5 Impacts of waste in Africa

5 Impacts of waste in Africa

What the reader can expect

This chapter focuses on the impacts of poorly managed waste on human health and the environment in African countries. It brings major flaws in waste management practices to the fore, including uncontrolled dumping and open burning, the most commonly used waste management practices in Africa. The impact of these practices on human health and the environment is discussed, with supporting case studies. The chapter also sheds light on illegal cross-border trafficking of waste and its impacts on human health, especially on vulnerable groups, including waste collectors, children and women. In addition, the chapter considers the hazards posed by the poor management of health care and nano wastes and the need for more stringent measures and regulatory frameworks for hazardous waste in general. The chapter draws attention to the impact of poor waste management practices on climate change and ecosystems, including the impact of littering on the marine environment. The chapter ends with recommendations to reduce the negative impacts of waste in Africa.

Key messages

The following are the key messages regarding the impacts of waste on human health and the environment in Africa:

- Waste management is a major challenge facing many African countries. Factors such as lack of awareness; weak environmental legislation and enforcement; and limited resources, including financial resources, result in inefficient waste management in many African countries, with the potential to directly impact human health and the environment.
- Open dumping (uncontrolled and controlled), often associated with burning, are the predominant disposal methods used in Africa (**see chapter 3**), with the potential to have serious implications for human health and the environment.
- The impacts are not always local, but can be far reaching (e.g. methane and black carbon released through open burning of waste are short-lived climate pollutants with strong effects on regional and global climate change).
- Africa is a global destination for end-of-life EEE and vehicles exported from developed countries in North America, Europe and Asia, where it accumulates as waste (See **Topic Sheet 2** in **chapter 3**). Current e-waste recycling practices, often informal, pose potential risks to people and the environment. Children and women are heavily involved in e-waste recycling in Africa, constituting the most vulnerable group for this waste.
- Recycling of used lead-acid batteries in informal workshops in Africa is a major source of lead pollution, exposing considerable numbers of people and the environment to adverse effects.

Key messages (continued)

- In many African countries facilities for the final treatment or disposal of health care waste are inadequate or sub-standard. It is therefore imperative to enforce special legislative and regulatory measures to help manage the often virulent nature of health care waste.
- Emerging waste streams such as nano-waste, pose a potential future risk for Africa, as these wastes usually end up in the MSW, exposing communities and ecosystems to potential risk.
- Plastic waste is growing in Africa. With weak waste collection systems and disposal of waste to uncontrolled and controlled dumpsites, the leakage of plastic into the environment poses a significant threat to the environment and economies. This is compounded by the lack of recycling in Africa.

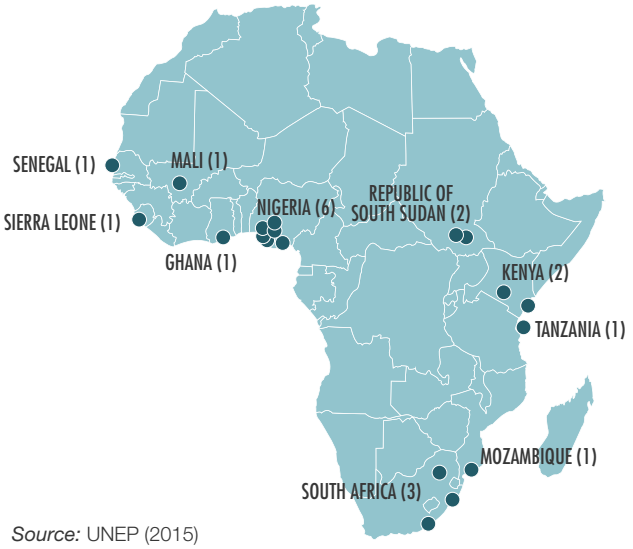
5.1 The waste-environment-public health nexus

Chapter 3 presented the state of waste and waste management in Africa and highlighted the key waste management challenges facing the African continent. These include:

- Uncontrolled dumping of waste
- Open burning of waste
- Poor waste collection coverage, resulting in the accumulation of waste in urban areas
- Trafficking and dumping of waste, particularly hazardous waste, in Africa
- Informal collection and recycling
- Informal land reclamation
- The emergence of new, often complex waste streams

The impact of these activities on human health and the receiving environment (water, air, soil) in Africa are discussed in the following sections.

Figure 5.1 Dumpsites in Africa included within the world's 50 biggest dumpsites



Source: UNEP (2015)

5.1.1 Uncontrolled dumping

Open dumping (uncontrolled and controlled), with associated burning of waste, is the most common waste disposal method in Africa (Hoornweg and Bhada-Tata 2012, Johannessen and Boyer 1999) (**see chapter 3**). According to UNEP (2015), 19 of the world's 50 biggest dumpsites are located in Africa, all in sub-Saharan Africa (**Figure 5.1**). Uncontrolled dumping of waste in African cities has the potential to cause significant direct and indirect impacts[11] on communities and receiving environments (Mpofu 2013, Jerie 2016). Residents, particularly those living adjacent to dumpsites, are at risk from the improper disposal of waste, owing to the potential of the waste to contaminate water and food sources, land, air and vegetation (Kimani 2012). Furthermore, the impacts of open dumping and burning on human health and environment can be diverse.

Dandora dumpsite, Nairobi, Kenya

Photo credit: © Janis Brizga, Green liberty / EEB

11 According to the GWMO (UNEP 2015) direct health impacts affect those coming into contact with uncollected wastes or breathing the fumes if those wastes are burned. Indirect health impacts occur for example via blocked drains and watercourses, which provide breeding grounds for vectors causing infectious diseases such a cholera, dengue fever and plague, and also cause flooding.

Table 5.1 Analysis of soil samples from Dandora dumpsite, Nairobi, Kenya

Elements	Mean elemental conc. of soil samples (ppm)			Reference values in soil standards	
	Within the dumpsite	Adjacent to the dumpsite	Waithaka soil samples (pre-urban area on the outskirts of Nairobi)	The Netherlands	Taiwan
Potassium	19 100	20 758	7 835	–	–
Calcium	77 000	14 558	4 300	–	–
Titanium	6 100	5 433	5 650	–	–
Chrome	689	157	118	100*/250**	100[a]/400[b]
Magnesium	3 500	4 366	2 400	–	–
Iron	84 800	45 800	57 100	–	–
Copper	507	105	BDL	50*/100**	120[a]/200[b]
Zinc	2 100	462	133	200*/500**	35[a]/500[b]
Mercury	46.7	18.6	BDL	0.5*/2**	0.29[a]/2[b]
Lead	13 500	264	34.5	50*/150**	50[a]/500[b]
Cadmium	1 058	40	–	1*/5**	2[a]/5[b]

Source: Kimani (2012)

Abbreviations: BDL, below detection limit

* Tentative soil quality standards for the Kingdom of the Netherlands

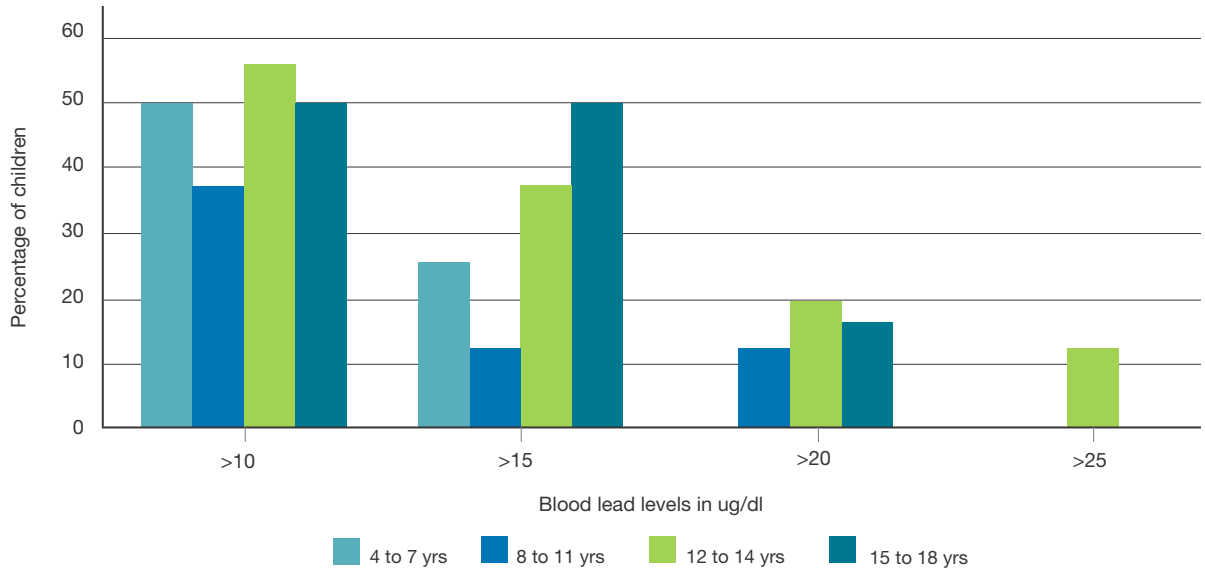
** Reference value for good soil quality

[a] Taiwan's standard values to assess soil quality,

[b] The upper limit of the background concentration

A study of the Dandora municipal waste dumping site in Nairobi, Kenya, for example, showed high levels of heavy metals not only within the dumpsite, but also in adjacent soils, well above the control sample taken from a residential area on the outskirts of Nairobi (Waithaka) and reference values in soil standards (**Table 5.1**) (Kimani 2007, 2012). Dandora is the main disposal site for most of the solid waste generated in the Nairobi area, and is surrounded by both informal and formal residential areas. The risks from the disposal of waste at Dandora are further complicated in that the Nairobi River flows in close proximity to the dumpsite, and waste from the dump ends up in the river. This creates additional potential risks to downstream communities who use this water for domestic and agricultural purposes (Kimani 2012).

Figure 5.2 Blood lead levels in children living in proximity to the Dandora dumpsite, Kenya



Source: Kimani (2012)

Through various routes of exposure, pollutants from uncontrolled dumping can have a direct impact on human health. A medical evaluation of children and adolescents living and schooling in close proximity to the Dandora dumpsite reported respiratory, gastrointestinal and dermatological illnesses such as upper respiratory tract infections, chronic bronchitis, asthma, fungal infections, allergic and unspecified dermatitis (Kimani 2012). Blood samples collected from children in the vicinity of the Dandora dumpsite showed that half of the children examined had blood lead levels equal to or exceeding internationally accepted toxic levels of 10 µg/dl (**Figure 5.2**).

In addition to risks caused by heavy metals, uncontrolled dumping of waste also presents a potential threat of pathogenic infections, chronic diseases and the infestation of vermin. Proximity to open dumps has been significantly connected with the upsurge and spread of pathogenic infections, including cholera and other diseases, in various African cities (Abul 2010, Jerie 2016, Suleman *et al*. 2015). A study focusing on the spatial dependency of cholera prevalence in Kumasi, Ghana, showed a direct spatial relationship between cholera prevalence and the density of refuse dumps, and an inverse spatial relationship between cholera prevalence and distance to refuse dumps. A GIS-based buffer analysis showed that the minimum distance for the siting of refuse dumps from community centres is 500 m. The study concluded that proximity and density of open dumps play a contributory role in cholera infection in Kumasi (Osei and Duker 2008). Several case studies have highlighted the connection between uncontrolled dumping and human health impacts across the African continent (Kebedde 2004, Mpofu 2013, Osei and Duker 2008).

Table 5.2 Related diseases contracted and distance from disposal sites, Kumasi, Ghana

			Distance of final disposal sites			Total
			Less than 5 minutes	5-10 minutes	11-15 minutes	
Related diseases contracted	Cholera	Count	4	2	0	6
		Percentage	67	33	0	100
	Malaria	Count	75	26	2	103
		Percentage	73	25	2	100
	Typhoid fever	Count	9	3	0	12
		Percentage	75	25	0	100
	Skin infections	Count	13	5	0	18
		Percentage	72	28	0	100
Total		Count	101	36	2	139
		Percentage	73	25	2	100

Source: Suleman *et al*. (2015)

A study conducted in the Sawaba community in Kumasi, Ghana, showed startling relationships between proximity to open dumpsites and incidence of disease (**Table 5.2**). The study showed cholera cases for 67 per cent of participants who lived less than 5 minutes from the open dumpsite but none for residents living 11 to 15 minutes away. In the case of malaria, 73 per cent of participants who lived less than 5 minutes from the open dumpsite had suffered from the disease compared to only 2 per cent of participants living 11 to 15 minutes away. Similar relationships between proximity and incidence of disease were found for typhoid fever and skin infections (**Table 5.2**). Open dumpsites typically included building sites, areas along water channels and other unauthorized places (Suleman *et al*. 2015).

Box 5.1. Dumping of waste and the spread of *Aedes aegypti* and the Zika Virus

Aedes aegypti is one of several species of mosquitos that breed in stagnant water and can transmit human diseases. *A. aegypti* has been implicated in the spread of dengue fever and recently, the Zika virus. Following the outbreak in 2007 in West Africa, the Zika virus has spread rapidly throughout the tropics and sub-tropics, and recently into the Americas. *A. aegypti* appears to thrive in artificial habitats created by discarded waste such as tyres, cans and plastic containers. The rapid spread of Zika in South America and the Caribbean in 2015 and 2016 may have been exacerbated by the lack of effective waste collection and disposal (UNEP 2016).

Rescue workers search for those buried by a landslide at Koshe landfill, Addis Ababa, Ethiopia
Photo credit: © Minasse Wondimu Hailu / Anadolu Agency - Getty Images

Finally, uncontrolled dumping of waste can cause direct physical risks to neighbouring communities, often poor communities that spring up around dumpsites. The past year has seen more than 130 people killed in waste landslides in Africa, the most devastating of which was at the Koshe landfill in Addis Ababa, Ethiopia, in March 2017, where 115 people were killed, including children[12]. The second waste landslide was at the Hulene landfill in Maputo, Mozambique, where 16 people were killed. More than two thirds of those killed in these landfill collapses were women, many of whom informally picked for food and recyclables on the landfill sites (Moshenberg 2018).

Other dumping incidents relevant to Africa include the 2006 illegal dumping of petrochemical slops from the ship "Probo Koala" at the port in Abidjan, Côte d'Ivoire. Eighteen casualties were reported, over 30,000 people injured and over 100,000 people sought medical attention. The owners of the ship, Trafugura, eventually paid heavy financial penalties and compensation in relation to the incident (BBC 2010). For a discussion on the impacts of uncontrolled dumping of illegally trafficked e-waste from developed countries into Africa, see the **Topic Sheet 2 in chapter 3**.

12 https://www.reuters.com/article/us-ethiopia-accident/ethiopia-trash-dump-landslide-death-toll-rises-to-115-idUSKBN16N0NR

Box 5.2. The impact of poor waste management on bird migration in East Africa

The Rift Valley-Red Sea Flyway is the second most important flyway in the world for migrating soaring birds. Twice each year over 1.5 million birds from 37 species migrate between their breeding grounds in Europe and West Asia and wintering areas in Africa. For some species, 50-100 per cent of the global or regional bird populations pass along this route over just a few weeks, through narrow "bottlenecks". These migratory birds are vulnerable to a number of threats along the route, one of which is the poor management of waste disposal facilities (Clark 1987 in UNDP/GEF n.d.).

Waste disposal sites, when properly designed and managed, offer a number of ecological services, including resting and feeding sites for migrating and resident birds. However, improper waste management such as uncontrolled dumping, common across Africa poses a number of threats.

Negative impacts of poor waste management on migratory soaring birds include intoxication from contaminated water or ingestion of hazardous substances such as plastics, heavy metals, polychlorinated biphenyls (PCBs), endocrine disrupting chemicals (EDCs) and veterinary drugs; injuries from such things as exposed broken glass or wire; accidents such as drownings in sludge; accidental poisoning from poison baits set to control animals like scavenging foxes, jackals or feral dogs; and infections and spread of disease such as botulism, salmonellosis or avian cholera. Furthermore, smoke from the open burning of waste, common at many of Africa's dumpsites, may contain toxic gases that can affect the health of birds. Inhalation of, or plumage impregnation by, toxic compounds can affect bird fitness and navigation capabilities and cause breeding problems for both local and migrant populations.

Waste sites pose particular threats in desert environments (predominant in the Rift Valley-Red Sea Flyway corridor) where they represent attractive sources of food and water to migrating soaring birds.

Source: Porter (2006) in UNDP/GEF (n.d.)

Developing integrated waste management and conservation strategies in the Rift Valley-Red Sea Flyway corridor countries could therefore be an important step in both addressing the waste challenges experienced in those countries and protecting migrating birds by extending the flyway corridors beyond the existing protected areas.

[a] Information drawn from UNDP/GEF (n.d.)

5.1.2 Open burning

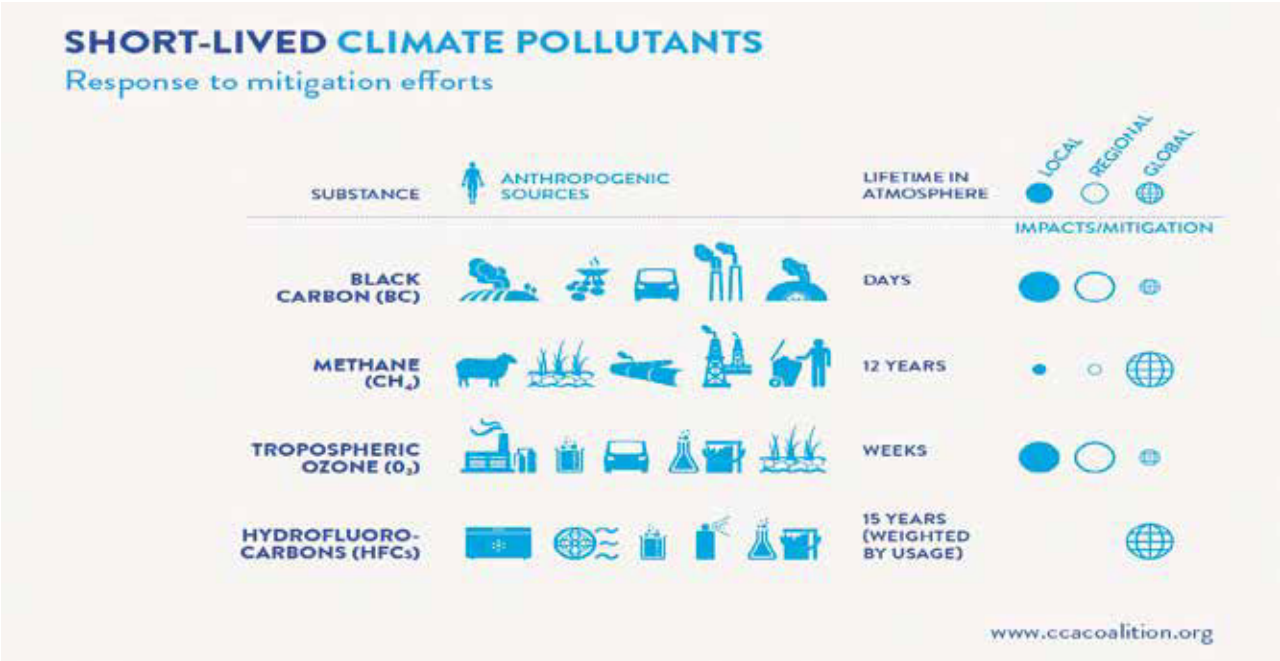
Open burning of waste is widely practised across Africa. It provides a means of reducing the volume of accumulated waste where waste collection services do not exist, or managing waste in dumpsites (UNEP 2015). Typical emissions associated with open burning of waste include dioxins, polycyclic aromatic hydrocarbons and black carbon, which are highly toxic, carcinogenic and powerful short-lived climate pollutants respectively (UNEP 2015). Open burning is often the result of a lack of awareness of alternative disposal options, high levels of poverty, and lack of environmental regulation or enforcement (Cointreau 2006, Oelofse and Musee 2008, Al-Khatib *et al.* 2009, Narayana 2009, Hilburn 2015, Jerie 2016).

Families with inconsistent waste collection services in Accra, Ghana, who were forced to burn their waste as a management solution, for example, were found to be vulnerable to respiratory diseases. The burning of waste was the suspected cause of their symptoms. Children and women, the main people involved in the burning process, were found to be the most vulnerable in the community to respiratory diseases (Surjadi 1993). Open burning of agricultural waste, particularly rice straw, is a common practice in Egypt that causes a host of allergic reactions and lung infections in many residents (Safar and Labib 2010). Furthermore, the black clouds of smoke caused by the burning process are heavily laden with greenhouse gases (GHGs).

Open burning of waste on a kerbside in Nairobi, Kenya
Photo credit: © C Velis, University of Leeds

Open burning of waste at dumpsite
Photo credit: © Manoocher Deghati, IRIN

Figure 5.3 Short-lived climate pollutants



Source: CCAC (2017)

Waste and climate change, open burning and short-lived air pollutants

The poor management of waste can have significant repercussions on the global climate, aggravating climate change. Open burning of waste and the decomposition of high volumes of organic waste in uncontrolled dumpsites generates many atmospheric pollutants. According to Hoornweg and Bhada-Tata (2012) methane from landfills represents 12 per cent of total global methane emissions. A study by the European Environment Agency noted that the amount of municipal waste was expected to grow by 25 per cent from 2005 to 2020. It also indicated that limiting or avoiding growth in waste volumes would reduce GHG emissions from the waste sector and deliver other benefits to society and the environment. Africa has one of the highest rates of population growth and as a result the contribution of the waste sector in Africa to climate change is expected to increase (Nakićenović *et al.* 2000). While global annual methane emissions from landfilling of solid waste were estimated at 29 Mt in 2010, methane emissions from landfills in Africa were estimated at 1.3 Mt, equivalent to 32 Mt of CO_{2e} emissions (Scarlat *et al*. 2015).

The most recent Greenhouse Gas Inventory for South Africa (DEA 2014) shows that the waste sector was the second largest contributor to total national methane emissions in 2010, accounting for 37.2 per cent. Furthermore, while other economic sectors have shown declining contributions of methane (and total GHGs), the methane contribution from the waste sector has increased by 11.3 per cent, reflecting the increase in waste generation and disposal in South Africa. GHG emissions from the South African waste sector increased by 59.3 per cent from 2000 to 2010 (from 12,434 Gg CO_2 eq to 19,806 Gg CO_2 eq) (DEA 2014). This is in stark contrast to the European Union, where GHG emissions from waste have more than halved over the period 1990 to 2007 (Hoornweg and Bhada-Tata 2012), as a result of efforts aimed at decoupling economic development from waste generation.

Open burning is a major source of black carbon, one of the short-lived climate pollutants, a group of pollutants that have a particularly high impact on climate change (**Figure 5.3**) (Hansen *et al*. 2010).

Eliminating uncontrolled dumping and open burning of waste in Africa and diverting organic waste away from landfill towards alternative waste treatment technologies such as composting and anaerobic digestion (**see chapter 7**), have the potential to create significant positive benefits for Africa, including reduced GHG emissions.

Box 5.2. Endocrine disrupting chemicals and e-waste burning

There is growing concern about e-waste as a source of endocrine disrupting chemicals when burned (UNEP/WHO 2013). Burning e-waste is a common practice in a number of African countries, but research on the impacts on human health and the environment in Africa is meagre. The possible impacts of endocrine disrupting chemicals on humans and the environment in Africa is a priority that needs to be fully investigated. In many African countries, women and children are on the front lines of extracting recyclable resources from e-waste, besides being highly involved in burning waste (Moukaddem 2011). The International Labour Organization (ILO) has highlighted the difficulties of assessing the extent to which children are involved in e-waste recycling, though many studies indicate that children are a significant proportion of all workers. The difficulties are largely attributable to a lack of data on the segregation of e-waste, as there is a considerable knowledge base for child labourers working as “waste pickers” (Lundgren 2012).

5.1.3 Poor collection coverage

In Africa, a lack of waste collection and disposal facilities has compelled many communities to use watercourses such as rivers and canals for waste disposal. The problem is compounded by the attitude of communities that do not responsibly participate in waste management, and further aggravated by the inability of local councils to enforce existing waste management laws (Majale-Liyala 2011). A body of literature has documented the impacts of waste disposal on receiving water resources in many African countries. In addition to chemical and microbiological pollution of the water, disposal of solid waste to watercourses results in blocked canals, stagnant water and flooding (Uchegbu 2002, Adeyemo 2003, FAO 2005, Etuonovbe 2009, Akinbile 2012, Okot-Okumu 2012, Fortune *et al.* 2015).

The impacts of uncollected waste are also likely to reach farther than just the immediate area of disposal. For example, over 80 per cent of ocean plastic is thought to originate on land, entering the oceans via rivers and storm-water runoff or directly discharged into coastal waters. Of that, 75 per cent comes from uncollected waste (poor city cleansing) and 25 per cent from collected waste, where the waste re-enters the environment from poorly operated formal or informal dumpsites (Ocean Conservancy 2015). Rivers act as conduits for pollution, moving mismanaged and uncollected waste from inland to coastal areas and finally into the oceans. The impact of uncollected waste in Africa on marine litter is likely to be significant, particularly as populations on the continent grow and corresponding waste volumes increase (**See Topic Sheet 3**).

Accumulation of municipal solid waste, in particular plastic waste, in urban river in Kenya.
Photo credit: © James Wakibia

13 https://www.aljazeera.com/news/2018/01/dr-congo-floods-leave-45-dead-thousands-homeless-180111090152024.html

Box 5.3 Poor waste management and urban flooding

The lack of proper waste management services in many African countries compels people to dispose of their waste in streets, open spaces and watercourses, leading to water stagnation, pollution and flooding. Heaps of waste left uncollected in streets is often washed into drainage systems, damaging pumping stations and causing flooding. In Kampala, Uganda, indiscriminate dumping of waste in stormwater canals blocks water drains, causing floods and health hazards, as well as aesthetic impacts (Okot–Okumu 2012). Ziraba *et al.* (2016), discussing flooding in urban cities in Africa, identified poor urban planning as a major culprit, but added that the problem could also be attributed to rampant blockage of drainage systems by solid waste, especially non-degradable plastic bags. They added that floods claim lives and damage sewerage systems, causing even wider environmental contamination. Lamond *et al.* (2012) pointed out that in Africa, waste can quickly block drain systems, causing flooding in neighbourhoods with inadequate solid waste management or drain maintenance. In Dar es Salaam, United Republic of Tanzania, residents of Tandale district, Kinoni municipality, expressed their discontent about the poor management of waste, which when dumped in streams resulted in blockages and heightened the impact of flooding (Dodman *et al.* 2011).

A study of poor settlements in Accra, Kampala, Lagos, Maputo and Nairobi revealed that housing development in floodplains and inadequate waste management are potential causes of flooding. The study indicated that people in these settlements dump solid waste haphazardly into valleys and natural drains (Douglas *et al*. 2008). Waste dumped in watercourses also contaminate surface and groundwater with serious health implications. A serious outbreak of diarrhea in Kenya was attributed to solid waste dumped upstream from an irrigation canal, causing water stagnation. Downstream water used to irrigate vegetable farms was badly affected by stagnation and was considered the main source of the outbreak (Henry *et al.* 2006).

According to Ojolowo and Wahab (2017) 27.2 per cent of the waste generated in Lagos, Nigeria was dumped in canals and lagoons. This indiscriminate dumping of waste was identified as a major cause of flooding within the city, resulting in the spread of water-borne diseases. An estimated 11.2 per cent of the MSW was collected by the Lagos Waste Management Authority (LAWMA), 9.9 per cent by private service providers, and 29.2 per cent by cart pushers, while 16.7 per cent was disposed of to communal dump-grounds, 1.3 per cent burnt and 4.6 per cent buried.

In January 2018, at least 45 people died from flooding in Kinshasa, Democratic Republic of Congo, and more than 5000 people were left homeless[13]. Many residents accused blocked drainage channels in the city for the flooding, which further exacerbated an ongoing cholera outbreak (ISWA 2018).

Waste dumped by upstream community and market accumulate in river, Cameroon
Photo credit © Nche Tala Aghanwi

TOPIC SHEET

3

MARINE LITTER IN AFRICA:

Identifying sources and seeking solutions[1]

Introduction

The following text is an extract from a discussion document prepared for the first African Marine Waste Conference held in South Africa in July 2017. The discussion document was further extended and published as Jambeck *et al.* (2017a).

Plastic has been found on the remotest of beaches, afloat in the middle of the ocean, frozen within polar ice, building up on the sea floor, and inside marine animals and sea birds. In fact, this manufactured material is now recognized as being one of the most noticeable pollutants affecting the ocean worldwide (UNEP 2016). Recent studies have suggested that the ocean receives an estimated 8 million tonnes of plastic waste per year. As plastic remains in the environment for hundreds of years, the trillions of plastic pieces accumulating in the ocean form part of a global pollution issue that affects all coastal countries (van Sebille *et al*. 2015). If nothing changes, by 2025 the ocean could contain 1kg of plastic for every 3kg of fish. Despite this stark reality, awareness of this issue has grown slowly, alongside a global consensus that action must be taken to stem the flow of plastic entering the ocean.

Current estimates of the volume and weight of plastic entering the ocean from land are generally based on the following indicators: (i) waste generation per capita, (ii) proportion of waste that is plastic and (iii) percentage of waste that is mismanaged. Calculations using globally available data have shown that the majority of countries contributing most significantly to marine litter are in Southeast Asia. However, with significantly less data available from the majority of countries in Africa, the regional governmental complexities and the scale of African waters (an exclusive economic zone three times the size of its landmass), the amount of mismanaged waste in this region is more difficult to estimate with accuracy.

Why Africa? A continental overview

Africa, the world's second largest continent, is experiencing unprecedented population growth, with predictions that it will add 1.3 billion people to the planet by 2050. This is the equivalent of 3.5 million more people per month, or 80 additional people per minute, thus making Africa the biggest contributor to future global population growth (UNEP 2015). Furthermore, the highest rates of population growth and urbanization are expected in the coastal zone, with an estimated 49 million more people in flood plains by 2060 (Neumann *et al.* 2015). Alongside this rapid rate of urbanization, Africa's growing middle class is creating large consumer markets for plastic goods and goods packaged in plastic, and supermarkets are replacing informal shops and markets. Eighty per cent of the continent's GDP is concentrated in just 11 African countries (Nigeria, South Africa,

[1] Topic sheet prepared by Jenna Jambeck, Britta Denise Hardesty, Amy L. Brooks, Tessa Friend, Kristian Teleki, Joan Fabres, Yannick Beaudoin, Abou Bamba, Julius Francis, Anthony J. Ribbink, Tatjana Baleta, Hindrik Bouwman, Jonathan Knox, Chris Wilcox

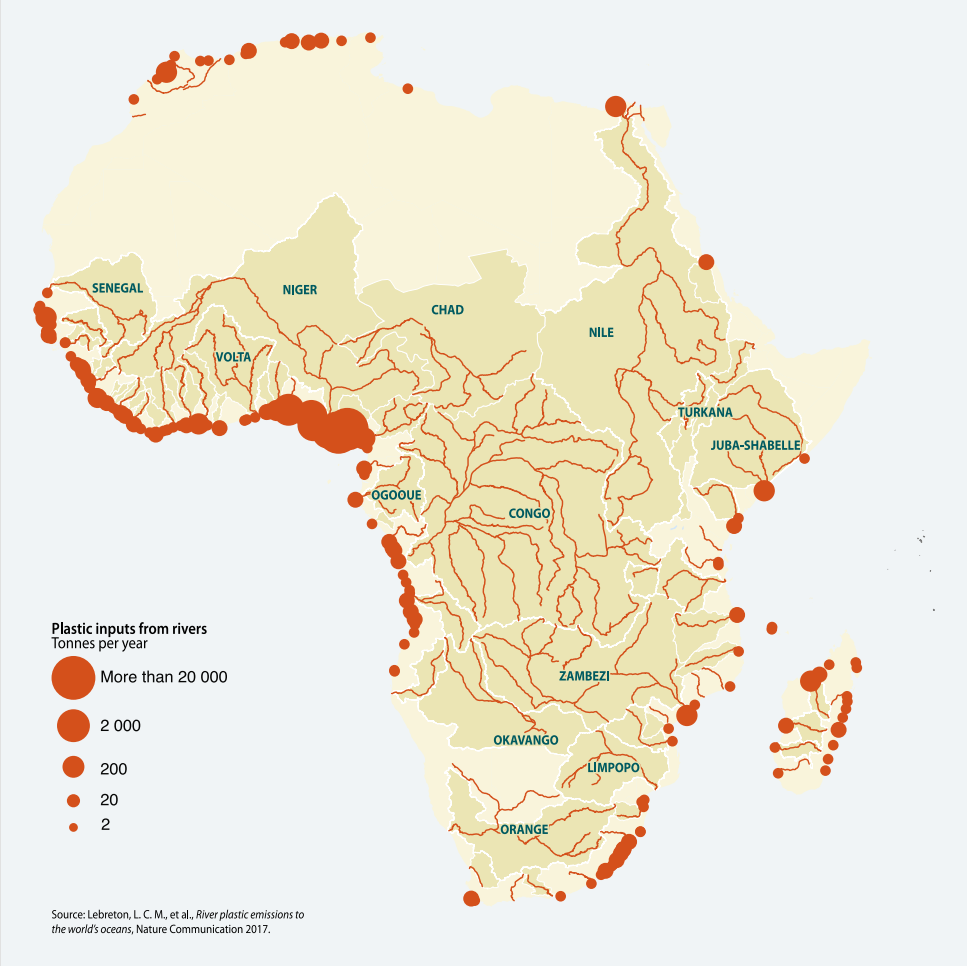
Egypt, Algeria, Angola, Morocco, Sudan, Tunisia, Kenya, Ghana and Libya), all of which have prominent coastlines (Deloitte 2014).

Similar to the expanding coastal populations in Africa, there are an increasing number of people living in high densities a short distance from river systems. For example, the population density of the Nile delta is 1,000 people per square kilometre, which is much higher than the global average for coastal areas (80 people per square kilometre). The extensive river basins of the Niger, Congo, Zambezi and Nile contain some of the largest cities in the world and empty a significant volume of fresh water into the Atlantic Ocean, the Indian Ocean and the Mediterranean Sea. A lack of waste management infrastructure in these areas also means that these rivers are likely to transport a large volume of pollution, including plastic waste, as they make their way to the ocean (**Figure 1**).

While land-based sources of plastic pollution in the ocean are significant, it is also important to consider the plastic pollution resulting from Africa's shipping and maritime activities, such as fishing. Abandoned, lost or otherwise discarded fishing gear contributes an estimated additional 640,000 tonnes of marine litter globally (Macfadyen *et al.* 2009). With over 12 million people engaged in Africa's fisheries sector, this is therefore likely to be a factor in African waters. Furthermore, given that subsistence fishing is significant in African countries and the proportion of protein intake from fish is high (i.e. 50 per cent in Mozambique, 60 per cent in Sierra Leone and Ghana, and 70 per cent in the United Republic of Tanzania), marine litter represents a significant threat to food security, economic development, the viability of marine ecosystems and the establishment of a vibrant and productive blue economy (Climate Smart Oceans 2017).

The increasing trend in per capita consumption, urbanization and population growth is especially worrying when combined with a lack of sufficient infrastructure to deal with the increased waste generation.

Figure 1
Mass of river plastics flowing into oceans



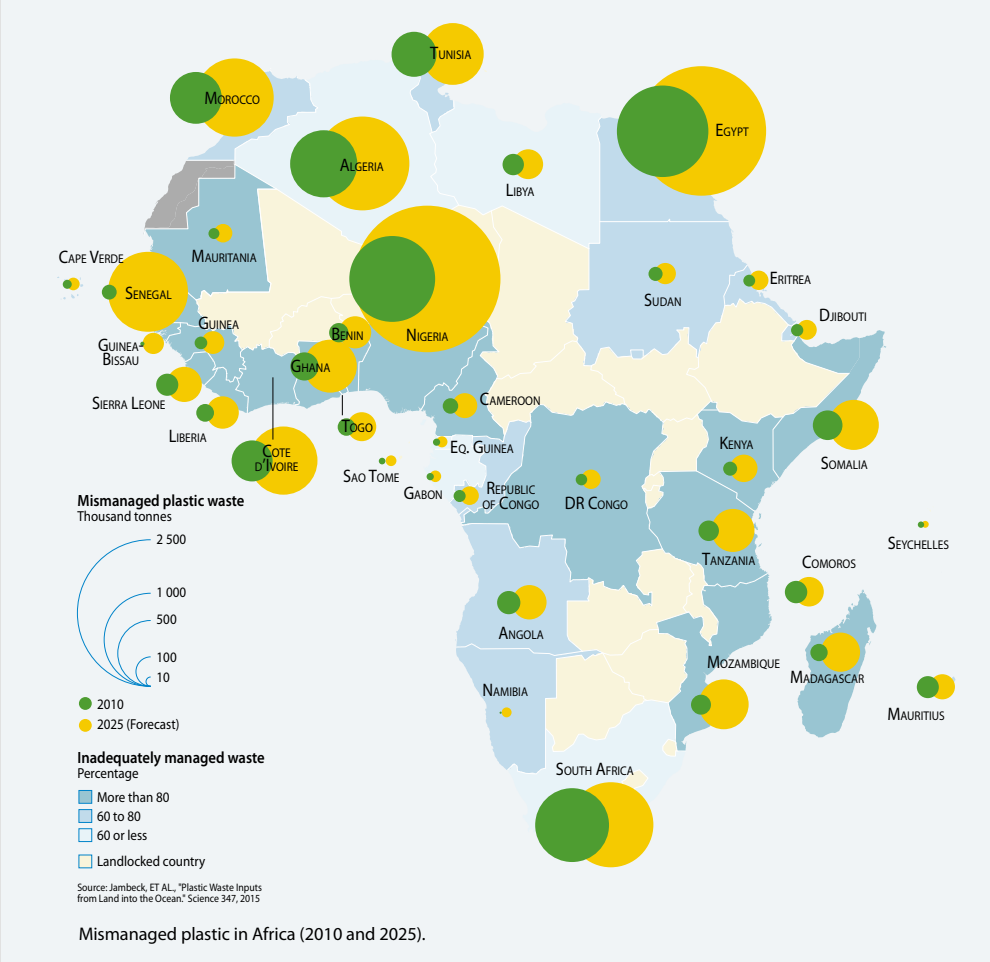
Source: Jambeck *et al.* (2017b)

MARINE LITTER IN AFRICA:
Identifying sources and seeking solutions[1]

In fact, the resulting potential for waste accumulation is so severe that many fear Africa could become the most polluted continent on Earth, if it is not already. This presents a significant risk to human health, the environment and the economy. As seen in the Ghanaian capital of Accra, where plastic bags and other plastic consumer goods accumulated in waterways and clogged drains, causing significant flooding that killed at least 150 people and caused millions of dollars of damage (Hinshaw 2017). Furthermore, it is worth noting that improperly disposed of plastic waste on land may also contribute to the spread of disease by providing standing water for mosquitoes to use as breeding grounds, enabling the spread of diseases such as Zika virus, dengue fever, malaria and chikungunya (Moss *et al.* 2017). In response to the environmental and health threat posed by plastic bags, more than 20 countries on the African continent have now put bag bans and taxes in place (Global Press Journal 2015).

Although the data is patchy, a recent study estimates the quantity of mismanaged plastic waste available to enter the ocean from each of Africa's coastal and island countries. Of particular relevance are Egypt, Nigeria, South Africa, Algeria and Morocco, which are estimated to be among the top 20 countries around the world contributing to marine litter each year. Based on country-level data, the total mismanaged plastic waste for the continent was estimated at 4.4 million tonnes in 2010 (out of 32 million tonnes globally) and could be as much as 10.5 million tonnes in 2025 if the trend continues ("business-as-usual") (**Figure 2**).

Figure 2
Mismanaged plastic waste, 2010 actual and 2025 forecast



Mismanaged plastic in Africa (2010 and 2025).

Source: Jambeck *et al.* (2017b)

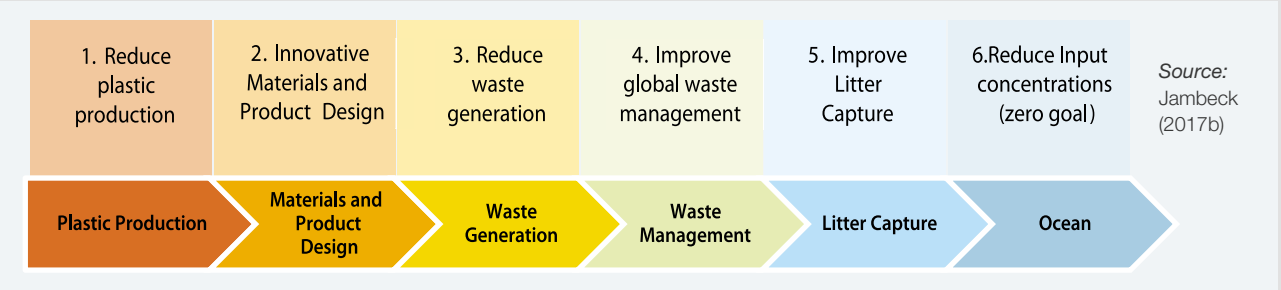


Figure 3 Intervention points to mitigate the flow of plastic to the ocean

Solutions and innovation across Africa

The three African regional seas conventions and action plans (RSCAPs) including the Barcelona Convention (Mediterranean), the Abidjan Convention (West Africa) and the Nairobi Convention (East Africa), are instrumental in encouraging regional cooperation and coordination among countries sharing common resources along their coastlines. Globally, the three conventions have pioneered the development of regional seas action plans on marine litter. For example, Mediterranean coastal states have recently adopted one of the most advanced regional instruments on marine litter, with a strategic plan that includes legally binding measures. Initial scoping work is being done under the Abidjan and Nairobi conventions for the development of their respective action plans.

Initiatives aimed at mitigating the flow of plastic into the ocean can occur at various intervention points along the plastic value chain. These possible interventions include activities that reduce plastic production, provide innovative materials and product design, reduce waste generation, improve waste management, improve litter capture and reduce input concentrations to the ocean (Jambeck 2017b).

While the examples in this section relate to interventions on solid waste management, other actions can be taken both upstream and downstream. Most importantly, these actions can be integrated with each other along an entire continuum of possible solutions (**Figure 3**).

Summary and way forward

The marine environment is an important source of livelihoods, food security and economic development in the 38 African coastal and island countries. Interest in the blue economy is growing rapidly. Given the potential for economic opportunities to be undermined by pollution, it is critical that the issue and scale of marine litter be explored, understood, managed and mitigated on a pan-African scale. This is essential if the continent is to avoid the scale of marine litter and waste-related challenges that are plaguing other regions. The situation in Africa undoubtedly requires African-led solutions.

Establishment of the African Marine Waste Network is a critical step in facilitating collaboration on this issue and the development of regional and national action plans. Such plans will need to take the local context into consideration, current realities in Africa, and the barriers and opportunities that exist within Africa to address marine litter and other waste-related issues across the continent.

In short, the African continent can no longer be ignored on the issue of marine litter and plastic waste leakage into the ocean. There is a significant opportunity for Africa to play an important role on the world stage with regard to reducing global marine litter.

Plastic waste on the shoreline of Accra, Ghana
Photo credit: © Christoffer Back Vestli

5.1.4 Informal collection and recycling

Africa has a very active informal waste sector, reclaiming food and valuable recyclable material from waste at kerbside (households and businesses) and from open dump sites and landfills (**see chapter 6**). Informal waste pickers in Africa are vulnerable to a wide range of chemical, biological and physical health risks posed by waste. These include such things as wound infections from sharp objects, inhalation of dangerous gases, swallowing of dangerous and contaminated materials including condemned food, diseases like cholera, typhoid, diarrhoea, viral hepatitis and human immunodeficiency virus (HIV) infection, and musculoskeletal injuries from manual lifting or sorting tasks (Phuka *et al*. 2003, Riungu 2003, Jerie 2016). Informal waste workers that work at kerbside are also at risk from traffic hazards while transporting their material in the streets (ILO 2013). The safety and security of informal waste pickers is also an issue, as many resort to sleeping on the streets at night to be close to the recyclable material, making them vulnerable to crime (Schenck *et al.* 2013).

Informal waste pickers sort and store their recyclable material recovered from a dumpsite in Southern Africa
Photo credit: © Linda Godfrey, CSIR

Box 5.4 Used lead-acid batteries: Impacts on health and environment

Lead-acid batteries are widely used in many African countries as a source of power for things like passenger and commercial cars, tractors, and telecommunication gadgets. Around 85 per cent of the total lead produced worldwide is consumed by lead-acid batteries (ILA 2012). Batteries reaching their end-of-life are in most cases recycled to take advantage of their lead content. Lead is a very toxic heavy metal, however, causing direct effects on red blood cells and interfering with the absorption of calcium. Children and women are particularly vulnerable to lead toxicity, and during pregnancy lead can cross the placenta and affect the unborn child. Lead is a major concern in Africa, as used lead-acid batteries are often recycled in small unlicensed, informal workshops, mostly operating in the open air, with very limited infrastructure.

In March 2008, Senegal was unfortunate to experience the deaths of 18 children under 5 years of age in the Dakar neighbourhood of Thiaroye-Sur-Mer from acute exposure to deadly lead dust, owing to informal recycling of used lead-acid batteries from cars (Blacksmith Institute 2009). With the lack of proper facilities for recycling, these illegal workshops are potential sources of lead pollution causing irreversible damage to human health.

Informal recycling of core lead from used lead acid batteries
Photo credit: © UNEP 2017

Well-equipped recycling plants with environmentally safe technologies are expensive to establish, and require large volumes of end-of-life batteries to be economically viable. One option to tackle this hurdle is for African countries to come together to establish regional facilities that can handle batteries coming from different countries, under safe conditions (UNEP 2017). However, this regionalization of secondary resource economies can be hindered by international conventions, aimed at protecting countries from illegal dumping of waste, particularly hazardous waste (**see chapter 4**).

5.1.5 Informal land reclamation

In some coastal regions in Africa, vehicle tyres and other debris have been used to reclaim land where land for housing is in short supply or too expensive. In Sierra Leone, mangrove land in the coastal area is subjected to major encroachment by poor communities who deposit huge volumes of waste, including vehicle tyres and other debris, to build their informal houses. The Kroo Bay slum in Freetown, on the coast of Sierra Leone, is one such site (Frazer-Williams, 2014). The slum is adjacent to two rivers, and highly exposed to frequent floods. Inhabitants dispose of their waste along the coastline, causing serious impacts on the quality of life in the adjacent ocean.

In some parts of Africa, waste is used for flood control during heavy rains and storm surges. This practice, usually called waste-filling, is not only a cheaper alternative to sand-filling when constructing the foundation of a house it also generates an income for waste collectors. In many parts of Africa, especially in poor settlements, MSW is used to control frequent floods in the heavy rain seasons. In the informal settlement of Badia, near Lagos, Nigeria, waste-filling is a source of pollution for the local environment and exposes residents to flood risks, as Lagos is a coastal city with a history of flooding owing to low-lying terrain (Njoku *et al.* 2015).

5.1.6 Health care waste

The state of health care waste management in Africa, particularly health care risk waste (HCRW), has been highlighted in **chapter 3**. Currently, poor HCRW management practices, including inappropriate or insufficient treatment technology, mean that untreated HCRW is often dumped in uncontrolled dumpsites, active with informal waste pickers. HCRW is also illegally dumped in open areas owing to the lack of treatment infrastructure or lack of willingness to pay for safe treatment and disposal (Stinger 2011, Nwachukwu *et al*. 2013, Hangulu and Akintola 2017). HCRW management is of particular importance because of the dire and wide-spread impacts it can have if not managed properly.

A common practice in many urban areas in Africa is the disposal of untreated HCRW along with MSW (Okot-Okumu 2012). A study in Nigeria showed that waste handlers at some hospitals treat HCRW the same as domestic waste (Nwachukwu *et al*. 2013). Furthermore,

Kroo Bay slum, Sierra Leone, where debris is used to reclaim land for building informal homes
Photo credit: © UNEP 2017

in the absence of take-back programmes, unwanted pharmaceuticals may be dumped into the local sanitation outlet, whether a sewage system, septic tank or latrine, causing pollution of the receiving water environment (USAID 2009).

Impact of HCRW on human health

HCRW is the second most hazardous waste after radioactive waste (Manyele 2004). The major threat of HCRW is the transmission of diseases. Pathogenic microorganisms can enter the body through punctures, cuts in the skin, mucous membranes in the mouth, or inhalation (WHO 1992). The WHO has estimated that in 2000, injections with contaminated syringes caused 21 million hepatitis B virus infections (32 per cent of all new infections), two million hepatitis C virus infections (40 per cent of all new infections) and 260,000 HIV infections (5 per cent of all new infections) worldwide (WHO 2007). In this respect, it is worth mentioning that syringe reuse is practiced in some African countries (Nwachukwu *et al.* 2013).

The WHO also reports that in Africa, infectious waste from health care activities is not adequately segregated, which increases the volume of infectious waste requiring special treatment and increases treatment costs. In the absence of proper treatment and safe disposal, this poses high risks to operators, the public (in particular children and other vulnerable groups) and the environment in general (WHO 2010). In Africa, waste handlers, health care workers and also drug addicts who handle sharps are most vulnerable and highly exposed to infection with HIV/AIDS and the hepatitis B and C viruses (USAID 2009).

Impacts of HCRW on the environment

Besides the health impacts of HCRW, this waste stream also poses a potential threat to the environment. Contamination of water bodies from untreated HCRW can have serious effects. Infectious stool and bodily fluids can cause serious epidemics if not treated properly before disposal, as sewage treatment in Africa is often non-existent (USAID 2009).

The lack of sanitary landfills had led to the increased use of incinerators for HCRW. While it is estimated that there are more than 1,000 incinerators in Africa, many are reported to be inoperative or operating below standards. Some hospitals have re-built their incinerators a number of times owing to frequent break downs (Harhay *et al.* 2009, UNDP 2009). The environmental and health impacts of improper incineration may cause irreparable damage. SBC and WHO (2005) report that incineration, or the incineration of unsuitable materials, results in the release of persistent pollutants into the air, including dioxins and furans, which are human carcinogens with a wide range of adverse health effects. In addition, incineration of heavy metals can release and spread toxic metals into the environment.

5.1.7 Emerging waste streams

Chapter 3 alludes to new emerging waste streams, such as nano-wastes (nanomaterials and nanoparticles) and micro-wastes. Nanotechnology is widely used in large and diverse industries that include computers, cellular phones, cosmetics, textiles and medicines. In many African countries, however, these wastes are being disposed of together with conventional MSW without any special segregation, precautions or treatment, despite inherent risks. While this may be owing to lack of awareness by communities and authorities, it raises the question of whether current waste treatment and disposal technology is appropriate for dealing with these waste streams, and what impacts these nano- and micro-wastes may have on human health and receiving environments during and/or after treatment (OECD 2016). Failing to address nano-waste as a special constituent of the waste stream may have significantly adverse repercussions on human health and environment. There is a pressing need to raise awareness on these emerging waste streams, particularly in African countries that are often ill-equipped to deal with such wastes, as well as to introduce the infrastructure needed to identify and segregate nano- and micro-waste and provide the necessary training to mitigate and manage related risks.

5.2 The cost of inaction

The cost of providing sound waste management services is considered a burden and a challenge by African governments with limited resources and many priorities. However, failing to provide sustainable waste management services has long-term impacts that come at a cost to society and to the economy, as shown in this chapter.

The cost of inaction can be defined as the damage incurred to human and environmental health as a result of environmental degradation, in this case from poor waste management services (UNEP 2015). The OECD (2008:3) goes further, suggesting that "*some of the costs of inaction will be incurred locally (and immediately), while others will fall on citizens in other countries (and perhaps in the distant future).*" The GWMO points out that the major impacts of inaction include public health impacts of uncontrolled waste and environmental impacts of open dumping and burning (UNEP 2015).

Assessing the cost of inaction is crucially important to placing the human health and environmental impacts of poor waste management in context and, in particular, in an economic context that business and government understand. Assessing the cost of inaction is not always a straight forward process, however. In addition to the complication of establishing the baseline conditions and the limits of the estimates, it entails several uncertainties, especially at the economic level. This is particularly true for psychological damage (non-tradable goods), as the impact of inaction is not usually reflected in market values. Examples of this would include the feeling of unease and suffering that can be evoked in some people by the eyesore of heaps of accumulated mismanaged waste in their vicinity. Information about the monetary value of inaction of poor waste management in Africa is further limited by the dearth of comprehensive, reliable waste data and information. Very few studies have been done on the monetary value of inaction in Africa, although sporadic assessments of the cost of waste management inaction are reported in some North African countries as part of general studies on the cost of environmental degradation (Hussain 2008, Sarraf *et al.* 2004).

Hussain (2008) showed that the average annual damage costs of environmental degradation for waste management in North African countries ranges between 0.1–0.5 per cent of GDP. Here, environmental degradation is seen to include loss of healthy life and well-being, economic losses and the loss of environmental opportunities. Owing to the lack of data, however, no cost estimates could be calculated for environmental degradation associated with industrial, hazardous and hospital waste, which would significantly increase the estimated costs. In Morocco, the cost of groundwater pollution from contamination by unsanitary landfills was estimated at US$25 million per year (Hussain 2008), while in Tunisia, the annual damage costs associated with solid waste management were calculated at 0.15 per cent of GDP (Sarraf *et al.* 2004).

Nahman and de Lange (2013) calculated the total cost of edible food waste throughout the value chain in South Africa to be approximately US$4.8 billion[14] or 2.1 per cent of GDP, a significant percentage of the country's GDP. The results highlight the significant impact that unsustainable food systems can have in developing countries like South Africa (**See Topic Sheet 1 in chapter 3**).

Table 5.3 Average annual damage costs of environmental degradation from waste in countries in the Middle East and North Africa

	Average annual damage costs (percentage of GDP)			
	Algeria	Egypt	Morocco	Tunisia
Waste management cost	0.1	0.2	0.5	0.1

Source: Hussain (2008)

14 Assuming an exchange rate (at the time of writing) of R12.93 per United States dollar

5.3 Waste and gender

Women are actively involved in waste collection and sorting activities in many African countries, on dumpsites, at kerbside, and in waste facilities. In many cases, owing to limited alternatives for child care, their children accompany them and are exposed to the same conditions and risks. The Protocol to the African Charter on Human and Peoples' Rights on the Rights of Women in Africa, also known as the Maputo Protocol, guarantees the right of women to live in a healthy and sustainable environment (AU 2003). This includes ensuring that parties take all appropriate measures to "*regulate the management, processing, storage and disposal of domestic waste; and ensure that proper standards are followed for the storage, transportation and disposal of toxic waste*" (AU, 2003:17).

According to Amugsi *et al.* (2016), women tend to have a subordinate status when it comes to waste management activities, which exposes them to greater health and environmental risks than men. Studies in Ghana and Nigeria have found that men typically have access to higher value materials, leaving women to access the lower value, dirtier materials, usually from dumpsites, placing them at great risk (Amugsi *et al.* 2016). Gender division of labour strongly influences men's and women's differential exposure to specific health risks. In a study on the informal sector in Bulawayo, Zimbabwe, women and children who collect waste at dumpsites for recycling and re-sale were found to be more at risk (Jerie 2011). Brender *et al.* (2011) outlined significant relationships between maternal residential proximity to hazardous waste sites and adverse health effects, such as adverse pregnancy outcomes, childhood cancers, asthma hospitalizations and chronic respiratory symptoms, stroke mortality, PCB toxicity, end-stage renal disease and diabetes. Moshenberg (2018) points out that *"when it comes to urban disasters – both natural and otherwise – death has a gender".*

More than two thirds of the people killed in the Ethiopia and Mozambique landfill collapses in 2017 and 2018 were women. Waste management in Africa has largely ignored gender disparities. Women must be brought into the decision-making and policy process in Africa, to ensure that waste strategies, policies and services are gender-sensitive.

Woman and her children collecting recyclables from households, South Africa
Photo credit: © Linda Godfrey, CSIR

Women working informally on waste dumpsite

Photo credit: © Linda Godfrey, CSIR

5.4 Conclusions and recommendations for future action

This chapter has shown how the current waste management challenges facing Africa have resulted in significant environmental and human health impacts, and will continue to do so unless services and infrastructure improve. Lack of resources, awareness and rigorous regulations are among the major causes of the problem. There is an urgent need to enforce a set of special measures to help improve the management of waste on the continent, in order to mitigate current impacts. These measures would include:

Awareness raising

One of the chief problems facing waste management in Africa is the low level of citizen awareness of the impacts of waste. It is of crucial importance to raise awareness and to change people's perception of and attitudes towards waste and its associated impacts, especially emerging wastes. There is also an urgent need to change people's attitude towards uncontrolled dumping and open burning of waste, the chief precursors of air pollution and chronic respiratory diseases. On the other hand, it is the role of authorities to provide suitable, cost-effective alternatives that meet sound hygienic and environmental codes and requirements. Within the same discourse, civil society and NGOs have a major role to play in empowering communities when it comes to sound waste management practices. The media is one of the most influential instruments affecting awareness and can play a prominent role through its various programmes.

Training and education

Provision of sound training is an elemental step in waste management. Ideally, training would comprise a blend of bottom-up approaches that involve customized training programs for different tiers of waste management staff, raising their awareness, and providing them with the knowledge for sound waste segregation and handling. On a similar level, a top-down approach would be designed to enable and raise government capabilities in addition to upgrading administrative know-how. UNEP has already launched an initiative to introduce a graduate course in waste management in a number of African universities. Graduates would be equipped with advanced know-how to tackle waste issues in an integrated manner. It is hoped that this initiative would encourage other African universities to follow suit to help promote sound waste management throughout the continent. South Africa has taken the initiative of developing dedicated honours and master's degrees with specialization in solid waste management in an effort to strengthen its national capacity. In the same context, special curricula should be developed and incorporated into high- and medium-level educational programmes. Medical schools ought to consider providing training on health care waste as an integral part of their curricula as a vital component of good health and a safe environment.

Provision of proper infrastructure for health care waste

Health care waste management is of particular importance because of the dire and wider impacts it can have if not managed properly. Most African countries have ratified the Stockholm, Basel and Rotterdam conventions and committed to ensuring proper treatment and disposal of health care waste and other hazardous waste. However, health care waste management facilities in many African countries are inadequate, with sub-standard treatment and disposal. African countries should provide and improve health care waste management bodies by introducing legal and institutional frameworks specifically designed for health care waste.

Public-private partnerships

Sustainable waste management is one of the most expensive services provided by government. The low priority often assigned to waste by key stakeholders, combined with communities unwillingness to pay for waste services, means that there is often no funding available to improve waste service delivery and invest in waste infrastructure. To make ends meet, partnering with private sector organizations could be a positive strategy towards building robust infrastructure for tackling many waste problems. Experience from a number of African countries has shown that the private sector is many

steps ahead of government in dealing with waste. The involvement of the private sector in waste management should be a priority for African countries. Governments need to explore how such partnerships can be encouraged through such things as economic incentives and land allocations (**see chapters 4 and 8**).

Regulation of imported end-of-life electrical and electronic equipment

Africa is a major destination for used electrical and electronic equipment. The huge hauls of e-waste are becoming a flourishing business and the main source of income for a considerable number of Africans, despite the potential risks involved. Trade in end-of-life equipment is also turning waste into more sustainable resources, conserving valuable materials while creating a new class of African entrepreneur. However, the lack of a legislative body for the trade is creating many gaps and logistic flaws, with potential for significant human and environmental impacts. Countries involved in this trade should revisit their regulatory frameworks and assess whether mechanisms need to be put in place to address illegal imports. Frameworks should also embrace special measures and instruments, such as end-of-life measures and take back policies like EPR.