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Circular Economy from waste to wealth: Sustainable human development evidence in Nigeria

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ABSTRACT

The problem of waste disposal constitutes serious environmental challenges facing many cities and there is still a phenomenal increase in the volume of wastes generated daily across the globe. This study on the circular economy from waste to wealth employs a mixed-methods approach to comprehensively analyze waste-to-wealth initiatives in Nigeria, focusing on various waste management feats to generate wealth and solve environmental problems. Utilizing secondary data, the methodology aims to provide a good understanding of the economic, social, and environmental dimensions of these initiatives. Qualitative data from literature reviews and document analyses identify key themes, while quantitative data on waste generation, recycling rates, and economic outcomes underwent descriptive statistical analysis for key indicators. The results highlight Nigeria's significant plastic waste generation, with only 6% being recycled. The study reveals untapped potential in the recycling industry and showcases successful models, such as Wecyclers and Recycle Points. The findings suggest that with policy interventions and economic incentives, Nigeria could achieve a 70% recycling rate, offering substantial investment scalability and greenhouse gas savings. Additionally, the study emphasizes the positive correlation between the growth of private sector participants in waste management and increased job opportunities, indicating a potential positive impact on the economy and employment landscape.

Keywords: Waste-to-wealth, Plastics and electronic waste, Mixed-methods approach
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I. INTRODUCTION

The problem of waste management is a global challenge affecting developed and developing societies in spite of the declaration of the sustainable development goals. Waste generated from households, commercial places, markets etc. are either degradable, partially degradable or non-degradable. The waste sector contributes about 13% of the non-CO_2 greenhouse gas emission. In Nigeria, the improper disposal of waste poses significant challenges, urging a critical need to repurpose these discarded materials into valuable resources. Nigeria stands as the ninth-largest global contributor to ocean plastic pollution and currently lacks a federal ban on most single-use plastics and equipment (Nwabuisi and Ihenetu, 2022). The accumulation of plastic waste, including bottles, bags, microplastics and microbeads, has detrimental effects on humans, wildlife habitats, and aquatic life (Hammer et al., 2012; Encyclopedia Britannica, 2013). Additionally, e-waste, though a small but rapidly growing portion of the 2.01 billion metric tonnes of global solid waste generated annually (Kaza et al., 2018), presents a significant challenge. According to the International Telecommunication Union's Global E-waste Monitor 2017, Nigeria generated 277,000 tonnes of e-waste in 2016, ranking as the third-largest generator in Africa (with Egypt and South Africa producing 497,000 tonnes and 321,000 tonnes of e-waste, respectively). Despite the colossal daily waste generation, there are opportunities to convert these materials into products contributing to a sustainable environment and generating revenue for stakeholders. The recycling industry, through entrepreneurship opportunities, creates jobs in waste collection, sorting, processing, and the manufacturing of recycled products.

The problems of waste management in Nigeria include: irregular and uncoordinated waste collection, funding, poor landfill and incinerators, and the lack of political will. This is worrisome to all and sundry. It is imperative that Nigeria must embrace the circular economy principles. Hence, the researchers delve into this study insights into the economic, social, and environmental dimensions of waste-to-wealth strategies within the Nigerian context. The transformative journey from waste to wealth in Nigeria holds implications not only for the nation's socio-economic landscape but also for the broader discourse on sustainable development in a world grappling with escalating environmental concerns. This case study delves into the unique challenges and opportunities presented by plastics and electronic waste in Nigeria. It aims to explore innovative solutions that not only mitigate environmental hazards but also unlock the economic potential inherent in these discarded materials. By scrutinizing the current state of waste management in Nigeria and examining specific initiatives and strategies, this study seeks to illuminate the transformative journey from waste to wealth in the context of plastics and electronic waste.

II. LITERATURE REVIEW

The literature review examines existing studies and initiatives related to waste-to-wealth strategies, within the Nigerian context. Nigeria is located between longitudes 2°2′ and 14°30′ East of the Greenwich meridian and latitudes 4° and 14° North of the Equator. In the western part of Africa, Nigeria is one of the Sub-Saharan nations. The country has boundary with the Republics of Niger and Chad, the Atlantic Ocean, the Republic of Cameroon, and the

Republic of Benin form its northern, southern, eastern, and western borders, respectively. Over a national territory of 923,770 km^2, more than 220 million people are living in an unevenly distributed manner.

Adetola *et al.*, (2021) worked on waste to wealth perspective: identifying waste potentials for small-scale business development in Ogun state, Nigeria. The paper addresses the possibility of wealth creation in the real sense of it beyond theoretical postulations, which abound from previous studies on waste in Nigeria. Among such previous studies referenced, the majority did not delve into the real process of turning waste into wealth to create actual wealth. This study therefore intends to achieve actual wealth creation from waste by throwing entrepreneurial challenges to the indigenous talented and skillful individuals. The study discovered six 'waste' items, that is, maize husk, pure water nylon, banana stem, pineapple leaves, sisalina leaves and areca leaves that are convertible manually into new products such as maize-husk paper products; paving stones/slabs from pure water-nylon; banana stem, pineapple leaves and sisalina fiber for weaving products such as caps, bags, cloths, floor mats, table mats, decorations, and areca-leaves into -nut plates and spoons useful at parties, restaurants and bukas in Nigeria and Africa.

Wali, *et al.*, (2019) worked on waste-to-wealth, towards a sustainable zero-waste in a circular economy: an overview. The paper discusses extensively the rising quality of life, and high rates of resource consumption patterns have had an unintended and negative impact on the urban environment - the generation of wastes far beyond the handling capacities of urban governments and agencies. The major aim of this paper was to review the overall method in which the waste management system in a circular economy revolves under the scope of management, utilization and sustainable growth in an ailing economy. Waste-to-Wealth means moving waste from a platform of exhausted utility to a valuable and desirable level. Its transformation: in engineering, requires some form of energy, and in economics requires a factor of production. Zero waste means designing and managing products and processes to systematically avoid and eliminate the volume and toxicity of waste and materials, conserve and recover all resources, and not burn or bury them. Ideally, implementing zero waste will eliminate all discharges to land, water, or air that are threats to planetary, human, animal, or plant health. The circular economy can best be seen as a complex system with three basic parts: production, consumption, and the surrounding support system. Globally, it is estimated that only 9% of plastic waste generated between 1950 and 2015 was recycled. India has the highest plastic recycling rate ranging from 47 to 60%. In the EU, only approximately 30% of 25 million tons of post-consumer plastic waste was recycled in 2014; China had a recycling rate of 22% in 2013; while only 9.5% of plastics entering the US municipal solid waste stream were recycled in 2014.

Bassey and Akpan Roseline in 2020 research on the arts of converting waste to wealth: towards environmental sustainability in Nigeria. In the research, the concepts of waste and waste management of reduction, re-use, and recycling through various processes, particularly artistic processes were analyzed. Art as a concept and how artistic activities help to convert waste to wealth as well as invaluable contributors of some artists in waste management and environmental sustainability were also analyzed. The efforts of the Federal Government of Nigeria were also acknowledged through the promulgation of decrees and the establishment of various agencies and other legal frameworks. This study aimed to curb the menace of poor waste disposal and ensure a safe and sustainable environment. Results concluded that artistic activities, through junk collection

and assemblage compositions, are viable approaches to ensure a safe and sustainable environment. It was recommended that visual artists should be involved in decision making, environmental policy formulation as well as planning, designing, redesigning, and construction of urban renewal projects and programmers.

Oluwadare., (2021) worked on Need-driven Research Towards Plastic Recycling in Nigeria for Health, Wealth and Green Environment. In his research, he noted that need-driven research is required for plastic recycling in most nations of the world for a greener environment and national development. Plastics are cheap, lightweight, and versatile materials that can be conveniently formed into a variety of items and are used in a wide range of applications. This study examined plastic recycling in Nigeria for the achievement of health, wealth, and a better environment. The methodology includes a literature review and investigation of various plastic disposal sites. It was observed that the production of plastics has risen dramatically over the last 60 years. However, current levels of their usage and disposal create several environmental problems. Approximately 4 per cent of world oil and gas production, a non-renewable resource, is used as feedstock for plastics and a further 3–4 percent is expended to provide energy for their manufacture. A large portion of plastic manufactured each year is used to make disposable pieces of packaging or other short-lived items that are disposed off within one year of manufacture. These two findings alone prove that the current use of plastics is not sufficient. Unfortunately, it is a sector that is highly neglected in our country and there are issues linked to lack of knowledge or incompetence of the government. It was concluded that need driven research should be adapted to plastic recycling for health, wealth, greener environment, national development and sustainable development. Although the above research did extensive work on emphasizing the challenges faced by plastic recyclers in Nigeria, it lacked good data to back up its assertion.

Akuru and Okoro in 2019 worked on electronic wastes and the Nigerian experience. The research noted that due to the lack of financial resources available to most people in developing countries, much of the growth in the information communication technology (ICT) sector in developing countries has been fueled by the importation of hand-me-down, used equipment from rich, developed countries, whose consumers are all too happy to find buyers for it. As a result, many brokers and businesses have sprung up to channel used equipment from developed to developing countries thereby, encouraging the generation of electronic wastes (e-waste). This paper reviews the report from the study of Basel Action Network (BAN), "The Digital Dump: Exporting Re-use and Abuse to Africa", to investigate how these e-wastes contribute to Nigeria's energy use in the energy sector. This research failed to provide robust reference data to validate its assertion. This research sort to close this knowledge gap by analyzing data that show how Nigeria is moving gradually from waste to wealth.

Oranefo, in 2022 worked on the effect of waste recycling on the business profitability of Nigeria SMEs. The study examined the waste recycling on business profitability of small and medium enterprises (SMEs) in Nigeria. Data were generated from a questionnaire distributed to the respondents. Regression analysis was used to test the formulated hypothesis with the aid of SPSS version 20. 0. at a 5% level of significance. The study found that waste recycling, resource recycling, solid waste management, and municipal waste collection crew have a significant effect on the business profitability of small and medium enterprises (SMEs) in Nigeria, and this effect was statistically significant at a 5% level of significance. The study suggested that

development agencies and non-governmental organizations (NGOs) get involved by assisting scavenger groups and cooperatives with recycling program implementation

III. METHODOLOGY

This study employs a mixed-methods approach, utilizing both secondary qualitative and quantitative data, to comprehensively analyze waste-to-wealth initiatives in Nigeria. The focus is on understanding the economic, social, and environmental dimensions of these initiatives, with a specific emphasis on a case study involving plastics and electronic waste. This methodology aims to provide a robust and holistic understanding of waste-to-wealth strategies in Nigeria, combining the strengths of both qualitative and quantitative data to inform recommendations for sustainable practices and policies. Qualitative data, including information from literature reviews and document analyses, was used to identify key themes and patterns. Quantitative data on waste generation, recycling rates, and economic outcomes were subjected to descriptive statistical analysis to derive key indicators. Comparisons between different regions, periods, and waste types were conducted to assess variations and trends.

IV. PRESENTATION OF RESULTS & INTERPRETATIONS

With a population of over 200 million people, it is estimated that the country generates around 1.15 million tons of plastic waste per annum according to Anabaraonye *et al*., (2019). These plastics can be collected and recycled into useful materials that can be sold for profit (Singh and Sharma, 2016). The average per capita waste generation also stands at 5.9 kg. However, out of this total plastic waste, only 6% is recycled. The rest of the plastic waste ends up in landfills or becomes marine debris. Nigeria is ranked 9th among the top 10 countries in plastic marine debris pollution depositing 340,000 tons of plastic into the oceans every year. It is also estimated that the majority of the plastic waste in Nigeria ends up in landfills or burned. The other 30% becomes marine litter polluting the rivers and ocean.

Table 1: Plastic waste management in Nigeria

Parameters	Total Average
Unaccounted/ Marine litter	340,000
Recovery/ Recycling	70,000
Burn/ Landfilling	740,000

Source: Federal Ministry of Environment, Abuja, Nigeria (2020)

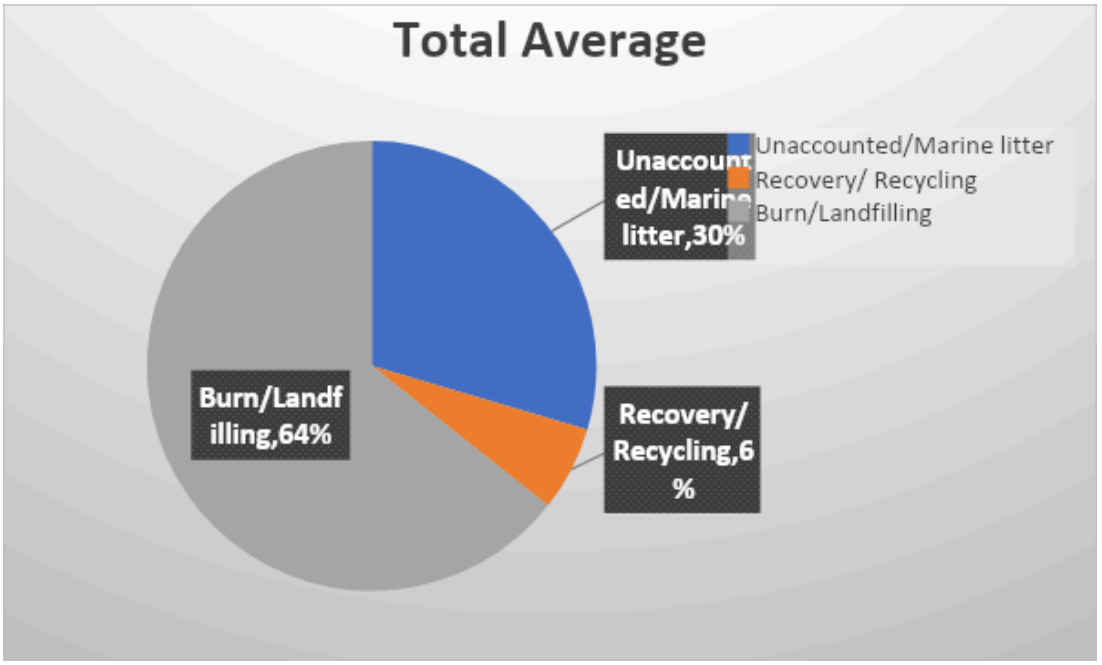


Figure 1: A pie chart showing the distribution of plastic waste management in Nigeria

Table 2: Nigeria states based on the amount of plastic waste generated between 2007 and 2017.

States	T_y	Q_r	Q_{ur}
Abia	1782241.74	213869.01	1568372.73
Abuja	764431.91	91731.83	672700.08
Adamawa	1143054.51	137166.54	1005887.97
Akwa-Ibom	1446412.3	173569.48	1272842.84
Anambra	1492179.68	179061.56	1313118.12
Bauchi	1724280.16	206913.62	1517366.54
Bayelsa	5647247.79	677669.73	4969578.06
Benue	1538017.2	184562.06	1353455.14
Borno	1545959.6	185515.15	1360444.45
Cross-river	1040475.9	124857.11	915618.79
Delta	1505514.25	180661.71	1324852.54
Katsina	3658644.59	439037.35	3219607.24
Kebbi	1185394.71	142247.37	1043147.34
Kogi	1275650.87	153078.10	1122572.77
Kwara	775368	93044.16	682323.84
Lagos	3333110.27	399973.23	2933137.04
Nasarawa	677425.86	81292.10	596134.76
Niger	1465914.8	175909.78	1290005.02
Ogun	1381993.55	165839.23	1216154.32
Ondo	1251871.26	150224.55	1101646.71

Osun	1208419.25	145010.31	1063408.94
Oyo	1996254.36	239550.52	1756703.84
Plateau	1308794.8	157055.38	1151739.42
Rivers	1854861.17	222583.34	1632277.83
Sokoto	1339147.97	160697.76	1178450.21
Taraba	1665614.9	199873.79	1465741.11
Yobe	866681.25	104001.75	762679.5
Zamfara	1150464.22	138055.71	1012408.51
Kogi	1275650.87	153078.10	1122572.77
Kwara	775368	93044.16	682323.84
Lagos	3333110.27	399973.23	2933137.04

Source: Federal Ministry of Environment, Abuja, Nigeria (2020)

Where; Ty = total quantity of plastic waste generated

Qr = quantity recycled and

Qur = quantity of plastic unrecycled

N.B: The quantity recycled was determined by multiplying the total plastic (Ty) by the percentage recycled. Total plastics waste generated (Ty) was calculated using the relationship:

Ty = sum (2007 - 2017)

Qur = Ty - Qr

The data in Table 2, contains background information on the volume of plastic waste generated by each state. Twenty-eight states with at least 11-year records (2007-2017) of the volume of plastic waste generated were considered and the results were used to predict for the entire 36 states. From the data it is clear that the recycling industry holds vast potential which is still underutilized.

Consequently, approximately 60,000 tons of PET waste is being managed efficiently in Nigeria through recycling into various applications such as PSF (Poly Staple Fiber). Private collection players play a key role in the management of plastic waste. Some of the companies that are involved in PET collection include Chanja Datti, Recycle Points, and Wecylers while Recycling

includes Alkem Nigeria Ltd and Lexsz Plastics Limited. All the recyclers and collectors are registered under the Recyclers Association of Nigeria (RAN) which is an umbrella body of indigenous enterprises registered in Nigeria with activities that promote Waste Recycling.

STATISTICS ON WECYCLERS:

Wecyclers are the collector and sorter of plastic waste in Lagos, Nigeria. They have two hubs in Surulere, 1 hub in Ebute-Metta, 1 hub in Ojota, and their headquarters at Lagos Island. Each hub covers a 2 or 3-mile radius of waste collection. 100,000 kgs of plastic waste is collected, sorted, and compressed monthly by Wecyclers. Alkem Nigeria Limited and other recyclers buy from Wecyclers at the rate between 180 and 192 USD per ton of PET.

Monthly Revenue generated by Wecyclers.

100,000 kgs ÷ 1,000=100 tons

1ton = 185 USD

100 × 185 = 18, 500 USD

= ₦ 14,853,465. Monthly

= ₦ 178,241,580 Annually

STATISTICS ON RECYCLE POINTS

Recycle Points is a plastics collector and sorter set up to combat the waste management crisis in Nigeria. They started as a household incentive program focused on earning points based on the weight of plastics collected. They later switched to the counting system based on their client's preferences. They have about 10,000 households and 22 corporate companies signed up. They collect PET, LDPE, and HDPE. PET and pure water sachets are the main items collected. PET makes up between 75%-80% of the used plastics they collect. Recycle Points sells a ton of PET for between 180 and 220 USD depending on the season. They supply 1500 tons of plastic flakes to Lexsz Plastics Limited.

According to the PricewaterhouseCoopers International Limited (PWC) report of 2019, Nigeria can achieve a recycling rate of 70% (benchmarking with the recycling rate of PET in India) with economic incentives tied to recycling and an enhanced collection system. The recycling rate of 70% translates to a theoretical potential of investment scalability of 480 to 560 million USD and a potential GHG savings of 280,000 tons per annum

Table 3 : Number of Private Sector Participants PSPs Operating in Lagos State

Parameters	2004 - 2007	2008 - 2011	2012 - 2015	2016 - 2019
Private Sector Participants (PSPs)	116	213	346	364
No of Jobs	696	1378	2076	Over 3,500

Source: PricewaterhouseCoopers International Limited 2019

Table 3 provides information on the number of Private Sector Participants (PSPs) and the corresponding number of jobs associated with these participants over four different periods: 2004-2007, 2008-2011, 2012-2015, and 2016-2019. Interpreting these trends suggests a positive correlation between the growth of private sector participants in waste management and the concurrent increase in job opportunities over the specified periods. The expanding private sector presence in waste management appears to be contributing to employment generation, showcasing a potential positive impact on the economy and employment landscape in this sector.

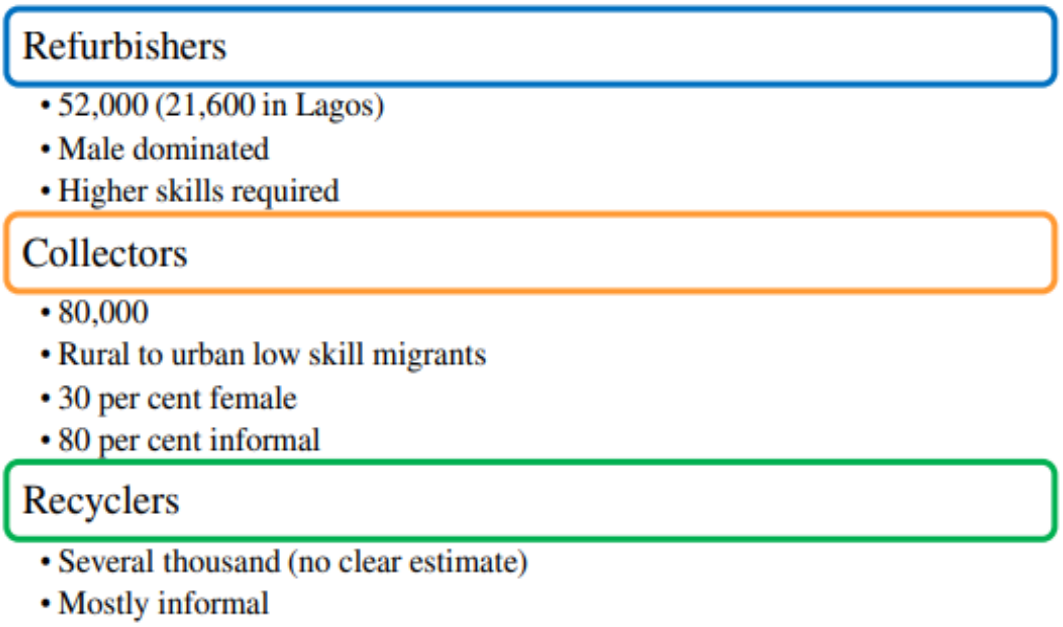
ELECTRONIC WASTE RECYCLING & FUTURE PROSPECT

E-waste is an emerging problem as well as a huge business opportunity given that discarded electronic waste is the fastest growing stream of waste in industrialized countries. This is not surprising considering that the electronic industry thrives mainly on new evolving products giving rise to increasing growth and production rate. This increasing growth rate is encouraged by consumer's appetite for the latest electronic devices. The easier, lightweight yet sophisticated the device, the higher the consumption rate as in the case of Smartphones (International Data Corporation (IDC), 2012). The frequency by which manufacturers churn out more advanced and sophisticated electronic devices gives rise to a throw-away principle increasing obsolesce at the same time it also ensures monetary benefits for producers. Obsolete computers are regarded as a 'gold mine'. A metric ton of electronic scrap from used computers contains more gold than can be extracted from a 17-ton gold ore (United States Geological Survey, 2001). Ironically, e-waste contains both toxic and valuable materials with elements including iron, copper, aluminum, gold, and other metals in e-waste estimated at over 60%, while plastics account for about 30% and the hazardous pollutants comprise only about 2.70% (Widmer *et al.*, 2005). There is a thriving

market for copper and iron in the electronic industry. The economic benefits of re-using extracted materials far outweigh extracting the raw materials from mines and converting them for manufacturing purposes. It is no wonder then that the host community where e-waste is housed finds it a valuable source of income amidst the obvious health and environmental hazards.

Informal recycling of e-waste as a profession became an important income-generating activity for small businesses operating in Nigeria. This sector provides over 30,000 jobs for the populace (Schluep, *et al.*, 2009) According to recent data from the International Labour organization as of 2019 (Fig. 2), this number has risen to well above 130,000 individuals. Therefore, it becomes clear that every reform of the sector requires a careful investigation of its impact on businesses and employment.

Figure 2: Estimates of e-waste workers in Nigeria



Source: International Labour Organization 2019

The management of e-waste in Nigeria involves several actors along the different stages of the e-waste value chain outlined below (Figure 9). These include distributors, repairers/refurbishes, consumers, collectors, recyclers and final disposers.

Distributors are entities that buy EEE and UEEE from various sources and sell this equipment to consumers directly. The Alaba International Market located in Ojo, Lagos state is the largest market for EEE and UEEE in Nigeria. The market brings together a large number of buyers and sellers with over 5,000 business outlets (Obioha, 2013). Another major EEE and UEEE market is the Computer Village located in the capital city of Lagos state, Ikeja. EEE and UEEE are channeled to other states of Nigeria from these major markets.

Consumers of new EEE and UEEE can be divided into three categories: private, institutional and corporate consumers. In contrast, Nnorom and Osibanjo (2010) found that corporate and institutional consumers were the major domestic generators of e-waste and that households only generated approximately 15 percent of the e-waste in Nigeria. Given these conflicting statistics, it is not currently possible to determine which category of consumer generates the most e-waste.

Refurbishers extend the lifetime of both new and used EEE. In doing so, they also invariably generate e-waste from UEEE that cannot be repaired. As mentioned above, large volumes of UEEE are imported into Nigeria, often in poor condition, which provides a large market potential for refurbishers in the country. Service centers provided by manufacturer representatives and importers, as well as other repair shops found in places such as the Ikeja Computer Village, fall under this category. From the country assessment, approximately 52,000 persons were involved in the refurbishing sector, almost all of whom were male (Ogungbuyi et al., 2012).

In Nigeria, the collection of e-waste is largely an informal economic activity, and collectors are referred to as “scavengers". They make a living from collecting different types of recyclable waste simultaneously, making it difficult to identify how many collectors work with e-waste specifically. In 2010, it was estimated that approximately 80,000 people were engaged in the collection of recyclable waste, including e-waste and metal scraps, and that 80 percent of these collectors operated in the informal sector and 20 per cent worked in the formal sector (ibid.). While refurbishing in Nigeria is male dominated, it was observed that approximately 30 percent of collectors in Nigeria were female. This contrasts to Ghana, where it was found that e-waste was collected by young children (mostly male) and women (Osibanjo, 2015).

Most recyclers in Nigeria work in the informal sector, as there are only very few registered recycling facilities. However, in February 2018, the Government of Nigeria approved the establishment of its first formal e-waste recycling facility in Ojota, Lagos state, which is run by Hinckley Recycling (Okeke, 2018). In the absence of publicly financed or managed e-waste systems and infrastructure, private enterprises such as Sunray Ventures and Eterra Technologies Ltd. play an increasingly important role in e-waste management in Nigeria.

SUMMARY

In Nigeria, the improper disposal of waste poses a pressing challenge, prompting the need to convert discarded materials into valuable resources. This case study focuses on the distinctive challenges and opportunities associated with plastics and electronic waste in Nigeria. The aim is to explore innovative solutions addressing both environmental hazards and the economic potential of these materials. By analyzing the current state of waste management and specific initiatives, the study illuminates the transformative journey from waste to wealth.

Nigeria ranks ninth globally in ocean plastic pollution without a federal ban on most single-use plastics. The accumulation of plastic waste has adverse effects on humans, wildlife, and aquatic life. E-waste, a rapidly growing portion of global solid waste, poses a significant challenge. Nigeria generated 277,000 tonnes of e-waste in 2016, ranking third in Africa. This study provided insights into the economic, social, and environmental dimensions of waste-to-wealth strategies in Nigeria. With a mixed-methods approach, combining qualitative and quantitative data, the research comprehensively analyzed initiatives, particularly focusing on a case study involving plastics and electronic waste. The methodology provided information on sustainable practices and policies by understanding key indicators, trends, and variations. With a population of about 220 million, Nigeria generates approximately 1.15 million tons of plastic waste annually. Only 6% of this waste is recycled, contributing to the country's ninth position in plastic marine debris pollution. The study emphasizes the potential to convert waste into products for a sustainable environment and economic gain. The recycling industry, offering entrepreneurship opportunities, creates jobs in waste collection, sorting, processing, and manufacturing.

The data reveals the vast potential of the recycling industry, which remains underutilized. Approximately 60,000 tons of PET waste are efficiently managed in Nigeria, contributing to revenue generation. Private sector players, including Chanja Datti, Recycle Points, and Wecylers, play a crucial role. The study refers to a PricewaterhouseCoopers report suggesting a 70% recycling rate could lead to significant investments and greenhouse gas savings. Also, the data analyzed showed the growth of Private Sector Participants (PSPs) in waste management, showing a positive correlation with job opportunities. Over the years, the increasing private sector presence appears to contribute to employment generation, indicating a positive impact on the economy in waste management.

CONCLUSION & RECOMMENDATIONS

This study considered the role of waste management and wealth Creation in Nigeria taking inference from private sector participation in franchise operations and whether there has been a significant effect on job creation and if waste recycling has no significant effect on business creation in Nigeria. The evidence of the practice of circular economy of waste was minimal. It was apparent that the basic principles of the circular economy were poorly understood.

The private sector involvement in waste management did not deliver on the gains of the circular economy. Policy documents for effective delivery of circular economy waste were not made available to the private sector.

The outcome of the study seems positive from both hypotheses and the following recommendations can be summarized;

i. Since it has been reflected in this study that the private sector participation in franchise strategies affects job creation in enterprises, Waste management authorities should endeavor to provide franchising opportunities to entrepreneurs to create more jobs for the populace.

ii. It is recommended that waste recycling should be regulated and controlled efficiently to encourage more individuals to participate in the processes since it has been discovered that waste recycling can create business for entrepreneurs

iii. The government should ensure that dumpsites should be managed efficiently so

that waste managers and franchisees can generate income for themselves and their organizations thereby contributing to the gross domestic product of the nation.

iv. Organizations should invest more in infrastructures by providing an enabling environment so that more individuals and entrepreneurs can benefit from waste management business and also to encourage development of the small and medium-scale enterprises.
v. Advocate for comprehensive policies and regulations to address plastic waste and e-waste management. Implementing a federal ban on single-use plastics and equipment could significantly curb the plastic pollution problem.
vi. Develop and support programs that create employment opportunities in the waste management sector. This includes training and capacity-building initiatives for individuals involved in waste collection, sorting, and recycling.
vii. Households, markets, industries and government authorities should provide waste bins for segregation.
viii. Private firms should be encouraged to establish recycling plants that use wastes as resources in line with circular economy principles.
ix. There should be training and retraining of all stakeholders in the waste management sector of the economy.
x. There is need for massive education of the public on the fundamentals of circular economy and the potential to create wealth

By implementing these recommendations, Nigeria can fully harness the economic potential of waste-to-wealth strategies, mitigate environmental hazards, and contribute to sustainable development. The findings of this study not only have implications for Nigeria but also offer valuable insights for global discourse on waste management in the face of escalating environmental concerns

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