

Why waste segregation policies fail – and how training makes them work

Reducing landfill use cuts greenhouse gas emissions and costs less

Managing the urban waste footprint is one of the most pressing challenges facing rapidly growing cities (Bryan et al, 2020). Poorly managed waste contributes to local pollution, public health risks and climate change – particularly through methane emissions from landfills, which are rising rapidly in many low- and middle-income countries. Waste management is also among the largest spending items in municipal budgets, especially for cities with limited fiscal capacity.

In response, many countries have introduced policies requiring households to segregate waste at source, typically separating wet (such as food and green waste) from dry waste (such as paper and plastics). Such policies are widely viewed as best practice, as segregation enables recycling and composting while reducing the volume of waste sent to landfills (UNEP, 2015). Yet compliance remains low in many cities, even where segregation is legally mandated, and waste segregation practices are limited despite being crucial for

reducing landfill use, saving resources and fighting climate change.

Why do these policies fall short, and what can be done to make them work?

Mandates fail when sorting waste gets complicated

Waste remains a highly understudied environmental challenge, particularly in the developing world. Rapid consumption growth and urbanisation have created a burgeoning waste burden that technologies from advanced waste systems – such as sanitary landfills or waste-to-energy plants – are often unable to address at scale. While segregation-at-source policies are increasingly being adopted in law, there is still limited evidence on why they have yet to reach their potential in reducing landfilling and emissions.

This question is particularly salient in low- and middle-income countries, where fiscal, monitoring and enforcement constraints limit the effectiveness of standard regulatory tools.

Recent work emphasises that many high-return climate mitigation opportunities in these settings remain underexploited precisely because they rely on instruments that are difficult to implement at scale (Glennerster and Jayachandran, 2023). Policies that generate self-enforcing citizen participation are therefore particularly valuable in these settings.

One overlooked constraint is household capability. Segregating waste is not costless: it requires time, space, coordination with collection systems and an understanding of what should be separated and why. If households lack practical skills, segregation policies may impose high effort costs, reducing compliance even when awareness is high. When there is a lack of knowledge, other factors compound the problem, such as space constraints, inconsistent rules, prohibitive costs and habit.

This raises an important policy question: can improving citizens' skills, rather than

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relying solely on enforcement or price incentives, deliver meaningful environmental gains?

Helping households make the most of their bins

New evidence from the city of Patna, India, suggests the answer is yes. In collaboration with the Patna Municipal Corporation, we studied a large-scale citizen training programme designed to improve waste segregation at source.

The programme trained more than 10,000 households through door-to-door visits. Crucially, the intervention went beyond passive information provision. Trainers demonstrated how to segregate waste in practice, explained how segregation affects landfill operations and environmental outcomes, and helped households set up waste management routines in their homes.

The programme was rolled out using a staggered randomised design, allowing for credible causal evaluation. Waste outcomes were measured through direct observation of household waste disposal along waste truck routes, rather than self-reports – a major advantage in settings where reporting may be unreliable.

Before the intervention, only around 10% of households in Patna segregated their waste. Citizen training increased segregation by 4.5-6 percentage points among treated

households – an increase of roughly 50% relative to baseline levels.

However, despite these sizeable improvements, a striking finding is that the effects did not stop there. Households living near trained neighbours also changed their behaviour, before receiving any training themselves. These spatial spillovers more than doubled the overall impact: once spillovers are accounted for, waste segregation increased by around 12 percentage points.

Importantly, waste segregation rates persisted and continued to grow over time. After the full rollout of training, segregation rates continued to rise, reaching nearly 30%, and remained elevated months later. This pattern suggests that training generated persistent self-enforcing compliance.

The surprising spillovers of training

Why does citizen training succeed where many recycling campaigns fail?

The evidence points to training acting as a productivity-enhancing investment. By reducing the effort required to segregate waste correctly – through skills, routines and understanding – training lowers the ongoing cost of compliance. Once households learn how to manage waste efficiently, continuing to segregate is much easier.

This mechanism also helps explain the large spillovers. When people observe their neighbours segregating waste successfully, they learn from

them. In dense urban environments, these interactions can substantially amplify policy impacts and improve cost-effectiveness.

Improved waste segregation has important climate benefits. By diverting organic waste away from landfills, methane emissions from household waste fall by approximately 26.5%. Methane is a particularly potent greenhouse gas, making such reductions highly valuable for climate mitigation. Scaling the effects linearly to urban households nationwide implies potential emissions reductions of over 6.5 million tonnes of CO₂e annually, which is roughly equivalent to avoiding the combustion of about 15 million barrels of oil.

From a fiscal perspective, the intervention is also highly cost-effective. Reduced landfill use alone is sufficient to recover programme costs within about 18 months. When the climate benefits of lower methane emissions are valued using carbon prices, the estimated benefit-cost ratio rises into double-digit multiples.

This makes citizen training for waste management a rare example of a negative-cost climate policy – one that delivers environmental gains while saving public resources.

Urban waste management has long been seen as an intractable problem in developing cities. Our evidence suggests that relatively simple, well-designed and clearly implementable interventions can make a substantial difference in managing the urban waste footprint of cities in the developing world.

Citizen training for waste management delivers environmental gains while saving public resources



Incentives for rubbish reduction

The scale of the problem

The 2026 World Bank report "What a waste 3.0" details how worldwide waste is being generated much faster than anticipated. Earlier projections estimated that by 2030, 2.59 billion tonnes of global waste would be generated per year. Yet, already in 2022, around 2.56 billion tonnes have been produced. Without intervention, this figure is expected to reach 3.86 billion tonnes by 2050, with the fastest growth projected in sub-Saharan Africa and South Asia regions, which will double their current waste production.

Although high-income countries generate the highest waste per capita, lower-income countries face more struggles with management. In high-income countries, almost 100% of waste is managed through controlled landfill sites, recycling or incineration. In low-income countries, only 3% of waste is processed in controlled facilities, or sites that follow basic standards of recovery and disposal set under Sustainable Development Goals by the UN. Most is either not collected or goes to open dumpsites, where it is discarded with no oversight or management. Landfills are the most prevalent waste management system worldwide (29%), followed by recycling (21%) and incineration with energy recovery (20%). Nearly 30% of all global waste is either openly dumped or not collected.

One city's solution

Ljubljana, Slovenia, was the first European capital to implement a "zero-waste" objective in 2014 – shifting its focus from recycling waste to achieving zero waste. This saw the city push for policies in which products were to be reused or recycled, minimising what was sent to landfills or incinerated.

The goal builds on previous initiatives such as a "pay-as-you-throw" system. Under this system, public bin sites with separate bins for recyclable, biodegradable and the remaining non-recyclable (residual) waste were introduced for residents in the city. The bins could only be opened with a smart card and specific standardised bags were used. The cards were used to record the amount of waste thrown away – with higher tariffs for residual waste than bio waste and no charge for recyclables. Door-to-door collections were also upgraded with strict requirements on separating recyclable, biodegradable and residual materials.

Policymakers used media campaigns to raise awareness of the harms of municipal waste. These policies have reverberated nationally, with Slovenia now having one of the highest municipal recycling rates across Europe, at 62% in 2024 compared with the EU average of 42%.

The risks of inaction

Improving the management of municipal waste is a central issue for sustainable urban development. Uncontrolled waste ripples across many aspects of city life. Pollution can reduce tourist numbers and revenue, agribusinesses suffer if landfill contaminates water and soil, waterway and transport systems can face disruption from uncollected waste – and there are public health risks from tainted water or air. Solid waste sites also represent 20% of global methane emissions, a potent greenhouse gas.

By Lia Bergin

This article summarises Dhingra, S., and Machin, S. (2025) *Citizen training and the urban waste footprint*, CEP Discussion Paper No. 2124. An earlier version appeared on VoxDev. Reprinted here by permission from VoxDev, Swati Dhingra and Stephen Machin. (<https://voxddev.org/topic/energy-environment/why-waste-segregation-policies-fail-and-how-training-makes-them-work>).

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Discover Swati Dhingra's recommendation for must-read papers on **page 28**.

Nearly 30% of all global waste is either openly dumped or not collected at all



Further reading

Bryan, G., Glaeser, E., and Tsivanidis, N. (2020) 'Cities in the developing world', *Annual Review of Economics*, 12(1): 273–297.

Glennerster, R., and Jayachandran, S. (2023) 'Think globally, act globally? Opportunities to mitigate greenhouse gas emissions in low- and middle-income countries', *Journal of Economic Perspectives*, 37(3): 111–136.

UNEP (2015) *Global waste management outlook*.