Findings

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URBAN FINDINGS

What Drives Organic Waste Diversion? A Multilevel Analysis of Residential Collection Policies

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Findings

Municipal organic waste programs play an important role in reducing landfill demand and methane emissions, but their performance varies across urban contexts. This study examines the relationship between residential waste collection policy implementation and organic waste collection in the Agglomeration of Montréal between 2012 and 2024. We use data for 33 administrative units and use multilevel models with random intercepts, predicting the total organic waste collection and capture rates, while accounting for socio-demographic characteristics and housing typologies. The results show that organic waste policies targeting single-family and small multi-unit buildings are positively associated with higher total organic waste collection and capture rates, while policies for larger multi-unit buildings show no statistically significant associations. The bi-weekly garbage collection policy is positively associated with higher rates for both outcomes. These findings highlight the importance of organic waste collection policies while suggesting that these policies are strengthened by bi-weekly garbage collection.

1. QUESTION

Municipal organic waste programs can reduce demand for landfill space while decreasing methane emissions (Bourgeois and Hughes 2017). Although many cities face similar waste challenges, waste management approaches vary across contexts (Bugge et al. 2019).

This variation is driven by a range of factors that shape waste diversion programs. In addition to the design and implementation of the programs, socio-demographic conditions, including education, household size, and age, are frequently associated with household waste generation and management practices, although the findings across contexts remain inconsistent (Ahmad et al. 2025; Srijuntrapun et al. 2025; Herzberg et al. 2020). Housing typologies and the convenience of waste sorting and disposal systems also shape participation in waste diversion practices (Lakhan 2016; MacLaren et al. 2022). This study examines the relationship between residential waste collection policy implementation and organic waste collection in the Agglomeration of Montréal between 2012 and 2024, while accounting for socio-demographic characteristics and housing typologies.

Table 1. Organic waste measures extracted (Ville de Montréal 2025)

Measure	Calculation	Methodological note
Organic waste generated	Upstream recovery + organic waste collected through municipal services + organic waste estimated to remain in household garbage	Upstream recovery is estimated by the City of Montreal at 1.7 kg per resident. Organic waste remaining in household garbage is estimated using RECYC-Quebec waste-characterizations studies.
Organic waste collected	Organic waste collected through municipal services	

2. METHODS

Waste data were obtained from the City of Montréal open data portal, from 2012 to 2024 (Ville de Montréal 2025). We retain 33 administrative units, including 19 boroughs and 14 demerged municipalities. For our analysis, we selected two waste performance metrics: organic waste generation and organic waste collection (Table 1). All data were expressed in tonnes per year for each administrative unit. From these variables, capture rates were constructed:

$$\text{Capture rate }(\%) = (\text{Organic waste collected}/\text{Organic waste generated}) * 100$$

Socio-demographic variables, including population, average household size, and educational attainment, as well as housing typologies were extracted from the Canadian Census for 2011, 2016, and 2021. Based on documented municipal implementation dates, three policy implementation variables were created: (1) implementation of organic waste collection for single-family and residential buildings with eight or fewer units (small multi-res policy); (2) implementation of organic waste collection for residential buildings with nine or more units (large multi-res policy); and (3) implementation of bi-weekly garbage collection.

For the waste performance metrics, observations from 2012 to 2014 were linked to 2011 census data, observations from 2015 to 2019 were linked to 2016 census data, and observations from 2020 to 2024 were linked to 2021 census data, reflecting the most recent census wave available at each point in time. Each of the three policy variables was coded as a binary indicator, with a value of 1 in years when the policy was in effect and 0 otherwise. The final dataset included 429 observations.

Two multilevel models were estimated, one for total residential organic waste collection, and one for residential organic capture rate, each with random intercepts for administrative units. The models were then tested for collinearity, and only variables displaying variance inflation factor values below five (VIF < 5) were retained in the final models.

3. FINDINGS

Table 2 presents the results of the multilevel models for residential organic waste collection and capture rates. The findings indicate that the implementation of organic waste collection policies for single-family and small residential multi-unit buildings presents statistically significant positive associations with higher collection totals and capture rates. Holding the other variables constant, the small multi-res policy is associated with approximately 444 additional tonnes of organic waste collected per administrative unit per year and an increase of about 4 percentage points in capture rate, relative to years in which the policy is not in effect. In contrast, the large multi-res policy does not display statistically significant associations with either collection totals or capture rates. The implementation of bi-weekly garbage collection is statistically significant and positively associated with both organic waste performance indicators, ceteris paribus. In these models, administrative units in years where bi-weekly garbage collection is in effect are associated with approximately 511 additional tonnes of organic waste collected per administrative unit per year and a 3.7 percentage point increase in capture rate, all else equal.

After controlling for policy, socio-demographic conditions, and housing typology, the models still show a clear temporal structure. Relative to 2012, the later years were generally associated with higher organic waste collection totals and higher organic capture rates, indicating that performance improved over time beyond the specific policy and contextual factors included in the models. However, the pattern is not perfectly linear, and coefficients fluctuate in magnitude between 2019 and 2021, relative to 2012.

Among the socio-demographic variables, population is positively associated with collection totals but negatively associated with capture rate. When all other factors included in the models are held constant, an increase of 1,000 residents is associated with approximately 31 additional tonnes of organics collected, alongside a slight decline of about 0.1 percentage points in capture rate.

After accounting for confounding factors, we find that administrative units with more single-detached dwellings have better capture rates. A one percentage point increase in the share of single-detached dwellings is associated with an increase of approximately 0.5 percentage points in capture rate. However, there is no statistically significant association with total organic waste collection. In contrast, a one percentage point increase in the share of apartments in buildings of five or more storeys is statistically significant and associated with approximately 33 fewer tonnes of organic waste collected but does not influence capture rates in a statistically significant way.

Table 2. Multilevel models of residential organic waste collection total (tonnes) and capture rate (%) at the administrative unit level

Variables	Collection total (tonnes)		Capture rate (%)	
	Coef	*CI*	*Coef*	*CI*
(Intercept)	-4294.28 *	-8087.95 - -500.60	27.67	-4.93 - 60.28
Policy variables				
Small multi-res policy	444.25 **	151.40 - 737.10	4.03 ***	2.13 - 5.94
Large multi-res policy	25.00	-264.84 - 314.84	-0.24	-2.14 - 1.65
Bi-weekly garbage collection	510.56 *	68.64 - 952.47	3.67 *	0.76 - 6.59
Year effects				
2013	226.43	-126.30 - 579.17	2.36 *	0.08 - 4.64
2014	295.78	-58.74 - 650.30	3.61 **	1.32 - 5.90
2015	415.77 *	46.23 - 785.31	7.22 ***	4.79 - 9.65
2016	514.72 *	103.54 - 925.90	8.08 ***	5.38 - 10.78
2017	928.75 ***	517.32 - 1340.19	11.79 ***	9.08 - 14.49
2018	1245.03 ***	831.70 - 1658.35	14.03 ***	11.31 - 16.75
2019	1513.03 ***	1099.70 - 1926.35	16.02 ***	13.30 - 18.74
2020	1840.78 ***	1402.55 - 2279.00	18.16 ***	15.17 - 21.16
2021	1518.23 ***	1064.94 - 1971.52	16.46 ***	13.36 - 19.56
2022	1360.71 ***	881.34 - 1840.09	21.79 ***	18.51 - 25.06
2023	1611.17 ***	1107.82 - 2114.51	24.86 ***	21.43 - 28.29
2024	1421.10 ***	906.94 - 1935.26	25.23 ***	21.73 - 28.73
Socio-demographic variables				
Population (per 1000)	31.05 ***	23.91 - 38.19	-0.08 *	-0.15 - -0.02
Average household size	2313.87 ***	984.45 - 3643.30	-10.03	-21.11 - 1.05
No post-secondary (%)	-65.62 **	-114.38 - -16.86	0.17	-0.21 - 0.55
Housing typology variables				
Single-detached (%)	-1.84	-22.30 - 18.61	0.46 ***	0.27 - 0.64
Apartments 5+ storeys (%)	-33.29 *	-60.83 - -5.76	-0.01	-0.23 - 0.22
ICC	0.62		0.81	
Observations	429		429	
Marginal R2 / Conditional R2	0.66 / 0.87		0.68 / 0.94	
Administrative unit intercept variance	848402.51		96.04	
Residual variance	528092.03		22.08	
Unit level random intercept (median)	-219.18		-1.45	
Unit level random intercept (range)	-1513.65 to 2524.40		-16.59 to 24.75	

Reference year is **2012**. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

The model fit statistics indicate that both the fixed effects and area-level random effects explain a substantial share of variation in the two outcomes. The marginal R^2 values show that the fixed effects explain roughly 66% of the variation in collection totals and 68% of the variation in capture rates. When the area-level random effects are included, the conditional R^2 values increase further, indicating that differences between administrative units account for an important share of variation in organic waste collection performance. It is important to note that the models showed mild heteroskedasticity and a modest linearity deviation at higher fitted values, common for skewed, nonnegative outcomes; residuals were otherwise close to normal. We kept the original model specification to preserve interpretability for municipal waste planners and policymakers.

These findings highlight the importance of both policy implementation and local conditions in shaping organic waste collection performance. Effective policies and strategies will need to account for local housing and demographic conditions and be supported by complementary measures such as bi-weekly garbage collection.

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