

Behavioral Insights for Better Waste Management

Deliverable 2: Contextual Research & Evidence Synthesis

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Outline

Summary	4
1. Purpose	5
Finding 1: Infrastructure is the dominant driver, and the rural deficit is acute.	5
Finding 2: The risk is compounding and concentrated where capacity is weakest.	5
Finding 3: Two behavioral gaps persist independently of infrastructure.....	5
Finding 4: The GWMO and WRP datasets are complementary and together give a fuller picture than either alone.	5
2. Methodology	6
3. Finding 1: Evidence for Infrastructure as the Binding Constraint	6
RQ: Does literature support infrastructure, especially collection system, as the binding constraint on proper waste disposal, more than regulation, awareness, or individual behavior? ..	6
3.1. Contradicts Finding.....	9
3.2. Complicates the Finding	10
3.3. The Separation-Recycling Association	13
4. Finding 2: Evidence on Regulation, Enforcement, and Behavior	14
RQ: Does the literature support that waste-management risk is compounding fastest where capacity is weakest?	15
4.1. Aligns with the Finding.....	16
5. Finding 3: Evidence on Generational and Norm-Driven Behavior Gaps.....	19
RQ: Does literature support that generational and awareness-related behavior gaps persist independently of infrastructure?	19
5.1. Aligns with the Finding.....	21
5.2. Contradicts Finding.....	22
5.3. Complicates the Finding	23
6. Finding 4: Evidence on Data Quality & Triangulation.....	24
RQ: Does literature support administrative and self-reported data as complementary rather than redundant?	25
6.1. Aligns with the Finding.....	25
6.2. Complicates the Finding	26
7. Structured Narrative for the Draft Report	27
7.1. Invest in infrastructure first, in the fastest-growing, worst-off countries	27
7.2. Don't ban burning until collection exists	28
7.3. Run youth-focused campaigns alongside infrastructure work.....	28
7.4. Shift messaging from "raise awareness" to "make it normal".....	28
7.5. Treat closing the data gap as its own policy goal.....	29
8. Updated Recommendations	29
Recommendation 1 — Invest across the full waste chain, not just collection	29
Recommendation 2— Pair burning bans with enforcement funding, not just collection	29
Recommendation 3 — Redesign youth programs around habits, not awareness	29
Recommendation 4 — Test new messaging before rolling it out, and don't oversell the evidence	29

Recommendation 5 — Report a plausible range, not a single number, and fix both data problems separately	30
9. Questions for the September Workshop	30
General	30
Recommendation 1 — infrastructure across the full chain	30
Recommendation 2 — sequencing bans with enforcement	30
Recommendation 3 — youth-targeted interventions	30
Recommendation 4 — messaging strategy	30
Recommendation 5 — data gaps	30
10. Reference	31

Summary

Deliverable 1 made four claims about what drives waste management outcomes worldwide, and Deliverable 2 checked each one against outside academic and field research from India, Brazil, Kenya, and other countries. Outside research mostly backs up Deliverable 1's four findings, but with an important twist: infrastructure investment alone won't fix the problem, and the data behind the whole project is less reliable than it looks. Five recommendations follow from this.

On infrastructure, Deliverable 1 found that missing waste collection is the single biggest reason waste goes uncontrolled. Outside research agrees infrastructure matters, but shows it's rarely the only problem: even in Brazil, where collection trucks reach over 90% of households, a lot of waste still ends up dumped or burned, because sorting, treatment, and enforcement are missing too, and in Kenya one study found corruption and weak enforcement, not missing trucks, are the main reason waste management fails.

On the countries falling behind fastest, Deliverable 1 found that the places with the fastest-growing waste problems are also the ones burning and dumping the most today. Outside research confirms this and adds more detail. The money that is being invested tends to go toward places that already have some collection service, not toward the places that need it most, which means the gap is widening rather than closing.

On the generational gap, Deliverable 1 found that older people consistently separate their waste more than younger people, and that awareness campaigns alone don't change behavior. Outside research confirms both patterns but corrects the reason behind them. Younger adults are actually just as aware of climate issues as older adults, sometimes more so, so what's missing isn't knowledge but habits and a sense of responsibility to future generations, meaning awareness campaigns are the most effective tool and habit-building or social-norm campaigns are more promising.

On the data itself, Deliverable 1 combined two data sources, official government records (GWMO) and a household survey (WRP), on the idea that each fill in what the other misses. Outside research shows this isn't enough. Government records undercount waste in some countries by a wide margin, and people also tend to under-report their own bad habits, like burning or dumping trash, in surveys, and since both problems can pull the numbers in the same direction, combining the two sources doesn't fully solve the accuracy problem of the data.

In conclusion, these findings point to five updated recommendations:

- Invest in the full waste chain (sorting, treatment, disposal) rather than just expanding collection to more households.
- Combining any burning-ban policy with real investment in enforcement and in the fee systems that keep new services funded
- Designing youth programs around building habits and making separation feel normal rather than around raising awareness.
- Treat the assumption that awareness campaigns don't work as one view in an ongoing debate and test new messaging before rolling it out fully.
- Report a realistic range for uncontrolled waste rather than one single number, treating gaps in official data and bias in survey data as two separate problems that both need fixing.

1. Purpose

This report is the second deliverable under the project “Behavioral Insights for Better Waste Management,” implemented by GEC with support from the Lloyd’s Register Foundation and in collaboration with UNEP-IETC. Where Deliverable 1 (D1) established what the data shows, this report brings in external literature to explain why those patterns hold and to test whether they are consistent with evidence from other contexts.

Deliverable 1’s central conclusion is that infrastructure — not regulation, awareness, or individual behavior — is the binding constraint on proper waste disposal, and investment must be sequenced accordingly. According to the two datasets (World Risk Poall(WRP) and Global Waste Management Outlook (GWMO)), a consistent pattern emerges: where formal collection exists, uncontrolled disposal falls; where it is absent, burning and dumping follow regardless of income level, age, geography, or the presence of a legal ban. Two behavioral gaps persist independently of infrastructure and require dedicated intervention, but neither substitute for collection. Behavioral and communication measures matter only as complements to collection, never as replacements for it.

Building on this conclusion, these deliverables conducts contextual research based on the four findings below using the existing literature.

Finding 1: Infrastructure is the dominant driver, and the rural deficit is acute.

Lower collection coverage predicts higher uncontrolled disposal. The relationship is strongest in rural areas. Urban households are 81% less likely to report uncontrolled disposal than rural households after controlling income, age, and gender. These are infrastructure gaps, not behavioral ones.

Finding 2: The risk is compounding and concentrated where capacity is weakest.

The countries projected to grow their waste fastest by 2050 are the same countries where households most frequently report burning or dumping today. Without targeted investment in low- and lower-middle-income countries, this gap will widen by mid-century.

Finding 3: Two behavioral gaps persist independently of infrastructure.

Older generations separate waste more consistently than younger ones, even after accounting for income, gender, and infrastructure access. Separately, environmental risk is not salient as a daily concern — fewer than 5% of respondents globally name pollution or climate as their greatest daily risk — and communication campaigns premised on raising environmental awareness are therefore unlikely to deliver substantial behavioral outcomes without accompanying infrastructure investment.

Finding 4: The GWMO and WRP datasets are complementary and together give a fuller picture than either alone.

GWMO’s administrative records track formal waste infrastructure and flows, while WRP’s household survey reveals the informal burning and dumping that official systems do not record. Combining the two is the foundation for credible and complete monitoring of waste management globally.

Each of the following sections pairs one of these findings with related literature, aiming to strengthen the evidentiary basis for the corresponding policy recommendation in the draft project report.

2. Methodology

Each of Deliverable 1's four findings are examined against the external literature through a single research question, framed to test whether the finding's central claim holds. The four focal countries — the UK, India, Brazil, and Kenya — were selected because of the project's collaborating institutions; country-specific literature is also used where relevant to a given research question.

Evidence located for each finding is classified into three categories relative to the claim under review.

- **Aligns with the Finding** — the source's results are directionally consistent with the claim and support it as stated, including any comparative or magnitude element the claim makes.
- **Contradicts the Finding** — the source's results run counter to the claim, or to a specific premise it depends on.
- **Complicates the Finding** — the source adds a condition, alternative mechanism, or additional causal factors the claim doesn't account for, without fully confirming or contradicting it.

Each section below can now code its literature against this same four-category scheme, substituting the relevant finding and comparison term.

3. Finding 1: Evidence for Infrastructure as the Binding Constraint

Deliverable 1 found that infrastructure — not regulation, awareness, or individual behavior — is the binding constraint on proper waste disposal. Lower collection coverage predicts higher uncontrolled disposal, and this relationship is strongest in rural areas. More specifically, urban households are 81% less likely than rural households to report uncontrolled disposal, even after controlling for income, age, and gender. This section tests that claim against external literature.

RQ: Does literature support infrastructure, especially collection system, as the binding constraint on proper waste disposal, more than regulation, awareness, or individual behavior?

The literature reviewed does not support Finding 1's claim that infrastructure is the binding constraint above regulation, awareness, or behavior. Of the eight sources across India, Brazil, and Kenya, none aligns with that ranking: seven show the different factors as complicatedly intertwined, and one directly names enforcement and governance failure, not infrastructure, as the dominant driver. This holds for three converging reasons. First, sources that test multiple factors side by side (Kumar 2017, Njoroge 2014, Souza-Dal Bó & Bernardin 2026) list infrastructure alongside training, budget, enforcement, and awareness gaps without ever ranking one above the others. Second, sources that isolate disposal-stage outcomes (Lino 2023, Rebehy 2023) show that high collection coverage in Brazil (92–93%) still coexists with high uncontrolled disposal, meaning the actual bottleneck sits downstream of collection, in segregation and disposal infrastructure Finding 1 doesn't distinguish. Third, the two Kisumu sources (Salvia 2021, Davan Wetton 2025) shows infrastructure failure directly causes behavioral failure (correctly segregated waste getting remixed erodes residents' motivation to segregate), which weakens treating infrastructure and behavior as independent causes at all, with Amugsi (2022) naming corruption and political will, not infrastructure, as Kenya's central problem. Figure 1 presents the findings identified in the literature, while Table 1 summarizes the reviewed studies.

Figure 1. Causes of improper waste management in literature

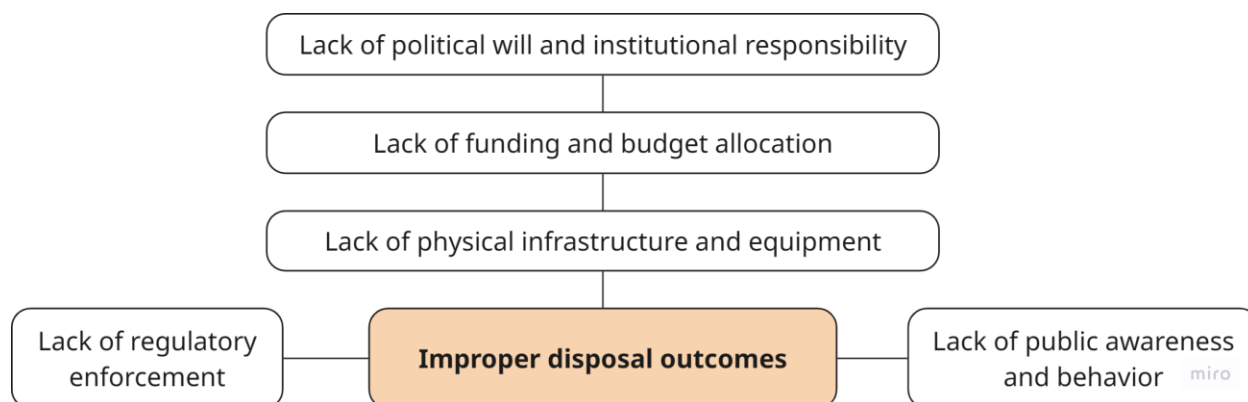


Table 1. Literature Alignment with Finding 1: Infrastructure as the Binding Constraint

Category	Country / Context	Source	Key Finding
Complicates the Finding	India	<i>Kumar et al. (2017)</i>	Confirms infrastructure and technical capacity (engineered landfills, waste-to-energy, engineering/professional shortage) as a binding barrier to waste management in India, but does not establish it as more binding than regulation, awareness, or behavior — these are listed alongside infrastructure as comparably "major" barriers with no comparative weighting.
Contradicts the Finding	Brazil	<i>Lino et al. (2023)</i>	Even with high collection coverage (93%), 39% of collected waste is still dumped rather than landfilled, and recycling/composting remains under 2%. This indicates that disposal-stage infrastructure, not collection coverage, as a binding gap. National Solid Waste Plan targets ending open dumping from 2024 and lifting recovery to 48.1% by 2040, with the shortfall attributed to landfill construction and funding capacity rather than regulatory gaps or behavior.
Complicates the Finding	Brazil	<i>Rebehy et al. (2023)</i>	Collection coverage doesn't predict disposal outcomes in Brazil — segregation and compliance infrastructure is the missing variable. Brazil's collection coverage (92%) beats the global average (90%), yet uncontrolled disposal (41%) and low recovery (4% vs. 16%) do too. Only 24% of municipalities offer selective collection; 29% meet legal collection standards.
Complicates the Finding	Brazil	<i>Souza-Dal Bó & Bernardin (2026)</i>	Regular collection coverage averaged 90.4% nationally (2022) but ranged from 79.2% (North) to 95.7% (Southeast); ~19.8M people (9.7%) lack coverage, concentrated in rural Northeast areas. The gap did not narrow over 2012–2022 despite the National Solid Waste Policy (PNRS) equity targets, which authors attribute to insufficient regional infrastructure investment.

Category	Country / Context	Source	Key Finding
			However, the study is descriptive (not a regression testing infrastructure against behavioral factors), and elsewhere attributes related outcomes to a mix of infrastructure, training, budget, and awareness factors with no ranking.
Complicates the Finding	Kenya (Kisumu)	Salvia et al. (2021)	Only 20–40% of waste is collected citywide; slum households go largely uncollected due to accessibility/financial constraints, consistent with a coverage gap.
			However, the paper explicitly treats infrastructure, enforcement, and behavior as entangled, not separable . Stakeholders disagree on which dominates, and infrastructure failure is shown actively undermining correct household behavior (source-separated waste remixed by the county).
			Authors state consensus on causal drivers "is not reached in scientific literature."
			This is a qualitative case study, not a controlled household-level comparison.
Complicating Evidence	Kenya (Kisumu)	Davan Wetton et al. (2025)	Behavioural systems map of the same city finds infrastructure-type (opportunity) influences dominate — 30 of 49 influences relate to opportunity (budget, staff, bins/skips/trucks) vs. only 3 to capability — consistent with infrastructure mattering more than awareness or ability.
			However, the paper's central reinforcing loop shows underfunding is self-perpetuating through belief, not scarcity alone: less budget → fewer staff → stronger government belief the public should pick up the slack → weaker government sense of responsibility → less political priority → less budget next cycle.
			Infrastructure failure also directly undermines correct behavior. For instance, few bins/skips/trucks causes previously segregated waste to get mixed in transit, creating uncertainty about where waste ends up and eroding public motivation to segregate with echoing Salvia et al.'s (2021) finding in the same city.
Contradicts the Finding	Kenya (Nairobi & Mombasa)	Amugsi et al. (2022)	Qualitative study across 40 interviews finds Kenya's SWM "bane" is poor policy implementation/enforcement, driven by corruption, lack of political will, political interference, and low citizen cooperation , not infrastructure.

Category	Country / Context	Source	Key Finding
			Infrastructure gaps exist (43 of a needed 85 trucks in Nairobi; inaccessible, understaffed dumpsites) but are framed as contributing, not central. A 10-year delay in relocating Dandora dumpsite is attributed to lack of political will, not funding or technical capacity.
Complicates the Finding	Nairobi (Kenya)	<i>Njoroge et al. (2014)</i>	Ties Nairobi's collection collapse (90%+ pre-1970s to 33% currently) partly to declining vehicle numbers from poor maintenance, alongside urbanization-driven waste growth. But its own conclusions give equal or greater weight to regulatory/institutional gaps (absent actor coordination, weak enforcement, no monitoring/sanctions) and recommend public awareness campaigns — infrastructure is not ranked above these.

3.1. Contradicts Finding

Kenya: Amugsi et al. (2022)

This literature contradicts Finding 1's comparative claim. Rather than infrastructure being the binding constraint above regulation, awareness, or behavior, the study's own central conclusion names corruption, lack of political will, political interference, and cooperation from the citizenry as "the bane" of Kenya's solid waste sector, based on 40 interviews (10 focus groups, 15 in-depth interviews, 15 key-informant interviews) across Nairobi and Mombasa.

That contradiction rests on three things:

1. **The paper's own stated "bane" is enforcement, not infrastructure.** In the authors' words: "The results showed that the bane of the Kenyan SWM sector is poor implementation and enforcement of SWM policies and regulations." The key obstacles named are "corruption, lack of political will, political interference, and cooperation from the citizenry."
2. **Infrastructure is also present** The study does document infrastructure shortfalls — Nairobi has only 43 of a stated-needed 85 waste collection trucks ("we need enough waste collection trucks. The least the county can have should be 85 trucks... only 43 trucks"), both major dumpsites (Dandora, Mwakirunge) are hard to reach because of unpaved, rain-damaged access roads, and the Nairobi dumpsite is described as short of staff ("the capacity in terms of human resource to deal with the day-to-day business of the dumpsite is dying").
3. **A concrete case shows governance failure blocking an infrastructure fix, not the reverse.** The relocation of the Dandora dumpsite was recommended roughly ten years before the study as part of an integrated SWM plan and still had not happened at the time of writing. The authors attribute this specifically to "a lack of political will to carry through the recommendation" — not to a shortage of funds or technical capacity to build a new site. This is a case where the infrastructure problem could plausibly have been solved, but a governance failure is what stopped it.

Because this source's own explicit diagnosis names enforcement and governance failure, not infrastructure, as the dominant driver, while treating infrastructure gaps as contributing rather than central, it's best coded Contradicts the Finding.

3.2. Complicates the Finding

Brazil: Lino et al. (2023)

This literature complicates Finding 1's mechanism, as **it shows that collection coverage and disposal infrastructure are distinct bottlenecks, and that high collection does not guarantee proper disposal.** This illustrates a distinction that Finding 1's "collection coverage predicts uncontrolled disposal" framing doesn't fully capture.

That complication rests on two things:

- **High collection doesn't guarantee proper disposal.** Brazil generated an estimated 81.8 million tons of municipal waste in 2022, of which 93% was collected, with showing a well-functioning system. **Yet 39% of collected waste (29.7 million tons) still ended up in dumps rather than sanitary landfills, and recycling and composting together accounted for under 2% of the total.** This isolates disposal-stage infrastructure, not collection-stage infrastructure, as the binding constraint in Brazil's case.
- **The proposed fix is capital and engineering capacity, not behavior or new regulation.** Brazil already has a the National Solid Waste Policy (PNRS, now Planares) requiring the elimination of open dumps, the deadline for which expired in 2022 with over half of municipalities still non-compliant. Therefore, the shortfall isn't regulatory intent but construction and funding capacity. The paper estimates roughly 500 new sanitary landfills are needed nationally, at a cost of about R\$2.6 billion, to close the gap. Planares now targets eliminating open dumping from 2024 and raising the recovered-waste share to 48.1% by 2040.

Because this source refines the "collection coverage" indicator rather than simply confirming or contradicting it, introducing disposal-stage infrastructure as a distinct causal factor behind improper waste management, it's best coded Complicates the Finding.

Brazil: Rebehy et al. (2023)

This literature complicates Finding 1's mechanism, as it shows that collection coverage and disposal/recovery outcomes **move independently at the national level**, and that high collection does not translate into below-average uncontrolled disposal. This illustrates a distinction that Finding 1's "collection coverage predicts uncontrolled disposal" framing doesn't fully capture.

That complication rests on two things:

- **High collection doesn't predict low uncontrolled disposal.** Brazil's collection rate is 92%, above the global average of 90%, indicating a well-functioning system. However, 41% of Brazilian waste is disposed of in landfills, rivers, or seas, above the global average of 30%, and the recovery rate through recycling and energy reuse is just 4%, against a global average of 16%. **This isolates segregation- and recovery-stage infrastructure, not collection-stage coverage, as the binding constraint in Brazil's case.**
- The gap is in collection quality and legal compliance, not collection existence. Only 24% of Brazilian municipalities offer selective (segregated) collection, and only 29% meet legal requirements for the collection process itself, despite basic collection reaching 92% of the population. The paper's regression analysis also finds that organized waste-picker cooperatives improve circularity, while scattered, informal waste pickers impair material recovery. This points to a further layer of infrastructure — formal collection, sorting, and cooperative structures — that sit beneath the visible coverage number.

Because this source refines the "collection coverage" indicator, introducing segregation-stage and recovery-stage infrastructure as distinct causal factors behind uncontrolled disposal, it's best coded Complicates the Finding. This also corroborates Lino et al. (2023), an independent Brazil source finding the same disconnect (93% collection, 39% still dumped) — **two sources triangulating the same pattern.**

Kenya (Kisumu): Salvia et al. (2021)

This literature complicates Finding 1: it shows a real collection-coverage gap concentrated in poor, underserved settlements, but the same paper explicitly treats infrastructure, enforcement, and behavior as entangled rather than separable causes, with the authors stating outright that **The complexity lies not just in the waste system itself, but in each stakeholder's own environment — their distinct priorities, pressures, and attention — which shapes why they each blame someone else.**

That complication rests on three things:

1. A access-driven coverage gap exists, that is described qualitatively, not tested statistically. **Only 20–40% of Kisumu's generated waste is collected for disposal at all.** In slums and informal settlements, "most household waste remains uncollected, mostly because of accessibility and financial constraints," leading to dumping along roads, alleyways, and vacant lots. This is directionally consistent with Finding 1's coverage-gap mechanism.
2. The paper explicitly refuses to isolate infrastructure as the single cause for the improper waste management. Official sources cited in the study attribute improper disposal to "scarce human and financial resources, poor organizational structures, inadequate legislation and weak enforcement, poor public attitude and low awareness". The infrastructure listed alongside enforcement and attitude, not above them. Stakeholders themselves split along institutional lines: government blames resident behavior ("it is more an attitude problem"), while residents and CBOs blame government infrastructure and enforcement ("we have very weak infrastructure systems") with neither view treated by the authors as more correct.
3. Where infrastructure and behavior interact, infrastructure failure undermines good behavior — the two are not independent. One participant describes households correctly separating waste at the source, only for the county to remix it before disposal: "They are trying to do separation at source and then the same county mixes the waste going to the dumpsite, waste being mixed then again, the waste pickers now do the sorting. You see, it is a bigger challenge." (CBOs/NGOs, MR3). This cuts against treating infrastructure gaps and behavioral gaps as cleanly separable categories, since here poor infrastructure erases already-correct behavior rather than existing "independently" of it.

Because this source shows a real coverage gap in inadequate infrastructure areas, while explicitly disagreeing with the "infrastructure, not behavioral" dichotomy the finding asserts, it's best coded Complicates the Finding.

Kenya (Kisumu): Davan Wetton et al. (2025)

This literature complicates Finding 1: it identifies underfunding as the central driver of Kisumu's waste problems, but the paper's own behavioral systems map ties that underfunding into reinforcing loops with government attitudes, public motivation, and disputed responsibility for waste — treating infrastructure and behavioural/attitudinal factors as mutually reinforcing rather than as separable, rankable causes.

That complication rests on three things:

- **Opportunity-type (largely infrastructural) influences dominate the resulting map, and capability barely registers.** Of the 49 influences on behaviour identified from 45 interviews and focus groups across seven stakeholder groups, 30 relate to opportunity (features of the physical and social environment, including county budget, human resources, and availability of bins, skips, and trucks) and 16 to motivation, against only 3 relating to capability (knowledge and skill).

- The paper's main feedback loop shows that low funding doesn't just run out but it keeps itself going through a change in attitude. When the county allocates less budget to waste, it ends up with fewer staff. With fewer staff, the government starts believing the public should handle more of the work itself, and feels less responsible for waste overall. That weaker sense of responsibility means waste gets less political priority, so the next budget allocation shrinks again; and the cycle repeats. In other words, underfunding isn't a separate cause sitting outside people's behavior; it's tangled up with an ongoing disagreement over whose job waste management actually is.

Where infrastructure and behavior interact, infrastructure failure actively undermines motivation rather than the two running on separate tracks. Because there are too few bins, skips, and trucks to keep waste streams apart, previously segregated waste gets mixed en route to the dumpsite. This produces 'uncertainty about where waste ends up,' which the authors find undermines public motivation to segregate waste in the first place. This echoes Salvia et al.'s (2021) account of the same city, in which county remixing of source-separated waste discourages residents from segregating.

Because this source identifies underfunded infrastructure as central to Kisumu's waste problems while explicitly showing that funding operates through, and is entangled with, government and public attitudes and disputed responsibility — rather than dominating as an independent, separable cause — it's best coded Complicates the Finding.

India: Kumar et al. (2017)

This literature complicates the RQ: it supports infrastructure and technical capacity as a binding barrier to waste management in India, but not as the binding constraint above regulation, awareness, or behavior — because it never compares their relative significance.

This finding rests on two things:

- Infrastructure and technical capacity are treated as central. The paper's priority is shifting from unprotected dumps toward systems that retain material value, with source segregation and dedicated recycling facilities playing a key role. Residual waste after recycling requires engineered landfills or waste-to-energy investment. **The paper singles out the shortage of qualified engineers and environmental professionals as a major obstacle to building and running these systems.**
- But infrastructure is listed alongside other barriers, not ranked above them. The paper also cites lack of SWM training, weak accountability, insufficient municipal budgets, absent strategic MSW plans, missing collection/segregation systems, no regulatory/finance framework, low environmental awareness and motivation, and poor public attitudes.

Brazil: Souza-Dal Bó & Bernardin (2026)

This literature complicates Finding 1: it shows a persistent, regionally concentrated collection-coverage gap, worst in rural and low-density areas, that a decade of national policy did not narrow. The authors attribute this to inadequate regional infrastructure investment, but the study never tests infrastructure against behavioral or awareness factors.

This rests on two things:

- **A large, rural-concentrated coverage gap, directly measured. Regular household collection coverage averaged 90.4% nationally in 2022, but ranged from 79.2% in the North to 95.7% in the Southeast.** An estimated 19.8 million Brazilians (9.7% of the population) lack regular collection, "predominantly in rural Northeast areas." Despite PNRS explicitly targeting equity, "the coverage gap has not significantly narrowed over the decade," which the **authors attribute to insufficient regional infrastructure investment rather than a demonstrated behavioral cause.**

- This paper found Brazil's rural regions have much lower waste-collection coverage than wealthier regions, and that gap didn't shrink over ten years despite a national policy, and from that single pattern the authors concluded the cause is insufficient "targeted regional investment". However, that's an inference, not a tested result, since the study only tracks coverage percentages over time and never runs an analysis that separates "lack of investment" from other possible causes like weak local governance, low demand, migration, or under-reporting, **so while investment is a reasonable explanation, the paper doesn't rule out alternatives or prove investment is the dominant cause — it just noticed a pattern and named the most likely explanation.**

Because this source confirms a persistent, infrastructure-associated coverage gap without testing or demonstrating infrastructure's primacy over behavioral factors, it's best coded **Complicates the Finding**.

Kenya: Njoroge et al. (2014)

This literature offers **Complicates the Finding** — no comparative weighting for Finding 1: it confirms infrastructure decline as a real driver of Nairobi's poor collection and disposal outcomes, but the paper's own conclusions place at least as much weight on regulatory, institutional, and awareness gaps, without ranking infrastructure above them.

This claim rests on three things:

1. **Infrastructure decline is explicitly tied to the collection collapse.** The paper traces Nairobi City Council's (NCC) collection rate from over 90% (until the mid-1970s) down to just 20% by the mid-1980s, and attributes part of this directly to **"a decrease in the number of waste collection vehicles due to lack of appropriate maintenance,"** compounded by rising waste generation from urbanization and industrial growth. By the time of writing, the collection rate stood at 33%, leaving roughly 2,690 of the 4,016 tonnes generated daily uncollected, with only about 3.7% recovered through reuse/recycling. The Dandora dumpsite is also described as **"almost full to its capacity,"** with over 70 illegal dumpsites operating around the city. These supports Finding 1's core mechanism: infrastructure shortfalls (vehicles, dumpsite capacity) correspond to worse disposal outcomes.
2. **But the paper's own diagnosis and recommendations weight regulatory and institutional gaps just as heavily.** More than 120 licensed and 140 informal private companies operate alongside NCC and community-based organizations (CBOs), and the paper states plainly that **"effective coordination among these actors is absent and regulation of the private companies by the city council is only beginning to emerge."** Its conclusion section is dominated by regulatory and institutional fixes — **"regulations are inadequately enforced and SWM seem considered of low priority,"** a call for a **"SWM monitoring system... to ensure adherence to SWM regulations/laws,"** and for "sanctions and penalties of waste mismanagement" — outnumbering infrastructure-specific recommendations (dumpsite rehabilitation, adopting sanitary landfilling technology).
3. **The paper also recommends public awareness measures as a distinct lever, not subordinate to infrastructure.** One of the conclusion's recommendations is that "public awareness should be created especially at the generators level so as to minimize waste generation," listed alongside infrastructure and regulatory fixes rather than treated as secondary to them.

Because this source confirms infrastructure's contribution to Nairobi's collection and disposal problems without establishing it as more binding than the regulatory, institutional, and awareness gaps it gives comparable emphasis to, it's best coded **Complicates the Finding**.

3.3. The Separation-Recycling Association

This section addresses one sub-finding under RQ1: the negative association between household separation and the national recycling rate. In Deliverable 1's logistic regression of waste separation (Table 4, N =

104,187), a country's GWMO recycling rate is negatively associated with the odds that a household reports separating waste (OR = 0.727, 95% CI [0.696, 0.759], $p < 0.001$), after controlling for age, income group, urbanicity, and gender. A parallel result appears in the OLS model (Table 8), where higher national collection coverage is associated with a 3.2 percentage-point decrease in individual separation probability ($\beta = -0.0318$, $p < 0.001$). Both run against **the expectation that stronger infrastructure and higher recovery accompany more household separation. Based on the previous literature, separation and the recycling rate can be positively correlated only where sorting and reprocessing capacity exists to carry separated material from the household to a recycler intact. Where that capacity is missing or where the sorting is performed by someone other than the household, the link between the two breaks and the indicators can move in opposite directions. Two reasons in the literature account for this.**

- **Separated waste at households is remixed downstream.**
 - a. **Salvia et al. (2021), Kisumu, Kenya:** Stakeholders describe households separating at source only for the county to recombine the streams before disposal. "They are trying to do separation at source and then the same county mixes the waste going to the dumpsite, waste being mixed then again, the waste pickers now do the sorting" (CBOs/NGOs, MR3). The separation would be captured by a household survey, but no separated material reaches a recycler in separated form.
 - b. **Davan Wetton et al. (2025), Kisumu, Kenya:** This paper's causal map traces two feedback loops related to this issue, or remixing of the separated waste. Remixing reduces the value of recoverable material, which weakens the income and payment cycle that funds collection. Also, remixing creates uncertainty about where waste ends up, which lowers public motivation to segregate at home and at bins.
- **Sorting is performed downstream by the informal sector**
 - a. **Kumar et al. (2017), India:** Waste pickers extract material "from waste bins, trucks, streets, waterways and dumpsites." A study of six Indian cities found that pickers recovered approximately 20% of waste, with 80,000 people recycling around three million tonnes. Recovery at this scale is generated after households have disposed of mixed waste, and does not depend on household separation.
 - b. **Rebehy et al. (2023), Brazil.** Only 24% of municipalities offer selective (segregated) collection, yet the regression finds that the presence of waste-picker cooperatives positively influences the circularity of municipal waste, while scattered waste pickers impair material recovery.
 - c. **Lino et al. (2023), Brazil.** Selective collection programmes operate in about 32% of municipalities and involve 39,100 formal collectors but capture only 1.47% of collected MSW (2022). The waste management scheme is "significantly enhanced by cooperatives, associations and informal waste pickers estimated of about 800 thousand workers." The household-facing formal channel is marginal beside the informal one.

In both cases, the negative relationship arises after the household has acted, in how waste is handled, transported and sorted. Raising the recycling rate therefore depends on sorting and reprocessing capacity rather than on household separation alone, and self-reported separation is not a sufficient indicator of waste recovery.

4. Finding 2: Evidence on Regulation, Enforcement, and Behavior

Deliverable 1 found that the countries projected to grow their waste fastest by 2050 are the same countries where households most frequently report burning or dumping today, and that without targeted investment in low- and lower-middle-income countries, this gap will widen by mid-century. This finding supports Policy Recommendation 7.1 (infrastructure investment in the fastest-growing, worst-performing countries) and 7.2 (sequencing burning bans after collection coverage expands).

RQ: Does the literature support that waste-management risk is compounding fastest where capacity is weakest?

Yes. According to the five literatures, we could say the risk is highest exactly where capacity is weakest, and financing reinforces rather than corrects the gap, which is why it's widening rather than closing. This supports Policy Recommendation 7.1 and 7.2.

Capacity gaps concentrate exactly where risk is worst, down to the neighborhood level. Low-income countries start from the lowest baseline (28% collection) and face the steep rising need (Cook et al., 2026). Within Sub-Saharan Africa (SSA) cities, coverage is "abysmally low" in low-income neighborhoods specifically, not just low nationally (Adedara et al., 2023). In Kenya, failure concentrates in the counties with the weakest staffing and funding (ANDE & KOIS, 2024).

Financing reinforces the gap instead of correcting it. The existing financing is allocated significantly to collection over treatment with 85% of India's MSW budgets, 90% of Egypt's (Yadav et al., 2026; Zhang et al., 2024). Also, even where capital investment happens, operating costs remain unfunded (Zhang et al., 2024). Private capital in Kenya stays small and early-stage, leaving growth-stage financing scarce (ANDE & KOIS, 2024).

Where capacity fails, risk becomes realized, not projected, and self-perpetuating. Uncollected waste directly drives dumping, burning, and scavenging harm in low-capacity areas (Adedara et al., 2023). Also, underfunding directly produces unenforced policy and contamination risk (Zhang et al., 2024). This is the same mechanism driving Deliverable 1's finding: the countries where waste is growing fastest are also the countries where households burn or dump waste most often today.

Table 2. Literature Alignment with Finding 2: Risk Compounding Where Capacity Is Weakest

Category	Country / Context	Source	Key Finding
Aligns with the Finding	Global (low-income countries)	<i>Cook et al. (2026)</i>	Financing reinforces rather than corrects the capacity gap. Low-income countries' investment needs rises with ambition (\$50B→\$60B) from a 28% collection baseline. Yet low-income countries received the small ODA allocation (\$1.05B of \$14.5B, 2003–2021). Domestic spending shows the same pattern: low-income countries need ~0.8% of GDP but report under 0.15%.
Aligns with the Finding	India	<i>Yadav et al. (2026)</i>	MSW generation is projected to grow 5–12x by 2050 (58.5 Mt today to 206–711 Mt), while existing investment has already proven insufficient to build required infrastructure. Funding is also misallocated toward the stage disproportionately. Cities spend up to 85% of MSW budgets on collection/transport alone, leaving treatment/disposal capacity starved. As a result, only 27.16% of MSW is landfilled and ~51% remains mismanaged despite near-universal collection.
Aligns with the Finding	Sub-Saharan Africa (Ghana, Nigeria + region-wide meta-analysis)	<i>Adedara et al. (2023)</i>	Meta-analysis of Sub-Saharan Africa (SSA) collection/coverage rates (65%/67%) shows the gap concentrates in low-income neighborhoods specifically phased as "abysmally low" versus middle- and high-income areas of the same cities (p. 407); with uncollected waste

Category	Country / Context	Source	Key Finding
			directly driving illegal dumping, open burning, and scavenging-related health hazards (pp. 389, 396–397, 404). SSA's "inadequate funding" are cited as root causes (pp. 390–391).
Aligns with the Finding	Asia & Africa (Egypt, Nigeria, Morocco + cross-regional review)	<i>Zhang et al. (2024)</i>	Financing shortfalls aren't limited to infrastructure investment — they show up in day-to-day running costs too: Egypt puts 90% of its solid waste budget into collection alone, leaving nothing for treatment (p. 4). Even where private capital funds are construction, cities "can still not pay for the expensive operation and maintenance" afterward, while developing-country authorities commonly face "the lack of financial funds and technical support" that high-income governments don't (p. 10). Funding shortfalls translate directly into realized risk. Nigeria's 1999 waste policy remains unimplemented due to "corruption and embezzlement" (p. 3), and Morocco's waste centers face groundwater contamination risk "due to the lack of funds and environmentally friendly treatment" (p. 3).
Aligns with the Finding	Kenya	<i>ANDE & KOIS (2024)</i>	Public capacity fails where county staffing/funding is weakest , with 75% of Kenya's 8.8Mt annual waste mismanaged despite existing policy — enforcement, not policy design, is the gap (p. 7) . Private capital has entered due to public capacity failure but hasn't scaled to close it. The market opportunity remains largely unmet, with the private sector still "embryonic" and most businesses reliant on donor grants rather than growth-stage investment (p. 13).

4.1. Aligns with the Finding

Global: Cook et al. (2026)

Low-income countries face the steepest and only rising investment need, yet receive the least aid and spend the least relative to that need — financing moves in the opposite direction of where the gap is actually widest.

This holds across three independent indicators:

- Investment needs are rising fastest exactly where capacity is weakest. Because low-income countries start from a 28% collection baseline, their investment requirement climbs as ambition increases from \$50 billion to \$60 billion.
- Aid flows run counter to that need curve. Of the \$14.5 billion in total sector ODA committed between 2003 and 2021, **low-income countries received just \$1.05 billion**; while most funding went to upper-middle-income countries at US\$6.48 billion.

- Low-income countries face the widest funding gap of any income group. They need ~0.8% of GDP for basic waste coverage but report spending under 0.15%. Need scales inversely with income. For example, low-income countries need ~0.8% of GDP, middle-income 0.3–0.5%, high-income ~0.33%. However, spending doesn't follow. The reported spending is under 0.15% of GDP in three-quarters of low- and middle-income countries alike.

India: Yadav et al. (2026)

Investment has flowed into India's MSW sector for two decades, but funding has scaled with neither the pace of waste growth nor the stage of the problem that actually needs it. This leaves the same capacity gap Cook et al. describe at the global level, reproduced at the national scale.

This holds across three independent indicators:

- **Investment needs are set to outpace funding by an order of magnitude.** India's MSW generation has already grown roughly tenfold since 1947 to about 58.5 million tonnes (Mt) and is projected to reach 206–287 Mt under a moderate-consumption pathway or 436–711 Mt under a high-consumption pathway by 2050 with a five- to twelvefold increase. Yet even the discrete national programs already funded — INR 21.86 billion for Jawaharlal Nehru National Urban Renewal Mission (2005–2012) and INR 3.27 billion for Urban Infrastructure Development Scheme for Small and Medium Town — were insufficient "to establish the infrastructure required for source segregation, collection, transport, processing, and environmentally sound disposal" even at then-current waste volumes.
- **Funding is misallocated toward the front end while the back end starves.** Indian cities "often allocate up to 85% of their MSW budgets to collection and transportation alone, leaving relatively little capacity for treatment and recovery". This shows up directly in outcomes. Despite collection efficiency reaching 95.97% by 2019–20, only 27.16% of MSW was scientifically landfilled by 2020, and an estimated 51% of MSW may remain mismanaged overall. **This shows collection capacity was built, but treatment and disposal capacity was not.**
- **MSW funding is structurally deprioritized against competing municipal needs.** The paper attributes the "chronic shortage of funding available to implementation bodies" to municipal revenue being split across water supply, roads, public health, sanitation, and education, with MSW "often deprioritised as a result".

Sub-Saharan Africa: Adedara et al. (2023)

Waste collection coverage in SSA is lowest precisely in neighborhoods, and where coverage fails, the realized risk (uncollected waste, illegal dumping, open burning, scavenging) shows up directly in those same places.

This holds across three independent indicators:

- Capacity is weakest at the bottom of the income distribution within cities, not just across countries. SSA's meta-analysis-derived collection and coverage rates sit at 65% and 67% respectively with already below the 96% collection rate in high-income nations. Also, this paper is explicit that these regional averages mask a sharper gap: "collection rate and coverage are abysmally low" in low-income neighborhoods "compared to the middle- and high-income areas of the city". Coverage varies little between countries (67% Nigeria, 78% Ghana, 60% other SSA countries).
- Where capacity fails, risk shows up as a direct, observed consequence, not a modeled projection. The review documents uncollected waste directly driving illegal dumping and open burning in low-income areas (p. 396–397), and describes low-income neighborhoods as facing "poor sanitary

conditions" specifically because of unaddressed collection gaps (p. 406). The paper also ties the same coverage gap to scavenging on unengineered landfills, with documented occupational health hazards for scavengers (p. 389 and p. 404).

- The gap is structural and self-perpetuating, tied to weak fiscal capacity, not a temporary shortfall. SSA holds just a 2.23% share of world GDP against high infrastructure inadequacy (p. 391). Also, the review lists "inadequate funding" alongside weak infrastructure and lack of political will as root causes of the persistent collection gap (p. 390). This echoes the same capacity-financing bind Cook et al. and Yadav et al. describe, but this illustrates the gap as an outcome (uncollected waste, low coverage) rather than as an investment/spending figure.

Asia & Africa: Zhang et al. (2024)

Financing scarcity in developing-region MSW systems isn't confined to capital investment — it extends into routine operating costs, and it concentrates what funding exists into collection alone, leaving treatment and disposal structurally underfunded even where investment does occur.

This holds across two independent indicators:

- Available funds are consumed by collection alone, leaving nothing for treatment. For instance, Egypt, "collection costs are as high as 90% of the MSWM budget" (p. 4). Financing is structurally too thin to reach beyond collection into safe treatment or disposal.
- **Financing gaps persist even where capital investment happens, because operating costs — not construction costs — are the real constraint, and where funding fails, that failure shows up as realized environmental and policy risk, not just an accounting shortfall.** High-income governments "could allocate more money to waste infrastructure," while developing-country authorities commonly face "the lack of financial funds and technical support" (p. 10), and even when private capital funds construction, "many cities can still not pay for the expensive operation and maintenance" afterward (p. 10). Corruption diverts what funding does exist — Nigeria's 1999 waste policy "has not been implemented to date" due to "corruption and embezzlement" (p. 3). Also, the shortfall translates directly into environmental harm. For instance, Morocco's waste centers face groundwater contamination risk specifically "due to the lack of funds and environmentally friendly treatment" (p. 3).

Kenya: ANDE & KOIS (2024)

Kenya's public waste-management capacity is failing at the county level, and private capital hasn't scaled to close the gap — investment stays concentrated in small, early-stage, concessional deals, while the growth-stage financing needed to build real capacity remains scarce.

This holds across three independent indicators:

- Public capacity is failing where funding and staffing are weakest, not uniformly. National governments are constitutionally responsible for waste management, but "counties are struggling to perform these duties, especially those that lack suitably trained staff, infrastructure and funding" (p. 13). The consequence is stark. Kenya generates 8.8 million tons of waste annually, and "more than 75% of this waste is mismanaged, despite the government having "enacted progressive policies", enforcement, not policy design, is the gap (p. 7).
- Private capital has stepped in because public capacity failed but hasn't reached the scale needed to fix it. "The private sector's role in waste management has emerged due to the public sector's limited capacity to manage increasing waste quantities", yet ANDE's own market sizing shows the gap between opportunity and actual investment. A potential market of "US\$1 billion for solid waste

management services and US\$53 billion for sanitation services", against a private sector still "at an embryonic stage," where "few private companies have shown the ability to scale" and most "rely on grants from donor-funded organizations to pilot and expand their operations" (p. 13)

5. Finding 3: Evidence on Generational and Norm-Driven Behavior Gaps

Deliverable 1 found that older generations separate waste more consistently than younger ones, a pattern that holds even after accounting for income, gender, and infrastructure access (65+ is 36% more likely to separate than the 30–49 group; the youngest cohort is 22% less likely). **Separately, environmental risk is not salient as a daily concern — fewer than 5% of respondents globally name pollution or climate as their greatest daily risk — and while greater climate concern is associated with a modest increase in separation behavior, the effect is too small to drive behavioral change.**

Deliverable 1 concludes that communication campaigns premised on raising environmental awareness are therefore unlikely to deliver substantial behavioral outcomes without accompanying infrastructure investment. This finding supports Policy Recommendations 7.3 and 7.4.

RQ: Does literature support that generational and awareness-related behavior gaps persist independently of infrastructure?

Yes, but only partly. Deliverable 1 makes two claims — that older people recycle more than younger people, and that awareness alone doesn't drive behavior. Both turn out to be true, but not in a simple way. And when it comes to why older people recycle more, the answer isn't that they know more but it's that they care more about the future.

Both patterns are independently established. Koll muss and Agyeman (2002) show "increases in knowledge and awareness did not lead to pro-environmental behavior" (p. 241), with four documented reasons why (p. 242). Aviva (2020) confirms the generational pattern directly with 84% of over-55s recycle compared to 54% of 16–24-year-olds.

However, the awareness-behavior link is directly contradicted by recent evidence. Hristova et al. (2025) find attitudes are the strongest predictor of ecological behavior ($R^2 = 0.348$) — though from a single-country, self-reported, cross-sectional design the authors themselves flag as limited.

Also, the generational gap's mechanism is complicated on scope and cause. Wiernik et al. (2013) find most age-environment relationships negligible. Lin and Fung (2026) find awareness doesn't differ by age at all. Instead, the gap is driven by social generativity (~10% of variance) over risk perception (<4%). Timlett and Williams (2008) show infrastructure isn't the deciding factor either for recycling research. **Personalized feedback halved contamination with infrastructure held constant, while generic doorstepping didn't.**

Net assessment: the gaps are real, but awareness doesn't explain them — motivation, norms, and campaign design do. This supports 7.3 (norm-driven generational gap) and 7.4 (shift from awareness to norm change) but refines 7.4 with a scope limit: campaigns don't need infrastructure investment where basic collection already exists, but this doesn't extend to contexts still lacking collection access, where Finding 1's infrastructure-first logic still applies.

Table 3. Literature Alignment with Finding 3: Generational and Norm-Driven Behavior Gaps

Category	Country / Context	Source	Key Finding
Complicates the Finding	Global (organizational psychology meta-analysis, 1970–2010)	<i>Wiernik, Ones, & Dilchert (2013)</i>	Meta-analyzed age against environmental concern, values, attitudes, awareness, knowledge, motives, intentions, and pro-environmental behaviors broadly. Found "most relationships were negligibly small"; where a relationship generalized, it illustrates older individuals for engaging in nature, avoiding environmental harm, and conserving raw materials/natural resources. This paper is not recycled specifically. Weakly directionally consistent with the generational claim, but narrower in scope (workplace-focused constructs, not household waste behavior) and weaker in strength (most negligible effects) than Deliverable 1's framing implies.
Aligns with the Finding	Global (foundational theory)	<i>Kollmuss & Agyeman (2002)</i>	Directly states that early "knowledge → attitude → behavior" models "were proven to be wrong," since "increases in knowledge and awareness did not lead to pro-environmental behavior" (p. 241), despite this remaining the default assumption behind most NGO awareness campaigns. Identifies four specific causes of the attitude-behavior gap: direct vs. indirect experience, social/normative influences, temporal discrepancy between attitude and behavior measurement, and mismatched breadth between attitude and behavior measures (p. 242).
Aligns with the Finding	United Kingdom	<i>Aviva (2020)</i>	Survey of 4,000 UK adults finds over-55s report the highest recycling rate of any age band: 84%, versus 54% for 16–24-year-olds (73% all-ages average).
Contradicts the Finding	Bulgaria (N = 669, online sample)	<i>Hristova et al. (2025)</i>	Regression model finds environmental attitudes (verbal, actual, and affective commitment) are the strongest predictors of general ecological behavior ($R^2 = 0.348$), outweighing personality traits and self-efficacy — verbal commitment alone is the top predictor ($\beta = 0.288$, $p < 0.001$). Directly contradicts the weak attitude-behavior link Deliverable 1 assume. It would be worth noting that this study uses a single-country, self-selected, self-reported, cross-sectional design. The authors themselves acknowledge limited generalizability and an inability to establish causal direction.

Category	Country / Context	Source	Key Finding
Complicates the Finding	Hong Kong (N = 473: 235 older, 238 younger adults)	<i>Lin & Fung (2026)</i>	The generational gap in pro-environmental behavior isn't driven by an awareness difference at all, but it's driven by motivation. Older adults act more not because they know more about climate risk, but because they're more motivated by concern for future generations. Awareness doesn't differ by age. The study's own data show "ecological risk perceptions did not differ between younger and older adults" directly contradicting the assumption that younger adults are more climate-aware. Older adults still act more, and social generativity — not awareness — explains why. Older adults reported greater recycling, political support, and consumption-related pro-environmental behavior, driven primarily by social generativity (concern for future generations), which explained ~10% of the variance in behavior versus under 4% for risk perceptions. The stated reasons behind the behavior confirm this is motivational, not informational. Older adults' reasons were pro-environmental, habitual, and norm-conforming; younger adults' reasons were more monetary — a difference in what drives action, not in what each group knows.
Complicates the Finding	England (Portsmouth)	<i>Timlett & Williams (2008)</i>	With infrastructure held constant at an already-functioning level (2005–2006), personalized feedback and incentives halved contamination, while generic doorstepping showed little improvement — campaign design, not additional infrastructure spending, drove the difference. No approach moved overall participation. Scope limit: tests refinement of existing collection systems, not substitution for absent ones — doesn't extend to contexts still lacking basic collection access.

5.1. Aligns with the Finding

Global: Kollmuss & Agyeman (2002)

Environmental awareness campaigns rest on an assumption the research literature disproved decades ago — that more knowledge leads to more pro-environmental behavior. Also, the paper identifies specific reasons why the gap persists.

This holds across two independent indicators:

- The "more knowledge → more behavior" model was tested and rejected as early as the 1970s. The paper describes the earliest models of pro-environmental behavior as a simple chain: environmental knowledge → environmental attitude → pro-environmental behavior. It states: **"These models from the early 1970s were soon proven to be wrong. Research showed that in most cases, increases in knowledge and awareness did not lead to pro-environmental behavior."** (p. 241).
- The gap between what people believe and what they actually do isn't just a vague mismatch. This literature have pointed specific reasons for it. This paper lists four: **people act more on what they've directly experienced than on what they've just read or heard about; social norms and cultural habits shape whether a belief turns into action; attitudes and behavior are often measured too far apart in time to compare fairly; and studies frequently compare a broad belief (like "Do you care about the environment?") against a narrow, specific action (like "Do you recycle?"), which makes the gap look bigger than it really is** (p. 242).

Because both the core claim (awareness doesn't reliably drive behavior) and the underlying mechanism (specific intervening factors, not just general skepticism) are directly and explicitly stated in the source, this remains solidly coded **Aligns with the Finding**.

United Kingdom: Aviva (2020)

Aviva's own consumer survey shows the same generational pattern as Finding 2, though it's a single-item, industry-sourced comparison rather than a controlled study.

This holds across two independent indicators:

- Over 55 report the highest rate of recycling of any age group surveyed. In a survey of 4,000 UK adults, 84% of over-55s reported "recycling through local bin collections" which is the highest of all five age bands tested (16–24, 25–34, 35–44, 45–54, 55+), against a 54% rate for the youngest group (16–24) and a 73% all-ages average.

5.2. Contradicts Finding

Bulgaria : Hristova et al. (2025)

This study directly contradicts the premise that awareness or attitude has only a weak effect on behavior with a regression model of 669 participants, environmental attitudes outweigh personality traits and self-efficacy as the strongest predictor of general ecological behavior.

This holds across two independent indicators:

- Environmental attitudes are the strongest predictors of general ecological behavior. Across three attitude components (verbal commitment, actual commitment, and affective commitment), the model explains 34.8% of the variance ($R^2 = 0.348$) in general ecological behavior. Verbal commitment is the single strongest predictor ($\beta = 0.288$, $p < 0.001$), followed closely by actual commitment ($\beta = 0.274$, $p < 0.001$) and affective commitment ($\beta = 0.102$, $p = 0.013$). Personality traits, by contrast, were largely non-significant predictors of this behavior.
- This runs counter to the value-action gap consensus. The authors state directly: "environmental attitudes are the strongest predictors of general ecological behavior". However, the sample is a single-country, self-selected online sample of 669 Bulgarian adults (60.5% women), and the authors themselves flag two relevant limitations: the cross-sectional design "limits causal inferences" and self-reported measures introduce "the possibility of response biases, particularly social desirability bias, where participants may overstate their environmental behaviors or commitment."

This source still counts as directly contradicting the weak-effect premise — its own results run the opposite way. But that contradiction comes from a single-country, self-reported, cross-sectional study, and the authors themselves acknowledge it can't establish causality or generalize broadly. So it's coded Contradicts the Finding, with those limits attached.

5.3. Complicates the Finding

Global: Wiernik, Ones, & Dilchert (2013)

Age-related differences in environmental sustainability are mostly negligible. The few relationships that do generalize describe broad environmental constructs, not recycling specifically, which is a narrower and weaker basis for the generational claim than Deliverable 1's framing suggests.

This holds across two independent indicators:

- Most of the connections this study tested between age and environmental attitudes turned out too weak to matter. It compared age against a broad range of measures — environmental concern, values, attitudes, awareness, knowledge, motives, intentions, and actual pro-environmental behavior — drawing on studies from 1970 to 2010, and found that most of these relationships were essentially negligible
- Where a relationship did hold, it favored older individuals, but on different behaviors than recycling. The paper's finding was that "small but generalizable relationships indicated that older individuals appear to be more likely to engage with nature, avoid environmental harm, and conserve raw materials and natural resources" — directionally consistent with Deliverable 1's generational claim, but measuring broader environmental engagement rather than waste separation or recycling specifically, and drawn from an organizational psychology literature focused on workplace behavior rather than household waste practices.

Because this source only partially and indirectly supports the claim — confirming a weak directional tendency while explicitly reporting that most of the underlying relationships were negligible, and measuring different behaviors in a different context. It is best coded Complicates the Finding rather than Aligns.

Hong Kong: Lin & Fung (2026)

This study finds that awareness of climate risk doesn't differ by age at all — across all four measures tested, younger and older adults perceived the same level of risk. What actually explains why older adults engage in more pro-environmental behavior is concern for future generations, not any advantage in climate awareness among the young.

This holds across three findings from the paper itself.

- Ecological risk perceptions did not differ by age in this study's own data. The paper states directly: "Ecological risk perceptions did not differ between younger and older adults" (p. 6 of 12, Discussion). This directly contradicts the outline's claim that younger adults are more aware. In this study, younger and older adults reported about the same level of climate risk awareness. There was no meaningful difference between the two groups.
- The study identifies concern for future generations — not climate awareness — as the real driver of older adults' greater pro-environmental behavior, despite equal risk perception, "older adults reported greater recycling, political support, [and] consumption-related pro-environmental behaviors... and higher social generativity compared to younger adults" (Abstract), and in the regression model "social generativity explained approximately 10% of the variance, and risk

perceptions explained lower than 4%" (p. 6 of 12) — more than double the explanatory weight. **The stated reasons behind the behavior confirm this is motivational, not informational.** For instance, "older adults reported more pro-environmental, habitual, and norm-conforming reasons, while younger adults reported more monetary reasons" (Abstract).

Because the paper's own finding is that awareness doesn't differ by age at all. This study doesn't deny that older adults act more sustainably than younger adults — it still confirms that gap exists. But it tells a different story about why the gap exists: instead of one age group knowing more than the other, the real reason is that older adults are more motivated by concern for future generations. This should be coded Complicates **the Finding**.

England (Portsmouth): Timlett & Williams (2008)

Holding collection infrastructure constant across all three trials, the paper found that outcomes differed sharply by which behavior-change tool was used. **Personalized feedback and incentives halved contamination, while doorstepping produced little improvement; showing that intervention design, not infrastructure investment, was the variable driving the difference in this study.**

This holds across three independent indicators:

- **Generic communication underperforms, even with infrastructure held constant.** Three behavior-change tools — doorstepping, incentives, and personalized feedback — were trailed in Portsmouth, England, between 2005 and 2006, "during a period where there were no major changes to the collection infrastructure," isolating their effects from any infrastructure change. Doorstepping alone produced "little improvement in the quality of collected materials."
- Targeted, personalized feedback succeeded substantially without any infrastructure investment. "Personalized incentives and feedback were highly effective at reducing contamination. Both methods resulted in a halving of the number of households setting out contaminants on collection day." Feedback was also the most cost-effective of the three tools.
- None of the three approaches moved overall scheme participation, which complicates how much weight this study can carry. **"None of the projects resulted in significant changes in recycling scheme participation; however, this may be because participation was initially high"** meaning the study demonstrates that intervention design changes contamination/material quality, but the evidence for changing whether people participate at all is inconclusive in this setting.

This source is best coded Complicates the Finding rather than Aligns or Contradicts, because its evidence splits by outcome and intervention type instead of settling the infrastructure question outright. It doesn't confirm or deny that campaigns need infrastructure to work, but it does show that campaign design — generic versus personalized/targeted — is the variable that drives contamination outcomes.

6. Finding 4: Evidence on Data Quality & Triangulation

Deliverable 1 found that the GWMO and WRP datasets are complementary and together give a fuller picture than either alone. GWMO's administrative records track formal waste infrastructure and flows, while WRP's household survey reveals the informal burning and dumping that official systems do not record. Low-income countries illustrate this most sharply, as they have the least administrative data on collection and the highest reported rates of uncontrolled disposal. Deliverable 1 concludes that combining the infrastructure view from GWMO with the behavioral view from WRP is the foundation for credible and complete monitoring of waste management globally. This finding supports Policy Recommendation 7.5.

RQ: Does literature support administrative and self-reported data as complementary rather than redundant?

Literature aligns with treating the two data sources as complementary, but "complementary" understates how each is independently biased rather than merely incomplete. No literature reviewed contradicts the complementarity claim itself. Three sources reinforce it directly: Chaudhary et al. (2021) shows India's own administrative generation estimates are so unreliable (51–300 Tg for 2015, depending on source) that no single dataset can be trusted alone. Also, Adedara, Taiwo & Bork (2023) shows the same problem extends even to administrative and academic sources within a single data type, where city-level collection-rate estimates for Accra and Lagos vary by tens of percentage points depending on source and year. Moreover, Wright et al. (2022) shows the triangulation necessity is not unique to GWMO and WRP, since even a novel household-survey-based method for estimating plastic waste in Ghana and Kenya requires validation against retail and regulatory data that is itself scarce in low- and middle-income countries. Together these sources support triangulation as necessary, not merely additive.

What Deliverable 1 does not address is that self-reported survey data carries its own documented, and likely bias. Vesely & Klöckner (2020) find social-desirability effects on pro-environmental self-reports are small but consistent (pooled $r = 0.06\text{--}0.13$), meaning respondents tend to over-report compliant behavior and under-report burning or dumping — in the same direction as administrative undercounting. Van der Werf, Seabrook & Gilliland (2020) complicate this further with a direct empirical test. Comparing self-reported food waste against physically weighed curbside garbage for the same households, they find only a weak-to-fair correlation between the two, and importantly that different factors predict self-reported waste (attitudes, gender) than predict actually measured waste (household size, housing status, composting habits). This suggests the self-report/administrative gap is not a fixed, generalized offset of the size Vesely & Klöckner's correlation implies, but something that varies unevenly by context and can be considerably larger in practice. Taken together, the GWMO/WRP perception gap Deliverable 1 documents may be partly explained by households under-reporting noncompliant behavior in the same direction as administrative undercounting. We cannot assume the under-reporting problem is small and consistent everywhere.

6.1. Aligns with the Finding

India: Chaudhary et al. (2021)

This literature aligns with Finding 4's complementarity claim. **India's 2020 waste generation is estimated at 192 Tg, including 74 Tg openly burned — but even the generation figure itself is uncertain, ranging from 51 to 300 Tg in 2015 estimates, because official government reporting (51 Tg) effectively excludes rural waste generation.** This source independently confirms that combining data sources is necessary to expose gaps that any single source would hide on its own, it strengthens Finding 4's premise and belongs in "Aligns with the Finding."

Sub-Saharan Africa: Adedara, Taiwo & Bork (2023)

This literature aligns with Finding 4's complementarity claim, offering evidence that even administrative and academic sources on waste collection are fragmented and inconsistent. That alignment rests on two things.

- First, the meta-analysis had to pool just 12 studies out of thousands of search results, and even the studies that did meet inclusion criteria reported wildly inconsistent figures for the same cities. For example, collection rate estimates for Accra ranging from 79% to 93%, and Lagos ranging from 10% to 63% depending on the source and year.

- Second, the pooled result itself is very uncertain. The average collection rate across sub-Saharan Africa comes out to 65%, but the true value could plausibly be anywhere from 43% to 87%, and the underlying studies barely agree with each other.

Because this source independently demonstrates that reconciling multiple studies is necessary just to produce a usable regional estimate and that no single national or city-level figure can be taken at face value This reinforces rather than complicates Finding 4's premise that triangulating across sources is the only path to a credible picture and belongs in "Aligns with the Finding."

Ghana and Kenya: Wright et al. (2022),

This literature aligns with Finding 4's complementarity claim by demonstrating, in a different data pairing, that no single source — survey or administrative — is sufficient alone, and that triangulation is necessary even when neither source is a traditional waste-management dataset.

That alignment rests on two things.

- First, the study uses nationally representative household expenditure survey data as a proxy to estimate mismanaged plastic waste from packaging (cooking oil and packaged water) in Greater Accra and urban Kenya, precisely because comprehensive administrative waste-composition data doesn't exist in these settings.
- Second, the authors explicitly note that expenditure-survey-based estimates need to be triangulated against other sources, including retail sales records and regulator waste-composition data, to be validated, but that these complementary sources are themselves scarce in low- and middle-income countries, meaning the data-gap problem Finding 4 identifies extends beyond GWMO and WRP specifically.

Because this source independently demonstrates that combining data sources is the only viable path to estimating waste outcomes in data-scarce settings. This reinforces Finding 4's premise and belongs in "Aligns with the Finding."

6.2. Complicates the Finding

Vesely & Klöckner (2020)

This literature complicates Finding 4's complementarity claim by identifying a bias on the WRP side of the pairing that Deliverable 1 does not address. Self-reported survey data isn't simply incomplete relative to administrative data, it carries its own documented distortion, and in the same direction as administrative undercounting.

That complication rests on two things.

- The meta-analysis — pooling 29 studies — finds social desirability effects on pro-environmental self-reports are small but consistent (pooled $r = 0.06-0.13$), meaning respondents tend to over-report compliant behavior and under-report burning or dumping.
- Second, this means the GWMO–WRP disposal gap Deliverable 1 documents (e.g., India's 80.7% GWMO vs. 42.4% WRP) may partly reflect both sources understating true uncontrolled disposal in the same direction, rather than WRP cleanly correcting GWMO's administrative blind spot.

This source doesn't dispute that combining GWMO and WRP gives a fuller picture than either alone. But it shows that WRP doesn't fully correct GWMO's blind spots, both datasets likely understate uncontrolled disposal in the same direction. That's a complication, not a contradiction, so it belongs in "Complicates the Finding."

Canada: van der Werf, Seabrook & Gilliland (2020)

This study complicates Finding 4 because it directly checks what people say about their own waste against what their garbage actually contains, which is closest real-world test of the same gap at stake between GWMO and WRP.

- The researchers surveyed 189 households about how much food they wasted, then physically weighed each household's curbside garbage. The two didn't match well. The households said they wasted about 6.63 "portions"(handfuls) of food a week, but their garbage held 2,783 grams of food waste a week, most of it avoidable. **The two measures were only weakly-to-fairly related (not strongly related), meaning what people report is a rough, imperfect stand-in for what they actually throw out.**
- It also matters what predicts each kind of waste. What predicted self-reported waste (things like attitude and gender) wasn't the same as what predicted the actual garbage weight (things like household size, housing status, and whether someone had a backyard composter). In other words, the gap between what people report and what's actually in their trash isn't a simple, consistent undercount — the two are driven by different underlying factors altogether.

This shows self-reported waste behavior can diverge substantially, and unevenly, from directly measured waste — the gap isn't a fixed offset but varies by context.

7. Structured Narrative for the Draft Report

Literature broadly supports Deliverable 1's findings, but with a significant qualification. The underlying picture is more complex than the report currently conveys. **For Findings 1 and 2, infrastructure emerges as necessary but frequently not the primary constraint, as governance and enforcement failures are shown to be equally, and in some cases more, consequential. Finding 3 holds up well overall, though the mechanisms underlying the generational gap and the rationale for the proposed communication strategy may require revision. Finding 4 similar warrants reconsideration.** Rather than GWMO and WRP straightforwardly compensating for each other's limitations, **the evidence suggests both datasets share overlapping sources of bias, such that combining them does not fully resolve the underlying measurement problem.**

Each subsection below follows a consistent structure: Deliverable 1's original recommendation, the corresponding literature evidence, and the resulting refinement to that recommendation.

7.1. Invest in infrastructure first, in the fastest-growing, worst-off countries

Deliverable 1 recommends prioritizing investment in countries with the weakest rural collection coverage, on the premise that these represent both the most severe and the most rapidly growing waste management deficits. Literature complicates this premise. For instance, in Brazil, where collection coverage is already high (92–93%), a substantial proportion of collected waste nonetheless remains uncontrolled. **This indicates that collection coverage is not only the binding constraint; rather, the bottleneck lies downstream, in sorting, treatment, and safe disposal infrastructure.**

Accordingly, the recommendation should be revised to broaden the investment target beyond expanding collection access to encompass the full waste management chain, including sorting, treatment, and disposal infrastructure, given that improvements in collection coverage alone have not resolved uncontrolled disposal where they have already been implemented.

7.2. Don't ban burning until collection exists

Deliverable 1 finds that burning bans are ineffective in the absence of a viable collection alternative, and accordingly recommends that bans be sequenced to follow, rather than precede, collection expansion. This is broadly corroborated by the literature: collection gaps are identified as a significant barrier in both India and Brazil.

However, most of the same sources also find that corruption, weak enforcement, or insufficient politics will constitute barriers of comparable, or greater, significance than infrastructure deficits. One study on Kenya goes further, identifying corruption and political interference, rather than infrastructure, as the primary driver of waste management failure. A separate study describes a self-reinforcing "vicious cycle," whereby poor service quality reduces households' willingness to pay for waste services, which in turn further constrains the revenue available to improve that service. This suggests that infrastructure investment alone does not guarantee that bans will be enforceable once collection is in place.

Accordingly, the recommendation should be revised to pair the sequencing principle with substantive investment in enforcement capacity and in the revenue-collection mechanisms required to sustain newly established services, since infrastructure expansion alone is insufficient.

7.3. Run youth-focused campaigns alongside infrastructure work

Deliverable 1 finds that younger individuals separate waste less consistently than older individuals, even after controlling for income, gender, and infrastructure access, and accordingly recommends a dedicated behavior-change program for the 15–29 cohort, implemented concurrently with infrastructure investment. This is well supported by the literature: a meta-analysis spanning several decades of research confirms a consistent age gradient favoring older individuals, one that is not attributable to geographic or infrastructural differences.

A more recent study complicates the underlying mechanism, however, finding that younger adults exhibit greater awareness of climate change than older adults, yet nonetheless engage less frequently in conservation behaviors such as recycling. This finding inverts the assumption that the youngest cohort underperforms due to a deficit in knowledge or concern.

Accordingly, the recommendation should be revised. Since the constraint does not appear to be awareness, the youth-targeted program should instead be designed around habit-formation and social-normalization mechanisms, such as point-of-disposal reminders and individual feedback, rather than an additional awareness-raising campaign.

7.4. Shift messaging from "raise awareness" to "make it normal"

Deliverable 1 finds that environmental risk is not perceived as a salient daily concern for most respondents and accordingly recommends redirecting communication investment away from awareness-raising and toward normalizing separation as an expected social practice. This is consistent with a well-established finding in environmental psychology: environmental knowledge and concern do not reliably translate into behavior change, as other psychological, social, and institutional barriers intervene.

However, a more recent study complicates this consensus, finding that environmental attitudes were the strongest predictor of behavior within its own model. This indicates that the evidence on attitude-behavior strength remains genuinely contested rather than settled.

The recommendation should be revised in two ways. First, present Deliverable 1's own finding, that environmental concern has only a modest effect on behavior, as one position within an active debate rather than a settled conclusion. Second, pilot-test the proposed normalization messaging against a conventional awareness campaign before full implementation.

7.5. Treat closing the data gap as its own policy goal

Deliverable 1 finds that GWMO collection data is missing for most low-income countries and accordingly recommends triangulating it with survey data (WRP) as the minimum condition for reliable monitoring, with strengthened national data systems treated as a fundable intervention in its own right. The literature supports the premise that no single data source is sufficient on its own. **Two independent studies demonstrate that official and academic sources diverge substantially from one another even before survey data is introduced, and a third demonstrates that this same triangulation requirement extends beyond the GWMO/WRP pairing specifically.**

However, the literature also complicates the assumption that combining GWMO and WRP constitutes a clean corrective. **Self-reported survey data carries its own directional bias, whereby respondents tend to under-report non-compliant behaviors such as burning or dumping, and this bias is neither fixed nor uniformly predictable in magnitude.** A study directly comparing self-reported behavior against physically measured outcomes found that this gap varies by context and can exceed conservative estimates.

Accordingly, the recommendation should be revised to target a plausible range rather than a single reconciled estimate, and to treat administrative undercounting and self-report bias as distinct, compounding sources of uncertainty requiring separate remediation, rather than assuming the two data sources offset one another's limitations.

8. Updated Recommendations

Recommendation 1 — Invest across the full waste chain, not just collection

Don't limit infrastructure investment to expanding collection. Waste may keep ending up uncontrolled even in places with high collection coverage/ Invest in what happens after pickup too: sorting, treatment, and safe disposal facilities. Collection alone won't fix the problem where it's already been tried.

Recommendation 2— Pair burning bans with enforcement funding, not just collection

Keep the rule that burning bans should only take effect after collection services exist. However. That is not sufficient. Fund enforcement capacity and the fee-collection systems that keep new services running. Corruption, weak enforcement, and lack of political will have been shown to block progress just as much as missing infrastructure, sometimes more. Poor service also discourages people from paying for it, which starves the system of the money it needs to improve. Building trucks and bins isn't enough on its own.

Recommendation 3 — Redesign youth programs around habits, not awareness

Keep the dedicated program for youth groups. However, changing focus is necessary. Don't build it only around raising awareness, since younger people can be already more aware of climate change than older people, yet still separate waste less. Instead, design the program around building habits directly including point-of-disposal reminders, feedback, and nudges that make separation automatic rather than something people have to consciously choose to care about.

Recommendation 4 — Test new messaging before rolling it out, and don't oversell the evidence

Present the finding that environmental concern only weakly predicts behavior as one perspective in an ongoing debate, not as settled fact, since at least one recent study found the opposite. Don't just switch straight to the new communication approach based on theory alone — test it first, in a small, controlled way, before rolling it out everywhere.

Recommendation 5 — Report a plausible range, not a single number, and fix both data problems separately

Stop trying to produce one single "correct" figure for uncontrolled waste disposal by combining GWMO and WRP. Report a realistic range instead. Treat the two underlying problems separately: administrative undercounting in official data, and self-report bias in survey data. These don't reliably cancel each other out. Survey bias isn't a fixed nor predictable amount. This varies by context and can be larger than expected, so it needs its own dedicated fix rather than being treated as something WRP automatically corrects for.

9. Questions for the September Workshop

General

- Does this synthesis match what you're seeing on the ground in your country or city? Where does it diverge most from your own experience?
- Of the five revised recommendations, which one would be hardest to act on with your current resources or mandate?
- What's one thing missing from this analysis that you think is critical to your context but hasn't come up yet?

Recommendation 1 — infrastructure across the full chain

- We found that even high collection coverage (Brazil, 92–93%) doesn't guarantee controlled disposal — the bottleneck shifts downstream to sorting and treatment. Does that match your experience, or does collection coverage remain the binding constraint where you work?
- If investment had to be split between expanding collection and building downstream treatment/disposal capacity, which would you prioritize, and why?

Recommendation 2 — sequencing bans with enforcement

- In your context, what has mattered more in practice: missing infrastructure, or weak enforcement and governance? Can you give an example?
- Is there a realistic path to funding enforcement and fee-collection systems in parallel with new services, or does that only become politically feasible once collection already exists?

Recommendation 3 — youth-targeted interventions

- Does the finding that young people are aware but still act less resonate with what you've observed? What do you think is actually stopping them, if not awareness?
- What would a habit-formation intervention (point-of-disposal nudges, feedback) realistically look like in your city or program?

Recommendation 4 — messaging strategy

- What would make it hard, or easy, to introduce a norm-based messaging campaign where you work, instead of a traditional awareness campaign?

Recommendation 5 — data gaps

- Given that both administrative data and self-reported survey data have limitations, what data source do you currently trust most in your own work, and why?
- Is a "plausible range" instead of a single number something policymakers you work with would actually find usable, or would that be seen as too uncertain to act on?

10. Reference

- Adedara, M. L., Taiwo, R., & Bork, H.-R. (2023). Municipal Solid Waste Collection and Coverage Rates in Sub-Saharan African Countries: A Comprehensive Systematic Review and Meta-Analysis. *Waste*, 1(2), 389–413. <https://doi.org/10.3390/waste1020024>
- Amugsi, D. A., Muindi, K., & Mberu, B. U. (2022). Implementation of solid waste management policies in Kenya: Challenges and opportunities. *Cities & Health*, 6(3). <https://doi.org/10.1080/23748834.2022.2071566>
- Aspen Network of Development Entrepreneurs (ANDE), & KOIS. (2024). *Investing in the waste and circularity sector in Kenya: An introductory guide*. Aspen Network of Development Entrepreneurs. <https://andeglobal.org/wp-content/uploads/2024/09/Investing-in-the-Waste-and-Circularity-Sector-in-Kenya-Sep-2024.pdf>
- Aviva. (2020, February 17). *Generation G – are over-55s the greenest of us all?* <https://www.aviva.com/newsroom/news-and-research-overview/news-releases/2020/02/generation-g-are-over-55s-the-greenest-of-us-all/>
- Chaudhary, P., Garg, S., George, T., Shabin, M., Saha, S., Subodh, S., & Sinha, B. (2021). Underreporting and open burning – the two largest challenges for sustainable waste management in India. *Resources, Conservation and Recycling*, 175, 105865. <https://doi.org/10.1016/j.resconrec.2021.105865>
- Cook, E., Ionkova, K., Bhada-Tata, P., Yadav, S., & Van Woerden, F. (2026). *What a waste 3.0: Global snapshot of solid waste management toward circularity until 2050*. Urban Development Series. World Bank. <https://doi.org/10.1596/978-1-4648-2309-1>
- Davan Wetton, J., Santilli, M., Gitau, H., Muindi, K., Zimmermann, N., Michie, S., & Davies, M. (2025). Behavioural systems mapping of solid waste management in Kisumu, Kenya, to understand the role of behaviour in a health and sustainability problem. *Behavioral Sciences*, 15(2), 133. <https://doi.org/10.3390/bs15020133>
- Hristova, V., Haralampiev, K., Vlaev, I., & Karabeliova, S. (2025). Predicting Pro-Environmental Behavior: The Leading Influence of Environmental Attitudes. *Behavioral Sciences*, 15(3), 291. <https://doi.org/10.3390/bs15030291>
- Kollmuss, A., & Agyeman, J. (2002). Mind the Gap: Why Do People Act Environmentally and What Are the Barriers to Pro-Environmental Behavior? *Environmental Education Research*, 8, 239–260. <https://doi.org/10.1080/13504620220145401>
- Kumar, S., Smith, S. R., Fowler, G., Velis, C., Kumar, S. J., Arya, S., Rena, Kumar, R., & Cheeseman, C. (2017). Challenges and opportunities associated with waste management in India. *Royal Society Open Science*, 4(3), 160764. <https://doi.org/10.1098/rsos.160764>
- Lin, Z., & Fung, H. H. (2026). Age differences in pro-environmental behaviors: Is it about me or future generations? *European Journal of Ageing*, 23(1), 22. <https://doi.org/10.1007/s10433-026-00918-9>
- Lino, F. A. M., et al., & Castañeda-Ayarza, J. A. (2023). Municipal solid waste treatment in Brazil: A comprehensive review. *Energy Nexus*, 11, 100232. <https://doi.org/10.1016/j.nexus.2023.100232>
- Njoroge, B. N. K., Kimani, M., & Ndunge, D. (2014). Review of municipal solid waste management: A case study of Nairobi, Kenya. *Research Inventy: International Journal of Engineering and Science*, 4(2), 16–20.

- Rebehy, P. C. P. W., Salgado Junior, A. P., Ometto, A. R., Espinoza, D. F., Rossi, E., & Novi, J. C. (2023). Municipal solid waste management (MSWM) in Brazil: Drivers and best practices towards to circular economy based on European Union and BSI. *Journal of Cleaner Production*, 401, 136591. <https://doi.org/10.1016/j.jclepro.2023.136591>
- Salvia, G., Zimmermann, N., Willan, C., Hale, J., Gitau, H., Muindi, K., Gichana, E., & Davies, M. (2021). The wicked problem of waste management: An attention-based analysis of stakeholder behaviours. *Journal of Cleaner Production*, 326, 129200. <https://doi.org/10.1016/j.jclepro.2021.129200>
- Souza-Dal Bó, G. C., & Bernardin, A. M. (2026). The (de)valuation of solid waste in developing countries: The Brazilian case (2012–2022) after the national solid waste policy. *Cleaner Waste Systems*. <https://www.sciencedirect.com/science/article/pii/S2772912525002556>
- Timlett, R. E., & Williams, I. D. (2008). Public participation and recycling performance in England: A comparison of tools for behaviour change. *Resources, Conservation and Recycling*, 52(4), 622–634. <https://doi.org/10.1016/j.resconrec.2007.08.003>
- Van Der Werf, P., Seabrook, J. A., & Gilliland, J. A. (2020). Food for thought: Comparing self-reported versus curbside measurements of household food wasting behavior and the predictive capacity of behavioral determinants. *Waste Management*, 101, 18–27. <https://doi.org/10.1016/j.wasman.2019.09.032>
- Vesely, S., & Klöckner, C. A. (2020). Social Desirability in Environmental Psychology Research: Three Meta-Analyses. *Frontiers in Psychology*, 11, 1395. <https://doi.org/10.3389/fpsyg.2020.01395>
- Wiernik, B. M., Ones, D. S., & Dilchert, S. (2013). Age and environmental sustainability: A meta-analysis. *Journal of Managerial Psychology*, 28(7–8), 826–856. <https://doi.org/10.1108/JMP-07-2013-0221>
- Wright, J. A., Damkjaer, S., Vaisanen, H., Adama-Tettey, Q., Dzodzomenyo, M., Hill, A. G., Okotto, L. G., Okotto-Okotto, J., & Shaw, P. (2022). On the use of household expenditure surveys to monitor mismanaged plastic waste from food packaging in low- and middle-income countries. *Environmental Research Letters*, 17(12), 124029. <https://doi.org/10.1088/1748-9326/aca623>
- Yadav, V., Shinde, A. M., Yadav, B. R., Pandey, D. S., Maji, K. J., Manu, M. K., Singh, V., & Arora, M. (2026). Projected twelve-fold growth in municipal solid waste generation calls for urgent techno-policy intervention across urban India. *Journal of Industrial Ecology*, 30(3), 987–1001. <https://doi.org/10.1007/s44498-026-00067-3>
- Zhang, Z., Chen, Z., Zhang, J., Liu, Y., Chen, L., Yang, M., Osman, A. I., Farghali, M., Liu, E., Hassan, D., Ihara, I., Lu, K., Rooney, D. W., & Yap, P.-S. (2024). Municipal solid waste management challenges in developing regions: A comprehensive review and future perspectives for Asia and Africa. *Science of The Total Environment*, 930, 172794. <https://doi.org/10.1016/j.scitotenv.2024.172794>