely on their servants, who would be less motivated to do a good job if there was no additional cash to be made from waste [10]–[12].

International donors turned down alternative proposals made by engineers from ERM in Chennai to give waste pickers legal access to secondary collection stations and organize waste unloading in a way that they could do this effectively out of concern for having to deal with small-scale cooperatives in a larger SWM project. Such procedures might be used by national and local authorities in India to guarantee that the most quantity of rubbish is retrieved before being sent to the dumpsite. This is especially more crucial given that new dumpsites are most likely to be situated far from Hyderabad, significantly raising transportation costs. Last but not least, the absence of recognition represents a missed chance to incorporate an already-existing, fully private market recovery mechanism—one that is both financially and economically viable—into the municipal system. By acknowledging current efforts, it is possible to bring new, inexpensive technology that have been locally adapted into the system to improve productivity while lowering the health risks faced by those involved in trash recovery.

CONCLUSION

Waste collectors from streets and dump sites in Hyderabad are an essential component of the informal waste management industry and make a substantial contribution to garbage recycling and reduction. The working circumstances and difficulties experienced by rubbish pickers in the city are clarified by this research. The research shows that garbage picker's deal with hazardous working conditions, poor pay, and health hazards related to handling rubbish. They endure societal stigma and a lack of appreciation for their crucial function in garbage management. Policy changes are required to solve these issues. The formalization of the waste management industry and the integration of garbage pickers into formal systems should be the main goals of the government and local authorities. This may be done by giving them access to social security programs, identification cards, and training chances to improve their abilities. The whole waste management system would also be improved by establishing safe working conditions and putting in place mechanisms for trash segregation and recycling infrastructure. Public awareness campaigns should also be launched to inform the public about the value of rubbish pickers and the need of their assistance. For stigma and prejudice against trash pickers to be reduced, social attitudes must shift.

REFERENCES:

[1] E. Sembiring and V. Nitivattananon, "Sustainable solid waste management toward an inclusive society: Integration of the informal sector," *Resour. Conserv. Recycl.*, 2010, doi: 10.1016/j.resconrec.2009.12.010.

[2] L. S. A. Yiougo, T. D. T. Oyedotun, C. Y. C. Some, and E. C. D. Da, "Urban cities and waste generation in developing countries: A GIS evaluation of two cities in Burkina Faso," *J. Urban Environ. Eng.*, 2013, doi: 10.4090/juee.2013.v7n2.280285.

[3] J. V. BAPTISTA JUNIOR and C. ROMANEL, "Sustentabilidade na indústria da construção: uma logística para reciclagem dos resíduos de pequenas obras," *URBE - Rev. Bras. Gestão Urbana*, 2013, doi: 10.7213/urbe.05.002.se02.

[4] P. A. Nwofe, "Management and Disposal of Municipal Solid Wastes in Abakaliki Metropolis, Ebonyi State, Nigeria," *Int. J. Sci. Res. Environ. Sci.*, 2015, doi: 10.12983/ijsres-2015-p0107-0118.

ISSN (Online) 2456-1290

International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)

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[5] A. W. Butu and S. S. Mshelia, "MUNICIPAL SOLID WASTE DISPOSAL AND ENVIRONMENTAL ISSUES IN KANO METROPOLIS, NIGERIA," *Br. J. Environ. Sci.*, 2014.

[6] H. A. Olayiwola, L. Abudulawal, and G. K. Adewuyi, "Effects of Indiscriminate Solid Waste Disposal And Environmental Issues In Ibadan South West Local Government ," *J. Nat. Sci. Res.*, 2017.

[7] T. B. Hammed, M. K. C. Sridhar, and B. Wahab, "ENHANCING SOLID WASTE COLLECTION AND TRANSPORTATION FOR SUSTAINABLE DEVELOPMENT IN THE IBADAN METROPOLIS, NIGERIA," *Eur. J. Res. Soc. Sci.*, 2016, doi: 10.29198/ejss.

[8] D. Ngo, "Waste and informal recycling activities in Hanoi, Vietnam," *Third World Plann. Rev.*, 2001, doi: 10.3828/twpr.23.4.61966251020431xv.

[9] P. Strach and K. Sullivan, "Studies in American Political Development," *Harvard-Smithsonian Centerfor Astrophys.*, 2020.

[10] A. El Maguiri *et al.*, "Landfills: Environmental impacts, assessment, and management in developing countries - the case of Morocco," in *Landfills: Environmental Impacts, Assessment and Management*, 2017.

[11] U. Joseph K., P. A. Essoh, and S. A. Inah, "An assessment of seasonal variation of waste generation and management in Cross River State, Nigeria," *Mediterr. J. Soc. Sci.*, 2012, doi: 10.5901/mjss.2012.v3n2.139.

[12] Y. O. N. Udoakah and U. S. Akpan, "A sustainable approach to Municipal Solid Waste management in Southern Nigeria," in *Proceedings of the 3rd IEEE Global Humanitarian Technology Conference, GHTC 2013*, 2013. doi: 10.1109/GHTC.2013.6713704.

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Reuse, Recovery and Recycling of Urban Inorganic Solid Waste in Nairobi

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ABSTRACT: ***Nairobi, like other cities, has a sizable issue in managing their urban inorganic solid waste. Strategies for reuse, recovery, and recycling are essential in resolving this problem. This study intends to investigate Nairobi's urban inorganic solid waste's potential for reuse, recovery, and recycling. It looks at the city's present waste management procedures and points out important challenges and openings for putting sustainable waste management techniques into effect. The study makes use of previously published research, case studies, and expert interviews on trash management. The results emphasize the value of integrated waste management strategies that place a focus on resource recovery, waste reduction, and circular economy concepts. The function of policy and governance frameworks in fostering trash reuse, recovery, and recycling is also covered in the study. The findings aid in a better understanding of the obstacles to sustainable urban waste management in Nairobi and provide potential for improvement, as well as insights that may guide future policy and practice in the area.***

KEYWORDS: ***Garbage, Reuse, Recovery, Recycling, Waste Management.***

INTRODUCTION

Traditionally, efficient collection, transportation, and disposal services have been at the heart of municipal governments' urban solid waste management plans. Protecting and raising public health standards was the main goal. In the 1960s and 1970s, this strategy came under growing criticism and scrutiny in the industrialized world as increased trash creation rates caused by shifting consumer patterns added to the strain already placed on garbage sinks. Waste production grew to a point where it was socially undesirable. Therefore, industrialized nations evolved a fresh viewpoint on managing urban solid garbage. This viewpoint, which emphasizes waste reduction via prevention, reuse, recycling, and energy recovery, aims to support a more ecologically friendly method of managing solid waste.

Waste traders and recyclers promote cleaner urban neighborhoods, financial viability, the reduction of the volumes of waste destined for disposal, as well as the creation of employment for primarily poor people through recovery, reuse, recycling, and composting. Public health objectives continue to dominate urban SWM efforts in emerging nations. However, the increasing waste flows are also aggravating the already severe SWM issues in these nations. In order to achieve more "integrated sustainable waste management systems," emerging nations also need new types of regulatory and incentive-yielding frameworks to promote the recovery, recycling, and reuse of inorganic waste materials. This is crucial in Kenya since the public sector's collection of SW has all but vanished by this point [1].

Urban governance today emphasizes the value of partnerships and alliances among different players delivering urban services, including SWM, as tools that give a higher possibility of achieving socio-economically sustainable service delivery systems. It is crucial to analyze the nature of these partnerships and how they contribute to the sustainable development of metropolitan areas in SWM operations. This chapter focuses on the players, procedures, and waste recovery, reuse, and recycling operations as they relate to Nairobi's arrangements for inorganic resource recovery and recycling. The chapter names the participants and their respective roles,

Characterizing the scale, structure, and nature of their activities as well as the institutional context in which they take place. Second, the sorts of alliances that players have created are explored, along with the disputes and forms of cooperation that are involved. The degree to which these activities contribute to the socioeconomic and environmental aspects of sustainable development is then examined. Activities like recovery, reuse, and recycling help the environment by reducing garbage that would otherwise be disposed of or allowed to build up in neighborhoods and houses.

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Increased job and income prospects are also provided by such activities for individuals who are directly engaged. However, if they are not properly controlled, they may cause environmental stress on their own by using production techniques that are harmful to the environment, disposing of production waste in a dangerous manner, and endangering the wellbeing of the actors and the communities around them [2]–[4].

The topic is being led by the following inquiries:

1. Who are the players in Nairobi's recovery, reuse, trading, and recycling of inorganic waste materials, and what legal framework governs their activities?
2. How are these processes and activities set up, and how do they contribute to sustainable development?
3. What are the key ties that the players have, and how do they support sustainable development?

Examination of the institutional setups engaged in the administration of SW in the city as well as the supply chains that the activities are organized under served as the basis for data collection1. Homes, rubbish pickers and itinerant purchasers, waste merchants, small and large-scale recycling firms, and homes were among the actors examined. Information on social and demographic traits, operational patterns and dynamics, norms and regulations (formal or informal), and their placement in the supply chain were gathered from each of these entities. Study topics included arrangements for collection, trading, reuse, and recycling, preferred materials, pricing, and price swings, as well as net incomes, economic mobility, and entrepreneur motives. Assessing the kinds of alliances, modes of cooperation, disputes, and tensions was helpful in determining how they impacted efficient SWM and sustainable development.

Inorganic Waste Defined

Waste made of anything other than plant or animal materials is referred to as inorganic waste. This includes artificial materials like glass, sand, and dust. However, waste materials including paper, sand, dust, glass, plastic, rubber, metal, bones, textiles, and leather are often classified as inorganic in studies on SWM even if they may be considered organic. Due to the non- or delayed biodegradability of inorganic waste, its disposal has especially perilous consequences for the capacity of regional and global waste sinks.

1. **Policies and the regulatory framework for recycling and recovering inorganic waste**

Waste minimization, recovery, reuse, and recycling of waste products should be included into current waste management techniques to make SWM more ecologically friendly. Like many other developing nations, Kenya does not address the recovery, reuse, or recycling of urban inorganic solid waste in its legislation on solid waste management. More focus will need to be given to these efforts, nevertheless, given the rise in trash flows and the difficulties the municipal authority is having effectively and efficiently managing the garbage. Although it has not yet been put into practice, the Environmental Management and Coordination Act of 1999 (EMCA, as mentioned in chapter 4) makes this guarantee.

2. **Regulations affecting garbage recycling and recovery**

The reuse, recycling, and recovery of inorganic solid waste in Nairobi are not seen as municipal issues or as having any bearing on NCC's SWM mission. In terms of policy or practice, the city does not support recycling, recovery, or separation of inorganic waste. Existing processes-related actions are publicly thwarted and legally undermined, especially at the lowest levels. Activities such as waste collection in Nairobi continue to be stigmatized, socially unacceptable, and formally unrecognized. Waste pickers are considered a troublesome gang of criminals by the NCC and city residents [5]–[7].

DISCUSSION

Similar to how small-scale trash recycling is not acknowledged as a meaningful activity for SWM and lowering environmental stressors. Issues of industrialization and expansion are prioritized in theoretical considerations even in academic assessments of small-scale recycling businesses. In respect to jua kali operations involving the utilization of inorganic waste materials, neither environmental nor public health problems are examined in the research in this field. A small amount of the Factory Act, Cap 514, applies to sizable recycling businesses that use waste products in their manufacturing. According to this Act, industries must be maintained tidy and free of

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effluvia caused by the drainage of waste, sanitary conveniences, or nuisances. Additionally, it mandates that waste buildup from different industrial processes be removed daily from the factory grounds using an appropriate way. The Act refers to trash merely as 'dirt and garbage' and does not make particular reference to hazardous wastes.

It does not include any relevant industrial operations occurring outside the plant grounds, such as the procurement or transportation of raw materials inputs. Such hazardous trash often finds up in the Dandora dumpsite as well as in the city's unauthorized garbage dumps. The official SWM policy does not categorize waste according to potential threats to human health and the environment. The producers of such trash are allowed to dispose of the material in an unregulated manner. The recovery and recycling of scrap metal get only sporadic attention under the Scrap Metal Act, Cap 503. According to this rule, anybody planning to sell scrap metal must get a license from the local government. Additionally, it forbids the storing of scrap metal anywhere other than the location designated in the license or another location specifically approved in writing by the licensing officer. With respect to scrap metal, which is first only implicitly designated as trash, the act does not encompass other waste items or even alternative waste management procedures. It does nothing to slow down the production of scrap metal or recycle garbage. Similar to other NCC SWM rules, it has significant enforcement issues.

Actors in Recovery, Reuse, Trade and Recycling

Nairobi's recovery and recycling efforts are organized into a number of commodities chains, which include garbage collectors, mobile purchasers, dealers or merchants, wholesalers, small- and large-scale recycling facilities, and more. Numerous actions are involved in these activities, which take place in a private market. Large recycling businesses are located at the highest income end of the chain, whereas waste pickers and nomadic purchasers are located at the lowest income end. The connection between the pickers and recyclers is provided by dealers and wholesalers that operate at the intermediary revenue levels of the commodities chain. Waste pickers collect trash from the streets and landfills to sell to wholesalers and retailers. The materials are then sold to both large- and small-scale recycling businesses. These actors do, however, sometimes sell items directly to recyclers, such as bottles and newspapers. Similar to how certain players periodically get waste material inputs from outside the local chain, particularly those at the higher revenue end of the chain. Large recyclers that use waste materials in manufacturing often set pricing in the commodities chain, which affects those farther down.

The way that pricing are set, the way that critical information about sales and material preferences is exchanged, and the arrangements that are made to transport garbage are all examples of the social and operational linkages that occur in the chain of recovery, reuse, and recycling operations. Providing interest-free loans and sometimes non-material assistance to merchants and pickers in times of need are examples of social security. The provision of garbage on credit is another kind of assistance. Given that they allow actors to exist, these relationships are crucial in analyzing how these activities affect sustainable development. There are connections found:

1. Within the group of garbage pickers
2. Between trash collectors and consumers
3. Between vendors and roving byers
4. Between retailers and distributors,
5. Between distributors and recycling plants
6. Between recyclers and both large- and small-scale recycling facilities
7. Between these groups and the companies that create solid trash

The actors with lesser incomes choose a livelihood strategy, as shown in Figure 1.

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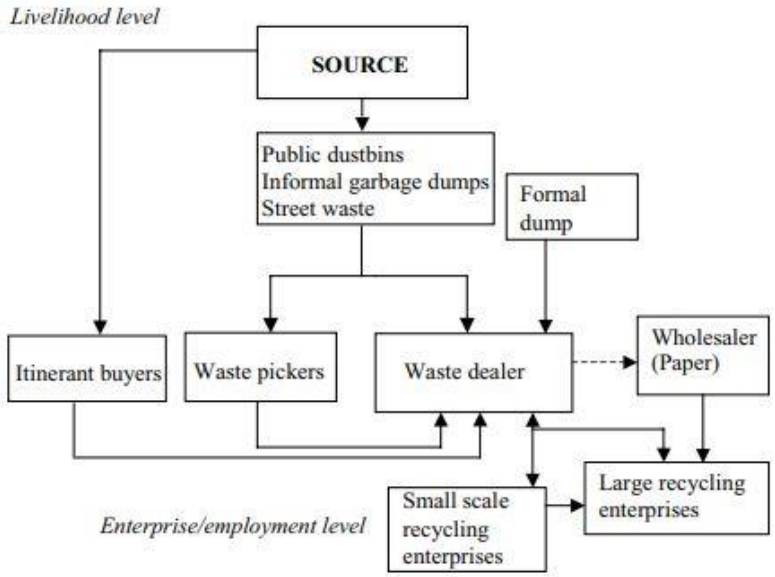

Figure 1: Scrap metal recovery and recycling chain in Nairobi

For the city's destitute and jobless, waste picking is a form of survival. Most of the time, those who participate in it lack access to basic requirements of life. Their lives are marked by fragility and instability as well. They believe that waste picking is the only legal way to make ends meet since it allows for both the creation of revenue and access to non-cash advantages. It is an investment from which the bigger, more formal players try to make a profit. However, the two are closely related, with bigger, more formalized industrial firms serving as the driving force behind lower-paying activities. The social, economic, and legal environment in which different actors operate, which also affects their place in the chain, has an impact on their ability to contribute to various areas of sustainable development. The lowest tiers' activities are prohibited, and they operate under less than ideal circumstances.

Street and Dump Waste Picking

The situation of homeless persons living on the streets, according to Hake, was a characteristic of Nairobi as early as 1901 and led to the adoption of vagrancy laws in 1902. Odegi-Awuondo discovered a 60-year-old rubbish picker who had been gathering and selling bones since 1944 when he conducted a study of trash collectors in Nairobi. Therefore, waste picking is a long-standing activity in Nairobi, while its scope and organization have evolved as a result of the city's demographic and socioeconomic changes Karanja, thesis under consideration. In 1963, when the new administration had dumped the copper-holed coins used by the colonial authority at a dump in Mathare North, individuals began to retrieve waste items for sale in Nairobi for the first time. To scrap metal traders, a kilogram of these coins went for Ksh. 2.50. In the 1960s, construction materials, bottles, scrap metal, rubber, tin cans, packing boxes, and cartons were among the additional commodities recovered for sale and reuse. Throughout the 1970s, waste picking persisted, although it was mostly unimportant and related to the parking boy4 problem. The primary materials used were bits of steel, bones, paper, aluminum, copper, and tins [8]–[10].

There was a little market for them, and not many individuals were engaged. Beginning in the middle of the 1980s, waste picking in the city became considerably more obvious. In our samples, 54 (73 percent) of the dump trash pickers and 63 (94 percent) of the street garbage pickers admitted to have begun waste picking around this period. This was further supported by the case studies of veteran pickers, who emphasized that throughout this time, the number of garbage pickers rose and that the rivalry for waste materials became one of the main issues in waste picking. The pickers also claim that this is the period when prices started to really fluctuate. Ironically, as indiscriminate dumping spread, there was also an increase in the waste products that could be recovered from the streets. At this period, waste creation rates were rising rapidly while the NCC, the primary service provider at the time, saw a decline in collection

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levels. The city of Nairobi was in the midst of a garbage management catastrophe. This implies that a variety of reasons led to the rise in the population participating in rubbish pickup and associated activities.

Social Aspects of Waste Picking And The Commodity Chain

Depending on the location of the activity, Nairobi has two primary categories of rubbish pickers: street waste pickers and dump waste pickers. Street waste pickers sort trash at modest, open municipal dumps, mostly in the sidewalks and trash cans. On the other side, dump garbage pickers work at large official or informal disposal5 sites where rubbish is finally disposed of. The organization, networks, preferred materials, marketability, and earnings of these groups are all notably different as a result of these characteristics. Additionally, they have various implications for the consequences on the workplace and health. However, both groups are mostly made up of young males (average age: 25–36 years) who have little formal education and little job skills and have lived in the city for around 15 years. They are sometimes referred to as "chokora," a disparaging word in Kiswahili for those without a permanent place of residence whose primary "occupation" is to rummage through trash cans in quest of food and other "valuables." They are also thought of as minor offenders. Their identity is intimately linked to that of parking guys, as was already noted.

Indicative of social and cultural norms of the kinds of occupations specifically for women, there aren't many women pickers on the streets. Large trash dumps that are hidden from the public view and have a higher concentration of female pickers. Their earnings are smaller than those of male pickers due to their incapacity to engage in the typical rubbish picking practices at the dump, but they also depend on the Dandora dump for household necessities including food, cooking fuel, soap, and other items. The majority of them are single women who are the heads of very poor households. Twenty percent of the Dandora dump waste pickers live within the dump and, like their colleagues on the streets, they buy food and clothes from the trash piles. Additionally, a sizable number of street rubbish pickers live on the streets. Both financial and non-cash revenue may be derived from garbage. The latter is more difficult to quantify but, in this instance, seems to be a substantial source of motivation or a means of survival.

These actors have developed a number of strategies to deal with the occupational restrictions that are characteristic in their line of employment. Gains from garbage picking are attempted to be increased by using certain "tricks." These practices include soaking paper to make it heavier and merchants "fixing" weighing equipment to make it lighter. All participants in the supply chain are educated of these and other crucial factors, such as the quality and demand trends of the various kinds of commodities. The most conspicuous of these are the unofficial but widely acknowledged territorial, picking, and trading systems that are common among dump and street rubbish pickers. At the Dandora dumpsite, they are the most advanced and consist of agreements that guarantee competitive access to the "high quality" garbage disposed of by private businesses and domestic utility producers.

Materials, Sales and Incomes

The majority (80%) of the waste materials collected at the Dandora dumpsite are sold to the Mukuru recycling project, a CBO founded by a local church in one of the nearby low-income residential districts. After a time of collection, the materials are taken straight from the project to recycling plants. The project leaders' arrangement, which successfully avoided the "exploitative" merchants operating near the dumpsite, led to comparatively better prices and earnings for the garbage pickers there. The recycling of plastic inside Mukuru itself is one of the additional measures aimed at improving the economic feasibility of these businesses. Mukuru and Skyplast, one of the city's large-scale plastics recycling businesses7, have come to an agreement for the transfer of technology and skills with the technical and financial support of UNEP.

Despite working outside of such agreements, street rubbish pickers often make more money from sales than dump waste pickers. This is due to the different sorts and quantities of materials that were gathered, both in terms of quality and quantity. At the landfill, waste is centralized in one location, saving time on segregation. On the other side, items that are found by street pickpockets sell for more money. These are the causes:

1. When compared to landfill pickers, street pickers gather waste products that are cleaner. While garbage recovered from the disposal is dirtier and sells for less money, rubbish collected from the streets is often close to the source of generation and is considerably cleaner. For example, plastics and bottles need more extensive cleaning, but tin cans are burned to burn off paint and residues. As a result, cleaning increases the expenses of reusing

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or recycling items collected from the landfill, leaving a smaller profit margin.

2. The prices offered by the merchants to whom street pickers sell their wares are higher than those at the trash. Street pickers sell to dealers who are further away from one another, making it more difficult for traders at the dump to successfully regulate pricing.

According to Odegi-Awuondo (1994), there seems to be no such thing as monoculture or specialization in trash collecting among the two groups of pickers. Salvaging is the process of recovering something that is deemed valuable in terms of marketability or utility. The ability of the material to endure damage and corrosion during collecting, transport, and disposal, as well as the demand by big trash recyclers, are the primary determinants of which materials street and dump pickers choose. According to Odegi-Awuondo (1994), bottles, paper, and scrap metal are the most often collected materials by street rubbish collectors. Pickers of dump debris choose plastic, bones, and scrap metal. Therefore, rather significant waste segregation is carried out at several phases before ultimate disposal. Additionally, as they mingle with other moist and unclean waste components, sections that survive this separation are very susceptible to spoiling. This might explain why street pickers are more likely to find paper than trash plastic in dumpsters. Scrap metal, bones, steel, and bottles are among other items that resist injury [11]–[13].

On the other hand, since scrap metals are widely used, the demand for them is stronger both large- and small-scale businesses recycle. Additionally, there is less reuse at the source and throughout the supply chain. Among landfill rubbish pickers, the abundance of plastic products sticks out. Despite the very low payments, dump garbage pickers continued to collect plastics since there was less demand at the recycling companies at the time. As purchases persisted, although at very cheap rates, in the expectation of selling it "when the factories re-open," large piles of plastic materials could be seen in the merchants' yards. However, the low demand and cheap pricing could have prevented plastics from being recovered upstream as much (by itinerant byers and street garbage pickers), leading to their abundance at the dumps and unintentional preference by dump waste pickers.

Before rubbish is collected and transported from the source, bottles are extensively recovered, so there aren't many of them at the landfill. Additionally, there is a buy-back or bottle-returns deal between the producers of soft drink bottles and Central Glass Industries (CGI), a sizable glass recycling business. Broken glass (vunjika), which is difficult for street pickers to carry about and is instead preferred at dumps, is heavy and difficult to pick up. However, CGI had stopped purchasing local broken glass at the time of our filedwork, leading to an excessive and obvious output at the dumps and at dealers' premises. Non-ferrous metals (aluminum, copper, brass, lead, and zinc), which can be easily distinguished, manually sorted, and cleaned, fetch higher and stable prices of up to Ksh. 30 per kg and produce significant environmental and economic benefits because they require relatively less energy to recycle than ferrous metals (iron and steel) and have more uses. However, they are relatively seldom seen in cities, particularly in the streets. Bones are likewise more expensive but more difficult to acquire and need specialization, making them impracticable, particularly for street rubbish collectors. Thus, there is a comparatively greater presence at the dumps.

Food waste is also widely collected, but it is not shown on the figure, mostly for direct consumption. Clothes, food, home goods, and fuel wood are some of the other commodities that may be rescued for immediate use. Only 3% of garbage collectors said they didn't reuse any of the rubbish they collected. It is improbable that an average monthly income of Ksh. 3,000 (US$ 40) can sustain an average HH size of 4 for street garbage picker(s) and 6 for dump waste picker(s), without a secondary source of income (which is not the case with both groups). Each person contributed an average of Ksh 1,600 (US$ 22) each month toward family costs. Street and waste pickers, respectively, are married with children in proportions of 75% and 57%.

Role of Itinerant Buyers in Nairobi

Up to 50 permits for barter hawking were granted by the City Council in 1967 (Hake, 1977: 180). The majority of itinerant purchasers in Nairobi now are males, older (average age was 49 years) than rubbish pickers and long-time city residents. Their primary method of trash separation is house-to-house and is driven by the need to have access to "uncontaminated" garbage. Although it is declining, this activity is concentrated in residential regions with middle- and high-income levels. Itinerant purchasers have similar low educational and skill levels to garbage pickers but have been working with rubbish for a longer period of time. They have greater experience and often organize, clean, or pack the things collected at home with the help of family members.

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Beginning in the early 1970s, Nairobi saw an increase in the itinerant purchasing of waste items, first via barter. New cookware and domestic necessities from city wholesale stores were donated by roving buyers, including buckets. Itinerant purchasers acquired bottles, tin cans, newspapers, and clothing in return, which they then traded for goods at the city's biggest open-air second-hand clothing market, "gikomba," which they then sold to merchants. The supplies were sold to individual customers from this location and most likely returned to homes. There was a lot of bargaining involved in exchange negotiations as each side sought to maximize their advantages. The mobile purchasers who participated in this study's interviews reflected on the declining economic feasibility. Additionally, the action was more respectable and primarily voluntary.

The primary driving factors and materials purchased have not changed, but the commodities chain now includes new participants. Domestic workers and extended family members increasingly play a significant part in these activities in higher income neighborhoods where homeowners give little thought to garbage after it is gone from the house for collection. These regions have connections with domestic servants that allow itinerant buyers to operate. The majority of the transactions take place in secrecy during the daytime hours while householders are at work. As a result of receiving a portion of the profits from such transactions, home employees have become interested in the household's trash management plans. The materials acquired are offered for sale to local businesspeople. Because of this, itinerant purchasers often operate in regions adjacent to both the selling locations and their residences, bringing waste products home to be sorted and packaged using family labor. The job of itinerant purchasers has become more challenging and less lucrative in terms of socioeconomic sustainability. Their average monthly earnings, Ksh. 3,500 (US$ 46), are just somewhat greater than those of rubbish pickers. Nevertheless Itinerant purchasers have side businesses that they use to make extra money. These include small-scale real estate ventures and farming. One needs soft loans from family members and/or friends in the amount of Ksh 1,000 (US$ 14) to Ksh 6,300 (US$ 90) in order to become an itinerant buyer. The operators in the chain with the lowest incomes cannot afford such sums.

The Dealer: Centrality in the Chain

In the pathways via which collected waste materials obtained by pickers and purchasers are transferred to small- and large-scale waste reprocessors, dealers are the primary trade middlemen. The demand for recyclable waste materials accounts for dealers' or small purchasers' status as a category in the recycling chain. In Nairobi, for example, scrap metal trading took place in the 1960s, "serving the useful purpose of retrieving waste material for reuse." The discarded scrap metal was sold to licensed dealers by a network of collectors who earned a career by finding it in "odd corners" and selling it to dealers. According to Hake, they sold for 60 cents for copper, 40 cents for aluminum, and 5 cents for other materials. Dealers gather waste materials by purchasing small quantities from garbage collectors and mobile purchasers and providing large quantities to industries as needed. Waste pickers are unable to bring waste items directly to recycling businesses due to the high prices and relatively large quantities that reprocessors need [14]–[16].

Operational expenses and revenues

Dealers incur more operational expenses than other actors do. The dealer pays for the majority of the hefty transportation expenses for the manufacturers that reprocess garbage. A typical rubbish trader in Nairobi starts off with an investment of roughly 6,000 Ksh (US$78). Money is generated by individual savings, amiable loans from friends and family, and collective savings (merry-go-round). The primary justification given by dealers for engaging in this profession is the necessity to make money. They also claim that the activity used to be more lucrative. Dealers are obliged to hold trade permits from the Nairobi City Council, unlike rubbish pickers. There is no set structure or cost for this. Bribery is widespread and often recognized as an essential step in the application and processing processes. The licensing fee may be paid annually in the range of Ksh. 300 to Ksh. 7,000 (US$ 4 - 92). Due to this, some sellers choose to operate without a license, yet they must continually bribe council askaris, claiming that one must always pay bribes whether they have a license or not. This is seen as an essential expense for the ongoing success of the company. Failure to comply with this often leads to significant stock seizure and removal from the trading platform.

Their monthly salaries vary from Ksh. 2,500 to 40,000 (US$ 33 - 526), with an average of 13,000 Ksh (US$ 171) each month. Most dealers also have additional sources of income that they co-manage with their wives and other family members. In addition to charcoal, 60% of the dealers in this survey also dealt in "mitumba" used clothing from overseas that is preferable to local production. Even

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though these activities seem to be new perhaps due to a drop in garbage trading, the second-hand clothing market is extremely lucrative yet challenging. Diversification efforts were made by this group, or as others have put it, departure planning should "business continue to decline." Additionally, with an average home size of nine people, dealers often have extended family members. In return for lodging and aid with the job hunt, they assist with the work.

CONCLUSION

Reuse, recovery, and recycling must be the primary goals of Nairobi's comprehensive and integrated strategy to managing urban inorganic solid waste. The results of this research suggest that the city has a great deal of potential for adopting sustainable waste management techniques. By establishing trash exchange platforms and programs that support the reuse of materials and goods, reuse practices may be improved. Composting and anaerobic digestion are examples of recovery solutions that may help produce organic fertilizers and biogas while minimizing the need for traditional waste disposal techniques. Establishing recycling facilities and putting in place efficient collecting and sorting methods may make recycling easier, especially for items like plastic, glass, and metal. To successfully promote the reuse, recovery, and recycling of urban inorganic solid waste, a number of issues must be resolved. These difficulties include a lack of suitable infrastructure, low public knowledge and engagement, and the need for helpful rules and laws. Collaboration amongst important parties, including the government, waste management businesses, NGOs, and the community, is essential to removing these obstacles. In order to promote a more sustainable waste management system in Nairobi, policy interventions should focus trash reduction and the use of circular economy concepts. Nairobi can handle its waste management issues while simultaneously promoting environmental sustainability, resource conservation, and the development of green employment by putting in place plans that give priority to trash reuse, recovery, and recycling. Utilizing the potential of circular economy strategies and technology breakthroughs, it is crucial for the government, legislators, and other stakeholders to collaborate in order to establish an enabling environment for sustainable waste management practices. This will not only help Nairobi, but it will also be a useful example for other cities facing comparable garbage management problems.

REFERENCES:

[1] A. M. Karanja, M. M. Ikiara, and T. C. Davies, “Reuse, recovery and recycling of urban inorganic solid waste in Nairobi,” 2004. doi: 10.1007/1-4020-2529-7_8.

[2] O. K. M. Ouda, S. A. Raza, R. Al-Waked, J. F. Al-Asad, and A. S. Nizami, “Waste-to-energy potential in the Western Province of Saudi Arabia,” *J. King Saud Univ. - Eng. Sci.*, 2017, doi: 10.1016/j.jksues.2015.02.002.

[3] R. P. Singh, P. Singh, A. S. F. Araujo, M. Hakimi Ibrahim, and O. Sulaiman, “Management of urban solid waste: Vermicomposting a sustainable option,” *Resour. Conserv. Recycl.*, 2011, doi: 10.1016/j.resconrec.2011.02.005.

[4] G. Bernache Pérez, “Evaluation of waste management systems in four municipalities of Jalisco, Mexico,” *Rev. Int. Contam. Ambient.*, 2019, doi: 10.20937/RICA.2019.35.esp02.03.

[5] R. Windraswara and D. A. B. Prihastuti, “ANALISIS POTENSI REDUKSI SAMPAH RUMAH TANGGA UNTUK PENINGKATAN KUALITAS KESEHATAN LINGKUNGAN,” *Unnes J. Public Heal.*, 2017, doi: 10.15294/ujph.v6i2.15360.

[6] E. Damanhuri, I. M. Wahyu, R. Ramang, and T. Padmi, “Evaluation of municipal solid waste flow in the Bandung metropolitan area, Indonesia,” *J. Mater. Cycles Waste Manag.*, 2009, doi: 10.1007/s10163-009-0241-9.

[7] M. Vicent, M. Criado, and J. García-Ten, “Alkali-activated materials obtained from asphalt fillers and fluorescent lamps wastes,” *J. Clean. Prod.*, 2019, doi: 10.1016/j.jclepro.2018.12.291.

[8] M. Domínguez, R. Paradelo Núñez, J. Piñeiro, and M. T. Barral, “Physicochemical and biochemical properties of an acid soil under potato culture amended with municipal solid waste compost,” *Int. J. Recycl. Org. Waste Agric.*, 2019, doi: 10.1007/s40093-019-0246-x.

[9] J. Sotamenou and L. Parrot, “Sustainable urban agriculture and the adoption of composts in Cameroon,” *Int. J. Agric. Sustain.*, 2013, doi: 10.1080/14735903.2013.811858.

[10] A. Rajor, M. Xaxa, R. Mehta, and Kunal, “An overview on characterization, utilization and leachate analysis of biomedical waste incinerator ash,” *Journal of Environmental Management*. 2012. doi: 10.1016/j.jenvman.2012.04.031.

[11] A. Jain, R. Goyal, S. Singh, and L. Pradhan, “Municipal solid waste management in India: A case study of post consumed tetra pak cartons in Delhi NCR,” *IIOAB J.*, 2016.

[12] R. Pratap, P. Singh, A. S. F. Araujo, M. H. Ibrahim, and O. Sulaiman, “Resources , Conservation and Recycling Management of urban solid waste : Vermicomposting a sustainable option,” *"Resources, Conserv.*

ISSN (Online) 2456-1290

International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)

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Recycl., 2011.

[13] R. K. Singh, H. Yabar, T. Mizunoya, Y. Higano, and R. Rakwal, "Potential benefits of introducing integrated solid waste management approach in developing countries: A case study in Kathmandu city," *J. Sustain. Dev.*, 2014, doi: 10.5539/jsd.v7n6p70.

[14] S. C. Marie-Rose, E. Chornet, D. Lynch, and J. M. Lavoie, "From biomass-rich residues into fuels and green chemicals via gasification and catalytic synthesis," *WIT Trans. Ecol. Environ.*, 2011, doi: 10.2495/ESUS110111.

[15] I. Baud, "Reuse, recovery and recycling of urban inorganic solid waste; modalities, commodity chains and sustainable development," 2004. doi: 10.1007/1-4020-2529-7_6.

[16] A. Rajor, "Bio-Medical Waste Incinerator Ash: a Review With Special Focus on Its Characterization, Utilization and Leachate Analysis," *Int. J. Geol. Earth Environ. Sci.*, 2011.

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Discussion on the Contributions to Sustainable Development

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ABSTRACT: ***In order to solve the global issues of the twenty-first century, this study analyses diverse contributions to sustainable development. In order to secure the welfare of current and future generations, sustainable development refers to the integration of economic, social, and environmental components. The report examines important industries and tactics that support sustainable development, such as waste management, education, sustainable agriculture, and renewable energy. It also analyses the value of stakeholder cooperation, regulatory frameworks, and technical advancements in accomplishing sustainable development objectives. The results emphasize the need for a comprehensive strategy and group effort to build a more sustainable and just world. Sustainable development requires a group effort that goes above and beyond individual acts. It necessitates a comprehensive viewpoint that recognizes the interdependence of the social, economic, and environmental systems.***

KEYWORDS: Garbage, Recycling, Sustainable Development, Waste Management.

INTRODUCTION

Technology in small-scale metal recycling

Fabrication of sheet metal takes the fewest resources and abilities. It mostly employs low-tech, informal tools and equipment and operates on a small scale. The businesses under investigation mostly used straightforward technology to carry out tasks like bending, riveting, straightening, folding, rolling, shaping, and moulding, among others. Other frequent tools include hammers, chisels, saws, pliers, scissors, axles, and brushes. Some of the businesses have drills, grinders, roller and welding machines, bending/punching machines, and riveting machines. Additionally, nearby businesses' services might be contracted for a cost. These machines get electricity from the local Undugu Society, which is distributed among a few businesses who also split the cost. Some manufacturing tasks, such as heavy welding, must sometimes be carried out at low power peaks due to power shortages. Few business owners have formal training in the fields they are working in. The majority of skills are learned via unofficial apprenticeships [1]–[3].

Markets and products

At Kamukunji, a wide range of domestic utility products are produced. They include wheelbarrows, cooking pots and griddles, charcoal jiko (cooking stoves), bicycle carriers, agricultural tools like hoes and jembes, water necessities like tanks, gutters, and watering cans, farm equipment like hoes, and sheet metal boxes. The most popular goods are charcoal jikos, sheet metal boxes, buckets, and cooking pots, with 40 percent of the businesses producing these items. Most of the products produced in Kamukunji are sold to private consumers, small businesses in and around Nairobi, shops, and wholesalers. Six businesses (18.2%) also export some of their goods to Germany, Uganda, Tanzania, Central Africa, Rwanda, Burundi, and Zaire. However, this is a one-time event that mostly stems from the fragmented regional trade agreements promoted by the government via COMESA27 or other regional trade organizations. These don't result in typical customized orders. Furthermore, even if large orders were available, it is doubtful that small businesses would be able to fulfill them without access to institutional funding.

Products are thus primarily created with the intention of being displayed and sold on-site, targeting the nearby community. 93% of business owners rely on 'chance' purchases from their immediate neighborhood. The enormous, dusty, orderly piles and rows of wheelbarrows, buckets, jikos, and metal sheet boxes are a striking aspect of Kamukunji. A few of the products were created "almost a year ago." Entrepreneurs have differing opinions on aggressive marketing by intermediaries for commission payments; some claim it increases

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sales, while others claim it drives down prices and turns off customers. The neighborhood has a reputation for being dangerous. The complexity and expensive expenses of obtaining store licences from the government hinder efforts to advertise goods outside of the Kamukunji precincts. Business owners bemoan the fact that Kamukunji is now doing far less business than it did 10 to 15 years ago. These activities have also been negatively impacted by the nation's economic downturn.

With the exception of sheet metal boxes, which reach their peak in October and November and between December and February, there does not seem to be any seasonality in the manufacture or marketing of items. Due to their durability during extended hauling, they are well-liked by boarding school students. The monthly income received during these uncommon "booms" may exceed Ksh 10,000 (US$ 32). The lowest season sees monthly wages as low as Ksh 1,600 (US$ 21). Entrepreneurs in Kamukunji acknowledge that they sometimes sell goods below cost out of need 'at least to continue producing'. There is scarcely any industrial reorganization in terms of specialization and/or innovation, notwithstanding the requirement for consistent sales. Even when sales are really low, entrepreneurs keep working. Instead of product marketability, tools and machinery availability, affordability, and simplicity appear to influence product choice. Entrepreneurs avoid risky investments or experiments despite the seeming fierce competition for a shaky and contracting market because of concern about losing what they perceive a "steady income," even if it is little. Because "one never knows when a big buyer may come by," large stockpiles are preserved [4]–[6].

Prices

Prices are influenced by the cost of manufacture and the number of outlets the product has for sale. They also depend on whether the entrepreneur is marketing the product directly or via a broker. At Kamukunji, a small jiko costs Ksh. 120 (US$ 1.6), whereas at the supermarket, it may cost Ksh. 150–200 (US$ 2-3). Locally, a medium one may cost Ksh. 180 (US$ 2), whereas in the store, it might cost Ksh. 300. Wheelbarrows, on the other hand, are very divisive in price, going for as high as Ksh. 2,200 (US$ 30) at Kamukunji but considerably less (Ksh. 1,700; US$ 22) at certain retail establishments.

Earnings

In our study, almost 40% of the business owners reported an average monthly income of Ksh 4,200 (US$ 56) and a monthly working capital of Ksh 6,300 (US$ 84). It was difficult to verify this figures because to the Jua kali companies' notoriously poor record-keeping and inaccurate cost computations.

Kinship and labor ties in small-scale metal recycling

Strong social and ethnic ties in Kamukunji serve as the primary means of obtaining education. An entrepreneur may provide his family free apprenticeships while simply participating in production on a managerial level. Additionally, owners rent out their workshop and equipment to family members and acquaintances. Under some circumstances, a piece-rate worker or a temporary employee may make his own items. He may purchase his own supplies and utilize a coworker's a family or friend workshop to create and sell his own things if he has made "substantial" savings. However, these metal workers mostly depend on sporadic and erratic income from piecework or transient employment in the factories to make ends meet. When necessary, employers appoint workers, who get a daily salary of around Ksh. According to Kinyanjui (1996), SSEs are often seen as deficient in entrepreneurship and development because of diversification, bad accounting, and the utilization of family labor and finance. However, it is often because to these reasons that individuals are able to enter, conduct business, and thrive in a hostile business climate. Because the entire costs of production are not included, the employment of (unpaid) family labor lowers production costs and increases profit margins. For the worker, whose labor is provided without immediate compensation, the employment functions as a sort of apprenticeship or training?

The two facets of diversification are the entrepreneur's participation in other revenue-generating activities and the investment of a significant percentage of revenues in markets other than the firm. According to McCormick (1991), small-scale business owners reduce risk by investing in land, rental property, or children's education rather than making investments in urban areas. Entrepreneurs in Kamukunji prefer to invest in real estate and other assets rather than businesses "when business is good" because they are seen as

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more reliable sources of security in old age and in the event that company operations fail. In this survey, 60 percent of the small-scale metal business owners reported having bought a plot of land and/or constructed a permanent home in their rural residence. This is seen as a big accomplishment despite the fact that the property acquired is quite modest averaging 0.5 acres and sometimes consisting of group-owned, surveyed portions in government-sponsored settlement programs. It is unclear if it is caused by entrepreneurs' preoccupation with tradition or culture, a fear of company failure due to the weakening economic climate, or both. Our polls' respondents seemed preoccupied with the "imminent collapse" of business as a result of the dire economic and political circumstances in place.

For many rural-urban migrants in Africa, living in the city is primarily a means of making money. Cities are thought to provide greater and more numerous chances for this. The maintenance of solid relationships fosters the anticipation and hope of one day going back "home". Even people who were born in a city and are dedicated to living in it are aware of a second "real home" and the prospect of going back there. Thus, even if there aren't as many immediate benefits, purchasing property and/or constructing a home "at home" is a formal way for them to stake their claim in the rural community. Thus, owing to familial, clan, or ethnic obligations, social loyalty is expensive. Therefore, it's possible that the stated amounts of revenue or profits are not the best way to assess the socio-economic viability of small-scale scrap metal recycling.

DISCUSSION

1. Changing Relations Between Actors in Recovery and Recycling

Despite their friendliness with garbage pickers, dealers may be gruff and authoritative, particularly while doing sales. The majority keep thorough records of the rubbish purchases and payments due to the waste pickers. Their business dealings seem to be highly trusted. Other relationships include giving pickers interest-free loans that are returned with rubbish or by working for the dealer. It is unclear whether or whether this phenomena involves "tying" or "bonding" the picker to the dealer, but it is obvious that overextraction may happen. The arrangements by which obligated pickers pay back their debts either via waste products or labor (doing chores like cleaning, sorting, packaging, or transporting things for sale) seem to be arbitrarily specified [7], [8].

Dealers keep close ties with all other participants in the supply chain. It is stressed how important it is for people to be informed on information such as buying and selling pricing as well as the demand for different waste items. It may be passed on selectively to the pickers, who then modify their picking preferences in accordance with the information, which is used to calculate the selling and buy prices of different materials. Sometimes it is necessary to provide cash tips and other incentives to factory staff members in charge of procuring raw materials, allowing for the frequent purchase of large quantities of goods from the specific dealer. However, due to a decline in the amount of local garbage that large-scale waste reprocessors are consuming, this cannot guarantee the dealer's existence to the same level. Additionally, there are too many dealers who are all equally competent and ready to purchase these rights. This indicates that the growing sums needed for the various trade transactions cannot be supported by the profits made. In addition, manufacturers increasingly favor clean, sorted supplies as opposed to the past when companies handled the cleaning and sorting tasks themselves. Many dealers have now discovered that they must take these steps in order to make their deliveries to the industries far more appealing. The dealers' operating expenses have risen as a result.

Small-scale metal recyclers' and dealers' interactions seem to have altered significantly, generating distortions in the supply chains that benefit large-scale reprocessors. These adjustments seem to have been planned by the latter in an attempt to increase competitiveness in the face of a challenging business climate, which in turn was brought on by the challenging economic circumstances the nation was experiencing at the time. Negative effects have been felt by the Kamukunji grounds' internal trash collection systems as well as small-scale recyclers. The latter's manufacturing expenses have grown, and the primary waste materials outlet for the internal women's group garbage collecting group is now unstable. The economic viability of the lower-income end players in the commodities chain has been harmed by these variables. At this link in the chain, coordination is either nonexistent or at best informal.

Regarding informal garbage collection and its function in the recycling of waste materials, the NCC has no official policies. According to JICA

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1998, garbage collection (or scavenging, as they termed it)30 was a "good" for the economy that needed to be regulated and controlled in a "socially acceptable" way. Their investigation into Dandora garbage pickers revealed "evidence of disease, poverty, malnutrition, and hunger" in addition to a pitiful daily wage of Ksh. 120 (US$ 2) for each picker. garbage picking seems to be a reaction to both poverty and the NCC's inability to provide efficient garbage collection services. However, rubbish picking also serves as a de facto waste collection and disposal service in addition to generating money.

NGOs have no part in commerce and rubbish collection operations. These operations are often seen as private companies with little involvement in urban garbage management or community development. At the neighborhood level, it's typical to hear claims that some activities lead to environmental and health issues, including foul odors and vermin (flies, cockroaches, and rats). Dealers have also been known to acquire goods that domestic staff have stolen from homes, which has led to suspicion on the part of homeowners and sometimes dissatisfaction of the placement of stores or transactions that buy or sell rubbish in the neighborhood. In the majority of the city's residential districts, garbage picker(s) are avoided due to their line of work, appearance, and living circumstances.

2. Socio-economic issues

The majority of those involved in the commodity chain seem to live off of subsistence. However, more enterprising vendors and itinerant byers both get comparatively better wages from their profession. Dealers and itinerant byers commonly use family labor for sorting, packaging, and cleaning, but trash pickers detest family participation in waste jobs. It's not uncommon for nomadic byers to bring materials home and use family labor for processing. Dealers staff facilities and carry rubbish using unpaid family labor in return for a phony apprenticeship. Additionally, accommodations and food are given to extended family members in return for their participation and labor contributions to the dealership. Even while it may be a sign of longer workdays, particularly for nomadic byers, using unpaid family labor lowers operating expenses and boosts earnings.

Dealers lack any competitive advantages in the garbage trading industry, while having a significantly stronger entrepreneurial ability. However, they have lived in the city for a longer period of time and have greater expertise in jobs involving trash. Even though only 11 (or 30%) of those surveyed had engaged in rubbish picking or itinerant shopping prior to participating in waste trading, this is still an important result, particularly in terms of the development of relevant trade contacts. An experienced dealer is better equipped to deal with the sometimes subdued, belligerent, and combative rubbish pickers and to mediate the trade agreements with substantial waste recyclers. For the maximization of profits, company survival, and stability, networking and marketing skills are essential. Dealers are knowledgeable about the varied sorts and demands for different waste products, the outlets that are available, their needs, and strategies for avoiding some of the procedures in order to gain an advantage.

Although the majority of performers voice their displeasure with the activities they are doing, it seems that they have limited ability to go to a more advanced level or to a more "pleasant" occupation. With the exception of the few individuals already mentioned, there is little indication of movement from one level to another at this lower income end of the commodities chain. Given the ongoing downsizing drive31, hopes or objectives for formal sector employment are now even more illusory. Similar to this, joining "a better kind of business" necessitates the amassing of cash, which most players (apart from dealers) are now unable to do. The desire to "change to other types of work" is expressed across the board, but with awareness and proof that there are no possibilities that are reasonable, legal, and widely accepted. Except among dealers, little preparation or strategy for this is shown.

The primary goal of garbage pickers working at the lowest wage levels is to meet "a compelling need of everyday life," i.e., to survive. Itinerant byers do a little bit better financially when they target garbage that is more readily resalable. The focus of this subset of operations is on dealers. Even if they rely on higher-level players in the chain and utilize unpaid family labor, their business is entrepreneurial. Recognizing the larger social, economic, and political context in which the chain is founded is necessary for assessment of the socio-economic, public health, and environmental components of this. Concerns about sustainable development with regard to these actors are limited by their roles in the chain of events and the nature of their activities, as well as by the larger social, economic, and political context in which these activities are embedded. More significantly, however, they are excluded from waste management policies.

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3. Environmental and health issues

Waste pickers live and work in run-down conditions with few basic amenities for basic hygiene. Their working circumstances are as appalling; they don't wear any protective gear or clothing. Exposure to pollutants occurs often. The majority of the players at this link in the chain lament their various health issues, which they believe are caused by their participation in garbage industry. A staggering 89 percent of the garbage pickers reported suffering from problems they believed to be brought on by handling rubbish on a regular basis. The most common ones mentioned were bodily aches and pains, scrapes and bruises, respiratory and skin conditions, headaches, and stomach and diarrhea issues. Despite the lack of epidemiological research to support a link between garbage employment and illness, given the nature of the job and living circumstances, it seems unavoidable. These illnesses may be brought on by traveling long distances in unfavorable weather, ingesting food waste from landfills, coming into touch with caustic and harmful chemicals, or coming into contact with disease-carrying vectors that thrive in the garbage.

The removal of waste products from the trash stream that would otherwise wind up in disposal sites adds to the environmental advantages of waste management, even while garbage pickers contribute to littering in the streets and surrounding areas. The quantity of rubbish that these individuals' actions have diverted from the municipal waste stream cannot be measured since there is a lack of statistics. It is impossible to estimate the amount of rubbish diverted from the municipal waste stream because to the negative attitude, frivolity, and contempt with which the public and authorities view these operations. The population of people living in and around the Dandora dump is unknown, and the number of people who pick up rubbish there is mostly estimated by the CBOs and NGOs participating. The overall population was estimated to be between 500 and 2,000 people by the NCC dumpsite office and the recycling operation run by Catholic priest Father Alex of Mukuru. Additionally, not everyone observed at the landfill is picking up trash. The dump is a well-known hiding place for many of the city's criminals, according to NCC officials working in the disposal-fee collecting office, who contact rather frequently with pickers [9], [10].

The average amount of plastics separated each day at the dump would be 9,000 kg (about 1 ton), whereas the average quantity of paper would be 4,000 kg (roughly 1/2 ton), based on a rough estimate of 2,000 pickers and average quantities separated each day as stated by individuals questioned. In addition to having a lower surface area, informal landfills also house a significantly smaller and more dispersed number of rubbish pickers. As a result, it is significantly more challenging to determine the quantities separated. The variety of machinery and equipment utilized in the small-scale company sector makes it challenging to build standard devices for usage across all sub-sectors. The use of protective equipment is not mandated by any laws, rules, or recommendations. The decision of what actions to take and what is harmful or not is left up to the artisans.

In Nairobi, kamukunji is often referred to as "clang clang" because of the loud, harsh noises it produces when metal items are repeatedly hammered into the correct shapes and sizes. The muddy/dusty32 uneven space, which is also utilized as the storage and show area, is also crammed full with craftsmen. Each metal worker has a workspace of about 6.2 m2 where they may do all tasks. To prevent "welding eyes," the artists do not wear any safety equipment like earmuffs, gloves, or eye protection, and they are forced to pay for private medical treatment when they get sick. Accidents have happened, for example, while cleaning drums that had previously been used to store "poison" dangerous chemicals, leading to "deep, difficult-to-heal" chemical burns. In these situations, the sole option for paying the sometimes exorbitant medical costs is "harambee," in which metal workers pool their money to pay for care. Jua kali recycling is a trade that should be undertaken at your own risk.

Despite this, the KJKA secretary claims that health concerns are not a major problem since the artists 'are acclimated' to the loudness and the other hazardous workplace conditions. Concerning environmental and sanitary concerns, particularly in respect to public restrooms in the grounds, were recently settled. Recently, the organization privatized the single restroom in the neighborhood and petitioned the NCC for a more consistent and regular water supply. Additionally, they asked the government to vouch for their occupancy and usage of the territory. An official title deed given to KJKA served as proof of approval. Industrial legislation in Kenya mandates that large-scale waste reprocessing businesses give factory employees, particularly those handling toxic or dangerous equipment, with the proper protective clothing, as well as other safety precautions. These are outlined in the labor laws, health and safety

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rules, and other regulations of the Ministry of Labor, which are carried out by the Inspectorate department.

They haven't, however, been properly applied. Job instability at large-scale recycling facilities, particularly in this period of widespread layoffs, prevents any form of petition or reporting to the ministry of any rules infractions out of concern for losing work. The abundance of labor makes it relatively simple to replace "errant" employees. Although many factory employees are adequately aware of the health concerns, they have few other career options. The Ministry of Labor's infrequent monitoring inspections are mostly conducted to solicit "bribes" from the owners of massive recycling facilities. Fieldwork trips to several of the plants disproved management' claims that they were following government regulations in the large-scale recycling units. Workers have been seen working without the most basic safety equipment, such gloves and masks [11]–[13].

Although the arrangements for resource recovery and recycling covered in this chapter have the potential to support SWM and sustainable development, numerous grave inconsistencies still stand in the way of their expansion and advancement. In terms of government regulation, it is still gravely neglected. Neither national nor local government policy takes into account the modality's importance to SWM and sustainable development. These activities, particularly at lower income levels, have received official acknowledgment, but certain players farther up the commodities chain have profited from recent government policies in a way that threatens the socioeconomic sustainability of lower levels. Through incentives, it is necessary to encourage and enable the recovery and recycling of local waste materials for socioeconomic and environmental reasons. On the one hand, it is argued that the government's unwillingness to acknowledge and promote these activities and the partnerships involved prevents this modality from contributing to SWM and from providing the chance to build sustainable alternatives33 or solutions to the issue. Through chances for recovery and recycling, these operations have the potential to enhance the amounts of inorganic waste materials removed from the municipal waste stream. Additionally, it may provide or improve the job and revenue generating options for city people by creating new types of labor.

CONCLUSION

The contributions to sustainable development covered in this article show how crucial it is to take a holistic and integrated approach to solving the problems caused by social inequality, environmental degradation, and economic instability. For lowering greenhouse gas emissions and limiting the effects of climate change, the switch to renewable energy sources is essential. Similar to this, sustainable agricultural techniques support rural development, biodiversity preservation, and food security. Recycling and appropriate disposal are two efficient waste management techniques that assist reduce resource depletion and environmental degradation. Additionally, education is crucial for promoting sustainable behaviors in both people and groups by increasing awareness, developing capacity, and strengthening these behaviors. In order to create successful policy frameworks and carry out sustainable development efforts at the local, national, and international levels, collaboration between governments, corporations, civil society groups, and academics is crucial. Resources may be used more efficiently and sustainably thanks to technological advancements like clean technology and digital solutions. We may strive toward a more sustainable future for the current and future generations by adopting sustainable behaviors, encouraging cooperation, and using technology breakthroughs, assuring a balanced and prosperous society for everyone.

REFERENCES:

[1] M. Blicharska *et al.*, "Biodiversity's contributions to sustainable development," *Nature Sustainability*. 2019. doi: 10.1038/s41893-019-0417-9.

[2] L. S. Conke and T. L. Ferreira, "Urban metabolism: Measuring the city's contribution to sustainable development," *Environ. Pollut.*, 2015, doi: 10.1016/j.envpol.2015.03.027.

[3] B. G. Rebelatto, A. Lange Salvia, G. Reginatto, R. C. Daneli, and L. L. Brandli, "Energy efficiency actions at a Brazilian university and their contribution to sustainable development Goal 7," *Int. J. Sustain. High. Educ.*, 2019, doi: 10.1108/IJSHE-01-2019-0023.

[4] F. Azcárate, F. Carrasco, and M. Fernández, "The role of integrated indicators in exhibiting business contribution to sustainable development: A survey of sustainability reporting initiatives," *Rev. Contab. Account. Rev.*, 2011, doi: 10.1016/S1138-4891(11)70033-4.

[5] M. Kühnen *et al.*, "Contributions to the sustainable development goals in life cycle

ISSN (Online) 2456-1290

International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)

Vol 9, Issue 6S, June 2022

sustainability assessment: Insights from the Handprint research project," *Nachhalt. | Sustain. Manag. Forum*, 2019, doi: 10.1007/s00550-019-00484-y.

[6] Paryono, "The importance of TVET and its contribution to sustainable development," in *AIP Conference Proceedings*, 2017. doi: 10.1063/1.5003559.

[7] J. Moon, "The contribution of corporate social responsibility to sustainable development," *Sustain. Dev.*, 2007, doi: 10.1002/sd.346.

[8] R. Laurie, Y. Nonoyama-Tarumi, R. Mckeown, and C. Hopkins, "Contributions of Education for Sustainable Development (ESD) to Quality Education: A Synthesis of Research," *J. Educ. Sustain. Dev.*, 2016, doi: 10.1177/0973408216661442.

[9] H. Kopnina, "Education for the future? Critical evaluation of education for sustainable development goals," *J. Environ. Educ.*, 2020, doi: 10.1080/00958964.2019.1710444.

[10] E. Sinakou, J. Boeve-de Pauw, M. Goossens, and P. Van Petegem, "Academics in the field of Education for Sustainable Development: Their conceptions of sustainable development," *J. Clean. Prod.*, 2018, doi: 10.1016/j.jclepro.2018.02.279.

[11] M. M. L. Lim, P. Søgaard Jørgensen, and C. A. Wyborn, "Reframing the sustainable development goals to achieve sustainable development in the anthropocene—a systems approach," *Ecol. Soc.*, 2018, doi: 10.5751/ES-10182-230322.

[12] V. Spaiser, S. Ranganathan, R. B. Swain, and D. J. T. Sumpter, "The sustainable development oxymoron: quantifying and modelling the incompatibility of sustainable development goals," *Int. J. Sustain. Dev. World Ecol.*, 2017, doi: 10.1080/13504509.2016.1235624.

[13] W. Leal Filho *et al.*, "Reinvigorating the sustainable development research agenda: the role of the sustainable development goals (SDG)," *Int. J. Sustain. Dev. World Ecol.*, 2018, doi: 10.1080/13504509.2017.1342103.

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Reuse Practices and Issues for Solid Waste Management in Developing Countries

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ABSTRACT: ***In developing nations, managing solid waste is a major concern because of urbanization, population increase, and resource scarcity. Reusing materials may be an efficient way to reduce the negative social and environmental effects of waste disposal. This chapter examines solid waste management techniques and problems related to reuse in developing nations. It covers several reuse strategies, such as recycling, composting, and upcycling, and evaluates the advantages and difficulties of each. This study also discusses important problems such insufficient infrastructure, a lack of knowledge and education, and gaps in policy and governance. The results emphasize the significance of encouraging reuse behaviours and offering assistance methods to get beyond the obstacles that are currently present in developing nations. These countries can decrease trash production, save resources, and advance a circular economy by implementing sustainable reuse techniques. Developing nations may significantly improve their solid waste management by adopting reuse methods. In addition to creating cleaner, healthier surroundings, this will promote sustainable growth by lowering greenhouse gas emissions and resource depletion.***

KEYWORDS: Organic, Reuse, Solid Waste, Waste Management.

INTRODUCTION

Urban organic composting is a process that helps the environment by turning organic waste products like food scraps and yard debris into nutrient-rich compost. However, there are a number of issues with urban organic composting that must be resolved for it to be used effectively.

1. **Space Restrictions:** The lack of accessible space for composting is one of the major issues in metropolitan settings. Traditional composting techniques, including open heaps or large-scale facilities, are sometimes impractical in urban settings due to a lack of land or backyard space. Due to this restriction, it is vital to investigate alternate composting methods that may be used in compact areas, such as vermicomposting or composting in containers.

2. **Odor and Pest Issues:** Problems with odor and bugs may result from improperly managed organic composting, which can also attract pests and bother surrounding homeowners. Urban regions with high population densities are especially vulnerable to these problems. These issues may be reduced with the use of efficient odor control systems, suitable waste segregation, and appropriate management methods such routine turning and covering of compost heaps [1]–[3].

3. **Lack of Participation and Awareness:** Many urban residents are ignorant of the advantages of organic composting or lack the skills and information required to participate in composting operations. Programs for education and awareness are essential to promoting community involvement in composting projects. Information on the procedure, advantages, and regulations for urban composting may assist remove this obstacle and encourage broad adoption.

4. **Contamination and quality control:** The contamination of organic waste streams with non-compostable items like plastics or metals is a difficulty for urban organic composting. When utilized in gardens or agricultural areas, contaminants not only lower the quality of the compost but also present safety issues. To guarantee a clean and secure finished product, proper waste segregation at the source is necessary, as are appropriate monitoring and quality control procedures throughout the composting process.

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5. **Issues with rules and policies:** It's possible that there aren't enough laws or policies in certain metropolitan areas to support and encourage organic composting. The construction of composting facilities or neighborhood-based initiatives may be hampered as a result. To promote and impose restrictions on urban organic composting techniques, governments and municipal authorities must provide clear rules.

6. **Scale and Infrastructure:** To satisfy the waste management demands of big cities, scaling up urban composting programs calls for the right infrastructure, such as composting facilities, collecting systems, and transportation networks. Lack of infrastructure investment may restrict the growth of composting programs and reduce their efficiency.

The solution to these issues requires a multifaceted strategy that includes community involvement, infrastructure development, supporting legislation and regulations, education and training initiatives, and public awareness campaigns. Urban organic composting may manage organic waste in urban settings, reduce landfill trash, and create nutrient-rich compost for soil enrichment and gardening applications by overcoming these difficulties. This chapter explains the interest in urban organic solid wastes, the importance of these wastes to municipal solid waste management, the primary methods by which organics are produced and reused, and the challenges associated with the desire to ensure safe and efficient reuse as part of sustainable development in cities in Africa and Asia.

For the reasons listed below, urban administrations are now looking for strategies to separate organic waste from municipal solid waste streams. To enable safe composting, recommendations are offered for separation at the source. Composting is being promoted among private businesses, often via P3 arrangements. The importance of non-governmental organizations in fostering public understanding of organic waste concerns and cooperation with source separation is receiving more emphasis. This experiment highlights the extensive informal recycling of organic wastes already occurring, which is seldom included in official strategies for managing organic wastes [4]–[6].

Numerous academic and policy viewpoints have been used to analyze and conduct research on the characteristics and applications of urban organic solid waste1. A groundbreaking book with a technical focus, Food, Fuel and Fertilizer from Organic Wastes (NRC, 1981), focused on research in the context of the late 1970s concern about finite resources in the globe. Early in the 1980s, the World Bank's Water Supply and Sanitation department established the Integrated Resource Recovery Program. Urban garbage recycling caught the attention of environmentalists at the same time. An interest in low-cost methods led WASTE, a Dutch consulting organization, to chronicle the utilization of organic waste. Solid wastes and human excrement were included into aquaculture studies and initiatives. Health risk studies were started by epidemiologists and specialists in water and sanitation. However, this strategy has not yet been used in relation to the recycling of organic waste generated by municipal trash.

A "food security" viewpoint on development first appeared in the late 1980s. Recycling and reuse were first emphasized by the International Institute for Environment and Development, and this theme, which was incorporated into the Brundtland Report (World Commission on Environment and Development, 1987), is especially emphasized in relation to food production. Urban agriculture has long piqued the curiosity of geographers. As evidenced by the creation of the Cities Feeding People program at the International Development Research Centre (Canada) and the collaborative Centre for Research on Urban Agriculture and Forestry (Netherlands and Canada), as well as networks like City Farmer and The Urban Agriculture Network, this field is now interdisciplinary and has broad support from bilateral and international agencies.

Although reuse of urban organic wastes as inputs was rarely discussed in early writing about urban agriculture, more academics have begun to see connections between urban solid waste management and the use of organic wastes in urban and periurban agriculture over the past ten years. Two points are emphasized: first, reuse can help with urban waste management by lowering some disposal costs and reducing toxic, infectious, and

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unsightly residues; second, urban organic wastes largely come from resources removed from near-urban and rural areas that could be returned to the production cycle. Initiatives to converge the interests in food production and urban solid waste management have existed since the middle of the 1990s. This was one of the objectives of the Dutch government-financed Urban Waste Expertise Program, which has sponsored a number of composting.

Research on trash composting for urban and peri-urban agriculture is being supported by the International Water Management Institute of the UN Food and Agriculture Organization. The viewpoint of peri-urban stakeholders in Hubli-Dharwad, India, and Kumasi, Ghana has recently been included into the British DFID program on natural resource systems. Urban waste-to-energy is once again being investigated, and nutrient flow analysis has become a sub-topic in urban and peri-urban resource systems. Nowadays, it is common to discover policy suggestions for municipal solid waste management that particularly address the need to treat and recycle organic wastes. In other words, the foundation is being built for a comprehensive framework for comprehending urban organic solid waste in emerging nations. Public-private partnerships the cooperation of governments, businesses, NGOs, and international organizations are now the focus of municipal solid waste management. This method is being used in relation to composting when dealing with organic waste.

However, this focus on urban organic solid waste hasn't led to any systematic or sufficient study on the types and amounts of organic garbage in cities of developing nations. Their application in any particular city or area has not been thoroughly investigated, and it is unclear what consequences reuse will have for the management of solid waste. Every study that directly examines the system-wide consequences of the reuse of urban organic wastes contributes to laying the groundwork for the required all-encompassing strategy. The significance of the project effort described in this part may be seen in this.

DISCUSSION

Urban Organic Solid Wastes and Municipal Solid Waste Management

Urban organic solid wastes also comprise garbage produced by gardening, urban agriculture, maintaining parks and roads, raising animals, processing food, tanning, and other similar activities. These wastes are in addition to the organic material found in municipal waste streams. Though human excreta are also organic wastes, they are not discussed in this article since they are seldom used in solid waste management. The generators can be divided into three groups: large bulk generators of processed wastes such as food processing industries, large hotel/institutional kitchens, small bulk generators of raw and processed wastes such as households, and bulk generators of raw wastes such as green markets, parks, stables, and slaughterhouses. In the course of everyday life, kitchens produce the majority of the organic waste streams. Municipal managers are especially concerned about the organics that are sent out for general collection and combined with the solid wastes. Controlling the organic portion of waste streams, which generally makes up 35 to 70% of the total municipal garbage produced in big developing country cities, has long been of interest. In Africa and Asia, composting and reuse practices date back hundreds of years and include uses for animal feed, fuel, and construction. However, in the context of environmental thinking about trash reduction, strategic planning for solid waste management, and greenhouse gas emissions, interest in urban organic solid waste has expanded. Additionally, people who want to support small farmers and livestock keepers see urban organics as a resource that may be recovered [7]–[9].

The already challenging challenge of managing such organic wastes is made more challenging by the evolving character of solid trash in cities in developing nations. Due to a lack of baseline data and trustworthy research, it is difficult to pinpoint exactly how the makeup of solid waste is changing, but the following general trends have been identified: a significant increase in plastic film (small plastic bags), hard plastic fragments, broken glass, medical wastes, and industrial residues from unregulated industries. Problems with the non-biodegradable and hazardous components arise when recycling urban organics, particularly when doing so in ways like transporting waste to peri-urban farms or planting crops on former dump sites. Because of their decomposability, seasonal change in character and amount, mixing with non-biodegradable wastes, and practical challenges in

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selling compost products, organic wastes provide a significant issue for solid waste management.

In addition to the complexity of these wastes, management must take into consideration the variety of 'actors' that produce, handle, and consume the wastes and their byproducts. Although home inhabitants are the largest generators, a variety of official, formal, and informal actors including hotels, restaurants, food stalls, stores, marketplaces, butchers, food processing factories, and parks and roads departments also contribute. Generators, official collection teams, disposal employees, and those who carry organics to final users mostly nearby farms and animal owners handle organic waste.

Customary and Informal Practices in Recovery and Reuse of Organics

In the developing world, organic wastes are often in great demand for use as building materials, fuel, fertilizer, and even animal feed. Any big city and its surrounding areas support a variety of strategies that allow for the reuse of a significant portion of the organic waste produced. The majority of recovery and reuse, but not all of it, is "informal," "customary," and long-standing. Production of fertilizer and animal feed is also done by the business sector. At the current state of knowledge, it is impossible to predict the amounts of trash involved or the costs and advantages of reuse techniques. The majority of activities are informal and unrecorded, which makes it difficult to ensure secure and long-lasting trash reuse.

Farm reuse of organics is one sort of reuse that has gotten special focus in the Hyderabad study for this project. The primary techniques used in agricultural reuse are:

1. The development of landfills
2. 'Mining' of waste sites for organic material
3. Moving mixed solid waste to farms where the inorganics are mostly separated before the garbage is put to the soils
4. On-farm co-composting of agricultural and animal waste from urban areas also relevant to "backyard farms".

Farmers may use municipal landfills to gather decomposed material in several Indian towns. Pits at landfills are sometimes put up for sale by the municipality (Nunan, 2000). Under private contracts and agreements with municipal collection teams (who deliver to the farms instead of dumping at the landfill), municipal solid trash may be transferred to peri-urban farms. Farmers that supply food to green markets may also bring rubbish from the market back in their empty vans. Small farmers have been seen cultivating former dumpsites in the Accra, Ghana, area (Drescher, 1994; Asomani-Boateng, 1999; Osborn, 2000). In Asia, there is evidence of a persistent drop in agricultural reuse, mostly as a result of high transportation costs and inorganic pollution of the waste. On the other hand, agricultural reuse seems to be growing in West African cities, where chemical and other commercial fertilizers are scarce and costly (for example, in Kano, Nigeria, cf. Lewcock, 1994).

It's common practice to utilize food and green waste as animal feed and fodder. This comprises food and canning wastes used in commercial animal husbandry (such as pig farms and goat farms) as well as food and peelings supplied to domestic animals. Goats are estimated to eat roughly 30% of the urban solid trash in Khartoum. Municipal garbage that has been sieved and has decomposed may be utilized as a cover material at dump sites. In certain regions of Asia, agricultural wastes and urban and periurban cow dung are often utilized as fuel. These techniques lessen the burden of garbage collection for a city to the degree that reuse is of materials that do not enter the municipal waste management system. When wastes are redirected, or taken out of landfills, less room is required for disposal. However, despite the high rates of informal reuse, a significant portion of organic waste still finds its way into municipal waste streams, which solid waste managers are working to treat and divert from disposal.

Urban Organic Composting Problems

Organic wastes can be used for energy, formally through anaerobic digestion to produce gases, pelletization and briquetting, and informally for domestic fuel, but the majority of urban organic wastes are still used for food and plant production (in agriculture, horticulture, forestry, and aquaculture). The ideal processing technique is composting, which involves the controlled breakdown of organic materials by a variety of microorganisms. However, the experience with composting of urban organics has been rife with several issues, including feedstock, plant management, product quality and pricing, marketing, customer awareness, and institutional support.

1. Motivations for composting

Composting is a method of processing garbage and minimizing the quantity that has to be disposed of at a final location from the perspective of solid waste management. Resource recovery is important to backyard composters, but the majority of homes cannot reuse their organic waste and must put it out for collection. As a result, they lack motivation to keep organic garbage distinct from other types of

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trash. According to Lardinois and Furedy (1999), pilot initiatives for composting often attempt to include broader environmental, health, and particular socioeconomic problems. Instead of doing so to increase their "green" brand, private fertilizer firms may choose to compost urban trash. What will spur home and institutional waste producers to start and continue the challenging process of properly separating wet wastes is a key challenge for solid waste management. This sorting would appear to be necessary for the long-term viability of composting of urban organic solid waste [10]–[12].

2. City experiences with mechanized compost plants

Many nations have noticed the shortcomings, high costs, and failures of big, automated compost facilities. Such facilities have generated poor-quality compost since they often employed mixed municipal wastes as feedstock, in addition to issues with inappropriate technology, inadequate knowledge, high operating costs, challenges in creating markets, etc. As municipal trash include more glass, plastics, and biomedical wastes, contamination is becoming a bigger concern. It is challenging for city governments to identify suitable locations for big plants. A few large-to-medium-sized facilities, including the municipal plant in Accra and the autonomous Karnataka Compost Development Corporation factory in Bangalore, are still in operation using older technology and government subsidies. Due to these issues, small-scale units and privatization have been taken into account.

3. Urban organic solid waste composting is a privately run business

In South and South-east Asia, private businesses are becoming more interested in composting. The push for public-private partnerships in solid waste management has promoted this. As is the case with the Excel Industries plant in Bombay and some of the company's franchisees, the units are often established by agro-chemical companies and may obtain support from municipalities in the form of access to free municipal wastes and a rent-free location. Private businesses that invest in R&D are more likely to be profitable than any other kind of business. Terra Firma Bio-Technologies, which does vermicomposting in Bangalore, is one example.

4. Neighbourhood-scale composting

Neighborhood-scale compost plants are being promoted by international organizations, bilateral aid initiatives, and NGOs. These facilities are often maintained by NGOs or CBOs with support from municipal governments, such as access to land. Over the last ten years, there have been a number of these kind of pilot initiatives. For example, UNCHS has supported small-scale composting, especially in Nairobi, the World Bank continues to support composting of solid waste in Indonesia; and the Dutch government, through the foundation WASTE, has supported initiatives and research in India, the Philippines, and Mali.

5. Vermicomposting

Compost that is mostly made of worm castings produced by worms that have been fed organic wastes has a higher fertilizer value than aerobic compost made from organics and can often be sold for more money. Many solid waste pilot projects have been conducted and private fertilizer businesses such as Terra Firma Bio-Technologies in Bangalore have embraced this method. However, there remain unsolved health concerns and the NGO initiatives are too small to have a considerable impact on the handling of municipal trash. Vermiculture using urban organics is likely to be limited to demonstration projects for primarily educational purposes or to small businesses where there are niche markets with customers willing to pay a higher price than compost, leaving aside its incorporation in some commercial operations. If they can additionally sell the worms for fish bait or chicken feed, squatter households without solid waste collection, for example, may continue with vermicomposting beyond a trial project. The Hyderabad pilot project is an example of a funded initiative that hasn't yet established a reliable market for its goods.

6. Collaboration between waste producers and organic waste management

Large-scale "separation at source" would seem to be necessary in order to generate compost on the scale necessary to considerably decrease urban organic solid waste in terms of quality and cost to consumers. That is, waste producers keep the organic wastes apart or segregate them, and they are separately collected for processing. Residential consumers mostly homes and bulk or single-source producers food processing companies, wholesale market terminals, green markets, major hotels, large restaurants, large institutions, parks are the two primary sources of source-separated organics in cities. The separated organic wastes that are accessible are in great demand and are heavily exploited via unofficial networks in many cities of poor nations. Cities have so far had only little success in persuading home garbage generators to separate organics that had previously been left out for collection combined with conventional rubbish.

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Although households may show a readiness to separate when first questioned, reports on pilot projects have identified several compliance hurdles. The separate collection of household organics on a broad scale demands fundamental modifications in the current solid waste management systems, and the unit costs are quite expensive. This is important to mention in addition to waste-generator collaboration. Doorstep sorting by garbage collectors is a strategy that does not need total compliance with separation from waste generators. This may be put into practice by having collectors gather rubbish from door to door and quickly separate organic garbage from inorganic waste. It is used in initiatives for neighborhood composting on a modest scale.

The most recent evaluations of studies with small-scale composting indicate that it is only marginally relevant for the reduction of solid waste in bigger cities. The feasibility of three such facilities in Bangalore, Kathmandu, and Manila was examined by Lardinois and Marchand, who came to the conclusion that small-scale facilities are not only technically feasible but also financially unviable. As a result, they produce little compost, which drives up the cost of sale. Compost generated at the Centre for Environmental Education pilot plant in Bangalore, for example, cost $1,514, plus an additional $724 in hidden costs per ton. For African instances, the issue of tiny plants being positioned distant from farmers is observed. However, these plants may contribute to environmental education and poor individuals' jobs.

CONCLUSION

Implementing efficient reuse strategies may help solve many of the problems that solid waste management in developing nations faces. This essay examined several reuse strategies, such as recycling, composting, and upcycling, and emphasized their potential advantages for resource conservation, waste reduction, and the development of a circular economy. The broad adoption of reuse procedures in underdeveloped nations is hampered by a number of problems. A major obstacle is inadequate infrastructure, which includes collecting and processing facilities. An additional factor in the issue is a lack of knowledge and instruction on the value and techniques of reuse. Additionally, the incorporation of reuse methods into waste management systems is hampered by governance and legislative limitations. It is vital for developing nations to give infrastructure for garbage collection, segregation, and processing top priority in order to overcome these obstacles. Concurrently, promoting reuse and offering educational programs on its advantages might aid in modifying attitudes and practices related to trash management. To encourage the adoption of reuse methods, governments and politicians must provide supporting laws, rules, and incentives. Implementing successful reuse plans requires cooperation amongst stakeholders, including public sector institutions, businesses, and civil society groups. In order to overcome the problems and obstacles related to reuse in solid waste management and advance a circular economy strategy in developing nations, it is essential for stakeholders at all levels to collaborate.

REFERENCES:

[1] S. Kumar, S. Singh, and S. Banerjee, “Solid waste management in developing countries,” *J. Crit. Rev.*, 2020, doi: 10.31838/jcr.07.10.252.

[2] R. E. Marshall and K. Farahbakhsh, “Systems approaches to integrated solid waste management in developing countries,” *Waste Manag.*, 2013, doi: 10.1016/j.wasman.2012.12.023.

[3] N. Ejaz, N. Akhtar, H. Nisar, and U. Ali Naeem, “Environmental impacts of improper solid waste management in developing countries: A case study of Rawalpindi City,” *WIT Trans. Ecol. Environ.*, 2010, doi: 10.2495/SW100351.

[4] N. K. Sharma and S. Sharma, “Municipal solid waste management in developing countries: Future challenges and possible opportunities,” *J. Green Eng.*, 2020, doi: 10.5772/16438.

[5] Y. Dhokhikah and Y. Trihadiningrum, “Solid Waste Management in Asian Developing Countries: Challenges and Opportunities,” *J. Appl. Environ. Biol. Sci. J. Appl. Environ. Biol. Sci.*, 2012.

[6] S. A. Ahmed and M. Ali, “Partnerships for solid waste management in developing countries: Linking theories to realities,” *Habitat Int.*, 2004, doi: 10.1016/S0197-3975(03)00044-4.

[7] L. A. Guerrero, G. Maas, and W. Hogland, “Solid waste management challenges for cities in developing countries,” *Waste Manag.*, 2013, doi: 10.1016/j.wasman.2012.09.008.

[8] L. Rodić and D. C. Wilson, “Resolving governance issues to achieve priority sustainable development goals related to solid waste management in developing countries,” *Sustain.*, 2017, doi: 10.3390/su9030404.

[9] S. Kumar, *Municipal Solid Waste Management in Developing Countries*. 2016. doi: 10.1201/9781315369457.

[10] B. D. Azevedo, L. F. Scavarda, and R. G. G. Caiado, “Urban solid waste management in developing countries from the sustainable supply chain management perspective: A case study of Brazil’s largest slum,” *J. Clean. Prod.*,

ISSN (Online) 2456-1290

International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)

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2019, doi: 10.1016/j.jclepro.2019.06.162.

[11] V. Ibáñez-Forés, M. D. Bovea, C. Coutinho-Nóbrega, and H. R. de Medeiros, "Assessing the social performance of municipal solid waste management systems in developing countries: Proposal of indicators and a case study," *Ecol. Indic.*, 2019, doi: 10.1016/j.ecolind.2018.10.031.

[12] N. Serge Kubanza and M. D. Simatele, "Sustainable solid waste management in developing countries: a study of institutional strengthening for solid waste management in Johannesburg, South Africa," *J. Environ. Plan. Manag.*, 2020, doi: 10.1080/09640568.2019.1576510.

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Health Issues in Organic Waste Reuse

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ABSTRACT: ***Reusing organic waste has drawn a lot of interest in recent years because of its potential economic and environmental advantages. Reusing organic waste, however, raises additional health issues that need attention. This study explores the health risks of reusing organic waste and suggests some viable remedies. The research evaluates pertinent literature on the subject and highlights the main health dangers, such as microbiological contamination, build-up of heavy metals, and the presence of dangerous substances. The consequences for human health are discussed as well as possible exposure routes to these health risks are examined. The health dangers connected to the reuse of organic waste are also highlighted, along with alternative solutions and tactics. These consist of appropriate waste management practices, composting methods, testing and monitoring procedures, and regulatory measures. Prioritizing public health is essential, as is creating thorough rules and regulations to guarantee the sustainable and safe reuse of organic waste. A comprehensive strategy that incorporates waste management, composting techniques, monitoring procedures, and regulatory measures is needed for the sustainable and secure reuse of organic waste.***

KEYWORDS: ***Health Issues, Management, Organic Waste, Reuse***

INTRODUCTION

Reusing organic waste has drawn a lot of interest as a resource recovery and sustainable waste management strategy. Organic waste includes essential nutrients that may be recycled back into the environment or utilized in a variety of ways, such as food waste, agricultural leftovers, and sewage sludge. However, there are certain health issues with the reuse of organic waste. Through a number of exposure paths, inappropriate handling, treatment, and application of organic waste may endanger human health. This introduction gives a general overview of the health problems brought on by the reuse of organic waste and emphasizes the need of resolving these issues. It paves the door for further in-depth investigation of the subject, which will include identifying the main health hazards, the exposure routes, and viable remedies to lessen these risks. Processes including composting, anaerobic digestion, and land application are used to recycle organic waste. While these procedures may successfully convert organic waste into useful products, they can also foster the development of microbes, the buildup of heavy metals, and the presence of hazardous compounds. Depending on the kind of waste and the exposure routes, these health risks may have a direct or indirect effect on human health [1]–[3].

The reuse of organic waste raises serious concerns about microbial contamination. When pathogenic bacteria, viruses, and parasites found in the trash come into touch with people, they may spread a variety of infectious illnesses. These bacteria may survive and spread as a consequence of inadequate composting or inappropriate compost application, potentially causing epidemics of gastrointestinal disorders or respiratory infections. Organic waste may also be contaminated with heavy metals, which may collect in the environment and be harmful to human health. Lead, cadmium, and mercury are just a few of the elements that may enter the food chain via the use of polluted compost or soil. Long-term exposure to heavy metals may cause a number of harmful health outcomes, including as developmental defects, renal damage, and neurological issues.

Additionally, hazardous compounds including pesticides, drug leftovers, and industrial contaminants may be included in organic waste. These compounds may be present in recycled organic products as a consequence of improper waste stream management or poor waste stream treatment. Chronic exposure to these compounds may have harmful consequences on human health, such as reproductive problems, endocrine disruption, and carcinogenicity. It is essential to address these health concerns in order to guarantee the safe and long-term reuse of organic waste. This entails putting into practice appropriate waste management procedures, improving composting methods, setting up protocols for testing and monitoring, and putting regulatory controls into place. We can advance a circular economy while preserving public health by efficiently controlling and reducing the health hazards connected with the reuse of organic waste.

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1. Microbial Contamination:

The presence of microbial infections is one of the main health issues connected to the reuse of organic waste. Organic waste may include germs, viruses, and parasites that are harmful to human health, especially food waste and sewage sludge. The multiplication of pathogens that results from improper organic waste treatment, storage, and processing raises the risk of contamination. Organic waste is often home to pathogens including Salmonella, Escherichia coli (E. coli), and Campylobacter, which may lead to gastrointestinal diseases. These viruses may be transmitted to people directly, via polluted aerosols inhaled, infected food, and contaminated water consumed.

Proper waste management procedures are essential to reducing the danger of microbiological contamination. Cross-contamination may be avoided by separating organic waste from other waste streams at the source. By creating high temperatures during the breakdown process, composting, a common technique for treating organic waste, may significantly lower pathogen levels. To accomplish pathogen eradication, composting must be done under carefully monitored conditions, including the right temperature and moisture levels.

2. Heavy Metal Accumulation:

Heavy metals, which may come from a variety of sources including industrial effluents, agricultural inputs, and home chemicals, can also be found in organic waste. When present in organic waste and later employed in agricultural or horticultural applications, these heavy metals including lead, mercury, cadmium, and chromium—can pose significant health concerns. Organic waste may get polluted with heavy metals due to industrial contamination, poor waste management techniques, or the use of tainted feedstock. Heavy metals may be absorbed by plants and make their way into the food chain when organic waste is added to soils, potentially exposing people. Long-term exposure to heavy metals may harm one's health and lead to developmental defects, renal damage, and neurological issues.

It is crucial to properly monitor and evaluate organic waste in order to reduce the buildup of heavy metals. To guarantee adherence to permitted limits, heavy metal content should undergo routine analysis. Additionally, waste characterization and source separation may be used to locate and send waste streams with high levels of heavy metals to the proper treatment facilities.

3. Harmful Chemicals:

Pesticides, herbicides, pharmaceutical residues, and industrial pollutants are just a few examples of the dangerous compounds that organic waste may include. When organic waste is reused without sufficient treatment and monitoring, these compounds may linger in the environment and pose dangers to human health. Organic waste may be contaminated by pesticides and herbicides used in agricultural activities, especially in the case of crop leftovers and yard garbage. The leftover pesticides in these waste items have the potential to infiltrate the food chain and have negative health consequences when composted or applied to the ground [4]–[6].

Organic waste from hospitals or homes may include pharmaceutical residues, such as antibiotics and hormones, which might be dangerous. These residues may be found in organic waste as a result of inappropriate medical waste treatment or incorrect prescription disposal, which can result in the emergence of antibiotic resistance or endocrine system disturbance. It is essential to create thorough waste management systems that take into account the various sources of contamination in order to solve the problem of dangerous substances. To reduce the amount of dangerous compounds in organic waste, proper segregation and treatment of certain waste streams, such as pharmaceutical waste and residues contaminated with pesticides, are required.

DISCUSSION

Exposure Mechanisms and Their Effects on Human Health

There are several exposure routes that might result in the health hazards linked to the reuse of organic waste. The main routes of exposure include direct contact with contaminated organic waste, inhalation of aerosols produced during waste processing, and ingestion of food or water contaminated by repurposed organic waste. Various ailments, such as gastrointestinal infections, respiratory tract infections, and skin infections, may be brought on by exposure to microbial pathogens. Children, the elderly, and those with weakened immune systems are vulnerable groups that are especially at danger.

Reusing organic waste may expose people to heavy metals, which can have both short-term and long-term health impacts. Abdominal discomfort, nausea, and vomiting are some of the early symptoms that may result from acute exposure to high amounts of heavy metals. Chronic exposure may cause long-term health issues, including organ

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damage, reduced cognitive function, and an increased chance of developing cancer, even at low exposure levels. Organic waste exposure may have a variety of negative health effects. Pesticide residues in recycled organic waste may increase human pesticide exposure, which may result in neurological abnormalities, reproductive issues, and an increased chance of developing cancer. Pharmaceutical residues in organic waste may disturb hormonal balance and contribute to the development of antibiotic resistance, both of which have a negative impact on human health.

Compost credits: Assistance from international organizations for composting

The Global Environmental Facility (GEF) is now a source of worldwide funding to support the production of compost from organic waste collected in cities. For procedures that lower greenhouse emissions (GHGs), the GEF provides funding. Although it is unknown how much GHGs are reduced by anaerobic composting, GEF has accepted the premise that it is better than sanitary landfilling or open dumping. Cities and regions have started making funding requests under the heading "compost credits." India is putting up a proposal to the GEF, and the West Java and Jakarta Environmental Management Program has obtained a sizable GEF funding to assist a community-based organic waste compost program.

Persistent problems

It shouldn't be assumed that the best technique to recycle all urban organic wastes is by composting. The 'purer' wastes, or those that are not combined with other junk, will have a greater value as animal feed, as Harriss and his colleagues note. Composting is still the method by which a sizable amount of organic waste produced in urban dwellings and institutions (the wastes that constitute the majority of the duty of solid waste management) might be treated and avoided disposal. However, according to the existing techniques of cost accounting used by solid waste management agencies in developing nations, composting of urban organic solid waste is not financially viable. Composting is a costly alternative for cities and municipalities in these regions as long as the majority of trash are disposed of via free open dumping. Private businesses with a diverse range of goods offered to a variety of consumers (nationally and even internationally) make up the composting units in Asia that are most successful and are able to recoup their expenses from sales. However, their compost is out of the price range of tiny peri-urban farms that desperately need compost and would be ready to purchase a cheap, pure product made from garbage. However, neighborhood-level composting initiatives may contribute to the public's understanding of solid waste management. For these initiatives, good source separation or doorstep sorting compliance is crucial. In cities where the local government has aggressively backed source separation and neighborhood organizations and NGOs carry out this or doorstep sorting, source separation has advanced the greatest. The cooperation of trash generators is further strengthened by support from regional and national governments for separation. There is still a larger matter of how to define the existing uses of urban organic wastes, who "owns" the wastes, and how the conflicting claims to these resources should be expressed and settled, apart from the arguments about what kind of composting is practical.

The possible health effects of the reuse of urban organic wastes are quite complicated since it is so variable and often done informally. Every element of reuse, including the transportation and management of organic wastes, processing, adding organics from mixed municipal trash to soils, cultivating on former dump sites, and feeding animals with wastes, may pose health concerns. There are several participants and potential human-animal illness connections. The study Health Impacts of Peri-urban Resource Development (Birley and Lock, 1999), which addresses organic waste reuse in urban and peri-urban agriculture, provides a complete general review of possible issues linked to this subject [7]–[9]. The March 2001 edition of Urban Agriculture Magazine contains a list of issues and potential solutions. De Zeeuw and Lock categorize the major issues as:

1. Persistence of harmful bacteria in leftovers
2. Zoonosis brought caused by pet excrement
3. Growth in disease-carrying insects
4. Breathing issues brought on by dust and gases
5. Wounds caused by shards of glass
6. Crop contamination brought on by the uptake of heavy metals and pesticide residues via wastes and their leachates.

Composting of urban organic wastes is often claimed to completely remove or greatly minimize any health concerns to farmers and consumers. The truth is more complicated than that. The majority of pathogens must be eliminated during decomposition in order for it to proceed, and the product must develop for a number of weeks. Vermicomposting, which occurs at lower temperatures, is a topic of debate. Prior to

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vermicomposting, organic waste must be processed anaerobically in Europe, although this is not done in underdeveloped nations. Few organic wastes are currently being composted safely in Africa and Asia.

'Garbage farming' (i.e., using municipal solid wastes on farms), the cultivation of former landfills, and animal feeding are all far more common than composting as sources of organic waste entering the food industry, and these practices are seldom regulated. Therefore, there must be a very high number of people who are at danger. However, not much particular study has been done on these health issues. There is no consensus on adequate requirements for safe heavy metal bioaccumulation for the large range of crops planted, even when testing of soils or compost is done to look for the presence of heavy metals. Brook and Davila (2000) describe a promising outcome of pathogenic testing. The U.K. Natural Resources Systems Programme in Kumasi, Ghana tested compost made from urban wastes, and the pathogen levels in the soil were neither particularly high or connected to the distribution of local illnesses. Workers who handle and manage organic wastes, particularly those derived from mixed municipal wastes, are likely to face more hazards than consumers of crops produced on soils that have been fed by organic waste.

International discussion has started on potential control measures for waste reuse in urban and periurban agriculture for example, crop selection, worker education and protection, controlled disposal of hazardous and biomedical wastes based on the extensive research done on the use of human excreta and wastewaters in agriculture. The main obstacle to progress in lowering health hazards is the informality of the majority of urban organic solid waste reuse in Africa and Asia (Furedy, 2001; Cointreau-Levine et al., 1998). A significant portion of the existing informal, and even official, reuse methods would be restricted if cities took action to manage the health concerns from organic waste reuse. The necessity for a multi-level strategy that aims to balance health hazards against the advantages of trash reuse has been emphasized by the editors of Urban Agriculture Magazine.

Mitigation Strategies and Best Practices for Health Issues in Organic Waste Reuse

Several mitigation techniques and best practices should be used to reduce the health concerns related to the reuse of organic waste. These techniques attempt to minimize the possibility of microbiological contamination, heavy metal buildup, and the presence of hazardous compounds while ensuring the safe handling, treatment, and monitoring of organic waste.

1. **Proper Waste Management:**

To reduce health concerns, good waste management procedures are essential. To avoid cross-contamination with hazardous waste streams, source separation of organic waste is used. To reduce exposure to viruses and pollutants, proper organic waste storage, processing, and transportation are crucial. Another way to guarantee correct handling across the waste management chain is to create comprehensive waste management plans that give priority to health and safety issues.

2. **Composting methods**

The treatment of organic waste by composting is a common practice, and using the right methods may help minimize health hazards. Applying composting methods that encourage pathogen eradication, such as maintaining proper temperature and moisture levels, is crucial. Ample maturation times provide the decomposition process enough time to break down organic contaminants and lower the concentrations of hazardous microbes. Composting processes must be regularly monitored and managed in order to provide the ideal environment for microbial activity and organic matter breakdown.

3. **Testing and monitoring**

It is essential to set up monitoring systems to evaluate the efficacy and security of organic waste and its byproducts. To maintain adherence to health and safety regulations, routine testing of organic waste for microbiological pathogens, heavy metals, and dangerous compounds is required. Effective pollutant detection and quantification requires the use of reliable sampling procedures and precise laboratory analytical techniques. This makes it possible to quickly identify any potential health risks and take the necessary remedial measures.

4. **Regulatory Actions**

Effective regulatory controls are essential for guaranteeing the safe re-use of organic waste. It is vital to create and enforce strict rules and regulations for the management and reuse of organic waste. This involves establishing allowable limits for heavy metals, dangerous compounds, and microorganisms in organic waste products. Maintaining public health and safety requires conducting audits and inspections to check for compliance with rules and encourage best practices.

5. **Training and Education**

It's crucial to educate and train the many parties engaged in reusing organic waste. This includes

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those who produce garbage, those who manage waste, those who run composting operations, and those who work in agriculture. It is possible to assure correct handling, treatment, and reuse by raising knowledge of the health hazards and best practices for managing organic waste. Training programs may concentrate on appropriate waste segregation, composting methods, monitoring procedures, and regulatory compliance.

6. Research and cooperation:

Effective health risk reduction requires cooperation between a variety of stakeholders, including governmental organizations, waste management businesses, researchers, and public health groups. The creation of novel solutions and best practices may result through the sharing of information, skills, and resources. Additional study is also required to comprehend and treat new health issues related to the reuse of organic waste, such as the existence of developing pollutants or the effects of prolonged exposure.

The health concerns connected with the reuse of organic waste may be considerably decreased by putting these mitigation methods and best practices into effect. The safe and sustainable reuse of organic waste requires careful waste management, the use of appropriate composting methods, the implementation of rigorous monitoring and testing protocols, the enforcement of regulatory measures, the provision of education and training, and the encouragement of collaboration and research. These initiatives maximize the environmental and financial advantages of reusing organic waste while preserving public health.

Context At The Institute

It is typical to think of the institutional context or "framework" for managing urban organic solid waste as encompassing elements like who handles waste processing (the city, for-profit businesses, NGOs), and whether there are specific policies and regulations governing the management of organic wastes. Further recommending the inclusion of elements influencing farmers' capacity to purchase compost or use advised control measures, Brook and Davila. Therefore, it is important to look at the networks and systems of land tenure for informing farmers and other players. Who legally owns the trash produced in a city and how conflicting claims for access to wastes might be settled are larger issues. The majority of local governments will claim ownership of these resources, but none have policies for taking into account competing current or prospective uses. This category may also take into account if a nation or community has laws and initiatives that undercut socially responsible reuse. In certain nations, a hurdle is the preference for unworkable waste-to-energy programs or pelletization factories over support for composting [10]–[12].

There aren't many particular laws governing the recycling of organic waste in underdeveloped nations, save from where there are municipal composting facilities and slaughterhouses that feed fertilizer industries. Farmers in cities and peri-urban areas are not considered stakeholders. To put it another way, the institutional environment is not established. African nations are most affected by this. The transition to strategic planning in solid waste management, which would enable the management system to take account of both positive and negative environmental externalities, would be the most significant advance in the institutional setting to promote sustainable reuse of organic wastes. Composting and other safe uses of organic wastes could be improved and promoted if they were recognized as preventing waste from being disposed of and improving soils (Dulac, 2001). This would make these methods of waste processing more practical for cities. Cities that are adopting door-to-door trash collection for residential properties have the option of including door-step sorting to recover organics and, eventually, separation at source, into their collection systems.

Two recent events, listed above, imply that institutional background changes are imminent, at least in Asia. The first is the approval of solid waste management regulations for big cities by the Indian Ministry of Environment and Forests, which include specifications for source separation and composting of organic wastes (India, 2000). The second is the potential for receiving substantial funding from the GEF to start composting urban garbage. These awards are intended to promote composting across sectors. Most likely, shortly, several African nations will submit financial applications. Reduced waste loading on regional and global "sinks" is necessary for sustainable development. Sustainable development refers to actions that increase output and employment as long as they don't jeopardize the environment and, by extension, human and animal health. Thus, a key component of sustainable development is the safe reuse of organic waste from cities.

If organic wastes could be efficiently processed and repurposed, solid waste management would be substantially aided. The difficulties in achieving these aims stem primarily from concerns of safety, viability, and equality in addressing the demands of the many social entities that are involved in the

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reuse of organic waste. As was already said, there are a lot of barriers in the way of fully safe reuse of organics from various sources in cities. Without significant institutional backing, applying high standards to processes and products would lead to a decrease in reuse rather than an increase in it. Finding a compromise in the conflict between waste reduction and public health has not yet received much thought. There are markets for uncontaminated organics in significant Asian and African cities.

Similar to how garbage trade and recycling businesses handle recyclable inorganics, considerable amounts of these organics are captured throughout Asia by private and informal operators. The organics that are intermingled with home, institutional, and commercial wastes provide a challenge for municipal solid waste departments. Composting with source separation is advocated as the best method for making them less of a burden on solid waste management. Given the lack of significant incentives for waste producers to preserve their organic wastes suitable for safe composting, doing this on a sufficient scale in big cities appears unrealistic anytime soon. The easiest method of catching a lot of domestic organic garbage is doorstep sorting, however. Dealing with some of the unused urban organics calls for supporting private companies' entry into composting by providing free wastes and even land. However, the goods of for-profit businesses are often too costly for small and basic crop producers. If municipal or commercial initiatives redirect the organics that the farmers obtained earlier, local producers would suffer.

Policy conundrums stem from the fact that the interests of the actors or stakeholders who want to access or manage urban organic solid waste differ: small and marginal farmers seek a low-cost and easily accessible input for their fields; private compost-making firms want to capture the available, uncontaminated organics; solid waste managers see subsidies to such firms as the simplest way to reduce some of their responsibility for organic wastes; NGOs may see c A sensible plan for managing urban organic waste will try to take into account all of these considerations. This objective may be accomplished with the support of a partnership strategy. In the meanwhile, both domestic and global developments are occurring. While the GEF's interest in composting to reduce greenhouse emissions is tying local practices to global concerns, the consequences of India's demand that "class one" towns use composting have yet to be assessed.

CONCLUSION

Reusing organic waste has a lot of potential for resource recovery and sustainable waste management. However, it's crucial to address any possible health problems this practice may cause. The presence of toxic compounds in organic waste and microbial contamination are only a few of the major health problems that have been addressed in this research. Human health may be seriously endangered by exposure to these threats, which can include anything from chronic long-term consequences to infectious infections. It takes a multifaceted strategy to reduce these health hazards. To reduce microbial contamination and stop the spread of infections, proper waste management techniques, such as source separation and treatment, are essential. Techniques for composting, such as temperature management and sufficient maturation times, may assist in lowering the concentrations of dangerous microbes and degrading organic contaminants. To make sure that organic waste and its byproducts are compliant with health and safety regulations, regular monitoring and testing is required. Testing for heavy metals, potentially dangerous compounds, and microorganisms is part of this. Regulations play a critical role in guaranteeing the safe reuse of organic waste by establishing acceptable limits and implementing stringent rules.

REFERENCES:

[1] C. G. Awuchi, H. Twinomuhwezi, C. G. Awuchi, I. S. Victory, and I. O. Amagwula, “Industrial Waste Management, Treatment, and Health Issues: Wastewater, Solid, and Electronic Wastes,” *Eur. Acad. Res.*, 2020.

[2] K. Andersson, M. Otoo, and M. Nolasco, “Innovative sanitation approaches could address multiple development challenges,” *Water Science and Technology*. 2018. doi: 10.2166/wst.2017.600.

[3] P. Lens, B. Hamelers, H. Hoitink, and W. Bidlingmaier, “Resource Recovery and Reuse in Organic Solid Waste Management,” *Water Intell. Online*, 2015, doi: 10.2166/9781780402765.

[4] A. Rajor, M. Xaxa, R. Mehta, and Kunal, “An overview on characterization, utilization and leachate analysis of biomedical waste incinerator ash,” *Journal of Environmental Management*. 2012. doi: 10.1016/j.jenvman.2012.04.031.

[5] S. N. Ahmed, A. M. Sinha, M. Haider, and H. Craddock, “Community Perception of Solid Waste Management (SWM) in Dhaka, Bangladesh,” *Ann. Glob. Heal.*, 2017, doi: 10.1016/j.aogh.2017.03.197.

[6] U. Arachchige, R. Silva, and P. Niroshan, "Plastic Waste Management in Sri lanka," *J. Res. Technol. Eng.*, 2020.

[7] G. Pantano, G. M. Grosseli, A. A. Mozeto, and P. S. Fadini, "SUSTENTABILIDADE NO USO DO FÓSFORO: UMA QUESTÃO DE SEGURANÇA HÍDRICA E ALIMENTAR," *Quim. Nova*, 2016.

[8] R. S. Quilliam *et al.*, "Can macrophyte harvesting from eutrophic water close the loop on nutrient loss from agricultural land?," *Journal of Environmental Management*. 2015. doi: 10.1016/j.jenvman.2015.01.046.

[9] K. Mohammed and O. Sahu, "Recovery of chromium from tannery industry waste water by membrane separation technology: Health and engineering aspects," *Sci. African*, 2019, doi: 10.1016/j.sciaf.2019.e00096.

[10] S. Sayadi-Gmada *et al.*, "Inorganic waste management in greenhouse agriculture in Almeria (SE Spain): Towards a circular system in intensive horticultural production," *Sustain.*, 2019, doi: 10.3390/su11143782.

[11] A. Mohammadi Torkashvand, M. Alidoust, and A. Mahboub Khomami, "The reuse of peanut organic wastes as a growth medium for ornamental plants," *Int. J. Recycl. Org. Waste Agric.*, 2015, doi: 10.1007/s40093-015-0088-0.

[12] D. Massa, F. Malorgio, S. Lazzereschi, G. Carmassi, D. Prisa, and G. Burchi, "Evaluation of two green composts for peat substitution in geranium (Pelargonium zonale L.) cultivation: Effect on plant growth, quality, nutrition, and photosynthesis," *Sci. Hortic. (Amsterdam).*, 2018, doi: 10.1016/j.scienta.2017.10.025.

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Urban Organic Solid Waste: Practices in Hyderabad

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ABSTRACT: ***This research investigates Hyderabad, India's urban organic solid waste management procedures. In order to manage the growing volumes of organic garbage produced by fast urbanization and population increase, the city must overcome substantial obstacles. The research looks on current procedures, such as garbage collection, sorting, composting, and recycling. It also examines the difficulties the city has had in putting into practice efficient waste management plans and offers viable remedies. The results add to our knowledge of Hyderabad's urban organic waste management methods and provide policymakers and urban planners useful information for creating environmentally friendly waste management systems. In order to promote cooperation in waste management projects, alliances should be formed between government agencies, NGOs, and private businesses. It is possible to build financial incentives and legal frameworks to promote composting, recycling, and waste reduction activities among families, companies, and industries.***

KEYWORDS: ***Composting, Garbage, Hyderabad, Organic Waste, Recycling, Waste Management.***

INTRODUCTION

This chapter focuses particularly on the flow of organic waste through Hyderabad's solid waste management system. The activities are looked at in light of potential contributions that may be made to a system that develops more sustainably. In India, where a sizable amount of trash is still organic, local governments have a significant difficulty in managing organic solid waste in terms of collection, transportation, treatment, and final disposal. Although dumping at disposal sites is still practiced in Hyderabad, urban administrations in India are increasingly seeking for other methods of getting rid of organic garbage due to a lack of land around cities and the high expense of long-distance trash transportation. This is seen, for instance, in the annual conferences held by the Urban Think Tank in India for local governments in India and the surrounding area, where the 1999 conference focused on SWM [1]–[3].

Although this concept is not yet fully reflected in the operations of local authorities in Hyderabad, it is acknowledged that recovering organic waste for composting is an essential technique for decreasing waste flows (UNEP, 2001). Source separation of organic materials would improve the quality of organic waste for these recovery operations and make them economically viable, which is not the case in India at the moment (UNEP, 2001). In the literature, waste reduction operations relate to the separation and composting of uncontaminated organic material in order to divert post-consumption wastes from local ultimate disposal. Households would have to separate their garbage at the source for municipal waste. In order to utilize organic waste, municipal authorities must promote source separation of "wet" and "dry" wastes by families.

This necessitates more involvement from the community in solid waste management. Non-governmental organizations (NGOs) could provide the required education on the public's involvement in solid waste management. It is possible to use the services of garbage pickers and itinerant purchasers, particularly if they are able to handle source-separated solid waste that is uncontaminated. This chapter investigates how often the practices identified in the literature as crucial for organic reuse really take place in Hyderabad. Due to the city's increasing urbanization and population increase, Hyderabad, India's procedures for handling urban organic solid waste are very important. This debate examines possible areas for development while highlighting some important elements of Hyderabad's handling of organic waste.

1. **Waste Segregation:** Effective waste segregation at the source is essential for effective management of organic waste. Hyderabad, however, is having trouble properly segregating its trash. The significance of separating organic garbage

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from other forms of trash is not well understood by people. Campaigns for education and awareness should be launched to encourage households to separate their garbage. The segregation procedure may also be facilitated by providing separate containers for organic trash across the city.

2. **Collection and Transportation:** Managing organic waste requires effective collection and transportation systems. Hyderabad has to make investments in a well-planned garbage collecting system with specialized trucks and qualified staff. It is important to create regular collection schedules so that organic waste from homes, businesses, and public locations is collected on time. Costs and environmental effect may be decreased and minimized by coordinating collection routes and improving transportation.
3. **Composting Facilities:** Composting is essential for the management of organic waste. Hyderabad has to make investments in substantial composting infrastructure to handle the accumulated organic waste. These facilities have access to cutting-edge composting methods that may hasten decomposition and provide high-quality compost. Furthermore, encouraging decentralized composting at the community and household levels may ease the load on centralized facilities and boost local involvement in waste management.
4. **Recycling and Resource Recovery:** In addition to composting, recycling organic waste may have positive effects on the environment and the economy. It is possible to investigate cutting-edge methods and technology to transform organic waste into beneficial resources like biofuels or biogas. The establishment of recycling facilities or anaerobic digestion facilities may aid in the extraction of energy from organic waste, lowering reliance on fossil fuels and minimizing environmental pollution.
5. **Public-Private Partnerships:** The effectiveness of trash management projects depends on cooperation between government agencies, NGOs, and private businesses. Public-private partnerships may make it easier to put sustainable practices into place, upgrade infrastructure, and guarantee efficient trash disposal across the city. Industries, enterprises, and families may be encouraged to embrace waste reduction, recycling, and composting methods via the establishment of incentives and regulatory frameworks.
6. **Monitoring and Evaluation:** To determine the efficacy of adopted techniques, regular monitoring and assessment of waste management procedures are required. For the purpose of tracking trash creation, collection, segregation, and disposal, Hyderabad needs to create a reliable monitoring system. This information may support decision-making procedures and assist in identifying areas that need improvement or more assistance.

Hyderabad's management of urban organic solid waste requires an all-encompassing strategy that includes trash segregation, effective collection and transportation, composting, recycling, and cooperation among stakeholders. Hyderabad can advance toward a sustainable and ecologically friendly waste management system that supports a cleaner and healthier urban environment by putting these strategies into practice and resolving the problems that have been identified [4]–[6].

DISCUSSION

ECOLOGICAL WASTE

It is spoken about how Hyderabad's garbage is changing in composition. There isn't much information available on the makeup of the trash, and what there is often based on broad guesses. According to a 1997 research on waste characteristics, biodegradable material made up roughly 55% of the garbage in three Hyderabad dumpsites. In Hyderabad, the two primary groups of producers of organic garbage. The first category includes businesses that produce large quantities of organic waste (both mixed and one specific kind). These consist of stables, dairy farms, lodging facilities, dining establishments, event spaces, marketplaces, and slaughterhouses. The second category consists mostly of houses and is made up

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of continuous producers of modest volumes of organic waste combined with other garbage. Figure 1 depicts the wide range of products available on the organic waste market.

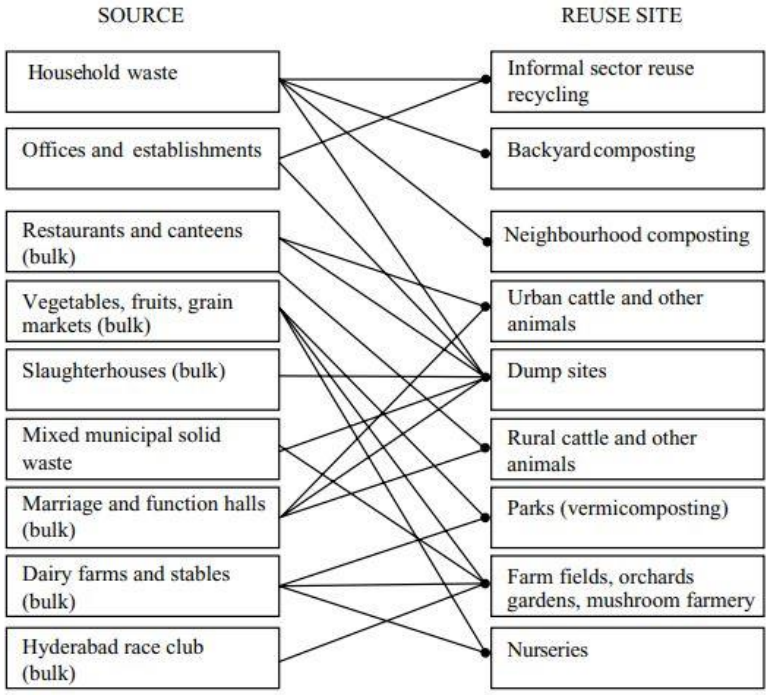

Figure 1: The agents of organic waste supply and demand in Hyderabad.

The municipal trash stream and private sector channels both receive garbage from bulk waste producers for reuse. Private vehicles collect the dung from dairy farms and stables and deliver it straight to farmers. Herdsmen, staff, and truck crews from the Municipal Corporation of Hyderabad (MCH) collect waste from hotels and restaurants. The food scraps gathered by herders are fed to pigs, chicken, goats, and sheep in addition to being utilized as cow fodder. Employees and municipal workers place the garbage in trash cans, where it is collected and transported by MCH and independent contractors for disposal. MCH employees carry market garbage for the most part; just a minor portion is used for vermicomposting. MCH employees collect organic waste from slaughterhouses, which is then transported to dumpsites using the standard municipal infrastructure.

An estimated 80 tons of garbage are produced each day by hotels and restaurants. Beggars get edible garbage, while vegetable waste is collected by cow farms. In 34 markets and slaughterhouses, organic waste is produced. Every day, markets produce between 20 tons and 200 kg of garbage, mostly organic waste. One acre of land is designated for a vermicomposting facility operated by the Society for Preservation of Environment and Quality of Life (SPEQL), an NGO, on the grounds of the Kothapet Fruit Market. Every market has issues with garbage buildup, which results in unsanitary conditions within the marketplaces. The MCH is in charge of the five slaughterhouses. About 10 tons of organic waste and 20 tons of solid trash are produced daily by the sheep, goat, and cow slaughterhouses, respectively. MCH collects the organic waste from these slaughterhouses. These slaughterhouses have water clogging issues as a result of the massive waste buildup [7]–[9].

Workers from both the private sector and MCH collect waste from houses, the second sort of generator. The edible leftovers are taken by the servers, while the remaining organic waste is disposed of in the trash cans. Wet and dry garbage are not separated in the municipality's collection system. Residential welfare groups, NGOs/CBOs, and neighborhood and backyard composting programs utilise the garbage collected in certain locations where the tricycle collecting program is in place6. The majority of the residential garbage

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that MCH and independent contractors collect is dumped in landfills.

Re-Using and Recycling Organic Waste

A vital strategy that encourages sustainability, waste reduction, and environmental preservation is the reuse and recycling of organic waste. Any biodegradable waste material generated from plants, animals, or their derivatives is referred to as organic waste. This includes organic wastes like yard clippings, leftover food, and leftover agricultural products. Finding substitute applications for the waste material without undergoing extensive processing or transformation is known as recycling organic waste. Composting is a typical illustration, in which organic waste is gathered and digested in a controlled setting to create nutrient-rich compost. With the help of this compost, soil health may be improved and the need for synthetic fertilizers can be decreased by using it as a natural fertilizer in landscaping, gardening, and agriculture.

Additionally, via procedures like anaerobic digestion, organic waste may be utilized to produce energy. This process involves the breakdown of organic waste by microbes in the absence of oxygen to create biogas, which may be used to generate energy, heat homes, or even fuel automobiles. Recycling organic waste entails turning the waste into new resources or goods. One well-known instance is the creation of biofuels. Organic waste may be transformed into biofuels like biodiesel or bio gasoline, providing a sustainable alternative to fossil fuels, including vegetable oils, animal fats, and food waste. There are several advantages to recycling and reusing organic waste. In the first place, it keeps garbage out of landfills, cutting down on greenhouse gas emissions and decreasing pollution. Methane, a strong greenhouse gas that contributes to climate change, is produced by organic waste in landfills. Methane emissions may be greatly decreased by redirecting organic waste via reuse and recycling.

Second, recycling and reusing organic waste contributes to the preservation of natural resources. Utilizing organic waste into compost or biofuel eliminates the need to harvest and process virgin materials and lowers the use of synthetic fertilizers and non-renewable energy sources. Additionally, these methods support the sustainability of agriculture and the health of the land. As a result of improved soil structure, moisture retention, and nutrient content brought about by compost made from organic waste, less dependence on chemical fertilizers is required for good plant development. Reusing and recycling organic waste is not without its difficulties. To guarantee successful recycling, the necessary infrastructure for trash segregation, collection, and processing must be in place. Programs for public awareness and education are crucial for motivating people and companies to take part in organic waste recycling activities.

In order to manage trash sustainably, organic waste must be reused and recycled. We may lessen environmental pollution, protect natural resources, and advance agricultural sustainability by diverting organic waste from landfills and using it for energy production or composting. Maximizing the advantages of organic waste reuse and recycling requires putting in place strong waste management systems as well as educating and increasing public awareness of the issue. Initiatives to reuse and recycle organic waste have been taken in a wide range of ways, but the results have been inconsistent. A significant portion of the bulk generators work to encourage reuse via private sector channels. These projects, which are based on the economic viability of the resale of waste products, continue to fall beyond the scope of the municipal waste stream. Additionally, there have been several efforts throughout the years to implement large-scale public sector composting. Recently, a number of initiatives have been launched to support decentralized composting through partnerships between local government and NGOs, based on the use of both household and bulk organic waste generators such as the Fruit Market where SPEQL undertook activities. Both kinds of composting procedures include the home organic waste mixture that is produced.

1. **Large-scale public sector composting**

The Ministry of Environment and Forests has enacted new regulations that demand composting as a strategy to decrease garbage levels in dumpsites, making composting of municipal waste current (India, 2000). Since the late 1950s, the Municipal Corporation of Hyderabad has been active in projects to utilise solid waste for composting. Early initiatives failed towards the end of the 1960s as a result of the high compost costs. Once again in 1977, a large mechanical compost facility was built in conjunction with NEERI and afterwards leased to a private business. It was

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discontinued in 1986 because there was no longer a market for the plant's output in light of the sale of cow dung, which also contained more nitrogen than compost. The MCH is now working on projects for both large- and small-scale private garbage-processing facilities. The Hyderabad Municipal Corporation and Selco International Limited have a contract for the anaerobic composting facilities to produce pellets and electricity. The business has built a facility at the Gandamguda dumpsite that turns mixed trash into fuel pellets [10].

2. Decentralized Composting

Decentralized composting may be roughly categorized into two groups: composting of single source waste and composting of many sources of mixed waste. Decentralized composting at the neighborhood level was also a feature of the MCH's "voluntary garbage disposal scheme" (VGDS). The Reddy Foundation first committed to composting trash in a neighborhood park, where it would be turned into manure by a vermiculture process. The NGO was given a plot by the Hyderabad municipal corporation to do decentralized composting. The plan, however, encountered problems when mixed rubbish was brought to the park and neighbors complained about the degradation of their neighborhood. Sukuki Exnora, another NGO, has now taken over the program, which now delivers market garbage much of it is organic, and the location has been moved to a less conspicuous area of the park. Composting is carried out on a very limited scale, hence it is impossible to say that it has any discernible effect on SWM in the city.

The SPEQL launched a second project with the MCH's assistance. It set up a composting facility next to the fruit market in Kothapet. The SPEQL used the fruit, grain, and vegetable waste produced at the fruit market for vermicomposting without charging anything for the trash or the space given in the market yard. Fruit, grain, and vegetable waste were provided gratis by the MCH authorities. The project was initially intended to be a pilot, but after recovering from a fire that put a hold on operations for many months, it is now operating on a wider scale. There are eight individuals working in the yard right now, both men and women. According to latest sources, it has 15 composting beds and can accommodate 90 trash trucks. To make it more beneficial, organic waste is blended with neem oil cake and cow manure. Both public and government nurseries purchase compost. Through this route, vermicomposting training is also offered. Other actors in Hyderabad engage in composting operations as well. These include the military, who do vermi-composting using farm waste and cow dung slurry at their farms in Bowenpally dairy and agricultural enterprises. Nurseries have utilized cow manure for composting around the city. When planting, red soil is combined with the organic manure that results from composting [11]–[13].

A vehicle delivers the horse excrement from the Hyderabad Race Club's 600 horses every day to the Tekron Industry in Medchal, where it is composted and utilized as manure for mushroom fields. The park service composts leaf and flower waste and reuses it in its parks (five parks were evaluated). The Viceroy and Green Park hotels, two of the city's top hotels, provide garbage collection services that carry waste to their agricultural grounds. Traditional composting techniques are used to turn food waste into manure. Rich neighborhoods in the city's Banjara Hills and Jubilee Hills are home to high-income group families that compost their kitchen and garden trash using conventional ways before utilizing it as organic fertilizer in their own gardens.

CONCLUSION

Hyderabad, a fast expanding metropolitan hub, has a difficult time controlling the rising levels of organic solid waste produced inside its borders. The research looked at the city's present methods for managing organic waste, including collection, segregation, composting, and recycling. Despite attempts to put different waste management systems into place, the system still has glaring holes and difficulties. Effective organic waste management continues to be significantly hampered by inadequate waste segregation at the source. The necessity of trash segregation among people should be promoted via education and awareness efforts. The city must have a sufficient infrastructure for garbage collection, including separate containers for organic waste.

Composting becomes a practical option for Hyderabad's handling of organic waste. The city needs to fund large-scale composting facilities and encourage neighborhood and home composting. These actions may lessen the load on landfills and produce important compost for use in agriculture. Recycling should be promoted in addition to composting as a way to recover resources from organic waste. When organic waste is transformed

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into biofuels or biogas, new energy sources are created while having a less negative effect on the environment. Overall, trash segregation, composting, recycling, and cooperative efforts amongst diverse stakeholders are all necessary for the successful management of urban organic solid waste in Hyderabad. Hyderabad can reduce the risks to the environment and human health posed by organic waste by using sustainable waste management techniques while fostering a cleaner and healthier urban environment for its citizens.

REFERENCES:

[1] G. Ungureanu *et al.*, "Management of urban organic solid waste applied in Romanian Metropolitan city," *Rev. Chim.*, 2018, doi: 10.37358/rc.18.6.6375.

[2] K. R. Sridhar and C. N. Ambarish, "Pill millipede compost: A viable alternative to utilize urban organic solid waste," *Curr. Sci.*, 2013.

[3] C. G. Recalde, M. M. Echeverría, and R. P. Castro, "Descomposición de materia orgánica con microorganismos benéficos magnetizados," *Inf. Tecnol.*, 2013, doi: 10.4067/S0718-07642013000600003.

[4] R. Espinosa-Salgado, G. Saucedo-Castañeda, and O. Monroy-Hermosillo, "Composting a digestate from the organic fraction of urban solid wastes," *Rev. Mex. Ing. Quim.*, 2020, doi: 10.24275/rmiq/IA1236.

[5] B. M. Verstappen *et al.*, "Market-driven Upcycling of Urban Organic Solid Waste in Indonesia," *SANDEC News*, 2016.

[6] H. I. Abdel-Shafy and M. S. M. Mansour, "Solid waste issue: Sources, composition, disposal, recycling, and valorization," *Egyptian Journal of Petroleum*. 2018. doi: 10.1016/j.ejpe.2018.07.003.

[7] R. Pretel, P. Moñino, A. Robles, M. V. Ruano, A. Seco, and J. Ferrer, "Economic and environmental sustainability of an AnMBR treating urban wastewater and organic fraction of municipal solid waste," *J. Environ. Manage.*, 2016, doi: 10.1016/j.jenvman.2016.04.057.

[8] P. R. Kumar, A. Jayaram, and R. K. Somashekar, "Assessment of the performance of different compost models to manage urban household organic solid wastes," *Clean Technol. Environ. Policy*, 2009, doi: 10.1007/s10098-009-0204-9.

[9] U. Di Matteo, B. Nastasi, A. Albo, and D. Astiaso Garcia, "Energy contribution of OFMSW (Organic Fraction of Municipal Solid Waste) to energy-environmental sustainability in urban areas at small scale," *Energies*, 2017, doi: 10.3390/en10020229.

[10] F. Di Maria, M. Benavoli, and M. Zoppitelli, "Thermodynamic analysis of the energy recovery from the aerobic bioconversion of solid urban waste organic fraction," *Waste Manag.*, 2008, doi: 10.1016/j.wasman.2007.03.021.

[11] Y. Duan, A. Pandey, Z. Zhang, M. K. Awasthi, S. K. Bhatia, and M. J. Taherzadeh, "Organic solid waste biorefinery: Sustainable strategy for emerging circular bioeconomy in China," *Ind. Crops Prod.*, 2020, doi: 10.1016/j.indcrop.2020.112568.

[12] S. Wainaina *et al.*, "Resource recovery and circular economy from organic solid waste using aerobic and anaerobic digestion technologies," *Bioresource Technology*. 2020. doi: 10.1016/j.biortech.2020.122778.

[13] Q. Zhang *et al.*, "Biocomposites from organic solid wastes derived biochars: A review," *Materials*. 2020. doi: 10.3390/MA13183923.

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An Overview on the Reuse of Dump Solid Waste by Farmers in Hyderabad

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ABSTRACT: ***Farmers in Hyderabad have recently developed a considerable practice of recycling dump solid waste. The purpose of this research is to investigate the advantages, difficulties, and possible remedies related to the reuse of dump solid waste in agricultural operations. The study comprised examining the present waste management system, interviewing farmers, and determining how dump solid waste affected agricultural productivity and soil fertility. The results show that Hyderabadi farmers are aware of the value of solid waste dumps as a resource for restoring soil health and increasing agricultural output. The efficient use of trash reuse is hampered by a number of issues, including contamination, inadequate sorting and processing methods, and low awareness. This research suggests a thorough strategy that includes trash segregation, composting, and farmer education initiatives to solve these problems. Hyderabad's ecology, trash reduction, and sustainable agriculture may all benefit from the effective utilization of dump solid waste.***

KEYWORDS: ***Dump Solid, Farmers, Organic Waste, Solid Waste, Soil.***

INTRODUCTION

The usage of organic solid waste from the dumpsites was the subject of interviews with farmers from a number of villages close to one of the Hyderabad dumps (Mansurabad). Large and medium-sized farmers employed a combination of different organic and chemical fertilizers as well as mixed solid waste from dumpsites while producing commercial and horticultural crops. Farmers mostly exploited irrigated area where commercial crops are cultivated to use the mixed urban garbage. The crop yields improved as a result of the application of urban organic waste, according to the farmers who utilized it on their property. Benefits included a loosening of the soil, an improvement in soil fertility, a rise in the weight of potatoes cultivated, and a longer shelf life for flowers (chrysanthemums). Urban organic waste had the benefit of being beneficial for two crops, while fertilizer and poultry waste were only useful for one crop and could not be utilized to condition soil. Although there used to be a lot of farmers that utilized urban organic waste, that number is now declining [1]–[3]. Due to the following causes, they had difficulties employing such solid waste that was immediately removed from dumpsites:

1. The application of mixed solid waste over a number of years caused the soil to become tougher;
2. Slowly, issues with soil, crop plants, ground, and surface waste contamination occurred when wastes were sprayed to agricultural regions where crops were grown;
3. Due to the presence of blades, nails, and other sharp objects as well as the offensive odor, the field workers were hesitant to load and unload the trucks with solid waste;
4. The cost of transporting solid waste from landfills to settlements has increased;
5. The farmers believed that cow dung and poultry manure were less expensive than solid trash; and
6. Last but not least, when collection was privatized, the garbage's composition altered to contain a lot more inorganic waste and inert building materials.

The technique of using waste materials, often produced from municipal or industrial sources, in agricultural operations is known as the reuse of dump solid waste by farmers in Hyderabad. Organic and inorganic components from dump solid trash are collected and processed for use as a resource to improve soil fertility and crop output. Farmers in Hyderabad might gain from the reuse of solid waste from dumps in a number of ways. First, it offers a less expensive option to chemical fertilizers. Farmers may increase soil structure, nutritional content, and moisture retention by integrating organic waste into the soil, which will enhance plant development and increase

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agricultural production. Additionally, this method lessens farmers' reliance on synthetic fertilizers, which may be costly and have negative environmental effects.

Reusing solid waste from dumps also encourages trash management and eases the load on landfills. Like many other metropolitan regions, Hyderabad has issues with landfill space and trash disposal. Farmers contribute to trash reduction and aid in the development of a more sustainable waste management system by diverting solid waste from landfills to agricultural areas. The circular economy's guiding principles are adhered to by this strategy since it turns trash into a useful resource. However, using solid dump trash in agricultural techniques presents several difficulties. Contamination is one of the main worries. Hazardous materials, heavy metals, or diseases that are harmful to crops, animals, or human health may be present in solid waste dumps. Therefore, it is crucial to sift, process, and handle waste materials properly in order to guarantee that only safe and advantageous components are employed in agriculture [4]–[6].

The fact that farmers are not aware of the potential advantages and appropriate methods of waste reuse presents another problem. Programs for education and training are required to instruct farmers about the proper handling and application techniques for dump solid waste in order to maximize benefits and minimize dangers. Technical assistance and the promotion of best practices may be greatly aided by governmental organizations, agricultural extension services, and non-governmental groups. Farmers in Hyderabad have the opportunity to support sustainable agriculture, waste management, and environmental preservation via the repurposing of dump solid waste. It lessens the burden on landfills and provides an economical and environmentally beneficial alternative to chemical fertilizers. To successfully adopt trash reuse procedures, it is essential to deal with issues like contamination and awareness. Hyderabad may profit from the reuse of solid waste from dumps by implementing comprehensive methods that include garbage segregation, composting, and farmer education initiatives. This would also open the door for a more sustainable agriculture sector.

DISCUSSION

City Composting Experiences And Their Impact On Sustainable Development

The above-discussed composting experiences are examined in this part for their effects on sustainable development. Decentralized composting of single-source waste is done privately without outside assistance and seems to be effective, perhaps because they are composting just one kind of trash. In reality, further research on this unregulated private market of suppliers and consumers of single-source garbage might be fruitful. Decentralized composting via NGOs and CBOs is highly pushed, but in the few places where it happens, it is still in the experimental phases. These studies will be evaluated using the standards established before (Baud et al., 2001). Established in 1998, Sukuki Exnora is an NGO connected to the Chennai-based Excellence-Novelty and Radical (Exnora) International. In July 1999, it established a vermicomposting unit with the overarching goal of "engaging the common man in environmental conservation," particularly with regard to solid waste management10. As part of Hyderabad's move toward privatization, Sukuki Exnora was hired as the contractor for rubbish collection in many districts of the city, including Begumpet, Methodist colony, and Minister's colony. They provided collection and cleaning services.

They began the "Zero Garbage or No Garbage to Landfill Site" programme on the advise of the MCH Additional Commissioner. Sukuki Exnora began vermicomposting initiatives at Jubilee Hills and Indira Park11 as part of the project in July 1999 in collaboration with the MCH. As the whole amount of garbage collected from a neighborhood is segregated, sold, or composted, these activities aid in improved resource recovery. Even if a residue is left, it may still be accessed more easily than on the street for trash recovery reasons. This residue returns to the municipal dumpsite. It is impossible to determine if the volume of garbage being sent to the dumpsite for ultimate disposal has reduced based on the information currently available. Too early in the process for a remark on this element of the activity.

The vermicomposting facility was established by Sukuki Exnora at a spot in Indira Park. They made an investment of Rs 70,000 in both this and the other Jubilee Hills facility. At Indira Park, the government gave them access to land, water, and electricity without charging them anything. The NGO is the waste collection contractor for a number of residential neighborhoods, and they deliver two trucks of trash every day to the park.

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The environmental circumstances became worse since it was combined rubbish. Market garbage is being used as a foundation for composting. Because of the way things are set up, investment in this activity is significantly subsidized, and the necessary materials for composting and sale are provided at no cost. However, by Indian standards, the NGO's investment is rather substantial. Composting requires a lot of labor to complete. Once the trash has been delivered to the dumpster, the employees sort it into plastic, paper, glass, metal, and other recyclables such coconut shells, rubber/tyre waste, fabric, and wooden debris. Household waste and other compostable materials make up the remaining trash.

In pre-treatment beds, they give the biodegradable material roughly 15 to 20 days to break down. The pre-treatment bed is 2 meters wide and 30 meters long, and it generates 30 to 40 tonnes of waste every day. Cow dung is sprayed over the bed as part of the treatment process for cow dung slurry. Black polythene covers that cover these beds hasten the decomposition process since they quickly absorb heat. After 20 days, the biodegradable material is transferred to vermicomposting beds. The composting bed is 30 meters in length, 12 meters in width, and a height of one meter. In this technique, no chemicals are utilized. on the Indira Park, two distinct kinds of worms are employed and placed on the bed in various levels. For around 45 to 60 days, these beds are routinely irrigated in the morning and evening. After 60 days of this procedure, the manure is harvested.

Over the initial period of operation, there is minimal seasonal change in the production. In the six months before to the interview, barely one ton of manure was retrieved every month. Since January 2000, they have been selling manure under the brand name "Suvarna Manure" for Rs 4 per kg, although sales are still a challenge. One ton of the entire amount of manure was consumed by Exnora. In the event that the manure is not sold on the open market, there is a purchase back arrangement with the municipal corporation of Hyderabad via the state government's horticulture division. About 5 tons of manure were available for purchase at the facility at the time of the interview. For six months of labour, this would indicate a maximum sales level of Rs 20,000. Four rubbish pickers, including one woman, were hired by Sukuki Exnora and were paid Rs 2,000 per month. Sukuki Exnora funded employee pay from other sources since the composting unit hasn't yet generated any revenue. These numbers show that throughout the research period, expenditures were much higher than prospective revenue levels. Even without accounting for investment expenditures, this activity's financial sustainability could not be guaranteed [7]–[9].

The NGO offered regular, somewhat safe, and well-paying around Rs 2,000 per month employment opportunities, together with housing and safety gear. While working with another NGO with expertise, two employees received one week of training in the composting process. The workload, however, was said to be excessive given the number of people working at the time. The organization's actions do not promote a clean and safe environment in the neighborhood. This is one of their most important issues since before, when unmixed trash attracted vermin and the unit stank, Indira Park residents received negative feedback. More room would be required to construct more vermin-composting beds to accommodate the 10 tons of waste that would need to be absorbed daily in order to make the unit more profitable. This would exacerbate the issue already present in the neighborhood and demands explicit restrictions on such decentralized compost production.

The Case of SPEQL: NGO Decentralized Composting in a Market

With a grant of Rs. 350,000 from the Government of India through the Department of Agriculture, Government of Andhra Pradesh, SPEQL established a vermicomposting plant on a half-acre at Kothapet Fruit Market. The primary raw source for this facility was the organic waste from the fruit market. Ten sheds were built for Rs 100,000, which was less per shed than Sukuki Exnora charged. A bore well, a drip system, a storage area, a shredder, and a device that separates compost from other solid wastes were among the additional infrastructural facilities in this unit. As a result, this NGO started off in a strong financial position.

The earthworms utilized in this device are replenished. These worms were offered for sale to others for Rs 50 per kilogram.12 Each bed produces roughly 5 tons of compost every two months, which means that three beds might produce up to 7.5 tons per month in total. Households, farmers, horticulturists, fertilizer stores, and NGOs may purchase the manure for Rs 2 per kilogram, with farmers being a significant share of the buyers. With the MCH, there was no buy-back agreement. Although it is unknown how much organic waste is treated using this technique, it might increase recycling and reuse rates. The manner in which the wastes are ultimately disposed of and whether it is done securely remain unknown.

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Ten laborers were engaged by this unit, and additional workers were added as needed. The employees' labor cost was Rs 10,000 per month. Women's wages are paid at a rate that is seventy percent that of men's, and there are differences among males as well. These employees received housing inside the unit but received no additional social security benefits. One laborer received instruction in the specialized abilities needed for releasing worms and constructing vermi-beds. This implies that the work offered was regular for a select few individuals but irregular for a larger number. There was little information on health and safety aspects, and income levels were just half of what Exnora was paying. Implicitly, providing housing improved income as well.

The cost of cow dung each truck was Rs 200, while the monthly cost of energy was Rs 1000. This increased monthly expenses to an estimated Rs 12,000 If the maximum amount of compost could be produced and sold, the basic monthly income of Rs 15,000 would be enough. These numbers imply that although financial sustainability was feasible, there was limited room for either future investment or the payback of the unit's original investments. Another SPEQL facility was slated to open in Secunderabad's Monda Market. On this matter, they and the administration have not yet come to an understanding. The fruit market committee caused issues for the organization in 1999. Despite being ordered to leave the property, they kept composting because of government assistance. They did have to give the fruit market some land, however. Conflicts over fruit market organization may indicate that local companies question the legality of composting efforts.

Contributions of the Partnerships to Aspects of Sustainable Development

In conclusion, an effort has been made to look at the following concerns about the handling of organic waste;

i. enumerate some of the ways that parties collaborate to control organic waste;
ii. evaluate the collaborations in terms of elements related to socioeconomic development and environmental health; and
iii. examining ways to make already-existing ties stronger. The sorts of cooperation between local actors that have been mentioned in the preceding sections are as follows:
iv. truckers that deliver garbage from landfills to farms;
v. CBOs are NGOs that collaborate with local governments, and
vi. producers that sell their organic waste only to farmers and horticulturists. The first and final partnership types are driven by the market, but the second partnership type is an example of cooperation between local governments and civil society organizations.

1. Environmental Impacts

These coalitions' effects on the environment have been investigated in terms of source separation, reuse and recycling promotion, and safe ultimate disposal. Truck drivers, farmers, and CBOs-NGOs alliances that utilized mixed organic waste from municipal garbage flows did not improve source separation or improve the quality of waste that was recycled. They did stimulate recycling and helped to lower the amount of garbage entering the municipal stream. The cooperation between truckers and farmers has, however, significantly decreased as it became obvious that the combined urban garbage badly impacted worker willingness and soil fertility over a longer length of time [10]–[12].

2. Social and economic effects

These alliances' socio-economic effects have been evaluated in terms of their potential to generate money, employment, and legal and social legitimacy. Concerning their capacity to make money, all of these coalitions have issues. Farmers who picked up trash from the dumps discovered that the cost was going up and the quality of the urban trash was troublesome. Single source producers discovered that their collaboration with organic waste purchasers remained financially feasible. However, the vermicomposting program sponsored by an NGO and the local government struggles due to a lack of market for the compost produced and a lack of social acceptability among the units' close neighbors. Due to the refusal of certain agricultural employees to participate, the social validity of the trash utilized by farmers was also poor. In the case of private sector partnerships, there is not a significant amount of job creation. For the organization in question, it offers a rather regular job situation with ancillary perks.

3. Ecological Safety

Single-source garbage producers' actions help to keep neighborhoods clean and safe. The NGOs that conduct composting operations in neighborhoods do not promote hygiene. Regarding workplace safety and health, the alliance between truckers and farmers had a detrimental effect on both human and

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animal health. The NGOs gave safety issues significant consideration. In these types of cooperation, safe ultimate disposal was not specifically taken into consideration. The absence of source separation, which has a detrimental impact on the quality of the organic waste transported via the municipal trash stream, is one of the major issues with organic waste reuse and recycling. This prohibits a significant amount of municipal garbage from being used effectively. There should be an effort made to advance locally appropriate separation practices. The current private sector operations of the single-source bulk producers of garbage, who have minimal problem in having their waste collected via private trucks, suggest that there is a potential market for "pure" organic waste and well-composted waste. Given the environmental circumstances in Hyderabad, composting organic waste is still a challenging technological procedure. Composting on a large scale in the public sector has proved to be unprofitable since there is no market for the output, while small-scale decentralized composting with the aid of NGOs and CBOs is still difficult and is not well-liked by the surrounding residential neighborhoods [13]–[15].

In Hyderabad, the process of using solid waste materials, often collected from landfills or dumping sites, as a resource in agricultural operations is referred to as "reusing dump solid waste." To increase soil fertility, boost crop development, and advance sustainable agriculture, farmers in Hyderabad are integrating garbage into their agricultural operations rather than discarding or disposing of it. Food trash, agricultural leftovers, animal manure, paper, plastics, and other non-biodegradable garbage are some examples of the numerous organic and inorganic components often found in dump solid waste. Farmers reuse and recycle these waste products to add value to their agricultural systems rather than letting them build up in landfills.

There are various advantages to recycling solid waste from dumps. First off, by keeping garbage out of landfills, it aids in waste management by lowering the environmental effect of waste disposal. In addition, it gives farmers affordable substitutes for pricey soil additives and fertilizers, lowering input costs. Additionally, the addition of organic waste products to the soil strengthens soil structure, raises nutrient availability, and improves water retention, which increases soil fertility and boosts crop output in general. Farmers in Hyderabad have several difficulties while reusing solid waste from dumps. Implementing waste reuse activities successfully might be hampered by contaminated waste materials, inadequate sorting and processing methods, and farmers' poor knowledge of the safe and efficient use of waste resources. In order to overcome these obstacles, suitable waste segregation procedures, effective composting processes, and awareness campaigns designed to educate farmers about the advantages and the treatment of dump solid waste are all necessary. Overall, farmers in Hyderabad are using solid waste from dumps again, which is a sustainable strategy that not only encourages ecologically responsible farming methods but also helps reduce trash. Utilizing waste materials to their full capacity allows farmers to increase output while reducing the negative environmental effects of waste disposal.

CONCLUSION

Hyderabad farmers have the ability to significantly improve waste management and sustainable agriculture via the reuse of dump solid waste. This research demonstrates how farmers appreciate solid waste from landfills as a resource for enhancing soil fertility and crop productivity. To optimize the advantages of trash reuse, a number of issues must be resolved. The main challenges to be solved include contamination, poor sorting and processing methods, and low farmer knowledge. A complete strategy that includes trash segregation, composting, and farmer education initiatives is advised in order to accomplish efficient waste reuse. Not only will these actions increase agricultural output, but they will also help reduce waste and protect the environment. Hyderabad may make a huge step toward developing a more sustainable and environmentally friendly agriculture industry by encouraging the reuse of dump solid waste.

REFERENCES:

[1] E. M. Abalo, P. Peprah, J. Nyonyo, R. Ampomah-Sarpong, and W. Agyemang-Duah, “A Review of the Triple Gains of Waste and the Way Forward for Ghana,” *J. Renew. Energy*, 2018, doi: 10.1155/2018/9737683.

[2] M. Somani, M. Datta, G. V. Ramana, and T. R. Sreekrishnan, “Contaminants in soil-like material recovered by landfill mining from five old dumps in India,” *Process Saf. Environ. Prot.*, 2020, doi: 10.1016/j.psep.2020.02.010.

[3] V. R. Polzer and K. M. Persson, “MSW Management in São Paulo City and the National Policy of Solid Waste,” *Open Waste Manag. J.*, 2016, doi: 10.2174/1876400201609010001.

[4] G. Manjula, V. Rajagopalan, and N. T. Nayahi,

ISSN (Online) 2456-1290

International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)

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"Environmental assessment of solid waste dump site," *J. Environ. Biol.*, 2019, doi: 10.22438/jeb/40/4(SI)/JEB_12.

[5] A. Rim-Rukeh, "An Assessment of the Contribution of Municipal Solid Waste Dump Sites Fire to Atmospheric Pollution," *Open J. Air Pollut.*, 2014, doi: 10.4236/ojap.2014.33006.

[6] J. G. M. Ailton, C. G. Juliano, de B. M. Joana, and B. D. C. J. Armando, "Application of a decision support tool for municipal solid waste open dumps remediation in Cape Verde," *African J. Environ. Sci. Technol.*, 2020, doi: 10.5897/ajest2019.2800.

[7] B. Mekonnen, A. Haddis, and W. Zeine, "Assessment of the Effect of Solid Waste Dump Site on Surrounding Soil and River Water Quality in Tepi Town, Southwest Ethiopia," *J. Environ. Public Health*, 2020, doi: 10.1155/2020/5157046.

[8] O. Díaz Rizo, M. Hernández Merlo, F. Echeverría Castillo, and J. O. Arado López, "Assessment of metal pollution in soils from a former Havana (Cuba) solid waste open dump," *Bull. Environ. Contam. Toxicol.*, 2012, doi: 10.1007/s00128-011-0505-7.

[9] D. Justus Reymond, J. S. Sudarsan, R. Annadurai, and S. Nithiyanantham, "Groundwater quality around municipal solid waste dump in Tiruchirappalli (South India)," *Int. J. Environ. Sci. Technol.*, 2019, doi: 10.1007/s13762-018-2063-6.

[10] G. Blight, "Slope failures in municipal solid waste dumps and landfills: A review," *Waste Management and Research*. 2008. doi: 10.1177/0734242X07087975.

[11] C. Nwaogu, H. D. Ogbuagu, S. Abrakasa, M. A. Olawoyin, and V. Pavlů, "Assessment of the impacts of municipal solid waste dumps on soils and plants," *Chem. Ecol.*, 2017, doi: 10.1080/02757540.2017.1337101.

[12] R. E. Daffi, A. N. Chaimang, and M. I. Alfa, "Environmental Impact of Open Burning of Municipal Solid Wastes Dumps in Parts of Jos Metropolis, Nigeria," *J. Eng. Res. Reports*, 2020, doi: 10.9734/jerr/2020/v12i317083.

[13] S. Vambol, V. Vambol, M. Sundararajan, and I. Ansari, "The nature and detection of unauthorized waste dump sites using remote sensing," *Ecol. Quest.*, 2019, doi: 10.12775/EQ.2019.018.

[14] A. Kumar, M. Datta, A. K. Nema, and R. K. Singh, "Suitability of hazard rating systems for air contamination from municipal solid waste dumps and improvements to enhance performance," *Can. J. Civ. Eng.*, 2017, doi: 10.1139/cjce-2016-0500.

[15] B. J. Ramaiah, G. V. Ramana, and M. Datta, "Mechanical characterization of municipal solid waste from two waste dumps at Delhi, India," *Waste Manag.*, 2017, doi: 10.1016/j.wasman.2017.05.055.

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Demand for Compost from Urban Organic Solid Wastes in Hyderabad

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ABSTRACT: ***This research investigates Hyderabad's market for compost made from urban organic solid waste. The city's fast urbanization and population expansion have led to a major rise in the production of organic garbage. Organic waste composting is a useful waste management technique that may lessen the negative environmental effects of waste disposal while producing high-quality compost for agricultural use. The study's objectives are to evaluate the present demand for compost in Hyderabad, pinpoint the primary drivers of this need, and emphasize the potential advantages of compost use in urban settings. Surveys and conversations with stakeholders in the waste management and agriculture sectors were used to gather data. The results show that there is an increasing demand for compost in Hyderabad as a result of expanding knowledge of sustainable practices and the requirement for organic fertilizers in farming. Government actions, market trends, and environmental concerns are important elements influencing demand. According to the study's findings, Hyderabad can assist sustainable agriculture, a circular economy, and better waste management practices by addressing the need for compost from urban organic solid wastes.***

KEYWORDS: ***Compost, Solid Wastes, Urban Organic, Waste Management.***

INTRODUCTION

The majority of Indian metropolitan regions' municipal solid trash is mostly composed of organic garbage. It has the potential to be a significant resource for food production if handled and used appropriately. Utilizing urban organic wastes may lessen the burden of garbage disposal on municipalities while also improving the environmental issues brought on by organic wastes that have not been handled. In the past, urban and peri-urban farmers in India could access relatively uncontaminated urban organic solid wastes, which were primarily "mined" from garbage dumps. However, as contamination levels have risen along with other aspects of urban development and management, there has been a decline in the reuse of organic waste at a time when demand for dumping space is on the rise. Most municipal corporations showed little interest in increasing composting after municipal trials with mechanical compost facilities (constructed in the middle of the 1970s) failed. However, a few business ventures as well as smaller initiatives involving NGOs and community organizations were launched in the 1990s. Composting is now considered to help with sustainable waste management, as well as employment and income development, according to a recent regulation change. Composting is required as part of solid waste management in big cities under the Solid Waste Management Rules issued by the Supreme Court of India and accepted by the Ministry of Environment and Forests in 2000 (India, 2000) [1]–[3].

The quality of compost products created from municipal trash has been subpar. The major cause of this is inadequate management in terms of avoiding contamination with glass fragments, sharp objects, plastics, industrial, and medical pollutants. In order to overcome organizational, technological, and product quality challenges, municipalities, the local government, residents, and the business sector must work together to fulfill the new municipal solid waste management objectives. While a few compost businesses have been successful in selling compost throughout India and even internationally, the markets for compost goods in urban and peri-urban regions are underdeveloped, and there hasn't been much independent study on the topic. Examining the market potential for compost made from urban organic solid waste in and around Hyderabad-Secunderabad was the main goal of this research. For this kind of pilot research, this city is ideal for a number of reasons: It has a history of municipal compost production; nearby farmers have previously purchased organic waste for animal feed and land application; recently, some NGOs and community projects have shown an interest in the potential for compost production; and, similar to a number of Southern Asian cities, the decline in the use of unprocessed urban organic solid waste is contributing to the city's growing solid waste disposal crisis.

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The following were the particular research's objects:

1. To investigate the market potential for compost created from urban organic waste in and around Hyderabad and to provide recommendations for how to make composting more sustainable.
2. With considerable attention to parks, hotels, nurseries, and luxury homes, the focus was on peri-urban farmers;
3. To comprehend how private businesses in Bangalore and Hyderabad produce and sell compost in order to enhance performance;
4. To examine how the Municipal Corporation of Hyderabad (MCH), NGOs, the business sector, and the general public interact in Hyderabad in order to determine how they may work together more effectively to carry out composting and sell the product;
5. To compare compost production in Bangalore and Hyderabad with the goal of promoting it in Hyderabad.

Bangalore's composting initiatives were included in Kulkarni's study since this city has a number of compost manufacturing businesses and because the municipality, private industry, and NGOs have collaborated on composting from urban organic solid waste. The lessons learned in Bangalore were thus considered applicable to enhancing Hyderabad's performance in the treatment of organic wastes.

The study's scope

Since this research is management-focused, composting's technical specifics are only mentioned briefly. Although we acknowledge that the cost-effectiveness of compost operations and the price of compost have a significant impact on consumer demand, no financial study could be done. This research study was hampered by a number of informational obstacles, namely the lack of knowledge on the types of solid waste generated in Hyderabad, how it is managed, and how much it costs. The information provided by informants sometimes had gaps or inconsistencies. The data supplied in this research nonetheless sheds some light on the players involved in the management and use of urban organic solid waste as well as the potential market for compost in and around a metropolis like Hyderabad [4]–[6].

Role of Government

The MCH lacks an effective strategy for managing solid waste that pays attention to waste minimization and reduction. The Housing and Urban Development Corporation (HUDCO), which receives funding from the federal government, is helping to strengthen the fundamentals of solid waste management. A sizable funding from HUDCO is primarily intended to upgrade the garbage collection and disposal infrastructure. In the endeavor, there is no mention of reducing organic waste. By the late 1980s, the MCH's attempts to commercialize compost made at a municipal facility had been unsuccessful. The compost was of poor quality, and marketing efforts were not made with enthusiasm. The demands of the prospective consumers weren't well understood. Although the Parks Department temporarily experimented with vermicomposting in the 1990s, the MCH has not been interested in restarting a compost plant or in significantly promoting composting since then. Composting, whether of source-separated organics or mixed municipal trash, doesn't seem to be a current MCH focus. They are willing to assist private initiatives, but they haven't focused on the many supports in urban and peri-urban regions that would be required to encourage successful composting of urban garbage. The MCH does not seem to be aware that its support for a newly opened private solid waste pelletization factory in Hyderabad may be at odds with its declared desire to promote composting, notably vermicomposting. This facility demands mixed garbage, which goes against the idea of separating organic material for composting. The needs of peri-urban agriculture and horticulture appear to be subordinate to energy production (supported by the central Ministry of Non-Conventional Energy), and the plant currently operates on a small scale, but if the process is successful and is expanded, it could undermine support for composting. In Hyderabad, there is no public involvement in composting, and it seems that there are no plans to educate the public about the advantages of decreasing urban trash via source separation of organic matter and its redirection to compost production. Nevertheless, certain public officials' readiness to help NGOs that undertake composting programs shows a favorable attitude, and interest may soon increase given the Ministry of Environment and Forests' urge for composting of urban garbage in its solid waste management guidelines.

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DISCUSSION

Analysis of Results Relating To the Demand for Compost

1. The respondents

Farmers, hotels, nurseries, public parks, and homes were among the players whose market potential for compost was examined. In Hyderabad (Banjara Hills, Jubilee Hills, and Mahindra Hills), surveys of 21 farmers, 10 hotel managers, 7 nursery managers, 4 public park managers, and 20 members of high-income families were conducted. The farmers picked were determined by data provided by Drs. Galab and S. Reddy of the Hyderabad-based Centre for Economic and Social Studies. The farmers are situated in the Ranga Reddy district, close to Nagaram, Shamshabad Mandal. This district was selected because, while being a fair distance (about 30–40 km) from the city dumps, it is one where evidence of the usage of municipal solid waste can still be found. The 10 hotels five five-star and three three-star are regarded as representative of their class [7]–[9].

The snowball approach was used to approach the nurseries, beginning with a well-known nursery and making contacts along the way. The ease and response readiness of the homes in the affluent regions were taken into consideration while selecting them. Interviews with the Society for Preservation of Environmental Quality of Life (SPEQL), a local NGO engaged in vermicomposting in Hyderabad, as well as certain government representatives were done to better understand the context of compost production. Key informants in Bangalore provided information on the composting activities of one public sector organization, two commercial businesses, and three NGOs.

2. Demand for compost

This tiny pilot research found evidence of demand among certain wealthy homes, nurseries, hotels, parks, and peri-urban farms. The usage of organic materials was appreciated by all growers who responded. The majority is ready to use compost made from urban garbage. As a result, it may be claimed that there is a need for this kind of compost. However, farmers are only prepared to buy compost made from urban garbage if it is clean (free of harmful material) and easy to access (delivered to the farm or sold nearby). Farmers are hesitant to accept payments more than one rupee per kilogram (40 rupees to one US dollar). Some more prospective customers are ready to spend much more.

3. Farmers

i. Chemical and organic fertilizers are used by all 21 farmers ('Organic fertilizers' include animal manures, compost, and decomposed solid waste).
ii. Five farmers continue to work their fields using municipal solid trash. Most inorganics, which make about 15% of the material, are taken out of the garbage on the spot. Farmers apply around 10 truck loads to an acre and pay Rs 700–Rs 1,000 every four-ton lorry load.
iii. In the last one to two years, 3 farms stopped using municipal solid waste.
iv. Ten farmers use animal manure, bird droppings, and other materials without properly composting them.
v. Two farmers use conventional compost; one gets it from a private vendor, while the other makes it from his own farm and animal waste.
vi. One farmer uses animal slaughtering byproducts.
vii. As long as the compost was of high quality, 85.7% of respondents were willing to purchase compost created from urban organic waste. They also want to get it from a location that is close to their farms.
viii. The majority of farmers either claimed they had no notion what they should be paid when asked what price they would be ready to accept. The farmers who responded said they wouldn't spend more than one rupee each kilogram.

4. Non-farm respondents

i. In addition, households, hotels, nurseries, and parks are prepared to purchase compost made from garbage.
ii. According to park authorities, the Parks Department may not need much more compost since they are generating their own from park trimmings.
iii. The amount these respondents are prepared to pay per kilogram is between Rs 3 and 5. Several hotels are prepared to pay far more, up to Rs 20 per kilogram. They (like the farmers) were unsure of what a fair asking price would be.

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5. **Further comments**
   i. In the abstract, the compost has a very high potential. A easy way to acquire a pure product is in demand. However, potential consumers know very little about compost and its advantages.
   ii. The majority of respondents were unsure about what would be a fair price to pay for the desired goods. Lack of information about compost market prices, the standards for generating high-quality compost, transportation costs, etc. are likely all factors in this uncertainty.
   iii. Farmers growing lucrative commodities (such flowers and chillies), 3-5 star hotels, nurseries, and the horticulture department are the most likely to be frequent purchasers who are prepared to pay a market price among the possible clients taken into account in this research. The highest price (up to Rs 20 per kilogram) was offered by hotels.
   iv. Since there were so few high-income homes with gardens that were surveyed, it is impossible to draw any clear conclusions from their replies.

6. **Conclusions regarding demand for compost**

The market potential could be significantly increased if potential users had access to information about compost and its relevance to their needs, as evidenced by the lack of knowledge about the environmental benefits of composting urban organic solid waste and uncertainty about how it should be valued and priced. The desire to support composting should increase if it was further known that composting organic material helps to promote waste reduction and urban solid waste management [10], [11].

NGO Interest in Vermicomposting

Vermicomposting demand was not examined in the research, although information about Hyderabad's interest in this area was acquired. The Society for Preservation of Environmental Quality of Life is one NGO that has a keen interest. At a location it leased from the Kothapet Fruit Market in 1996, it carried out a successful trial project with green market garbage. The L. B. Nagar Municipality provided support monies, and fruit, grain, and vegetable waste was provided at no cost. An environmental education program hosted by the Centre for Environmental Education in Bangalore provided training in vermicomposting. As a result, this initiative received some municipal backing as well as help from an NGO in a different city. 400 kg of vermicompost were generated every 35 days and sold for Rs 2 per kg. Farmers that cultivate flowers, tobacco, and chilies made up the majority of the purchasers. Additionally buyers were the Horticultural Department, the Agro-horticultural Society, and various locals. The conclusion that there is a market for compost made from urban garbage provided it is made from source-separated, uncontaminated organics and sold cheaply is supported by the project's success. Since SPEQL is a non-profit organization, they were able to get the wastes for free, allowing them to sell the compost at a very cheap price.

The main issues with this project were a shortage of labor, equipment that wasn't up to par, a lack of funding, and issues extending the lease with the market committee. When a fire decimated the Kothapet Fruit Market site in 1999, it was put on hold. The project work has just started up again. An organization with its main office in Chennai, Civic Exnora, started a compost initiative a few years ago. Although it was abandoned, Sukuki Exnora, a branch of Exnora, chose to restart it in 1999, utilizing the park locations of the earlier experiments with the Parks Department. They made a deal with the MCH to utilize the locations without paying rent and to receive daily deliveries of solid garbage. However, the project was put on hold as a result of complaints from the public concerning waste that had piling up in the parks, along with the odors and rats that went along with it. In the park, yet another endeavor has started on a very modest scale. The Hyderabad-based NGOs who are interested in vermicomposting think that there is a market for it among hotels, institutions, and apartment residents who have container gardens. Since SPEQL offered their compost for Rs 1-2 per kg, it is unknown how huge the market may be if the product were to be sold at a price of Rs 5 per kg, as it is in Bangalore. This research did not evaluate whether a significant quantity of such compost might be marketed in the metropolitan region.

Composting in Bangalore: Hyderabad's Learning

Composting of urban organic solid waste is done in Bangalore via private, semi-government, and neighborhood programs. The state government oversees the independent organization known as

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the Karnataka Compost Development Corporation (KCDC). The KCDC is a division of the Karnataka Agro Industries Corporation Limited (KAIC), and it was founded in 1975 when the Indian government provided subsidies for compost factories in major towns. The Government of India provides capital cost subsidies for it, while the Bangalore City Corporation (BCC) and the Karnataka State Cooperatives Marketing Federation also provide further help. The business creates compost products from mixed municipal trash and sells them outside of Karnataka to other states for Rs 0.8 to Rs 1.5 per kilogram. (The proportion of municipal garbage and separated market wastes utilized is not known).

Sunrays Composts and Terra Firma Bio-Technologies Inc. are two private businesses that compost municipal trash. This company specializes on vermicompost and includes a research branch. It began producing in 1994. For between five and eight years, a number of NGOs in Bangalore have worked on projects and gained experience in small-scale, decentralized composting and vermicomposting, including Waste Wise (Mythri Foundation), the Centre for Environmental Education, and Clean Environs. In public parks, they work on a very limited scale and generate less than 50 kilogram daily. The price of the compost varies between Rs 3 and Rs 5 per kilogram, however the more expensive variety is less popular. The selling of compost does not allow the NGO programs to recoup their expenses.

Public knowledge of solid waste concerns and different regional efforts seems to be pretty high. However, garbage producers do not follow the NGOs' advice to segregate trash at the source. However, compared to mixed municipal trash collected by city vehicles, the garbage utilized in these neighborhood pilot programs is less polluted. These initiatives have received assistance from the municipal corporation. By providing municipal garbage, the BCC supports the businesses, particularly the Karnataka Compost Development Corporation. The businesses seem to be doing well; they advertise their goods to farmers, parks, forestry, and horticultural departments as well as in other states. As they handle mixed municipal wastes, the ventures must contend with issues such contamination, operations during the wet season, NIMBY (Not in my backyard) objections from neighbors, and securing constant and reliable garbage supplies.

It's becoming more common for businesses to hire marketing agencies or consultants to manage their marketing. Farmers, departments of agriculture, horticulture, and forestry, and plantations (producing tea, coffee, and areca nuts) are the primary clients of private businesses. These elements of the Bangalore experience should be taken into consideration by Hyderabad-Secunderabad:

i. Compost may be produced from mixed urban garbage and marketed in Southern India at a price that is suitable for farmers and plantations. The product's quality is unknown.

ii. A range of initiatives are creating competence in manufacturing and marketing while composting and vermicomposting urban organic solid waste.

iii. After many years of spending money on research and technology, the private firm is now creating the greatest product and turning a profit.

iv. Composting projects are given a specific level of financial support, such as free materials, free use of plant locations, and technical assistance. The private company is given the least assistance.

v. Specialized departments or consulting businesses have had more success marketing significant amounts of compost.

vi. Composting businesses offer their goods across India rather than only in local marketplaces.

vii. Why Since trash producers seldom persevere in maintaining organic waste free of contamination, source-separated organic waste production for composting demands a significant investment in education and monitoring.

viii. If a small NGO's composting activities are not backed by enough personnel to allow for diligent monitoring and attempts to inform trash producers, they risk failure.

ix. Small NGO initiatives are unable to sell and generate enough compost to meet their start-up and ongoing operational expenses.

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x. Obtaining enough uncontaminated organic material, the rainy season, quality control, maintaining an acceptable pricing for the goods, and expanding markets are all issues that urban organic solid waste composting currently has to deal with.

xi. Swabibmana is an NGO that serves as a platform for residents with an interest in solid waste management.

xii. The municipal administration has collaborated with decentralized trash reduction projects and is receptive to suggestions from the general people and NGOs.

Recommendations

This study's key result is that farmers that cultivate higher-value products like flowers, tobacco, and chillies are more likely to utilize compost made from waste and to be willing to pay a fair price for it. This is in line with findings from other places that farmers who grow commodities like rice or wheat cannot afford to purchase compost made in a manner that minimizes contamination (Cointreau, personal communication, 2000). Such compost's market growth must take into account the needs of these sorts of farmers. Customers who may buy compost seek high-quality items. Hyderabad's peri-urban farmers have shown a waning interest in rubbish dump-sourced, severely polluted decomposed waste. The requirement might be met by the production of enough high-quality compost if broad source separation were used. Vermicomposting produced from market wastes won't be enough to meet the needs of many peri-urban farmers and other clients, and it will be too expensive even with heavy subsidies. Vermicomposting will not significantly reduce the volume of solid waste that has to be disposed of. However, metropolitan areas may have a niche market for this product.

It will need the cooperation of many parties, a lot of education, and promotion to preserve the motivation of waste producers to do the separation properly in order to generate enough high-quality compost. The promotion of separation at source will benefit from the involvement of NGOs and community organizations. The research suggests a methodical approach for comprehending the need for waste-derived compost, particularly the requirements of consumers. The experience of projects in Bangalore might be useful in this study of potential restrictions and bottlenecks. A strategic plan for municipal solid waste management must be considered while implementing the strategy to encourage composting of organic waste. The municipal employees, particularly those in the Municipal Officer of Health department, need some training in strategic planning, particularly with respect to methods for reducing waste.

If the MCH wants to play any part in trash reduction via composting, it must enter into partnerships with private businesses and NGOs since it does not intend to participate in centralised composting after the failure of its prior endeavor. The efficient, sustainable production and distribution of compost from solid waste tend to need some level of government assistance. Since understanding the nature of agriculture and the requirements of farmers is crucial for an organic waste plan, some of this help need to come from the Ministry of Agriculture and rural extension organizations. Demonstration projects, displays, seminars, focus meetings, and informational pamphlets may all be used for education and marketing. Civic and community leaders in Hyderabad-Secunderabad might invite other cities with trash reduction and composting expertise to share their knowledge.

CONCLUSION

Compost made from urban organic solid waste is more and more in demand in Hyderabad. Effective waste management solutions are required due to the city's fast urbanization and population expansion, which has increased the creation of organic garbage. A sustainable alternative that not only lessens the environmental effect of garbage disposal but also yields excellent compost for agricultural use is composting organic waste. This report emphasizes the rising need for compost in Hyderabad, which is being fueled by a variety of causes, including greater environmental consciousness, the need for organic fertilizers in agriculture, government efforts, market trends, and market trends. By satisfying this need for compost, we can advance the circular economy, enhance waste management procedures, and promote urban sustainable agriculture. More work has to be done to encourage composting habits, provide effective waste collection and processing infrastructure, and educate people about the advantages of using compost. Hyderabad may take steps to develop a waste management system that is more ecologically responsible and sustainable by addressing the need for compost from urban organic solid wastes.

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REFERENCES:

[1] C. Furedy and R. Kulkarni, "Demand for compost from urban organic solid wastes in Hyderabad," 2004. doi: 10.1007/1-4020-2529-7_11.

[2] I. Baud, J. Post, and C. Furedy, *Solid Waste Management and Recycling; Actors, Partnerships and Policies in Hyderabad, India and Nairobi, Kenya*. 2016.

[3] D. P. S. R. Nalla Naresh, "Limnological Study of Hasmathpet Lake Situated in Hyderabad Region of Telangana," *Int. J. Eng. Res. Technol.*, 2014.

[4] J. Ariunbaatar, A. Panico, G. Esposito, F. Pirozzi, and P. N. L. Lens, "Pretreatment methods to enhance anaerobic digestion of organic solid waste," *Applied Energy*. 2014. doi: 10.1016/j.apenergy.2014.02.035.

[5] Y. Duan, A. Pandey, Z. Zhang, M. K. Awasthi, S. K. Bhatia, and M. J. Taherzadeh, "Organic solid waste biorefinery: Sustainable strategy for emerging circular bioeconomy in China," *Ind. Crops Prod.*, 2020, doi: 10.1016/j.indcrop.2020.112568.

[6] S. Wainaina *et al.*, "Resource recovery and circular economy from organic solid waste using aerobic and anaerobic digestion technologies," *Bioresource Technology*. 2020. doi: 10.1016/j.biortech.2020.122778.

[7] R. Xiao *et al.*, "Recent developments in biochar utilization as an additive in organic solid waste composting: A review," *Bioresource Technology*. 2017. doi: 10.1016/j.biortech.2017.07.090.

[8] Q. Zhang *et al.*, "Biocomposites from organic solid wastes derived biochars: A review," *Materials*. 2020. doi: 10.3390/MA13183923.

[9] D. Sarpong *et al.*, "Biodegradation by composting of municipal organic solid waste into organic fertilizer using the black soldier fly (Hermetia illucens) (Diptera: Stratiomyidae) larvae," *Int. J. Recycl. Org. Waste Agric.*, 2019, doi: 10.1007/s40093-019-0268-4.

[10] M. Rasapoor, M. Adl, S. Baroutian, Z. Iranshahi, and M. Pazouki, "Energy performance evaluation of ultrasonic pretreatment of organic solid waste in a pilot-scale digester," *Ultrason. Sonochem.*, 2019, doi: 10.1016/j.ultsonch.2018.04.021.

[11] D. Sasaki, T. Hori, S. Haruta, Y. Ueno, M. Ishii, and Y. Igarashi, "Methanogenic pathway and community structure in a thermophilic anaerobic digestion process of organic solid waste," *J. Biosci. Bioeng.*, 2011, doi: 10.1016/j.jbiosc.2010.08.011.

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Urban Organic Solid Waste: Practices in Nairobi

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ABSTRACT: ***The procedures and issues of Nairobi's handling of urban organic solid waste are examined in this chapter. Urbanization has significantly increased the production of organic waste, presenting threats to the environment and human health. The research investigates existing procedures, such as programs for trash collection, segregation, composting, and recycling. Additionally, it lists important parties playing a part in waste management along with their functions. The difficulties encountered in putting into practice efficient organic waste management solutions are highlighted, including insufficient infrastructure, ignorance, and little financial resources. In order to solve Nairobi's expanding organic waste issue, the study emphasizes the value of comprehensive waste management legislation, public involvement, and sustainable practices.***

KEYWORDS: ***Management, Organic Waste, Solid Waste, Urban Organic.***

INTRODUCTION

Technically speaking, organic waste is any trash that contains carbon, such as paper, plastic, wood, food scraps, and yard debris. In reality, the phrase is often used in a more constrained meaning in municipal solid waste management to refer to material that is more directly generated from plant or animal sources and that can typically be digested by microbes. Organic waste comes from three main sources: (a) rural generation; (b) source-separated organics in urban areas (such as green market wastes and canning industry wastes); and (c) mixed municipal waste, which is largely organic but significantly contaminated by post-consumer inorganics. For the purposes of this research, human excreta are not considered to be urban organic solid waste. Over 60% of Nairobi's municipal solid waste load is organic, which includes green waste, meat, bone, and fish leftovers from markets, hotels, schools, hospitals, and other institutions, kitchen wastes, farmyard manure, crop residues, and yard trimmings, leftovers from slaughterhouses, and some that ends up in landfills. The quantity of raw organic waste dispersed on farms is proven to be negligible, but a variable part of these wastes are sorted and redirected to composting or fed to cattle. Composting and the use of raw materials like cow dung and poultry waste as manure, together with food waste from restaurants, grocery stores, and other institutions as animal feed, continue to gain significance as waste-reuse activities that are assisting in lowering the amount of organic waste in Nairobi that has to be disposed of [1]–[3].

The biodegradable nature of these wastes creates health problems since they serve as a breeding ground for rodents, insects, and disease-related microorganisms when coupled with badly managed mixed urban garbage. Many people are inconvenienced by the smell of rotting organics in piles of mismanaged solid waste, and unintentional or intentional burns worsen the air pollution. Despite this, it is becoming more and more apparent that this portion of the waste stream is a resource that, if properly managed, may provide the community a variety of socio-economic and environmental advantages. This chapter discusses agricultural methods and current use patterns for organic waste in Nairobi's urban and peri-urban regions. It looks at the contributions of new private players and the function of various partnerships in encouraging this understanding of the management of organic waste streams in Nairobi. It reviews efforts made by official and informal organizations, including local governments, NGOs, and CBOs, to transform organic waste into compost and organic manure for sale and reuse. In light of the introduction of suitable crops to satisfy shifting urban demand and the development of new production techniques, the idea of an urban farmer is considered.

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Trends in Urban Organic Solid Waste Management

According to Peters (1996), organic wastes are often picked through by street children in search of their next meal, even though trash pickers do not typically hunt for them. Some of Nairobi's bigger hotels and eateries also sell their leftover food to farmers so they may turn it into pig feed. Due to the fact that many types of animals, including goats, chickens, and even cows, graze on garbage heaps, organic wastes are essential to the urban agriculture industry. Due to extended droughts, this has been increasingly clear during the last year or so. Cattle were eating whatever they could find once pastoralists visited Nairobi, including leftovers from food processing plants, debris from parks and street vegetation, garbage from racetracks, dairy products, and other sources.

Urban agriculture is practiced on both private and public lands across the city. Urban poor people particularly those without land holdings may minimize their reliance on food by producing crops since it lowers their income expenditure on food. According to Freeman's (1991) estimation, Nairobi's urban families produce crops to some extent. According to a Mazingira Institute research from 1987, 75 percent of urban farmers devoured all they produced. Therefore, urban agriculture is a significant source of food for many people and should be supported. In Nairobi and the peri-urban regions, agricultural farming, livestock husbandry, and poultry keeping are all practiced to varying degrees [4]–[6].

Our most current research shows that more over 80% of Nairobi's farms utilize some kind of on-site organic waste, and roughly a third of the farmers use urban organic waste produced elsewhere. The latter kind of organic waste is also in demand, and many farmers purchase it from this market, albeit respondents are unable to provide exact information on application rates. However, the majority of the organic waste carried in from outside is animal manure. A tiny portion of the organic wastes collected from restaurants, marketplaces, and other establishments are spread directly to the fields to supplement the function of crop residues as soil conditioners. The majority of these wastes are utilized to feed cattle. 43 percent of the markets and institutions polled said part of the organic waste removed from their property was fed to animals, mostly pigs.

Additionally, according to a study conducted by the Mazingira Institute in 1985, in the rainy season in Nairobi, 14 percent of animal producers fed their animal's rubbish, compared to 12 percent in the dry season (Mazingira Institute, 1987). Urban and peri-urban farmers also utilize compost, in addition to using organic waste collected directly from markets, restaurants, hotels, and other establishments as animal feed and on farms. Up to 70% of all farms use family labor for applying organic waste, which is how most farmers operate. However, it's also crucial to engage hired labor for routine agricultural tasks.

According to the Mazingira Institute's 1985 study (1987), 35% of Nairobi's farmers utilized compost, 91% of which came from their own sources. In Nairobi, composting of organic waste is done by a number of community-based organizations. Organic garbage is not often obtained from landfills, however in certain outlying locations, farmers may request trash delivery services to bring municipal waste to their farms. Thus, the primary determinants of patterns of urban solid waste reuse in Nairobi are recycling of urban organic waste, including composting, and consumption of significant portions of food wastes as a result of the recovery of some components at the household and institutional levels, though a minor seasonal impact may also be present.

DISCUSSION

Urban Organic Solid Waste Recycling and Reuse

There is no denying that Nairobi recycles and reuses some organic garbage. It's difficult to determine whether or not these activities have a major influence on fluxes in the urban solid waste cycle since it's unclear how big they are. It is necessary to handle issues like the amount of diverted food waste and the amount of manure coming from cities. Households, markets, institutions, CBOs that compost, NGOs that support CBOs, and farmers that utilize compost are some of the players engaged in waste creation. Institutions produce a large and fluctuating quantity of organic waste. Because they seldom ever weigh the garbage created, it is difficult to calculate exact estimations of volumes. The majority of trash processing by institutions requires separation and sorting, however many institutions just toss all of the rubbish into a bin or other container and wait for pickup. A market or establishment in Nairobi

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employs 51 people on average to handle rubbish. However, the spans from 1 to 400, with 4 to 15 employees participating in trash disposal in 47.4% of markets and institutions. This chapter covers further characteristics of the institutions' organizational structure in the City of Nairobi [7]–[9].

Contributions to Sustainable Development

Urban organic waste handlers in Nairobi really perform at least two significant social roles, much as the union of pickers in Quezon City, Mexico (Vincentian Missionaries, 1998). Through their self-employment programs, they bear a portion of the societal costs of "modernization," such as underemployment and unemployment, that would otherwise be handled by the state. Second, they process waste, which the state would otherwise have to pay for in terms of organic solid waste transit and disposal, shouldering some of the environmental costs of development. By moving away from environmentally hazardous mechanized forms of production and toward traditional urban agricultural systems with "self-conserving" technologies, the various relationships mentioned present opportunities to find alternative forms of agricultural development for urban environments. This transformation is believed to have the ability to reduce pollution and ecological deterioration while enabling higher revenue creation, which would help large populations with little economic means. The quest for a production technique that respects the wellbeing of the animals while preserving a fair quality of living for the producers is another goal that relates to animal welfare.

Large metropolitan centers are often seen as pollutant producers, destroyers of natural ecosystems, and heavy users of external inputs, notwithstanding some progressive views toward sustainable development. But it turns out that this view of the urban environment is overly limited. New markets have been created as a result of the expansion and development of the urban core, directly affecting the existing manufacturing methods. Contrary to the government's narrow perspective, the urban farmer's immense inventiveness and talent have made it feasible to grow food in an urban setting. The ability of the unprotected sectors (such as the urban farmer) to come up with alternative solutions in the face of the environmental "catastrophe" caused by the city's unchecked expansion is shown by this phenomena, which adds a crucial dimension. In order to meet the needs of the urban sector, they have rearranged space, created new methods to use degraded land, altered traditional agricultural systems, and realized the possibility for utilizing enormous amounts of trash as a source of food for animals and/or plants. Composting is becoming more and more popular, but the marketplaces are still small and difficult to find. Compost is now mostly employed in the city's Asian and expat communities' small-scale flower gardens. However, composting has enormous potential for use in both cash production in the long run and waste minimization now.

Regarding worries about public health, we must admit that while there is a chance that crops with improved nutritional quality will be produced as a result of the transfer of vital nutrients from the residues to the crop's edible portion, there is also a chance that food and feed crops grown on land treated with organic residues may contain materials from these residues that will be harmful to the nutritional quality of these crops. Although it is now commonplace in agriculture to repair micronutrient deficiencies, many of the mechanisms that govern these connections at a high level are still poorly understood. It must be encouraged that this topic be investigated. The lack of communication about urban agriculture among its current and future practitioners, be they researchers, city farmers, urban planners, consumer organizations, city administrators, national and international support organizations, and other stakeholders in urban agriculture, is one of the barriers to sustainable food production in and around developing cities. Urban farmers have been encouraged to utilize compost, and good composting has been promoted as an example. The demand for compost is still low due to a lack of an aggressive marketing plan and the accessibility of artificial fertilizers.

Potential customers are also not sufficiently aware of its advantages in terms of agricultural output and environmental friendliness. In order to support sustainable growth in urban agriculture, which will continue to play a significant role in ensuring food security in emerging cities, it is necessary to reverse this tendency via communication. The means of communication must be inclusive of all stakeholders, including the city farmers themselves (both sexes), and not only for specialists. A key step toward self-sustainability is ensuring people's engagement and full social preparation throughout the program cycle. Our understanding of the potential for reusing urban organic solid waste in Nairobi and if it can really assist with solid waste management still has several limitations. Further research is required to answer questions like whether or if source-separated organics will be used more or less informally (in marketplaces, food

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processing, etc.). We conducted an interview with Grace (a pseudonym), a subsistence farmer who lives close to her shamba (farm) in Kwawangware, on the outskirts of Nairobi, in an effort to create the framework for a questionnaire for our study on organic farming systems. Grace is a single lady who is around 60 years old.

Grace has a title deed to a 6-acre clan farm known as her shamba. Despite the fact that she has a number of sons who are also parents, she runs the business autonomously. On her property, organic waste has been dumped since 1989. She receives a fixed payment of Ksh. 50 ($0.65) every truckload of discarded rubbish. Grace sorts the food herself and sells the proper quantities, which are mostly used to feed animals. She acknowledges that the neighborhood has a somewhat active market for organic trash. She scatters the remainder throughout her property and asserts that spreading organic trash has improved the quality of her crops. The majority of the crops are raised for domestic use. Two female neighbors arrived to collect some organics from her farm's garbage while we were there. One of the issues Grace encounters is the occasional argument with the neighbors about the visual appeal of the property and the release of offensive odors. However, she often prevails in these arguments as well [10], [11].

The reasons presented above make it evident that Nairobi's recovery and use of urban organic waste might provide a very genuine chance to address some of the city's waste management issues. Additionally, given that this represents a significant portion of the overall waste load produced in the City, it may be thought of as a crucial waste minimization method. To accomplish economic, environmental, and social goals in a balanced and integrated way, a strategy for the sustainable recovery and use of organic waste must use a participative and cyclical planning and action process. All three issues should be addressed by the plan. The procedure need to include the formulation of policies and action plans as well as their execution, supervision, and routine evaluation. City administrators should put much more effort into planning the reuse of organic waste produced by families and institutions so that it does not end up in the municipal garbage stream. Effective implementation of this would significantly aid solid waste management.

Various national and international NGOs and funders who fund certain components of the integrated community development program support initiatives by composting groups. 15 organizations in Nairobi were engaged in composting and other programs for the community's integrated social development by the year 1997. These organizations now number over 20 and are mostly found in low-income communities, where they carry out admirable activities that contribute to the improvement of environmental integrity. Composting organizations have the opportunity to help raise this understanding in their communities, which is rewarding and helps make up for the current lack of reliable and sustainable markets. The lines of communication must always be kept open to all stakeholders in order to drive home the benefits of urban agriculture but also to raise awareness on the pitfalls of improper application. Good management, i.e. proper selection of wastes, soils, and crops, and proper reliance on soil and plant testing, can avoid most of the identified potential problems from waste-borne microelements. When applying urban organic wastes and compost to agricultural areas, contamination may be prevented by employing adequate control measures, which need knowledge of the source of different harmful substances and their relative strength. It must be encouraged that this topic be investigated.

AFFECTS ON HEALTH

When discussing the reuse of garbage, health issues are often brought up (e.g., Furedy, 1996; Contreau-Levine et al., 1998; Ratha and Sahu, 1993). Urban pollution has been created as a result of urbanization in general. This has unavoidably had an impact on the environment, resources (water, soil, and air), and agricultural environment, resulting in a decrease in the production of conventional cash crops like maize. Agricultural activities has been abandoned in favor of regular employment in the city, aggravating the situation and creating a vicious cycle of abandoned farmland, urban growth, and pollution. Neither the degree of these pollutants' harmful impacts on people, animals, or plants has been well recorded, nor has sufficient study been done on the consequences of reusing organic solid waste in developing cities like Nairobi. The scope of waste reuse is unknown, illness outbreaks are seldom linked to particular activities, there are few professionals qualified to conduct the study, and developing nations are among the reasons for this, among others (Furedy, 1998).

There are a number of ways to lessen dangers to employees and customers if worries about the health concerns of waste reuse in urban agriculture grow (Furedy, 1996). Organic waste and wastewater pollution should be kept to a minimum for both health and economic reasons. Many threats

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to the public's health may be decreased and the final product is more marketable when pure organics are used.

To get reasonably pure organic wastes, there are two basic methods:

1. Separate collection from certain generation places, such as markets for fruits, vegetables, and flowers and canteens;
2. Separate collection based on home and institutional waste producers separating their organic waste (Furedy, 1998).

Although some studies on the relationship of socioeconomic status to morbidity and mortality have been conducted that suggest a potential relationship between environmental agents and lowered health status, the association has not yet been proven, except in some specific cases that are typically occupationally related. Investigation of these problems is challenging. Sexton et al. (1993) outlined a few of the challenges. These include the lack of adequate surveillance systems and methodologies that would accurately track environmental hazards, the lack of complete knowledge of the aetiology and pathophysiology of many diseases, the latency period of more than 20 years between exposure and clinical effects, and the wide range of non-environmental disease causes that could be affected by environmental hazards.

1. Effects of composting on health

More than a third of the composting organizations that were questioned claimed that group members or workers had health issues as a consequence of their job, despite wearing different types of protective gear. These included physical injuries or wounds as well as headaches, skin conditions, gastrointestinal disorders, body aches, respiratory issues, and fungus infections. Only 50% of the composting teams said their team members or workers sought medical attention when they were unwell as a consequence of their labor. Other impacts, such as parasite infections, are unknown since health inspections of composters have not been conducted. Bad smell is the main issue that arises while storing and using urban organic waste, according to virtually all of the respondents. Flies and wounds from sharp objects were two more significant issues that were brought up.

2. Urban organic solid waste's trace element and heavy metal content

The soil has a huge capability for absorbing waste and turning it into useful nutrients for plant development via microbial activity. However, the potential for soil contamination by heavy metals and other trace elements has made the utilization of urban organic solid waste problematic in recent years. Purves and Mackenzie (1973) found that samples of city compost had up to 100 times as much copper and 300 times as much zinc and lead as uncontaminated, typical soils. A number of studies conducted in Hyderabad (e.g. Rao and Shantaram, 1994) have shown that the land application of organic waste enhances the concentrations of trace elements in soils. However, there is little information available on the composition of trace elements and heavy metals in urban organic solid wastes in Nairobi. The concentrations and relative availability of heavy metals in urban solid wastes, as well as any potential effects of adding urban solid waste to soil with regard to heavy metals, have also been discussed in these research.

These studies have shown the need for ongoing monitoring of the long-term impacts of such treatments to land because even while plant clearance of the majority of heavy metals would be modest, their accumulating over time may pose a risk. Therefore, it is crucial to determine how long-term fresh waste application may affect the soil's characteristics and the levels of trace metals in agricultural areas. The inherent unpredictability in the content of wastes and the manures produced from them makes it often difficult to predict potential risks linked with the land application of rubbish. It must be assured that the disposal of wastes on land does not endanger the ecosystem or affect soil fertility in the future. Most potential issues related to the application of waste on land may be avoided with prudent management, including careful selection of wastes, soils, and crops, as well as careful reliance on soil and plant tests.

Perceptions of Waste Workers In General

The majority of employees in the composting industry saw financial gain as the main advantage of their profession. They also appreciate the contribution they make to the improvement of environmental quality and the pursuit of a cleaner environment. Composting organizations have a distinct idea of what they want to happen in the future. Sixty percent of our respondents mentioned intentions to grow their companies and production levels, build additional facilities, and relocate to other locations. Others expressed a desire to expand their business into new forms of farming, greater sanitation services, and building homes for group members to rent. While one group revealed intentions for launching the operations of the previously established Nairobi Compost Co-ordinating Group, another group said that they

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intended to create a training institution on agro-forestry and composting.

Most urban farmers have a favorable opinion on the usage and application of urban organic waste. The usefulness of municipal organic waste as a fertilizer, as a soil conditioner, and for the enhancement of soil texture, crop production, and plant health are its key benefits. Given its impact on agricultural production, they argue that urban organic waste has a commercial value and is lucrative. They also place a high value on the intangible benefits of farming, such as the satisfaction that comes from knowing that their work is appreciated and the advantages it brings to the family. The 'organic waste' they refer to is compost, vegetable trash, and farmyard manure, it should be stressed. The farmers' comments offer no indication of the positive impacts of any of these waste applications, but the pattern of application makes it clear that the relative amount of these wastes used would somewhat rely on availability at any given moment. However, a more significant factor would be the artificial fertilizers' sometimes excessive and expensive prices. For Ksh. 3.50 (US$ 0.05) to Ksh. 5.0 (US$ 0.065) per kg, small-scale community-based composting organizations offer ready compost to farmer's on-site, while chemical fertilizers may sell for up to hundreds of Kenyan shillings per kilogram.

1. **Views of farmers towards the usage of urban organic waste**

Urban organic waste is used by farmers, who feel that it has long-term benefits, particularly as a soil conditioner that improves soil fertility and texture. Additionally, they believe it increases water retention capacity and increases agricultural and livestock productivity.

The examination of our findings made it clear that the most frequent finding among organic farmers was an increase in plant yields on treated regions compared to surrounding untreated areas. In terms of food chains, the most frequent result of using organic waste on agricultural land is an increase in overall food output.

CONCLUSION

Nairobi's increasing urbanization and population increase make managing urban organic solid waste an urgent concern. While some attempts have been made to solve this issue, the research shows that there are still big obstacles to overcome. Despite being in existence, waste collection systems often face infrastructural and resource limitations. Limited waste segregation methods lead to mixed waste streams that are challenging to efficiently manage. Additionally, recycling and composting programs are not extensively used, which results in lost chances for resource recovery and positive environmental effects. Implementing comprehensive waste management regulations that place a strong emphasis on recycling, composting, and trash segregation will be necessary to address these issues. It is essential to promote behavioral change and encourage active engagement in waste management methods via public awareness campaigns and education initiatives. To build effective garbage collecting systems and infrastructure, cooperation between the government, commercial sector, non-profit organizations, and local communities is important. To develop waste management infrastructure and implement sustainable practices, national and international sources of funding and assistance are needed. Nairobi's urban organic solid waste management calls for a multifaceted strategy that includes integrated planning, the application of technology, and stakeholder involvement. Nairobi can lessen the harmful environmental and health consequences of organic waste and progress toward a more resource-efficient and ecologically friendly urban environment by adopting sustainable practices and incorporating the community.

REFERENCES:

[1] J. Ariunbaatar, A. Panico, G. Esposito, F. Pirozzi, and P. N. L. Lens, "Pretreatment methods to enhance anaerobic digestion of organic solid waste," *Applied Energy*. 2014. doi: 10.1016/j.apenergy.2014.02.035.

[2] Y. Duan, A. Pandey, Z. Zhang, M. K. Awasthi, S. K. Bhatia, and M. J. Taherzadeh, "Organic solid waste biorefinery: Sustainable strategy for emerging circular bioeconomy in China," *Ind. Crops Prod.*, 2020, doi: 10.1016/j.indcrop.2020.112568.

[3] S. Wainaina *et al.*, "Resource recovery and circular economy from organic solid waste using aerobic and anaerobic digestion technologies," *Bioresource Technology*. 2020. doi: 10.1016/j.biortech.2020.122778.

[4] Q. Zhang *et al.*, "Biocomposites from organic solid wastes derived biochars: A review," *Materials*. 2020. doi: 10.3390/MA13183923.

[5] R. Xiao *et al.*, "Recent developments in biochar utilization as an additive in organic solid waste composting: A review," *Bioresource Technology*. 2017. doi: 10.1016/j.biortech.2017.07.090.

[6] D. Sarpong *et al.*, "Biodegradation by composting of municipal organic solid waste into organic fertilizer using the black soldier fly (Hermetia illucens) (Diptera: Stratiomyidae) larvae," *Int. J. Recycl. Org. Waste Agric.*, 2019,

ISSN (Online) 2456-1290

International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)

Vol 9, Issue 6S, June 2022

doi: 10.1007/s40093-019-0268-4.

[7] Z. Abbas, S. Utomo, and B. Budiyono, "Analysis of Optimum Garbage Heaps Age on Recovery of Landfills Dominated by Organic Solid Waste," *J. Ecol. Eng.*, 2020, doi: 10.12911/22998993/127092.

[8] H. I. Abdel-Shafy and M. S. M. Mansour, "Solid waste issue: Sources, composition, disposal, recycling, and valorization," *Egyptian Journal of Petroleum*. 2018. doi: 10.1016/j.ejpe.2018.07.003.

[9] P. T. Sekoai, K. O. Yoro, and M. O. Daramola, "Batch fermentative biohydrogen production process using immobilized anaerobic sludge from organic solid waste," *Environ. - MDPI*, 2016, doi: 10.3390/environments3040038.

[10] D. Sasaki, T. Hori, S. Haruta, Y. Ueno, M. Ishii, and Y. Igarashi, "Methanogenic pathway and community structure in a thermophilic anaerobic digestion process of organic solid waste," *J. Biosci. Bioeng.*, 2011, doi: 10.1016/j.jbiosc.2010.08.011.

[11] M. Rasapoor, M. Adl, S. Baroutian, Z. Iranshahi, and M. Pazouki, "Energy performance evaluation of ultrasonic pretreatment of organic solid waste in a pilot-scale digester," *Ultrason. Sonochem.*, 2019, doi: 10.1016/j.ultsonch.2018.04.021.

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A brief introduction of Urban Agriculture

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ABSTRACT: ***Urban agriculture is a new concept that entails growing, processing, and distributing food inside of cities. Numerous advantages are offered, including greater nutrition, less food miles, and higher environmental sustainability. This study examines the idea of urban agriculture, its numerous applications and strategies, and its possible effects on urban neighbourhoods. It also explores the prospects and difficulties of putting urban agricultural programs into practice and offers suggestions for effective implementation and fusion with urban planning. Cities may optimize the potential advantages by including urban agriculture into urban planning procedures, allocating sufficient land, and fostering community participation. Additionally, it promotes a circular economy approach to food production and waste management while reusing unused urban areas to help build sustainable communities. Urban agriculture does, however, confront a number of difficulties, such as spatial restrictions, access to land, a lack of resources, and possible incompatibilities with already-existing urban systems and laws.***

KEYWORDS: ***Agriculture, Food, Organic, Urban Agriculture, Waste.***

INTRODUCTION

Since the days of colonialism, it has been the local government, in Nairobi's case the NCC that is in charge of providing the majority of urban services. In this regard, the NCC has mainly fallen short. Urban-agricultural connections, including a variety of different actors from those responsible for the creation of urban wastes to those active in recycling, are seen to have the potential to enhance SWM. Farmers themselves, private waste management businesses, CBOs, the Ministry of Social Services, NGOs, and establishments including hotels, marketplaces, hospitals, and schools are a few of the more important characters in this scenario [1]–[3].

1. The urban space

Farming in cities has been divided into two main categories: (i) the 'urban' level, which refers to small-scale crop gardens close to the city center, frequently found along roadsides and flood plains, and (ii) the 'peri-urban' level, which refers to farming in areas where land holdings are sufficiently large to permit cultivation and livestock keeping for commercial purposes, such as in Karen and Langata. But 'zero grazing' the practice of keeping one or more dairy cow behind the house and poultry rearing are a phenomena that are growing more and more widespread in Nairobi. This technique is popular among city dwellers who want to augment family food supplies and make additional money. Along the streets and around buildings in the city's core, flowerbeds and little gardens are typical. The main agricultural operations in river valleys are food crops and nurseries for flowers and trees. In Nairobi, food production is regarded as the most significant kind of agriculture. According to a research by the Mazingira Institute from 1994, of the 20% of families who engage in urban agriculture, 90% grow crops for personal use on their property.

The livestock activities used before to urbanization are what gave rise to the urban agricultural producing area. The fact that the agricultural systems are framed within the "urban" concept and that access to infrastructure and public amenities leads to an increase in land prices is a key aspect of this idea (Losada et al., 1998). The two fundamental assumptions that the urban concept is built upon first, the availability of vegetable waste from the city's large markets and other food-handling institutions as feed and fodder, as well as for composting, and second, the sustained demand from the local population for the resulting agricultural products are what make them the most significant characteristics of the concept. The added pressure of producing in an urban context, which does not present in the rural environment, is another factor to take into account.

2. The peri-urban space

The second agricultural space mentioned here is the peri-urban, which, according to Losada et al. (1998), is made up of the last rural areas left in the metropolitan area. Despite the presence of an urban infrastructure and other telltale signs of an urban influence, the peri-urban area still has a distinctly rural atmosphere. It is obvious that the way in which agriculture is produced has been impacted by urban influence. A commercial kind of farming is practiced in this environment. A range of crops, including maize, beans, Irish potatoes, a variety of

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vegetables, bananas, flowers, fodder, and cash crops, are supported in Nairobi's western and northern suburbs thanks to the area's rich, well-drained soils. Both large- and small-scale livestock rearing is also practiced.

Small subsistence farms and sizable horticultural and coffee plantations focused on export may be found to the north of Nairobi. In addition to raising cattle, many farms also raise pigs and chickens. There are both big and small farms in the western region, where the majority of the products are cultivated for local markets. Smaller communities within Kibera Division, like Karen, have farms with a total area of up to 10 hectares where dairy animals are kept together with high-value horticultural products like fodder [4]–[6].

FARMERS

As mentioned above, although some composting organizations do, the vast majority of urban (and peri-urban) farmers in Nairobi typically do not utilize organic waste from the dumpsites. However, they make use of compost and recent garbage from stores, institutions of higher learning, and other places. According to our studies, a farm is 1.2 acres in size. In comparison to conventional farmers, farmers who use urban organic solid waste typically have much smaller holdings (averaging 0.82 acres), which may indicate that farmers with larger holdings are able to produce enough organic waste on their farms to avoid the need to purchase waste from outside sources. Additionally, it can imply that wealthy farmers with greater holdings can afford to purchase fertilizer and manure. Family labor makes up up to 60% of all labor used on farms in urban farming for the application of organic waste. KSh 5,687.50 (US$ 74) is the average labor cost per farm or family. The average labor cost is 21.3 percent of agricultural revenue, which seems too expensive. Survey respondents from 195 family farms were chosen using a grid sampling design to represent urban and peri-urban Nairobi. The survey was about the use and application of organic waste.

1. Issues in the management and recycling of urban organic solid waste

Major barriers to the reuse of urban organic solid waste cited by survey participants were a lack of funding, lengthy travel times, high manufacturing costs, and challenging trash storage. Because they do not know the source of the organics, which may originate from a variety of municipal trash, farmers who do not apply urban organic solid waste claim that they are concerned about soil contamination. Only a few additional issues were identified as being crucial, including the difficulty in getting the garbage, labor shortages, high sorting prices, lengthy transportation distances, and the accompanying health hazards while handling the waste.

2. Farmers' suggestions for resolving the issue of solid waste

The 195 individuals who participated in our poll offered several approaches to solving the solid waste issue. The startling finding is that privatizing trash collection is not seen to be a significant answer. Another interesting fact is that farmers still think the NCC is the ideal organization to handle the solid waste issue, despite its track record of sluggishness and seeming inability to provide services. Nearly 50% of farmers think the ideal solution is effective solid waste collection and transportation, led by the NCC but also incorporating other stakeholders. They emphasized the need of educating stakeholders about recycling and reuse as well as the need to promote the commercial use of organic waste via composting and sale in farming.

DISCUSSION

In Nairobi, the NCC is alone in charge of managing solid trash (Mwanthi et al., 1997), but the quality of its services has been declining, particularly in the informal settlements. The local government is being forced to advocate for the participation of both large and small private institutions as well as NGOs and CBOs in all segments of the SWM chain, from collection and separation to marketing and reuse, due to the NCC's inability to handle solid wastes, including the organic waste load. The NCC seek assistance from educational institutions, NGOs, religious organizations, health professionals, women's groups such as Maendeleo ya Wanawake, and landlords to address solid waste management challenges. These organisations have emerged during the last four to five years, but only the composting industry, which was founded explicitly in 1992, presently has an established institutional structure. Through the help of NGOs, the Uvumbuzi club began composting that year as a way to deal with the organic portion of solid waste, largely from houses particularly in low-income regions, where these wastes were being discarded haphazardly.

For the initiatives it organized, the Uvumbuzi club had two major goals: (i) to launch an effort to clean the city in response to the NCC's ongoing decline in service quality; and (ii) to set up the projects as income-generating ventures, particularly in low-

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income regions. The Uvumbuzi Club first helped 10 groups begin, but since then, many other organizations have started self-help SWM programs in the City that mostly emphasize composting. In addition to composting, trash reuse initiatives that are assisting in lowering Nairobi's organic waste burden include the usage of raw materials such animal manure and dung from cows, as well as food waste from restaurants, grocery stores, and other institutions. In addition, the Mukuru Recycling Centre (MRC), as part of its many operations, is a pioneer in the creation and use of fuel briquettes. Poor residents of the City also gather a significant amount of the municipal trash load to be used as fuel wood, which also contributes to a decrease in the overall load of organic waste produced [7]–[9].

Composting groups

The functioning composting organizations in Nairobi, which number approximately 20, are relatively new, having been founded almost exclusively in the 1990s, according to data from our fieldwork. These organizations were founded in over 60% of cases between 1994 and 1998. There are presently between five and 62 people in each group, but there were once 200 members in one of the groups. The present membership of 60% of the organizations ranges from 20 to 50 individuals, and there seems to be a gender balance with women making up around 49% of the total. Composting groups were founded in a number of methods, but mostly via a group's collaborative effort during activities that ultimately resulted in composting. It seems that financial gain served as the original impetus for the founding of a composting organization.

Seventy percent of the organizations polled said they were founded in order to provide employment that would allow members to make enough money to improve their level of life. The aim to enhance the sanitary and all-around hygienic conditions of their properties is another significant goal. Additionally, a number of composting organizations participate in other civic initiatives including offering health services and educating the public on better garbage disposal techniques. Eighty percent of all composting organizations received some support to get started, with fifty percent of all organizations naming international agencies like the United Nations Population Fund (UNFPA) and the United Nations Centre for Human Settlements (HABITAT) as their initial sponsors. 40% of the organizations claim to have benefited from support from regional NGOs like the Uvumbuzi Club.

Eighty percent of the composting organizations work on NCC property that has been given to them without the need to pay rent, and other organizations, like the Mukuru Recycling Group, have actually recovered the land from a garbage dump. Indigenous knowledge does not seem to have played a significant role in the knowledge acquisition process for any of the composting groups. The Kenya Institute of Organic Farming (KIOF), Uvumbuzi Group, Habitat, and Kuku Women's Group have all made significant contributions to training and capacity building in the field of composting. The Foundation for Sustainable Development in Africa (FSDA) is a significant training institution for composting groups.

Wastes for composting are often collected from homes near composting facilities, as well as from surrounding markets, farms, and businesses, as well as from trash sites. Ninety percent of composting facilities get their garbage for free rather than purchasing it. Composting is a reclamation method that includes triggering and managing the biological fermentation of organic waste to produce a substance that may be used as a soil conditioner for agricultural use. Nairobi composting organizations begin by gathering organic debris, creating a compost pile, and screening to produce such a product. They all suggest that the composting process is closely monitored to guarantee the highest quality final result. According to the data from the respondents, monthly composting costs range from Ksh. 50 (US$ 0.65) to Ksh. 35,000 (US$ 455) per group per month, while the projected monthly compost production ranges from 700 kg to 5 tons per month. One of the biggest and longest-running composting organizations, the Mukuru Recycling Centre, claims a monthly turnover of 3–4 tons of compost made from 6–8 tons of rubbish (Mukuru Integrated Recycling Project, 1998). The MRC has a supply of more than 6 tons of compost, which it sells for Ksh. 10 (US$ 0.13) per kg. Although its primary clients are independent farmers, the organization also utilizes part of the compost to produce vegetables that are sold in the market.

The most significant source of income for Nairobi's composting organizations is money from regional NGOs. The group's earnings and members' contributions, support from international organizations, and donations from private individuals are other important financial sources. The majority of the composting organizations polled said that neither governmental nor private institutions had given them enough support. As a

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result, a lot of these composting organizations had failed to accomplish one of their main goals, which was to be able to pay their employees fairly. Most of the group members were discouraged from composting since the costs were far greater than the profits.

complications with composting

Although composting has the potential to generate cash, community organizations are faced with a variety of obstacles. The acquisition of land to conduct the operations on is perhaps the most crucial of them.

The following list of additional challenges composting organizations encounter during the rainy season is the result of our survey:

1. Compost's lower quality as a result of erosion and nitrogen loss;
2. Drying the compost takes a long time;
3. Because of the moisture, it is more challenging to gather the trash and convert it into a mound;
4. The breakdown process is slowed by moisture; and
5. Difficulty in sieving as a result of compost blockage.

During the dry season, restrictions include:

1. Using more water;
2. Need for a longer composting time;
3. The dust generated while sifting;
4. Market shortage.

As a result, during the rainy season supply cannot keep up with demand, yet during the dry season supply may exceed demand and there is hardly enough room for compost storage. Composting operations struggle to be sustainable since there isn't a ready market for their goods, which group members blame to ineffective marketing tactics. However, synthetic fertilizers are also widely available on the market. Additionally, it was thought that transportation was a recurring and significant issue in the marketing of compost since it required members to spend a significant amount of money on transportation because none of them had a car. Many of the potential markets for compost are in locations that are difficult to get to. Due to these mobility issues, group members have turned to using handcarts, wheelbarrows, and sacks, as well as other inexpensive public transit options, or they have asked consumers to utilize their own methods of transportation.

Food is grown, processed, and distributed inside urban areas as part of urban agriculture, a rapidly expanding practice. Urban agriculture presents a unique option to solve numerous issues related to food security, nutrition, and environmental sustainability as urbanization continues to expand globally and more people than ever before choose to live in cities. Urban agriculture has the potential to make cities become self-sufficient, resilient, and healthier communities by bringing food production closer to where people live. Cities have often depended on remote agricultural regions and rural areas to provide their food needs. However, this reliance on outside food sources has dangers, including interruptions in the food supply chain, an increase in food costs, and environmental damage from long-distance transportation. Contrarily, urban agriculture provides a decentralized and locally oriented approach to food production, lowering dependency on outside sources and minimizing the length of the food supply chain.

Urban agriculture includes a wide variety of activities, including community gardens, aquaponics systems, small-scale rooftop gardens, and vertical farming. With the help of these cutting-edge techniques, food may be produced in unusual places including unused lots, roofs, and indoor facilities. Urban agriculture has the potential to dramatically boost the supply of fresh, nutritious produce in locations where access to healthy food alternatives is limited by effectively using urban spaces. Urban agriculture addresses nutrition and food security, among many other advantages. It may boost biodiversity, improve air and water quality, lessen the impact of urban heat islands, and revitalize abandoned and underused urban sites. Urban agriculture also develops social cohesiveness, community involvement, and educational possibilities for city dwellers, especially children and young people.

Urban agriculture's implementation confronts a number of difficulties despite its numerous benefits. Some of the obstacles that must be overcame include confined space, contaminated soil, lack of technical expertise, availability to water and resources, and zoning laws. However, these issues may be successfully resolved with careful planning, encouraging laws, and community engagement. This study tries to go further into the idea of urban agriculture, looking at its numerous applications and methods as well as its possible effects on urban neighborhoods. It will also go through the benefits and difficulties of putting urban agricultural programs into practice and provide suggestions for effective integration into urban planning. Policymakers, urban planners, and community stakeholders may collaborate to build sustainable, resilient, and food-secure cities by comprehending the principles and promise of urban agriculture.

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Advantages of Urban Agriculture:

1. **Increased Food Security:** By supplying readily available, locally farmed food in urban settings, urban agriculture may help combat food insecurity. It improves the stability of food supply systems and lessens reliance on long-distance travel.

2. **Better Diets and Health:** Urban agriculture encourages the availability of fresh, nutritious vegetables, which may enhance citizens' diets and their general health. It promotes the intake of produce that is often absent from urban diets, such as fruits, vegetables, and herbs.

3. **Environmental Sustainability:** Urban agriculture optimizes land use efficiency by making use of underused areas such as roofs, empty lots, and vertical gardens. It lessens the need for chemical inputs, decreases food waste, conserves water via inventive irrigation techniques, and promotes ecosystem services and urban biodiversity.

4. **Community Engagement and Social Cohesion:** Urban agricultural initiatives unite communities and promote social cohesion by encouraging a feeling of pride, responsibility, and collaboration. It offers chances for learning, developing skills, and sharing information across generations. Farmers' markets and community gardens provide venues for fostering interpersonal relationships.

5. **Economic possibilities:** In especially for underprivileged groups, urban agriculture may provide income and job possibilities. By generating employment in agriculture, food processing, distribution, and associated industries, it helps local economies.

Urban agriculture's drawbacks include:

1. **Limited Space and Land Availability:** Urban regions often have a limited amount of space and land available, particularly in heavily populated cities. Scaling up urban agricultural initiatives may be difficult due to a lack of adequate land, which can also limit the types and amounts of crops that can be cultivated.

2. **Access to Resources:** Access to basic resources like water, soil, seeds, and fertilizers is necessary for urban agriculture. Implementing and sustaining urban agricultural efforts may be difficult or costly in certain circumstances due to the restricted or expensive access to these resources.

3. **Environmental and Health Risks:** Environmental and health risks include soil contamination from prior land usage, air pollution, and exposure to pesticides or other pollutants as problems that urban agriculture may have to deal with. To reduce these hazards, appropriate soil testing, cleanup, and input management are required.

4. **Regulatory and Legal Challenges:** metropolitan agriculture efforts often encounter regulatory and legal obstacles since current zoning and land use laws may not permit or promote agricultural operations in metropolitan settings. Dealing with legal obstacles and navigating complicated permitting procedures may be time-consuming and expensive.

5. **Knowledge and skill gaps:** Successful urban agriculture requires expertise in a variety of fields, including agricultural practices, pest control, business administration, and marketing. The growth and success of urban agricultural programs might be hampered by a lack of access to technical assistance and training.

It is crucial to remember that although urban agriculture may present certain obstacles, many of them can be overcome with careful planning, legislative support, community involvement, and investments in infrastructure and resources. According to the ideas presented above, Nairobi might have a very genuine chance to improve some of its waste management issues if urban organic waste is recovered and used. Since this represents a significant portion of the overall waste load produced in the City, it may also be regarded as a crucial waste minimization technique. In order to accomplish economic, environmental, and social goals in a balanced and integrated way, a strategy for the sustainable recovery and use of organic waste must use a participative and cyclical

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planning and action process. The plan should work to address all three issues. The procedure need to include developing policies and action plans, putting them into effect, keeping an eye on them, and reviewing them often. In order to prevent organic waste produced by homes and organizations from entering the municipal trash stream, city officials should organize the utilization of this waste much better. If done well, this will have a significant positive impact on solid waste management.

Composting groups' initiatives are backed by several national and international NGOs and funders who fund certain elements of the integrated community development program. In Nairobi, there were 15 organizations engaged in composting and other programs for the community's integrated social development by 1997. These organizations now number over 20 and are mostly found in low-income communities, where they contribute admirably to the improvement of environmental integrity by engaging in laudable activities. It is encouraging that composting organizations have the ability to help raise this knowledge in their communities, which helps to make up for the current lack of reliable and sustainable marketplaces [10]. The lines of communication must always be kept open to all stakeholders to drive home the benefits of urban agriculture but also to raise awareness on the pitfalls of improper application. Good management, i.e. proper selection of wastes, soils, and crops, and proper reliance on soil and plant testing, can avoid most of the identified potential problems from waste-borne microelements. For establishing efficient control measures to avoid contamination while applying urban organic wastes and compost to agricultural areas, knowledge of the source of different harmful substances and their relative strength is required. There is no doubt that this topic warrants investigation.

CONCLUSION

The urgent problems that urban areas confront may potentially be solved by urban agriculture. It provides several advantages via its many forms, including rooftop gardens, communal gardens, vertical farming, and aquaponics. First off, urban agriculture helps to ensure food security by boosting regional food production and lowering dependency on imported food. By encouraging social connections, boosting community cohesiveness, and presenting chances for education and skill-building, it also supports community development. Urban agriculture also offers substantial environmental advantages, including lowering carbon emissions via localized food production, preserving water resources through effective agricultural methods, and lessening the impact of urban heat islands. Various parties, including lawmakers, urban planners, community groups, and people, must work together to address these issues. Cities may fully use urban agriculture as a transformational force for sustainable urban development by incorporating it into frameworks for urban planning and governance, investing in auxiliary infrastructure, and developing knowledge-sharing networks.

REFERENCES:

[1] R. R. Shamshiri *et al.*, “Advances in greenhouse automation and controlled environment agriculture: A transition to plant factories and urban agriculture,” *Int. J. Agric. Biol. Eng.*, 2018, doi: 10.25165/j.ijabe.20181101.3210.

[2] M. Dobele and A. Zvirbule, “The concept of urban agriculture – Historical development and tendencies,” *Rural Sustain. Res.*, 2020, doi: 10.2478/plua-2020-0003.

[3] C. Tornaghi, “Critical geography of urban agriculture,” *Prog. Hum. Geogr.*, 2014, doi: 10.1177/0309132513512542.

[4] G. A. Azunre, O. Amponsah, C. Peprah, S. A. Takyi, and I. Braimah, “A review of the role of urban agriculture in the sustainable city discourse,” *Cities*, 2019, doi: 10.1016/j.cities.2019.04.006.

[5] B. Duží, B. Frantál, and M. Simon Rojo, “The geography of urban agriculture: New trends and challenges,” *Morav. Geogr. Reports*, 2017, doi: 10.1515/mgr-2017-0012.

[6] M. Horst, N. Mcclintock, and L. Hoey, “The Intersection of Planning, Urban Agriculture, and Food Justice: A Review of the Literature,” *J. Am. Plan. Assoc.*, 2017, doi: 10.1080/01944363.2017.1322914.

[7] A. Siegner, J. Sowerwine, and C. Acey, “Does urban agriculture improve food security? Examining the nexus of food access and distribution of urban produced foods in the United States: A systematic review,” *Sustainability (Switzerland)*. 2018. doi: 10.3390/su10092988.

[8] A. Pinheiro and M. Govind, “Emerging global trends in urban agriculture research: A scientometric analysis of peer-reviewed journals,” *Journal of Scientometric Research*. 2020. doi: 10.5530/JSCIRES.9.2.20.

[9] S. Yoshida, H. Yagi, A. Kiminami, and G. Garrod, “Farm diversification and sustainability of multifunctional peri-urban agriculture: Entrepreneurial attributes of advanced diversification in Japan,” *Sustain.*, 2019, doi: 10.3390/su11102887.

ISSN (Online) 2456-1290

International Journal of Engineering Research in Mechanical and Civil Engineering (IJERMCE)

Vol 9, Issue 6S, June 2022

[10] G. Feola, J. Suzunaga, J. Soler, and A. Wilson, "Peri-urban agriculture as quiet sustainability: Challenging the urban development discourse in Sogamoso, Colombia," *J. Rural Stud.*, 2020, doi: 10.1016/j.jrurstud.2020.04.032.

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Market and Community in Urban Solid Waste Management

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ABSTRACT: ***Management of urban solid waste is a major problem that affects cities all over the globe. Effective waste management requires the fusion of market forces and community involvement. This chapter explores the connection of the market and community in the management of urban solid waste. Collaboration between public and private sectors, local government, and community groups is crucial. Community-based activities should be supported and encouraged by policies and laws, which should also encourage innovation and market competitiveness. Cities may develop a sustainable waste management ecosystem that reduces environmental impact, encourages resource efficiency, and improves the general quality of urban life by combining market forces and community involvement.***

KEYWORDS: ***Recycling, Solid Waste, Waste Management.***

INTRODUCTION

1. Solid waste collection: contextual factors

The first study topic examines how the institutional environment affects the character and operation of SWM activities, actors, and relationships. The investigations support the notion that an efficient SWC depends on the local political and administrative environment. Authorities at all levels have all acknowledged the need to take action in Hyderabad, where there seems to be a sincere commitment to serving the public good. This is evident, for instance, in the fact that the Central Government published new Municipal Solid Waste Rules in 2000, the Andhra Pradesh Clean and Green Campaign was launched in 1998, and the MCH was heavily privatized. The MCH has increased the geographical coverage and quality of SWC services via privatization, and has done so at lower costs per ton than earlier when the SWC system was completely dependent on direct public supply.

Nairobi's municipal administration is mainly unaccountable, unresponsive, and ineffective, as seen by the authorities' near-total disregard for the SWC issues [1]–[3]. This is strongly tied to the problems with the country's political system, but it is made worse by the ongoing political conflict between the central government, which manages funding for local authorities, and the (oppositional) NCC, which has almost paralyzed local administration. This city's spontaneous privatization of SWC services in response to local consumer demand has not been accompanied by any measures taken by the (local) government to maintain health and environmental standards, ensure coordination among participants, or reduce inequality in service delivery.

The trial-and-error process that preceded the implementation of Hyderabad's unit system of privatization makes the influence of contextual elements quite obvious. In order to address past flaws, particularly the system's susceptibility to corruption and misuse, a strict system of contract requirements and performance monitoring was implemented. Additionally, political pressure from labor interest organizations against reform efforts and in favor of the safeguarding of labor rights, particularly those of MCH employees, is primarily to blame for the existing contracting structure. Contractual obligations, however, prevent private initiative. Given the requirements for the number of people, the kinds of vehicles, and the equipment, technological innovation with the potential for cost savings cannot be adopted. The customary short term of contracts also discourages innovation and investment. Additionally, the authorities deliberately prevent the concentration of power in the hands of a small number of contractors by limiting them access to a maximum of three unit areas. Even while this raises transaction costs, it also gives the local organization the ability to maintain tight control over the privatization process and effectively carry out its regulatory duty. Though scale economies are purportedly modest in SWC, Cointreau-Levine (1994: 16), the small size of the whole region to be served by one contractor prohibits cost reductions via scale economies.

In other words, the particular contracting model used in Hyderabad may fit the unique political-

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administrative circumstances in this Indian city, including a relatively strong state apparatus, a strong concern for public health, and strong labor unions, but it does not allow for the full economic benefits of privatization. The official contract system is also so rigid that it cannot be applied to slum regions, which continue to be glaringly neglected. Obviously, Nairobi has considerably more individual freedom of activity. There is some disparity among service providers in this sector, with relatively large companies serving high- and middle-income regions for comparably expensive prices, and many tiny (informal) ones providing services to low-income areas at much reduced costs. If at least the potentials of small-scale firms are recognised, this circumstance highlights the ability of the private sector to meet the requirements of diverse demographic groups.

The function of residents' CBOs is a significant difference between the Nairobi and Hyderabad experiences in SWC. In the latter city, SWC initiatives via CBOs are crucial, especially constructive partnership with local authorities. One of the main factors contributing to the VGDS's success is the MCH's political and financial backing. The effectiveness of the program has been greatly influenced by the strict oversight provided by residential welfare associations. Although CBO engagement may be seen in all types of neighborhoods, including slums, their efforts seem to have the most impact in middle- and high-income communities. CBOs' influence on SWC is less pronounced in Nairobi. In the slums, CBOs work to make up for the NCC's shortcomings and the seeming incapacity or reluctance of the private sector to provide services there (sometimes with the assistance of NGOs). By actively taking part in these CBOs' environmental cleanup activities, the (local) government simply offers some moral support and maintains its distance from these organizations. Relationships between CBOs and local authorities are often nonexistent or hostile. These residential welfare societies are taking the NCC to task more often for poor administration and a lack of responsibility [4]–[6].

2. Solid Waste Collection: Outcomes

The second study topic examines the contributions made by different SWC players (individually or in collaboration) to the objectives of urban sustainable development. The way that SWC is organized varies across the two cities, therefore one may anticipate that the socio-economic repercussions would also vary. A first noteworthy finding is that actors in both cities have chosen labor-intensive and technologically basic modes of SWC (primarily working with open vehicles without mechanical lifting devices, manual sweeping), whereas many (top-down and large-scale) privatization exercises in the developing world encouraged by international organizations (e.g. World Bank) have been based on the application of sophisticated, labor-saving technologies (compaction truck). The techniques used in Nairobi and Hyderabad are inexpensive, well suited to the local physical environment, and offer the added benefit of allowing the integration of small businesses without significant financial investments.

Despite the fact that certain technological options seem to be appropriate for the environment, their practical viability cannot be assumed. The Nairobi instance demonstrated how significantly harmed the economic sustainability of privatized SWC is as a result of businesses competing in an open and unrestrained manner to meet the demands of dispersed customers. There is no governmental or legal justification for granting service providers exclusive rights to the service in a certain location and for requiring residents to use the service. This is often seen as a need for cost-effective maintenance in the SWM literature. There were quite a few so-called "briefcase" businesses in Nairobi that provided collection services to households in low-income areas of the city for very cheap prices, but without any assurance of regularity owing to the appalling condition of their vehicles. Contrarily, in Hyderabad, extensive requirements in the service contracts created by the MCH, including a 10% net gain for the contractor, more or less assure the financial sustainability of privatised SWC. Profit margins may really be somewhat greater or lower depending on how much is saved from minor violations on the one hand, and how much is lost in fines and bribes on the other. The rigidity of the unit system bothered the contractors, despite the fact that they were all keen to maintain their businesses. Because they are about the same size, it is assumed that the regions covered have collection needs that are more or less equivalent. In reality, there are variations in the amounts of garbage produced as well as in the roads' usability and condition. There is little doubt that the workload varies by place, resulting in longer working hours for the laborers in "difficult" areas.

3. Solid waste collection: system concerns

In the research, we also took into account the coordination between different sub-sectors of the SWM system as well as their interactions with one another. No of their level of wealth, all inhabitants

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of Hyderabad's planned neighborhoods get a minimum level of SWC services, including garbage collection from vantage points that are within walking distance of their homes. This is a key strength of the city's SWC system. However, since they are constrained by the contract structure, private suppliers are unable to customize their offerings to meet the unique needs of their clients. Areas that want higher-level services must plan this on their own. This has recently been accomplished via the VGDS, which provides a house-to-house collection service in exchange for a little user charge. The fundamental collecting mechanism has no bearing on how the VGDS functions. As a result, chances for greater coordination and cost savings that might be gained if all operations in a certain region were handled by a single business are missed. The absence of coordination is a far greater issue in Nairobi. There is an environment of free competition between a range of operators, from respected companies to briefcase businesses. Furthermore, there is no formal monitoring organization or regulatory framework to regulate private service providers. Even if a lack of organization may provide appealing chances for informal innovation and entrepreneurship, it also poses a serious danger to the general welfare.

DISCUSSION

Higher levels of employment within the industry have been achieved as a consequence of both the planned privatization in Hyderabad and the unplanned privatization of SWC in Nairobi, mostly due to the expansion of services. Obviously for varied reasons, privatization has not yet resulted in the layoff of public sector employees. This suggests that in the instance of Hyderabad, a key justification for municipal governments to start down the path of privatization a decline in public spending does not hold true. However, relative costs are lower when privatization is included. This is partly because the working circumstances are poorer in the private sector than in government employment (lower pay, more job instability, and fewer non-wage perks and facilities). However, since state employment in Kenya is (no longer) an accepted advantage, the discrepancies in Nairobi are far less prominent than in Hyderabad. In compared to workers in the private sector, who are constantly under pressure to perform out of fear of losing their jobs, low pay are a key factor in the frequent absenteeism and poor labor productivity of NCC employees. The new hires in the private SWC enterprises itself may also be used to examine the inequalities in Hyderabad.

They contrast themselves with persons from comparable circumstances who endure even worse working conditions rather than the MCH employees. When SWC is organized by the private sector, there are clear signs of increases in production efficiency (measured in terms of expenses per ton of collected and disposed trash or in terms of the number of employees per ton). Additionally, private operators often prove to be successful service providers, and clients are pleased with their job. Therefore, the results in the two cities support a further transfer of SWC to the private sector in these regards [7]–[9]. The conditions in Nairobi and Hyderabad are not truly similar in terms of allocative efficiency (the extent to which charges cover expenditures). Although Nairobi residents pay for rubbish pickup via their water bills, the majority do not use NCC services.

Therefore, those who have employed private operators have a double responsibility. Allocative efficiency is strong at the level of individual private providers since fees cover incurred direct costs. The issue with this city is that a sizable portion of the slums are ignored by private businesses, and as far as lower-income areas go, only those that are close to the dump can be taken on board at a price that is both affordable for the consumer and profitable for the entrepreneur. The exclusion of individuals who cannot pay commercial rates results from the privatization of SWC in Nairobi on the basis of full cost recovery. Additionally, it is important to keep in mind that the indirect costs of privatized SWC, such as using some of the municipal dump's capacity and environmental externalities, are not taken into account.

The allocative efficiency track record in Hyderabad is pretty dismal. The whole system will continue to depend on funding from the general municipal budget and hence continue to be subject to political discussion (choosing between competing objectives) as long as the introduction of service charges is seen as politically impossible. Given that SWC costs now account for one-fifth of the total municipal budget and that the city relies on outside finance for any significant expenditures in future system improvement, it is still unclear if the system can be maintained. In terms of allocative efficiency, only the VGDS is rated well. The program demonstrates citizens' willingness to make financial contributions for higher-quality SWC. It also puts into perspective the opposition of political parties and unions to starting a discussion about cost recovery in the provision of public services.

The feasibility of collecting activities in slum regions deserves particular attention. SWC in

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Nairobi is scarce in these regions, and when it does exist, it heavily relies on the engagement of CBOs. These are often organized by youth and self-help organizations that also participate in other community services. The majority of slum dwellers are unable to pay user fees, hence the CBO employees' revenues come mostly from composting operations and the sale of inorganic waste products. Due to the lack of reliable markets for recycled and compostable goods, the financial feasibility of these CBO-activities is somewhat contested, and the majority of them still rely on funding from donor organizations. In Hyderabad's slum neighborhoods, where NGOs struggle to persuade locals to pay for SWC services, this reliance on donor funding is also evident. Nairobi's environment is far more dangerous than Hyderabad's in terms of environmental risks. Nairobi's collection performance only manages to collect roughly 25% of the entire garbage produced, compared to Hyderabad's actors' combined collection of 70%. And although though Hyderabad's slum neighborhoods are undoubtedly underdeveloped, trash that is placed in public locations is at least sometimes removed. The authorities seldom pay any attention to the Nairobi slums when it comes to SWC.

Due to more efficient collection, privatization has improved the overall state of environmental health in both situations. To cut down on transportation expenses and avoid dealing with dump gangs, private companies have turned to unrestricted dumping tactics as a result of the spontaneous privatization of SWC in Nairobi. Hyderabad's privatization process is strictly monitored, and private contractors' dumping is managed. The risks to public health posed by current dumping methods are undoubtedly greater in Nairobi than in Hyderabad. Waste stream separation, particularly between hazardous (industrial, chemical, medical, etc.) and regular wastes, still needs a lot of improvement. In Hyderabad, the institutional and regulatory structure for overseeing the SWC process is better established and its enforcement power is stronger (regardless of any corruptive activities).

Lack of dumping places, a problem that is prevalent in quickly expanding cities in Africa, Asia, and Latin America, is a significant cause for concern. The new dump locations that are being considered in Nairobi and Hyderabad are far from the city, which would raise transportation expenses. This will probably result in more indiscriminate dumping in the short term, particularly in Nairobi. Additionally, both cities' open dumping practices are a major source of concern. Even though ecological concerns may now be included in formal papers, local SWC procedures still just barely mention them. This is caused in part by executive level ignorance and in part by budgetary limitations. In reality, towns often tell people to dump their trash in low-lying locations that aren't even classified as landfills. The construction of the pelletization facility in Hyderabad is a significant step in the right direction. A suitable sanitary landfill's development is considerably more expensive than the city can afford, according to the MCH.

The lack of coordination in the SWM sector is a systemic flaw that can be seen in both cities. The focus of policies is always on collection and disposal, and little or no attention is paid to the possibility for lowering waste flows via recycling and reuse. This is particularly apparent in the area of SWC where there are no formal regulations or tools to improve source-to-point waste separation. There is no such thing as an effective SWM policy in Nairobi. Even though it hides behind the idea of promoting environmental health, the NCC's limited contribution seems to be determined by political and particularistic goals. Almost little effort is made to go beyond SWC and incorporate collection with the recycling and reuse industry. Collaboration across the three disciplines has coincidental beneficial and negative externalities, but nothing more.

Another city without a SWM policy is Hyderabad. The traditional concerns for environmental health, service efficiency, and service effectiveness seem to be the authorities' main priorities. They pay little attention to recycling and reuse of (in)organic waste materials in their privatization strategy. However, the circumstances for merging viewpoints seem to be increasingly favorable. An effort is being undertaken in the VGDS, sponsored by the MCH, to bring together traditional SWC issues with more general socio-economic and environmental aims rubbish collection employees, whether in the public or private sector, and rubbish pickers looking for valuable items tend to be antagonistic to some extent. They are accused of making the job of collectors and sweepers more difficult by cluttering the area surrounding collection stations for garbage sorting and by removing important waste components that collection personnel might otherwise recover. The livelihood of garbage pickers is in greater danger the more structured and controlled the SWC system is. The amount of mixed rubbish that is transported to the ultimate disposal location increases since

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there are less possibilities for waste pickers to sort and exchange waste.

1. Contextual aspects of inorganic waste recycling and reuse

The assertions below are limited to the trading and recycling of common materials from homes, businesses, and institutions, it must be noted up front. For instance, industrial recyclables were not taken into account. Since garbage is used as a raw material by businesses in both cities, different legal frameworks have an impact on waste recycling, trading, and collection. These have to do with labor and factory legislation, municipal bylaws on SWM, and rules governing raw material imports. The findings show that there has been no 'greening' of local government bylaws on SWM by the local authorities. They continue to be firmly grounded in the public health viewpoint, where waste material recovery and recycling have no place. In neither city have components of the "waste management" hierarchy been imposed by the local government. Source separation by households is not covered by the regulatory framework either. This indicates that ongoing operations in that sector continue to be conducted primarily for economic reasons and remain beyond the jurisdiction of the government. The risk is that when these causes fade, so will the recycling industry (as happened in Europe in the 1960s and early 1970s). If so, it will need more resources to reconstruct it once an environmental viewpoint is more widely recognized [10]–[12].

The economic environment of both cities, the lack of living wage jobs, and businesses making goods without high quality raw materials are the present drivers for trading and recycling waste materials. In India, this issue has long existed, but Nairobi has only just begun to experience it as a result of the country's declining economy. The activities take place within the framework of an economy that is distinguished by businesses and jobs that span a spectrum from extremely formal to very informal. Waste pickers and itinerant purchasers may survive in this environment since they are exempt from labor and business restrictions. Although such changes are unlikely to occur in any nation very soon, it is probable that these activities will no longer be economically viable if the legislative backdrop for employment and production changes.

Entrepreneurs have usually found it challenging to access virgin materials, such as plastic in Kenya and high-quality paper in India, due to national regulatory frameworks for raw material imports. However, once the two nations began liberalizing their economies in the 1990s, import restrictions were lowered, which led to the availability of substitute sources in both nations. Plastics and paper recycling have suffered as a result, and the plastics sector in Kenya has completely collapsed. Kenya is more affected than India because of the less established waste materials market. The international trading of waste materials is not prohibited. This would be an alternate market, as van Beukering argued (2001), if they weren't dangerous. The latest significant change to the regulatory environment was privatization. The investigations revealed no significant cutting off of access as a result of this procedure, despite the fact that altering the method garbage was collected should have had an impact on access to waste for recycling in both cities. The garbage collection businesses in the private sector make money in both cities by exchanging rubbish.

2. Results of reuse, recovery, and recycling of inorganic waste

Glass, paper, plastic, and metal are significant categories in both cities, and similar commodities serve as the foundation of their respective recovery and recycling processes. However, there are significant differences between the two cities in the intricacy of the commodities networks. The degree of specialization is lower in Nairobi than it is in Hyderabad. This is due to the lower levels of profitability and demand for recycled materials there, which prevent wholesalers from specializing in a single kind of material and force them to spread risks by dealing with a variety of materials. In Hyderabad, wholesalers often specialize.

The way in which waste products are demanded by recycling facilities reflects differences in profitability. In Nairobi, just one huge corporation (with several hundred employees) purchases any particular material, giving it the exclusive right to set the price and volume of commerce. This has caused significant price swings and a recent decline in demand for waste products from Kenya. The lone exception is scrap metal, where small businesses are also involved in the recycling process. However, Asian merchants are presently pushing up the price of scrap metal, which might prevent small metal recyclers from becoming profitable. In Hyderabad, however, a sizable number of mostly small businesses (7 out of 10 employ fewer than 50 people) purchase waste materials in order to create new products. They demonstrate an average profit level of 10%. Although the recycling businesses adhere to the letter of the law, the wholesalers that supply them often tread lightly. They need licenses to operate in both Nairobi and Hyderabad, but they may get by with unofficial payments to inspectors and police

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monitoring operations. The rubbish pickers and nomadic purchasers who supply the wholesalers and dealers do so in an entirely informal manner, making them open to intimidation and "illegal payments" from the police and others. As a result, their operations are less profitable and productive.

In both cities, recycling businesses that use recovered materials do so for technological and financial reasons. In both cities, waste resources and virgin materials are blended to create finished goods of greater quality. Entrepreneurs in Nairobi have altered the makeup of their inputs as a result of price drops on imported virgin plastic. Similar to Hyderabad, there may be less market for native waste paper due to imports of better grade paper from overseas. Due to the exclusivity of one recycling company per material in Nairobi, the trade and recycling chain is more vulnerable than it is in Hyderabad. The scale and variety of the waste materials industry in India provide more of a buffer for these fluctuations. This means that these elements are still crucial for the degree of production in these businesses. Entrepreneurs choose whether or not to continue utilizing secondary materials based on the trade-off between cost and quality because there is no external subsidy (which may be the case if the contributions to environmental elements were recognized).

The quality of the employment produced in both cities throughout the whole supply chain varies greatly. Street and dump pickers in both cities gather and sell trash on a subsistence level in exchange for money and products in kind. In Nairobi, this profession has grown significantly since 1985, but it has been around in India for much longer. Men predominate among street pickers and women among waste pickers in both cities. In their professions, women make less money than men. The pickers are not protected from harassment by the police or the general public since they are unlawful in both towns. The loans they get from the merchants they sell their goods to are their primary source of social security. Even though they are often in the informal sector, itinerant purchasers typically have greater salaries than garbage pickers in both cities. Their connections with business owners who provide funds or items often also increase their sense of security. The fact that neither category takes safety precautions while working results in dangerous and unhealthy working conditions for both groups.

There is limited opportunity for pickers and itinerant purchasers to advance to work at the next stage of the commodities chain. In reality, both towns are dealing with growing rivalry for waste resources. People who work for dealers and recycling facilities are the only ones who can work in businesses. Small merchants in India and Nairobi both rely heavily on family labor.

Although they serve as a bridge between recycling facilities, pickers, and nomadic purchasers in both cities, the differences between dealers in India and Nairobi are significantly bigger. The tiny dealers mostly rely on unpaid family labor, whilst the major wholesalers sort products using temporary and contract workers from India. Women and kids often work on this. Contract labor is another kind of employment at the recycling plants in both cities. Although the businesses in Nairobi employ more people than those in India, they are the only ones operating in their industry. The average number of employees in recycling plants in India is 50, and about 40% of those employees are women. Once again, there are no worker safety and health precautions in the recycling units. The provision of medical insurance and other non-monetary perks is only made to more permanent employees.

Pickers and small dealers suffer from this lack of legitimacy since the trade and recycling sector's credibility is poor with relation to the operations of collecting and selling. Police and inspectors harass them, and since they are required to pay bribes, they are obliged to incur increased overhead expenses. The fact that the recycling businesses are recognized members of the formal economy gives their producing operations more credibility. The government and the business owners themselves do not, however, formally acknowledge their contributions to environmental sustainability. The investigations demonstrate that significant volumes of garbage are recovered, which is relevant given the environmental benefits of waste recovery and recycling. It is difficult to compare the volumes of recovered garbage between the two cities since Nairobi receives rubbish from all across the nation whereas Hyderabad receives waste from local and regional sources. However, the figures demonstrate that many tons of the primary material categories (glass, metal, and plastic) are recovered each week in both locations.

The studies demonstrate that trash recovery is related to waste streams outside of the residential and municipal sectors. Institutional and industrial wastes are also recommended sources since they provide unmixed trash of a better quality. As a result, improving source separation by families is not a more essential method of resource recovery than initiatives to promote waste segregation at the source in institutions and businesses. Additionally, it implies that fostering higher resource recovery is

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more important than attempting to restrict private access to waste streams.

3. System issues with inorganic waste recycling and reuse

The primary system issues are the lack of coordination between municipal SWM collection activities and waste recovery and recycling initiatives. Since there is currently a significant issue with inadequate room for garbage disposal in both cities that local authorities are unwilling to address, this should be of rising concern. While efforts to promote trash recovery and recycling may significantly help to reduce waste flows, efforts to improve collection efficiency only serve to make the problem of disposal worse. Promoting cooperation and partnerships between the private sector and local government will be very difficult as long as the SWM regulatory framework does not contain objectives for waste recovery and recycling. Entrepreneurs, traders, itinerant buyers, and pickers are currently very hesitant to become more formalized than they already are because they believe that their business activities are currently on the fringes of the law or in violation of employment and tax laws. However, the regulatory framework must be changed to add more incentives for waste generators to segregate waste and for waste recycling businesses to invest in increasing production and raising the quality of the products produced if waste recovery is to be increased and the quality of waste maintained and improved [13]–[15].

Last but not least, it is important to place the problem of balancing open imports of raw materials with encouraging the recovery of local waste materials as input on the agenda in order to maintain production quality and maximize the amount of materials recovered. The fact that garbage recycling transcends municipal limits and, in the case of plastics, reaches to the national level in Kenya and has sub-national, regional, as well as international connections, creates yet another coordination issue. This suggests that integrating such systems with municipal SWM may not always be simple since trade and recycling businesses may operate on different scales from the neighborhood municipality.

CONCLUSION

Urban solid waste management requires a comprehensive strategy that integrates market processes and community involvement. By encouraging trash reduction, recycling, and the creation of cutting-edge technology, the market plays a significant part in waste management. It promotes private sector involvement, resulting in enhanced trash collection and disposal systems that are more effective, affordable, and efficient. However, the market cannot solve every problem related to waste management on its own. Urban solid waste management places equal value on community involvement and engagement. Communities are the sources of garbage, thus their participation is crucial for the success of projects for waste reduction, separation, and recycling. A feeling of ownership and responsibility is fostered through including the community in decision-making processes, education, and awareness campaigns. Composting, garbage segregation, and neighborhood recycling programs are examples of community-driven projects that may make a big difference in waste reduction and sustainable practices. For urban solid waste management to be successful in the long run, the community and market must be integrated.

REFERENCES:

[1] S. Wahab, “Impact of social capital on community-based urban solid waste management initiative in Ibadan, Nigeria,” *J. Solid Waste Technol. Manag.*, 2015, doi: 10.5276/JSWTM.2015.341.

[2] M. A. Maiyaki, A. Marzuki, and R. I. A. Mustafa, “a Review of Rationale of Community Participation in Urban Solid Waste Management in Nigeria,” *Int. Trans. J. Eng. Manag. Appl. Sci. Technol.*, 2018.

[3] S.-M. Paul, O.-O. Kwaku, A. A. Albert, K. A. Theophilus, and T. O. Richard, “Solid waste management in urban communities in Ghana: A case study of the Kumasi metropolis,” *African J. Environ. Sci. Technol.*, 2019, doi: 10.5897/ajest2019.2713.

[4] M. R. Nguyen and M. F. O. Tan, “Solid waste management in urban and rural communities of santa cruz watershed, Laguna, Philippines,” *Pertanika J. Soc. Sci. Humanit.*, 2020, doi: 10.47836/PJSSH.28.4.20.

[5] Zulmira Ximenes Da Costa, “Urban Solid Waste Management in Dili Community,” *Int. J. Eng. Res.*, 2018, doi: 10.17577/ijertv7is050040.

[6] C. Kanchanabhandhu and S. Woraphong, “A model of solid waste management based multilateral co-operation in semi-urban community,” *Int. J. Environ. Sci. Educ.*, 2016.

[7] R. Yadav, “Solid waste management,” *Pollut. Res.*, 2015, doi: 10.5958/2395-3381.2016.00015.0.

[8] G. Lema, M. G. Mesfun, A. Eshete, and G. Abdeta, “Assessment of status of solid waste management in Asella town, Ethiopia,” *BMC Public Health*, 2019, doi: 10.1186/s12889-019-7551-1.

[9] S. Kumar, S. Singh, and S. Banerjee, “Solid

waste management in developing countries," *J. Crit. Rev.*, 2020, doi: 10.31838/jcr.07.10.252.

[10] N. Yukalang, B. Clarke, and K. Ross, "Solid waste management solutions for a rapidly urbanizing area in Thailand: Recommendations based on stakeholder input," *Int. J. Environ. Res. Public Health*, 2018, doi: 10.3390/ijerph15071302.

[11] M. Subhan, A. B. A. Ghani, and M. H. R. Joarder, "Urban community willingness to pay for improved solid waste management in malaysian municipality: A choice modeling approach," *Asian Soc. Sci.*, 2014, doi: 10.5539/ass.v10n18p122.

[12] M. Wan, T. Qu, M. Huang, L. Li, and G. Q. Huang, "Cloud-based product-service systems platform for household solid waste classification management," *IET Collab. Intell. Manuf.*, 2020, doi: 10.1049/iet-cim.2019.0062.

[13] K. M. Kapepula, G. Colson, K. Sabri, and P. Thonart, "A multiple criteria analysis for household solid waste management in the urban community of Dakar," *Waste Manag.*, 2007, doi: 10.1016/j.wasman.2006.07.009.

[14] S. Towolioe, A. S. Permana, N. A. Aziz, C. S. Ho, and D. G. Pampanga, "The Rukun Warga-based 3Rs and waste bank as sustainable solid waste management strategy," *Plan. Malaysia*, 2016, doi: 10.21837/pmjournal.v14.i4.157.

[15] K. O. Apreku, "Solid Waste Management: A Socio-Economic Perspective of Urban and Peri-Urban Communities in Honiara," *Int. J. Environ. Sci. Nat. Resour.*, 2020, doi: 10.19080/ijesnr.2020.26.556173.

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Determine the Effect of Reuse and Diversion of Organic Waste

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ABSTRACT: ***The principles of recycling and diverting organic waste are examined in this essay as sustainable waste management techniques. It looks at the possible advantages and difficulties of using these strategies and emphasizes how crucial it is to do so in order to deal with the rising problem of organic waste creation. Composting, anaerobic digestion, and bioenergy generation are a few of the technologies and strategies for recycling and diverting organic waste that are examined in the research. It also looks at the possible environmental, social, and economic effects of putting these techniques into practice. According to the research, organic waste may be recycled and diverted in order to lower greenhouse gas emissions, protect natural resources, and advance a circular economy. However, strong infrastructure, policy backing, and public involvement are necessary for successful implementation. In order to maximize the potential for reuse and diversion of organic waste, the study emphasizes the necessity for coordinated efforts across stakeholders, including governments, companies, and communities.***

KEYWORDS: ***Environmental, Organic Waste, Urban Organic, Waste Management.***

INTRODUCTION

1. Reuse and diversion of organic waste: contextual factors

Similar to other developing nations, both cities' municipal garbage is mostly composed of organic waste. Therefore, both SWM and the promotion of sustainable development are extremely concerned with the patterns of recovery. The reuse and diversion of urban organic garbage in Hyderabad and Nairobi involves an odd fusion of individual creativity, neighborhood action, and donor-funded social welfare. In this area of the SWM system, the (local) authorities have mostly maintained their distance. Although there are regrettably no formal plans for improving organic waste recovery, the MCH did at least try to utilize urban organic waste as a resource in the 1970s and 1980s. Unfortunately, large-scale municipal composting experiences have proved unsatisfactory, and as a result, interest in investing in such operations has decreased. Currently, the MCH does provide some assistance to small-scale trial composting projects (giving them with land and sometimes selling trash), however this is more of a symbolic gesture than an actual effort to minimize municipal waste flows. The MCH has not yet taken any action to improve waste separation via awareness-raising initiatives, technical assistance, or legislative measures [1]–[3].

The recent promulgation of the national directive for solid waste management in big cities, which makes source separation and composting necessary, may, however, cause a shift in this scenario in the near future. The MCH has placed its current faith in a private effort for energy recovery from (organic) waste1, despite the fact that the national setting seems to have become more receptive to the notion of tackling urban organic waste concerns. This action serves as a deterrent to more aggressive policy development regarding the use of urban organic waste in (peri)-urban agriculture.

Any effort at cogent policy formation in Nairobi, much alone execution, has been thwarted by the city's broader political environment. The authorities have not taken any action to better use the potential of organic waste, with the exception of the sporadic assistance they provide to composting organizations (by supplying them with garbage and land). Waste diversion occurs mostly as a result of non-public actors working together. In fact, a crucial finding in both cities is that CBO-NGO cooperation, rather than public sector policy measures, is the main driver of composting programs. The majority of NGOs actively support community action by providing both financial and technical support. The concept of neighborhood composting, however, has not really been able to go past the stage of trial and become a cornerstone of official SWM policy in Nairobi and Hyderabad.

2. Reuse and diversion of organic waste: outcomes

The ultimate method of lowering volumes of solid waste in cities in Africa, Asia, and Latin America is now garnering a lot of attention in the literature: recycling and diverting urban organic garbage. The potential seems to be greatest in places with significant urban and peri-urban agriculture sectors

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like Nairobi. The results show that it is crucial to distinguish between different forms of urban organic waste, including compost and urban organic waste that has been combined with other types of garbage. Bulk generators can readily locate suitable outlets for the first scenario, and towns don't need to become involved. We may further distinguish between animal manure and food and fruit leftovers mostly utilized as animal feed or for fertilizer production under this category of pure urban organic waste. While goats are fed market scraps, animal excrement is the primary agricultural use of pure urban organic waste in the Kenyan capital. Both styles of use are widely used in Hyderabad. Nairobi does not utilise a lot of mixed urban organic waste from the municipal garbage stream for (peri-) urban farming. Farmers in Hyderabad did have a history of employing decomposed material from mixed municipal solid waste, but in the last five years, it appears to have lost some of its appeal. At least in the region covered by our research, many farmers have stopped utilizing this sort of municipal organic waste on their fields due to the growing negative impacts health risks for people and animals, worker obstruction, poorer yields due to soil contamination. Furthermore, the transportation expenses for this specific low-quality agricultural resource quickly become unaffordable, indicating a very confined and hence constrained demand.

The absence of waste separation is the main issue preventing greater use of municipal organic waste in and around the two cities. This disadvantage has been worse over time due to rising levels of waste contamination more hazardous compounds entering the waste stream, more non-biodegradable components. This issue also pertains to composting initiatives, which are now dominated by small-scale units in both cities. Compost of high quality is challenging to produce. It relies on the availability of a sufficient supply of uncontaminated feedstock in addition to the necessary technical expertise and resources. However, not all composting facilities are successful in gaining enough access to pure organic material. This is problematic for neighborhood composting systems, which rely on community garbage collecting activities rather than the cleaner supply provided by bulk producers such markets and food processing facilities.

Compost was employed mostly in niche markets non-food crops, particularly floriculture and mushroom growing where it may effectively compete with artificial fertilizers in both cities. The main cause of this is that the majority of local farmers either have suitable substitutes (particularly manure) or cannot afford the goods (small and marginal farmers). Additionally, it seemed that farmers in both cities lacked enough information about compost's potential as a fertilizer and soil conditioner, and as a result, about what a reasonable price would be for them to pay. It's important to remember that the majority of composting operations take place in modest neighborhood businesses that lack the necessary marketing and promotion resources to properly tap into the market's potential. The development of the composting industry is further hampered by a lack of support and attention from the government. Even the more sophisticated vermicomposting plant in Hyderabad, which operates in several neighborhoods, is now an unproductive venture. Both cities' activities significantly relied on donor finance, not only to pay for initial investments but often also to keep firms operating. The creation of employment and training opportunities for a group of disadvantaged people, increased community awareness of solid waste problems, etc. may partially justify this, but the long-term viability of these schemes is not guaranteed as external support is likely to be phased out. The continuity issue in Hyderabad was made worse by the unfavorable attitudes of the nearby people who complained about vermin and odor during communal composting experiments [4]–[6].

3. Reuse and diversion of organic waste: system concerns

In Nairobi and Hyderabad, there has been little overall success in lowering the amount of mixed municipal garbage being dumped at landfills via reuse and diversion of urban organic waste from homes. The prospect of development in this area is minimal without a deliberate strategy toward source-level waste separation. The two cities lack a system of incentives that would incentivize homeowners to engage in source separation, such as differentiating collection fees for mixed and separated garbage. They are also unable to educate people about the benefits such programs have on the environment. This is simply another example of how poorly the SWM system is integrated and coordinated. However, responsible city authorities have not yet adopted a more comprehensive perspective that would enable a balancing of brown and green agenda issues at the local level. Potential savings in collection and disposal costs could be used (partially) to subsidize waste separation, reuse, and composting schemes. An underestimation of the potential savings from reducing waste volumes results from the current bias towards service efficiency and effectiveness at

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the expense of long-term environmental concerns. This makes systems of solid waste disposal artificially cheap (especially due to the practice of open dumping). Therefore, it appears less probable that cities will want to support programs that help reduce garbage. However, as big cities in India are now compelled to divert organic waste from landfills via composting and other methods, they will have to deal with the challenges of managing organic waste. Smaller cities and other nations will be able to learn from India's achievements and failings in the next years.

DISCUSSION

Partnerships, Governance, and Social Capital

The study project included a number of topics that are controversial in both academic and policy circles. The findings allow us to emphasize or clarify a number of these concepts, particularly three closely related ideas: partnerships, social capital, and (environmental) governance. Numerous SWM system operations in Nairobi and Hyderabad are built around collaborations. These arrangements' nature might vary depending on the task at hand. Even while an activity may have significant externalities in terms of environmental health, the decrease of waste flows, or social legitimacy, it is often organized on a purely commercial basis, such as the trading in recyclables. On the other end of the spectrum are operations like street sweeping or the ultimate disposal of leftover garbage that fall under the category of exclusively community commodities for which there is no market. In such case, the public sector often assumes primary responsibility for both organizing and funding its delivery. It goes without saying that a partnership's fundamental direction affects how different interests are balanced. But what sets partnerships apart from just business-related interactions is that they either directly or indirectly serve the public interest (Gonzalez et al., 2000; Baud et al., 2001). What safeguards have been put in place to protect the public interest within different forms of partnerships is thus a crucial topic. This often prompts writers to assert that under partnership agreements, at least one partner should be publicly known (Peters, 1998).

There is an evident bias in the literature in favor of partnerships that have been organized top-down by the government. Their growth may be attributed to fresh interpretations of local administration and public management (in urban settings), which are predicated on the notion that each actor has unique comparative advantages. The primary difficulty is to determine the optimal combination of capabilities since it is assumed that using these potentials would serve the common purpose the best. The public sector is always the main participant in these agreements. However, partnerships may also form from the ground up as a result of group efforts, such as those made by CBOs involved in garbage collection, recycling, and reuse. Collective action is the organization of housing, essential services, jobs, and security by local communities themselves, frequently against great odds and without any help from the government (Baud, 2000; Mitlin, 2001). Communities may make a lot of improvements to their living and working conditions on their own, but many of these efforts need forming partnerships with outside actors who can provide crucial supplementary resources (Lee, 1998). Our research on SWM in Nairobi and Hyderabad has amply shown the relevance of such partnerships and the necessity to take them into account in addition to public-private partnerships. In the study that follows, we'll consider a number of variables that contribute to discrepancies in the kinds and modes of operation of SWM partnerships between the two cities under consideration.

Although the governments of Kenya and India have started along the path of economic liberalization and deregulation with the intention of handing over traditional state tasks to the private sector, the reality is considerably different. Kenya's government is experiencing a crisis of legitimacy. It is often charged with corruption and poor administration, and is essentially unable to fulfill basic duties for the public good. Actors in the private and civic sectors are hesitant to collaborate with such an unworthy counterpart. The Nairobi instance demonstrates the absence of a crucial element needed for effective public-private partnership (Evans, 1996; Ostrom, 1996; Mwangi, 2001). Mutual trust standards that serve as the foundation for maximizing synergy potential are not developed. Private operators make an effort to avoid engaging with the government and their agents, and when they are forced to (to acquire a business license, to gain access to the dump site, etc.), they make an effort to do so informally. Similar to this, locals are looking for alternate means of meeting their common needs since they no longer trust the authorities. Nairobi has seen a significant loss of the social capital necessary for effective state-society cooperation [7], [8].

One may also see some reluctance on the part of public and private players in Hyderabad to collaborate on the basis of confidence. While

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contractors believe the MCH is unnecessarily pressuring them due to the rigorous application of the deductions system and the rigid implementation of contracts, authorities have learned via the privatization of SWC to be continually vigilant to violations and misuse by contractors. However, the legality and dependability of the local state are practically never contested. A sense of mutual respect and trust is growing between a council that fulfills its financial commitments and successful private contractors. Furthermore, the MCH provided financial and logistical assistance for the program in addition to accepting the VGDS as an addition to its own standard SWC service. To enhance social capital, the social foundation of governance, in Hyderabad, both public and private actors are working toward this end (Stoker, 1998).

This does not imply that in the Indian context, the shift to governance from public control to power sharing in common affairs comes naturally. In reality, in both of the communities under study, there are still issues with governmental commitment to the concept of partnership. Additionally, the administrative structure and culture (attitudes, working methods), which call for more transparent and inclusive planning and policy-making processes, are still not well suited to the notion of collaborating across the public-private divide. Although there is a lot of pressure on Nairobi's authorities to form partnerships, such as via the internationally funded Nairobi Urban Slum Development Project, the majority of government officials and staff still have unfavorable opinions. The old elite is still reluctant to change the power structure, and authoritarianism still permeates the political atmosphere. Because of this, there aren't many people who really commit to the concept of partnerships; those who do tend to be driven more by a desire to access foreign capital than by a sincere conviction in the advantages of doing so. The private-private partnerships that came up in the city have jointly built "regulatory rules" and market-efficiency themselves in the lack of a regulatory framework for partnering. Conflicts and a lack of trust between the businesses demonstrate how complex this process is and how much may go wrong.

In Hyderabad, there is still considerable political and administrative hostility to shifting long-standing public sector tasks to the private sector or civil society. Reforms that challenge the state's dominant position are implemented slowly due to the history of state-led growth in the nation and the socialist ideologies ingrained in many of its key organizations political parties, labor unions. This is shown by the institutional reform's considerable path dependency, or the difficulty in changing not just the official rules and regulations but also the mindset and capabilities of people in charge of carrying them out. The partnership concept may be gradually gaining traction in Hyderabad, but the government has made it plain that it wants to maintain control over the situation. The public sector's ability to effectively play its part in partnership arrangements must also be taken into consideration. It is often said that for privatization to be successful, the "guiding hand of the state" is necessary.

When duties are transferred to the private sector, protections 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. Local government entities must fundamentally restructure and refocus their administrative machinery with a considerably greater emphasis on contract management and performance monitoring as a result of the shift from direct providing to coordinating and overseeing private delivery. The whole regulatory structure must also be changed to accommodate the new job and responsibility division. These prerequisites are undoubtedly not met in Nairobi, hence there is no suitable governmental foundation for the development of partnerships with the private sector.

The municipal government in Hyderabad is significantly more capable and well-equipped to carry out its supervisory duties effectively. Despite the fact that the first steps on the privatization track had mixed outcomes, the local body soon learnt from its errors and modified its function. The government has established conditions that allow private businesses to function successfully and efficiently. However, their urge to maintain order also suggests that private partners' freedom of movement is severely restricted. From a different angle, the relative strength or weakness of the public partner is equally significant. The ability of each partner to negotiate on its own behalf and make decisions without consulting with other authorities is a key feature of partnerships. The NCC's inability to serve as a primary is a significant obstacle in the Kenyan capital. The NCC is ineligible in this regard because to its ongoing financial difficulties caused by Kenya's inadequate local government system and its tense relationship with the federal government. On the other hand, the MCH is a strong partner since it is

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adequately solvent and autonomous. Therefore, for individuals seeking to interact with the MCH, there is very little ambiguity [9]–[11].

The private, commercial, and community sectors must meet the same qualifications as the governmental sector to become partners. According to complementarity, one of the prerequisites for partnerships, each participant must offer something to the table that the others lack or could only give at prohibitive expense. The first issue is that, while potential may exist, it goes unnoticed by the authorities. The authorities often show hesitation, for instance, when it comes to dealing with many informal operators such rubbish pickers. This aversion is partly caused by anticipated transaction expenses. The fact that these activities are evasive, however, makes it difficult to implement effective punishments in cases of malpractice and is at conflict with the enforcement of laws and regulations including sanitary codes and health standards.

Official views toward these endeavors continue to be disproportionately unfavorable, particularly when they pertain to the waste sector's least formalized operations, which are demonized in society as filthy, sick, chaotic, and unlawful. In the two cities under study, there is now zero cooperation of any kind between small private recycling businesses, rubbish pickers, dealers, and local authorities. There is a lot of hostility and avoidance in this relationship. This is unfortunate since collaboration may result in better outcomes by raising resource recovery rates and providing garbage pickers, itinerant buyers, and dealers with higher-paying, safer job opportunities. There is no evidence from other sources to show that there are ways to build partnerships, and the case studies do not reveal how to bridge this gap. Nevertheless, it is nevertheless crucial to look into this matter further in light of environmental concerns.

Both cities have well-established (commercial) collaborations within the inorganic waste recycling commodity chains, however those in India typically have been around for longer. By ensuring the consistency and continuity of the economic activities undertaken, they help to increase social capital. Additionally, they provide significant unofficial forms of social security via the loans that dealers grant to pickers and traveling purchasers. Despite the fact that neither city's labor laws provide protection for the jobs generated by these commodity chains, efforts may be made to improve safety and health conditions rather than restricting the private sector in a manner that encourages company owners to close their doors. CBOs are not always seen by local governments as possible partners, despite the excitement among many academics and policy-makers about the possibilities of community engagement in urban governance and environmental management.

Although there are numerous instances of community action in SWM in our two cases, as well as numerous benefits of community involvement (participation in clean-ups, organizing for political pressure, and community-based projects giving unemployed youth work), most of the time it concerns one-time initiatives or actions that are strictly confined to neighborhood level or both. It's challenging to connect with the local authorities. Nairobi's "collaboration" with CBOs is limited to putting up with sporadic cleanup operations and some foreign donor activity. The fact that many CBOs operate in unrecognized slums and that their solutions don't always adhere to current standards are significant obstacles. Official sentiments seem to be a little more favorable in Hyderabad. Through its Voluntary Garbage Disposal Scheme, which also indirectly connected them to a sizable number of garbage pickers, the MCH was eager to work with CBOs in the neighborhood. However, the assistance was not only one-time in the form of a free trike, but also had a middle-class slant. Only donor activity allowed the VGDS to be deployed in the slum regions. Our results support judgments made elsewhere on the complex interactions between CBOs and municipal governments in urban environmental management. The local authorities' lack of cooperation within the SWM system, particularly their preference for effective and efficient garbage collection over recycling and reuse, is likely a contributing factor. Collaboration with the community and the unofficial private sector would presumably be given more prominence if more focus were placed on the latter characteristics.

The power of collective action shouldn't, however, be overstated. Our two examples demonstrate how often such action relies on NGO backing and/or the dedication of underpaid labor, both of which are uncertain (non-structural) components. This was especially true of both cities' community composting programs. The degree of organization that citizens and businesses have in engaging with the government influences their relative power in doing so (Schenk, Baud, and Bhuvaneshwari, 1998). In our research, self-employed small- or micro-business units make up the majority of the private sector collecting companies, and none of them have the authority to exert pressure on the

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government. The degree of organization among collecting businesses was higher in Hyderabad than it was in Nairobi. As a consequence, it was easier to challenge the authorities or negotiate with them by making demands as compared to the tactic of manipulating bids previous to the establishment of the unit system. Similar to this, very well-organized middle-class communities were able to get government backing via the VGDS for enhancing the service in their localities. The lack of any entrepreneur interest organization in Nairobi contributes to the lack of bylaws that have been created to support privatized collection services. In order to exert pressure on governments to become more responsible and responsive, networking among local organizations seems to be a viable strategy. Fostering various types of social capital may make authorities more trustworthy partners or actors.

The Trade-Offs For More Sustainable Solid Waste Management

In contrast to what is often provided in the area of urban planning and management, this research was created to provide a more comprehensive understanding of the dynamics of the SWM system. It extends beyond concentrating on particular concerns like the privatization of SWC, garbage pickers' livelihoods, or the potential of composting organizations. The performance of SWM systems has also been qualitatively examined, going beyond the usual emphasis on either technical, financial, socio-economic, or environmental elements. This strategy is based on the integrated sustainable waste management concept created by WASTE researchers. It is clear that we could only partially fulfill the requirements of such an integrated approach, which is challenging because it not only incorporates the majority of stakeholders, solid waste sub-sectors, and aspects of sustainable development, but also aims to link it to other systems (like health, infrastructure, and scale levels) and to cover a range of scale levels. However, the research gives us the opportunity to remark on a number of crucial points of debate about how to improve SWM's sustainability.

First and foremost, the fragmentation of state responsibilities for the many areas covered (such as the sectoral foundation of government organization) prevents the SWM sector from making greater contributions to sustainable development. The implication of this is that demands for policy initiatives and measures combining environmental health, ecological, and socioeconomic issues are not always given priority. An option would be to coordinate efforts among government agencies, although this is notoriously hard to do in reality. Collection is mandated to local Public Health Departments, with a focus on public health in the traditional sense rather than on a more comprehensive agenda of environmental health. This situation is particularly challenging when integrating ecological concerns in current patterns of solid waste collection, transportation, and disposal. The formal responsibility for environmental concerns falls to provincial or federal ministries, who concentrate on large-scale (national or global) environmental challenges, often in the context of natural resource management. Although these agencies do pay some attention to urban environmental concerns, the focus is mostly on industrial pollutants.

This indicates that there is no explicit legal need for any level of government to minimize resource consumption by families and institutions while promoting trash separation, recycling, and reuse. However, it must be noted that the current SWM regulations in India make an effort to address this problem by giving local governments a more comprehensive mandate. The majority of current waste material recycling activities have financial justifications. Additionally, because many of these activities take place in informal settings, it is difficult to integrate them into any system in which the government is involved. The Departments of Economic Affairs, whose primary responsibility is financial regulation, and the Departments of Employment and Social Affairs, who enforce labor standards, are in charge of these activities when they are somewhat regulated. While the latter primarily focus on safety and health issues at the firm level as part of their mandate, the former are just starting to realize the importance of environmental regulation partly to satisfy requirements emerging from international agreements, partially to accommodate increasing pressures from national environmental movements.

All of these elements work against efforts to develop a more integrated SWM policy. This is especially true for the elements of sustainable development the green agenda that address ecological sustainability. The process requirements outlined by Satterthwaite and McGranahan (2000) to reconcile the green and brown agenda include a widespread use of open and participatory methods of designing environmental policies, national policies and guidelines that support urban development, and a solid understanding of the state of the environment. These requirements are necessary to promote such an integrated policy. The contradiction between scale levels for which a

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mandate is granted, which limits the integration of various components of sustainable development, is a second, related problem. It is sometimes necessary to involve a larger area than just the city in order to encourage resource reuse and recycling, ideally a regional or even national context. If the environmental effects of garbage disposal on the ability of local and regional sinks to absorb waste are to get proper consideration, this is also essential. It means the need for the creation of a new regulatory framework that transcends the concept of the single city and necessitates local government involvement in at least activity coordination with neighboring or higher level authorities.

Thirdly, the division of domains causes variations in the amount of resource and material recycling. Macroeconomic factors have an impact on the relative costs of local and imported resources and materials. For example, there won't be a significant market for resources recovered from trash if domestic used materials are priced at a level or below that of imported virgin materials. Although little is now understood about the macroeconomic setting of material price, this is a crucial subject for more study. Conflicts in funding various parts of sustainable development in SWM are a final problem. It is almost difficult to evenly distribute expenses across all integrated SWM objectives and to assign a precise cost to each of them. Typically, only two parties provide financial support for SWM: local governments (sometimes with the aid of funds from the center) and waste producers. Although cost recovery may be utilized as a technique to boost financial sustainability via service charges, it is doubtful that the whole cost can be recovered in an urban setting with many low-income residents. Although many low-income citizens cannot be paid for the services they use, disregarding them will have serious negative impacts on both the general health of the public and the sustainability of the environment. Therefore, in order to fulfill its statutory duty to provide proper collection services and to maintain public health standards, the local government will have to accept the need of subsidizing the system from general funds. However, they are often forced to make concessions on equity and total coverage issues at the cost of those living in slums, spontaneous settlements, or unplanned communities with detrimental knock-on repercussions for serviced regions. Additionally, due to environmental concerns, they won't be eager to invest in technologies for improved waste separation and recycling. As a result, different priorities in integrated SWM are disregarded. This issue may be further illustrated by the experiences with the privatization of solid waste collection in Nairobi and Hyderabad. Since private contractors often do not do waste separation, the downside of privatization is that environmental problems are not yet addressed in the rules for private collection businesses. Gains in efficiency and effectiveness in waste collection due to privatization consequently lead to an increase in the amount of waste offered for final disposal, which lowers environmental sustainability (i.e., waste that could have been diverted if promotion of recycling and reuse had been included in the agreement). But neither the cost nor the responsibility for this loss is laid on anyone's doorstep.

Areas For Future Research And Action

The investigations have identified a number of topics that need more study, both to investigate the analytical problems and to look into potential avenues for practice improvement. How the "waste management hierarchy" and concepts of integrated sustainable waste management might obtain greater awareness and acceptance by governments (both local and national) in developing nations is a significant subject for future investigation. The question entails both further research into how research findings can be more successfully incorporated into administrative and policymaking processes as well as the role of research in analyzing the trade-offs inherent in the multiple goals of an approach integrating socioeconomic and environmental aspects in SWM. The latter is a topic that has been discussed elsewhere in broader terms, but it is applicable to urban basic services as well. The promotion of partnerships and the "up-scaling of partnerships" as well as the circumstances necessary to do so successfully constitute a second crucial topic. Although the study has highlighted some of these potentials, further comparative research is still needed to fully understand the many circumstances in which the informal trash recovery industry has been successful in forging partnerships. It is important to look more into the topic of three-way collaborations, in which NGOs may and often do operate as a bridge between local governments and groups of individuals engaged in unofficial or illegal business.

Finally, future research must examine ways to strengthen the connections between urban SWM issues and the area where the city is situated. Such connections span a number of domains. They might affect the regulatory environment, which compel local governments to coordinate acts with

environmental effects that extend beyond municipal limits. Additionally, it addresses the connections with the surrounding area that are necessary to support composting and waste reuse in collaboration with rural farmers, as well as the drawbacks of employing urban organic waste in peri-urban agriculture and how to mitigate them. Future research on the fluxes of different waste products within and across nations may help us better comprehend integrated sustainable waste management.

CONCLUSION

For sustainable waste management systems, managing organic waste poses considerable issues. However, the recycling and redirection of organic waste provide interesting options that may solve issues in the areas of the environment, society, and the economy. Composting, anaerobic digestion, and bioenergy generation are a few techniques and technologies that have been identified in this research as viable ways to reuse and divert organic waste. By putting these tactics into practice, society may gain a number of advantages, such as decreased greenhouse gas emissions, resource conservation, and the development of a circular economy. However, a thorough strategy is necessary for the effective implementation of reuse and diversion tactics. In order to guarantee that garbage is properly segregated at the source, it is necessary to build a strong infrastructure that can handle organic waste effectively, supporting regulations that promote waste separation and recycling, and public engagement. To fully realize the promise of these methods, cooperation among numerous stakeholders, including governments, businesses, and communities, is crucial. We can work towards a more sustainable and resource-efficient future by embracing the reuse and diversion of organic waste. This change would not only lessen the negative environmental effects of organic waste but also open up new possibilities for producing renewable energy, improving soil fertility, and promoting a circular economy.

REFERENCES:

[1] S. Sakai *et al.*, "World trends in municipal solid waste management," *Waste Management*. 1996. doi: 10.1016/S0956-053X(96)00106-7.

[2] D. Spuhler, A. Scheidegger, and M. Maurer, "Comparative analysis of sanitation systems for resource recovery: Influence of configurations and single technology components," *Water Res.*, 2020, doi: 10.1016/j.watres.2020.116281.

[3] P. Sullivan, "the Importance of Landfill Gas Capture and Utilization in the U . S .," *Comp. Gen. Pharmacol.*, 2010.

[4] S. C. J. M. S. S. Kumar, "Wastewater Treatment and Reuse: Sustainability Options," *Cons. J. Sustain. Dev.*, 2013.

[5] O. . Agbede *et al.*, "Anaerobic Conversion of Biodegradable Municipal Solid Waste to Biogas: A Review," *LAUTECH J. Civ. Environ. Stud.*, 2019, doi: 10.36108/laujoces/9102/20(0230).

[6] N. M. Power and J. D. Murphy, "Composting of biodegradable municipal waste in Ireland," *WIT Trans. Ecol. Environ.*, 2006, doi: 10.2495/WM060331.

[7] A. Curtis, P. S. Phillips, and T. Tudor, "Driving sustainable waste management in Northern ireland-home composting of 'green garden waste' in Castlereagh," *J. Solid Waste Technol. Manag.*, 2009, doi: 10.5276/JSWTM.2009.191.

[8] K. D. Best and L. A. Lundberg, "Regional biosolids recycling with negative carbon power oxidation," in *Proceedings of the Air and Waste Management Association's Annual Conference and Exhibition, AWMA*, 2017.

[9] I. Oncioiu, S. Căpuşneanu, D. I. Topor, M. Petrescu, A. G. Petrescu, and M. I. Toader, "The effective management of organic waste policy in albania," *Energies*, 2020, doi: 10.3390/en13164217.

[10] L. Alibardi *et al.*, "Organic waste biorefineries: Looking towards implementation," *Waste Management*. 2020. doi: 10.1016/j.wasman.2020.07.010.

[11] T. Chen, S. Zhang, and Z. Yuan, "Adoption of solid organic waste composting products: A critical review," *J. Clean. Prod.*, 2020, doi: 10.1016/j.jclepro.2020.122712.