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## Summary Series

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# Social and Environmental Sustainability of Municipal Solid Waste in the Context of the UN Sustainable Development Goals

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Globally, significant, and continuously growing, volumes of municipal solid waste (MSW) are generated, and are often disposed of in sub-optimal ways resulting in undesired environmental, social and economic impacts. It is estimated that MSW generation by households will reach 3.8 billion tons by 2050 if urgent action is not taken, a 56% increase compared to 2020 (UNEP, 2024c). Developing scientifically based sustainability metrics is required to give a sound basis for decisions regarding future generation and treatment of MSW.

The United Nations Sustainable Development Goals (SDGs)<sup>1</sup> are now widely used as a means of tracking progress towards the more sustainable use of natural and human resources for the betterment of global society, and have been applied widely to MSW (Elsheekh et al., 2021, Abubakar et al., 2022, Ram and Bracci, 2024). This report does not consider the full 17 SDGs, rather it considers SDGs related to MSW from the perspective of the environmental, social and economic impacts indicated as very important by the stakeholders participating in the regional workshop series organised by IEA Bioenergy ‘Task 36 - Material and Energy Valorisation of Waste in a Circular Economy’ and held in South Africa, North America and Europe in 2022 and 2023 (Murphy and Gusciute, 2024).

Current levels of MSW generation and many of the employed management practices impact on each of the 9 SDGs considered in this report. However, several potential solutions exist to address the negative environmental and social impacts relating to MSW generation and management, thereby contributing to the achievement of the SDGs reviewed in this report, including:

**Waste Reduction:** Minimising waste generation aligns with achieving many SDGs, reducing pressure on ecosystems by reducing the volumes of MSW to be treated. Community engagement and education are crucial; educating the public on proper waste disposal and its impact on SDGs such as water and sanitation promotes responsible behaviour (Dri et al., 2018). Involving communities, non-governmental organisations (NGOs) and the private sector in waste management planning and implementation enhances shared responsibility and sustainable solutions.

**Recycling and Circular Economy:** Sustainable MSW management practices such as reuse, recovery and recycling can promote the reuse of resources, reducing the demand for raw materials and mitigating deforestation and ecosystem degradation. Recycling MSW reduces

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<sup>1</sup> See <https://sdgs.un.org/goals>

the amount of land needed from landfills and avoids overexploitation and destruction of ecosystems (Cui et al., 2024). Circular economy practices such as composting can enhance soil health and reduce the need for chemical fertilisers, promoting sustainable land use (Choudhary et al., 2024).

Proper Waste Disposal and Treatment: Governments, municipalities, and businesses can contribute to implementation of sustainable MSW management strategies, and appropriate infrastructure to prevent land degradation and contamination of ecosystems. For example, municipalities should ensure that proper landfill design is followed.

Policy and regulatory frameworks are crucial for promoting sustainable MSW management and are related to achieving many of the SDGs considered in this report. Examples include extended producer responsibility schemes which shift financial responsibility for end-of-life disposal to product manufacturers, thereby providing an incentive for improved product design, reuse, and recycling (Tibbetts, 2015). Further, implementing policies that prevent the disproportionate siting of landfills in marginalised communities and integrating informal waste pickers into formal systems. Enforcing strict waste disposal regulations and penalties for non-compliance encourages proper practices, while financial incentives for recycling and waste reduction motivate environmentally friendly behaviour.

SDG2 ('Zero hunger') aims to end hunger, achieve food security and improved nutrition, and promote sustainable agriculture<sup>2</sup>. Food waste is one of the largest contributors to MSW which ends up in landfill (EPA, 2023a), not only exacerbating environmental issues (Crippa et al., 2021) but directly impacting on potential opportunities to address hunger and food insecurity.

SDG6 ('Clean water and Sanitation') aims to ensure availability and sustainable management of water and sanitation for all<sup>3</sup>. The use of landfills for disposal of MSW is still one of the most common approaches employed across the global, irrespective of the countries developmental status and uncontrolled "landfills" (known as open dumpsites) are widely used in many developing countries (Siddiqua et al., 2022). Improper handling and disposal of MSW can lead to contamination of water resources and hinder sanitation efforts, posing severe environmental and social challenges. When waste is improperly disposed of, it can generate leachate, a toxic liquid formed when rainwater percolates through waste materials, dissolving harmful substances, adversely affecting water quality (Eggen et al., 2010).

SDG7 ('Affordable and clean energy') centres on the global ambition to achieve universal access to affordable, reliable, sustainable, and modern energy by the year 2030<sup>4</sup>. Properly managed, MSW can become a valuable resource for clean energy generation, addressing both waste management and sustainability goals. MSW can be converted into energy using Waste-to-Energy (WtE) technologies, which align with SDG7's objectives by increasing renewable energy use and improving energy efficiency (Khan and Kabir, 2020).

SDG9 ('Industry, Innovation, and Infrastructure') focuses on building resilient infrastructure, promoting industrialisation, which is sustainable and inclusive, as well as fostering innovation<sup>5</sup>. MSW management and SDG9 are related in several ways including sustainable waste management infrastructure development, innovation in waste management technologies, and the promotion of resource efficiency.

SDG10 ('Reduced inequalities')<sup>6</sup> focusses on reducing inequality within and among countries. The level of controlled<sup>7</sup> MSW management varies greatly by region, with Sub-Saharan Africa and Central and South Asia having the lowest rates, while North America and Western Europe have the highest (UNEP, 2024c). Fraudulent activities, the high cost of responsible waste management, and inconsistent regulations across nations creates significant opportunities for corruption in the global waste trade. Studies have shown evidence of disproportionate siting of hazardous waste treatment, storage and disposal facilities in ethnic and racial minority communities, communities of colour and communities with lower socio-economic status.

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<sup>2</sup> See <https://sdgs.un.org/goals/goal2>

<sup>3</sup> See <https://sdgs.un.org/goals/goal6>

<sup>4</sup> See <https://sdgs.un.org/goals/goal7>

<sup>5</sup> See <https://sdgs.un.org/goals/goal9>

<sup>6</sup> See <https://sdgs.un.org/goals/goal10>

<sup>7</sup> 'Controlled waste' refers to waste which is collected, and then either recycled or disposed of in a controlled environment. See UNEP (2024).

The issue of MSW is strongly linked to SDG12 ('Responsible production and consumption') as it focusses on ensuring sustainable consumption and production patterns<sup>8</sup>. MSW generation and disposal pose a significant burden on human health, land use and environmental sustainability. There is a clear divergence between collected and properly managed waste across regions, highlighting the differences in MSW infrastructure between regions. Economic development drives a growing demand for natural and energy resources; which if not well managed, they may eventually end up as waste (OECD, 2020).

Climate change is the focal point of the SDG13 ('Climate action')<sup>9</sup>. MSW management practices have an impact on GHG emissions with the waste sector accounting for 3.3% of global GHG emissions in 2019 (Climate Watch, 2024). Many regions are still reliant on landfilling of waste, including in open landfills, and on open burning of waste which contribute significantly to GHG emissions (e.g., methane from organic waste decomposition in landfills) with the resulting climate change affecting terrestrial ecosystems, accelerating biodiversity loss and desertification (Ali et al., 2014).

SDG14 ('Life Below Water') aims to conserve and sustainably use the oceans, seas and marine resources for sustainable development<sup>10</sup>. MSW management and SDG14 are related as inefficient MSW management practices can have detrimental effects on marine ecosystems and the sustainability of marine life. Landfilling of MSW is associated with underground water pollution due to the leaching of organic, inorganic, and other substances of concern contained in the pollution from landfill runoff (Siddiqua et al., 2022).

SDG 15 ('Life on land') aims to "protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss"<sup>11</sup>. Effective waste management strategies can support SDG15 by reducing pollution, improving environmental health and conserving resources (Ram and Bracci, 2024). Leachate generated by open burning and dumping of solid waste is hazardous to soil microbes, and causes chemical and biological contamination in soil (Mor and Ravindra, 2023).

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<sup>8</sup> See <https://sdgs.un.org/goals/goal12>

<sup>9</sup> See <https://sdgs.un.org/goals/goal13>

<sup>10</sup> See <https://sdgs.un.org/goals/goal14>

<sup>11</sup> See <https://sdgs.un.org/goals/goal15>