Professor Kelly Mua Kingsly
PhD/MBA, MPA, CFA, CFI, PMP, ISO
Finance engineer (Forensic finance and audits)
(4) Professor Kelly M Kingsley | Harvard University - Academia.edu
blog:www.kellykingsly.com
My Papers:SSRN
https://www.linkedin.com/in/kelly-kingsley-ph-d-2a5a1416/

Exploring the Waste Problem in Africa: Transforming Untapped Resources into a Billion-Dollar Industry

1. Introduction

Waste generation in many African countries has increased with growing urban populations and increased production and consumption. At the same time, organisational and technological problems are a significant constraint to efficient and effective waste collection and disposal. The capacity to produce a broad spectrum of secondary materials, which could be used for industrial production and energy or resource recovery applications, has received little attention in much of Africa. However, bold experiments in self-reliance have demonstrated the potential of waste materials processing and provided initial guidance for designing sound and adaptive waste management strategies in developing countries.

It is shown that vast economic and environmental benefits are possible from integrated waste utilisation strategies. Developing and deploying small and medium-sized conversion and community-based collection and processing technologies are identified as strategic steps necessary to tap into the rich resource base of African cities. By mimicking natural ecosystem material flow, recycling technologies can be employed to convert all types of waste materials into valuable uses. Where waste residues are not readily recyclable, energy is recovered efficiently, reversing the costly and irreversible eco-flow. In a developing world context, this people-centred economic development is founded on the principle that by designing and managing cities as productive ecosystems, the profound economic powers of nature can be harnessed in a regenerative way.

1.1. Background and Significance of the Issue

The Global Partnership for Waste Management defines waste as a collective term for unwanted and leftover materials unrecognised as having a value that is unwanted and left over due to incomplete, incorrect, or inadequate actions in industries and society.' This description is dependent upon both perspective and time. It is a concept that is best understood in situ, in context, by looking at items discharged at industrial plants, streets on a Friday morning, bins waiting to be emptied, and uncontrolled dumpsites. A definition that will last longer is that waste is a loss of resources. It is an unwanted suspension in a given material flow, and, in this sense, it is undesirable in time and a specific place.

Waste is a significant problem in Africa. Millions of metric tons of solid waste are generated in Africa. Per capita waste generation points to an essential source of waste in urban areas. Significant waste management challenges in Africa inhibit waste collection from the street and its removal to landfill or incineration. These challenges include the lack of or limited capacity for collection and transfer, limited resources and capacity often failing to operate disposal facilities effectively, and the rapidly escalating number of underemployed or, in some cases, unemployed people who rely on removing nontoxic and recyclable waste wherever they find it to supplement inadequate incomes. These challenges are symptomatic of the need to change focus. On the one hand, raising the issue's profile and adjusting existing services to new demands is necessary. On the other hand, it is required that the approach to dealing with waste develops into one based on adding value to resources, embracing waste avoidance, reuse, recycling, composting, incineration, and landfilling of the residue.

2. Current State of Waste Management in Africa

Informal sector workers segregate and collect waste in most African countries, and they are called waste pickers. Officially, waste pickers look for and collect recyclable materials from what others discard. They are independent, and their earnings are derived from what is collected and sold. The absence of segregated streams at disposal facilities makes it impossible for the waste pickers to maximise the value they recover from the recyclables. These more lucrative items are commonly sold to intermediaries and local entrepreneurs or metal scrapyards, wholesalers, shopping centres, waste-to-energy plants, manufacturers, producers, construction companies, local informal collectors, processing entities, or

international buyers. The rest of their collected materials are resorted for sale to local brokers or bartered for food and other necessities. Since the informal sector often lacks capital in the form of money, informal and community-based trading can occur.

In most countries, there are no bills of lading to maintain order or international transportation documents to streamline goods movements by the informal sector. There is little long-term consistency in the type, availability, and quantity of materials collected. Sacks and sacks of unsorted mixed waste are randomly transported. These waste pickers often handle toxic compounds without any protection and have lower respiratory health problems, open injuries, intrinsic skin burns, and digestive diseases. Support in different forms is required to introduce universal healthcare insurance in all communities. Support could be offered in other approaches. These include the development of health and safety guides for waste pickers, ensuring low hygiene and sanitation facilities in landfills and waste processing areas in dumpsites to the degree of establishing separate areas for men and women in hazardous biodegradable and mixed waste, as well as groundwater contamination in situ landfills. In an attempt to do so, it is hoped that the environmental merits of the urban waste recycling industry will not be entirely offset.

2.1. Challenges and Impacts

Over the years, several global platforms have debated waste management challenges. Pioneering debates have become the pivotal issue of multilateral agreements and protocols, highlighting the intrinsic link between the environment and health. However, a statistical reflection of these sustainable development efforts shows the contrary, witnessing a 2:1 ratio of waste generated on average across the globe, implying that for every two parts of waste taken away from a highway, another part is dumped into the environment.

Despite being the fastest growing region in terms of urbanisation, the Sub-Saharan Africa region contributes the least to such waste generation. While several scholars agree that the ten fastest urbanising centres by 2025 will be within the area, statistics demonstrate that Africa Growth Enterprises cities contribute the least to world income. Furthermore, findings show the Sub-Saharan Africa region contributed only around 6% of the world's population in 2018, which seems to grow towards around 18% to 23% by 2050, calibrated with more significant

numbers of less developed regions. With the expected continuation of development trends, waste generation is likely to soar due to increased production of goods resulting from the growing purchasing power of the global developing populace.

3. Untapped Resources in African Waste

While waste represents a huge problem worldwide, it also offers enormous untapped opportunities for those who can unlock and convert it into value. This is especially true in the burgeoning continent of Africa, where many communities struggle to cope with the vast amounts of solid waste created daily. Much of the waste in African cities is organic: food scraps, garden and yard waste, and paper – about 50 to 60 per cent. This is a big problem because many African cities are also going through a construction boom, and more and more of their people are moving into swelling urban areas and rapidly embracing eating habits that are continental in size. African cities also tend to be landlocked, meaning that waste left to sit around will breed diseases and smell bad, and an unused landfill can be harmful. However, it also means that waste can be turned into resources sold to and used by others. That's an opportunity many Africans – and many others working on waste-to-wealth strategies for Africa's cities – are now waking up to.

3.1. Types and Quantities

To develop efficient and cost-effective solutions for waste management, it is essential to know the characteristics of the waste to be dealt with. This section sets out data on the types and quantities of waste in the main cities of African countries and their islands, including domestic and industrial waste categories. It shows significant differences in the state of the waste, whether within towns in the same country, between countries themselves, or between continents. Such differences will be substantial when designing appropriate waste management systems.

From an examination of waste content in cities of various countries and islands from the African continent, it is possible to assess the average characteristics of typical waste generation in Africa. A solid waste determination conducted in different cities using gravimetric composition data enabled the generation of four models for African countries and islands. The data support the development of waste management and bring valuable insight into the dynamics of waste generation. Significant differences could be found when waste composition in different continents or even the same country was compared. Many developing

countries export their waste, which becomes an environmental problem in another location, potentially misleading the real issue. For an efficient waste management system, improved characterisation is fundamental. This work will illuminate how diversified waste generation is in Africa, providing a deep understanding of the topic.

4. Economic Potential of Waste Management

Waste represents a nullity and disservice not only to the urban environment but also to national economies. The generation of excess waste indicates a clogged economic cycle, misapplication of technical skills, capital, and natural resources, and inefficient use of national incomes. Therefore, waste is like any money-making venture: the less generated, the better. It doesn't have to exist everywhere to be recognised as a potential source of value. Hence, good waste management is distinguished by insufficient materials that could have been recycled or reused. However, there lies enormous potential in ridding our cities of the mounds of filth - from waste itself to recycling, reusing, and recovery as energy - effective waste management will help improve local economies.

Waste management is necessary for public safety, convenience, and sanitation and is an essential and fundamental utility service for every sector in a city. The failure of significant cities in the developing world to keep waste off the streets at enormous costs is often symptomatic of weakness in both managerial and financial functions - they cannot afford to transport, transfer, and dispose of the significant amounts of waste accumulating from industrialisation and increased consumer power. However, the strong demand for the occupational and production needs served by transactions involving the Earth's material resources suggests that effective and remunerative waste management programs could flourish throughout the economy. It is not enough to design or innovate methods of efficiently removing these wastes - most of them can be money-makers in their own right. Why destroy them when you can make more money by charging a premium for removing them and converting them into new products or energy?

4.1. Case Studies and Success Stories

Currently, enterprises from across Africa work within the waste sector, with some having stand-alone waste management, recycling, or provision of related goods or services that are either the core or offshoot of their businesses. In this section, some of the successful women entrepreneurs are profiled. Some success stories in waste

recycling and handling have been significantly more energy-consuming than possible with the help of technology, tools, and business support from investors or funding agencies, in conjunction with enabling public policy and an increasingly enlightened general public. Without these enablers, these women's economic gain and experiences have hinged mainly on the prospect of struggling to feed their families and realising sole ownership of self-initiated income-generating projects.

The three case studies visited: Eco-Plastic, an enterprise from Ghana; The Safe Environment, an enterprise from Burkina Faso; and Solar Development, a Zambian-based international company. This privately owned enterprise runs an educational campaign. It is working with the waste collectors in Hohoe and its immediate environs to set up an accurate waste sorting and collection system that can identify the best source of plastics for the flaker unit, as well as amass a large enough quantity to make the costly investment in mechanical chipping worthwhile. If successful, this unit could have the potential for national replication, with a considerable economic and environmental impact.

5. Technological Innovations in Waste Management

This paper argues that with the emergence of technological innovations in waste management, African governments are better positioned to attract both local and foreign investments in the green industry. First, secondary data are analysed to highlight the role of technology in converting potential waste into a billion-dollar industry. With the economic relationship between a dirty environment and poor health established, the paper also highlights the government's position on the treatment proposition that allows them to access the market for pure water. The paper also discusses how African countries link environmental commercial activities to derive clean energy and invest in energy independence. Technological innovation plays a significant role in converting untapped waste resources into a million-dollar industry, thus enabling African countries to achieve various sustainable green objectives. The transformation of these resources also saves industries from potential shutdowns that might result from regulatory and institutional failures. The capacity of the waste sector to deliver inflammatory growth, attract capital inflows, and create jobs depends on the array of technological factors, including a skilled labour force, research-oriented universities, the availability of regular and sound capital markets, government tax

credits, and public utility incentives. Suppose the technology-driven capital inflows into the new sectors are regions that solve waste problems with sophisticated solutions and contribute to transforming untapped waste into a billion-dollar industry. In that case, the role of industry in nation-building is illustrative.

5.1. Opportunities and Advancements

The successful drive towards a resource revolution on the continent is highly promising for converting the appropriation of these untapped resources into a thriving billion-dollar resource cooperation process. Most importantly, this resource revolution has given a new meaning to "value for service" by potentially transforming the informal sectors that have been dependent upon recycling the most priceless and unrenewable resource of all time while advocating for increased efficiency in lifestyle and being a watchdog against the appallingly wasteful ways that arable land is mismanaged. Across the continent, a solid waste crisis is providing a goldmine for a new generation of investors who view solid waste not as a dangerous and shameful mess but as a lucrative commodity. They are driven not by altruism but by the brute force of a coalition of ambitious business operations with increased and burgeoning private interests pooling their capital to uncover and convert the waste potential in high-density, low-income urban communities.

In developing urban communities, private initiatives can process waste into inorganic materials after being easily separated at the source into reusable, valuable global materials. The most valued of these is high-quality, non-ferrous aluminium that can be produced into cans, siding, construction materials and fire-resistant items. After aluminium, steel is in high demand because it is too valuable to relegate to the ground. Glass can be used for containers and a range of valuable re-manufactured heavy products. Organic components can be separated and converted into high-quality composts, soil enhancers, and valuable methane gas in low-technology anaerobic digesters with the power to operate mechanical systems or produce electricity. Such opportunities and advancements give the developed world's international business communities the challenge to earn the trust of fresh generations of prospective customers and declare their interest in mining, agriculture, and metals trading partnerships.

6. Policy and Regulatory Frameworks

Policy guidelines in the waste management sector should have a viewpoint of being implementable and achievable. This is more so because there is gross non-compliance with policy measures in Africa for various reasons. Furthermore, the planning and implementation of policies should be emphasised in local governments that interface with the public. The realisation of policy goals and objectives impacts the cooperation of the populace and other stakeholders, hence the need for them to take a more active role in the policy initiatives. This will only happen in a decentralised system to avoid bottlenecks and a tendency to be more centralised.

The waste sector's challenges can be better addressed if the government takes the lead in policy formulation and implementation. This requires appropriate legal frameworks for decision-making. In many African countries, policies are outdated and fail to address fundamental issues. The lack of capacity to review policies or formulate new ones due to various constraints perpetuates the status quo. This is seen in the environment, where the erosion of the natural resource base is evident. Policy dialogue is non-existent among the technocrats and thematic experts. The majority of the countries in Africa are signatories to international environmental conventions, but this has not resulted in the domestication of international agreements. Domestication only occurs when a government can enforce such contracts, a rarity in Africa due to financial or other constraints.

6.1. National and Regional Strategies

When I think about which countries are the most severe and organised regarding their waste being a resource, I think of South Africa and Rwanda. South Africa has been progressing on this front for over 20 years. There are import restrictions in place, landfill taxes are a list of strategies promoted, and several organic waste recycling facilities are being established. The same can be said for Rwanda, which has a total ban on thin plastic retail bags. The lesson? It seems to be that African countries can be organised and put into place all the necessary legislation to manage waste. The challenge is that we haven't got to the point of seeing this as a business opportunity for everyone. A little further away on the African continent, Egypt, Tanzania, and Nigeria are also making significant strides. By far, the biggest movers are the countries of Northern Africa. The percentage of waste formally collected is over 80%, and they are well on their way to having a

functioning collection and dumping services in place. On the downside, from a regional perspective, only about 52% of the population in urban areas in Sub-Saharan Africa are fortunate enough to have their waste collected formally. The rest are serviced through inefficient and environmentally unsound practices. So, what are some successful strategies followed both on a national and regional level?

7. Sustainable and Circular Economy Approaches

Recently, the ideas of a circular economy have been eagerly embraced in building development policies that could be employed to process waste materials and eliminate waste in general. We often see examples of the most straightforward recovery of products sold or reprocessing of post-consumer or post-production recyclates mixed up with the principles of the circular economy. In this regard, understanding how practical and economically sound the development of the so-called circle-related technologies for reprocessing numerous very different planning solid industrial and, to a greater extent, consumer wastes is an acute issue.

The European approach substantiates the circular economy philosophy as a necessary response to the problem of uneven use of a limited quantity of natural materials, especially with their skyrocketing prices. As distinct from developed countries, the resource base problem in developing countries may have an opposite character. Plenty of natural resources are just partially used, and this is nothing but one of the driving elements of their national economy. Although the philosophy of the circular economy could also be considered universally applicable, its fundamental basics look otherwise inherent and sustainable in terms of their application and approach comprehensiveness in addressing the significant risks of industrialisation in developing countries.

7.1. Benefits and Best Practices

The benefits of engaging the informal sector in waste recycling are numerous. Employment creation is probably the most widely discussed benefit of integrating the informal sector into the collection, recycling, and production process. In many developing countries, slowly reviving economies are characterised by a little entrepreneurial spirit, resultant job sectors, no formal social security, and an expanding informality. The informal sector's collection, sorting, and repairing activities can involve a large share of the urban population. In some countries, public concerns about environmental problems grow faster than the market can

supply the necessary jobs to address the issue. Disposal sites are not always large employment generators, whereas a recycling centre has a higher job multiplier than the same-value product at the local incinerator or landfill.

Despite these general points, the benefits of engaging with the informal sector cannot be assumed. Private-sector companies and governments can take several proactive steps to optimise these potential gains and minimise the negative aspects of maintaining a robust informal sector. Most of these steps involve providing regulated entities, including local administration, cooperatives, non-governmental organisations, and even private entrepreneurs, with proper access to appropriate credit, technology, training, information, and markets. Companies can set up appropriate partnerships with the informal sector to optimise each side's production and gains, making available technical expertise; purchasing standardised, segregated refuse at fair market prices; offering credit terms, inventory systems, marketing information, and pooling of loads; and providing waste handling training sessions.

8. Social and Environmental Impacts

Municipal solid waste management in the African cities studied has social and environmental impacts that need to be managed to avoid impeding economic development and seriously affecting the quality of life of present and future city dwellers. The impacts include generating products such as recyclable materials, compost, and energy, effects on other economic sectors, more employment opportunities, health and environmental costs, and social actions with low-income people. Coordinating and integrating waste programs, both official and informal, along with the various other urban activities, particularly those involving people with low incomes, is complex and involves trade-offs with the time of implementation and operation of such waste programs and with the multiple other targets pursued by city, local, and national governments. However, the present study suggests that such issues and costs can be included in a comprehensive assessment of the costs of waste management and the involved trade-offs within the framework of sector and city development. Moreover, the benefits of integrating waste management programs and other sectors, along with the involvement of various agents, will tend to increase with economic growth and expand rapidly during the early stages of urban economic development, alongside the reduction and elimination of many trade-offs.

District, community, and faith-based organisations are increasingly involved in many African cities in providing primary services, collective goods, or safety nets in situations of second- or first-best provision. Such situations, along with increased availability and quality of professional expertise and management promoted by the private sector and donor contributions, can overcome the present levels of social protection instruments in sanitation, reduce costs and risks for responsible resettlements, and replace the dominant supply and demand of private informal operators with transparent, pragmatic, and accountable cooperative or private formal enterprises that meet a wide range of needs for local services based on flexible contracts, targeting low-income households with corresponding investments in upgrading of case management, capital, or designated sites and community health and sanitation. Local self-help is also an essential social strategy for achieving access to safe water and sanitation services, even in urban settings marked by informality and decentralisation of services' supply and contractual arrangement when included in such an intermediate level of waste collection and treatment.

8.1. Community Engagement and Empowerment

Communities and youth in Africa have an arsenal of powerful resources. They are creative, innovative, entrepreneurial, and have great potential that needs investment, encouragement, and nurturing. Transforming the burgeoning problem of waste in Africa into an industry that participants, communities, and governments can be proud of requires ground-up, locally-led, and locally-empowered solutions. In addressing youth unemployment and expanding income-earning opportunities for women in communities, waste value chain livelihoods have been of primary interest, as expressed directly by the communities.

The essential component of community engagement is critical to the introduction, implementation, and sustainability of many recycling schemes. They not only energise and activate the communities in which the programs operate; they ensure that all individuals understand the scheme and recognise its benefits to the community and the potential harm to the environment should it not receive full support. Such understanding includes recognising – and undertaking to support in various ways – the income generation role of informal community waste collectors. Handling waste for the betterment of the community is frequently seen

as unskilled and undesirable work by people outside of the informal waste collection community itself. Informal waste collectors often have to work with others' disdain for and avoid the unhygienic work that others outside the community level at the waste pickers' place.

9. Investment and Funding Opportunities

National governments and international donors are showing a growing interest in waste management as the sector matures into a professionally managed and increasingly profitable industry. This chapter presents the business environment that permits returns on investment to be generated in a socially good investment. Funding these growth models' scaling up and replication remains a crucial challenge. Local authorities have weak balance sheets and limited room for manoeuvring on tariff adjustments. There is no shortage of private entrepreneurs eager to invest in the sector, but the problem would be finding mechanisms to involve them. The size and nature of the capital needed are poorly understood, and a clear outline of successful investments needs to be drawn. Section 3 examines those businesses that are already profiting from the situation. The industry is going through essential changes reflecting these new dynamics. Some drivers of change are internal to the industry, while others stem from the external business environment.

9.1. Public-Private Partnerships

Effective waste management systems have been established through forging strategic partnerships between governments and the private sector, with community organisations providing services such as waste collection and recycling cooperatively with government-privatized waste management programs. Successful waste management contracts exist where communities, the private sector, and municipalities work together. Community organisations, mainly operating informally, manage most of the solid waste generated within urban centres in partnership with the private sector and municipalities. Most waste management companies collect waste generated at the household or customer level and transport it to locations to rehabilitate and recover recyclable materials. However, the vast majority of small, informal businesses that are involved in the recovery of recyclables and organic materials continue to be sidelined.

To address the problems related to the solid and organic waste generated in low and middle-income countries, promote successful models, and encourage further investment, the business of managing waste needs to transform from a highly informal industry to a formal, professional, and socially responsible one. This evolutionary process will likely involve strong partnerships between the government, the private sector, and community organisations, especially those that collect and recover recycling materials and the informal players involved in waste recovery. There are already several successful examples of solid waste management projects initiated and financed by various categories of players in the waste recovery business. The public-private partnership is a governance structure adopted by governments worldwide to meet the needs of their citizens and organisations, where service provision and infrastructure sustenance are all crucial factors for societal success. This section focuses on establishing successful public-private partnerships in solid waste management.

10. Capacity Building and Skills Development

Most of the activities in waste management systems are labour-intensive and, as a consequence, tend to be poorly remunerated. However, as a labour-intensive sector compared to capital-intensive industries, a unique characteristic of waste management is its potential capacity to generate direct and indirect employment. Direct employment is related to waste collection, transportation, treatment, recovery, recycling, final disposal, composting, biological treatment, and maceration. As waste collection can happen at any level in society, while recovery and recycling activities tend to increase marginalisation, they do not tend to value labour, tend to be low organisation and low qualification activities, and involve socio-environmental conflicts, mediating institutions, and regulations.

The need for standardised processes with the association of development through technical, economic, financial, and socio-environmental informality requires the valuation of labour in addition to qualification, potentially representing the inclusion of various actors – companies, organisations, cooperatives, associations, foundations, training centres, and business schools. Such an area as a labour-intensive sector is required to provide professional qualification, requalification, vocational training, and arrange adapted professional specialisations with updates on the complex dynamics, legal and executive aspects, operating in business management processes, communication, marketing, storage, and logistics. The

goal is to support economic and organisational development with scenarios that reveal and reverse social inequalities.

10.1. Training Programs and Educational Initiatives

The drive required to realise the benefits of biomass management is an essential strength. These benefits take time to accrue and may require as much as five years before they are fully recognised. Training programs and educational initiatives that meet the needs of low-income, less-educated dwellers of the peri-urban and rural areas are critical to developing and implementing sustainable waste-to-energy practices, projects, and banking carbon credits. Preparing thousands of young Africans for stimulating careers in waste management and biomass projects is not just a necessity but a beacon of hope for the future, needed to stem the rural-urban drift that marginalises thousands yearly.

The strategic plan for forests will need significant waste-to-energy contributions to meet many of its goals, including four of the six global forest goals. It is suggested as the designated institute to help create a billion-dollar industry based on converting the untapped resources that are the 'waste dumps' of Africa into forest and rural community savings bank accounts. Expanding the effort of government, intergovernmental organisations, consultants, and non-governmental organisations to build the capacity required to accomplish Africa's sustainable waste management, increased use of biomass, and the preservation of her bountiful forests can be one of the outstanding achievements of the twenty-first century.

11. Gender Perspectives in Waste Management

Introducing gender considerations into waste-related projects is an unavoidable imperative in development interventions today to enhance women's real opportunities in terms of assets and capabilities. We reviewed the primary sources to investigate the presence of gender viewpoints in waste management studies, identifying some existing gender considerations. Almost all the references mentioned dealt with some issues, interventions, or critical aspects of gender; most of the references focused on environmental dimensions, sustainability, or activities. The ultimate aim of this work was to develop gender-oriented tools to guide processes for the design, implementation, management, sustainability, and monitoring of waste-related interventions. We contributed to focus on the more gender-sensitive part of what has increasingly become, in many countries, a

billion-dollar industry. We utilised our effort for an academic course encouraging students and young graduates from all degrees to acquire general competencies and specific skills in Participatory Development and Tools for Project Cycle Management. We designed an international Master's program in coordination with academics from countries characterised by different levels of participation and capabilities of men and women.

This study was part of an ongoing project to improve technical innovation and governance in solid waste management. The issue of gender equality involves factors that contribute to the reproductive function of women both within their homes and within society. These factors have a direct or indirect relationship with food, health, water, air, sanitation, etc., all issues related to environmental and waste problems. These problems also foster poverty, limiting the access of vulnerable groups in society to opportunities for income generation and social, political, and economic empowerment. The empowerment of women, coupled with the proper modelling of waste management, could enhance visible physical and social orders. In many countries, women are the leading waste pickers, sorting rags, rubbish, etc., from waste that can be recycled, repaired, and reused. They represent the most critical link in the chain of scavenger collection services. In a broader context, women could profoundly influence the structure of society because they decide the models for the nourishment of the body and spirit of future generations.

11.1. Women's Role and Inclusion

There are specific roles for women in the waste sector at the middle and end stages of the activities, including collection, sorting, and trading, as well as in the production of secondary products. Women and female children naturally assume these roles over time as they contribute to adequately managing the household's micro-waste stream. They naturally assume these roles due to the peculiar nurturing skills vested in them. In most African communities, women contribute significantly to generating nutrition through crop cultivation in the micro-gardens, which directly depends on wastewater. Therefore, it is necessary to recognise the contribution and dependence of waste management in developing cities' water infrastructure and urban agriculture.

Inclusion is essential. Women should be better assisted in performing their daily activities. For example, women should adhere to cultural gender roles that prevent

young women from removing food remains from the table during festivities. Moreover, comfortable collection transport given to women, brokering agreements, and creating a crisis fund to purchase household goods ensure the financial solvency of the entire family. Policy prescriptions can lead to more comprehensive state and peacebuilding. Such prescriptions can form part of the peace agenda in various countries. Proper and formal consultation of a sustainable human settlement outcome should include women's roles in the solid waste chain.

12. Cross-Sector Collaboration and Synergies

Collaboration occurs in unplanned sectoral, spatial, and time overlaps at specific places and times. Countries benefit from industry agglomerations not just because they reflect shared government policies, labour, and skills but also because they benefit from supporting industries, which, in turn, offer cost savings and efficiencies locally and globally. Any sector losing the potential to expand contributes to the multiplier effect in reverse for the present or future industries. Instead of seeing waste sector opportunities as purely or short economic transactions, researchers and policymakers need to consider the existence of these creative interactions over time, which depend on both the adaptation of markets and on the public sector fostering a critical mass of related activities while also nudging within the aggregated environment. Knowledge clusters are developing on urban resilience, reversing the depletion of natural resources, and the quest for available renewable energy.

Often required is improving and intensifying a myriad of cross-scale and sector interactions at national and international arenas where the local thrusts are much rooted in a 'can do' mentality developed on the street. A series of global and national meetings on innovative issues are already stimulating what in the past have become cross-cutting outcomes, often in surprise occurring at the pace of leisurely hiking. A stronger focus on linking waste with the main drivers of urban economies, building crafts based on metabolising, and adding complexity to these collaborations around a regional, national, and international public policy framework dedicated to inducing, supporting, and connecting should be the new general trajectory for the public sector tasked with stimulating the needed transformations of the current wastebasket societies of the 21st-century cities.

12.1. Industry Partnerships and Collaboration

Chapter 10 argues that no institution can solve the problem of economic opportunities from waste. In the preceding chapters, we argued that collaboration and partnership with the private sector, along with a recognition by the government of the legitimate role and contribution of the informal waste sub-economy and some degree of innovation, perhaps through pilot projects, would be much more beneficial and effective. We are therefore encouraged by the advent of the partnership and the ongoing discussions in its development to buy into our arguments. We are further encouraged by the fact that this partnership also focuses on other areas that greatly need emphasis: energy and water. This chapter will discuss the many interventions that may precede the advent of such cross-cutting interventions, but that must eventually give way to the desired top-down approaches. Cross-collaborative partnerships, deliberate policy choices, and bargaining for a "seat at the table."

When the Minister of Energy called on Eskom to look at ways of using the waste from suppliers in their production processes, he was indicating a policy choice that could be far-reaching in its contribution to the independence and effectiveness of the security of energy provision, besides making the waste dilemma a reality for companies in the business of supplying coal. Experience with the waste function shows that collaboration provides for less fractious relations and the development of commercially viable incentives to participate. The first level of cooperation is vertical and includes working with players at different stages but in the same "product chain," so to speak, such as composting. Companies that produce large enough quantities of organic waste may consider installing their composting plants. Then, all waste needs to be considered through the introduction of planning controls and waste taxation on organic waste that is not handled in this manner.

13. International Cooperation and Knowledge Exchange

The challenges faced by African urban areas are similar, and joint initiatives to seek out, identify, and exchange experiences can answer the critical question of what to do with the growing quantities of waste produced in people's homes and businesses. Exploiting new economic opportunities through waste recycling as domestic markets grow and diversify is encouraging the growth of local enterprises in highly labour-intensive activities such as collection, sorting, material

upgrading, and small business growth. Governments have a significant stake in these developments; small-scale waste recycling enterprises can help meet urban development goals, and many are contributors to what is possible with the most modest investments to step up collection services. Street cleaning lessons are vital to burgeoning populations as they undertake the complex process of setting up in a newly urban environment. Groups of informally employed street cleaners in refuse disposal, often part of a private enterprise service, are responsible for the sites of all cities and identify areas where on-site segregation and composting may reduce costs. Joint initiatives to seek out, identify, and exchange experiences can answer critical questions as people build and grow economic activities in closely recognised waste recycling levels. Governments have an essential role in market development that has helped shape these activities; each city or town can help formalise the political tradition that converts the informal waste collection sector into a growing business income. The expected benefits are a dedicated group of employees engaged in improving the cleanliness of the urban environment. City awareness campaigns involve those indispensable people who risk stigmatisation and have generated image-building activities to increase social status. International knowledge exchange will inform the context of this practical knowledge essential to evolve leading practices in the collection, disposal, energy recovery, and recycling of domestic waste. Finally, data on specific waste-producer behaviours of the urban poor do not support analyses that may disturb the adoption of waste management systems.

13.1. Lessons from Global Initiatives

We can learn several lessons from global initiatives' successes and failures before proposing possible solutions for Africa, and this is what this section attempts to do. We have already seen that China's initiative provides low- and high-road scenarios. The low road scenario perpetuates the unsustainable pollution and environmental devastation mainly associated with waste exportation. The high-road scenario, however, could easily break this unsustainable tradition. Here, the dilemma is whether we promote multinational corporations with solid Western sentiments and weak environmental responsibilities or an autocratic model, where recycling companies have little or no ecological responsibilities with strict labour laws. The highest investor in Africa is currently exporting technologies like recycling, and adopting the world's most significant capitalist model translates into adopting this model.

The low road scenario can easily dominate, imparting even higher levels of risk on Africa's citizens who earn their daily bread from arguably the most significant sector of the informal economy, as Asia currently does, or else we can adopt the high road scenario where aggressive new laws on the use of environmentally friendly and safer materials and extension of the producer's responsibility mandate are enforced. Significantly, studies have provided comprehensive assessments of the recycling industry, informing policy recommendations and exploring future research that initially focused on sustainable design and harmful product substances.

14. Media and Public Awareness Campaigns

Liberal use should be made of the various communication resources to highlight the urgency of the waste dilemma and sensitise the populace on the importance and potential benefits of their greater involvement at the personal and community level to get first abreast of the problem and after that, cooperate with government and other agencies to ensure that the proposed recycler-oriented activities take off effectively. Ever present, though it seems, the population often regards waste as an existential or invisible issue. Thus, it becomes obligatory for the government, the donor community, the private sector, and various religious and civil organisations to devote considerable resources to educating the populace on the urgent attention needed in waste handling and management.

There is much truth in the adage 'seeing is believing,' and solid-waste disposal sites and a procession of dumps must be made more of the urban cultural scene. In addition, the problems that stem from waste accumulation should be the focus of more questioning interviews and well-spaced commercials by distinguished Nigerians. Lamentations of the early 70s question, 'What will we eat?' When conducted by a well-known personality, the English translation of a West African distiller's question in one of its adverts has transformed businesses in Nigeria. In assessing the feasibility of the modest proposal mentioned in this report, support pricing and awareness generation could be persuasive small-budget media tools.

14.1. Communication Strategies

Our communication activities will partner with governments, the private sector, and community organisations to address and resolve environmental change issues and clarify our mission and goals to significant actors and stakeholders, including key investment groups, at every opportunity. It is important to stress the

immediate and long-term opportunities and results of establishing waste treatment, collection, and recycling firms, which offer a much-needed bridge between economic and social development and environmental improvement in Africa. We will sponsor and create professional communications events, such as Waste Treatment and Recycling Week, that provide opportunities for corporations to showcase new technologies and services and for end-users to see solutions to environmental problems. We will also develop high-impact direct mail initiatives that link educational and business purposes, such as a flyer to be sent to presidents of large corporations to educate them about improving waste treatment, management, and recycling. We will also invest in unique newsletters and alerts relating to critical issues and insights regarding community activities, special corporate meetings with key customers, and operational solutions to take advantage of upcoming events and information opportunities that could be missed unless money is devoted to follow-up and make plans.

15. Future Trends and Emerging Technologies

It is difficult to predict the future, particularly in a rapidly changing scenario in Africa. However, in terms of alternative ways of achieving a zero-waste society, it is widely recognised that end-of-pipe solutions are costly and unsustainable in the developing world. It is also recognised that inappropriate technology has often resulted in waste management treatments that are both complex and expensive. Technologies that reflect societal development, such as cleaner production and sustainability, have far-reaching implications for everyone and are likely to become synonymous with wealth. Furthermore, over the past 20 years, the harmful substances associated with industrial waste streams have been a continual, progressive reduction. Concisely, the future of waste management in Africa is more likely to see the separation and recovery of valuable resources from waste rather than employing traditional end-of-pipe solutions alone. Consequently, new emerging technology and environmental protocols that result in recovering nontoxic resources from waste could evolve rapidly in the African competitive market. As a result, a new generation of business activists is focusing on the environment and assisting Africa in leveraging its industrial systems and resources to help sustain future products and technology. Indeed, in the knowledge-based society of the 21st century, experience from the mining and oil industries suggests that African countries have the opportunity to benefit. Mining and mineral extraction and agricultural and waste processing can significantly

increase demand for waste recycling and recovery services. Analysis suggests a projected value of the environmental sector, particularly the recycling sector of renewable resources, could be up to 20% of the GDP due to global changes within the next ten years.

15.1. Predictions and Innovations

The problems of waste, climate change, and minimised resources won't disappear overnight. But there is one certainty—I believe the waste industry will one day be worth billions. Additionally, we can predict by 2030 that the investment in plastic recycling equipment will reap five-fold benefits in plastic recycling infrastructure. It is also predicted that Nigeria, being a country with sizeable disused factory sites and decommissioned refineries, will have privatised those facilities to regional recycling hubs that are equipped with the latest machinery to reclaim plastics that would then be used to meet some of the growing domestic plastic needs.

We predict business-as-usual plans to build materials recovery facilities, as would Rwanda, introducing policies to reduce the amount of plastic produced in the first place through a ban on non-bio-based, non-compostable plastics. Other transformations that will drive the redirection away from mobilisation standing still are that a massively subsidised plastics industry will have had its wings clipped, informed by view one and the inability to work in an environment without a government handout. Small land grab specialist logistics operators will have been vertically integrated by larger corporation transport operators, and those that had refused to adapt would have gone bust, unable to compete either on the quality or the price of the finished goods that could only ever attract commodities prices when manufactured. As in Rwanda, there has been growing pressure to introduce policies to reduce the amount of plastic in the economy in the first place through stricter legislation and industry self-regulation.

16. Conclusion and Call to Action

This article presented a deep analysis of the regionally differentiated waste management practices in developing urban areas, focusing on the single cases of Bamako and Ouagadougou. The study led to manifold conclusions on country-related specifics for the unfolding waste problem. From the results obtained, it is generally concluded that a one-size-fits-all approach for adapting SWM institutional arrangements to local circumstances does not exist. The specific setting of regional markets for goods and services produced from waste dictates

the direction of institutional change towards which these markets should evolve. The development of the private waste pickers group in Ouagadougou shows how vulnerable urban poor can mobilise themselves in a rather tricky legal and fiscal environment. They have the skills and the resources needed to clean the cities' roads and neighbourhoods even without formal employment. By focusing efforts regarding policy and managerial measures towards improving environmental conditions for the immediate benefit of the urban dwellers, the waste pickers could further standardise their services and contribute to a clean and healthy urban environment. Specifically, disease-related spending on access to health services for the urban population could be sensibly reduced. The sophisticated international cooperation system aiming at integrated waste management in the direction of industrialised and energy-reliant countries predominantly neglects the waste pickers with their locally specific occupational risks and economic needs and remains stuck in a deadlock in the developing countries. Incapable of promoting capital-led investment strategies for efficient, land-consuming SWM technology or appropriate policies that incentivise incineration-based energy recovery in a renewable energy governance system, international donors are well advised to generally take account of the SWM development gap and the local-specific culture and economies of these countries.

16.1. Key Findings and Recommendations

Africa is entering a waste crisis, making addressing waste management issues increasingly important. In this concept note, we analyse the current problems surrounding waste in Africa and provide exciting examples of companies that innovate to integrate waste into production, creating social and economic returns. In light of these findings, we offer policy prescriptions aimed at tackling the crisis that will enable the transformation of the unmanaged waste problem in Africa into a billion-dollar industry. Indeed, when managed effectively, waste treatment can provide a source of energy, carbon emissions reduction, and materials mobilisation, providing three of five solutions to resource scarcity and depletion based on the principles of the circular economy.

Information in this report is presented in four sections. Section 1 outlines the key issues surrounding the production and recycling of plastics. Section 2 documents the problems associated with rapidly increasing waste in the context of rapid population growth and urbanisation in Africa. Section 3 presents innovative

companies integrating waste into production, creating social and economic returns. We then present policy recommendations to turn the waste problem in Africa into a billion-dollar opportunity. These range from manufacturing useful products through government tax incentives and mitigation of ongoing pollution in the absence of an effective policy regime.