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The Production of Space in the Informal Waste Economy.
Waste Picking in the Tondo Manila Bay Area

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Abstract
This study explores the dynamics of the informal waste economy in an informal settlement in Tondo, Manila, highlighting its role in shaping urban form. While waste pickers significantly contribute to solid waste management (SWM) through the recovery, recycling, and diversion of waste, they are constantly exposed to harmful environments and substandard living conditions that remain unaddressed by formal systems and urban planning. Additionally, their impact on urban form is frequently sidelined, despite operating within SWM – an urban system that is inherently spatial. To examine the spatial outcomes of informal waste sector (IWS) activities, the research examines the historical and geographic context of the Vitas Temporary Housing Facility in Tondo, the agency and networks of its waste pickers, and the spatial outcomes of their activities. Findings reveal that the waste picking community functions as an agglomerated informal economy operating as an informal materials recovery facility (MRF), with decentralized waste management activities integrated into residential and commercial spaces. This integration creates a unique urban landscape that highlights the need for sustainable, inclusive, and adaptive SWM solutions and urban planning strategies that consider the agency of waste pickers, the distribution of informal SWM functions within their networks, and the spatial organization of the urban environment they co-create within their communities.

Keywords: waste picking, solid waste management, informal economy, urban morphology

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Introduction

The role of waste picking by the informal sector in solid waste management (SWM) is well-documented, acknowledging both its positive impacts and its negative outcomes. Waste pickers contribute significantly to SWM by diverting waste from landfills, providing raw materials for recycling, and supporting livelihoods in the informal waste economy (Hartmann, 2012; Ezeah, Fazakerley and Roberts, 2013; Gutberlet *et al.*, 2017a; Sandhu, Burton and Dedekorkut-Howes, 2017; Landsberger, 2019; Harfadli *et al.*, 2024a). Conversely, waste pickers are exposed to occupational risks and social stigmatization that negatively affect their health and well-being (Hartmann, 2012; Cruvinel et al., 2019; Zolnikov et al., 2021a; Harfadli et al., 2024b).

Informal waste recovery and recycling practices are commonly associated with the emergence of informal settlements on the peripheries of waste disposal sites. Waste pickers, often operating in precarious conditions, create a network of waste flows that intersect with urban spaces and affect urban form. However, dumpsite informal settlements, shaped by the spatial necessities of waste picking and the economies that emerge around them, are typically overlooked in urban planning and are underexplored in informal waste sector (IWS) studies. The main themes that frequently emerge in the existing literature highlight the occupational hazards faced by waste pickers, the social stigma and exclusion they experience, and the regulatory challenges of integrating them into formal SWM (Harfadli et al., 2024b). While these factors are crucial for understanding the IWS, they do not address how their activities impact the urban environment. IWS practices, specifically the interactions between waste pickers, waste materials, and waste management, have very spatial consequences. They affect land use patterns, spatial organization, and the equitable distribution of urban spaces. Informal settlements significantly influence the physical layout of city peripheries, reflecting the stark socio-economic disparities characteristic of many cities in the Global South. Considering the spatial outcomes of intersections between formal and informal SWM practices can provide a more comprehensive view of urban development that can inform inclusive and sustainable planning strategies, specifically, one that recognizes and integrates the contributions of the IWS in the distribution of urban space.

This study aims to shed light on these dynamics by examining the interfaces between waste pickers, discarded objects, and the urban environment in an informal settlement along the coast of Tondo, Manila in the Philippines known as the Vitas Temporary Housing Facility. Using 'Smokey Mountain,' Metro Manila's historical dumpsite in the Tondo Manila Bay Area, as a focal point, the study scrutinizes IWS practices and evaluates how these activities influence the development and organization of peripheral urban spaces by analysing three (3) major themes: historical and geographic context, informal agency and networks, and informal urban space. While SWM involves a wide network of actors, including government agencies, the private sector, non-government organizations (NGOs), and community-based organizations (CBOs), this study focuses primarily on the waste pickers themselves – the individuals at the bottom of the SWM hierarchy – and how they interact with waste and their surroundings. By narrowing the focus on this sector, this study aims to highlight the agency of marginalized groups in co-creating urban space. This perspective emphasizes the significance of IWS activities in shaping urban environments – critical urban morphological processes involving the city's waste and its (mis)management. Understanding the broader implications of the

interfaces within informal waste management systems in urban form is crucial in developing countries facing complex challenges with waste.

Background of the Study

The legislative framework for SWM in the Philippines is defined by Republic Act (RA) 9003, known as the 'Ecological Solid Waste Management Act of 2000.' This law promotes a hierarchy in waste management, prioritizing the reduction, reuse, and recycling of waste before resorting to recovery, treatment, and safe disposal. Its key provisions include the segregation of waste at the source, proper methods for the collection and transport of segregated waste, and the establishment of Materials Recovery Facilities (MRFs) in every community or *barangay* (Congress of the Philippines, 2000). While RA 9003 sets forth commendable goals for sustainable municipal SWM, its effectiveness is impeded by weak implementation, resulting in continued environmental and public health challenges (Ryan and Galarpe, 2017; Camarillo and Bellotindos, 2021; Coracero et al., 2021).

These issues were highlighted as contributors to the "garbage crisis" faced by Metro Manila since the early 1990s, documented in "The Garbage Book," a situational report printed by the Asian Development Bank (ADB) for the Department of Environment and Natural Resources (DENR) nearly two decades ago in 2004 (Asian Development Bank, 2004). This publication provided a synthesis of Metro Manila's struggles with waste and offered recommendations to address the predicted catastrophic scenarios in the city's SWM systems. Also mentioned in this publication, and the accompanying technical report on waste disposal, were the estimated 4,300 informal waste pickers and the 150,000 residents living in perilous conditions on the periphery of dumpsites (AEA Technology, 2003; Asian Development Bank, 2004).

While it detailed recommendations aimed at mitigating public health and environmental risks, waste picking practices still largely persist on the margins of Metro Manila's waste disposal systems. This persistence and its associated socio-environmental challenges reflect the city's ongoing struggle to implement effective SWM solutions, echoed in the historical narrative of the Tondo Manila Bay Area. Despite the closure of the Smokey Mountain dumpsite in Tondo over three decades ago, its legacy continues in the area's urban form, demonstrating the enduring impact of the intersections between formal SWM and IWS practices on the social and physical urban landscape. Tondo's coast, still deeply entrenched in the informal waste economy, reveals how waste disposal and IWS activities are embedded in the urban fabric.

Research Problem and Objectives

The IWS plays a critical role in shaping urban peripheries. By examining the intersections between waste pickers, waste materials, and waste networks, this study aims to reveal how informal economic activities in SWM impact urban space, contributing to the formation and transformation of unique urban landscapes and architecture along the city's margins. Additionally, it seeks to highlight the agency of waste pickers to offer insights into the spatial outcomes of their activities.

The IWS is a vital component of SWM in Metro Manila. The interactions between waste pickers and waste in the Tondo Manila Bay Area, along with the economy that revolves

around these activities, have significantly shaped the urban morphology of Tondo despite the closure of Smokey Mountain and continuous infrastructure development along the bay's arterial road. However, the spatial dynamics of these marginal spaces remain underexplored, resulting in a limited understanding of how informal waste management activities shape urban spaces and their peripheries. This study seeks to address the gap by investigating how IWS practices in an informal settlement in the Tondo Manila Bay Area contribute to urban form. Specifically, it:

1. Situates the informal settlement within its historical and geographic context.
2. Examines the agency of waste pickers and their relationships and interactions within IWS networks; and
3. Evaluates the significance of space in the interfaces within informal waste management.

First, this study discusses the historical roots and geographic characteristics of the Vitas Temporary Housing Facility to lay the foundation for examining the persistence and perpetuation of the informal waste economy in the Tondo Manila Bay Area. Second, it explores the role of waste pickers in influencing the spatial organization of dumpsite peripheries by examining their interactions with waste and urban space. Next, it investigates the networks within the informal waste economy – connections between waste pickers, waste sources, and informal waste infrastructure – to understand how these interactions create and transform urban spaces. Lastly, it examines the implications of these dynamic relationships and their spatial outcomes for urban planning and development. This approach highlights the importance of the contextual and spatial realities shaped by IWS practices in facilitating more effective, inclusive, and sustainable strategies for SWM.

Review of Related Literature

This literature review provides an overview of existing research on informal waste management practices, particularly focusing on the socio-spatial dynamics of IWS activities. To frame the study within this context, these themes are explored: the role of the IWS in SWM, their agency and networks within the informal waste economy, and the spatial implications of their activities on urban peripheries.

The IWS plays a vital role in SWM systems in developing countries, contributing significantly to recycling efforts and the reduction of landfill waste (Burcea, 2015; Gutberlet et al., 2017b; Yang, Ma, Julian R. Thompson, et al., 2018; Landsberger, 2019; Tong, Huynh and Khong, 2021; Harfadli et al., 2024b; Nesheim et al., 2024; Pottinger-Glass et al., 2024). It also provides a myriad of economic opportunities for the urban poor (Choudhary, 2003; Nzeadibe, 2009; Hartmann, 2018). However, waste picking is a precarious occupation and waste pickers are frequently subject to occupational hazards and health risks, without safety and protective measures and access to social services (Dias, 2016; Zolnikov et al., 2021b). IWS activities have detrimental effects on the environment as well. Informal waste recycling practices, such as inadequate handling of hazardous materials like electronic waste, lead to severe environmental contamination and health risks for the workers involved (Yang, Ma, Julian R. Thompson, et al., 2018; Hoang et al., 2023). Recommendations to address these issues frequently identify IWS integration, community participation, and infrastructure development.

Waste pickers often face legal and social marginalization, operating without formal recognition, protection, or support from the government (Hartmann, 2012; Burcea, 2015; Dias, 2016; Landsberger, 2019; Tong, Huynh and Khong, 2021). In acknowledging their significant contributions to formal systems of SWM, the body of scholarly literature calls for policy development that officially recognizes and integrates waste pickers into municipal SWM frameworks, to ensure they receive appropriate health, social, and economic benefits, improve their livelihoods, and promote better environmental management (Sasaki et al., 2014; Sandhu, Burton and Dedekorkut-Howes, 2017; Yang, Ma, Julian R. Thompson, et al., 2018; Tong, Huynh and Khong, 2021; Zolnikov et al., 2021b; Nesheim et al., 2024). In addition, there are many advocates for meaningful participatory processes and stakeholder engagement in facilitating SWM policy formulation and its effective implementation (Hartmann, 2012; Burcea, 2015; Nesheim et al., 2024).

Cultural norms and existing informal practices significantly impact the development and effectiveness of formal policy (da Silva, Weins and Potinkara, 2019). Interventions that involve privatization can result in inequalities and further marginalization of vulnerable groups in the waste economy by inhibiting access to waste resources and displacing communities (Hartmann, 2012; Burcea, 2015; Sandhu, Burton and Dedekorkut-Howes, 2017; Landsberger, 2019; Schindler, Demaria and Pandit, 2019). Moreover, formal employment structures conflict with the preferred flexibility allowed by informal employment (Landsberger, 2019). Waste pickers often engage in waste collection not only out of necessity but also for the autonomy it provides (Wu and Zhang, 2019). Contrary to the perception of the IWS as passive participants in SWM, waste pickers have agency and actively make decisions that affect waste recovery (Wong, 2022). Their practices are further reinforced by social networks, mutual support systems, and shared identity among waste pickers, affecting their day-to-day lives and resilience (Wu and Zhang, 2019). These mechanisms contribute to the social capital of IWS workers, enhancing the functionality of informal waste management systems (Nesheim et al., 2024).

Policy development for infrastructure that addresses poor working environments and strengthens municipal SWM is also frequently recommended. Infrastructure that prioritizes the integration of safer workspaces with efficient waste management systems can result in more effective SWM practices. These recommendations include the development of infrastructure that supports waste segregation and facilitates the collection and selling of recyclables by waste pickers (Dias, 2016), and health and safety measures for safer working conditions and environments (Burcea, 2015; Wu and Zhang, 2019; Zolnikov et al., 2021b; Harfadli et al., 2024b). In addition to this, modern and more efficient recycling technologies and infrastructure that can reduce environmental impact and streamline recycling processes, while improving working conditions, are also highlighted (Yang, Ma, Julian R Thompson, et al., 2018; Tong, Huynh and Khong, 2021; Hoang et al., 2023; Pottinger-Glass et al., 2024).

The central issues of waste – its mobilities and material transformations – are inherently spatial and geographic (Davies, 2012). However, the impact of IWS practices on urban space is often sidelined and viewed merely as a background or setting. The spatial organization of dumpsites provides the context and functional base of the informal waste economy (Rankokwane and Gwebu, 2006). These sites are not only essential for the disposal of waste but also serve as significant nodes within waste flows and economic networks. Furthermore, the spaces occupied by itinerant waste pickers along

these chains and their other spatial needs must also be considered (Charlton, 2014). While waste disposal sites and IWS workspaces are essential urban spaces and central to SWM and the informal waste economy, there is a notable lack of research into the socio-spatial qualities of this urban landscape and its peripheries. The complex relationships between waste picking and urban form – how they shape and are shaped by urban environments – have yet to be comprehensively investigated. This perspective shifts the focus from merely integrating waste pickers into formal systems to understanding how their practices and spaces impact the urban environment.
There are numerous studies on the roles and contributions of the IWS in SWM. The current literature acknowledges its dual nature: it significantly contributes to recovery, recycling, and diversion of waste, while also posing health risks, occupational hazards, and social stigmatization to waste pickers. Recommendations in the literature often focus on policy development, particularly the integration of the IWS into formal SWM systems, the application of waste infrastructure that improves working conditions, creates safer working environments, and facilitates more efficient recycling practices, and participatory planning and decision-making processes. While these strategies are crucial for implementing effective and sustainable SWM strategies, there is a need to incorporate the socio-spatial aspects of the IWS, as activities in waste streams, waste access, and informal waste economies are highly spatial phenomena. This study explored these dynamics by examining how marginal urban spaces are shaped by the agency of waste pickers and their interactions with waste as valuable resources to be recovered.

Methodology

To provide an understanding of the influence of the IWS on the urban environment, this study employed a qualitative approach that aimed to capture the experiences of waste pickers and the spatial implications of their interactions with waste. The research analysed the Tondo Manila Bay Area as a case study, utilizing interviews, field observations, secondary data, remote sensing and street-level imagery to gather comprehensive data. It focused on the main arterial road, Radial Road 10 (R-10), and the Vitas Temporary Housing Facility. This property, situated near the former dumpsite, Smokey Mountain, and occupied by different functional zones – port, temporary dumpsite, and temporary housing facility – has a long history in the informal waste economy and serves as a critical point for understanding the spatial dynamics of the IWS. It includes a mix of densely packed residential structures, makeshift sorting and recycling areas, and pathways used to facilitate the flow of waste and recyclable materials. Waste picking, in this community, is central to the local economy.
IWS activities and the spaces where they occur along R-10 and the Vitas Temporary Housing Facility were investigated through semi-structured and unstructured interviews with waste pickers and direct observation during periodic field visits from 2013 to 2020 (Image 1). Interviews with waste pickers were also conducted remotely in 2020 using video conferencing software. This data set documented waste picking activities, the spatial organization of the settlement, and waste recovery patterns to provide direct insights into the socio-spatial characteristics of IWS practices in the area. The on-the-ground data collection efforts were facilitated by community guides who were either current or former members of the community with deep familiarity and strong ties with the residents. This longitudinal approach allowed for the documentation of changes and

continuities over time, providing a view of the persistence, perpetuation, and adaptations of IWS practices and their impact on urban spaces. The specific dates of the field visits were influenced by the availability of both the researcher and the community guides to ensure meaningful access and engagement with the study area.

Image 1. Collection of photographs taken at the Vitas Temporary Housing Facility; clockwise: photographs taken in 2013, photographs taken in 2015, photographs taken in 2016, photographs taken in 2019. (Sicam, 2013; Sicam, 2015; Sicam, 2016; Sicam, 2019).

Primary data collection was reinforced by remote sensing data using Google Earth Pro and street-level imagery using Google Street View. These tools provided both bird's-eye and ground-level views of the area, offering a macro-to-micro and temporal perspective on the spatial organization and land use patterns influenced by IWS activities, contextualizing the observations made during the field visits. Maps acquired were used as base and key maps to illustrate urban spatial patterns and to geographically situate site images. Street-level imagery at critical points pinned on the satellite image map (e.g. street and alley intersections, waste accumulation areas), indicating varying dates ranging from 2018 to 2024, were used to scrutinize activities and spatial and architectural character, and were cross-referenced with interviews and field observations. Documentary, empirical, and archival data from various sources were also gathered to build the foundation for the study. Government reports, policy documents, and official statistics were obtained from the National Housing Authority (NHA) to provide the legal and regulatory background of the community within the Vitas Temporary Housing Facility. Empirical and archival data on Smokey Mountain and Tondo were also collected to ground the site in its historical context. These reports and narratives situate the study area within its past and present urban setting.

A thematic analysis was employed to identify and investigate patterns and themes within the qualitative data collected from interviews and observations. The analysis revolved around three (3) distinct themes – the agency of waste pickers, the interactions within informal waste networks, and their spatial outcomes within the context of the Tondo Manila Bay Area. A spatial analysis was conducted by analysing these themes and identifying the emergent patterns, providing a broad perspective of the role of IWS activities in the co-creation of urban environments on the margins of SWM.
The results of this study should be viewed with consideration for the limitations encountered. First, the study focused exclusively on the informal aspects of SWM, excluding the detailed examination of government and private sector involvement. It centred primarily on waste pickers to maintain the focus on the individuals at the bottom rung of the informal waste economy hierarchy and their direct impact on urban peripheries. However, this approach limits the study to this specific perspective and may not provide a comprehensive view of urban development that larger organizational entities, whether formal or informal, can reveal. Second, access to the site was limited and posed challenges due to safety concerns and may have affected the depth of the data collected. This includes the irregular schedule of daytime field visits, based on safety, convenience, and availability, that may not capture the routine patterns of the IWS in the informal settlement. Lastly, the findings from this study may not be fully generalizable to other urban contexts with different historical, geographic, socio-economic, and environmental conditions.

Data and Findings

The data and findings in this section are organized into three (3) main categories: historical and geographic context, waste picker agency and networks, and urban spatial outcomes. The first part provides a detailed background of the Tondo Manila Bay Area, including its historical development and geographic characteristics. The second part explores the roles and agency of waste pickers within the informal waste economy, examining social relationships and processes that facilitate waste picking activities. The last part investigates the manifestations of IWS practices on urban form and architecture, focusing on how these activities influence the physical layout, organization, and characteristics of marginal spaces.

Historical and Geographical Context

The urban landscape of the Tondo Manila Bay Area is impacted by its roots in the informal waste economy, dating back to the 1950s with the establishment of the dumpsite in *Baryo Magdaragat*, which would later become known as 'Smokey Mountain', an area along the coast of Tondo, Manila (Abad, 1991; Beltran, 1994). This brought in waves of migrant workers who earned a living through waste picking. By the 1970s, the Tondo Foreshore, encompassing Smokey Mountain, was populated with approximately 27,000 families at 1,694 persons per hectare. These families were predominantly informal settlers living in poor housing conditions without essential services such as electricity and running water (Estioko, 1977).
An attempt in 1982 to relocate the Smokey Mountain waste pickers and informal settler families (ISFs) to a development in Cavite, a peri-urban area 40 kilometres south of Manila, was unsuccessful due to the resettlement site's lack of livelihood opportunities.

Waste picker families returned to Smokey Mountain within weeks of formal resettlement (Beltran, 1994). A decade later, in 1992, the Smokey Mountain dumpsite was officially closed, and a 73-hectare sanitary landfill facility (SLF) in San Mateo, Rizal, 30 kilometres east of the city, became Metro Manila's receptacle for waste (AEA Technology, 2003). The Smokey Mountain Development Project, which evolved from the Metro Manila Solid Waste Management Program in 1987, was initiated and sought to provide the ISFs with onsite housing in tenement buildings. This necessitated the temporary relocation of 2,584 ISFs, out of the 4,223 living in Smokey Mountain, to a warehouse-type housing complex on the Vitas Reclamation Project site built in 1995 (National Housing Authority, 2008, 2012). This project, covering 7.79 hectares of the 44-hectare government-owned property less than a kilometre south of Smokey Mountain, was developed as transitional housing for those displaced by the construction of onsite permanent housing in Smokey Mountain (Image 2). The property also housed the Vitas Industrial Estate Centre and Pier 18, which served as a temporary dumpsite and waste transfer station (Asian Development Bank, 2004). Upon completion of the Smokey Mountain tenement housing project and the resettlement of ISF beneficiaries in 2004, the Vitas Temporary Housing Facility evolved into an enduring settlement having generated an additional 2,643 ISFs comprised of extended families, renters, and other illegal entrants (National Housing Authority, 2008), demonstrating the unintended consequences of urban renewal and infrastructure development processes (Table 1).

Image 1. Annotated Google Earth Pro satellite image of Tondo, Manila. (Google Earth Pro, 2024).

Table 1. Historical Timeline of the Vitas Temporary Housing Facility, Tondo, Manila.

HISTORICAL TIMELINE OF SMOKEY MOUNTAIN AND THE VITAS TEMPORARY HOUSING FACILITY	
1950s	Dumping of waste in Baryo Magdaragat, Tondo, Manila
1970s	Tondo Foreshore population of 27,000 families at 1,694 persons per hectare
1982	Attempt to resettle ISFs in Cavite
1987	Conception of the Smokey Mountain Development Project (evolving from the Metro Manila Solid Waste Management Program
1992	Closure of Smokey Mountain Dumpsite
1995	Construction of Vitas Temporary Housing Facility and relocation of 2,584 Smokey Mountain ISFs (out of 4,233 ISFs in Smokey Mountain)
1997-1998	Construction of medium-rise permanent housing buildings at Smokey Mountain
2004	Resettlement of ISF beneficiaries in permanent housing buildings at Smokey Mountain
2008	Census of new occupants at Vitas Temporary Housing Facility: 2,643 ISFs composed on extended families, renters, and other illegal entrants
(Estioko, 1977; Abad, 1991; Beltran, 1994; AEA Technology, 2003; National Housing Authority, 2008, 2012)	

ISFs at the Vitas Reclamation Project site have been undergoing eviction and resettlement for over a decade. The northern portion of the property used to be occupied by Sitio Damayan, an informal settlement containing a small community, known as Ulingan, involved in the communal production of charcoal. Ulingan was a 300-family community, within the informal settlement, facilitating the recovery of large volumes of discarded wood for the large-scale informal manufacture and selling of charcoal all over Metro Manila. The informal settlement was incrementally demolished between 2013 and 2014, and residents qualified for socialized housing from the NHA were resettled at a rowhouse development outside the city. Despite the improved housing conditions at the resettlement site, former residents of Ulingan still maintained ties with their social networks in the Tondo Manila Bay Area, with some returning to the Vitas Temporary Housing Facility to secure livelihoods (Sicam, 2018).

Both the Smokey Mountain housing development and the Vitas Temporary Housing Facility are located along the spine of R-10. The R-10 thoroughfare, extending 9.70 kilometres along the Manila North Harbor in the Tondo Manila Bay Area from the Delpan Bridge in the south to the mouth of the Malabon River at Bangkalusi Bridge in the north, serves as a primary conduit for cargo transportation, and is also central to this narrative. It is a major route for cargo trucks bound for both the north and south ports of Manila. Road widening initiatives in 2017 necessitated the relocation of 2,197 ISFs and the removal of makeshift structures and waste materials from the roadside (Department of Public Works and Highways, 2016, 2018), reflecting the ongoing tension between formal urban development and informal settlement growth in the area.

The Tondo Manila Bay Area's urban environment is in a continuous state of flux, shaped by formal urban planning and the informal sector's adaptation to infrastructure development. The dynamic relationship between 'planned' and 'unplanned' forces is evident in Google Earth temporal satellite images, which reflect Tondo's ever-evolving

landscape and formal and informal conflicts with urban space (Image 3). Waste serves as a focal point for these dynamics, not only as the discarded objects found in Tondo's waste disposal sites, but also as a crucial economic resource for the communities living along R-10 on the margins of Smokey Mountain.

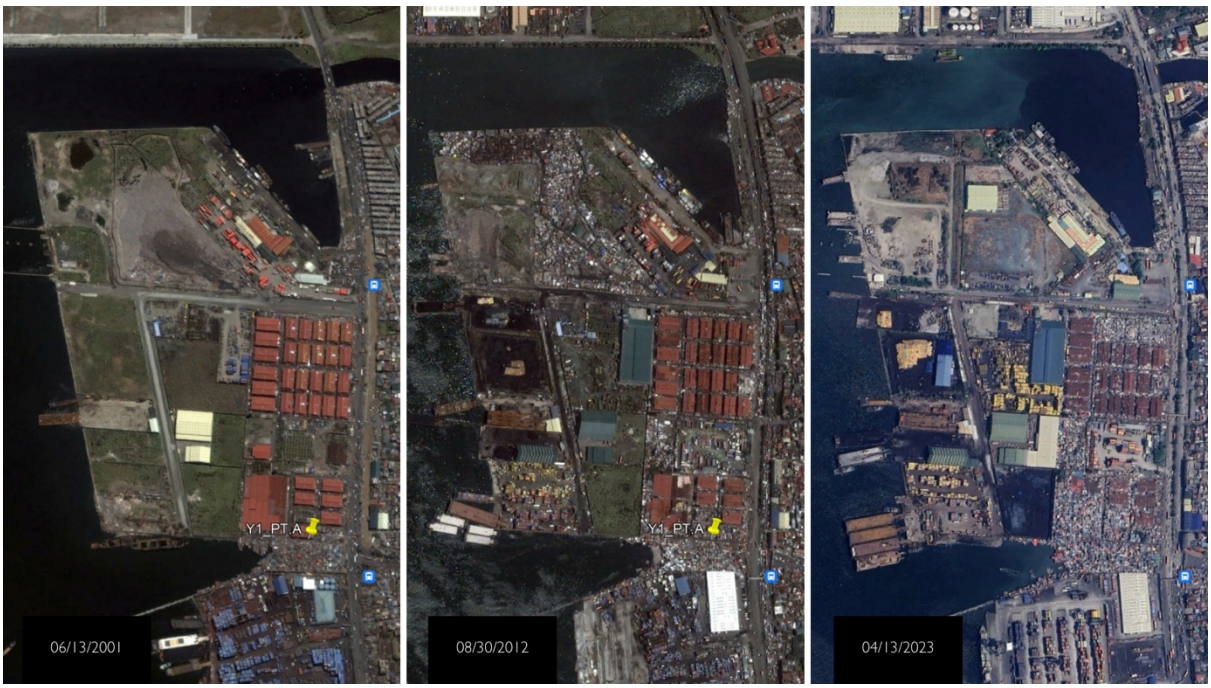

Image 3. Google Earth Pro satellite images of the Vitas Reclamation Project taken in 2001, 2012, and 2023 (Google Earth Pro, 2024).

Waste Picker Agency and Networks

Formal SWM at the barangay level, particularly in the Smokey Mountain Development Project, interfaces with IWS activities in the Tondo Manila Bay Area (Zortea, 2019). Informal waste recovery and recycling serve as the main source of income and employment for many of its residents. Waste picking is a low-skill, low-investment occupation that requires little or no educational qualifications, making it accessible to a broad segment of the population in the Vitas Temporary Housing Facility and its vicinity. A diverse range of materials, including plastics, metals, glass, paper, wood, electronics, and food waste, are recovered in this economy, demonstrating waste pickers' skills at identifying and assigning value to different types of discarded objects that can be reused or recycled as valuable resources.

Waste pickers operate within a straightforward commodity chain. They collect, sort, and sell recyclable materials through a variety of channels. Waste materials are sourced from various locations across the city. Some are transported to the site along R-10 via trucks, while itinerant waste pickers rove the city for door-to-door collection of recyclable waste. Additionally, some waste supplies come directly from commercial establishments such as banks, shopping malls, and food chains. Within the community, collected waste is sorted along R-10 and the inner streets. Sorted materials are stored in spaces that range from small to large storage areas or stockpiles. These are sold

through different methods and in various locations, from sales to junk shops, middlemen, or to recycling industries (Table 2).

Table 2. Actors and Networks, Nodes and Interactions/Activities, and their Locations.

ACTORS	**NETWORKS**	**LOCATIONS**
Waste Pickers	Central Node	
Waste Sources		
Dump Trucks, Trucks	Waste Pickers, waste collectors	R-10, Inner Streets
Door-to-door Collection	Waste Pickers, residential and commercial	All over the city
Temporary Dumpsite	Waste Pickers, dumpsite operators	Pier 18, Waste Disposal Site/s
Buyers of Recovered Materials		
Middlemen	Waste Pickers, middlemen	R-10, Inner Streets, All over the city
Junk Shops	Waste Pickers, junk shops	R-10, Inner Streets, All over the city
Recycling Industries	Waste Pickers, recyclers	R-10, All over the city
NODES	**INTERACTIONS/ACTIVITIES**	**LOCATIONS**
Transactions		
Receiving/collecting waste from Dump Trucks, Trucks	Waste collection and delivery	R-10, Inner Streets
Door-to-door Collection	Waste picking and collection	All over the city
Accessing Dumpsite	Waste picking and collection	Pier 18, Waste Disposal Sites
Selling	Transactions with middlemen, junk shops, and recycling industries	R-10, Inner Streets, All over the city
Functions		
Collection	Waste picking and recovery	R-10, Inner Streets, All over the city
Sorting	Sorting	R-10, Inner Streets, Alleys
Stockpiling	Storage	R-10, Inner Streets, Alleys

The Vitas Temporary Housing Facility serves as a central hub for an informal agglomerated waste economy, collectively functioning as a waste processing industry. Its location along R-10 makes it a major node that provides the infrastructure and spatial arrangement necessary for the efficient operation of the informal waste economy. Waste pickers operate at varying scales, from organized groups to individuals, across the informal settlement and demonstrate significant agency in the way they assign value to waste and navigate informal waste networks to sustain their livelihoods. This

underscores their critical and dynamic role in recycling processes and their contribution to the recovery of reusable discarded objects. The complex network they operate in involves interactions from individual waste pickers to group collaborations, extending to institutional connections throughout the city, highlighting the scale and extent of their engagement with municipal SWM.

Impact on Urban Space

The informal agglomerated waste economy facilitated by the IWS in the Vitas Temporary Housing Facility functions as a decentralized and informal materials recovery facility (MRF). This can be observed in the spatial organization and distribution of transactional and functional spaces throughout the community. Various waste recovery activities characteristic of MRF operations are carried out along R-10 and the inner streets and alleys of the informal settlement, including waste delivery, collection, sorting, and stockpiling, by different groups and individuals.

R-10 serves as a vital artery for IWS activities. Spaces along the main thoroughfare are allocated for the different functions of an MRF. These workspaces, junk shops, and other related businesses line R-10, forming the front boundary of the informal settlement and also facilitating the sale and further processing of recyclable materials. The MRF and junk shop frontage also interfaces with port industry activities, where waste pickers recover port-related waste products such as shipping crates, pallets, and rubber tires.

Image 2. Google Earth Pro satellite images of Radial Road 10, Tondo Manila and Google Street Views (Google Earth Pro, 2024).

The inner streets within the Vitas Temporary Housing Facility are characterized by a more intricate distribution of waste management activities. Longitudinal photographs taken during field visits from 2013 to 2020 and Google Street View imagery, with dates

ranging from 2018 to 2024, show how spaces are allocated for sorting and segregating waste along the R-10 sidewalk and the informal settlement's inner streets, as well as for storing and stockpiling sorted waste materials (Image 4, Image 5, Image 6). These activities are not centralized but are distributed according to the groups or individuals managing them and the types of waste materials recovered. Major nodes of activity are typically found along R-10 and main street intersections within the settlement (Image 7). The informal settlement is divided in the middle by a privately-owned enclosed container yard. There is a notable concentration of storage and stockpiling along the perimeter of this boundary, suggesting a spatial relationship with this hard edge that facilitates activities in the informal waste economy (Image 7).

Image 3. Google Earth Pro satellite image of the Vitas Temporary Housing Facility and street views along paths perpendicular to R-10, x-axis (Google Earth Pro, 2018).

The informal waste economy is deeply intertwined with residential spaces. IWS activities dominate the streetscape, interspersed with homes and other informal economies. The warehouse-type temporary housing buildings serve as the main structures. Built nearly thirty (30) years ago, they are old and substandard, in varying stages of dilapidation (some structures have burned to the ground), and have undergone processes of informal architectural renovation over the years. Many adaptations in the buildings' architecture are constructed of recovered discarded materials such as plastics, plywood, wood, steel railings, tarpaulin, and metal sheets, further integrating waste recovery with residential life. The defining characteristic of the Vitas Temporary Housing Facility is its integration of living, working, and waste recovery spaces. Intertwined with spaces for IWS activities, other informal economies can be found inside the community, such as the essential *palengke* market strip (wet and dry market), *carinderias* (outdoor eateries), *sari-sari* stores (informal convenience stores), internet and karaoke stalls, and itinerant food vendors.

Image 4. Google Earth Pro satellite image of the Vitas Temporary Housing Facility and street views of paths parallel to R-10, *y*-axis (Google Earth Pro, 2018).

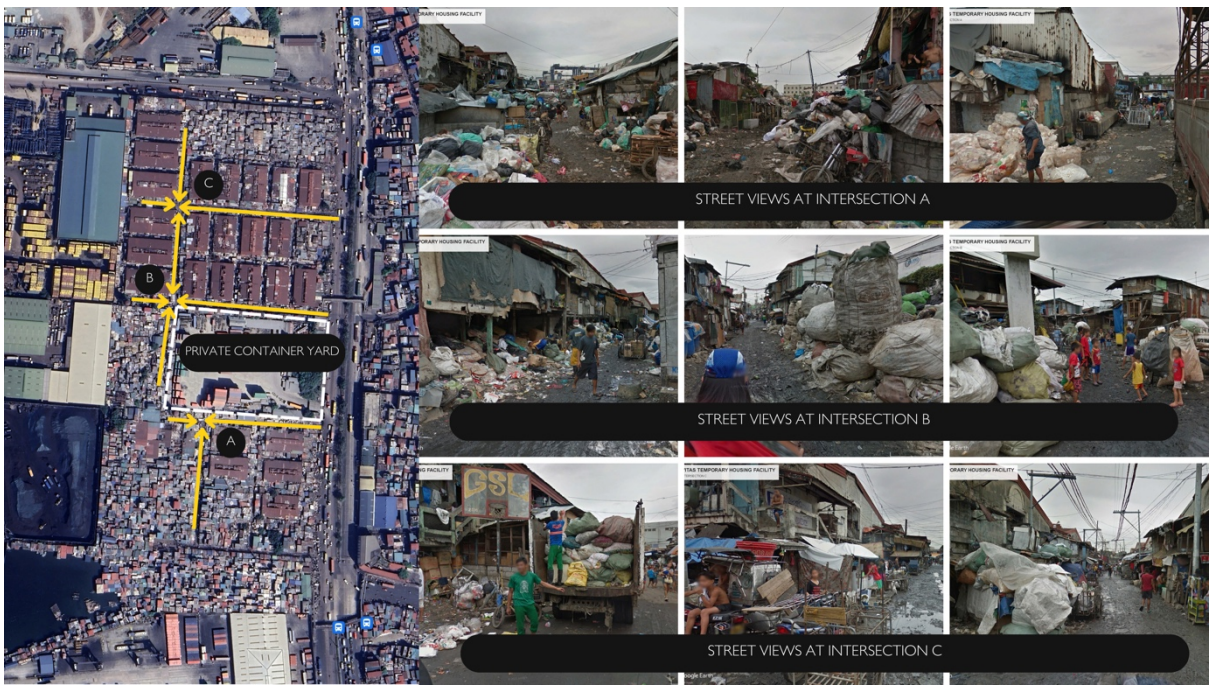

Image 5. Google Earth Pro map and street views of major nodes at intersections inside the Vitas Temporary Housing Facility. (Google Earth Pro, 2024, 2018).

Unlike formal MRFs, where functions are typically centralized, the informal settlement features a distributed approach. Collection points, sorting areas, and stockpile zones are spread throughout the community. These distributed nodes reflect the decentralized nature of the informal waste economy in the informal settlement and its autonomous, but collective, operations. The primary nodes of IWS activities are located where major streets converge, facilitating waste recovery processes. The streetscape is dominated by the informal waste economy, intertwined with residential spaces and other informal economic enterprises, within a zone of port-related industries, resulting in a unique urban environment co-created by waste pickers and their interactions with waste materials and IWS networks.

Analysis

The Vitas Temporary Housing Facility along R-10, built in 1995 as a temporary staging area for ISFs living in Smokey Mountain, has a rich history that dates to the 1950s. Despite the closure of the dumpsite in 1992 and numerous resettlement programs, the waste picking practices of Smokey Mountain endured, adapted to changes, and still thrive as an informal collective industry for waste recovery and recycling. Urban development and infrastructure improvements in the surrounding areas, such as port-related projects and road widening, did little to displace the deeply entrenched informal waste economy of the Tondo Manila Bay Area. Instead, the waste picking community and network evolved, integrating new waste streams and adapting to the changing urban environment. This demonstrates the resilient and persistent nature of the informal waste economy and the significant role of the IWS in the urban socio-economic fabric. The Vitas Temporary Housing Facility transformed from transitional housing into a thriving community industry of IWS activities alongside other informal economies. The informal settlement itself functions as an MRF where networks in the informal waste economy converge, creating a vibrant and dynamic community centred around SWM. It is characterized by an active streetscape, with street-oriented extensions along building frontages hosting various socio-economic enterprises and activities. Interwoven with residential and commercial spaces are areas dedicated to waste, including collection, sorting, and stockpiling zones, as well as transactional areas. This spatial integration reflects a dynamic and complex urban environment that demonstrates the deeply intertwined nature of the informal waste economy and daily life and the co-creating capacity of waste pickers on urban form.

Functional spaces for waste management practices are distributed throughout the community. IWS activities are communal, with shared networks in the informal waste economy, but decentralized, having multiple points for collection, sorting, and storage distributed throughout the informal settlement, managed by different groups or individuals, often based on the type of waste material collected. This decentralization facilitates easier access to waste resources by different individuals or groups and supports both the efficiency and autonomy of informal waste recovery processes. Street intersections within the settlement serve as primary nodes for these activities, underscoring the importance of spatial organization and structure in facilitating efficient informal waste management systems. The community boundary along R-10, lined with junk shops and other related businesses, forms the economic front of the community, where waste pickers interface with the broader market.

The integration of residential and economic spaces with IWS activities in the informal settlement suggests a unique community identity centred around the informal waste economy. Waste pickers actively shape their environment by creating and managing spaces for their activities. This process introduces specific functional areas in the informal waste economy, transforming peripheral and residual urban spaces into crucial nodes in the urban waste recovery and recycling network, and supporting the emergence of other informal markets and vibrant transactional zones. Moreover, while waste pickers are commonly regarded as significant contributors to the diversion of waste into recycling systems, not all discarded objects collected enter the recycling chain. Many materials are kept, reused, and repurposed by other residents of the community and the waste pickers themselves, demonstrating a layer of value addition that goes beyond traditional recycling processes. This dynamic is physically translated in their spatial and architectural adaptations, forming an urban vernacular that incorporates waste, and the economic activities around it, amidst formal development. The ability of the IWS to sustain their livelihoods despite the complex challenges they daily face underscores the vital role of socio-economic connections and shared identity in supporting their resilience and operational efficiency, reflected in the interplay of living and economic spaces in the physical organization of their community. However, despite the community's adaptation, vibrant economic activities, and collective contributions to municipal SWM, it is important to acknowledge that the Vitas Temporary Housing Facility's physical state remains substandard and undesirable. The area, initially designed as a temporary situation, is characterized by poverty and marginality, with inadequate infrastructure and poor living conditions that pose health, safety, social, and economic risks to its residents. The convergence of adaptation and neglect within these urban environments emphasizes the need for integrative and participatory urban planning and policy approaches that recognize and support the critical role IWS communities play in sustainable SWM and the dynamics in which they operate while addressing their fundamental rights and needs.

Conclusion and Recommendations

Waste significantly shapes the physical layout and architecture of informal settlements in the Tondo Manila Bay Area, reflecting spatial adaptations that prioritize activities in the informal waste economy. The Vitas Temporary Housing Facility's dense constructions, makeshift extensions, and multi-functional zones that facilitate access to waste result in a unique distribution of spaces and building additions that integrate the informal waste economy with daily life. This suggests that waste is not merely a byproduct of urban consumption to be managed but a determinant of urban form and building configuration. The current recognition of IWS contributions to the reduction of the city's waste and the conservation of resources is an important step toward formulating comprehensive and integrative solutions to SWM. Despite this, attempts at meaningful and effective integration of the informal waste economy in formal systems of waste management are not apparent or substantial. Large-scale interventions in the Tondo Manila Bay Area have focused on infrastructure, which often involves the demolition and eviction of existing communities. While this strategy advances the development of the Manila North Harbor and related industries, a critical area in the city's overall growth, it tends

to prioritize the port industry and fails to address the broader and more complex issues of SWM and urban marginalization.

The persistence and adaptability of the IWS in the Tondo Manila Bay Area emphasize the need for urban planners and policymakers to recognize and support their contributions to Metro Manila's SWM systems. Policies aiming to formalize and integrate informal waste activities to enhance efficiency while protecting the rights and livelihoods of waste pickers should be developed within participatory planning processes that involve waste pickers and other IWS actors. Furthermore, understanding the context and spatial dynamics of the informal waste economy is crucial in the development of these policies and strategies. Planners and policymakers must consider the agency of waste pickers, the distribution of informal SWM functions within their networks, and the spatial organization of the urban environment they co-create within their communities to develop plans and policies for more equitable living environments and effective workspaces.

The informal landscapes created by waste pickers serve as critical urban spaces where issues of waste, resource, and marginality intersect. These environments, frequently overlooked in formal urban planning and formal SWM systems, highlight the stark disparities in how urban dwellers perceive, value, and interact with waste. Such disparities are distinctly translated in urban form, reflecting the deep-seated inequalities that are shaped by how waste is (mis)managed within cities. Future studies should continue to monitor the evolution and adaptation of informal waste economies, particularly in the context of urban form and its transformation. Longitudinal studies would be particularly useful for understanding how these economies adapt and persist over time in specific urban environments. Comparative studies across different urban contexts and involving other stakeholders (government and private sectors, NGOs, CBOs) are needed to provide a broader perspective on these impacts on urban environments to inform more sustainable, inclusive, and adaptive SWM strategies.

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