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Assessing the Environmental and Health Implications of Waste Disposal: A Case Study of Africa's Largest Dumping Site

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Authors' contributions

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ABSTRACT

This study investigates the environmental and health repercussions of generated and distributed waste stemming from dumpsites scattered across various Sub-Saharan Africa countries. Through a comprehensive examination of data gleaned from scholarly databases, published reports, to analyze the characteristics and impacts of dumpsites on the environment and public health; key findings illuminate the profound challenges posed by these dumpsites. Notably, large dumpsites such as Olusosun in Nigeria, Dandora in Kenya, and Agbogbloshie in Ghana emerge as focal points due to their staggering size and heightened risk profiles and the significant risk to nearby communities. The analysis underscores pervasive issues including air and water contamination, soil degradation, and the propagation of diseases within nearby communities. There are indications of

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progress and improvements being made in some dumpsites, and initiatives such as waste-to-energy projects, recycling programs, and community-driven interventions are emerging to address these challenges and mitigate the adverse effects of dumpsites on surrounding environments and human health. Considering these findings, recommendations are put forth for bolstering waste management strategies, advocating for meticulous site selection, promoting waste segregation practices, and fostering community engagement. These measures are essential to mitigate the adverse effects of dumpsites, safeguard environmental integrity, and uphold public health standards across the African continent.

Keywords: Dumpsites; waste generation and disposal; Sub-Sahara Africa; waste management; environmental impacts; public health.

1. INTRODUCTION

Dumpsites are essentially unregulated areas designated for the disposal of solid waste, often lacking proper management and environmental safeguards. They serve as on-land dumping grounds where waste is haphazardly disposed of without adequate containment or protection measures. Key features of dumpsites include widespread dispersion of waste, absence of covering or compaction, susceptibility to open burning and frequent fires, exposure to weather elements, attraction of disease vectors, and habitation by scavenging animals like birds and dogs. Typically devoid of engineering, dumpsites lack leachate management and landfill gas collection systems. They are characterized by poor or nonexistent management practices, lacking controls on materials accepted or maintenance of records, and offering no security measures. Informal recyclers, often unprotected, may be found collecting recyclables within dumpsites or even residing there, resorting to scavenging for food. High-income countries are responsible for the largest generation of waste per capita but Sub-Saharan Africa is the world's fastest-growing region in this regard, with its total generation expected to triple by 2050 [1]. This increase is being driven largely by the growth in consumption and changing production and consumption trends that have accompanied rapid urbanization [2].

Open dumps are the preferred method of disposing of solid waste as an alternative of landfills in most African countries. In open dumps refuse is simply dumped in low lying areas on open land. Open dumps are characterized by an absence of engineered measures, no leachate management or consideration of landfill gas management, and few if any operational measures, such as registration of users, control of the number of tipping fronts, or compaction of waste [3]. Consequently, dumpsites present significant health and environmental hazards to both those involved in their operations and the surrounding communities. In many parts of the African continent, environmental problems have emerged to pose a great challenge, especially in solid waste management. With population growth and waste generation on the rise, there needs to be a quick and effective waste management response to combat the challenges of sustainable development if there's any chance of meeting current needs without jeopardizing the potentials and ability of future generations to meet theirs [4]. As the quantity of waste produced in cities continues to increase daily, the effectiveness of waste management in terms of collection and disposal remains undesirably low in most parts [5]. Managing waste in urban areas is very important, especially given the fact that waste generated from these urban areas most likely ends up being transported to rural and low-income areas for disposal [6], with the full impacts of waste disposal activities to be felt years afterwards.

Waste management is of critical importance in Africa for reasons related to public health, human dignity, climate resilience, and environmental preservation. However, delivering waste management services requires adequate funding, which has generally been lacking in a context where the generation of waste is outpacing the development of waste management infrastructure in most cities in Africa [2]. The uncontrolled manner in which solid waste is disposed of at most open dumpsites creates serious health problems for humans, animals, and environmental degradation. This inadequate waste disposal translates into economic and other welfare losses [7]. The inadequate management of waste disposal sites across various regions in Africa poses significant environmental and public health challenges. Improper waste management practices, including open burning, lack of containment measures,

and inadequate infrastructure, contribute to air and water pollution, soil contamination, and the spread of diseases among waste pickers and residents. Furthermore, the presence of hazardous materials such as electronic waste (e-waste) exacerbates these issues. These challenges are compounded by the proximity of dumpsites to residential areas, natural resources, and water bodies, resulting in widespread environmental degradation and health risks for millions of people living in the vicinity. Urgent action is needed to address these issues and implement sustainable waste management solutions to safeguard public health and protect the environment in affected communities. Hence, this paper seeks to uncover the environmental and health implications of waste generation and distribution, with a focus on Sub-Sahara Africa's largest dumping site. Hence, this paper seeks to uncover the environmental and health implications of waste generation and distribution, with a focus on Sub-Sahara Africa's largest dumping site.

2. METHODOLOGY

The methodology for this study involves assessing the environmental and health implications of waste generation and distribution, focusing on Africa's largest dumping site. Secondary data collection will be conducted through platforms such as Google Scholar, Scopus, Web of Science and other published journals. The search will target information related to dumpsite sizes across Africa, with a specific aim to identify sixteen (16) dumpsites in Sub-Saharan Africa. Major data on dumpsites in Africa will be gathered from the Waste Atlas Report, a published work from 2014. This comprehensive approach will provide valuable insights into the environmental and health impacts associated with waste management practices, particularly in the context of Africa's largest dumping site.

3. RESULTS AND DISCUSSION

According to the Waste Atlas Report [8], Africa hosts numerous dumpsites, with many of them located in Sub-Saharan Africa. These dumpsites represent a pressing issue that requires effective management strategies to mitigate their adverse effects on both the environment and public health. For environmental and health's sake, dumpsites must be far away from residential areas as this would help protect residents of such areas. Love et al. [9] research suggests that the Golden Quarry landfill site in Harare, Zimbabwe, originally an abandoned gold mine, commenced landfill operations in 1985 to rehabilitate the land by filling the shafts and pits. Similarly, Rotich et al. [10] argue that in Eldoret, Kenya, the abandoned sand quarry at Mwendeni became a dumping ground for municipal solid waste, despite its evident role as a water catchment area for small streams flowing into the Sosiani River. The Dandora municipal dumping site in Nairobi, Kenya, repurposed an old quarry, filling it with garbage, but has since become a health hazard for nearby residents [11]. These examples are emblematic of major dumpsites across Sub-Saharan Africa, contributing to environmental and health challenges for local communities. Dumpsites in Africa are characterized by inadequate management practices, resulting in significant environmental and health risks for nearby residents. These sites often lack proper containment measures, leading to waste dispersal, open burning, and exposure to disease vectors. Moreover, informal recyclers may inhabit or scavenge within dumpsites, further intensifying the health hazards present.

3.1 Largest Dumpsites in Sub-Sahara Africa and their Environmental and Health Implications

3.1.1 Awotan (Apete) Dumpsite, Nigeria

The Awotan (Apete) Dumpsite is situated along Akufo Road in the Ido Local Government Area of Ibadan, Nigeria, which is the third metropolitan area in the country. Its geographical coordinates are latitude 7.463069°N and longitude 3.849106°. Operational since 1998, the dumpsite annually receives 36,000 tonnes of municipal solid waste [12]. Covering an area of 14 hectares, it has already accumulated between 370,000 to 525,000 tonnes of waste. Over 80 individuals scavenge for recyclables on the site, while many dumpsite workers, truck drivers, and lorry drivers engage in similar activities to supplement their monthly incomes [13, 14]. Unfortunately, the site serves as a breeding ground for diseases such as cholera, dysentery, as well as other airborne and skin diseases for the residents of the nearest settlement, located only 200 meters away. Reports indicate groundwater contamination, rendering local wells unsafe for consumption. The nearest natural resources, Eleyele Lake and International Institute of Tropical Agriculture (IITA) Forest Reserve, are approximately 2.5 km and 4.5 km away respectively. There have been reports of

plastic waste polluting the lake, posing a threat to aquatic animals and, subsequently, to human health when consumed.

According to a report by Remi [15] in Business Day Newspaper, efforts are underway to upgrade the dumpsite to meet international waste disposal standards and explore recycling as a means of converting waste to wealth. The report also highlights infrastructure improvements, including the construction of about 1 km of access roads to reach all areas of the dumpsite, addressing the issue of waste disposal trucks offloading their contents only at the entrance due to inaccessible areas. Besides enhancing the environmental landscape in Ibadan, the Awotan Landfill project has the potential to create jobs for at least 3,000 people. Additionally, the Oyo State Government is considering converting methane gas derived from the waste into electricity, demonstrating a commitment to sustainable waste management practices.

3.2 Lapite Dumpsite, Nigeria

The Lapite dumpsite is situated in Ibadan, Nigeria, and has been in operation since 1998. Covering an area of 20 hectares, it receives approximately 9,000 tonnes of Municipal Solid Waste (MSW) annually [12, 16]. Located in the Akinyele Local Government Area of Ibadan, Oyo State, the dumpsite's coordinates are between latitude 7°34'08"N and longitude 3°54'43"E. Positioned directly opposite a major road, the site is bordered by vegetation on both sides. Among the various types of solid waste found there are scrap metal materials, garbage, paper, nylon, rubber, cartons, and cans. It's estimated that between 95,900 to 137,000 tonnes of MSW have been deposited at the site [16, 17]. Near the dumpsite, there are a few residential buildings, a rehabilitation center, a petrol filling station, and several huts. The nearest settlement is approximately 2 km away. Due to open burning on the site, air pollution is a significant issue, and the leakage of heavy metals from the site's leachate poses a serious threat to groundwater and biodiversity in the surrounding area. The dumpsite is located 9 km from the IITA Forest Reserve, which is a significant natural resource of the area [16].

3.3 Eneka Dumpsite, Nigeria

The Eneka dumpsite, positioned west of City Port Harcourt, Nigeria, along Igwuruta/Eneka road at Longitude 7°02’33.18” E and Latitude 4°53’32.82” N, is encircled by neighboring settlements including Rumuokwurushi/Elimgbu to the North, Igwuruta to the South, and Rumuduru town (in Oroigwe) to the East. Covering an area of 5 hectares, the site faces frequent flooding year-round due to the region's annual rainfall exceeding 2,500 mm. Presently, it receives approximately 45,600 tonnes of waste annually and accommodates an estimated 8.4 to 12 million tonnes of Municipal solid waste [18]. With dimensions of approximately 200 meters in length and 425 meters in width, tapering to about 130 meters along Igwuruta/Eneka highway, the site primarily serves as a disposal site for non-hazardous domestic waste, predominantly kitchen waste sourced from various establishments such as offices, operational and residential areas, as well as waste from estate management activities, encompassing garbage (cardboard/paper), garden waste, food, plastics, metals (tins/cans), and trash [19].

Despite the closest building being approximately 200 meters away, the site was originally surrounded by dense bushland and has since been designated by the state government as an industrial area. It's estimated that the site adversely affects around 1.2 million people residing within a 10 km radius. Additionally, the site is situated 9 km from both the Okpoka River and Otamiri River [18]. Consequently, contamination of groundwater, surface water, and soil from heavy metals, along with air pollution, has been observed in the vicinity. Those employed at the site, particularly waste pickers, are susceptible to illnesses such as malaria, parasitemia, and blood disorders associated with high concentrations of heavy metals [18].

3.4 Olushosun Dumpsite

The Olusosun dumpsite, situated in Lagos, Lagos State, Nigeria, spans 100 acres and is renowned as the largest in Africa and one of the largest globally [20]. This colossal site receives up to 10,000 tons of rubbish daily, including waste from approximately 500 container ships, which contributes a significant portion of electronic waste. Some of this waste undergoes chemical treatment to extract reusable materials, resulting in the emission of toxic fumes. Approximately 500 makeshift homes dot the site, housing residents who eke out a living by scavenging for scrap to sell [21, 22]. Originally located on the outskirts of the populated area, Lagos's massive expansion in recent years has enveloped the dumpsite, rendering it surrounded by commercial and residential areas. Being the

Fig. 1. Olosusun dumpsite Image
Source: Punch news paper, 2023

largest dumpsite in Lagos, it receives around 2,100,000 tonnes of Municipal solid waste, construction, and E-waste annually, spanning an area of approximately 43 hectares [23, 24]. Operational since 1992, it's estimated that 17,150,000 to 24,500,000 tonnes of waste have already been disposed of at the site [23, 25]. Around 1,200 scavengers comb through the site daily in search of recyclables to sustain their livelihoods. These scavengers are organized into associations, which record their numbers and activities. Numerous health issues have been reported within a 3 km radius of the site, including headaches, nausea, skin irritations, dysentery, diarrhea, and water-related diseases. Over 5 million people reside within a 10 km radius of the site. Positioned just 5 km northeast of Lagos Lagoon, the site contributes to water contamination due to high concentrations of heavy metals in the leachate that reaches surface and underground water. Additionally, the site is located 9 km from the Ogun Forest Reserve. However, there have been multiple plans to close the dumpsite due to the environmental and health hazards it poses to scavengers and nearby residents.

3.5 Solous Dumpsite, Nigeria

The Soluos landfills, situated at the extreme east-west area of metropolitan Lagos in Alimosho Local Government, are among the five active landfills currently operated by the Lagos Waste Management Authority (LAWMA). According to LAWMA's monthly report in December 2011, Soluos 2 and 3 landfills received 81,388 metric tonnes of Municipal Solid Waste (MSW) out of a total of 239,282 metric tonnes landfilled [26]. These landfills receive waste from the entire Lagos metropolis, including domestic, commercial, and industrial sources. Originally burrow pits for lateritic soil, the sites are unlined and bordered by residential housing. Waste brought by trucks is dumped haphazardly without daily soil cover and is sorted by on-site waste pickers.

Solous 1, covering 7.5 hectares, is the oldest site, operational since 1993. It closed in 2006 without a final cap or cover but was reopened in 2011 and continues to receive waste. Solous 2, occupying around 8 hectares along University-Iba Road, less than 200 meters away from the nearest dwelling, has been active since 2006, receiving approximately 820,000 tonnes of waste annually [23, 27]. It is estimated that 4 to 5.8 million tonnes of MSW are already deposited there. Solous 3 commenced operations in 2008 and receives about 2,250m3 of waste daily. It is the largest of the three sites, spreading over 12 hectares, with a significant portion yet to be filled up. It is bordered by a government hospital, and approximately 350 - 400 scavengers work on-site, sorting out shoes, plastics, glass, scrap, and e-waste for sale to traders [28]. Due to the vulnerable sandy formations of the ground, leachate flows to the groundwater, causing contamination and rendering water unsuitable for human consumption. Almost 4 million people live within a 10 km radius of the site.

Furthermore, according to a report by Temitope [28] in Premium Times Newspaper, many scavengers not only work but also spend their nights at the landfills, creating a unique community that thrives amidst waste. These landfills, receiving about 4,000 tonnes of waste daily, are the second-largest landfill complex in Lagos, surpassed only by the Olusosun dumpsite in Ojota. Initially unnoticed by the local populace, as the city expanded, residential areas, businesses, and critical infrastructure like the Alimosho Medical Centre edged closer to these dumpsites, turning them from harmless landmarks into significant health hazards for neighboring communities. Residents in Igando now endure the pervasive and unpleasant smell of decomposing waste, a reminder of the growing environmental challenge at their doorstep.

3.6 Epe Dumpsite, Nigeria

The Epe dumpsite is located in Lagos, Nigeria, covering an area of 80 hectares [29]. Specifically situated in the Epe Local Government Area of Lagos State, it lies between Latitudes 6°33'00'' and 6°35'00''N and Longitudes 3°55'30'' and 3°56'30''E on the northern flank of the Coastal Lagos Lagoon. Operational for over 10 years, the dumpsite receives an annual input of 12,000 tonnes of Municipal Solid Waste (MSW) (LAWMA Report), with an estimated accumulation of 33,000 to 47,000 tonnes of waste to date. The site is located 500 meters from the nearest settlement, 2 km from the Osogbo River, and less than 7 km from the Lekki Lagoon, which are natural resources at risk from pollution. However, significant plans are underway to transform the dumpsite into a proper landfill by the Lagos State Government, with the project believed to be ongoing. These efforts aim to mitigate the environmental and health risks associated with improper waste disposal practices at the dumpsite [30].

3.7 New England Road Dumpsite, South Africa

The New England Road waste dumpsite, serving the greater Sobantu area in Pietermaritzburg, South Africa, opened 25 years ago [31]. This site receives approximately 140,000 tonnes of Municipal Solid Waste (MSW) annually and covers an area of 19.1 hectares [32]. It has been estimated that 2.5 to 3.5 million tonnes of waste have already been disposed of at the site. However, management by the Msunduzi Local Municipality has been problematic, with the dumpsite frequently experiencing fires, lacking a functional leachate collection system, and not meeting minimum lining requirements. Within the site, there are approximately 300 waste pickers, predominantly women and a few children. Many of these children exhibit visible health problems such as stunted growth, runny noses, chest problems, and skin infections. Furthermore, the dumpsite is located just 500 meters from the nearest settlement and the Msunduzi River, posing a serious threat to public health and aquatic life [32].

Fig. 2. New England dumpsite image
Source: Lethiwe Makhanya, (2022)

3.8 Luipaardsvlei Dumpsite, South Africa

The Luipaardsvlei dumpsite, located in Kagiso, South Africa, covers an area of 5 hectares [32]. Operating since 1980, the site has accumulated approximately 2.5 to 3.5 million tonnes of Municipal Solid Waste (MSW) over the years. Annual waste disposal reached 182,500 tonnes in 2013. It is estimated that 150 people reclaim recyclables for selling and organic matter for feeding livestock at the dumpsite. The site is situated 7 km away from the Walter Sisulu National Botanical Garden and Krugersdorp Municipal Nature Reserve, and 9 km away from Robinson Lake. Consequently, it has caused environmental problems such as water contamination and biodiversity issues affecting flora and fauna. However, recent efforts have been made to address these environmental problems. On October 10, 2023, two 40-foot recycling containers were placed at the dumpsite by eWASA (Extended Producer Responsibility Waste Association of South Africa) and partners, in collaboration with the Mogale City Local Municipality, as part of wide-ranging recycling initiatives aimed at mitigating the environmental impact of the Luipaardsvlei dumpsite [33].

3.9 Arlington Dumpsite, South Africa

The Arlington dumpsite, situated in Walmer, Port Elizabeth, South Africa, has been operational since 1984 [34]. Over the years, it has received approximately 2.5 to 3.6 million tonnes of Municipal Solid Waste (MSW) and Liquid Hazardous waste. Covering an area of 13.2 hectares, the site is located 1.5 km from the nearest settlement and approximately 5 km from the sea. Additionally, it is situated 9 km from the Natural Resources at Risk, including the Nelson Mandela Metropolitan University Private Nature Reserve and North End Lake. Around 100 waste pickers are known to work within the site. A report by Luvuyo Mehlwana [35] on Spotlight News highlights the reliance of many scavengers on the Arlington dumpsite for their livelihood. According to interviews conducted by Mehlwana, scavengers depend on the dump not only for food but also for other necessities, despite being aware of the potential health hazards. They describe the dumpsite as very dirty, with a bad smell on sunny days that makes it difficult to breathe. Nonetheless, they continue to work there, fully aware of the associated health risks.

3.10 Dandora Dumpsite, Kenya

Dandora serves as Nairobi's primary dumping ground, receiving over 2,000 metric tonnes of waste daily from the city's 4.5 million residents. Spanning 53 hectares, it annually handles approximately 730,000 tonnes of Municipal Solid Waste (MSW), Hospital, Agricultural, and Industrial waste [36]. Since its establishment in 1975, an estimated 19,500,000 to 27,750,000 tonnes of waste have been deposited at the site. Each day, nearly 3,000 waste pickers, both men and women, converge on the site in search of sustenance and materials such as metals, rubber, glass, plastics, and electronics [37]. The nearby slums are densely populated, with approximately 1,000,000 residents living within close proximity, some as close as 200 meters, while nearly 3.5 million people reside within

Fig. 3. Dandora dumpsite image
Source: Joseph Limo-Tearfund

a 10 km radius [36]. Due to its proximity to dwellings, the dumpsite has been associated with numerous health problems, including respiratory issues such as chest pain caused by the smell and burning of waste, gastrointestinal and dermatological diseases, and elevated blood lead levels. Diseases such as cholera, malaria, typhoid, sexually transmitted diseases, and HIV/AIDS are prevalent among the slum population. Furthermore, heavy metals such as lead, mercury, and copper, as well as organic pollutants like aldrin, dieldrin, and carbonates, escape from the Dandora dumpsite, contributing to water pollution in the adjacent Athi River [38, 36]. The dumpsite is particularly inundated with plastic waste, which serves as a major draw for waste pickers in the area.

3.11 Granville Brook Dumpsite, Sierra Leone

The Granville Brook dumpsite, also known as Kissy, is situated at the neck of the estuary of Granville Brook, along the Bai Bureh road, which is the main highway from Freetown to the rest of the country. Over the years, this open dump has been the recipient of large quantities of solid waste from Freetown, covering an area of 3 hectares. It receives approximately 272,000 tonnes of Municipal Solid Waste (MSW), Industrial, Hazardous, and Medical waste annually [39, 60, 40]. Operations at the site began at the end of the civil war, and it has been in operation for 12 years. It is estimated that between 2.3 to 3.3 million tonnes of waste have been disposed of at the site. The dump is in close proximity to dwellings and is just 1 km away from the Atlantic Ocean, raising concerns about serious health problems and environmental impacts. Nearly 1.2 million people live within a 10 km radius of the site (Gogra et al., 2010). he dumpsite's location has led to numerous health issues among residents, with malaria being the most prevalent. Smoke from open burning during the dry season and underground water pollution during the rainy season have been attributed to chest pains, diarrhea, cholera, and irritation of the skin, nose, and eyes [40]. All waste disposed of at the dumpsite poses health risks and environmental disasters such as massive flooding during the rainy season [39]. Furthermore, the Granville Brook dumpsite is now located in the center of the city, surrounded by numerous human settlements, posing public health hazards to nearby residents. Additionally, the dumpsite has exceeded its capacity and due to poor operational systems, it has almost degraded into a potentially hazardous and toxic dump.

3.12 Hulene Dumpsite, Mozambique

The Hulene dumpsite, situated in the capital of Mozambique, Maputo, is located on a former wetland and is in close proximity to an airport and a primary school [41]. Covering an area of 25 hectares, the site receives almost 290,000 tonnes of Household, Commercial, Industrial, and Medical waste annually [42]. Since its opening 50 years ago, it has been estimated that around 1,750,000 to 2,500,000 tonnes of waste have been disposed of at the site [43, 44]. The dumpsite is a poorly secured area where more than 500 informal waste collectors search for recyclables. Open burning activities contribute to a constant smoky haze over the dumpsite, and groundwater contamination is reported during the rainy season. Scavengers face various health problems such as colds, headaches, diarrhea, malaria, accidental cuts, and backache. The site is located 7 km from the sea, and it is estimated that 2.7 million people live within a 10 km radius from the site. Inside the Hulene dump, at least 500 people scavenge through garbage every day to survive. Most of the collectors are women living on the poverty line, hailing from different provinces, although many are from the neighborhood of Hulene, on the outskirts of the Mozambican capital, Maputo.

3.13 Mbeubeuss Dumpsite, Senegal

The Mbeubeuss dumpsite, situated in Malika, serves as the primary solid waste disposal site for the capital city of Dakar, Senegal [45]. Established in 1968 as a replacement for the Hann Landfill, which closed in 1971 [46], the Mbeubeuss dumpsite covers an expansive area of 175 hectares. It receives approximately 475,000 tonnes of Municipal Solid Waste (MSW), Industrial, and Hospital waste annually. Over the course of its 45-year existence, an estimated 7.4 to 10.5 million tonnes of waste have been deposited at the site [47, 48]. The dumpsite is surrounded by a community of more than 3,500 people, with around 400 individuals residing within the site itself and an additional 1,000 to 1,200 scavenging for a livelihood [49]. The site features essential amenities such as a health center, literacy center, credit and savings co-op, and a training center. However, numerous health issues related to skin and respiratory diseases have been reported among residents and workers [48]. Environmental concerns are significant due to the dumpsite's proximity to lakes, wells, and the sea. Specifically, the Mbeubeuss dumpsite is adjacent to Mbeubeuss

Lake and is located 2, 3.5, and 9 kilometers away from the Atlantic Ocean, Malika Lake, and Rose Lake, respectively. Wells in the vicinity are not utilized for drinking water due to contamination by metals and pathogenic microorganisms. The landfill is also a hub for approximately 4,000 scavengers who search for recyclable materials, primarily plastic. Additionally, toxic fumes emitted by the dumpsite and high levels of Persistent Organic Pollutants (POPs) have been measured in the atmosphere and in local eggs. It is noteworthy that nearly 1 million people have settled within a 10-kilometer radius from the site, highlighting the potential risks to the surrounding population.

3.14 Agbogbloshie Dumpsite, Ghana

Agbogbloshie, located in the capital city of Ghana, Accra, is one of the largest e-waste dumps in Africa, spanning an average size of 10.6 hectares and with an annual capacity of 192,000 tonnes [50]. Over its 13 years of operation, the site has accumulated around 1,750,000 to 2,500,000 tonnes of e-waste. The informal sector plays a significant role, with more than 10,000 people engaged in processing e-waste on the site to recover precious metals such as copper, aluminum, and iron. Approximately 2.3 million people reside within a 10-kilometer radius of the site. According to a Bloomberg report by Peter Yeung [51], up to 10,000 workers laboriously sift through tons of discarded electronic goods as part of a vast informal recycling process, making Agbogbloshie one of the world's largest destinations for used electronic goods. However, these workers face numerous health challenges, including burns, back problems, infected wounds, respiratory issues, chronic nausea, and debilitating headaches, all exacerbated by the hazardous working environment and toxic air pollution.

Despite the staggering volume of e-waste accumulating at Agbogbloshie, only a fraction is appropriately recycled. The United Nations report highlights that around 50 million tons of electronic waste are discarded annually, a figure projected to double by 2050. Unfortunately, only 20 percent of e-waste is believed to be recycled appropriately, with the rest ending up in landfills or being disposed of by informal workers in poor conditions. Open burning is a common practice at the site, emitting thick black smoke that contributes to respiratory and chest problems, chronic nausea, and headaches among the informal sector. Alarmingly, reports indicate that 80% of children living on or near the site exhibit increased levels of lead in their blood. Moreover, high levels of toxins have been found in soil and food samples due to the release of toxic chemicals into the ground, water, and atmosphere during the breakdown, burning, and processing of e-waste. The aquatic life of nearby water bodies such as the Odaw River (200 m), Korle Lagoon (2 km), and the Gulf of Guinea (2.5 km) has been significantly impacted by high levels of heavy metals and e-waste contamination [52, 53].

Fig. 4. Agbogbloshie dump site image
Source: Peter Yeung, 2019

3.15 Pugu Kinyamwezi, Tanzania

The Pugu Kinyamwezi dumpsite, situated in Pugu village, Kisarawi, Tanzania, serves as the primary dumping ground for the majority of solid waste generated in Dar es Salaam city [54].

Since 2009, the site has accumulated an estimated 1,400,000 to 2,050,000 million tonnes of various waste types, including industrial, agricultural, domestic, commercial, institutional, medical, and other special wastes such as yard wastes, batteries, and electronics [55]. Presently, the site spans an area of 65 hectares and receives approximately 493,000 tonnes of waste annually [54]. Within the site, approximately 3,000 waste pickers are engaged in recovering recyclable materials. These workers frequently encounter health issues such as respiratory problems due to open burning, injuries from sharp objects, skin diseases, and diarrhea. Additionally, the presence of free-ranging livestock that feed on garbage further complicates the environmental and health hazards associated with the dumpsite. Water contamination of surrounding water bodies, which are utilized for various human activities including domestic use, has been observed. Moreover, the dumpsite's proximity to the nearest settlement, less than 200 meters away, significantly impacts approximately 4 million people within a 10-kilometer radius. The Pugu site is situated between two streams, with the Kinyamwezi stream located to the north and the Nyamaronda stream to the south. These streams receive water from the upstream areas of Pugu Forest Reserve and Kazimzumbwi Forest Reserve. Important natural resources, such as Mogo Forest Reserve and Kizinga River, are located within a distance of less than 10 km from the Pugu Kinyamwezi dumpsite [55].

3.16 Lagoon Dump Site, Republic of South Sudan

The Lagoon Dump Site, situated on Yei Road less than 10 km southwest of Juba Centre Town, has been operational since 2008. Spanning an area of 25 hectares, it receives approximately 182,500 tonnes of municipal solid waste (MSW), medical waste, and hazardous waste annually. Since its inception in 2008, an estimated 630,000 to 910,000 tonnes of waste have been deposited at the site [56]. Currently, nearly 100 waste pickers operate on the site, primarily scavenging for plastics such as PET bottles and nylon sacks, as well as metal scrap like aluminum and metal cans [59]. For many of these waste pickers, the dumpsite serves as an informal workplace, with individuals coming from outside Juba in search of employment opportunities. In addition to searching for recyclable materials, waste pickers also scavenge for food items amidst the waste. Middlemen purchase these materials from the waste pickers and export them to destinations such as China (as reported by Juba in the Making Website Report) [57]. Waste pickers face various health challenges, predominantly respiratory and skin diseases. Of particular concern is the disposal of biomedical waste at

Fig. 5. Lagoon dumpsite image
Source: Juba in making website

the site, including items such as needles, syringes, soiled swabs, and bandages. The inadequate handling of biomedical waste poses significant health risks to waste pickers, exposing them to infections such as HIV/AIDS and hepatitis. The site's proximity to the Juba Game Reserve, located 4 km away, raises environmental concerns [58]. The improper disposal practices and the presence of hazardous materials at the dumpsite underscore the urgent need for improved waste management strategies to mitigate health and environmental risks associated with the Lagoon Dump Site.

4. ENVIRONMENTAL AND HEALTH IMPLICATIONS

1. **Air Pollution**: Open burning of waste releases toxic fumes, contributing to air pollution and posing respiratory risks to nearby residents and workers. Inhalation of smoke and pollutants can lead to respiratory illnesses such as asthma and bronchitis.
2. **Water Contamination**: Leachate from dumpsites containing heavy metals and other pollutants can contaminate surface water bodies and groundwater, posing risks to aquatic ecosystems and human health. Waterborne diseases like cholera and dysentery can spread through contaminated water sources, impacting communities relying on them for drinking and sanitation.
3. **Soil Degradation**: Improper waste disposal practices lead to soil contamination and degradation, affecting soil fertility and vegetation growth. This can disrupt local ecosystems and agricultural activities, further exacerbating food insecurity and environmental degradation.
4. **Biodiversity Loss**: Habitat destruction caused by dumping waste near natural habitats contributes to biodiversity loss, threatening the survival of plant and animal species. Disrupted ecosystems can lead to imbalances in local wildlife populations and ecosystem functions.
5. **Health Risks to Wildlife**: Contaminated water and food sources pose health risks to wildlife living in or near dumpsites, potentially leading to population decline and ecosystem imbalances.
6. Skin Irritations and Infections: Contact with contaminated soil or water can cause skin irritations and infections among individuals living or working near dumpsites. Dermatological issues are common due to exposure to pollutants and hazardous materials.
7. **Heavy Metal Poisoning**: Exposure to heavy metals present in the waste, particularly through contaminated water sources, can lead to poisoning and associated health problems such as neurological disorders, kidney damage, and developmental issues.
8. **Occupational Hazards**: Workers involved in waste picking and disposal, as well as those living in nearby communities, are particularly vulnerable to various occupational hazards. These include injuries, infections, and exposure to hazardous substances present in the waste.

5. CONCLUSION

The exploration of dumpsites across Africa reveals a complex interplay of environmental degradation and public health risks. Large dumpsites such as Olusosun in Nigeria, Dandora in Kenya, and Agbogbloshie in Ghana stand out as epicenters of waste accumulation, posing significant threats to surrounding ecosystems and human well-being. However, amidst these challenges, glimmers of progress and improvement are discernible. Initiatives such as the upgrading of the Awotan (Apete) Dumpsite in Nigeria to meet international waste disposal standards, the establishment of recycling initiatives at the Luipaardsvlei Dumpsite in South Africa, and the ongoing efforts by the Lagos State Government to transform the Epe Dumpsite into a proper landfill exemplify proactive steps toward sustainable waste management. These endeavors signify a growing recognition of the urgent need to address the pressing issues posed by dumpsites, emphasizing the importance of collaborative action among governments, communities, and stakeholders. Furthermore, sustained commitment to innovative waste management practices, coupled with robust regulatory frameworks and community engagement, will be pivotal in mitigating the environmental and health impacts associated with dumpsites, fostering healthier, more sustainable environments for generations to come.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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