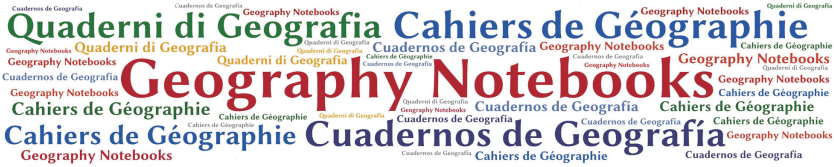

8 (2025)
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Congrès de fondation de l'AIGF (Association Internationale de Géographie Francophone)
La géographie francophone au défi du monde contemporain
Vol. 2

Dirigé par
Paolo Molinari et Luc Gwiazdzinski

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Measuring Imbalance: A Municipal Index of Urban Waste Management in the Metropolitan Area of Naples

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DOI: https://doi.org/10.7358/gn-2025-002-penp

Abstract

The article situates itself within the eco-Marxist analysis of the urban metabolism of waste, interpreting it as a material expression of the metabolic rift between society and nature under capitalism. Through the construction of the Urban Waste Management Imbalance Index (UWMII), which combines per capita residual waste and the distance from statutory recycling targets to quantify municipal-level imbalances in waste management, the study measures, at the municipal scale, territorial inequalities in the production and management of waste within the Metropolitan City of Naples. The results reveal a marked polarization between the urban core and its periphery, where marginal areas concentrate the environmental infrastructures of the urban metabolism.

Keywords: urban waste metabolism; eco-Marxism; UWMII; inverted-city; metropolitan area of Naples.

1. For an eco-Marxist reading of urban waste metabolism

The production and management of waste have accompanied the historical evolution of human societies. The transition from pre-capitalist forms of territorialization to the industrial metabolism entailed a progressive intensification in the use of materials, resources, and energy flows (Fischer-Kowalski 1998; Fischer-Kowalski and Haberl 2007), leading to an unprecedented increase in the volume of waste produced and accumulated (Melosi 1981; Wernick and Ausubel 1995). The generation of waste is an integral and constitutive function of social metabolism, historically

determined by specific modes of production and social reproduction (Marx 1974). In this sense, the issue of waste represents one of the most tangible manifestations of the metabolic imbalances that characterize the relationship between society and nature under capitalism.

In *Marxismo e geografia*, Quaini (1974) emphasizes that the ecological contradictions of capital find their most fully developed expression in the urban environment. In his reading of Marx, the modern city becomes the spatial arena where the metabolic rift manifests most acutely, through the accumulation of production and consumption residues that accompany the expansive logic of industrialization. What Quaini identifies is the qualitative transition of capitalist metabolism toward a phase in which waste becomes both a structural component of the valorization process and, simultaneously, its material limit.

From this perspective emerges the critique of the industrial city developed by Marx and Engels, which Quaini interprets as a foundational moment in the modern reflection on the relationship between urban form and the social production of space. The city, as the two authors observe, embodies the "ontological status" of bourgeois civilization (Choay 1973, 194): the locus where the "miasmas of civilization" become manifest, that is the concentration of the contradictions of progress. It is "the filth, this deprivation and corruption of man, the sewer (literally) of civilization [which] becomes the element in which he lives" (Marx 1977, 274; author's translation).

This representation anticipates the dialectic of the urban that Lefebvre would later systematize in his theory of the production of space (Lefebvre 1974): the city as a historical dispositive in which productive forces, social relations, and forms of everyday life intertwine within the contradictory process of construction and dissolution of social space. In this context, the city channels these flows within socio-natural dynamics that are overdetermined by the process of capital accumulation (Heynen, Kaika, and Swyngedouw 2005; Swyngedouw 2006).

In contemporary Wasteocene society, waste has acquired both material and discursive significance, becoming a device through which new forms of power and inequality are structured, both in relation to the "wasting relationships" it engenders (Armiero 2021) and to its centrality within emerging circuits of accumulation, particularly those associated with the green economy (Connett 2013). From this perspective, the reflection on waste as a form of power has further developed through growing attention to its role within the trajectory of capitalist urbanization and the infrastructures that sustain it (Strasser 1999; Rogers 2005). This line of

inquiry foregrounds waste as an instrument for the exercise of power and the governance of space (Liboiron and Lepawsky 2022), through which the boundaries between center and periphery are continuously redefined.

Studies at the intersection of urban processes and waste have revealed that practices of disposal and facility siting are far from neutral, responding instead to underlying logics of power and structural inequality. Research on environmental justice (Lake and Johns 1990; Heiman 1996; Pulido, Sidawi and Vos 1996) has shown the territorial and social selectivity of waste management processes, particularly concerning hazardous and industrial waste, demonstrating how the burdens of pollution and environmental externalities systematically fall upon socially marginalized communities (Pellow 2000; Mohai, Pellow, and Roberts 2009; Armiero 2021). In this sense, waste emerges not only as a product of the capitalist economy but also as a mechanism for reproducing its spatial and social hierarchies.

In contemporary contexts, waste increasingly permeates the infrastructural dimension, revealing how access to – or conversely, disconnection from – waste disposal and sewerage networks constitutes a material indicator of urban inequality. From this perspective, the relationship between the production of space and class structure appears inseparable, as the infrastructures that ensure the "cleanliness" and circulation of residues become instruments of social inclusion or exclusion.

As Millar (2018) reminds us, the labor of those who collect, recycle, and maintain "urban hygiene" lies at the center of a system of intersectional oppressions, in which the reproduction of inequalities is intertwined with the materiality of living labor and its contradictions. Waste, therefore, not only reveals the city's ecological fractures but also delineates a field of accumulation and conflict through which it becomes possible to critically interpret the political nature of urban capitalism and the forms of domination it inscribes into space.

In this scenario, the "right to the city" (Lefebvre 1968) also entails a right to metabolic functions that do not structurally reproduce old and new forms of socio-spatial inequality. This perspective extends the reflection beyond the confines of the urban, encompassing both the city's internal spatiality and its connective interstices with the outside, those zones where the metabolic relationships between the urban core and its hinterland are articulated (Barles 2009).

Building on this framework, the research advances an eco-Marxist approach to the analysis of urban waste metabolism, drawing on a conceptual model that places boundaries, understood as the delimitation of

the research problem – and flows – conceived as the ontological premises underlying conceptions of the city at its core (Guibrunet *et al*. 2017). Following this approach, it develops a methodological framework aimed at capturing territorial imbalances in the production and management of municipal waste, interpreting them as empirical manifestations that sustain and reproduce the metabolic rift.

2. From center to periphery: the inverted city in its metabolic functions

Placing these reflections within the context of Naples and its province means engaging with a territory where waste management has, for over three decades, constituted a structural node of crisis, both in its material configuration and in the stigmatizing narratives have accompanied it, where urban metabolism and social dynamics are deeply intertwined. Since the 1990s, the consolidation of a profoundly dysfunctional industrial waste metabolism, based on the systematic burial of toxic residues in the rural areas of the Neapolitan province, particularly along the border with Caserta, has starkly revealed the predatory and destructive nature of capitalism (D'Alisa *et al*. 2010), especially as a result of the processes of accumulation by contamination (D'Alisa and Demaria 2024) carried out by the criminal economy (Anselmo e Braucci 2008; Sales 2012).

To this was added the short-circuit of urban waste-cycle management. The great settlement transformation (Di Gennaro e Innamorato 2005) radically altered the living conditions and spatial organisation of the entire metropolitan agglomeration, forcing it to confront, for the first time, a pattern of territorialization misaligned with the actual carrying capacity of its primary infrastructures, beginning with water and sewerage networks.

The interplay of these factors quickly led to the saturation of landfills, paving the way for the Neapolitan waste crisis, an emblematic case of the entanglement between criminal dynamics, questionable infrastructural choices, and the parasitic use of public resources (Laino 2008), systematically absorbed into processes of capitalist accumulation. Thus began the long commissarial phase which, starting in 1994, became the politico-institutional mechanism for the extraordinary management of resources, without ever structurally addressing the organization of the waste cycle (Gribaudi 2008).

The emergency phase, which led to the construction of seven waste shredding and packaging plants and the Acerra incinerator, refunctionalized the managerial architecture of the Campanian waste cycle and spatially remetabolized its organization along specific territorial trajectories. This emergent spatial configuration had to contend with the broader system of urban functions, within which Naples has continued, through its long and well-documented historical continuity across several decades (Mautone e Sbordone 1983; Sommella e Stanzione 1992; Amato 2007; Buondonno 2009; Bencardino 2017; D'Alessandro 2018), to serve as the region's principal hub for higher-order periodic services, as well as a reference point for more continuously demanded functions across a wide area of immediate gravitation.

At the metropolitan level, one of the most densely populated areas in Europe has taken shape, with settlement patterns that, in some municipalities of the hinterland, exceed or approach 10,000 inhabitants per square kilometer. This is the case of Casavatore (11,895), Portici (11,151), and San Giorgio a Cremano (10,169), followed by Melito (9,481), which even surpasses the city of Naples itself (7,629). Such density does not correspond to a balanced territorial system; rather, it reveals a morphological saturation not matched by an equivalent functional intensity.

This fragmentation is reflected, first and foremost, in the absence of widespread centralities: although a clear tendency toward overcoming Neapolitan monocentrism has emerged (Amato 2007), most municipalities along the metropolitan margins have not developed genuine functional autonomy. In contrast to the functional deficiencies, the metabolic functions associated with the management of the urban waste cycle are concentrated precisely in these peripheral zones. The combination of high settlement density and the clustering of such functions produce an effect of selective hyper-functionalization in certain territories, which are assigned strategic tasks for the functioning of the entire metropolitan area. Within the metropolitan region, clear zones can be identified, stretching from the northern margins of Naples through the Agro Aversano and into the Caserta-Nola corridor, where the most critical, and in many respects least desirable, functions of the urban waste metabolism are concentrated.

Here are located the strategic facilities: the waste-to-energy incinerator in Acerra; the Mechanical-Biological Treatment (MBT) plants in Giugliano, Caivano, and Tufino; and the aerobic/anaerobic digestion plants in Giugliano and Caivano (*Fig. 1*). These facilities are situated within or adjacent to the industrial development areas, where they often

coexist with other types of plants dedicated to the management of special waste, as in the industrial zones of Giugliano-Qualiano, Caivano, and Acerra.

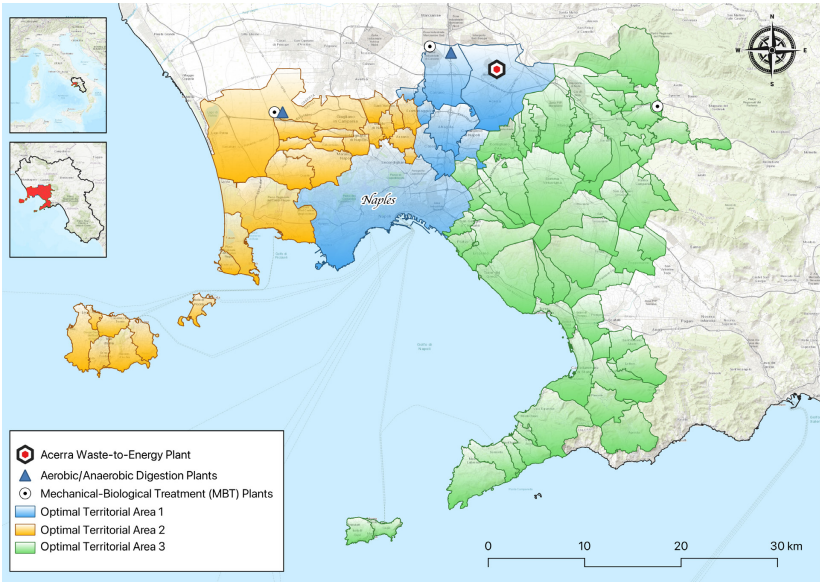

Figure 1. – Distribution of waste facilities in the metropolitan area by OTA (Optimal Territorial Areas).
Source: cartographic elaboration by the author.

These are support functions that, beyond embodying the materiality of the everyday flows sustaining metropolitan life, also acquire symbolic significance. In this sense, the periphery not only coincides with its representation as a subordinate space relative to the center but inverts that meaning: it is precisely here that the centralization of the metropolitan metabolic process occurs. Territorial marginality thus becomes, paradoxically, an essential fulcrum of urban metabolism, revealing that the symbolic and political center of the city rests upon the material centrality of its peripheries. Treatment plants and storage sites located near agricultural areas have produced a completely asymmetrical model of ecological cost distribution (Bullard 1983; Atlas 2002).

3. Convergences and differences in waste management: the OTA in the metropolitan area of Naples

The division of the province of Naples into three Optimal Territorial Areas (OTA, *Ambiti Territoriali Ottimali*) for the management of municipal waste represents the outcome of an institutional reorganization process initiated by the Campania Region with Regional Law No. 14 of May 26, 2016 (*Fig. 1*, *Tab. 1*). This reform marked the end of the centralized, commissioner-led management that had characterized the emergency phases of the waste cycle.

OTA Naples 1 includes the provincial capital and the continuous urban fabric formed by the eight municipalities extending toward the north-east, with a total population of 1,237,037. OTA Naples 2 encompasses the coastal belt to the west of the capital and the intermediate area to the northwest. It includes 24 municipalities with a total population of 689,661 inhabitants, nearly 20 percent of whom reside in the municipality of Giugliano in Campania alone. OTA Naples 3 covers the Vesuvian-Nolan area extending to the Sorrento coast, with a population of 1,041,117. Collectively, the three Neapolitan areas account for approximately 53 percent of the Campanian population, thus reflecting an operational rationale aimed at disaggregating the managerial burden and aligning planning.

Based on data from the ISPRA dataset (2025), the most recent available figures referring to the year 2023 show that OTA Naples 1 generated a total of 655,587 tonnes of municipal waste, confirming its position as the area under the highest absolute pressure in the entire province and representing a significant segment of Campania's urban waste metabolism.

The area recorded an average per capita production of 530 kg/year, slightly above the regional average. At the aggregate level, separate collection reached an average rate of 43.26%, with marked disparities among municipalities: performance ranged from virtuous cases such as Acerra (70.28%) and Cardito (64.54%), to the more critical data of Naples (41.91%), whose large demographic and urban weight heavily influences the overall average. This divergence reveals a structural tension running across the entire area-namely, the polarization between the provincial capital, characterized by high functional density but limited selective collection capacity, and the surrounding urban belt, which performs relatively better.

Table 1. – Municipal waste indicators for the three OTAs of the Metropolitan City of Naples (2023). Source: author's elaboration on ISPRA and ISTAT data.

OTA	Population	Number of municipalities	Total waste produced (t)	P.C. waste (kg/year)	Differentiated waste (t)	Residual waste (t)	Separate collection (%)
Na 1	1,237,037	9	655,587	530	283,544	371,993	43.26
Na 2	689,583	24	333,845	484	180,780	152,903	54.20
Na 3	1,041,116	59	484,862	466	293,767	190,399	60.73

The total amount of residual (non-separated) waste produced was 371,993 tonnes, corresponding to 301 kg/year per capita among residents who do not sort waste, an indicator of the structural weight of the residual fraction within the urban metabolism. By contrast, per capita production of separately collected waste reached 229 kg/year, with higher levels in municipalities with more mature integrated management systems and a negative gap for Naples, where the value stood at approximately 235 kg/year.

In 2023, OTA Naples 2 recorded a total production of 333,845 tonnes of municipal waste. Significant inequalities among municipalities persist: per capita waste generation ranges from below 400 kg/year (Calvizzano, Marano di Napoli) to over 600 kg/year in municipalities with high tourist intensity or low management efficiency (Ischia, Lacco Ameno, Serrara Fontana, Procida).

The separate collection rate in 2023 reached 54.20%, showing an increase compared to the previous year, though with highly uneven patterns: values range from 90.71% in Bacoli to below 40% in densely populated centers such as Melito (18.03%), Casamicciola Terme (32.58%), Serrara Fontana (37.42%) and Arzano (38.31%). In per capita terms, separately collected waste averaged 262 kg/year, slightly higher than in OTA Naples 1 but still far from the national strategic targets. The total amount of residual (non-separated) waste reached 152,903 tonnes, corresponding to an average of 222 kg/year.

With regard to the urban metabolism of the second-ring area corresponding to OTA Naples 3, total municipal waste production amounted to 484,862 tonnes. The average per capita generation reached 466 kg/year, a value slightly higher than the regional average.

The average separate collection rate achieved 60.73%, showing improvement over the previous year and standing well above the regional mean. Many municipalities display notable performances: sixteen municipalities exceed 75%, with some approaching or surpassing European standards, including Cimitile (95.07%), Massa di Somma (90.98%), Ottaviano (90.57%), and Visciano (87.77%). This generally highlights the overall performance of OTA 3 compared to other municipalities.

However, these results coexist with critical performances in several urban centers, such as the historical poles of Torre del Greco (26.02%), Ercolano (43.97%), and Castellammare di Stabia (45.98%), illustrating a variable-geometry metabolism within the same territorial ambit.

Despite these advances, residual (non-separated) waste still represents a considerable share, corresponding to 190,399 tonnes, with an average

per capita production of 183 kg/year. As in the other OTAs, this figure highlights the persistence of a substantial fraction of material processed in MBT plants and destined for incineration.

4. Measuring imbalance: the UWMII for the structural assessment of municipal-level urban waste management

The development of a Urban Waste Management Imbalance Index (UWMII), calculated at the municipal scale and based on parameters such as per capita residual waste (kg/year) and deviation from the statutory target for separate collection (percentage points), makes it possible to structurally assess the performance of urban waste management.

The index does not merely measure a municipality's efficiency in separating or intercepting recyclable materials; rather, it captures the tendential capacity of a territory to close material cycles within its own boundaries, thereby preventing waste from being diverted toward the Acerra incinerator or exported outside the region. In this sense, the most critical municipalities, characterized by high per capita residual waste and low or stagnant rates of separate collection, represent the areas where dysfunctions manifest most clearly, as the social production of waste systematically exceeds the territory's capacity for material interception.

Conversely, the most virtuous municipalities demonstrate that it is possible to contain residual fractions; yet even in these cases, the index reveals that meeting quantitative targets is not sufficient. The challenges of ensuring the quality of waste separation, regenerating materials, and overcoming structural dependence on large-scale facilities and extra-regional markets remain unresolved. Above all, the index underscores the enduring issue of the social relations underpinning material recovery and energy production, which continue to be constrained by the centralized logic of high-capacity waste management infrastructures.

4.1. *Methodology*

The database is composed of municipal-level data published by ISPRA and ARPA Campania for the reference period. In this analysis, the 2014-2023 historical series was considered, from which the following variables were derived: resident population, total municipal waste generation,

quantity and percentage of separate collection, and per capita indicators expressed in kilograms per inhabitant per year. From these data, two fundamental parameters were constructed: (1) per capita residual waste, calculated as the difference between total municipal waste per capita and separately collected waste per capita; (2) inverse separate collection rate, obtained by subtracting the % of recycling rate (RR) from 100, thereby directly measuring each municipality's deviation from the statutory target of 65%.

To enable comparability across municipalities, each indicator was normalized on a 0–1 scale, thus minimizing distortions due to extreme outliers. The per capita residual waste values were then compared to the threshold of 75 kg/inhabitant, adopted by Legambiente (2025) to identify the so-called *Rifiuti Free* (Waste-Free) municipalities.

$$S_{res} = \frac{Residual_{pc} - 75}{Residual_{pc,max} - 75}$$

The inverse separate collection rate was instead compared to a threshold value of 35%, corresponding to the gap from the statutory target of 65%:

$$S_{RRdiff} = \frac{(100 - RR\%) - 35}{(100 - RR\%)_{max} - 35}$$

In the equation, max refers to the maximum value observed within the historical series. All values were normalized on a 0–1 scale. The normalized values were then rescaled to a 0–100 range, where 0 indicates a virtuous condition and 100 represents a state of maximum criticality.

Based on these two fundamental variables, the Annual Waste Management Imbalance Index (ISGRU) was constructed. This index provides a snapshot of each municipality's level of criticality in a given year, derived from the two core parameters. It is calculated as the geometric mean of the two standardized values, ensuring a balanced contribution of both components. The UWMII thus offers a synthetic yet intuitive measure of the imbalance in municipal waste management, enabling the observation of temporal trends and the computation of diachronic variations over the study period.

$$\text{UWMII} = \sqrt{S_{res} + S_{RRdiff}}\, x\, 100$$

4.2. *Application to the case study and results*

Between 2014 and 2023, the trend of the Urban Waste Management Imbalance Index (UWMII) accurately captures the progressive reorganization of the urban waste metabolism within the metropolitan area of Naples, marked by generalized improvements yet unevenly distributed across the territory (*Fig. 2*).

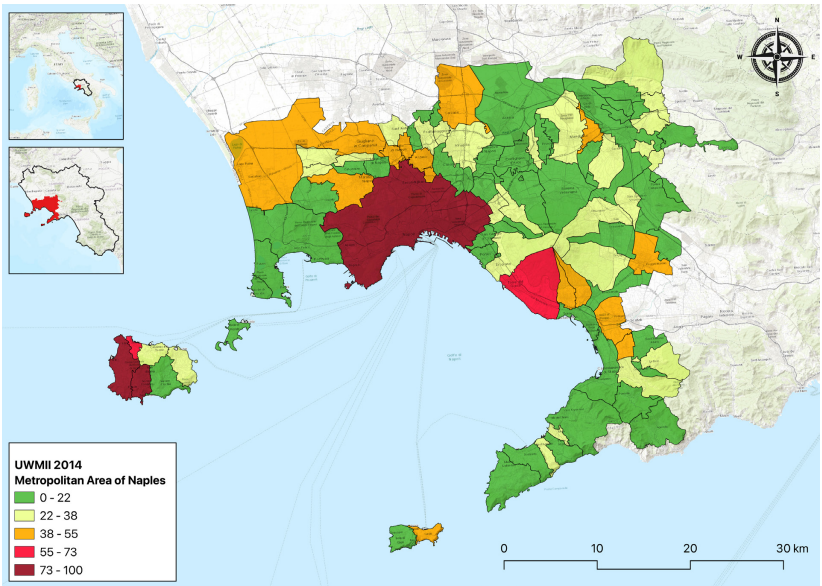

Figure 2. – Spatial distribution of the UWMII (2014) in the metropolitan area of Naples at the municipal scale. Source: cartographic elaboration by the author on ISPRA data.

The overall tendency is positive: most municipalities show improvement, although situations of stagnation or regression persist, particularly in areas subject to high demographic or touristic pressure. The most positive results are concentrated in the eastern and southeastern sectors of the province, especially within OTA Naples 3, where a structural consolidation of waste management systems is observable. Municipalities such as Nola, Marigliano, Scisciano, Saviano, San Vitaliano, Somma Vesuviana, Poggiomarino, and Ottaviano display a consistent improvement trend throughout the entire observation period. This suggests that the group of municipalities belonging to OTA 3 has benefited from a scale effect,

where coordinated management and infrastructural integration have yielded cumulative benefits (*Fig. 3*).

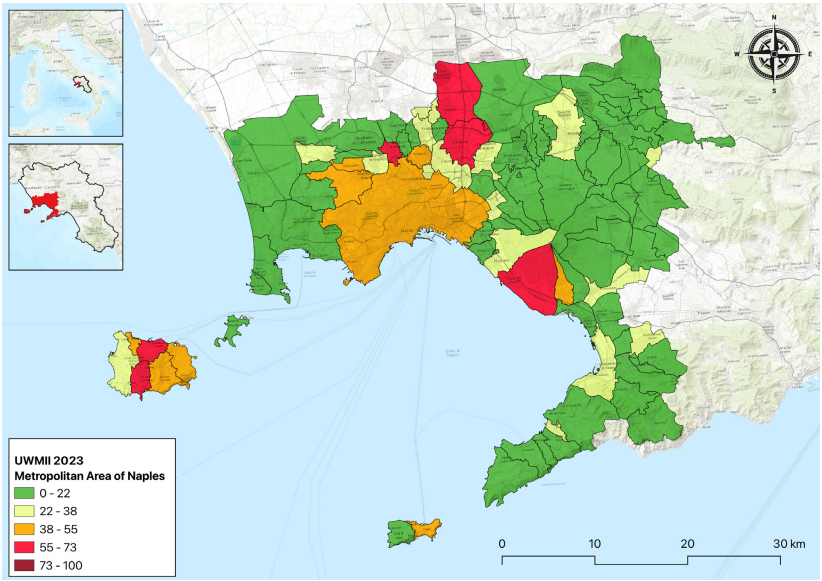

Figure 3. – Spatial distribution of the UWMII (2023) in the metropolitan area of Naples at the municipal scale. Source: cartographic elaboration by the author on ISPRA data.

This positive trajectory is further reinforced by the improvement of the Stabiae area and part of the Sorrento Peninsula, where municipalities such as Castellammare di Stabia, Gragnano, and Sant'Antonio Abate have recorded a significant reduction in the index. Here, the combination of local environmental policies, inter-municipal cooperation, and the gradual expansion of advanced separate collection systems has fostered a more efficient and resilient management model.

A substantial group of municipalities, however, exhibits relatively stable index values. This is particularly the case in the Phlegraean area (Pozzuoli, Bacoli, Quarto) and in several peri-urban municipalities of the mid-Vesuvian belt, where the improvements achieved during the first half of the decade have since stabilized without further significant variation. In these contexts, waste management has reached a level of efficiency sufficient to maintain equilibrium, yet the system appears to have approached an organizational saturation threshold, beyond which

additional progress would require qualitative, rather than quantitative, transformations.

In contrast, some areas show a worsening trend, attributable to two distinct functional typologies. The first includes the islands of the Gulf of Naples, particularly the municipalities of Ischia, Forio, and Casamicciola Terme, whose dynamics are heavily influenced by tourism-related fluctuations, but also by a marked degree of administrative fragmentation (Galluccio, Guadagno, e Mingo 2024). These are contexts characterized by seasonal metabolisms, subject to drastic variations in waste flows between peak and off-peak periods. In these cases, the index indicates a structural deterioration in some municipalities, suggesting persistent management inefficiencies linked to the volatility of tourist pressure and infrastructural limitations.

The second typology concerns high-density urban areas, such as Melito, Afragola, and Caivano. Despite recent investments, the growth in separate collection has not been sufficient to offset the total increase in waste generation. It is particularly noteworthy that among the six municipalities with the highest index values in 2023 namely Melito (70.42), Casamicciola Terme (60.70), Torre del Greco (60.71), Afragola (57.72), Serrara Fontana (57.57), and Caivano (55.69), all – except Serrara Fontana – have worsened compared to their 2014 levels. Within this framework, Naples, while still maintaining a relatively high index value in 2023 (47.75), has achieved a significant improvement relative to 2014 (73.40).

An analysis by OTA reinforces the scale-dependent dimension of the phenomenon. OTA Naples 3 emerges as the most efficient, with nearly all municipalities showing improvement. Here, economies of scale and consortial management have fostered an integrated territorial model. OTA Naples 2 presents a more heterogeneous trend: in some cases, significant progress is observed, such as in Giugliano and Sant'Anastasia, while in others, there are notable deteriorations, as in Casamicciola Terme, Melito, and Villaricca. On the islands of Capri and Ischia, the system appears under strain, highlighting how logistical fragmentation and seasonality remain decisive variables. Finally, OTA Naples 1 continues to exhibit the most pronounced criticalities. While the city of Naples shows improvement, the northern conurbation still suffers from sharp internal discontinuities, stemming from its urban and social complexity. Beyond Caivano and Afragola, the municipalities of Casoria and Crispano have also experienced significant deterioration, underscoring the structural persistence of waste management imbalances in the metropolitan core.

5. Conclusions

This study, predominantly quantitative in nature, forms part of a broader research project that integrates the statistical analysis presented here with a qualitative investigation aimed at exploring in depth the positions of the various actors and the dynamics that involve them within the urban waste metabolism.

The ability to identify, at the municipal scale, the structural imbalances of the waste metabolism make it possible to support regional and local administrations in defining intervention priorities, allocating resources, and monitoring compliance with statutory targets. The spatially explicit nature of the UWMII renders it a useful tool for OTA planning, for assessing the territorial distribution of metabolic functions, and for informing decisions regarding the siting or upgrading of waste facilities. In this sense, the index could contribute not only to interpreting the post-crisis configuration of the waste cycle but also to outlining governance strategies that are more equitable and attuned to territorial specificities, such as pay-as-you-throw strategies (Reichenbach 2008; Di Matteo and Guadagno 2024).

The UWMII provides a coherent and structurally grounded measure of imbalances in urban waste management, and its application in relation to socio-economic variables in future research could help uncover more fine-grained dynamics beyond aggregate municipal performance. A systematic integration of the index with other factors such as income, education, and infrastructure represents a natural step forward for subsequent investigations, strengthening its potential as a tool to support territorial planning and governance policies concerning the urban waste metabolism.

In the case of Naples, the trajectory of waste management in its metropolitan area extends beyond a mere sequence of emergencies, special commissions, and administrative failures. It constitutes an emblematic laboratory in which the structural contradictions of contemporary urban capitalism are reflected. The analysis reveals a complex territorial landscape marked by differentiated criticalities and uneven trajectories of recomposition, stagnation, and, in certain contexts, regression. Overall, the index shows better performance in the case of OTA Naples 3, suggesting a more effective approach that, when considered within the entire Neapolitan planning context, can contribute to improving performance at the metropolitan scale.

However, the situation highlighted by the UWMII – conceived as a tool to concretely measure progress toward a more recycling-oriented

waste management system – also reveals a deeper significance. The so-called "urban waste crisis" of Naples can now be considered overcome, yet this resolution has resulted in choices that have produced a form of selective hyper-functionalization of certain territories. These areas currently host the facilities that sustain the urban waste metabolism of the entire metropolitan region, but they also coincide with the very places that, over the past three decades, have concentrated the environmental externalities of capital accumulation cycles; territories that, not coincidentally, largely fall under the *mot-valise Terra dei Fuochi* (Pennacchio 2024).

It is precisely within this divide that the reflection proposed by this research is situated: the post-crisis "normalization" has reconfigured, along the margins, the elements that produced it, thus generating a new configuration of the problem.

In this sense, any technical interpretative tool, including the UWMII, may serve as a useful but ultimately insufficient support for addressing the complexity of urban waste governance. Each territory must be examined in relation to the specific socio-natural factors that shape it. The issue, in fact, exceeds the boundaries of technical-administrative measurement and pierces the rhetorical veil of the just transition, in which processes of material recovery and valorisation remain embedded within the contradictions of capitalism, its new frontiers of accumulation, and the socio-ecological externalisations it continues to generate. Accordingly, any prospect of metabolic rebalancing cannot disregard a critical reflection on the material and political conditions that enable or hinder a transition that is equitable, democratic, and territorially situated.

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How to cite this paper:
Pennacchio, P. 2025. "Measuring Imbalance: A Municipal Index of Urban Waste Management in the Metropolitan Area of Naples". *Geography Notebooks / Quaderni di Geografia / Cahiers de Géographie / Cuadernos de Geografía* 8 (2): 103-121. https://doi.org/10.7358/gn-2025-002-penp