Behavioral Insights for Better Waste Management

Deliverable 1: Comparative Analysis of the Global Waste Management Outlook (GWMO 2024) and the World Risk Poll (WRP 2024)

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For the Global Environment Centre Foundation (GEC), supported by the Lloyd's Register Foundation in collaboration with UNEP-IETC

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1. Executive Summary

This report presents the first integration of two complementary global waste datasets: the Global Waste Management Outlook 2024 (GWMO 2024), recording infrastructure and waste flows, and the Lloyd's Register Foundation World Risk Poll 2024 (WRP 2024), capturing self-reported household behavior from over 140,000 respondents. Four analyses examined how infrastructure, demographics, regulation, and risk perception shape disposal and separation behavior.

The central conclusion is that infrastructure, not regulation, awareness, or individual behavior, is the binding constraint on proper disposal, and investment must be sequenced accordingly. Across 142 countries and over 143,000 respondents, 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 substitutes for collection.** Behavioral and communication measures matter only as complements to collection, never as replacements for it. The evidence is detailed in the findings below.

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. The odds of reporting uncontrolled disposal are 81% lower for urban households than for rural households after controlling for income, age, and gender (OR = 0.187). 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, and this pattern holds even after accounting for income, gender, and infrastructure access. **Those aged 65+ have 36% higher odds of separating than the 30–49 group, and the youngest cohort 22% lower odds.** This pattern holds regardless of how well-developed a country's recycling infrastructure is. **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. While greater climate concern is associated with a modest increase in separation behavior, the effect is too small to drive the behavioral change.** 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. Each capture what the other misses. For example, 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 are the countries with the least administrative data on collection and the highest reported rates of uncontrolled disposal. **Combining the infrastructure view from GWMO with the behavioral view from WRP is the foundation for credible and complete monitoring of waste management globally.**

Five policy recommendations are considered. First, rural collection infrastructure should be implemented in the fastest-growing, worst-performing countries. Second, burning bans

should follow the expansion of collection coverage, since regulation works only where households have an alternative. Third, youth-targeted programs especially for waste separation should be deployed in parallel with infrastructure, as the generation gap shows no sign of closing through infrastructure improvements alone. Fourth, communication investment should be redirected away from raising environmental awareness and toward making waste separation socially visible and locally normal, since awareness alone is too weak an effect to drive meaningful behavioral change at the population level. Fifth, closing the data gap in low-income countries should be treated as an urgent policy objective, since effective targeting of investment requires a known baseline.

2. Introduction: Purpose and Scope

2.1 Project background

This report is the first deliverable of the project "Behavioral insights for better waste management", implemented by the Global Environment Centre Foundation (GEC) with the support of the Lloyd's Register Foundation in collaboration with the UNEP International Environmental Technology Centre (UNEP-IETC). The project explores the relationship between social behavior and waste management practices.

Building on the comparative analysis report (Deliverable 1), Deliverable 2 will comprise a compilation of supplementary information drawn from research conducted beyond the primary datasets, incorporating a synthesis of findings and an evidence-based structured narrative for integration into the draft project report.

2.2 Research questions

This analysis is conducted based on the following research questions.

- **Analysis 1 (A1)** Are the countries where waste is growing fastest also those where households dispose of waste most poorly?
- **Analysis 2 (A2)** Do countries with lower formal collection rates show higher household-reported burning and dumping, and does this differ by income group and urbanicity?
- **Analysis 3 (A3)** Do older generations separate waste at significantly higher rates than younger cohorts, and is this gap driven by infrastructure access or social norms?
- **Analysis 4 (A4)** How does environmental concern rank among perceived daily risks, and does concern predict separation behavior independently of infrastructure?

3. Data and Methodology

3.1 Data sources and key variables

Two primary data sources are used in this analysis: WRP in 2024 (Lloyd's Register Foundation, 2024) and GWMO 2024 (UNEP, 2025). The datasets, both the original files and those processed for data analysis — are available in the shared folder below: https://drive.google.com/drive/folders/12quzHMGqicJ2dOxTugNjzs-fZxG-hRoL?usp=sharing

An explanation of each dataset is omitted in this section, as a detailed description falls outside the scope of this report.

The two datasets were merged at country level via ISO3 code using an inner join. Countries present in only one dataset were dropped from joint analyses.

3.2 Statistical methods

Table 1. summarizes the statistical methods applied.

Table 1. Summary of Statistical Methods Applied in This Report

Method	Description	Where used
Spearman rank correlation (ρ)	Measures of whether two things tend to move in the same direction across countries. For example, do countries with less collection infrastructure also tend to have more burning and dumping? A value close to −1 means they move in opposite directions; close to +1 means they move together; near 0 means no consistent pattern. The further from 0, the stronger the relationship.	A1, A2, A4
Logistic regression	Used when the outcome is a yes/no question — for example, does this household separate its waste or not? It estimates how much higher or lower the odds are that a particular group answers "yes" compared to a reference group, while holding other factors constant. The result is expressed as an odds ratio (OR): an OR below 1 means lower odds, above 1 means higher odds, than the reference group.	A2, A3
Ordinary Least Squares (OLS) regression	Used to test whether one factor predicts an outcome after accounting for other influences. For example, does environmental concern predict separation behavior once income and infrastructure are already taken into account? The result shows both the direction (positive or negative) and the size of the effect.	A4
Quadrant matrix	A visual grouping tool that places every country into one of four categories based on two measures at once — for example, high or low infrastructure crossed with high or low separation rates. This makes it easy to spot countries that behave unexpectedly, such as those with strong infrastructure but poor separation, or vice versa.	A3

3.3 Limitations and data quality

This section documents six categories of limitations that apply across the analyses: anomalies in projected waste growth figures, implausible combinations in the merged dataset, a significant gap in infrastructure data for the countries that need it most, the inherent difference between what households report and what national systems record, statistical-inference constraints, and sample selection arising from the country-level merge. Where these limitations affect specific analyses, they are addressed directly in the relevant sections. In all cases, the main findings have been tested for robustness, and the constraints are treated as informative rather than reasons to discount the results.

- **Projection anomalies**
  In A1, some countries including Afghanistan (−100%), Romania (−99.9%) and Ukraine (−99.9%) show near-total projected declines in waste generation that almost certainly reflect data gaps linked to other external reasons rather than real reductions (see Annex_A1_step1_growth_rates.csv). These values are excluded from trend analyses.
- **Anomalous collection–disposal patterns**
  Nine countries show implausible combinations of GWMO collection rates and WRP-reported disposal (e.g. Uganda: 100% recorded collection yet 72% of households reporting burning/dumping; Argentina: 0% recorded collection). These are documented in Section 4.2 (A2). A sensitivity analysis confirms the main findings are robust to their exclusion.
- **The low-income data gap**
  GWMO collection-rate data is unavailable for 13 of the 16 low-income countries in the merged dataset, including Chad, Burkina Faso, Mali, and Afghanistan, the countries with the highest WRP-reported uncontrolled disposal rates. The countries most in need of infrastructure assessment are precisely those for which infrastructure data is absent. This highlights a critical monitoring gap with direct policy implications; consequently, low-income countries are excluded from the Spearman correlation by income group in A2.
- **Statistical inference constraints**
  The models in this analysis support directional findings, but not precise estimates of uncertainty or causal claims. Two sets of limitations drive this.
  First, the reported precision is overstated. Four features of the estimation contribute. The individual-level regressions include country-level predictors — income group, collection rate, and recycling rate — but standard errors are not clustered by country, so confidence intervals and p-values are too narrow. The A4 model is a linear probability model estimated by OLS without heteroskedasticity-robust standard errors, which its binary outcome requires. Survey weights are applied to the descriptive statistics but not to the regressions, so coefficients describe the sample rather than the population. And the large number of hypothesis tests is not adjusted for multiple comparisons, so borderline results may reflect chance. Confidence intervals and p-values should therefore be read as indicative rather than exact.
  Second, the design cannot establish causation. All analyses are cross-sectional, so reported associations describe patterns that occur together, not effects that one variable produces in another. The single cross-section also means age differences cannot be attributed with confidence to generational norms rather than life-cycle stage, since separating cohort from life-cycle effects requires observing the same respondents over time.
  As a result, these constraints affect the interpretation of magnitude and mechanism, not the direction or robustness of the main patterns, which hold consistently across specifications.

- **Sample selection from merging**
  Because the inner join drops countries absent from either source, disproportionately low-income countries, pooled correlations and regressions that use GWMO variables are estimated on a truncated sample. Estimates may therefore be attenuated or otherwise biased relative to the full set of countries.
- **Perception versus administrative measurement**
  WRP records what households perceive and report, while GWMO records what national systems register. Divergence between the two is treated throughout this report not as error but as an analytical object, while acknowledging self-report bias and social desirability effects as inherent limitations of survey data, without attempting to correct for them within this analysis.

4. Findings

4.1 Waste growth vs. disposal habits (Analysis 1)

Question

Are the countries where waste is growing fastest also those where households dispose of waste most poorly?

The relationship between waste growth and uncontrolled disposal

Method

Projected municipal solid waste (MSW) growth rates 2020–2050 were calculated for 197 countries from GWMO as **(MSW 2050 − MSW 2020) ÷ MSW 2020 × 100**. Uncontrolled disposal is defined as households reporting that waste is burned (WP23343 = 1) or thrown outside or in the street (WP23343 = 6), consistent with the GWMO definition of uncontrolled disposal. All other valid responses are treated as controlled disposal. **Spearman rank correlation** was used in preference to Pearson due to non-normal distributions and outliers.

Result: Waste growth patterns

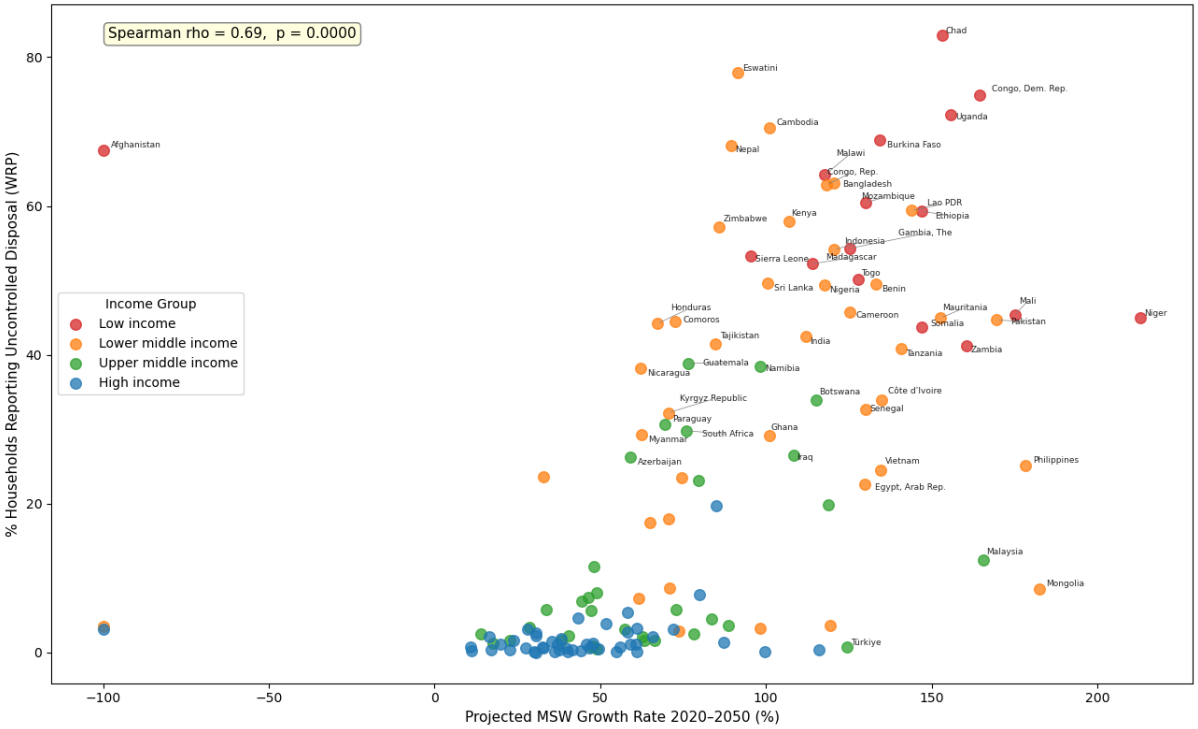
The top 20 fastest-growing countries are overwhelmingly in the low-income and lower-middle-income groups, led by the Maldives (+341%), Niger (+213%) and Mongolia (+183%). Sub-Saharan Africa accounts for 9 of the top 20. Slow-growing countries are predominantly high-income and upper-middle-income countries, such as Latvia, Lithuania, Germany and Japan, reflecting stable or declining populations and mature waste systems. Full rankings are provided at Annex_A1_step1_growth_rates.csv.

Uncontrolled disposal is strongly stratified by income. For instance, low-income countries report 63–83% uncontrolled disposal rates (led by Chad at 83%), against near-zero rates in high-income countries (Finland and Taiwan at 0%). (See Annex_A1_step2_uncontrolled_disposal.csv.)

Result: Waste growth × uncontrolled disposal

Figure 1 shows the relationship between projected waste growth (2020–2050) and household-reported uncontrolled disposal rates, with each dot representing one country, colored by income group. The pattern is clear and consistent. Countries expecting the fastest growth in waste are also the countries where households most frequently burn or dump their waste today. This relationship is strong ($\rho = 0.69$, meaning the two measures move closely together across countries) and statistically reliable ($p < 0.0001$, meaning an association this strong would be very unlikely to arise if no true relationship existed), based on 142 countries. Low-income countries (red dot) concentrate in the upper-right corner with facing both rapid waste growth and high uncontrolled disposal. Chad, DR Congo, Uganda and Burkina Faso among the most extreme cases show projected growth exceeds 130% and more than 60% of households report burning or dumping. High-income countries, by contrast, cluster near zero uncontrolled disposal regardless of how fast their waste is growing. In short, the countries that will generate the most additional waste by 2050 are the same countries currently least equipped to manage it safely. This gap will widen without targeted investment.

Figure 1. Projected Waste Growth (2020–2050) and Household-Reported Uncontrolled Disposal Rates, by Country Income Group



Perception gap between GWMO official uncontrolled disposal rates and WRP household-reported uncontrolled disposal rates at country level.

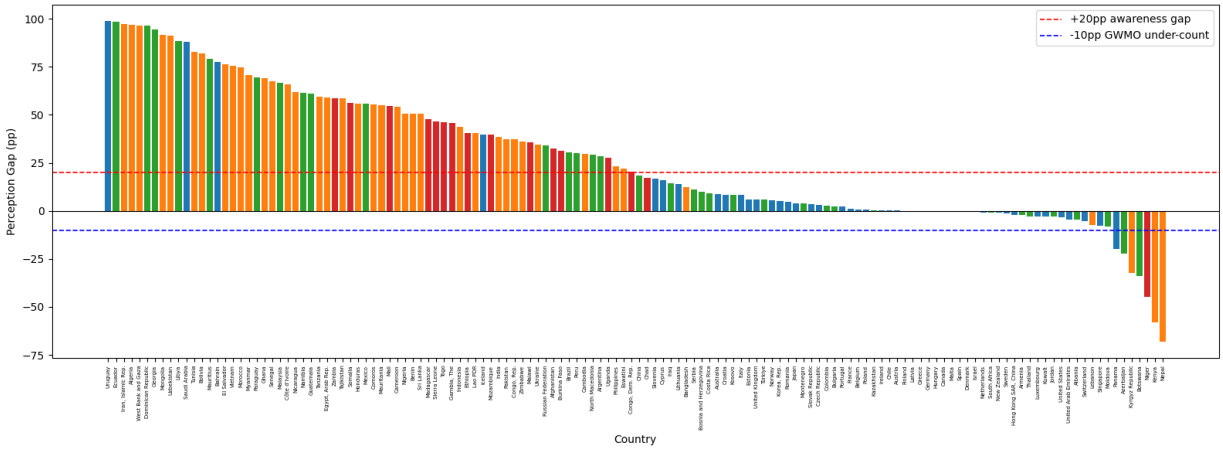
Method

The perception gap is defined as "(GWMO uncontrolled rate × 100) − WRP percentage uncontrolled" and is calculated. A positive gap means national statistics record more uncontrolled disposal than households self-report (an awareness gap), while a negative gap means households report more than official data records (possible GWMO under-counting). Reference lines at +20pp and −10pp are analytical choices based on the observed distribution. Note that the two rates also have different bases: the GWMO rate is a share of waste flows (tonnage), while the WRP rate is a share of households. The gap therefore combines this denominator difference with definitional and measurement differences and is best read as a divergence indicator rather than a pure perception measure.

Result: Perception gap

Figure 2 reveals a systematic disconnect between official waste data and household reports. Lower-middle-income countries dominate the high awareness-gap zone (above +20pp), while high-income countries cluster near zero, where official data and household reports are broadly consistent. A smaller group of countries falls below −10pp, where households report more uncontrolled disposal than GWMO records, suggesting that official statistics are missing significant informal disposal activity.

Figure 2. Divergence Between GWMO and Household-Reported Uncontrolled Disposal Rates by Country



Note: One bar per country, sorted largest to smallest gap, colored by income group, with +20pp and −10pp reference. Bar colors indicate red = low income, orange = lower-middle income, green = upper-middle income, blue = high income.

4.2 Collection coverage vs. uncontrolled disposal (Analysis 2)

Question

Do countries with lower formal collection rates show higher household-reported burning and dumping? Is the relationship the same across income groups and urbanicity?

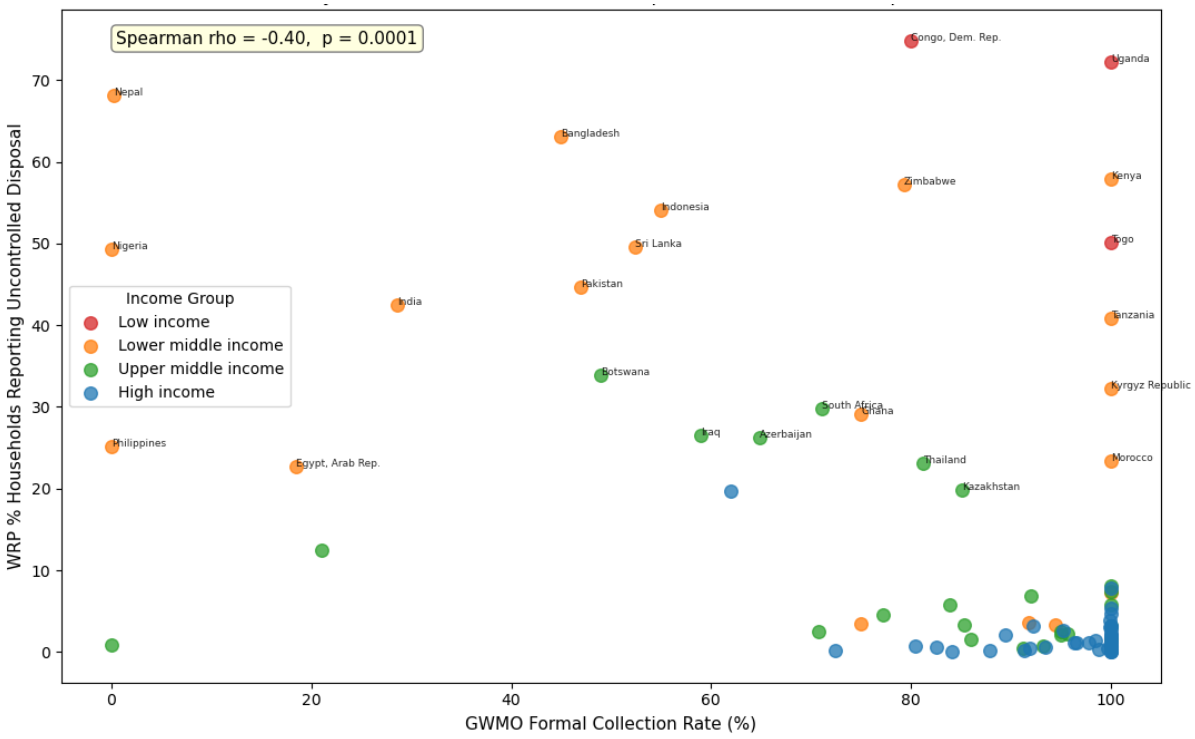
Collection coverage and uncontrolled disposal

Method

This analysis pairs each country's formal waste collection rate from GWMO, expressed as a value between 0 (no collection) and 1 (full collection) with the weighted share of households reporting burning or dumping from WRP. Spearman correlations were run globally and then separately within income groups and by urbanicity (rural versus urban), with a minimum of five countries required per group as a screening threshold. For the urban and rural breakdown, WRP respondents were divided into rural (Urbanicity codes 1–2) and urban (codes 3 and 6) subgroups, re-aggregated to the country level applying survey weights, and then merged with GWMO data. Countries whose combinations of collection rate and reported disposal deviated strongly from the expected pattern were flagged and investigated separately. A sensitivity analysis excluding these countries confirms that the main findings remain robust.

Result: Global relationship and anomalies

Figure 3. Formal Waste Collection Rates and Household-Reported Uncontrolled Disposal by Country, Colored by Income Group



Globally there is a moderate, statistically significant negative correlation ($\rho = -0.40$, meaning the two measures move in opposite directions across countries, and $p < 0.0001$, meaning an association this strong would be very unlikely to arise if no true relationship existed) as Figure 3 shows. Countries with lower formal collection rates tend to have higher uncontrolled disposal reported by households.

Two clusters deviate. In the top-left (low collection, high uncontrolled) sit Nepal and Bangladesh. In the top-right sit countries such as Uganda, DR Congo, Kenya, Togo and Zimbabwe, where GWMO records near-complete collection yet households still report very high uncontrolled disposal, suggesting either that GWMO overstates actual service coverage, or that collected waste is not safely managed downstream, or that informal disposal coexists alongside formal collection.

Nine countries were classified as anomalous and investigated separately. When these countries are removed from the analysis, the relationship between collection coverage and uncontrolled disposal becomes slightly stronger rather than weaker (the correlation increases from −0.40 to −0.46), which confirms that these outliers were diluting the overall pattern rather than creating it. The main finding therefore holds. Full details are provided in Annex A2.

Result: Stratified correlations

The relationship between collection coverage and uncontrolled disposal is strongest in rural areas ($\rho = -0.47$). Among income groups, the relationship is statistically reliable for upper-middle-income countries ($\rho = -0.44$). (Table 2). Low-income countries could not be assessed, as GWMO collection data is missing for 13 of their 16 countries in the dataset.

Table 2. Association Between Formal Collection Coverage and Uncontrolled Disposal, by Income Group and Urbanicity

Stratum	n	ρ	p-value	Sig.	Strength
Global	95	−0.403	0.0001	***	Moderate
Lower middle income	19	−0.267	0.270	ns	Weak
Upper middle income	28	−0.436	0.020	*	Moderate
High income	45	+0.098	0.522	ns	Weak
Rural stratum	94	−0.468	<0.0001	***	Moderate
Urban stratum	95	−0.336	0.0009	***	Moderate
Low income	—	N/A	N/A	—	Insufficient data (n = 3 of 16)

*Significance: *** p<0.001, ** p<0.01, * p<0.05, ns = not significant. Strength: strong |ρ|>0.5, moderate 0.3–0.5, weak <0.3.*

Urban-rural disparity at the individual level

Method

The country-level analysis above shows that rural areas have higher uncontrolled disposal, but this could partly reflect the fact that rural populations tend to differ from urban ones in income, age, and gender composition rather than location alone. To test whether the rural–urban gap holds even after accounting for these differences, a logistic regression was run on 143,705 individual WRP respondents. The outcome was whether a household reported uncontrolled disposal (burning or street dumping: WP23343 = 1 or 6). Two models were compared:

- Model 1 examines urbanicity alone, testing whether living in a rural versus urban area predicts the likelihood of uncontrolled disposal.
- Model 2 extends the first model by adding income group, age group, and gender as control variables, to test whether the rural–urban gap persists once these factors are considered. The reference categories are rural, lower-middle income, age 30–49, and male.

Result: Predictors of uncontrolled disposal — logistic regression

The urban effect is strong and robust as it remains large after adding demographic controls, indicating the gap between urban and rural households is not simply explained by differences in country income group, age, or gender. **The odds of reporting uncontrolled disposal remain 81% lower for urban households than for rural households in the same country income group with the same age and gender profile.** Income shows the largest effect overall: residents of high-income countries have 96% lower odds of reporting uncontrolled disposal than residents of lower-middle-income countries (OR = 0.036), while residents of low-income countries have more than twice the odds (OR = 2.187).

Age shows a moderate gradient in the expected direction. Younger respondents aged 15–29 have slightly higher odds of reporting uncontrolled disposal than the 30–49 reference group (OR = 1.126), while older respondents show progressively lower odds, anticipating the pattern of Analysis 3.

The gender effect, while statistically detectable, is too small to be practically meaningful (women's odds of reporting uncontrolled disposal are only 5% higher than men's, OR = 1.049).

It can be said that rural households face structural disadvantages in waste disposal that go beyond their demographic characteristics, most plausibly reflecting the absence of formal collection infrastructure. This reinforces rural collection expansion as a global priority for reducing uncontrolled disposal.

Table 3. Logistic regression: predictors of uncontrolled disposal (n = 143,705)

Variable	Model 1 OR	Model 2 OR	95% CI	p-value	Sig.
Urban (vs rural)	0.165	**0.187**	[0.180, 0.193]	<0.001	***
High income (vs lower middle)	—	0.036	[0.033, 0.038]	<0.001	***
Low income (vs lower middle)	—	**2.187**	[2.103, 2.274]	<0.001	***
Upper middle (vs lower middle)	—	0.263	[0.253, 0.273]	<0.001	***
Age 15–29 (vs 30–49)	—	1.126	[1.087, 1.166]	<0.001	***
Age 50–64 (vs 30–49)	—	0.870	[0.832, 0.910]	<0.001	***
Age 65+ (vs 30–49)	—	0.763	[0.721, 0.807]	<0.001	***
Female (vs male)	—	1.049	[1.018, 1.081]	0.002	**

*Note: OR = odds ratio, which expresses how much higher or lower a group's odds of reporting uncontrolled disposal are compared to the reference group. An OR below 1 means lower odds; above 1 means higher odds; 1 means no difference. Because the outcome is common, percentage changes in odds overstate percentage changes in probability. 95% CI = the range within which the true value is expected to fall with 95% confidence. Significance: *** p < 0.001, ** p < 0.01. Reference categories: rural, lower-middle income, age 30–49, male. Standard errors are not clustered by country; confidence intervals for country-level variables (income group) are therefore likely too narrow.*

4.3 Generational separation gradient (Analysis 3)

Question

Does waste separation behaviors vary by generation and gender, and to what extent are these differences driven by infrastructure access, income level, or social norms?

Generational gap in waste separation

Method

To examine whether age predicts waste separation independently of other factors, a logistic regression was estimated on 104,187 WRP respondents with complete data. The outcome was whether a respondent regularly separates their waste. The key variable of interest was

age group, with the 30–49 age group serving as the reference category against which all other age groups are compared. The model controlled for income group, urbanicity, gender, and each country's recycling rate from GWMO, ensuring that any observed age effect is not simply a reflection of these other differences.

The primary separation outcome variable combines WRP responses of "Yes" (code 1) and "Sometimes" (code 3) to WP23342 into a single binary indicator of waste separation behavior (coded 1 = separates, 0 = does not separate). This grouping reflects the judgment that partial separation represents a meaningfully different practice from no separation at all. Respondents answering, "Don't know" (code 98) or "Refused" (code 99) are excluded from all analyses (n = 653, 0.4% of total respondents).

Result: Predictors of waste separation — age effect persists across income, location, and infrastructure

The generational gap in waste separation persists even after accounting for differences in income, location, gender, and national recycling infrastructure**. The youngest age group (15–29) has 22% lower odds of separating waste than the 30–49 group (OR = 0.779), while those aged 50–64 and 65 and over have 32% and 36% higher odds respectively (OR = 1.321 and 1.362).** This indicates that the gap is not explained by the circumstances in which people live and is consistent with generational norms . Among all factors examined, income has the single largest effect. Residents of high-income countries have five times the odds of separating waste compared with those in lower-middle-income countries (OR = 5.024).

Two findings merit further attention. **First, urban households are less likely to separate waste than rural ones** (OR = 0.806), which runs against the expected pattern and may reflect the availability of informal disposal channels in cities, or differences in how separation is defined and practiced across settings. **Second, countries with higher national recycling rates do not necessarily show higher rates of household separation** (OR = 0.727), possibly because some high-recycling countries rely on centralized sorting systems that do not require households to pre-separate their waste, or because national recycling statistics do not fully capture what individual households do.

Table 4. Logistic Regression: Predictors of Waste Separation (N = 104,187)

Variable (reference mgroup in parentheses)	OR	95% CI	p-value	Sig.	Interpretation
Age 15–29 (vs 30–49)	0.779	[0.753, 0.806]	<0.001	***	22.1% lower odds of separating
Age 50–64 (vs 30–49)	1.321	[1.273, 1.370]	<0.001	***	32.1% higher odds
Age 65+ (vs 30–49)	1.362	[1.307, 1.418]	<0.001	***	36.2% higher odds
High income (vs lower middle)	5.024	[4.844, 5.210]	<0.001	***	5× the odds
Low income (vs lower middle)	0.530	[0.492, 0.572]	<0.001	***	47.0% lower odds
Upper middle (vs lower middle)	0.963	[0.930, 0.997]	0.034	*	3.7% lower odds
Urban (vs rural)	0.806	[0.784, 0.828]	<0.001	***	19.4% lower odds
Female (vs male)	1.162	[1.131, 1.194]	<0.001	***	16.2% higher odds

Variable (reference mgroup in parentheses)	OR	95% CI	p-value	Sig.	Interpretation
GWMO recycling rate (0–1)	0.727	[0.696, 0.759]	<0.001	***	Negative association

*Significance: *** p<0.001, * p<0.05. Reference categories: age 30–49, lower middle income, male, rural. Standard errors are not clustered by country; intervals for country-level variables (income group, GWMO recycling rate) are therefore likely too narrow, and the significance of the recycling-rate coefficient in particular should be treated with caution.*

Generational gap in waste separation and recycling infrastructure

Method

In a separate analysis, each country was assigned two scores: a generational gap score, measuring the difference in separation rates between the oldest (65+) and youngest (15–29) age groups in percentage points, and a recycling infrastructure level based on the GWMO national recycling rate. Countries were then placed into a 2×2 matrix divided at the midpoint of each measure — 24.7% for recycling infrastructure and 3.2 percentage points for the generational gap — producing four groups (Q1~Q4) that reveal whether the generational gap is larger or smaller depending on a country's infrastructure level. Dichotomizing continuous measures discards information, so the quadrant counts should be read as descriptive; the continuous association between the two measures is the more direct test. A total of 96 countries had sufficient data for this analysis.

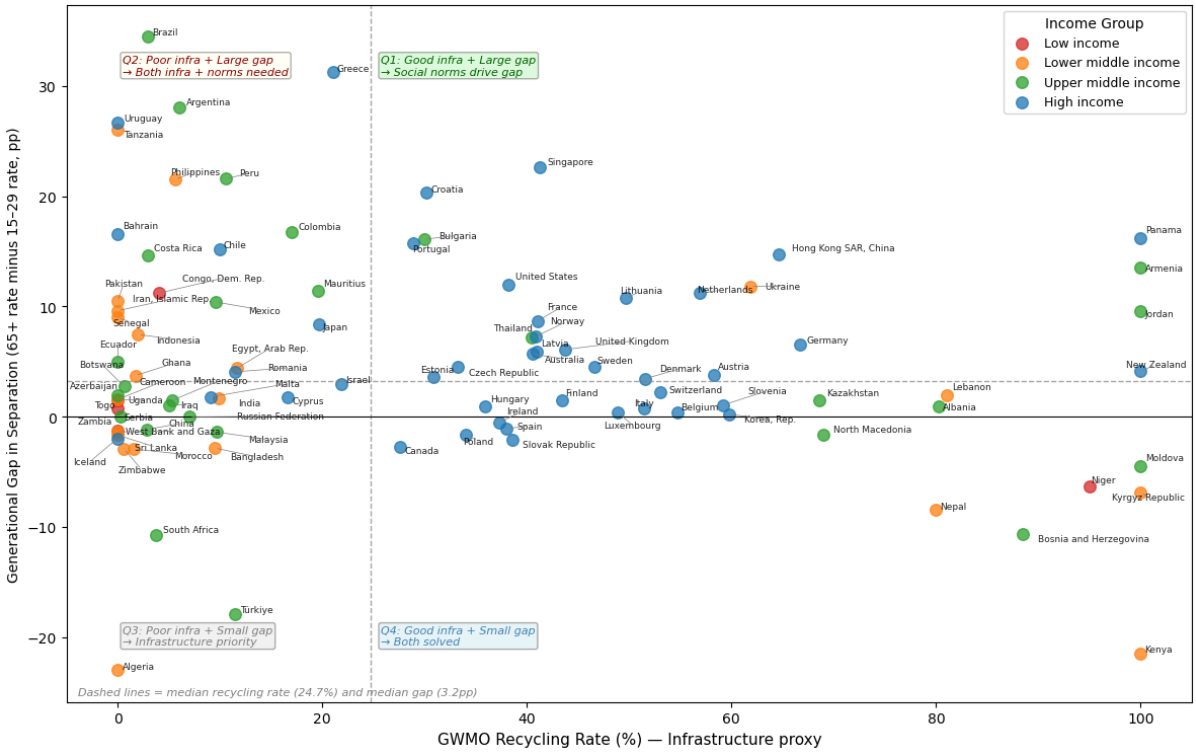
Result: Quadrant analysis

Figure 4 places each country into one of four groups based on two measures: how strong its recycling infrastructure is and how large the gap in separation behavior is between older and younger residents. Countries distribute almost evenly across all four groups (Q1: 25, Q2: 23, Q3: 25, Q4: 23), meaning there is no consistent pattern linking a country's infrastructure level to the size of its generational gap.

This even distribution carries an important message. Countries with strong recycling infrastructure are just as likely to have a large generational gap as countries with weak infrastructure (Q1). Equally, some countries with poor infrastructure show almost no gap between age groups (Q3) likely because when collection is absent for everyone, age makes little difference to behavior. Meanwhile, countries in Q2 show that even without strong infrastructure, older and younger generations can behave similarly.

With the regression findings, **this suggests that the gap between older and younger people in how they separate waste is largely unrelated to infrastructure availability and is consistent with generational norms and ingrained habits (subject to the cohort/life-cycle caveat above), not by whether recycling infrastructure is available. Better infrastructure alone will not close this divide. Dedicated programs targeting younger age groups are therefore needed as a separate and parallel effort to infrastructure investment.**

Figure 4. Quadrant Analysis: Generational Gap in Waste Separation versus Recycling Infrastructure



Gender gap in waste separation across income groups

Method

To examine whether men and women differ in their waste separation behavior, separation rates were calculated separately for male and female respondents within each income group, using survey weights to ensure the results are representative. The gender gap is defined as the difference between female and male separation rates in percentage points within each income group.

To test whether this gender difference is consistent across income groups or varies depending on a country's income level, a logistic regression was run that explicitly models the interaction between gender and income group. In other words, it tests whether being female has a different effect on separation behavior in high-income countries compared to low-income ones. The model controls age groups and whether respondents live in urban or rural areas. The reference point for comparison is male respondents in lower middle income countries.

Result: Gender gap in waste separation across income groups

Women separate waste at modestly but consistently higher rates than men across all income groups, with the gap ranging from 0.9 to 3.8 percentage points (Figure 5). A logistic regression confirms that this difference is statistically reliable (OR = 1.18, $p < 0.001$), meaning **women have 18% higher odds of separating waste than men after accounting for other factors.** Importantly, this gender gap does not vary meaningfully by income group — it is a stable, cross-cutting pattern that holds regardless of whether a country is low- or high-income, rather than being specific to any income level (Table 5).

Figure 5. Waste Separation Rates by Gender and Income Group

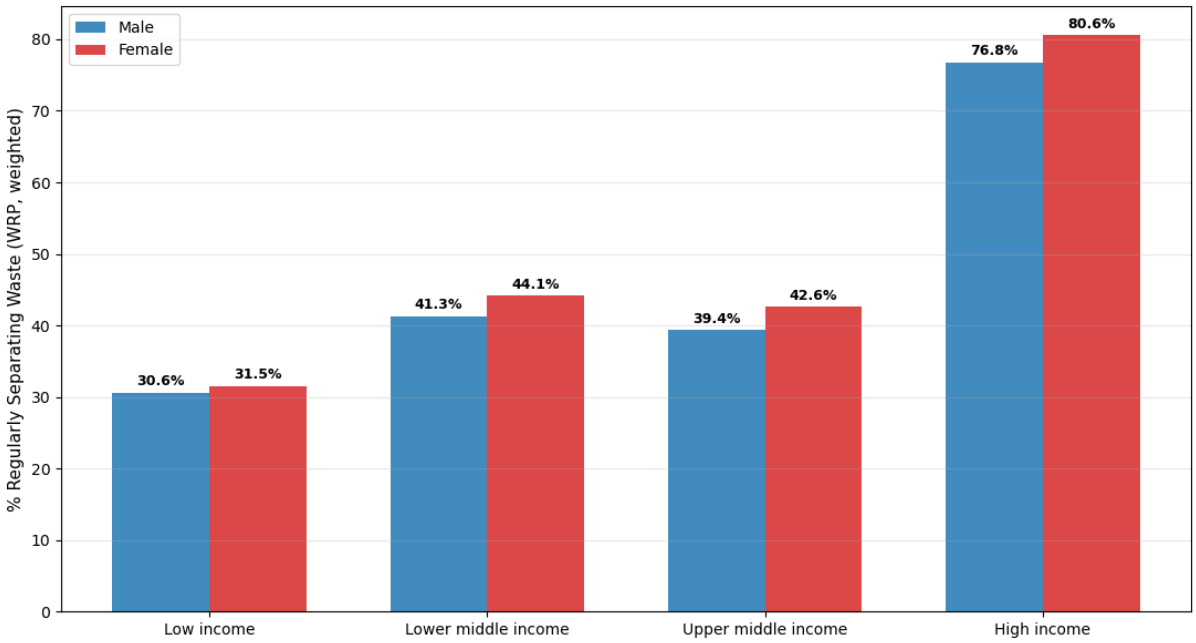


Table 5. Logistic Regression: Gender Effect on Waste Separation by Income Group

Variable	OR	95% CI	p-value	Sig.	Interpretation
Female	1.181	[1.121, 1.243]	<0.001	***	18.1% higher odds of separating waste than men in lower-middle-income countries (reference group)
Female × High income	0.958	[0.894, 1.027]	0.225	ns	The gender gap does not differ significantly from that in lower-middle-income countries
Female × Low income	0.942	[0.811, 1.093]	0.432	ns	Same as above
Female × Upper middle income	0.994	[0.928, 1.065]	0.863	ns	Same as above

*Note: Significance: *** p<0.001. Reference categories: male, lower middle income. Controls: age group, urban/rural.*

4.4 Risk perception and the concern–behavior gap (Analysis 4)

Question

How does environmental concern rank among perceived daily risks, and does concern predict separation behavior independently of infrastructure?

Environmental risk perception and waste separation behavior

Method

The analysis proceeds in four steps. First, all 23 daily risk categories (WP22331) asked in the WRP survey were ranked by the share of respondents selecting each one, both globally and within each income group, to establish where environmental concerns, defined here as pollution (code 18) and climate or weather risks (code 19), sit relative to other concerns. Second, respondents were grouped by how seriously they view climate change (WP20719: very serious, somewhat serious, or not a threat), and their waste separation and burning

rates were compared across these groups. Third, at the country level, the relationship between average climate concern and waste separation rates was examined across 95 countries, alongside the relationship between separation and national collection infrastructure, using Spearman rank correlation. Finally, an Ordinary Least Squares (OLS) regression was run to test whether climate concern independently predicts separation behavior after accounting for a range of other factors including collection infrastructure, education, income, urbanicity, gender, and regional differences. Because the outcome is binary, this OLS specification is a linear probability model, for which heteroskedasticity-robust standard errors are appropriate. Entering the 1–3 concern scale as a continuous variable also imposes a linear effect that Table 7 suggests is only approximate, since the difference in separation is concentrated between the “somewhat serious” and “not a threat” groups; a categorical specification would relax this assumption.

Like Analysis 3, the primary separation outcome variable combines WRP responses of "Yes" (code 1) and "Sometimes" (code 3) to WP23342 into a single binary indicator of waste separation behavior (coded 1 = separates, 0 = does not separate). This grouping reflects the judgment that partial separation represents a meaningfully different practice from no separation at all. Respondents answering "Don't know" (code 98) or "Refused" (code 99) are excluded from all analyses in which separation is used as an outcome variable (n = 653, 0.4% of total respondents).
Climate concern is measured on a 1–3 scale according to WRP question WP20719: 1 = Very serious threat, 2 = Somewhat serious, 3 = Not a threat. Note that the scale is inverse — higher values indicate lower concern.

Result: Risk ranking

Environmental risks are not a major daily concern anywhere. Pollution (code 18) and climate or weather risks (code 19) rank far below concerns such as crime, road accidents, and personal health across all 23 WRP daily risk categories (WP22331), and this pattern is essentially uniform across all income groups (Table 6).

Table 6. Global Risk Ranking, Top Categories and Environmental Risks

Rank	Risk	% global
1	Crime/violence	18.4
2	Road/traffic accident	16.5
3	Personal health	14.7
9	Climate/weather	3.8
19	Pollution	0.6
—	Environment (combined)	4.4

Note: WGT-weighted, N = 127,675. Full 23-category ranking and income-group breakdown in Annex_A4.docx.

Result: Separation rate and open burning rate

Separation rates are virtually identical between respondents who view climate change as a very serious threat (58.1%) and those who view it as somewhat serious (58.2%), with a modest drop among those who do not view it as a threat at all (52.5%). Open burning shows no consistent relationship with concern level, with the middle group (somewhat serious) recording the lowest burning rate (12.5%) rather than the most concerned group. Even among respondents who perceive climate change as a serious threat, waste practices do not substantially differ from those with lower concern (Table).

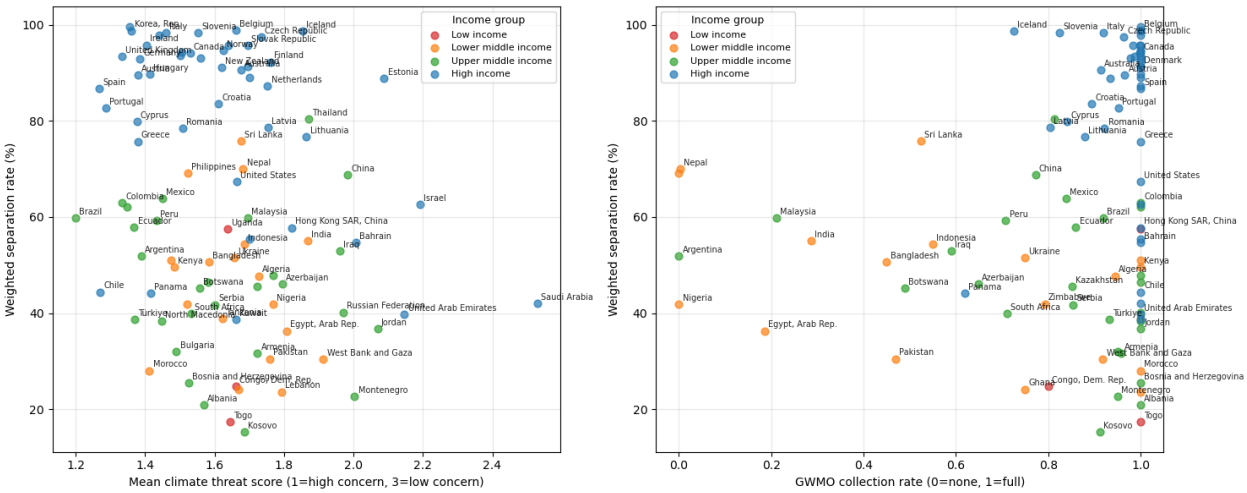
Table 7. Waste Separation and Open Burning across Climate-Threat Perception Groups

Indicator	Very serious (high concern)	Somewhat serious	Not a threat (low concern)
Separation rate (%)	58.1	58.2	52.5
Open burning rate (%)	14.9	12.5	16.6

Result: Country-level correlations and OLS

The association between climate concern and separation is weak (ρ = −0.23, p = 0.026). Since the climate concern variable is measured on an inverse scale — where lower values indicate higher concern — and separation is coded as a binary outcome (1 = separates, 0 = does not separate), **this negative correlation indicates that countries with more concerned populations tend to show modestly higher separation rates. This is the expected direction, but the effect is weak and unlikely to be practically meaningful (Figure 6)**.

Figure 6. Climate concern, collection infrastructure, and waste separation rates by country, colored by income group



When examining individual respondents while accounting for regional differences (Table 8 and Figure 7), both climate concern and national collection rates emerge as statistically reliable predictors of waste separation behavior (p < 0.001). Since climate concern is measured on an inverse scale (1 = very serious threat, 3 = not a threat) and separation is coded as a binary outcome (1 = separates, 0 = does not separate), the negative coefficient (β = −0.0248) indicates **that each one-step move toward lower concern on the scale is associated with an approximately 2.5-percentage-point lower probability of separating waste — equivalently, more-concerned respondents are slightly more likely to separate — assuming a linear effect across the three-point scale.** This is the expected direction, but the effect is small and does not translate into meaningfully different behavior across concern levels in practice, as Table 7 confirms.

The negative coefficient on collection rate (β = −0.0318) is difficult to interpret and runs against expectations. Living in a country with higher collection coverage is associated with a 3.2 percentage point decrease in individual separation probability. This may reflect that high-collection countries tend to rely on centralized sorting systems that do not require

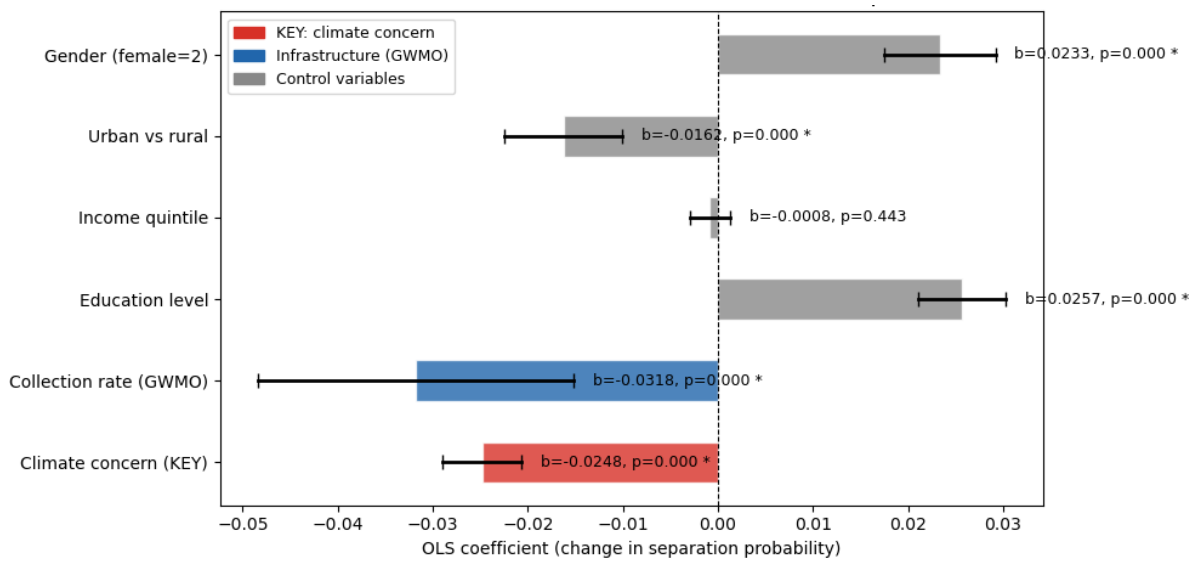
households to pre-separate their waste, rather than suggesting that infrastructure discourages separation behavior.

Table 8. OLS Regression: Predictors of Separation Probability

Variable	Coef.	Std. err.	t	p-value	95% CI	Sig.
Intercept	0.4649	0.013	36.03	<0.001	[0.440, 0.490]	***
Climate concern (1–3)	**−0.0248**	0.002	−11.79	<0.001	[−0.029, −0.021]	***
Collection rate (0–1)	**−0.0318**	0.008	−3.75	<0.001	[−0.048, −0.015]	***
Education	0.0257	0.002	10.84	<0.001	[0.021, 0.030]	***
Income (5-level)	−0.0008	0.001	−0.77	0.443	[−0.003, 0.001]	ns
Urban	−0.0162	0.003	−5.13	<0.001	[−0.022, −0.010]	***
Gender	0.0233	0.003	7.80	<0.001	[0.017, 0.029]	***
Region fixed effects	Included	—	—	<0.001	—	***

Region fixed effects (Regions 2–15 included)
Coefficients represent changes in separation rate (percentage points). Standard errors are neither heteroskedasticity-robust nor clustered by country; p-values, especially for the country-level collection rate, are therefore likely overstated
Climate concern is measured on a 1–3 scale: Coded 1 = Very serious threat, 2 = Somewhat serious, 3 = Not a threat.
Collection rate ranges from 0 (none) to 1 (full coverage)
Significance levels: *** p < 0.001, ** p < 0.01, * p < 0.05, ns = not significant

Figure 7. OLS regression: predictors of separation probability



5. Country Case Comparisons

This section uses country-level case studies to deepen the findings from Section 4. While the quantitative analyses establish broad patterns across 95–142 countries, they cannot explain why some countries deviate from those patterns, or what drives the gap between what official data records and what households actually report. Five countries were selected for the policy analysis in Section 5.2 (UK, Brazil, India, Kenya, and Cambodia) to represent a range of income groups, regions, and regulatory approaches. Three country pairs were selected for the data alignment analysis in Section 5.3 (Kenya/Ghana, Brazil/Colombia,

India/Bangladesh) because each pair shares the same income classification, region, and projected waste growth trajectory, making differences in disposal outcomes and data gaps more analytically interpretable. Together, the case studies address two questions: where and why do official data and household reports diverge, and does regulation change burning behavior in practice?

5.1 Burning ban and its behavior

This section examines **whether the existence of a national open-burning ban is associated with lower rates of household burning,** using five countries that vary in income level, regulatory approach, and enforcement capacity.

For each country, four figures are placed side by side: the share of the population formally served by waste collection (GWMO), the share of disposal officially classified as uncontrolled (GWMO), the share of households reporting open burning (WRP), and the share reporting any form of uncontrolled disposal (sum of burning and open dumping) (WRP). Full results are provided in Annex_Case study_1.csv.

The results are summarized in Table 9. Across the five countries, the existence of a national burning ban leads to almost no relationship to whether burning occurs. Instead, what predicts low burning rates is the combination of near-universal collection coverage and active enforcement of the burning ban. The five countries fall into three groups.

Group 1: Existence of the banning policies and low burning rate (UK)

The UK achieves the lowest burning rate in the sample — 0.3% of households report burning waste in the WRP — and it is the only country in the sample where both collection coverage (98.8%) and active enforcement of open-burning regulations are present simultaneously.The UK does not have a law that explicitly bans open burning of household waste. Instead, the Environmental Protection Act 1990 controls it indirectly through its statutory nuisance provisions. Section 79(1) defines smoke or fumes from burning as an enforceable offence when harmful or disruptive enough. Section 80(1) then requires local authorities to serve abatement notices where a statutory nuisance exists, and failure to comply is a criminal offence under Section 80(4), punishable by fines of up to £40,000 for commercial premises (Environmental Protection Act 1990, n.d.a; n.d.b). This institutional mechanism — a legal duty on authorities to act, backed by meaningful penalties — is what makes the regulation effective rather than nominal. The near-complete collection coverage ensures households have a viable alternative, making compliance both possible and expected.

Group 2: Existence of the banning policies but lack of enforcement and infrastructure (India and Kenya)

Three countries maintain explicit national open-burning bans yet record highest burning rates. In each case, the ban is undermined either by the absence of collection infrastructure that would make compliance possible, or by the absence of active enforcement of the ban itself, or both.

India

India has one of the most detailed regulatory frameworks in the sample. The Solid Waste Management Rules 2016 explicitly prohibit open burning both as an individual obligation stating that no waste generator shall throw, burn, or bury solid waste on streets, open public spaces, drains, or water bodies. Also, the Rule states the solid waste management as a duty of local authorities under Rule 15(g), which directs them to instruct waste generators not to

litter, burn, or bury waste (Ministry of Environment, Forest and Climate Change, 2016). Despite this, more than 22% of households report burning waste in the WRP survey, and GWMO records an uncontrolled disposal rate of 80.7%. With a formal collection rate of just 28.6%, the majority of households have no viable disposal alternative, and the ban cannot be enforced where no collection system exists to replace burning.

Kenya

Kenya has a comprehensive regulatory framework. The Environmental Management and Co-ordination (Air Quality) Regulations 2014 prohibit open burning of waste emitting air pollutants, and the National Environment Management Authority (NEMA) enforces this in practice including arrests for open burning of tyres (Lexology, 2022; National Environment Management Authority, 2023). Kenya further strengthened its framework through the Sustainable Waste Management Act 2022, which established a Waste Management Council and requirements for national waste data systems (Republic of Kenya, 2022). Despite this, 57.9% of Kenyan households report burning or dumping waste. GWMO simultaneously records Kenya's collection rate as 100% and uncontrolled rate as 0%, given this household-reported reality, this data almost certainly reflects data quality issues rather than actual service coverage. Kenya therefore illustrates a case where the regulatory framework is comparatively strong, but the data systems needed to monitor and target enforcement are unreliable.

Group 3: No burning-specific ban; regulatory blind spot for burning (Brazil, Cambodia)

In both Brazil and Cambodia, open burning of household waste is unregulated. Existing laws target dumping but leave burning unaddressed, and formal disposal systems offer no alternative to absorbing it. Household burning rates in both countries reflect this regulatory blind spot.

Brazil

Brazil's main waste legislation, the National Solid Waste Policy (Law No. 12,305/2010), prohibits open dump disposal and required all open dumps to close by August 2014 (Alfaia et al., 2017). The low open dumping rate of 0.8% in the WRP suggests this targeted legislation has had some effect on dumping specifically. However, no equivalent law bans open burning of household waste, and formal incineration remains negligible. This can be partly because waste pickers' organizations oppose formal incineration on the grounds that it would threaten the livelihoods of an estimated 800,000 to 1,000,000 workers nationwide (Trentinella, 2021). Open burning therefore falls into a regulatory blind spot. In other words, neither explicitly prohibited nor absorbed into a formal disposal system. This gap may account for the 6.1% WRP burning rate alongside a 37.5% GWMO uncontrolled disposal rate.

Cambodia

Cambodia introduced open burning as a target under Circular No. 01 on Measures to Prevent and Reduce Ambient Air Pollution (2020), alongside improved air pollution monitoring (Climate and Clean Air Coalition, n.d.). The Ministry of Environment has developed waste regulations since 1996, and a 2015 sub-decree allows authorities to contract private operators for collection, with private companies serving as the primary collectors in urban areas (Heinrich Böll Stiftung, 2025). These measures have not meaningfully reduced burning: the WRP records a burning and dumping rate of 70.4%, with open burning alone accounting for 68.0%. Cambodia illustrates that addressing burning as one item among many in a broader air quality circular, without dedicated enforcement of

open-burning regulations or sufficient collection infrastructure to offer households an alternative, produces no measurable behavioral change.

Table 9. Collection Coverage, Burning Rates, and Open-Burning Policy by Country

Country	Income	GWMO Collection	GWMO Uncontrolled*	WRP Burning+Dumping	WRP Dumping	WRP Burning	Gap**	Related Policies
UK	High	98.8%	6.3%	0.3%	0%	0.3%	+6.1	**Environmental Protection Act 1990:** open burning of household waste restricted through "statutory nuisance" regulation.
Brazil	Upper-middle	92%	37.5%	6.9%	0.8%	6.1%	+30.6	**National Solid Waste Policy (Law No. 12,305/2010):** no dedicated open-burning ban
India	Lower-middle	28.6%	80.7%	42.4%	19.7%	22.7%	+38.3	**Solid Waste Management Rules 2016:** explicit national ban on open burning of waste
Kenya	Lower-middle	(100%)	(0.0%)	57.2%	4.2%	53.8%	−57.2	**Environmental Management and Co-ordination (Air Quality) Regulations 2014:** prohibit open burning of waste that emits air pollutants
Cambodia	Lower-middle	N/A (unreliable)	(100%)	70.4%	2.4%	68.0%	+29.6	**Circular No. 01 on Measures to Prevent and Reduce Ambient Air Pollution (2020):** cover open burning as one of the targets

*Note: *GWMO Uncontrolled = 1 − controlled_rate (controlled = recycling + landfill + thermal)*
***GWMO Uncontrolled rate − WRP Burning+Dumping rate.*
Values of 100% or 0% are placed in brackets, as these are likely to reflect data quality issues rather than true zero/complete rates.

5.2 Data alignment: where official records and household reports diverge

The three country pairs in this section share the same income classification, region, and projected waste growth trajectory, so differences in their disposal figures and perception gaps are more likely to reflect genuine data or definition problems than underlying differences in country characteristics. Each pair illustrates a different type of divergence between GWMO and WRP.

Kenya and Ghana: opposite directions of the same gap

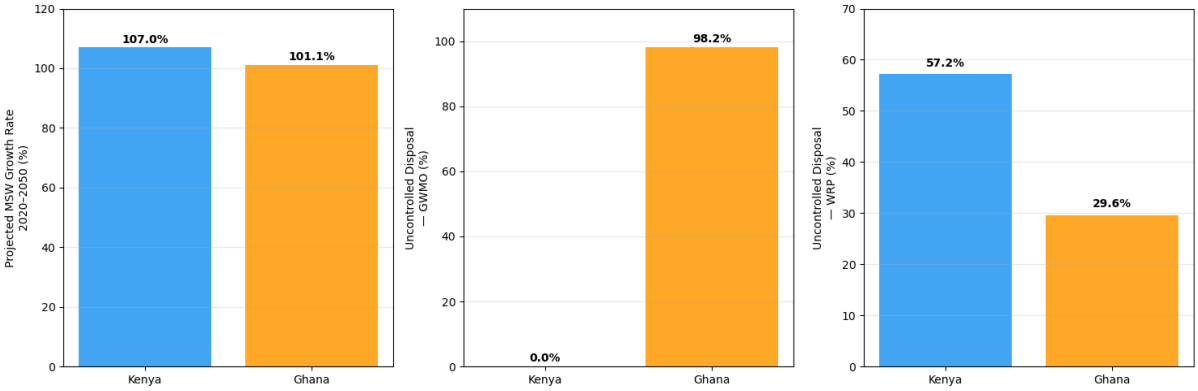
Kenya and Ghana share the same income classification (lower-middle income) and region (Sub-Saharan Africa), and their projected waste growth trajectories are nearly identical107.0% for Kenya versus 101.1% for Ghana over 2020–2050 (A1). However, on the question of how waste is actually disposed of, the two countries present an interesting contrast worth noting carefully (Figure 8).

According to official GWMO statistics, Kenya reports 0% uncontrolled disposal, while household-reported data from WRP shows 57.2% of Kenyan households disposing of waste in an uncontrolled manner. Given the size of this gap, it's worth considering whether the GWMO figure may reflect a data gap or measurement limitation for Kenya as a 0% value seems unlikely for a country with Kenya's growth profile and regional context, and the WRP figure may offer a more realistic picture of current practices.

Ghana, by contrast, reports a GWMO uncontrolled disposal rate of **98.2%**, while only **29.6%** of household's self-report uncontrolled disposal. This +68.6-percentage point gap of the perception gap likely reflects the differences in definition or reporting gap. **In other words, households may not classify certain disposal methods (such as informal collection or community dumping) as "uncontrolled," even where national assessments do.**

In summary, Kenya and Ghana illustrate that the perception gap does not point consistently in one direction. In Kenya, official data understates actual informal disposal. In Ghana, households do not recognize their own disposal practices as uncontrolled. Neither source- GWMO nor WRP - gives a complete picture on its own.

Figure 8. Comparing Kenya and Ghana on Waste Growth and Uncontrolled Disposal



Note: Uncontrolled Disposal GWMO (%) = 1 − controlled_rate (controlled = recycling + landfill + thermal)
Uncontrolled Disposal WRP (%) = the weighted share of households reporting burning (WP23343 = 1) or street dumping (WP23343 = 6) was calculated per country

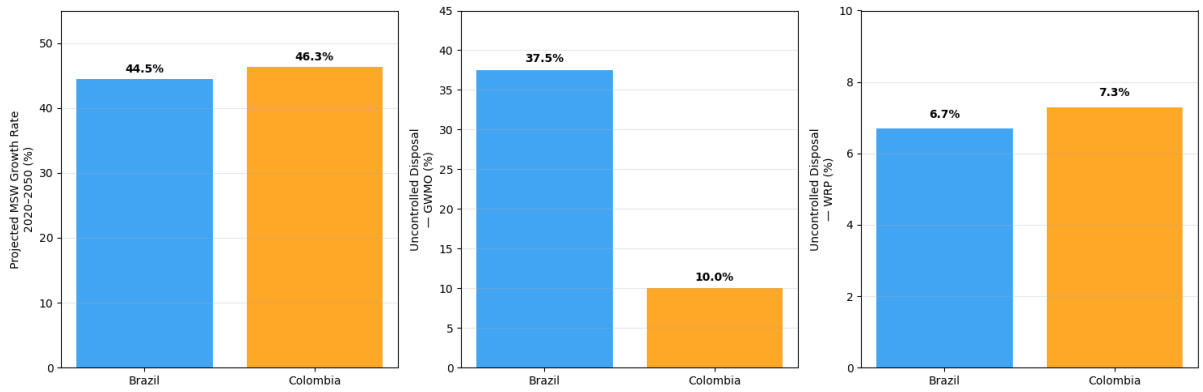
Brazil and Colombia: same trajectory but different data gaps

Brazil and Colombia share the same income classification (upper-middle income) and region (Latin America), with projected waste growth rates that are nearly identical with 44.5% for Brazil and 46.3% for Colombia over 2020–2050 (A1) (Figure 9).

Despite this similarity in growth trajectory, the two countries show a notable difference in uncontrolled disposal rates at GWMO. Brazil reports 37.5%, more than three times higher than Colombia's 10.0%. On the surface, this suggests Colombia manages a substantially larger share of its waste through controlled channels than Brazil, despite comparable growth pressures and income levels.

However, household-reported data from WRP tells a noteworthy finding. Only 6.7% of Brazilian households and 7.3% of Colombian households report disposing of waste in an uncontrolled manner with the difference less than one percentage point. This means Brazil's perception gap is roughly +30.6pp, while Colombia's is close to zero (+2.7pp). **The large gap for Brazil suggests that its uncontrolled disposal figure may include forms of disposal that households do not perceive or report as "uncontrolled," possibly due to the informal waste management system.** Colombia's near-alignment between the two sources suggests its statistics may more closely reflect household-level reality (Figure 9).

Figure 9. Comparing Brazil and Colombia on Waste Growth and Uncontrolled Disposal



Note: Uncontrolled Disposal GWMO (%) = 1 − controlled_rate (controlled = recycling + landfill + thermal)
Uncontrolled Disposal WRP (%) = the weighted share of households reporting burning (WP23343 = 1) or street dumping (WP23343 = 6) was calculated per country

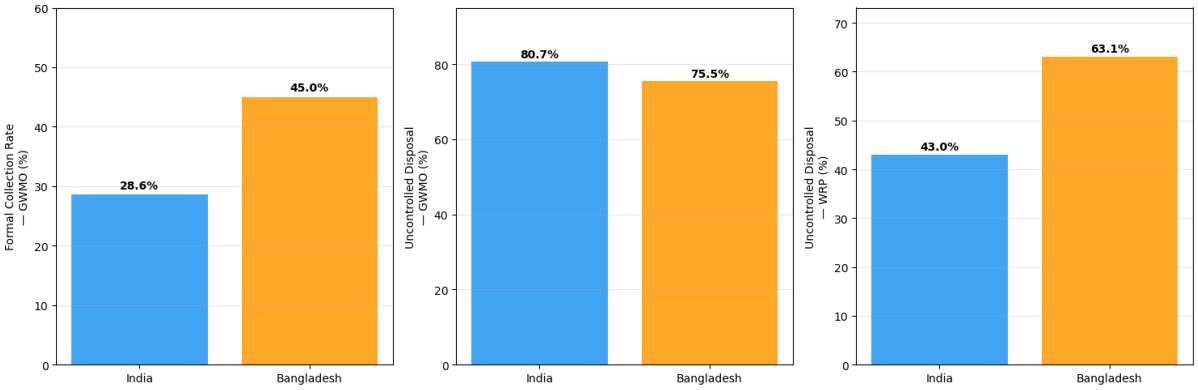
India and Bangladesh: reversed magnitude and consistent gap direction

India and Bangladesh share the same income classification (lower-middle-income) and region (South Asia). India reports a formal collection rate of just 28.6%, while Bangladesh's rate is higher at 45.0%. Also, uncontrolled disposal figures at GWMO are high for both countries with 80.7% for India and 75.5% for Bangladesh. This is consistent with the global negative correlation between collection rates and uncontrolled disposal at A2 ($\rho = -0.40$, $p < 0.0001$) (Figure 10).

Household-reported data from the WRP, however, reveals an interesting reversal in magnitude. While India's uncontrolled disposal rate (80.7%) is higher than Bangladesh's (75.5%) according to GWMO, the household-reported rate (WRP) shows the opposite ordering with 42.4 % in India and 63.1% in Bangladesh. This produces a substantial perception gap for India (+37.7pp) compared to a more modest gap for Bangladesh (+12.4pp). Although both countries show low collection coverage paired with high official uncontrolled disposal, the divergence between the uncontrolled disposal rate from GWMO

and household-reported figures suggests that India's GWMO data **may be capturing a broader definition of "uncontrolled disposal" than what households themselves recognize.**

Figure 10. Comparing India and Bangladesh on Collection Coverage and Uncontrolled Disposal



Note: Uncontrolled Disposal GWMO (%) = 1 − controlled_rate (controlled = recycling + landfill + thermal)
Uncontrolled Disposal WRP (%) = the weighted share of households reporting burning (WP23343 = 1) or street dumping (WP23343 = 6) was calculated per country

5.3 Key insights from the case studies

The case studies extend the Section 4 findings in two ways that the statistical analysis alone cannot capture.

First, they confirm that regulation does not substitute for infrastructure. The five countries in Section 5.1 span a range of regulatory approaches from explicit national bans to indirect statutory controls. However, what predicts low burning rates is not the existence of a ban but the presence of near-universal collection coverage and the enforcement of burning ban. Where households have a viable alternative and the rule is actively supported, compliance follows. Where neither condition is met, the regulation remains nominal.

Second, they show that the perception gap is a structured diagnostic. The three country pairs in Section 5.2 each illustrate a different mechanism: official data missing informal disposal entirely (Kenya), households not classifying their own disposal as uncontrolled (Ghana and Bangladesh), and administrative definitions capturing informal systems that households do not perceive as problematic (Brazil and India). Identifying which type of gap applies to a given country has direct implications for how monitoring systems should be designed and where investment in data quality should be directed.

6. Takeaways

6.1 Infrastructure is the necessary precondition — especially in rural areas

Invest in rural collection infrastructure first. No behavioral program can replace it. The evidence clearly shows where formal collection exists, uncontrolled disposal falls. Where it is absent, burning and dumping follow, regardless of income group, age, or geography. Two analyses converge on this conclusion.

A2 shows that at the country level, the collection–disposal relationship is strong and consistent, and it is sharpest in rural areas. At the household level, the effect is still significant, after controlling for income, age, and gender, urban households have 81% lower odds than rural ones of reporting uncontrolled disposal. Income compounds the gap further. For example, high-income country residents have 96% lower odds of unsafe disposal than their lower-middle-income counterparts (OR = 0.036). These are not behavioral gaps but infrastructure gaps.

The urgency is compounded by trajectory of the growth in waste generation. The countries most dependent on this investment are also the less likely to receive it in time. The countries projected to grow their waste fastest by 2050 are the same countries currently disposing of it most poor, as A1 concludes. Without targeted rural collection investment in low- and lower-middle-income countries, this dual exposure combined by worst performance and fastest growth will widen by mid-century.

6.2 Two behavioral gaps: generational norms and the awareness–action disconnect.

Two behavioral gaps persist independently of collection access and each requires a distinct intervention. Once infrastructure is controlled for, a generational norm gap for separation and an awareness–behavior disconnect remain. Neither closes as a by-product of better collection systems, and both require dedicated action.

The generational gap is consistent with norms rather than access to waste management infrastructure. A3 demonstrates respondents aged 65 and over have 36% higher odds of separating waste than those aged 30–49 and those aged 15–29 have 22% lower odds than those aged 30-49, after controlling for income, gender, urbanicity, and national recycling infrastructure. Critically, this gap is not an infrastructure gap considering that countries distribute almost evenly across all four quadrants of the infrastructure-by-gap matrix, regardless of whether their recycling coverage is above or below the median (A3). **Therefore, high-infrastructure countries exhibit the same generational divide as low-infrastructure ones. Youth-targeted behavioral interventions are therefore required in parallel with infrastructure investment.**

Environmental risk is not salient as a daily concern, and awareness alone does not drive disposal behavior. Environmental risk ranks ninth globally as a perceived daily concern, with pollution ranking nineteenth. While climate concern shows a small positive independent effect on waste separation once infrastructure and demographics are controlled (A4), **meaning more concerned respondents are slightly more likely to separate but the effect is too small to translate into meaningful behavioral change at the population level.** Communication campaigns aiming to raise environmental concern are therefore unlikely to deliver measurable outcomes on their own, regardless of how well they are designed.

6.3 What GWMO and WRP each get wrong and why it matters

The perception gap derived from GWMO and WRP data exposes a different blind spot in each data source. The divergence between waste records and household self-reports points to two distinct failures: **a household awareness deficit or a failure in official data systems.**

Households may underestimate their own uncontrolled disposal. Where GWMO records more uncontrolled disposal than households report, the gap reflects a definitional mismatch. In other words, informal dumping, open tips, and uncollected waste left outside are not perceived as "uncontrolled" by the households generating them, even when national

systems classify them as such. This is a genuine divergence in what counts as uncontrolled disposal between administrative and household frames.

Also, official data may underestimate actual disposal failures. Where households report more uncontrolled disposal than GWMO records, informal burning and dumping are falling outside administrative data collection entirely.

The countries most urgently requiring monitoring are precisely those for which no data exists. GWMO collection data is missing for 13 of the 16 low-income countries in the merged dataset. Those countries are the same countries where WRP records the highest uncontrolled disposal rates. **Triangulating administrative and survey data is the minimum condition for credible global waste monitoring.**

6.4 Regulation does not predict behavior

According to the case study analysis, especially 5.1, the existence of a national open-burning ban bears almost no relationship to whether burning occurs. The five countries analyzed show the two key takeaways on regulation and its enforcement.

Regulation succeeds only when paired with infrastructure and enforcement of the ban of open burning. Where collection coverage is near-universal and enforcement mechanisms function, a ban translates into low burning rates. Compliance is possible because households have a viable alternative and the rule is actively supported.

Regulation without infrastructure or enforcement has no measurable effect. Several countries maintain explicit national burning bans yet record some of the highest burning rates in the sample. Where households lack any collection alternative, prohibition is unenforceable in practice and the regulation remains nominal.

7. Policy Implications

7.1 Infrastructure investment in the fastest-growing, worst-performing countries

The collection–disposal relationship is strongest in rural areas, and the countries with the worst current disposal are the same countries projected to generate the most additional waste by 2050. Investment should be directed first to low- and lower-middle-income countries where rural collection coverage is lowest.

7.2 Sequence burning bans after collection coverage

Open-burning bans have no measurable effect where households lack a collection alternative. Regulation can change behavior only when collection makes compliance feasible. Governments should not treat burning bans as a standalone measure. Bans enacted without this foundation are nominal and erode regulatory credibility.

7.3 Deploy youth-targeted norm interventions parallel with infrastructure improvements

The generational separation gap survives all demographic controls and the control of infrastructure related variables. It will not close as a by-product of better collection systems. Dedicated behavior-change programs targeting the 15–29 cohort are required as a distinct intervention. Because this gap appears norm-related rather than access-driven, it can be addressed in parallel with the infrastructure improvements.

7.4 Reframe communication strategy: from awareness campaigns to norm change

Fewer than 5% of respondents globally identify environmental risks as their primary daily concern. While climate concern shows a small positive independent association with separation behavior once infrastructure and demographics are controlled for, meaning more concerned respondents are slightly more likely to separate but the effect is too small to drive meaningful behavioral change at the population level. **Campaigns premised solely on raising environmental awareness and expecting behavior change to follow are therefore unlikely to deliver measurable outcomes.** Communication investment should instead be directed at making waste separation socially visible and locally normal behavior.

7.5 Close the low-income data gap as a policy objective

Policy cannot be targeted, funded, or evaluated where the baseline is unknown. **GWMO collection data is missing for 13 of the 16 low-income countries in the merged dataset,** which are the countries where household surveys record the highest uncontrolled disposal rates. The perception gap further shows that **neither administrative nor survey data is reliable alone,** as each carries a distinct blind spot which can be compensated by the other: official systems under-counting informal disposal and households under-recognizing their own uncontrolled practices. Triangulating administrative and survey data is therefore the minimum condition for credible global waste monitoring, and strengthening national waste-data systems in low-income countries is itself an urgent and fundable intervention.

8. Reference

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