# FROM THE LAND TO THE SEA

*How better solid waste management can improve the lives of the world's poorest and halve the quantity of plastic entering the oceans*


March 2018

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## Executive Summary

A growing population, increasing urbanisation, and a shift to a consumer lifestyle are leading to the generation of ever great volumes of solid waste around the world, with estimates suggesting it will double in the next 15-20 years. Recent reports have increased attention on marine plastics:

- More than 90% of marine plastics come from land based sources.
- 4-12 million tonnes per annum comes from mismanaged solid wastes generated within 50 km of the coast, of which more than 50% comes from just five east Asia countries.
- Another 0.4-4 million tonnes come via rivers, with more than 90% of that from 10 major rivers in Asia and Africa.
- Overall, mismanaged municipal solid wastes in developing countries probably accounts for 50-70% by weight of plastics entering the oceans.

This is a major concern, but it is only one aspect of the problem. With **two billion** people living without waste collection and **three billion** without controlled waste disposal, the poor management of solid waste is a global crisis.

Poor management of solid waste leads to a range of negative impacts on:

- **the environment** – pollution of surface and ground water; climate-changing greenhouse gas emissions; air pollution; marine plastics; harm to wildlife; flooding
- **human health** – respiratory diseases; childhood stunting; water-borne diseases; infectious diseases; accidents; drowning
- **the economy** – healthcare costs; productivity losses; damage from flooding; reduced tourist income; clean-up costs; missed opportunities; social inequality

Whilst badly managed waste represents a threat to human health, the environment and economic development, there are also many opportunities from improved resource management to those otherwise economically marginalized and there is increasing interest from the global development community as to the opportunities that a more circular approach offers.

International donors are increasingly prioritising actions for the poorest and most marginalised, such as in the UK Department for International Development's Leave No-One Behind agenda.

A pro-poor, inclusive approach to improve solid waste management would be a win-win: provide a vital service to some of the world's poorest communities that would make them a healthier place to live, grow and do business, whilst creating jobs in itself. Furthermore, such approaches would also help address the global issues of climate change and, in coastal and riverine areas, marine plastics.

## Recommendations for Action

To address this global crisis, the international community needs to act. As part of this, the UK Government should:

1. Commit to increasing the proportion of its aid spent on waste management to at least 3% from its current estimated level of 0.3%;

2. Champion the need for increases in aid to waste management at the Commonwealth Heads of Government Meeting and at the G7 this year, for example as part of the blue economy priority; and

3. Spearhead negotiation of a binding international treaty to tackle marine plastic pollution, which should have at its core prevention through proper solid waste management, as well as efforts to clean up existing pollution.

In addressing the need for better solid waste management, the UK Government and other donors should:

4. Prioritise technical assistance to improve governance and the enabling environment, establishing multi-stakeholder coordinating bodies and scaling up contextually relevant community-based recycling approaches;

5. Where possible and especially in poorer countries, fund projects that work with local informal waste management approaches to develop sustainable solutions that enable the local communities to create value and not rely on continued external support;

Figure 1: Paving tiles from plastic bags in The Gambia

6. Avoid inappropriate large-scale, high-cost, high-technology projects, which often threaten waste picker livelihoods, are not suited to waste streams with high organic content and are reliant on very high capacity clients to ensure environmental standards are met; and

7. Work with the resource management sector, universities and development groups to:
   a) Leverage greater investment from the broader international development community and 'mainstream' waste;
   b) Incubate and support novel approaches to delivery of waste services in low income countries;
   c) Convene opportunities for international partnership and knowledge exchange;
   d) Share technical guidance and best practice; and
   e) Avoid the known pitfalls.

## A. The Problem

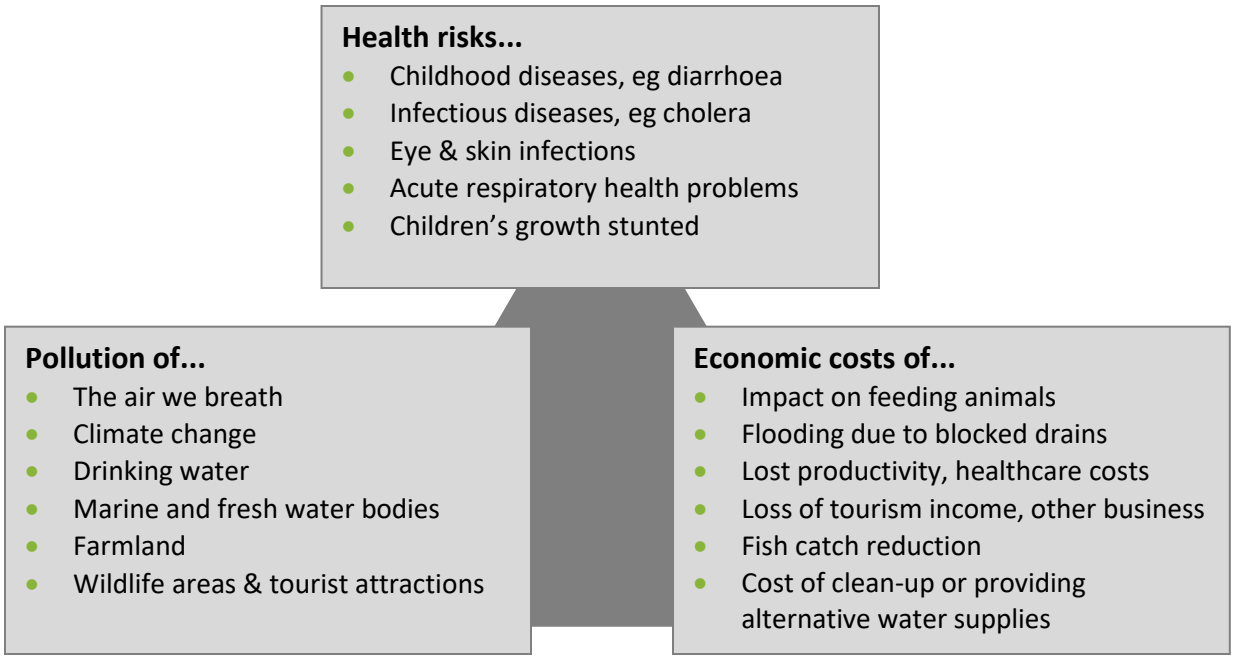


Figure 2: The various impacts of poor solid waste management

### a) The state of solid waste management around the world

We all generate solid waste and are all affected by it: individually, in our homes and communities, entire countries and internationally. Best estimates are that global municipal solid waste is around 2 billion tonnes per annum, and 'urban' wastes (including municipal, commercial, industrial, construction and demolition waste) is estimated at around 7 to 10 billion tonnes per annum.[1] Municipal solid waste generation is expected to double over the next 15-20 years.[2]

Meanwhile, traditional models of waste collection are struggling to cope. Waste collection costs can represent over 70% of the solid waste management budget of many municipalities in developing countries[3] as compared to around a quarter in the UK.[4] Richer developing countries are making progress, but despite this, many households in many cities receive no solid waste management collections services at all, with the result that much waste ends up in the environment - 30-60 per cent of all the urban solid wastes remain uncollected and less than 50 per cent of the population is served.[5]

In 2015 the estimate[6] was there are:

- Around two billion people without access to collection, meaning that their waste is openly dumped in communal areas, often adjacent to human habitation, with no measures to stop leakage into the surrounding environment; and

- Around three billion without controlled waste disposal, meaning that waste may be collected from a dwelling or a business but is taken to a site that is not properly managed, such as a dumpsite or for open burning.

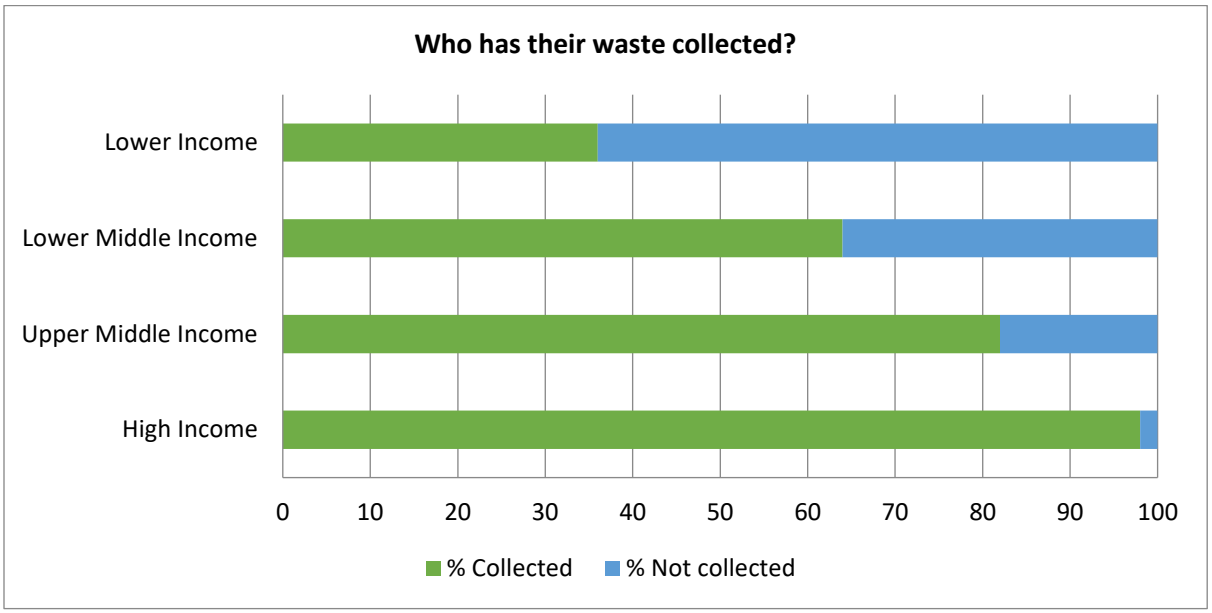


Figure 3: Percentage of the population with waste collection

Those who suffer from a lack of collection coverage are predominantly the poorest. On a regional basis, collection coverage is:[7]

- Africa 25-70%;
- Asia 50-100%;
- Latin America and Caribbean 80-100%;
- Europe 80-100%; and
- North America 100%.

Furthermore, collection coverage can vary widely, within countries and within cities. It is often high in the central business district and in wealthier areas and near zero in peri-urban areas and slums. One example is the West African country of Benin, where around 50% of households outside slums have waste collections, compared to only 10% in slum areas; in Ethiopia around 60% of households outside slums have waste collections, compared to only 30% within.[8]

### b) The local impacts of poor solid waste management

Poor handling and disposal of solid waste are major causes of environmental pollution and poor human health,[9] including by creating breeding grounds for pathogenic organisms and the spread of infectious diseases.[10] Approximately nine million people die of diseases linked to mismanagement of waste and pollutants, twenty times more than die from malaria.[11] Ninety-two per cent of these deaths occur in low and middle-income countries, with children facing the highest risks.[12]

**Uncollected Waste**


Figure 4: There are numerous health impacts on children of unmanaged waste

The two billion without waste collection face an immediate public health crisis. Uncollected waste has both direct effects on health, harbouring vermin and insects that are vectors for disease; and indirect effects through blocked drains causing the spread of water-borne diseases and widespread flooding.[13]

Uncollected waste is often openly burnt. UN-Habitat health data shows that acute respiratory infections six times higher for children living in households where solid waste is burned in the yard, compared to households in the same cities that receive a regular waste collection service.[14] Recent estimates are that uncontrolled burning of household waste cause an extra 270,000 premature deaths every year globally.[15] In China, the emissions of PM10 from open domestic waste burning has been estimated as equivalent to 22% of China's total reported anthropogenic small particles ($PM_{10}$) emissions. There have been suggestions that emissions of many air pollutants are significantly underestimated in current inventories because open waste burning is not included.[16]

Figure 5: Flooding in Kinshasa, attributable mainly to blocked drainage channels and rivers, killed 45 people in a week in January 2018 and was followed by a deadly outbreak of cholera

Uncollected waste is directly linked to gastro-enteritis and waterborne disease. UN-Habitat data shows rates of diarrhoea are twice as high where solid waste in not collected.[17] An EU funded solid waste collection programme in Kinshasa DRC between 2007 and 2015 was associated with a 40% drop in waterborne disease in recipient areas;[18] in 1994 a major flood in Surat in India in 1994 resulted in an outbreak of a plague-like disease, affecting 1000 people and killing 56. Annual floods in East and West African, and Indian cities are blamed, at least in part, on plastic bags blocking drains.[19]

Solid waste is part of the larger overall picture of poor sanitation. Uncollected waste has a direct impact on the efficacy of toilet and water drainage systems by blocking, filling and reducing the efficiency of these systems. It acts as an environment favourable to the breeding of vectors associated with faecal-oral transmission, such as flies and in some cases, is the way in which faeces are disposed of if there are no other toilet options. Standing water from blocked drains provides conditions favourable for breeding mosquitoes and associated diseases such as dengue and malaria. Hence it is reasonable to associate poor solid waste management with the long-term impacts of environmental enteropathy, child stunting, educational underperformance and life opportunities.[20]

**Uncontrolled Dumping**

Even where waste is collected there is often no proper disposal site. It is estimated that 40% of the world's waste is disposed of at uncontrolled dumpsites - to give an idea of the scale of the issue, the 50 biggest dumpsites in the world have around 64 million people living next to them.[21]

There is often no monitoring at these sites, and nobody to control the placement of waste, operation of the site or environmental engineering to prevent escape of waste into the surrounding land and watercourses.[22] Infiltration of leachate from uncontrolled sites is a particular threat in small island states, such as Jamaica where around one quarter of groundwater is contaminated.[23]

Figure 6: Plastic waste piled in the commune of Masina, a suburb of Kinshasa in the Democratic Republic of the Congo, in December 2017

For those living at dumpsites who scavenge through the waste, there are constant threats of injury, vermin, disease and death. In March 2017, 82 people died when a dumpsite at Addis Ababa in Ethiopia collapsed;[24] a month later, an informal dump of Colombo City in Sri Lanka collapsed, killing 28 and leaving hundreds of families homeless.[25]

**The Economic Impact**

Whilst more research is needed, a review of existing evidence concluded that it is much cheaper for society to manage its waste now in an environmentally sound manner than to carry on dumping. In value-for-money terms, the costs to society of inaction exceed the financial costs per capita of proper waste management by a factor of 5-10.[26] Poorly managed waste has numerous and disparate economic impacts in addition to the local human and environmental issues discussed above. These have been well summarised within the Global Waste Management Outlook:[27]

- The impact on feeding animals – in some areas up to a third of cattle and half of goats consume significant amounts of plastic, and that those that consume more plastic tend to be more emaciated, more prone to disease;[28]
- The contribution of waste, particularly plastic, blocking drains and increasing the risk of major flooding, leading to damage to property and disruption of normal economic activity;
- Costs of lost productivity due to disease, and the additional healthcare costs of treating it;
- Loss of tourist income due to visual impacts;

Figure 7: Plastic bags entangled in bushes - and often mistakenly eaten by livestock

- Loss of fish catch due to water pollution due to solid waste dumping; and
- Costs of decontaminating water or providing alternative supplies.

## c) The impact of poor solid waste management on the global environment

In addition to the upstream impacts of poor resource efficiency, poor solid waste management affects the global environment in two key ways.

**Climate Change**

The waste management sector has historically been considered a relatively minor contributor to greenhouse gas (GHG) emissions, estimated by the IPCC at approximately 3% of total global anthropogenic emissions in 2010, coming from emissions of carbon dioxide and methane (a 21x more powerful greenhouse gas than carbon dioxide[29]) from rotting organic matter in landfills and open dumps. This however is a significant underestimate of the role proper solid waste management can play in reducing GHG emissions. In part this is because this estimate is dominated by solid waste generated in rich countries. It therefore underestimates the potentially significant increase that may come if the growing volumes of waste in emerging economies is not properly controlled.

Figure 8: Open burning at a dumpsite

It is projected that dumpsites will account for 8–10 per cent of global greenhouse gas emissions by 2025.[30]

Another factor is the role of black carbon (soot), produced by open burning of waste. It is second only to carbon dioxide in contribution to global warming, and because of its short lifetimes, reducing emissions could result in near-term climate benefits.[31] Black carbon makes up a substantial part of the contribution from many developing countries in Asia and Africa.[32]

The third element is the role that a more circular economy can play in reducing GHG emissions in other parts of the economy. An on-going UN project estimates that 1.3 billion tonnes of edible food waste is generated each year,[33] representing one third of all food produced for human consumption. Prevention of this food waste would reduce global GHG emissions by 9%. Recycling a tonne of aluminium cans saves 95% of the energy required to produce them from bauxite (aluminium ore).[34]

Overall, the GWMO concludes that the potential impact of improved resource and waste management on reducing GHG emissions across a broad range of economic sectors could be 15-20%.[35]

**Marine Plastics**

There is increasing international concern associated with the health impact of microplastics and the conservation impact of macroplastics in the marine environment. The prevalence of marine plastics is a highly visible symptom of a failing land-based waste management systems in lower income countries.

The amount of plastics entering the oceans is estimated by modelling studies as at least an order of magnitude greater than estimates of the visible quantities in the oceans or on beaches[36,37] – so the first priority is to 'turn off the tap'. On present trends the ocean will

Figure 9: Most ocean plastics come from the land

contain one tonne of plastic for every three tonnes of fish by 2025, and by 2050, more plastics than fish by weight.[38] More than 90% comes from land-based sources.[39] Some 4-12 million tonnes per annum comes from mismanaged solid wastes generated within 50 km of the coast, of which more than 50% comes from just five east Asia countries.[40] Another 0.4-4 million tonnes come via rivers, with more than 90% of that from 10 major rivers in Asia and Africa.[41] Thirty-eight of the world's fifty largest uncontrolled dumpsites are in coastal areas, many of them spilling waste directly into the sea.[42]

Land-based sources include mismanaged municipal solid wastes in developing countries; litter from all countries; manufacturing wastes including spillages of plastic pellets; micro- and nano-plastics in products; fibres from washing synthetic textiles; and micro-plastics from road vehicle tyre wear.[43] Definitive data to separate out the quantities from each of these sources is not available, however, when considering all of the available evidence, a recent international expert meeting concluded that mismanaged municipal solid wastes in developing countries likely accounts for 50-70% by weight of plastics entering the oceans.[44] One study has suggested that 75% of this comes from uncollected waste and litter, and 25% from leakages post-collection and from uncontrolled disposal sites.[45]

It follows that the quantity of plastics entering the oceans could be halved by extending municipal solid waste collection to all and eliminating uncontrolled dumping and burning.

### d) The opportunities offered by decent waste management for sustainable jobs

Historically the waste management sector world-wide has offered opportunities to those in economically marginalised positions – whether through gender, ethnic or social grouping. Half a per cent of urban populations work in informal-sector recycling, some 15-20 million people globally.[46]

Although there is variation, the work tends to vary between primary collection and transport, collection of specific materials for onward sale or artisanal recycling or reprocessing. It is difficult and often dangerous work, characterized by a lack of access to legal and social protections and exposure to insanitary conditions and hazardous substances.[47] One study of waste pickers in Mexico City estimated their life expectancy to be just 39 years, compared to 67 years among city residents overall.[48]

Waste pickers rarely achieve economic mobility through this profession. Challenges include lack of access to credit to mechanise and an absence of economies of scale contributing to weak bargaining power in the recycling supply chain.[49]

**Circular Economy and employment**

A circular economy is one that keeps resources in use for as long as possible, and is regenerative by design, looking at upstream opportunities such as new models of purchase, focussing on provision of service rather than goods as we as recovering and regenerating products and materials at the end of their life. It

Figure 10: Newly trained community waste managers in Somaliland

contrasts with the traditional linear economy where we take, make and dispose of materials.

Whilst the benefits of good waste management are obvious in terms of avoidance of threats, there are also significant additional benefits from the potential of a Circular Economy (CE) approach. Developing countries are typically more circular than wealthier countries – waste arisings per capita are lower and there are thriving reuse and repair sectors due to lower labour costs. However, there is a concern that many low and middle-income countries may currently be becoming *less* resource efficient, as a traditional culture of repair and re-use is eroded. An example being the increase of leakage of plastics into the oceans, as reusable glass bottles are displaced by disposable PET bottles, and as the use of small sachets become ubiquitous. Given the growing waste crisis offered by a 'development as usual' to low and middle-income countries, such a shift may not only create jobs but alleviate this growing threat.

## e) Waste management: an engine for sustainable development

There are many linkages between the Global Goals for Sustainable Development and improved waste management – poverty reduction, improved health and equality, provision of clean energy, cleaner cities and healthier populations, and the protection of air, land and water from pollution.

Indeed, the provision of a decent waste management service across a city requires a standard of urban government that is responsive and transparent. Ensuring that all areas receive a service, not just the wealthier ones, requires an inclusive, participatory approach. Hence waste collection, and even the levels of openly dumped waste visible on the streets might be used as a proxy for good governance.[50]

Making progress in addressing waste management issues will contribute directly to 12 out of the 17 Sustainable Development Goals.[51]

| **Waste management can help deliver all Sustainable Development Goals**<br>  <br><br>***Key:***<br>*green = direct link*<br>*number = target that explicitly requires a basic level of waste management*<br>*blue = indirect link* | 1. Access for all to basic waste collection services | 2. Stopping uncontrolled dumping and open burning | 3. Managing all waste properly, particularly hazardous waste | 4. Reducing waste and creating recycling jobs | 5. Halving food waste from markets, shops and homes, and reducing food losses in the supply chain | *Governance' factors which underpin sustainable waste management* |
|---|---|---|---|---|---|---|
| 1 NO POVERTY | 1.4 | | | | | |
| 2 ZERO HUNGER | | | | | | |
| 3 GOOD HEALTH AND WELL-BEING | | | | | | |
| 4 QUALITY EDUCATION | | | | | | |
| 5 GENDER EQUALITY | | | | | | |
| 6 CLEAN WATER AND SANITATION | | 6.3 | | | | |
| 7 AFFORDABLE AND CLEAN ENERGY | | | | | | |
| 8 DECENT WORK AND ECONOMIC GROWTH | | | | | | |
| 9 INDUSTRY, INNOVATION AND INFRASTRUCTURE | | | | | | |
| 10 REDUCED INEQUALITIES | | | | | | |
| 11 SUSTAINABLE CITIES AND COMMUNITIES | 11.1<br>11.6 | 11.6 | 11.6 | | | |
| 12 RESPONSIBLE CONSUMPTION AND PRODUCTION | | | 12.4 | 12.5 | 12.3 | |
| 13 CLIMATE ACTION | | | | | | |
| 14 LIFE BELOW WATER | | | | | | |
| 15 LIFE ON LAND | | | | | | |
| 16 PEACE, JUSTICE AND STRONG INSTITUTIONS | | | | | | |
| 17 PARTNERSHIPS FOR THE GOALS | | | | | | |

Figure 11: Waste and the Sustainable Development Goals. Managing waste properly can help deliver all the Sustainable Development Goals

## B. Areas of potential action

Achieving two basic goals, of extending waste collection services to all and eliminating open dumping and burning, would likely reduce the quantities of plastics entering the oceans, from both coastal communities and via rivers, by more than 50%. If local people can make a livelihood from recycling plastics, or use it to create other products to sell in local markets, then there is a positive 'pull' to prevent the plastic reaching the oceans.[52]

Meeting these goals would also directly improve public health in developing countries: reducing diarrhoeal diseases and eliminating the estimated 270,000 premature deaths a year attributed to open burning of waste.

Policymakers increasingly agree on the need to take an Integrated and Sustainable Solid Waste Management (ISWM) approach. This focuses on the so-called 'two triangles', one looking at the three key physical elements (waste collection, treatment / disposal and the 3Rs – reduce, reuse, recycle) and the second at the governance strategies that all need to be addressed to deliver a well-functioning system.

The system as a whole needs to be inclusive, allowing stakeholders to contribute as users, providers and enablers; to be financially sustainable, i.e. cost-effective and affordable; and rest on a base of sound institutions and proactive policies.[53] It can be argued that poor governance is the systemic reason behind lack of coverage of waste services. Waste is often a low political priority, the evidence associating it with ill health and economic cost is either misunderstood or ignored and despite there likely being legal requirements and probably the structures set up, the services simply aren't delivered. Indeed, a 2001 DFID paper argued that the cleanliness of a city, i.e. the state if its municipal solid waste management system, could be used as a proxy indicator for good governance.[54]

Processing waste materials locally can help meet local demand for sustainable fuel, soil enhancer and construction materials. The sale of these products can generate a demand for clean, separated materials, thereby transforming the local waste problem into an opportunity. Recognising and treating waste as resources provides a cost-effective way to deliver waste management in smaller communities.

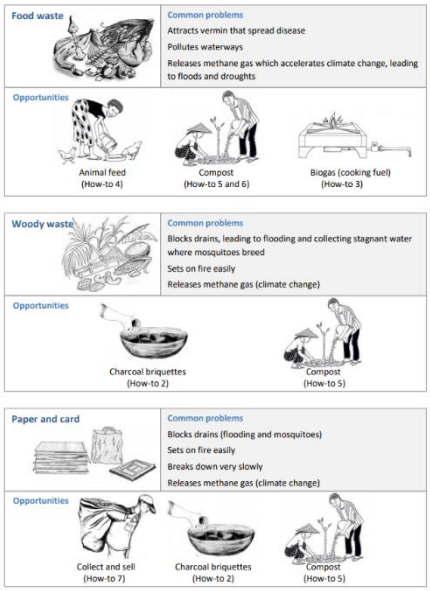


Figure 12: Different waste materials can be processed in a variety of ways to make useful products

This section provides some key areas where international aid donors such as the UK or World Bank might target aid to address poor solid waste management in developing countries, and by extension make a significant contribution to reducing marine plastic pollution.

## Recommendations for Action

To address this global crisis, the international community needs to act. As part of this, the UK Government should:

1. Commit to increasing the proportion of its aid spent on waste management to at least 3% from its current estimated level of 0.3%;

2. Champion the need for increases in aid to waste management at the Commonwealth Heads of Government Meeting and at the G7 this year, for example as part of the blue economy priority; and

3. Spearhead negotiation of a binding international treaty to tackle marine plastic pollution, which should have at its core prevention through proper solid waste management, as well as efforts to clean up existing pollution.

In addressing the need for better solid waste management, the UK Government and other donors should:

4. Prioritise technical assistance to improve governance and the enabling environment, establishing multi-stakeholder coordinating bodies and scaling up contextually relevant community-based recycling approaches;

5. Fund projects that work with local informal waste management approaches to develop sustainable solutions that enable the local communities to create value and not rely on continued external support;

6. Avoid inappropriate large-scale, high-cost, high-technology projects, which often threaten waste picker livelihoods, are not suited to waste streams with high organic content and are reliant on very high capacity clients to ensure environmental standards are met; and

7. Work with the resource management sector, universities and development groups to:
   a) Leverage greater investment from the broader international development community and 'mainstream' waste;
   b) Incubate and support novel approaches to delivery of waste services in low income countries;
   c) Convene opportunities for international partnership and knowledge exchange;
   d) Share technical guidance and best practice; and
   e) Avoid the known pitfalls.

The following sections provide more information on these five areas.

### a) Evidence: Leveraging greater investment from the broader international development community and 'mainstream' waste

The evidence shows that current donor spend on solid waste management is minimal, and not focused on the poorest countries. Despite recent attention, it is still a relatively niche issue amongst donors, governments and NGOs. There is a need to:

- Improve the evidence base for more action on solid waste.
- Distill the impacts with reference to the SDGs: More detailed evidence is needed on the direct impact in terms of the SDGs, particularly in terms of health, child development, disease and economic burden. The research would need to be wide ranging – including air pollution, marine plastics, waterborne diseases, plastic ingestion by livestock, cost of related flood damage etc.
- Mainstream understanding of waste within the global development sector: Work with other actors to improve understanding of the potential impact on solid waste of their activities – for example, how can humanitarian aid be delivered in a way that reduces the waste footprint and ensures that any waste produced can be effectively managed locally.

### b) Innovation: Incubate and support novel approaches to delivery of waste services in low income countries

Municipal-based models for solid waste management are often used as the default delivery approach. Given the ongoing failure of these systems, particularly in the poorest communities, there is a need to investigate novel approaches. Accordingly:

- Trial novel approaches to the delivery of waste services and how they are funded: Can the value of materials diverted for recycling cover collection cost? What can local government with very little cash do? Can waste services be cross-subsidised from the provision of other utilities? Is there an opportunity for co-delivery of solid waste and WASH programmes, for example?
- Incubate new circular economy models that prevent waste by design, including new approaches to product design, supply-chain management and purchasing models that might reduce the waste production in the poorest communities;

Figure 13: Local waste pickers seeking value

- Map and support the development of secondary markets for recyclate: The value of recycled material varies widely in different parts of the world. When value is high, recovery by the informal sector is high. Mapping and developing access to recycling facilities could provide a cost-effective way of reducing waste and increasing incomes for the poorest, with the caveat that appropriate environmental and health standards are part of the scope.
- Provide opportunities for cross-fertilisation of ideas from other global development disciplines: Learning from WASH programmes, community education and health programmes on how to engage communities and sensitisation, approaches

Figure 14: Child on a dumpsite in Cambodia

to sustainable funding, development of local partnerships and networks. These provides a substantial body of knowledge built up over years in a similar discipline, which is valuable considering the relative lack of work within the solid waste field.

- Work with government to ensure an enabling environment for new partners to take control: Develop protocols to ensure that communities are permitted to manage their own waste without retribution. It is so often seen as only a government competence. *In extremis* there are examples of people being arrested for trying to clean up their own environment. There is a lot at the most basic end that people can do to reduce impact – even simply selecting a dumpsite in less harmful area and enforcing that everyone dumps there.
- Engage local businesses: Much of the most important waste (plastic bags, water sachets, water and drinks bottles) is locally produced. To address much of this, particularly plastic containers, this local sector needs to be engaged either to become a market for secondary materials or adopt more circular approaches.

### c) Collaborative action: Convene opportunities for international partnership and knowledge exchange

Within the world of solid waste and global development, there are few, if any opportunities for practitioners and thinkers to come together, either physically or virtually, to share ideas, discuss and debate approaches and develop partnership for concerted international action. This offers up the opportunity to develop an international event that allows politicians, academics, NGOs, partners governments to come together and agree international action and pledge support. This could include:

- The development of communiqués that provide the ground for co-ordinated international action.
- Provide an opportunity for practitioners and academics to discuss and debate how action can be delivered; allowed novel approaches, successes and failures to be shared.
- Provide a platform for UK aid-supported research to be disseminated and promoted.

### d) Sharing technical guidance and best practice

There is a need within the international community to improve not only awareness of the importance of improved solid waste management, but also principles and practice. Actions could include:

- Access to simple, non-specialist information on the principles of improved solid waste management, provided in a context applicable to low-income countries and including technical information, that can be shared amongst practitioners and is also easily available to non-specialist delivery agents (local governments and INGOs).
- A menu approach to different 'off-the-shelf' solutions through best practice case studies on, for example, the delivery of solid waste management systems in fragile states, informal settlements and IDP camps.

Figure 15: Poor waste management near Lake Naivasha

- Development of best practice on the sustainability of waste-related interventions including more holistic approaches to communities or urban areas, complementing engineering solutions with approaches to sensitisation and improvements to governance. The timescales of traditional donor disbursement programs have not always supported this aim.
- Standardised approaches to measure success: simple, off the shelf monitoring and evaluation for waste/CE programmes that go beyond tonnages to metrics related to disease, air pollution, marine pollution, and other broader indicators.

### e) Pitfalls to avoid: Examples of failed high technology approaches to waste management in developing countries

There are several examples of 'failed' high technology approaches to solid waste management in developing countries, and the primary reason for this is not the technology itself. More often, the issue is that the technology solution is either inappropriate to the waste stream(s) and conditions in the country or incompatible with the existing political and municipal structures governing waste collection and treatment and the practical systems operating at community level – such as waste pickers, micro-enterprise recycling, etc. Some of the more recent cases documented in UN reports are included (Figures 16 and 17). Other examples exist from earlier; there were several failed incinerator projects in the 1970s in Africa and Indonesia and in Karachi, a World Bank funded landfill opened in 1996 but the city could not afford operating costs so it reverted to an open dump within a few years.

**Box 4.15 Failed treatment facilities in India[22]**

In 1984, the Municipal Corporation of Delhi, India, built an incinerator to process 300 tonnes per day of solid waste and produce 3MW of power, with technical assistance from Denmark, at a cost of around US$3.5 million. The plant was designed for segregated waste as input, which was not practised by the households or promoted by the municipality. The plant had to be closed down within a week of its opening as the waste had a very low heating value and a high percentage of inert materials.

In 2003, Lucknow Municipal Corporation built an anaerobic digestion plant, as a 5MW waste-to-energy project, to process 500 to 600 tonnes of municipal waste per day at a cost of US$18 million. Private companies from Austria and Singapore provided the technical inputs, while Indian firms supplied the human resources for execution on a build–own–operate (BOO) basis. The plant was not able to operate even for a single day to its full capacity due to the high level of inert materials in the waste and was closed down. The operational difficulties and the ultimate failure were mainly due to the difference between the design assumptions that were based on European waste and waste management practices, and the actual field scenario in India.

Both facilities are landmarks to the failure of imported waste-to-energy technolo-

Figure 16: UN-Habitat (2010), SWM in the World's Cities, page 114

**BOX 5.12 – PUBLIC-PRIVATE PARTNERSHIP FOR FINANCING AND OPERATING A MATERIAL RECYCLING FACILITY IN SURAT, INDIA[126]**

In Surat, India, the municipality, which was very keen on improving treatment, issued a tender using the public-private partnership model for solutions that would divert waste away from landfilling at minimal cost. The incentive used by the municipality was to provide infrastructure and land to the successful bidder for a token price. An Indian company from Mumbai won the bid by proposing a solution at no cost to the municipality. The required input amount of waste for the facility was 400 tonnes per day, which represented about 25% of the city's waste stream.

The MBT facility, fully operational since 2009, was extracting and selling metals and producing a compost-like output and refuse-derived fuel (RDF). At the time of the research carried out in this city in 2011, the investor was planning an expansion of the business. However, more recent information suggests that the plant closed in December 2013 due to financial losses incurred over five years of operation.[127] The same source states that a similar plant operated by the same company in another city closed at the same time after eight years of operation, while another three plants in other Indian cities have recently suffered catastrophic fires.[128]

The advantages of this investment from the viewpoint of the municipality were clear: it was private money engaging in resource recovery at no cost to them. At the same time, there were some issues to consider: the contract term was 30 years and locked the waste streams to an MBT facility processing mixed wastes, while better solutions may become feasible before the contract term expires. And, although the service was provided free of charge to the municipality, there may be some externalities that were not being adequately paid for upstream or downstream. For example the facility buying the RDF may not have had adequate environmental standards for using RDF and therefore was able to offer a better price for this fuel, or the compost was being prepared from mixed waste and therefore would contain some contaminants, or the informal sector that had formerly recycled this waste stream may have been displaced, since the facility was capturing a significant part of the waste stream and indeed relied for its income at least partly on separating materials for recycling.

Figure 17: UNEP (2015), Global Waste Management Outlook, page 243

These issues have been recognised to some extent. In the late 1990s, there were three World Bank 'standalone' solid waste management projects initiated but in two cases the World Bank withdrew after several years of project preparation as it judged that the governments in the countries concerned did not have the capability to deliver the projects. Around 2000, a decision was taken to stand back from frontline investment projects and concentrate on capacity building in a different context, focusing on technical capacity building including policy and legislation, private sector participation, financial sustainability, public awareness and community participation.

In seeking to define good practice in this field, and address the issues outlined above, for the UN-Habitat's Third Global Report on the State of Water and Sanitation in the World's Cities,[55] a new framework – 'integrated and sustainable waste management' – was used which is described in the accompanying paper 'What is good practice in solid waste management?'.[56]

Over the next decade plus, the proportion of development aid spent on solid waste management increased but that increase was against a very low baseline (0.15% to 0.3%). Much of the activity was focused on middle income rather than lower income countries as the governments and/or municipalities in the former were deemed to be more capable of delivering sustained change and progress in their waste management practices.

More widely, the international donor community remains very concerned about the continued risk of inappropriate high-technology projects being sold (from the UK, Europe, US and indeed China) in developing countries. In an attempt to ensure that better outcomes are delivered, a number of tools have been developed including:

- a GWMO one-page checklist of 'questions to ask yourself and any salesman';
- a 12-point decision making matrix from GIZ[57]; and
- a CWG assessment tool[58].

## Conclusion

A growing population, increasing urbanisation, and a shift to a consumer lifestyle are leading to the generation of ever great volumes of solid waste around the world. We now face a global waste management crisis and governments rich and poor need to act.

Poor management of solid waste leads to a range of negative impacts on:

- **the environment** – pollution of surface and ground water; climate-changing greenhouse gas emissions; air pollution; marine plastics; harm to wildlife; flooding
- **human health** – respiratory diseases; childhood stunting; water-borne diseases; infectious diseases; accidents; drowning
- **the economy** – healthcare costs; productivity losses; damage from flooding; reduced tourist income; clean-up costs; missed opportunities; social inequality

**A pro-poor, inclusive approach to improve solid waste management would be a win-win-win: provide a vital service to some of the world's poorest communities that would make them a healthier place to live, grow and do business; create jobs; and help address the global issues of climate change and marine plastics.**

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