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PLASTIC FOOTPRINTS AND ENVIRONMENTAL IMPLICATIONS IN AWKA, ANAMBRA STATE, NIGERIA: INSIGHTS FROM RWANDA'S POLICY FRAMEWORK FOR SUSTAINABLE SOLUTIONS

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Abstract

Despite extensive global research highlighting the risks of plastic waste, Nigeria's localized data and contextually relevant insights remain insufficient, and this hinders effective policies and practices. To address this gap, the study examined plastic footprints and their environmental impacts in Awka, Anambra State, drawing insights from Rwanda's successful plastic waste management strategies. A survey was conducted by randomly distributing 360 questionnaires and conducting key informant interviews. Findings showed that 77.5% of participants are youthful, single workers aged 18-30, who prefer consuming packaged foods and single-use plastics for convenience. Notably, 82.5% of participants have a tertiary certification, indicating an opportunity to improve awareness and participation in recycling efforts. Additionally, 42.5% of those surveyed are self-employed, reflecting a strong entrepreneurial culture in Anambra State that influences plastic use, especially in packaging. The findings revealed that packaging accounts for 95% of plastic waste, with improper waste management (95%) and inadequate infrastructure (90%) identified as major contributors to pollution. Weak government regulation (77.5%) and low public awareness (85%) also pose significant problems. The study highlights serious environmental impacts, including ecosystem degradation, soil and groundwater contamination, and human health risks due to pest attraction (95%) and toxic chemical release (90%). These issues disproportionately affect vulnerable groups (92.5%). To address these challenges, the study advocates for integrated waste management approaches, added to Rwanda's enhanced policy framework, environmental education initiatives focused on the youth, community-based recycling programs, and enforcement of environmental regulations.

Keywords: Plastic Footprints; Waste Management, Policy enforcement, Community perceptions

INTRODUCTION

Plastic pollution has emerged as one of the world's most pressing environmental challenges, posing risks to ecosystems, human health, and global sustainability. The rising demand for plastics, driven by their affordability, durability, and broad utility, has created high dependency and, consequently, vast waste flows (Geyer *et al*., 2017). In this study, *plastic footprints* refer to the total quantity of plastic materials consumed, discarded, or leaked into the environment by individuals, communities, or institutions over time (Jambeck *et al*., 2020). Plastic waste may enter formal waste management systems or be improperly disposed of in the environment. This includes single-use plastics, packaging, microplastics, and long-lasting plastic materials at the end of their life cycle. Because plastics are highly resistant to degradation, they persist in ecological systems, generating significant environmental, social, and health-related consequences (Jambeck *et al.,* 2015; Geyer *et al.*, 2017).

Plastics have transformed packaging, transportation, manufacturing, and household convenience, but these benefits come with substantial environmental costs. Each stage of the plastic life cycle, from raw material extraction and production to consumption and disposal, creates risks for ecological integrity and human well-being (UNEP, 2021).

Global plastic production has increased dramatically, reaching approximately 367 million metric tons in 2020 (PlasticsEurope, 2021). A substantial proportion of this production ultimately becomes waste, much of which leaks into terrestrial and aquatic ecosystems. Lau et al. (2020) projected that mismanaged plastic waste entering the environment could exceed 29 million metric tons annually by 2040 if current trends continue. The environmental effects are multifaceted: plastics break down into micro- and nano-particles that contaminate soil, freshwater bodies, and marine systems; they emit greenhouse gases during fragmentation and decomposition; and they endanger biodiversity through ingestion, entanglement, and habitat disruption (Royer et al., 2018). Because plastics persist for decades or centuries, most of the plastic ever produced remains in circulation as products or environmental waste (UNEP, 2022a).

Plastics are broadly categorized into macro-, meso-, and micro-debris based on particle size. Macro-plastics such as bottles, bags, and packaging materials dominate urban waste streams, while microplastics, often originating from degraded packaging, textile fibres, or industrial processes, have been found even in remote regions such as Henderson Island in the South Pacific and the Canary Islands in the Atlantic (Álvarez et al., 2019; Andrea, 2022). These findings highlight the global prevalence of plastic pollution and its nature as a transboundary environmental issue affecting both industrialized and non-industrialized regions.

Nigeria, the most populous country in Africa, faces an increasingly severe plastic waste crisis. Over 2.5 million tons of plastic waste are generated annually, yet less than 12% is recovered or recycled (Babayemi et al., 2018; ActionAid Nigeria, 2025). The country ranks among the top global contributors to plastic pollution, with a significant proportion of waste being mismanaged or discarded in open landfills, drainage channels, and water bodies (Dumbili et al., 2020). In urban centres such as Lagos, Port Harcourt, and Awka, improper plastic

disposal exacerbates flooding, contaminates water systems, and affects agricultural productivity (Adelekan & Folarin, 2019; Akanwa *et al.* 2022).

The impacts of plastic pollution extend beyond environmental degradation to significant human and animal health concerns. Plastic ingestion by wildlife, including fish, birds, and livestock, has been widely documented, often resulting in suffocation, intestinal blockage, malnutrition, and death (Derraik, 2002). In coastal regions of Nigeria, marine species such as turtles and dolphins are increasingly found with plastics in their digestive systems (Nwosu et al., 2020). For humans, microplastics have been detected in food, drinking water, and even the atmosphere, raising concerns about long-term health risks such as endocrine disruption, inflammation, and carcinogenic potential (Smith et al., 2018). In addition, the common practice of open burning releases hazardous pollutants such as dioxins and furans, worsening air quality and increasing respiratory health risks. In Awka, these effects are particularly concerning because residents depend heavily on clean water and functional drainage systems, all of which are vulnerable to unmanaged plastic waste.

These challenges reflect systemic gaps in urban planning, waste governance, and public environmental behaviour in Anambra State (Nkwocha *et al*. 2019; Okonkwo & Akanwa**,** 2017). In Awka, Anambra State, poor waste collection services and inadequate recycling infrastructure exacerbate the environmental risks associated with indiscriminate plastic disposal (Akpan & Ezeoha, 2019). Recent efforts to improve waste management have included stakeholder engagement and public–private collaborations. Partnerships between the Anambra State Waste Management Agency (ASWAMA), international organizations such as USAID, and private actors, including TechnoServe and the Coca-Cola Foundation, have sought to expand recycling capacity and promote a "waste-to-wealth" model (USAID, 2024). However, despite these initiatives, significant challenges remain: recycling rates are still low, public awareness of sustainable waste practices is limited, and infrastructure for waste segregation, collection, and environmentally safe disposal is grossly inadequate (MogboTochukwu et al., 2022.

Rwanda has become one of Africa's most notable examples of effective plastic waste governance through coherent and sustained policy implementation. The country banned plastic bags in 2008 and extended the prohibition to all single-use plastics in 2019 (Rwanda Today, 2024). Enforcement has remained strict, with penalties ranging from fines to licence revocation for offenders. By 2025, Rwanda had established 24 plastic collection centres that recovered more than 1,500 tonnes of single-use plastics and created nearly 1,500 green-sector jobs (The New Times, 2025). Additional measures, such as import levies on plastic-packaged goods, have encouraged local alternatives and strengthened domestic recycling initiatives (Sustainability Middle East & Africa, 2024). These combined efforts have significantly reduced visible plastic litter and positioned Rwanda as a continental model (Rej, 2025).

Nigeria's dependence on single-use plastics, including sachet water bags, plastic bottles, and disposable shopping bags, continues to fuel the plastic waste crisis. Sachet water packaging, though widely used to provide inexpensive drinking water, has become a major contributor to litter and blocked drainage channels in Anambra State (Timothy, 2019).

At the policy level, Nigeria has endorsed several international conventions and developed national frameworks addressing waste management and environmental sustainability. However, policy enforcement remains weak and inconsistent. Although more than 120 countries have introduced bans or restrictions on single-use plastics (Xanthos & Walker, 2020), Nigeria's implementation has been fragmented. In Anambra State, waste management agencies face persistent challenges, including insufficient funding, poor institutional coordination, inadequate technical capacity, and limited monitoring (Okoye, 2021).

The global implications of Nigeria's plastic challenge are equally critical. According to the United Nations Environment Programme (UNEP, 2022b; UNEP, 2023), plastic pollution contributes to climate change through greenhouse gas emissions generated during production, incineration, and environmental degradation. In Awka, where waste-to-energy systems are absent, mismanaged plastic waste may increase greenhouse gas emissions and worsen local climate vulnerabilities such as flooding, erosion, and blocked drainage pathways (Akanwa *et al*., 2022; Onuoha, 2020).

The urgency of addressing plastic pollution in Awka cannot be overstated. This study, therefore, examines the plastic footprints and environmental implications in Awka, Anambra State, drawing policy lessons from Rwanda's successful plastic governance model. Specifically, the study aims to:

(1) assess the sources, drivers, and eco-social and environmental impacts of improper plastic management in Awka Capital Territory.

(2) identify the policy, institutional, and infrastructural gaps hindering efficient waste management; and

(4) propose context-appropriate solutions informed by Rwanda's policy experience

Risk Society Model and Environmental Health Framework

The Risk Society Model, developed by Beck (1992), provides an important framework for understanding contemporary environmental challenges such as plastic pollution. Beck posits that industrial society has evolved into a "risk society," defined not only by wealth creation but also by the large-scale production of systemic risks. These risks are often unintended, invisible, and transboundary, including pollutants such as toxins, radiation, and microplastics that persist within ecosystems and accumulate in human bodies. Unlike traditional hazards that were localized and easily detectable, modern risks are diffuse, uncertain, and frequently manifest after long delays. Plastics discarded today, for example, may release microplastics and chemical additives decades later, affecting soil fertility, aquatic ecosystems, and human health. Beck (1992) also emphasizes that risks are unequally distributed, with disadvantaged communities disproportionately exposed and less equipped to mitigate their vulnerability.

Applying this model to Anambra State, Nigeria, plastic pollution emerges as a manufactured risk resulting from industrialization, rising consumerism, and weak environmental governance. Communities in Awka Capital City (ACT) where waste management systems remain inadequate (Akpan & Ezeoha, 2019), face heightened vulnerability to the ecological and health impacts of mismanaged plastics. Through the risk society lens, these challenges

are understood as products of global production-consumption systems that translate into localized and disproportionate harm for socially and economically vulnerable groups.

Complementing Beck's analysis is the Environmental Health Framework, which explicitly links environmental exposures to human health outcomes. The framework identifies the pathways through which pollutants, such as airborne particles, contaminated water, and degraded soil, produce acute and chronic health effects (Frumkin, 2016). This approach is particularly useful for analyzing how plastics affect health through chemical leaching, microplastic ingestion, dermal exposure, or emissions from open burning. Burning plastic waste releases toxic compounds such as dioxins and polycyclic aromatic hydrocarbons (PAHs), which are associated with increased risks of cancer and respiratory illness (Royer et al., 2018). Likewise, microplastics introduced into rivers and agricultural soils raise concerns about bioaccumulation within food chains, heightening risks of gastrointestinal, reproductive, and endocrine disruption (Geyer et al., 2017).

Importantly, the Environmental Health Framework situates these outcomes within broader social determinants of health. In Nigeria, where open dumpsites, inadequate waste segregation, and limited recycling capacity persist (Babayemi et al., 2018), disadvantaged populations experience greater exposure to pollution and reduced access to adequate healthcare. This reinforces Beck's assertion regarding the unequal distribution of risks in a modern risk society. Together, both frameworks underscore that plastic footprints must be addressed not only as an ecological challenge but also as an urgent public health concern requiring systemic intervention.

In summary, the Risk Society Model explains the social production and unequal distribution of risks associated with plastics, while the Environmental Health Framework identifies the biological and ecological mechanisms through which those risks manifest as health outcomes. Together, these frameworks offer a comprehensive analytical lens for understanding plastic pollution in Anambra State, revealing its dual nature as both a systemic modern risk and a direct environmental health threat.

Study Area

Awka, the capital city of Anambra State, is located in southeastern Nigeria (See Figure 1). It lies approximately between the bounding coordinates 6.250°N, 7.030°E; 6.250°N, 7.110°E; 6.170°N, 7.030°E; and 6.170°N, 7.110°E (See Figure 2) and functions as both a political and administrative center (Anambra State Government, 2024). The city's strategic position along the Enugu–Onitsha expressway establishes it as a major regional hub for commerce, education, transportation, and governance in the region (Ezenwaji et al., 2014).

Awka is historically renowned for its blacksmithing heritage, which contributed to its prominence before rapid urbanization expanded its socio-economic importance (Okoye, 2021). Today, it hosts major institutions such as Nnamdi Azikiwe University and several government establishments, which attract a growing population and influence rapid urban development (Ugwuanyi & Eze, 2020).

The population of Awka has grown substantially over the past two decades, due to migration, commercial expansion, and administrative development. According to the National Population Commission (2006), Awka Capital Territory's (ACT) population was 301,657.

Applying a 2.7% annual growth rate to the 2006 National Population Commission, the projected population of Awka Capital Territory for 2024 is approximately 487,283 people (NPC, 2006; UN Population Division, 2022) (NPC, 2006; United Nations, 2022). This rapid growth has intensified pressure on land resources, housing demand, water supply systems, and waste management (Ezenwaji *et al.,* 2014).

Climatically, Awka lies within the tropical wet- and -dry zone and experiences clearly defined rainy and dry seasons. The rainy season, which spans from April to October, is characterized by heavy precipitation that frequently contributes to flooding and erosion risks in parts of the city, while the dry season lasts from November to March (Nwankwo *et al*., 2015). These climatic dynamics, combined with Awka's rapid urbanization and socioeconomic growth, make the city an important case study for research on land use change, climate vulnerabilities, and sustainable urban development in south-eastern Nigeria.

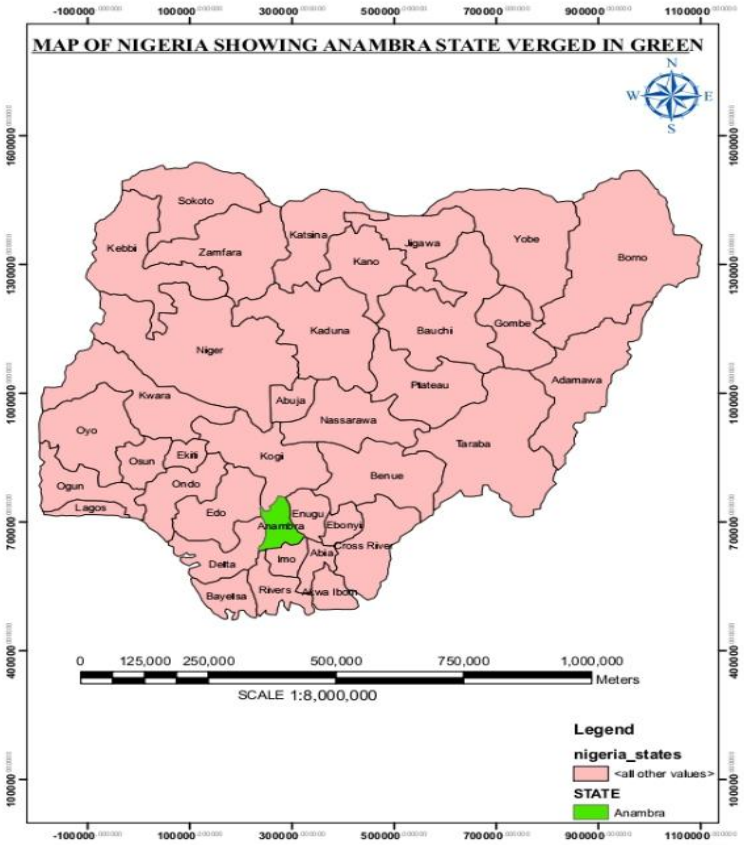
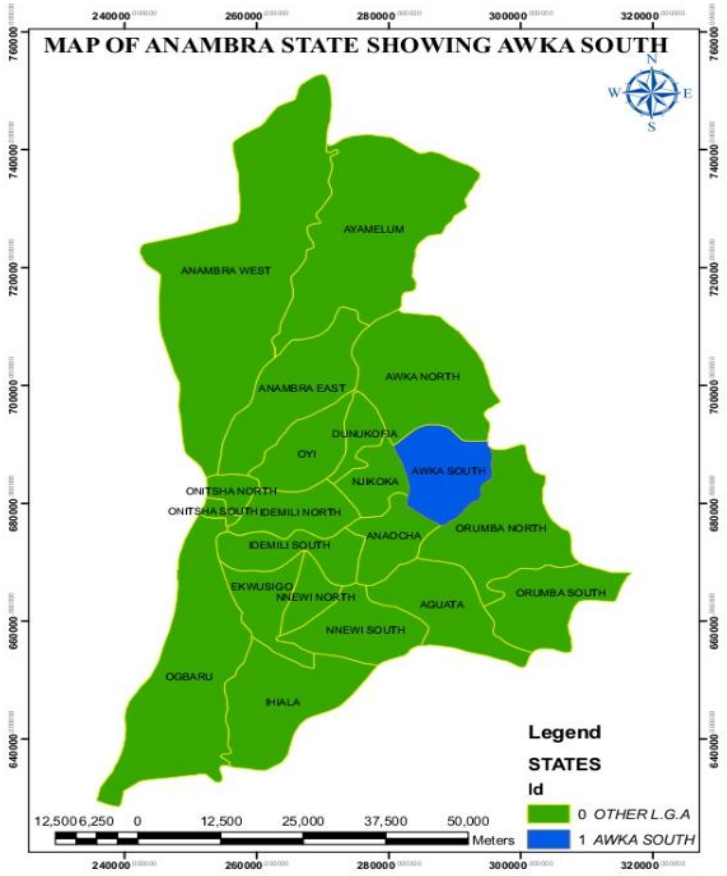


Figure 1: Map of Nigeria showing Anambra state
Source: Fieldwork, 2025

Figure 2: Map of Anambra State showing Awka South.



Source: Fieldwork, 2025

MATERIALS AND METHODS

The study investigated plastic footprints and their environmental and health consequences in the Southeast, Awka, Anambra State, Nigeria, using a mixed-methods design. Quantitative data were collected through a structured questionnaire, while qualitative evidence was collected through photography, key informant interviews, direct observation, and secondary sources. Rwanda was included as a comparative policy reference because of its well-documented achievements in plastic waste regulation and environmental governance. Quantitative data were analysed using frequency, percentages, and tables.

Questionnaire Survey

Awka Capital territory (ACT) had a population of 301,657 in 2006 (NPC, 2006). Using a 2.7% annual growth rate, the projected population of Awka Capital Territory for 2024 is approximately 487,283 people (NPC, 2006; UN Population Division, 2022) (NPC, 2006; United Nations, 2022). Based on Yamane's formula (1975) and a 5% margin of error, a sample size of 400 respondents was determined. A total of 400 questionnaires were randomly administered in Awka South, purposely selected because of its large waste stream. The

instrument captured demographic characteristics, perceptions of plastic use, waste handling patterns, and associated environmental and health concerns. Trained enumerators administered the questionnaires face-to-face to ensure clear communication and accurate completeness.

Qualitative Data Collection

6 Key Informants were interviewed (KII), including a community leader, Environmental officers from Anambra State Waste Management Authority (ASWAMA), the Ministry of Environment, and Awka Capital Territory Development Authority (ACTDA) to explore institutional practices, policy implementation, and local perspective on plastic waste management (Creswell and Poth, 2018). Direct observation and photographs supported these interviews by providing visual evidence of waste handling practices, hotspots, and environmental conditions within the study area.

Comparative Policy Reference: Rationale for Selecting Rwanda

Rwanda was selected as a comparative policy reference because it represents one of Africa's most successful examples of plastic waste governance. The country introduced a nationwide ban on plastic bags in 2008 and extended this prohibition to single-use plastics in 2019. These policies have been backed by strong political commitment, effective policy enforcement, and inclusive community participation through initiatives such as Umuganda (Rwanda Today, 2024; Rej, 2025). As a result, Rwanda has earned a reputation as one of the cleanest nations in Africa and leading example of circular economy practice on the continent.

Using Rwanda as a reference point allows this study to highlight clear policy gaps in Awka and identify approaches that can be adapted to the Nigerian context. The choice of Rwanda aligns directly with the study's aim of identifying sustainable, locally adaptable strategies for reducing plastic waste footprints in Nigeria through insights drawn from proven African success stories.

Data Analysis

Quantitative data from questionnaires were coded and analyzed using SPSS version 26. Descriptive statistics such as frequencies and percentages were used to summarise demographic information and key variables related to plastic consumption, sources of waste, causes of pollution, and environmental effects.

RESULTS AND DISCUSSION

A total of 360 completed questionnaires were retrieved out of 400 distributed. The results provide insight into how residents of Awka perceive plastic and its implications.

Table 1 shows that women constituted 234 respondents (65%), while men accounted for 126 respondents (35%). This indicates that women were more represented in the study, consistent with other community-based environmental surveys where women show higher participation.

Table 1: Gender Distribution of Respondents

Gender	Frequency	Percentage (%)
Male	126	35
Female	234	65
Total	**360**	**100**

Source: Fieldwork, 2025

As shown in Table 2, most respondents were single (77.5%), followed by married (17.5%), while 2.5% each were divorced or widowed. The dominance of single respondents reflects Awka's youthful and student –driven population.

Table 2: Marital Status of Respondents

Marital Status	Frequency	Percentage (%)
Single	279	77.5
Married	63	17.5
Divorced	9	2.5
Widowed	9	2.5
Total	**360**	**100**

Source: Fieldwork, 2025

Table 3 reveals that 12.5% of the respondents were under 18 years, 77.5% are between 18-30, 5% are between 31-45, and 5% are between 46-55 years. This again reflects the youthful demographics typical of urban centers with universities and also Nigeria's demographic structure in which more than 60% of the population is under 30 (NPC, 2022).

Table 3: Age Distribution of Respondents.

Age	Frequency	Percentage (%)
Less 18	45	12.5
18-30	279	77.5
31-45	18	5
46-55	18	5
56 and above	-	_
Total	**360**	**100**

Source: Fieldwork, 2025

Table 4 shows that 2.5% respondents had primary education, 5% had secondary education, 82.5% had tertiary education, and 10% had no formal education. The high literacy level supports the reliability of responses and aligns with 'role' of Awka as an academic hub.

Table 4: Educational level of Respondents

Educational level	Frequency	Percentage (%)
Primary education	9	2.5
Secondary education	18	5
Tertiary education	297	82.5
No formal education	36	10
Total	**360**	**100**

Source: Fieldwork, 2025

As shown in Table 5, 42.5% of the respondents were self-employed, 5% were unemployed, 40% were students, and 12.5% fell under ‘’other occupations’’. The large self-employed population could be related to the high unemployment level in the country (National Bureau of Statistics, 2023). This suggests high plastic use associated with trading and small businesses.

Table 5: Employment Status of Respondents

Employment status	Frequency	Percentage (%)
Self-employed	153	42.5
Unemployed	18	5
Student	144	40
Others	45	12.5
Total	**360**	**100**

Source: Fieldwork, 2025

Table 6 indicates that 42.5% had lived in the area for 4-6 years, 25% have lived for 1-3 years, 17.5% have lived for 7-10 years, 10% have stayed beyond 10 years and 5% of the respondents have lived in the study area for less than 1 year. This means most of the respondents have sufficient knowledge of the community’s environmental condition.

Table 6: Respondents' Residency Duration

Duration of stay	Frequency	Percentage (%)
Less than 1 year	18	5
1-3 years	90	10
4-6 years	153	17.5
7-10 years	63	42.5
More than 10 years	36	25
Total	**360**	**100**

Source: Fieldwork, 2025

Table 7 shows broad agreement that the leading sources of plastic waste include packaging for food and household items (67.5% strongly agreed), single-use plastics like straws (55% agreed), electronic and electrical equipment (27.5% strongly agreed), and fishing gear and equipment (37.5% agreed), construction and demolition activities (50% agreed), textiles and clothing (57.5% agreed), agricultural activities (37.5% agreed) and tourism and recreational activities (47.5% agreed). These findings reflect global patterns where packaging remains the most dominant contributor to plastic waste.

Table 7: Respondents Description of Sources/Uses of Plastic Wastes

S/N	Sources of plastic waste	Responses (Frequency and Percentage)					
		SA	A	U	D	SD	Total (%)
1.	Packaging items.	243 (67.5%)	99 (27.5%)	_	18 (5%)	_	360 (100%)
2.	Single-use plastic products.	144 (40%)	198 (55%)	9 (2.5%)	9 (2.5%)	_	360 (100%)
3.	Electronic/electrical equipment.	99 (27.5%)	63 (17.5%)	54 (15%)	135 (37.5%)	9 (25%)	360 (100%)
4.	Nets	117 (32.5%)	135 (37.5%)	54 (15%)	45 (12.5%)	9 (2.5%)	360 (100%)

5.	Construction.	81 (22.5%)	180 (50%)	27 (7.5%)	63 (17.5%)	9 (2.5%)	360 (100%)
6.	Textiles/fibers.	108 (30%)	207 (57.5%)	9 (2.5%)	36 (10%)	_	360 (100%)
7.	Agriculture.	117 (32.5%)	135 (37.5%)	81 (22.5%)	27 (7.5%)	_	360 (100%)
8.	Tourism/ recreation.	144 (40%)	171 (47.5%)	27 (7.5%)	18 (5%)	_	360 (100%)

Source: Fieldwork, 2025

Sources of Plastics and Implications of Employment Patterns in Awka City

Our findings identified packaging as the most significant source of plastic waste, with 95% agreeing. This aligned with global studies showing that packaging represents over 40% of total plastic waste generated worldwide (Geyer et al., 2017), and a Nigerian study highlights sachet water, food packs, and shopping bags as major contributors (Akinyemi et al., 2019).

Single-use plastics also emerged as a dominant source (95% combined agreement). Respondents linked these to beverages, take-away containers, disposable bags, and straws. This correlates strongly with Lagos, Port Harcourt, and Abuja studies showing similar patterns of consumption (Ajibade & Ojo, 2022a).

Importantly, respondents identified non-traditional sources such as textiles, fishing gear, construction materials, and agricultural plastics. The recognition of synthetic fabrics (microfibres) suggests growing awareness of microplastic contamination in laundry discharge, an emerging global concern. Construction and demolition waste also reflected expanding urbanisation in Awka, where plastic-based materials such as PVC and nylon coverings are common (Oloruntoba et al., 2023). This broad identification of sources demonstrates an informed population and broadens the scope of plastic footprint analysis beyond the usual household packaging.

Additionally, 80% of the respondents agreed that the affordability and convenience of plastics remain a major factor sustaining plastic dependence. This has remained a challenge in low- and middle-income countries (Eze & Nwankwo, 2022). 42.5% of the respondents are self-employed, indicating the high proportion of self-employed participants aligns with Anambra State's entrepreneurial culture, where small-scale businesses are dominant (Anyanwu, 2020). Employment type influences plastic consumption and disposal practices. Self-employed traders rely heavily on plastic bags, bottles, and sachets for packaging and customer use, thus contributing to urban plastic footprints (Okechukwu & Nnamani, 2021). Studies in Port Harcourt and Lagos confirmed that informal sector workers are among the largest users of single-use plastics, driven by affordability and accessibility (Nduka *et al*. 2021; Obinna & Okeke, 2023).

Awka, therefore, requires targeted interventions such as business-focused waste education, recycling incentives for students, and subsidized waste services for low-income groups. Notably, our results showed that 82.5% of respondents had attained tertiary education. This aligns with Awka's status as an academic centre hosting Nnamdi Azikiwe and Peter

universities, contributing to a highly literate population (Okafor, 2021). Education strongly influences environmental awareness; individuals with tertiary education are more likely to recognize plastic-related risks, support recycling and plastic bans (Ugwu & Okeke, 2020).

This youthful population and their high level of education can be strategic for effective plastic waste management. Studies in Ibadan and Ghana similarly found that higher education correlates with willingness to pay for waste services and support for sustainable packaging (Adedeji & Bello, 2019; Boateng *et al*., 2021). However, education alone does not guarantee behaviour change. Awka will require not just education campaigns but enforceable regulations and accessible waste-sorting infrastructure. Rwanda's experience showed that pairing education with strict enforcement is what drives lasting behavioural shifts.

Drivers of Plastic Pollution and Implications of Demographic Characteristics in Awka City

Our findings show that improper waste management remains the most widely acknowledged driver of plastic pollution in Awka, with 95% agreeing. Respondents also highlighted inadequate waste infrastructure (90% agreement), weak regulatory enforcement (77.5% agreement), and low public awareness (85% agreement). Also, insufficient infrastructure (90% agreement), and low cost and convenience of plastics (80% agreement), among others.

These results align with studies in Nigeria that identify open dumping, limited recycling systems, and insufficient collection facilities as central causes of plastic pollution (Nduka et al., 2021). The recognition of governance failures further reflects Adeola's (2021) argument that inconsistent enforcement perpetuates dependence on plastics.

Respondents' emphasis on limited availability of alternatives (72.5%) corresponds with research in Kenya and Ghana showing biodegradable options are still relatively scarce and expensive (Boateng et al., 2021). Fragmented supply chains (85% agreement) also reflect global research highlighting complex plastic flows, poor recycling markets, and weak stakeholder coordination (UNEP, 2022b). Rwanda's investment in biodegradable alternatives and restrictions on plastic imports provides a relevant model for improving access to sustainable options in Awka. Respondents also acknowledged the impact of COVID-19 (65%), consistent with global reports showing increased plastic consumption due to personal protective equipment and heightened packaging needs during the pandemic (Patrício Silva et al., 2021).

Our survey recorded a high single response (77.5%), within 18–30 years, and 40% are students, reflecting the youthful demographic typical of urban academic environments like Awka, which attracts young migrants for education opportunities (Ume & Aniche, 2020). This reflects Nigeria's demographic structure in which more than 60% of the population is under 30 (NPC, 2022).

Young, single individuals frequently consume convenience foods, bottled water, beverages, and packaged goods, as well as online retail products, leading to a heavy dependence on single-use packaged plastics (Chukwuma et al., 2021; Onyema et al., 2020; Eze & Nwankwo,

2022). These demographic dynamics help explain the high volume of packaging waste and disposable plastics identified in Awka. While married individuals may generate larger household waste volumes, they often adopt practices such as bulk purchasing or reuse, which reduces plastic intensity (Adeola & Ehigiamusoe, 2021).

However, this age is also highly receptive to digital environmental campaigns and more willing to adopt eco-friendly habits (Eze & Abah, 2023). A study in Kenya showed that university students support plastic ban, though struggled with behavioral consistency due to convenience pressures (Muriithi *et al*., 2019). In Nigeria, youths are identified as both major contributors to plastic waste and a critical demographic for behavioral change (Ajibade & Ojo, 2022a).

Environmental, Social, and Health Impacts of Plastic Pollution

Respondents overwhelmingly agreed that plastic pollution affects ecosystems, soil quality, groundwater, human health, and social well-being. Soil and groundwater contamination had the highest recognition (57.5%), followed by aesthetic degradation (55%) (See Figure 3). These aligned with literature showing that plastic blockages worsen urban flooding and degrade landscapes in Nigerian cities (Akanwa et al., 2022).

Health-related impacts were also widely acknowledged. Pest attraction (95%) and toxic chemical release (90%) reflect the dangers posed by microplastics, leachates, and open burning of plastics. Recent Nigerian studies confirm the presence of microplastics in fish, table salt, vegetables, and drinking water (Yusuf & Ogunyemi, 2021), illustrating clear human exposure pathways.

Respondents also recognized that plastic pollution disproportionately affects vulnerable groups (92.5%). Women, children, low-income communities, and informal waste pickers face higher exposure to plastic-related hazards, reflecting global inequality trends in environmental risk distribution (UNEP, 2021). Rwanda's policy model demonstrates that inclusive environmental policies, such as recycling and job creation, can reduce vulnerability while strengthening environmental outcomes (The New Times, 2025).

Economic impacts were also highlighted, including reduced tourism appeal, livelihood losses, and clean-up costs. The contribution of plastics to greenhouse gas emissions (90% agreement) reinforces the climate–waste nexus increasingly emphasized in global environmental policy discussions (IPCC, 2022).

Leveraging on the high female participation (65%) observed in this survey, which aligns with previous studies indicating that women frequently take part in community-based environmental studies, and decision–making in plastic reuse and recycling than men (Okonkwo & Eze, 2020; Ike *et al.,* 2019). Hence, engaging women's perceptions of environmental risks and responsibilities is essential since they are often more vulnerable to plastic-related exposures through water, food packaging, and domestic activities (Yusuf & Ogunyemi, 2021; Alabi *et al*., 2019; Adebayo & Oladipo, 2022).

Rwanda demonstrated this understanding by integrating gender consideration into environmental strategies. The expansion of plastic collection centres in 2025 generated nearly

1,500 green jobs, many of which targeted women in waste sorting and recycling (The New Times, 2025). This suggests that gender-sensitive interventions are essential for addressing plastic footprints effectively.

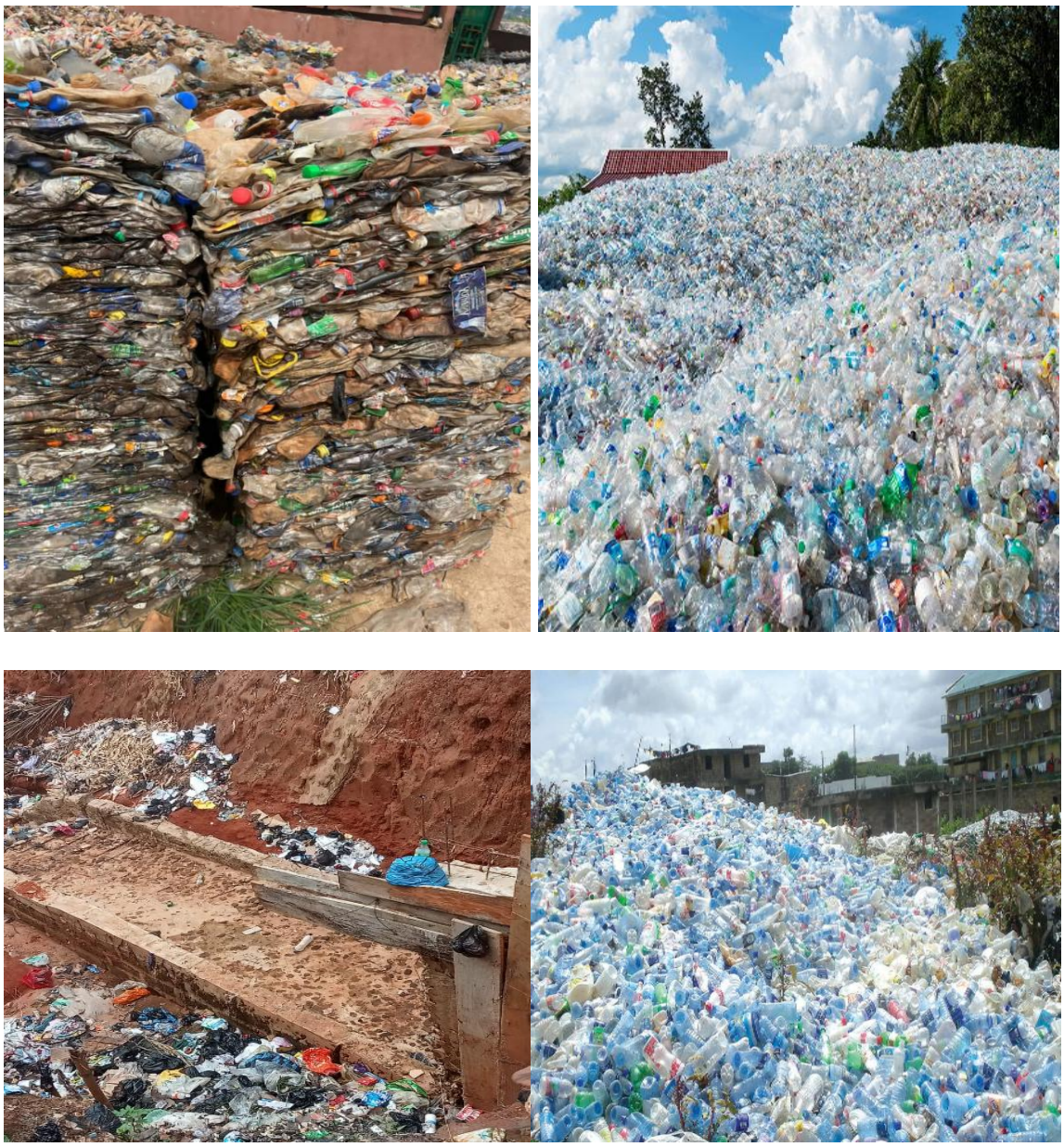


Figure 3: Plastic waste and disposal sites in Awka, Anambra State
Source: Fieldwork, 2025

Institutional and Policy Gaps in Plastic Waste Management in Awka, Anambra State.

Stakeholder interviews revealed that plastic waste challenges in Awka are accentuated by rapid urbanization and population growth. As Awka expanded into peri-urban and rural areas, land use patterns changed drastically (Ikedigwe et al, 2024), with the population increase in 2006 from 301,657 to 487,283 people in 2024 (NPC, 2006; UN Population Division, 2022) (NPC, 2006; United Nations, 2022).

Rapid urbanisation in Awka has significantly increased waste generation, outpacing existing waste-management capacity. As more people migrate to the city, population density and consumption patterns rise, producing larger and complex volumes of waste that local infrastructure struggles to manage (See figure 4). This multiplied the volume of domestic, industrial, and biomedical waste produced daily (Okoye & Okwuosa, 2019).

Waste generation in Awka is estimated to exceed 280 metric tonnes per day, with minimal segregation, limited recycling, and a dependence on unregulated open dumping and sites (Obi & Onu, 2020). Compounding this, poor urban planning and zoning have resulted in inadequate allocation of sanitary facilities, waste-collection routes, and designated disposal sites. Informal settlements and unplanned neighbourhoods lack proper waste-disposal access, leading to open dumping and inefficient collection and health-related concerns (Agu et al., 2021).

In Awka, the absence of a waste-segregation system has led to the mixing of plastics with organic and hazardous waste (See Figure 4), complicating recycling efforts and increasing pollution (Ezeanokwasa, 2019; UNEP, 2018). In the past three decades, Anambra State has evolved from ad-hoc cleaning to structured waste governance, with reforms in ANSEPA and the establishment of ASWAMA under a 2015 waste-management law. ASWAMA's focus on communal bins and roadside pickups, and struggles to keep pace with the city's rapid growth, resulting in frequent overflows and illegal dumping (Nzeadibe & Anyadike, 2019). While small private plastic waste recycling operations exist, overall waste management remains strained by funding, infrastructure, and enforcement challenges.

Recent years have seen practical steps, procurement of collection equipment, public sensitisation campaigns, and partnerships with private and donor actors to pilot recycling and recovery schemes (World Bank ESMP, 2018; BusinessDay, 2024). Despite these advances, implementation gaps and funding shortfalls persist, so progress remains uneven across localities.

Nationally, Nigeria has made efforts in waste management by introducing and practicing the monthly environmental sanitation exercise in 1984 to promote urban cleanliness and public health. Although the initiative initially improved waste removal and heightened environmental awareness, enforcement has weakened over time (Akinmoladun & Adejumo, 2011). In states such as Lagos and Anambra, participation has diminished due to inadequate monitoring, political neglect, and insufficient waste infrastructure (Nzeadibe & Ajaero, 2010).

Similarly, Awka has practiced the monthly sanitation strategy since 1984, but the sanitation programme remains fragmented and inconsistently implemented (Ajibade & Ojo, 2022b). Awka residents are focused mostly on their homes during sanitation, while the community level is absent, unlike Rwanda's cohesive community approach.

Figure 4: Illegal disposal of unsegregated waste in different locations of Awka South
Source: Fieldwork, 2025

Strict enforcement of environmental sanitation at the community level, which was the initial target, if enforced, will strengthen public awareness and regular participation in Awka and other parts of Nigeria. However, Rwanda's strict monthly community clean-up initiative, Umuganda, continues to reduce waste accumulation and could serve as a community-based model for Awka (Rej, 2025).

Notably, there have been significant steps taken to manage plastic waste in Anambra State by the Government. This was through the Anambra State Waste Management Authority (ASWAMA). It launched campaigns such as the *All Anambra Communities Plastic Waste*

Recovery Challenge, which targets the recovery of 100,000 tonnes of plastics across 197 communities, though implementation remains limited due to infrastructural deficits and weak enforcement (Anambra State Government, 2024).

The first phase of this initiative surpassed its modest target of 10,000 tonnes, but to measure up to the target of 100,000 tonnes has been challenging, reflecting persistent gaps in waste collection and recycling systems in the state (Anambra State Government, 2024).

Leveraging on the long-term residency of 42.5% of the respondents (7–10 years), this represents a key knowledge group that can be mobilised for community-based awareness and environmental campaigns. Long-term residents provide an essential historical perspective on evolving waste patterns and contribute valuable insights into behavioural and infrastructural gaps. Mobilising these groups in Awka could strengthen grassroots environmental stewardship, similar to Rwanda's *Umuganda*, demonstrating how community participation can embed waste management practices into civic culture.

Similar studies confirm that the length of residence in urban communities influences environmental perception and identification of pollution trends, thereby developing adaptive or coping strategies (Adeola & Ehigiamusoe, 2021). Longer-term residents demonstrate higher awareness of the implications of plastic waste compared to transient populations (Nwankwo and Okeke, 2022).

Rwanda Plastic Waste Management Model

Although Rwanda experienced similar challenges to Nigeria, it introduced import levies on plastic-packaged goods to curb excessive use and encourage alternatives (Sustainability MEA, 2024). Similar fiscal tools could strengthen Nigeria's environmental policies. In contrast, Rwanda demonstrates how strong policy implementation and strict inspections, including the ban on plastic bags (2008) and the 2019 extension to single-use plastics, can significantly improve waste outcomes.

Rwanda has recognized the centrality of youth in shaping waste practices. Policy strategies target schools and universities, banning single-use plastics on campuses while integrating environmental education into curricula (Rwanda Today, 2024). Such youth-focused interventions have proven effective in aligning awareness with enforceable behaviour, an approach Awka could replicate given its large young population. This suggests that awareness campaigns in Awka should particularly target younger, single populations who contribute disproportionately to plastic waste through lifestyle-driven consumption patterns.

In conclusion, Rwanda has implemented one of the most effective plastic waste policies in Africa, through strict enforcement and penalties that include fines and licence revocation. By 2025, Rwanda had established 24 plastic collection centers, recovered over 1,500 tonnes of plastics, and created nearly 1,500 green jobs (The New Times, 2025).

The Future of Plastic Waste in Awka

Our findings carry important policy implications for Awka and other urban centers in Nigeria. With young, educated, and self-employed individuals dominating the respondent population,

policymakers should design interventions that leverage their capacity for behavioural change. Incentives for recycling, waste segregation, support for eco-friendly packaging, and targeted reductions in single-use plastics can enhance sustainable business behaviour (Nzediegwu & Chang, 2020).

Government agencies should adopt integrated waste management systems that address improper disposal, weak recycling systems, and fragmented supply chains. Establishing material recovery facilities and enforcing extended producer responsibility (EPR) can reduce plastic leakage into the environment (UNEP, 2021). Strengthening local and national regulations, alongside effective monitoring, is essential for compliance.

Public education remains crucial. Given the high proportion of youth in Awka, environmental awareness should be embedded in school curricula, supported by social media campaigns and community sensitization efforts (Jambeck et al., 2018). Policies must also address equity concerns, ensuring that women and low-income households, who are more vulnerable to environmental risks, are included in waste management programs (Wilson et al., 2019).

Finally, the globalized nature of plastic production highlights the need for regional cooperation. Nigeria should align with evolving global frameworks such as the Global Plastics Treaty to harmonize regulations and benefit from circular economy innovations (UNEP, 2022a). Strengthening local enforcement while engaging in global initiatives will help mitigate plastic pollution and protect environmental and public health.

Contributions of this study to Knowledge

1. Plastic pollution in Awka is driven by a combination of behavioural, infrastructural, and governance gaps, providing critical insights for policy reform.
2. Packaging and single-use plastics dominate waste streams due to affordability and convenience.
3. Environmental and health impacts are widely recognized, especially flooding, contamination, and disease risks.
4. Demographic patterns, youthfulness, self-employment, and high tertiary education shape consumption and disposal habits.
5. This study provides evidence-based directions for environmental management, advocacy, and sustainable development in Awka, Anambra State, and sub-Saharan Africa.
6. Rwanda's success demonstrates that strict enforcement, political will, and community engagement are essential for reducing plastic footprints.

CONCLUSION

This study provided strong insights into the demographic profile, awareness levels, and lived realities of residents in Awka, Anambra State, Nigeria. Overall, it concludes that plastic pollution in Awka is not just an environmental issue but a socio-economic and governance challenge. Addressing it requires a holistic approach that integrates behavioural change, improved infrastructure, inclusive waste management systems, and stronger regulatory frameworks. Furthermore, aligning local initiatives with global efforts will be crucial in creating sustainable solutions. By recognizing community perceptions and realities, this study provides evidence-based directions for policymaking, advocacy, and future research.

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