OUR CIRCULAR FOODFUTURE

WWF

ENDING WASTED FOOD IN CITIES

A BEHAVIOR AND FINANCIAL BLUEPRINT FOR ACTION

2026

CONTENTS

ACKNOWLEDGEMENTS

WWF is grateful to the Global Methane Hub for its catalytic support in Jayapura and Merauke, and Delterra for its partnership in piloting waste baselining and behavior change efforts. We also extend our sincere thanks to Wika Rumbiak for her leadership and to the entire Papua team for their dedication. This report was designed by Kate Jin.

EXECUTIVE SUMMARY

Reducing food loss and waste is one of the fastest and most cost-effective climate solutions available today. Globally, up to 40% of all food produced is never eaten,[1] wasting land, water, energy, and labor while generating greenhouse gas emissions nearly five times greater than the aviation sector.[2] The scale of the impact is profound: wasted food consumes more than a quarter of global freshwater,[3] costs approximately $1 trillion annually,[4] and represents a massive ecological footprint—contributing to habitat loss, biodiversity decline, and missed opportunities to feed communities.[5]

In Indonesia, the stakes are especially high. The country generates an estimated 23–48 million tonnes of food loss and waste each year,[6] equivalent to 4–5% of GDP[7] and up to 7.3% of national greenhouse gas emissions.[8] Food waste also represents the largest share of Indonesia's waste stream, accounting for more than 40% of total waste.[9] At the same time, Indonesia is uniquely positioned to lead progress toward Sustainable Development Goal 12.3—halving food loss and waste by 2030—supported by strong national policy momentum, including a national roadmap, integration into development plans, a forthcoming presidential regulation, and standardized measurement systems.

1 J. Gustavsson, C. Cederberg, U. Sonesson, R. van Otterdijk, and A. Meybeck, Global Food Losses and Food Waste: Extent, Causes and Prevention (Rome: Food and Agriculture Organization of the United Nations, 2011), 4–5.

2 United Nations Environment Programme (UNEP), Food Waste Index Report 2024 (Nairobi: UNEP, 2024), 14–16.

3 World Bank, Addressing Food Loss and Waste: A Global Problem with Local Solutions (Washington, DC: World Bank Group, 2020), 1–2.

4 Ibid.

5 World Wide Fund for Nature (WWF), Living Planet Report 2024: A System in Peril (Gland, Switzerland: WWF International, 2024), 12–15.

6 Global Alliance for Improved Nutrition (GAIN), Food Rescue Efforts in Indonesia (Geneva: GAIN, 2020), 3–4.

7 Ibid.

8 Ibid.

9 Ibid.

Cities are at the forefront of this opportunity. With an estimated 70% of global food consumption occurring in urban areas,[10] and most organic waste still ending up in landfills,[11] urban systems represent a critical intervention point. Importantly, food should not be viewed as "waste," but as a resource whose disposal can be prevented, recovered, or transformed into valuable products such as compost or animal feed—provided the right systems are in place. Food is always "Food." We must think of inedible food as an input into an organic manufacturing industry.

To explore how this transformation can occur in practice, WWF (WWF-US and WWF Indonesia), in partnership with Delterra, implemented pilot projects in Jayapura and Merauke Regencies in Papua—two fast-growing but under-resourced urban areas facing rising waste volumes, limited collection coverage, and minimal organics processing. The pilots established baseline data, strengthened municipal capacity, and tested community-based behavior change interventions rooted in local values, trusted institutions, and existing reuse practices.

The findings demonstrate both the scale of the challenge and the strength of the opportunity. Households are the largest source of food waste in both locations, and a significant portion of discarded food remains edible—highlighting immediate potential for prevention, recovery, and redistribution. Informal reuse systems already exist, particularly the use of food scraps as animal feed. Communities show strong willingness to adopt new practices when interventions are practical, culturally relevant, and delivered through trusted local actors. However, local governments require significant strengthening of systems, including waste collection, source separation, organics processing, policy enforcement, and sustainable financing.▶

10 United Nations Environment Programme (UNEP), Urban Food Systems (Nairobi: UNEP, 2023); UNEP, Food Waste Index Report 2024 (Nairobi: UNEP, 2024).

11 Ibid.

Crucially, the pilots confirm that awareness alone is not sufficient. Meaningful progress requires coordinated, systems-level action that integrates behavior change, infrastructure investment, policy reform, and capacity building. Even in low-infrastructure settings, this integrated approach can deliver measurable results when grounded in local context and implemented incrementally.

THE CENTRAL CHALLENGE

A central challenge is financing. Many Indonesian cities face a "missing middle" gap, where required investments—typically in the range of $1–3 million—are too large for local budgets yet too small to attract traditional large-scale development finance. Addressing this gap will require blended finance solutions, national support, and phased investment strategies.

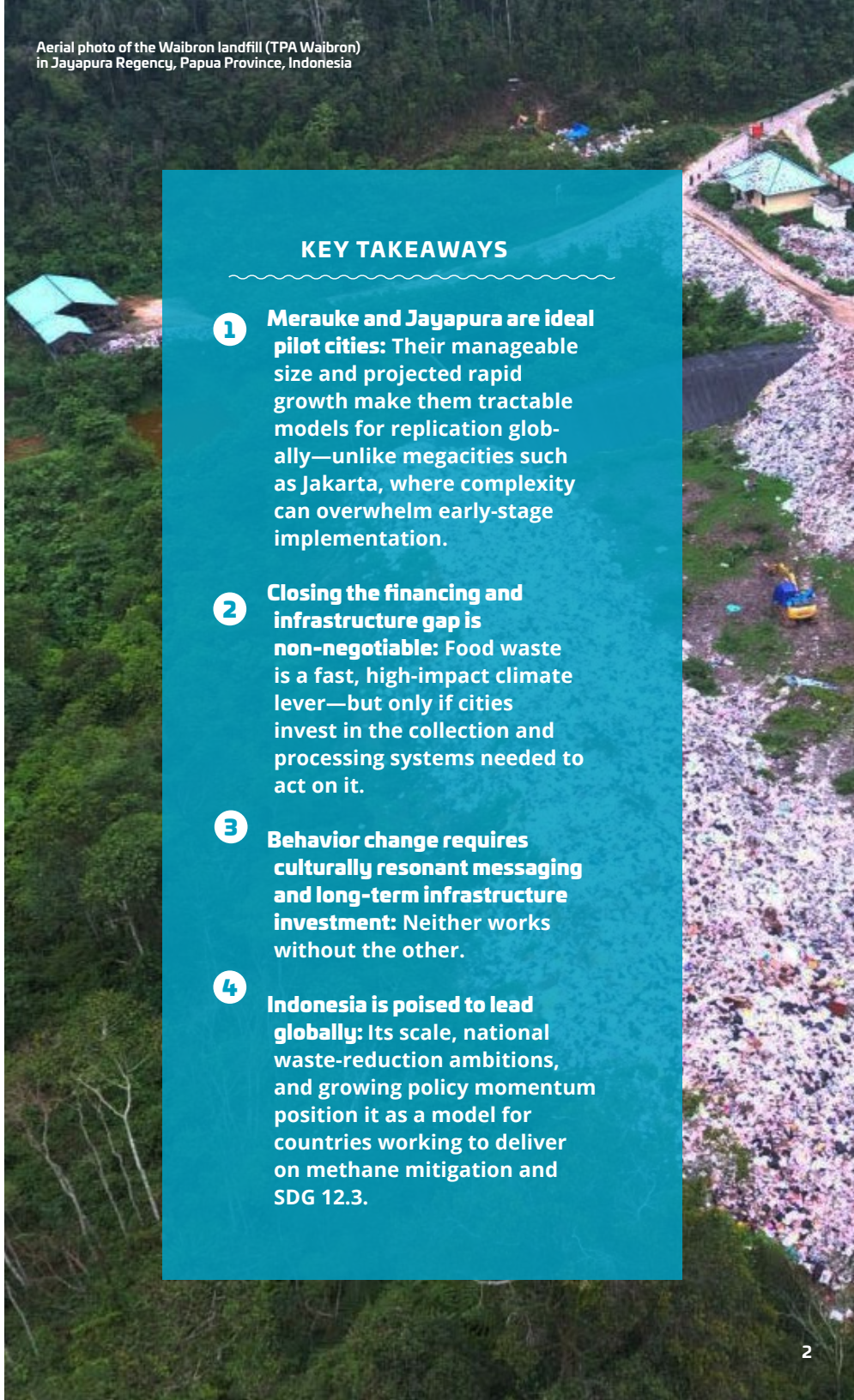
The report outlines a practical pathway forward:

- ⇨ **START WITH PREVENTION AND REDUCTION** by raising awareness, supporting schools and community groups, and reducing waste at the source.
- ⇨ **SCALE COMMUNITY-LEVEL SOLUTIONS** such as home composting, neighborhood compost hubs, animal-feed reuse, and decentralized processing.
- ⇨ **INVEST IN CENTRALIZED SYSTEMS** only once collection, separation, participation, and operational capacity are sufficiently strong.

By pairing data-driven insights with culturally grounded interventions and sequenced investment, cities can transition from fragmented waste systems to integrated, scalable models. This transformation unlocks significant opportunities to reduce methane emissions, improve food security, protect biodiversity, and create resilient local economies.

The core message is clear: food waste is not simply a disposal problem—it is a solvable systems challenge and one of Indonesia's most immediate and impactful opportunities for climate action and sustainable development.

The sections that follow detail the on-the-ground context, pilot findings, and phased investment pathway that together make this case. ■



Aerial photo of the Waibron landfill (TPA Waibron) in Jayapura Regency, Papua Province, Indonesia

KEY TAKEAWAYS

1. **Merauke and Jayapura are ideal pilot cities:** Their manageable size and projected rapid growth make them tractable models for replication globally—unlike megacities such as Jakarta, where complexity can overwhelm early-stage implementation.
2. **Closing the financing and infrastructure gap is non-negotiable:** Food waste is a fast, high-impact climate lever—but only if cities invest in the collection and processing systems needed to act on it.
3. **Behavior change requires culturally resonant messaging and long-term infrastructure investment:** Neither works without the other.
4. **Indonesia is poised to lead globally:** Its scale, national waste-reduction ambitions, and growing policy momentum position it as a model for countries working to deliver on methane mitigation and SDG 12.3.

INTRODUCTION

Reducing food waste is an environmental, social, and economic imperative. Food production has the largest global environmental impact of any human activity, accounting for 70% of biodiversity loss,[12] 70% of freshwater use,[13] 50% of soil erosion,[14] and one-third of greenhouse gas emissions.[15] Yet 1.05 billion tonnes of food is wasted globally each year.[16]

Indonesia is one of the countries with the greatest potential gains from scaling wasted food across the supply chain. Indonesia generates an estimated 23–48 million tonnes of food loss and waste (FLW) each year,[17] equal to 115–184 kg per person, placing it among the world's largest FLW producers (The range reflects differences between national survey-based estimates and supply-chain modelling approaches). This waste leads to IDR 213–551 trillion in economic losses annually, or 4–5% of GDP,[18] and contributes up to 7.3% of the country's greenhouse gas emissions.[19] If recovered, this discarded food could provide nutritional benefits for 29–47% of Indonesia's population.[20] Food waste also represents the largest component of the national waste stream, making up 41.4% of total waste in 2023—more than double the share of plastic waste.[21]

12 **Intergovernmental SciencePolicy Platform on Biodiversity and Ecosystem Services (IPBES).** *Global Assessment Report on Biodiversity and Ecosystem Services: Summary for Policymakers.* IPBES Secretariat, Bonn, Germany, 2019, pp. **11–13**.

13 **Food and Agriculture Organization of the United Nations (FAO).** *Water for Sustainable Food and Agriculture.* FAO, Rome, 2017, pp. **8–9**.

14 **Food and Agriculture Organization of the United Nations (FAO).** *The State of the World's Land and Water Resources for Food and Agriculture: Systems at Breaking Point (SOLAW 2021).* FAO, Rome, 2021, pp. **34–36**.

15 **Crippa, M., Solazzo, E., Guizzardi, D., Monforti-Ferrario, F., Tubiello, F. N., & Leip, A. (2021).** *Food systems are responsible for a third of global anthropogenic GHG emissions.* **Nature Food, 2**, 198–209. https://doi.org/10.1038/s43016-021-00225-9

16 **United Nations Environment Programme (UNEP).** *Food Waste Index Report 2024.* UNEP, Nairobi, 2024, pp. **10–12**.

17 **Global Alliance for Improved Nutrition (GAIN).** *Food Rescue Efforts in Indonesia.* GAIN, Geneva, Switzerland, 2020, pp. **3–5**.

18 **World Bank.** *Addressing Food Loss and Waste: A Global Problem with Local Solutions.* World Bank Group, Washington, DC, 2020, pp. **1–2**.

19 **Bappenas.** *National Food Loss and Waste Reduction Roadmap (2020–2030).* Government of Indonesia, Jakarta, 2021, pp. **22–26**.

20 **FAO; Bappenas.** *Food Loss and Waste in Indonesia: Baseline and Strategic Implications.* FAO and Government of Indonesia, Rome/Jakarta, 2021, pp. **18–20**.

21 **Ministry of Environment and Forestry (KLHK).** *Indonesia National Waste Management Information System (SIPSN) Annual Report 2023.* Government of Indonesia, Jakarta, 2024, pp. **12–14**.

Indonesia has developed a national Food Loss and Waste Reduction Roadmap that outlines priority interventions, regulations, incentives, and infrastructure needs to reduce FLW. FLW has also been formally integrated into both the National Medium-Term (**RPJMN**) and Long-Term (**RPJPN**) development plans, signaling the government's intent to link FLW reduction with food security, climate, and waste-management goals. A national presidential regulation on FLW is now being prepared, supported by extensive training for provinces and retailers using Indonesia's newly developed FLW Standard Calculation Method, which enables consistent measurement across regions. In parallel, **Bappenas**, Indonesia's central government responsible for national development planning, policy coordination, and strategic oversight, has led national dialogues to standardize definitions, establish incentives, and strengthen innovation strategies, feeding into broader circular economy plans.

Eighty percent of all food consumption is expected to occur in cities by 2050[22] and contrary to popular opinion, data shows that the Global South's urban populations generate waste at comparable levels to those in high-income countries.[23] These findings justify a strong focus on city-level action, especially in developing countries, as a frontline to diverting food waste from landfills and turning food and organic material into profitable businesses. Most Indonesian cities do not yet publish consistent, city-level food waste per-capita data, but national monitoring through **Pengelolaan Sampah Nasional (SIPSN)** shows that food waste accounts for ~40% of waste across 199 cities and regencies.[24]

In regions like Papua, where communities depend heavily on local food systems and supply chains are often fragile, preventing wasted food also strengthens local food security resilience, ensuring that more of what is grown and harvested reaches the people who need it.

Waste collection at Bokem Landfill, Merauke

22 **Ellen MacArthur Foundation.** *Cities and Circular Economy for Food*. Cowes, UK: Ellen MacArthur Foundation, 2019, Executive Summary **pp. 9.**

23 **United Nations Environment Programme (UNEP).** *Global Waste Management Outlook 2024: Beyond an Age of Waste.* UNEP, Nairobi, 2024, pp. **22–25**.

24 **Kompas.** *Sampah Makanan Mendominasi Timbulan Sampah Perkotaan di Indonesia.* Kompas Media Nusantara, Jakarta, 2022, pp. **1–2**.

TERM BANK

RPJMN (Rencana Pembangunan Jangka Menengah Nasional): Indonesia's 5-year national development plan that translates the long-term vision into specific priorities, programs, and investments aligned with the current presidential term.

RPJPN (Rencana Pembangunan Jangka Panjang Nasional): Indonesia's 20-year national development plan that sets the country's long-term vision, strategic direction, and overarching goals.

Regency: A regency (***kabupaten***) is a second-tier subnational government unit, equivalent in level to a city (***kota***), and sits below the provincial level. Regencies typically cover larger, more rural areas and have their own elected head (***bupati***) and local parliament, with authority over planning, public services, and local development.

Bappenas: Bappenas (Badan Perencanaan Pembangunan Nasional) is Indonesia's National Development Planning Agency. It is responsible for formulating national development plans, setting policy priorities, coordinating across ministries, and aligning budgets with Indonesia's medium- and long-term development strategies (such as the RPJMN).

Sistem Informasi Pengelolaan Sampah Nasional (SIPSN): Indonesia's National Waste Management Information System, developed by the Ministry of Environment and Forestry (KLHK). SIPSN is a centralized, digital platform that collects, integrates, and reports data on waste management across Indonesia, from local (district/city) to national level.

Less well-known, with fewer resources, and less highly trafficked than major destinations like Jakarta or Bali, Merauke and Jayapura represent more remote, rapidly growing urban areas that are less served by national initiatives and more representative of the reality of developing countries. Merauke **Regency**, a fast-growing economic center in the newly formed South Papua Province, is challenged by rising household waste volumes and limited waste-sorting systems. These pressures create a timely opportunity to pilot circular food system solutions that support more sustainable growth. Jayapura Regency, which surrounds the provincial capital of Jayapura City in Papua Province, includes many communities whose livelihoods depend on livestock, creating both a strong need and a clear opportunity to divert food waste for use as animal feed.

Since July 2024, World Wildlife Fund (WWF) has implemented food waste-reduction pilots, funded by the Global Methane Hub, in Papua's Merauke and Jayapura Regencies. The pilots strengthened municipal and local capacity to design and implement integrated wasted food solutions, while engaging communities, schools, and the private sector (through the GRASP 2030 voluntary agreement network) to drive sustained behavior change. In partnership with Delterra, baseline data collection, analysis, and training established a shared evidence base that is now informing regulatory revisions, financing mechanisms, and **TPS3R** (community-scale solid waste processing facility) infrastructure investments at the **district** level. This evidence-driven approach enabled the formation of multi-stakeholder governance platforms, including Waste Working Groups and a Food Bank Working Group, to coordinate upstream and downstream interventions and scale food recovery efforts. At the same time, partnerships with local government and Indonesia's national environmental education program, **Sekolah Adiwiyata**, are embedding food waste reduction into policy, education systems, and community practice—positioning these pilots as a replicable model for aligning local action with national FLW targets.

This report presents a comprehensive analysis of the pilots' baseline food waste data and its translation into targeted behavior change interventions, community engagement models, and governance mechanisms. It further outlines the infrastructure needs and investment requirements to scale impact, offering a phased implementation pathway supported by blended finance strategies to enable sustainable, system-wide transformation.

Jayapura City

Simulation of data sampling in baseline training at the Bokem TPA, Merauke

TERM BANK

Regency: A regency (*kabupaten*) is a second-tier subnational government unit, equivalent in level to a city (*kota*), and sits below the provincial level. Regencies typically cover larger, more rural areas and have their own elected head (*bupati*) and local parliament, with authority over planning, public services, and local development.

TPS3R: TPS3R (Tempat Pengolahan Sampah Reduce, Reuse, Recycle) refers to a community-scale solid waste processing facility focused on waste reduction, sorting, recycling, and composting. TPS3R sites are a key element of Indonesia's decentralized waste management approach, often supported by local governments and community groups to reduce waste sent to landfills.

District: A district (kecamatan) is an administrative subdivision below a regency (kabupaten) or city (kota). It is led by a camat and is responsible for coordinating local government services, administration, and development implementation across multiple villages or urban wards.

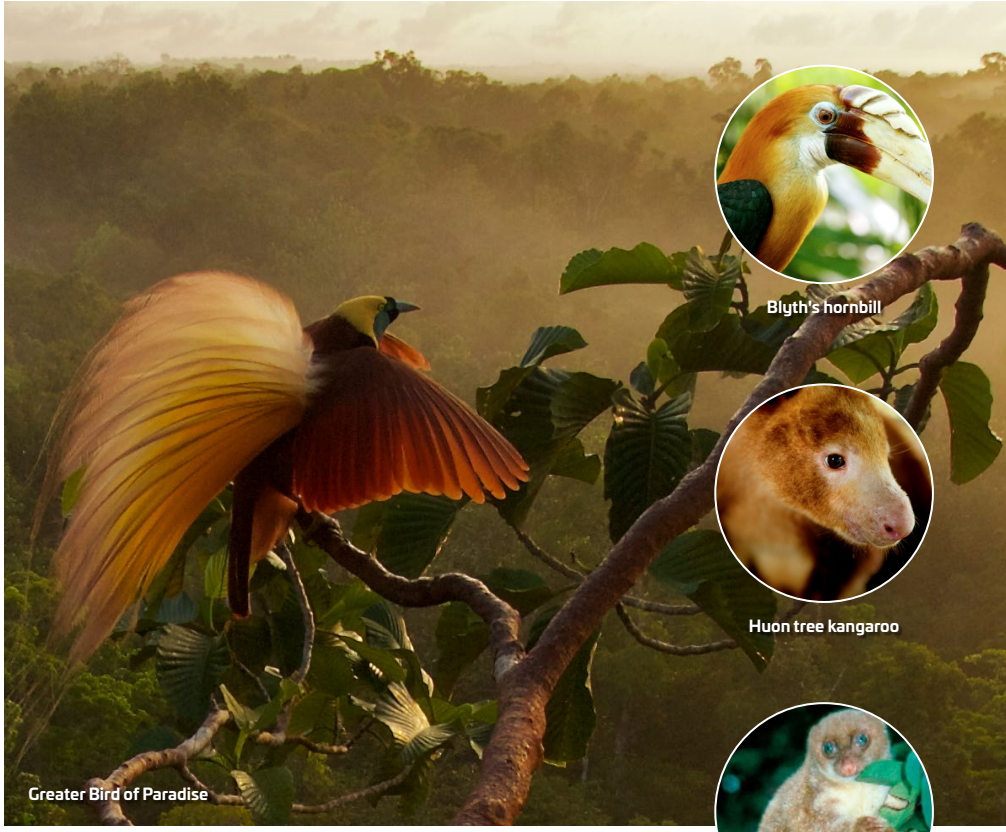
Sekolah Adiwiyata: A government-led initiative that integrates environmental protection, sustainability, and ecological awareness into school policies, curriculum, activities, and facilities.

CONTEXT AND DRIVERS OF CONSUMPTION AND WASTED FOOD IN PAPUA

A comprehensive situational analysis was conducted to examine the social, cultural, and economic conditions shaping food consumption and waste practices in Papua. This analysis identified key factors influencing community behaviors and the challenges stakeholders face in advancing food waste reduction efforts, while also highlighting opportunities to refine communication strategies.

Papua, located on the western half of New Guinea, is home to an estimated 4.5 million people (2025 estimate) and spans a diverse landscape of rugged mountains, vast lowland rainforests, mangroves, and coastal ecosystems. It is considered one of Earth's richest biodiversity regions, hosting over 16,000 plant species and more than 700 bird species, along with iconic wildlife such as birds of paradise, tree kangaroos, cuscus, and echidnas. With its forest cover remaining among the most intact globally, the island serves as a major carbon sink and climate buffer. Papua is globally critical because its extensive intact rainforests regulate water systems, store vast carbon stocks, and support numerous endemic species found nowhere else on Earth. Preventing further agricultural expansion and creating a circular food economy is an imperative for Papua.

Jayapura Regency is located in Papua Province, covering an area of 17,516.6 km^2, and is divided into 19 districts (**Table 1**). In practice, Jayapura City and Jayapura Regency function as a unified metropolitan area despite having separate legal administrations. Jayapura City acts as the urban, administrative, and commercial core—housing the provincial government, seaport, hospitals, universities, and the majority of formal employment—while Jayapura Regency surrounds it, supplying critical space, labor, food production, housing expansion, and key infrastructure including Sentani Airport and the Sentani Lake region. Daily commuting across the administrative boundary is routine for work, education, trade, and public services, with families, customary land ties, and local economies spanning both jurisdictions.



Residents often live in one area while working or studying in the other. As a result, the two operate as a single functional urban region in everyday life, even though planning, budgeting, and governance remain legally separate.

The population of Jayapura Regency in 2025 was 203,772, with the average adult having completed senior secondary education (high school or through Grade 12). The primary livelihoods in Jayapura Regency are gardening and farming, fishing, hunting, and livestock raising. Jayapura Regency's GRDP in 2024 reached IDR 11,251.92 billion, with agriculture, forestry, and fisheries contributing 17.78%, underscoring their importance to both the economy and household food systems. Local wisdom regarding waste management among some Jayapura Regency residents includes prohibiting the disposal of waste into Lake Sentani; a village-cleaning program for every traditional celebration; and the community's practice of collecting food scraps to be used as animal feed.

Merauke Regency is located in South Papua Province, covering an area of 46,791 km², and is divided into 22 districts. The population of Merauke Regency in 2025 was 255,168, and on average adults have completed lower secondary education (through Grade 9). Predominant Merauke Regency livelihoods include agriculture (especially rice and sago), fisheries (both capture and cultivation), hunting and forest gathering (traditional livelihoods), livestock (pigs and cattle), and local product processing industries with diversification efforts through processed **Micro, Small, and Medium Enterprise** (MSME) products. The Marind tribe, one of Papua's coastal tribes, resides in Merauke. Its members maintain deep cultural ties to forest foods, viewing plants and animals as relatives who shares feelings and ancestral spirits. This worldview fosters a profound respect for natural resources—especially food—which fundamentally shapes their attitudes and behaviors regarding waste and resource management.

Table 1. Snapshot of context for Jayapura and Merauke Regencies

	JAYAPURA	MERAUKE
Area (km²)	17,516	46,791
Districts	19	22
Population (2025)	203,772	255,168
Education of average adult	senior secondary education (through Grade 12)	lower secondary education (through Grade 9)
Primary livelihoods	gardening and farming, fishing, hunting, and livestock raising	agriculture, fisheries, hunting and forest gathering, livestock, and local product processing industries
Local wisdom regarding waste management	prohibiting the disposal of waste into Lake Sentani; village-cleaning programs for every traditional celebration; practice of collecting food scraps to be used as animal feed	Marind tribe members maintain deep cultural ties to forest foods, which fundamentally shape their attitudes and behaviors regarding waste and resource management

Sago dough. Sago is a common subsistence crop in Papua New Guinea

TERM BANK

Micro, Small, and Medium Enterprise: MSME products are deeply rooted in local natural resources and Papuan cultural heritage.

FOOD WASTE MANAGEMENT DATA AND COMMUNITY INTERVENTION RESULTS

Within the two-year pilot period, specifically from May to December 2025, WWF partnered with Delterra to apply a systemic approach to food waste reduction and methane mitigation in Jayapura and Merauke. Building on previous Delterra initiatives tested in Bali, this collaboration was an end-to-end demonstration of how awareness and behavioral change, local capacity building, and waste-system improvements can effectively integrate within a low-infrastructure context.

The study's recommendations for both regencies prioritize reducing food waste by upgrading landfill management toward controlled or sanitary standards, expanding wasted food utilization and processing systems, strengthening waste-management regulations and enforcement, and implementing public awareness campaigns that build on the following social and cultural factors:

- ⇨ Both Jayapura and Merauke show willingness to reuse organic waste, but system-wide improvements and sustained engagement are needed to boost sorting and proper disposal.
- ⇨ Culturally informed communication is essential; effective messaging must align with spiritual and moral values related to stewardship, cooperation, and respect for nature.
- ⇨ Behavior change strategies should focus on major waste generating sectors, especially households and the hospitality/leisure (Horeka) sector, which contribute significantly to food waste.
- ⇨ Leveraging local traditions, stories, and local leaders increases trust, cultural relevance, and long-term adoption of sustainable waste practices.

Simulation of data sampling in baseline training at the WWF Papua Program Office, Jayapura Regency

Simulation of data sampling in baseline training at the WWF Papua Program Office, Jayapura Regency

Understanding Waste Levels, Source & End Destinations

Jayapura and Merauke generate substantial levels of food waste despite differing economic profiles, with Jayapura producing an estimated 66 kg per capita per year—comparable to higher-GRDP cities such as Depok and Cirebon—and Merauke generating about 40 kg per capita per year (**Figure 1**). Source data indicate that **households are by far the dominant contributors to food waste in both cities**, underscoring the central role of consumer behavior, while markets, restaurants, and hotels make a more significant contribution in Merauke than in Jayapura; smaller generators such as schools, religious institutions, public spaces, and offices are excluded from the identified hotspots (**Figure 2a**). Composition analysis further reveals **a substantial proportion of edible food waste in both locations, highlighting missed opportunities for prevention, recovery, and redistribution** and emphasizing the potential to redirect food away from disposal toward social and environmental benefits (**Figure 2b**).

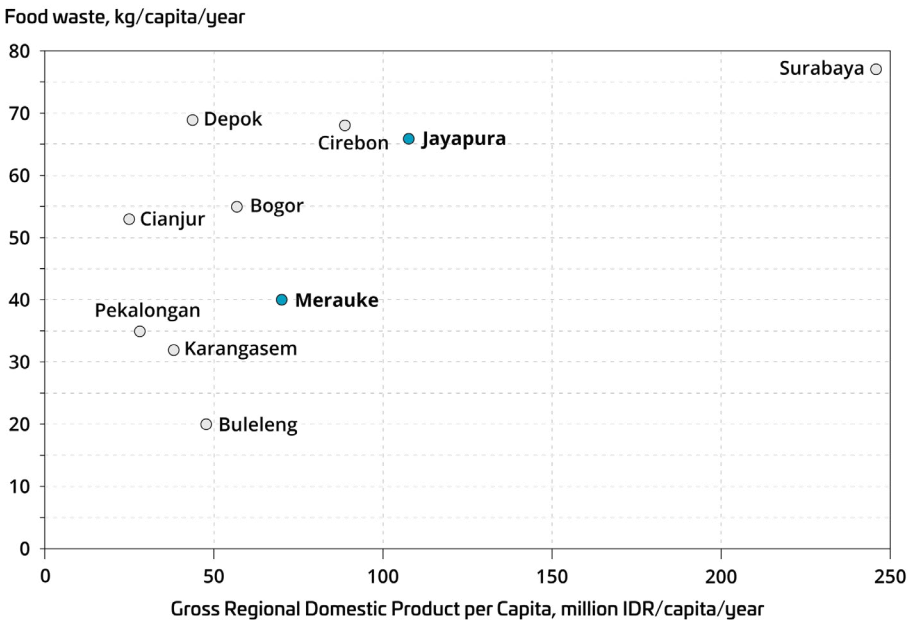


Figure 1. Food waste levels in Jayapura and Merauke compared to similar cities in Indonesia and their GDRP. Jayapura generates 66 kg/cap/year of food waste, on par with higher GRDP areas like Depok and Cirebon in terms of food waste. Merauke generates 40 kg/cap/year of food waste.

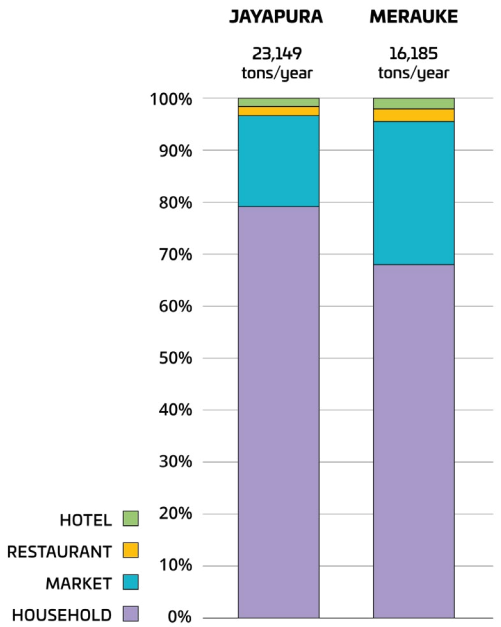


Figure 2a. Food waste sources with a focus on hotspots in Jayapura and Merauke. In both cities, households are by far the largest source of food waste. Markets, restaurants, and hotels contribute more food waste in Merauke than in Jayapura. Hotspots exclude schools, religious organizations, public spaces, and offices.

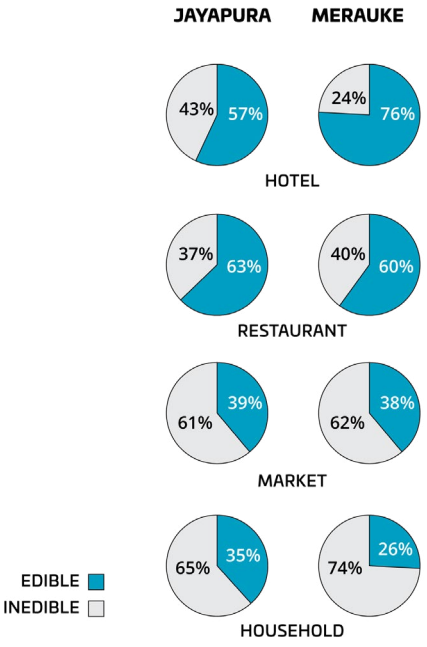


Figure 2b. Food waste composition of edible vs inedible in Jayapura and Merauke. There is a significant share of edible food waste, providing greater opportunity for recovery and redistribution.

Source: Analysis from waste composition in Jayapura and Merauke. WWF & Delterra, 2025.

Assessing Infrastructure Constraints + Solutions

Baseline research shows that despite Indonesia's national ambitions to reduce food loss and waste, waste management systems in Jayapura and Merauke remain severely constrained, leaving most wasted food unmanaged (**Table 2**). Jayapura generates roughly 23,100 tonnes of food waste annually and Merauke about 16,200 tonnes, with an estimated 50% and 83% respectively being landfilled, openly dumped, or burned under current practices. Formal collection, separation, and treatment of organic waste are extremely limited: Jayapura's Environmental Department operates in just 3 of 19 districts and relies on dumping without treatment, while Merauke serves only one district and lacks a formal processing system, despite some informal diversion by pig farmers and waste pickers. These local conditions reflect broader implementation challenges, including unenforced source separation regulations, gaps in infrastructure and budgets (with waste spending around 0.3% of regency budgets versus the national recommendation of ~3%), limited access to capital, weak offtake markets for recovered food or compost, and insufficient institutional capacity and partnerships. While community practices and traditional norms discourage waste and support informal reuse, the absence of reliable services, financing, and coordinated governance prevents these efforts from scaling into sustainable, systemwide solutions.

Table 2. High-level comparison of waste management infrastructure constraints in Jayapura and Merauke Regencies.

DIMENSION	JAYAPURA REGENCY	MERAUKE REGENCY
Settlement pattern	Dispersed mix of periurban areas around Sentani and many small rural villages, making collection routes fragmented and costly	Very wide, low-density regency with remote villages spread across plains and wetlands, creating long transport distances
Waste collection coverage	Limited coverage outside Sentani and nearby growth areas; many rural districts lack regular collection services, with only 3 of the 19 districts served	Very limited coverage outside Merauke town, only serving 1 out of 20 districts; most rural areas rely on informal dumping or burning
Final disposal facilities	Relies on basic landfill/**TPA** infrastructure with limited capacity and weak environmental controls	An existing small waste facility **(TPS)** only functions as a transit point before landfilling, with limited informal food waste diversion (e.g., pig farmers collecting the food waste)
Transport and logistics	Hilly terrain, lake areas (Sentani Lake), and road constraints complicate waste hauling and increase costs	Long distances, poor road conditions in wet seasons, and fuel costs constrain regular transport
Waste segregation & treatment	Lack of existing efforts and programs for waste sorting. Poor recycling infrastructure with only one waste bank operates with minimal coverage.	Very limited segregation or treatment; recycling depends largely on informal collectors
Institutional capacity	Local government faces budget and institutional constraints, with waste management competing against basic service needs and **DLH** leadership turnover	Even more constrained institutional capacity due to scale of territory and lower fiscal resources
Community practices	Burning and informal disposal common in rural and lakeside communities	Burning and dumping in open areas or waterways widespread in rural villages
Environmental risks	Pollution risks to Sentani Lake and surrounding ecosystems	Pollution risks to wetlands, rivers, and agricultural land
Overall constraint profile	Moderate urban pressure combined with weak rural service reach	Extreme spatial scale with very limited infrastructure and service penetration

TERM BANK

TPA: Tempat Pemrosesan Akhir (previously Tempat Pembuangan Akhir), which means Final Waste Processing Site—commonly referred to as a landfill. The final facility where municipal solid waste is disposed of after it has been collected and transported from households, markets, and other sources. It is the last step in the formal waste management system.

TPS: A TPS is a local, short-term waste collection site where garbage from households, markets, or businesses is temporarily deposited before being transported to a TPA (landfill) or another treatment facility.

DLH: Dinas Lingkungan Hidup refers to the local government agencies responsible for environmental management, protection, and cleanliness.

Applying the Research: Community-Based Behavior-Change Interventions

A central component of the work with Delterra was piloting behavior-change interventions at the household level, delivered through trusted community institutions such as youth groups and faith-based organizations. These pilots tested simple, culturally relevant actions including better meal planning, portion control, food storage, and waste sorting. While the pilots were small and time-bound, they provided valuable early insights. Rice was the single largest contributor to edible food waste in both cities. Key barriers included difficulty estimating portions, children not finishing meals, and reluctance to eat reheated rice or papeda. Informal diversion of food scraps to pig farmers represents an existing pathway worth formalizing.

The household-level interventions involved 15 households across Jayapura and Merauke. In Jayapura, edible food waste per capita decreased by 44% (0.09 to 0.05 kg/capita), likely due to improved portioning and meal planning, while in Merauke it increased (0.02 to 0.06 kg/capita), driven by seasonal mango surplus, rising rice leftovers, and children's uneaten food—underscoring the need for sustained, seasonally responsive interventions. Although based on a small sample and short measurement period warranting further validation, these results signal early promise: educators strengthened their knowledge, communities showed willingness to change, and both cities identified clear opportunities to improve waste management systems.

Importantly, the work confirmed that a systems-wide approach—linking infrastructure, awareness, and engagement—is essential for success.

Sago Sep ("Dakh Sep") is a traditional dish of sago, young coconut, and meat, slow-cooked with hot stones in layers of banana leaves and bus bark; typically served during Yamu rituals, weddings, and ceremonies honoring special guests

WWF staff visiting the Samb Kai Kindergarten, Our Lady of the Scared Heart, school located in Wendu, Merauke

Marind Tribe (Malind Anim or True Humans) youth from the Samb Kai Kindergarten gather for a community lunch in Wendu, Merauke.

Forecasting Key Financing + Potential Emissions Reduction

With wasted food projected to grow by 49% in both regencies by 2045, the proposed diversion strategy targets about half of potential wasted food across the two regencies (**Figures 3a** and **3b**). Jayapura and Merauke must close their solid waste management budget gaps and allocate **CAPEX** and predictable **OPEX** for waste collection and organic waste processing. This could be achieved by investing in solutions like centralized composting at a regency waste facility combined with home composting, and nature-based treatment using Black Soldier Fly (BSF) larvae.

The modelled diversion covers organized collection and processing in centralized composting facilities, as well as at-home composting. We also encourage exploring other

TERM BANK

CAPEX: Upfront spending on long-term assets that are expected to last for many years.

OPEX: Ongoing, recurring costs required to operate and maintain assets and services.

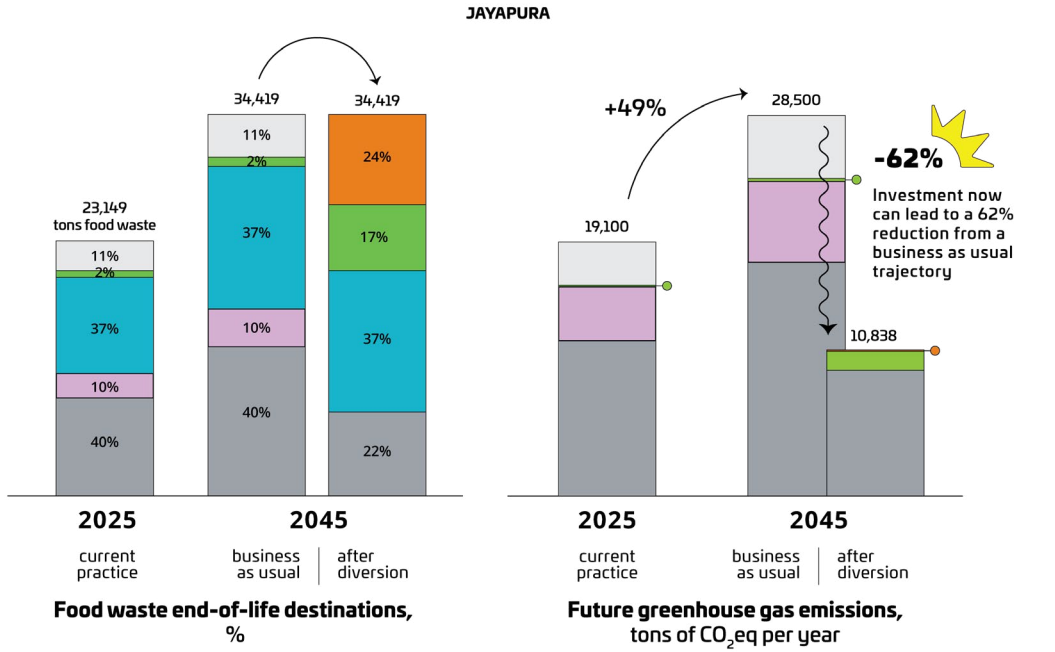


Figure 3a. Potential impacts of timely investment on food waste end-of-life destinations and associated greenhouse gas emissions in Jayapura.

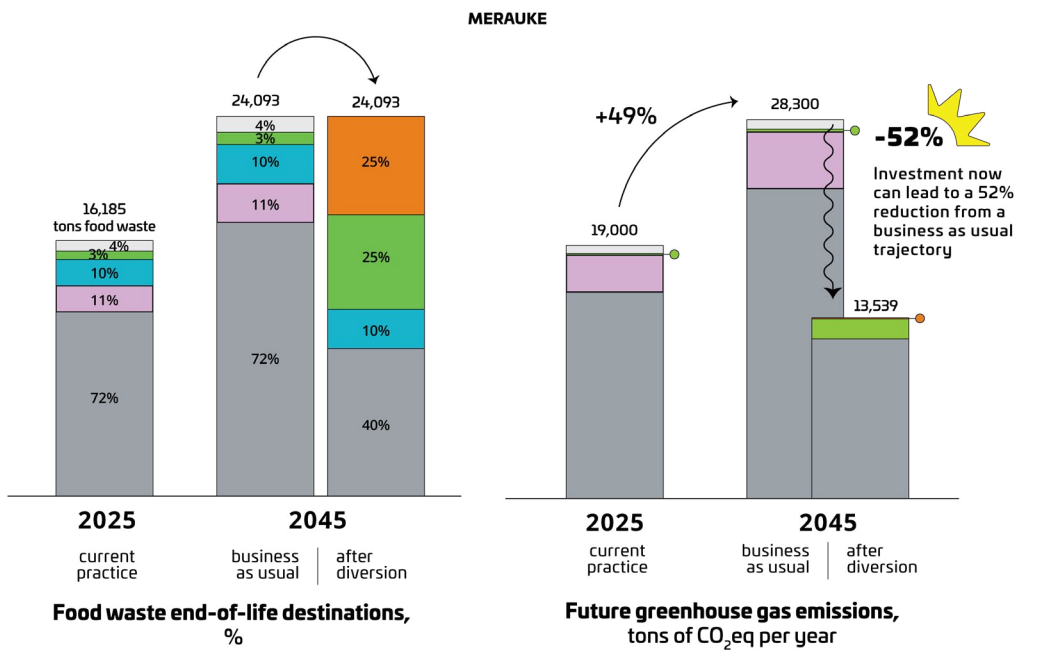


Figure 3b. Potential impacts of timely investment on food waste end-of-life destinations and associated greenhouse gas emissions in Merauke.

technologies such as BSF, when the regencies are confident they can secure consistent organic waste supply (wasted food and organic debris), and are able to run multiple BSF revenue streams (collection fee, larvae feed, edu-tourism). The key considerations for each solution are outlined below. Costs for collection and composting processing are benchmarked against the Badung TPST Mengwitani in Bali, a proven 20 tonnes per day municipal composting model by Delterra.

- ⇨ **Collection:** We propose doubling current collection capacity (16 trucks in Jayapura and 15 trucks in Merauke). At a cost of roughly $90,000 per truck, this would require a capital investment of $1.2–$1.4 million in each jurisdiction, and an annual operating cost of about $190,000–$300,000 (this would include personnel compensation, fuel, and maintenance).
- ⇨ **Centralised Composting:** We estimate a capital investment of about $1–$1.2M for Jayapura and $1.5–$2M for Merauke is required for infrastructure and equipment (i.e. machinery, shredding and pre-composting equipment, and composting hangar construction, conveyors, etc.). An annual operating cost of around $50–$80K for Jayapura and $100–$140K for Merauke would be needed for personnel, utilities, consumables, and maintenance.
- ⇨ **Home/Neighborhood Composting** can be an essential solution for Papua and complement centralized processing, with home composting kits sold at ~$8 per kit. Neighborhoods could also begin decentralized composting and feed scrap hubs where communities create locations that can take micro-aggregation and collection. There are several examples of these hubs active in Jakarta and other Indonesian cities.
- ⇨ **Black Soldier Fly (BSF)** treatment costs are modelled on the CCAC's BSF guide "Transforming Organic Waste with Black Soldier Flies" (2025), a lower-tech, manually-operated system designed for smallholder and community-scale operations and well-suited to Papua's context. At a lower end of the cost assumptions, the capital investment would be $1000–$4000 per tonne of installed daily processing capacity, while the annual OPEX per tonne of daily processing capacity would be about $6000–$7000 (including consumables, maintenance, and staff). This system will require electricity and running water and is best operated as a dedicated facility running year-round.

Composting materials and signage at Tampan Kompos in Jakarta


WWF visits Tampan Kompos, a neighborhood eco-park in Jakarta where people compost organic waste and grow plants together as part of a community sustainability effort

Dony Kristiawan, WWF waste management specialist overviews BSF lifecycle at the WWF-Indonesia Papua program office in Jayapura


Black Solder Fly larvae processing wasted food

Current municipal waste budgets cannot absorb these costs alone. Expecting local governments to leap from allocating approximately 0.3% of their budgets to the nationally recommended 3% in a single budget cycle is neither feasible nor credible to local decision-makers. At the same time, the investments required to close the infrastructure gap in regencies like Jayapura and Merauke, typically in the range of $1 million–$3 million, occupy a missing middle in the financing landscape: too large for local budgets but too small to attract direct multilateral development bank lending. This gap can be bridged through a phased approach, complemented by concessional grants, national support, technical assistance from donors and multilateral private partners.

Among those mechanisms, national government has a critical role to play in enabling this transition. Indonesia's DAK: Dana Alokasi Khusus (Special Allocation Fund) represents one of the most accessible financing channels. DAK Fisik for sanitation and environmental infrastructure has been used in the past and continues to be available in alignment with national priorities to fund solid waste equipment and facility construction across Indonesian regencies. The Ministry of Public Works funded the construction of a waste facility (TPS3R) in Citarik Village, Sukabumi Regency in 2016, one of hundreds of community-level waste processing sites built under national programs.[25] A monitoring report by the Ministry of Public Works (PUPR) covering 2015 to 2022 recorded 922 TPS3R (waste facilities) units built nationwide with government funding of approximately IDR 500 million (approximately $30,000–$34,000 per unit, depending on the exchange rate at time of construction) per unit.[26] More recently, Banyumas Regency in Central Java developed an integrated waste management system incorporating composting, sorting machinery, and refuse-derived fuel processing, supported by national and regional programs,[27] demonstrating what sustained public investment in waste infrastructure can achieve at regency scale.

Furthermore, at the national level, both Ministry of Environment (formerly KLHK) and Ministry of Public Works (PUPR) have led national programs for waste reduction infrastructure since the mid-2000s, with KLHK implementing 3R promotion programs since 2007 and PUPR conducting community-based pilot projects for waste facilities across cities including Malang, Jambi, Sidoarjo, and Jombang.[28] More recently, PUPR co-financed the Solid Waste Management for Sustainable Urban Development (SWM-SUD) project in partnership with the Asian Infrastructure Investment Bank (AIIB), channelling investment through regional infrastructure agencies and local environmental agencies for landfill upgrades and integrated waste processing facilities across participating cities.[29] Jayapura and Merauke governments can access these financing schemes and programs through coordinated planning submissions aligned with their RPJMD (Regional Medium-Term Development Plan) and annual work plans.

25 **Waste4Change.** *CommunityBased Waste Management and TPS3R Development in Indonesia.* Waste4Change, Jakarta, 2022, pp. **6–8**.

26 **Sleman Regency Government; Ministry of Public Works and Housing (PUPR).** *Evaluation of TPS3R Development and Performance in Indonesia (2015–2022): Lessons from Sleman Regency.* Sleman Regency Environmental Agency in collaboration with PUPR, Yogyakarta, 2024, pp. **9–11**.

27 **Oktaviani, R.; Prasetyo, A.; Nugroho, S.** *Integrated Waste Management Development in Banyumas Regency, Central Java.* Journal of Environmental Management and Sustainability, Vol. 7, No. 2, 2023, pp. **112–116**.

28 **Japan International Cooperation Agency (JICA).** *Data Collection Survey on Solid Waste Management Sector in Indonesia.* JICA, Tokyo, 2017, pp. **15–18**.

29 **Asian Infrastructure Investment Bank (AIIB).** *Solid Waste Management for Sustainable Urban Development (SWMSUD) Project.* AIIB, Beijing, 2025, pp. **4–7**.

A PHASED APPROACH ALIGNED WITH THE WASTE HIERARCHY

A phased approach can be developed using the waste hierarchy for the generation and management of municipal waste[30] to allow local governments to build capacity incrementally while managing fiscal risk (**Table 3**). While comparable examples from Papua itself remain limited, the underlying principles, starting with community engagement and low-capital interventions before scaling infrastructure, are particularly relevant in regions with nascent waste management systems. UNDP, GIZ, and other development partners have supported waste management pilot programs in eastern Indonesia including in NTT and Maluku, and lessons from these contexts should inform implementation design in Jayapura and Merauke.

This phased sequencing is consistent with the experience of comparable Indonesian cities. Surabaya built its waste management system incrementally over more than two decades, beginning with community-based composting and waste bank programs in the early 2000s before scaling to integrated facilities, earning multiple international recognitions including the Lee Kuan Yew City Prize Special Mention in 2018. Banyumas Regency followed a similar trajectory, starting with household-level source separation and education before investing in centralized processing infrastructure including composting and refuse-derived fuel facilities. These examples show that phasing is not a constraint but a strength: cities that invested in community participation and institutional capacity first consistently outperformed those that prioritized infrastructure without the behavioral and system foundation in place.

30 **United Nations Environment Programme (UNEP).** *Global Waste Management Outlook 2024: Beyond an Age of Waste.* UNEP, Nairobi, 2024, pp. **54–56**.

PHASE 1: PREVENTION, REDUCTION, AND REUSE (YEARS 1–2)

The first phase prioritizes upstream interventions through policy, community education, and partnerships with producers and retailers. These measures require comparatively modest investment, primarily in awareness campaigns, capacity building for local stakeholders, and regulatory frameworks that incentivize waste reduction at source. Establishing this behavioral and institutional foundation is critical: without source separation and community participation, downstream infrastructure cannot function effectively regardless of capital invested.

PHASE 2: COMMUNITY-SCALE RECYCLING AND RECOVERY (YEARS 2–4)

From there, cities can build incrementally by introducing community-scale recycling and recovery solutions, starting with lower-capital interventions such as communal composting and BSF bioconversion. These can be deployed at neighborhood level, generate recoverable value from organic waste in the form of compost and insect protein, and build local technical capacity before larger infrastructure is committed. This phase is well-matched to DAK Fisik allocations and donor co-financing, given its relatively modest unit costs and measurable outputs.

PHASE 3: CENTRALIZED WASTE FACILITY (YEARS 4–7+)

Once the collection system, community participation, and operational capacity are in place, cities can move toward centralized waste facilities capable of processing mixed waste streams at scale, including material recovery, energy recovery, and controlled disposal. This phase represents the largest capital commitment and is most appropriate for blended finance instruments, including concessional loans, green bonds, or co-financing arrangements with PUPR or multilateral partners.

Table 3. Waste hierarchy for the generation and management of waste in various sectors.

		GOVERNMENTS	PRODUCERS	RETAILERS	WASTE MANAGEMENT	CONSUMERS
Upstream	Prevent	⦿	⦿	-	-	⦿
	Reduce	⦿	⦿	⦿	-	⦿
	Reuse	⦿	⦿	⦿	-	⦿
Downstream	Recycle	⦿	⦿	-	⦿	⦿
	Recover energy, heat; control emissions	⦿	-	-	⦿	⦿
	Dispose	⦿	-	-	⦿	⦿

Source: Authors' elaboration on the waste hierarchy (UNEP and International Solid Waste Association [ISWA] 2015, p.31; Lansik 2018).

CLOSING

This report demonstrates that reducing wasted food is among the fastest, most cost-effective actions available to cut methane emissions while delivering simultaneous benefits for food security, biodiversity, and local economies. The Papua pilots in Jayapura and Merauke Regencies show that even in a low-infrastructure context, meaningful progress is possible when national policy ambition is paired with city-level implementation, culturally grounded community engagement, robust data, and targeted investment in organics systems. Indonesia now has a rare alignment of need, policy momentum, and practical evidence—positioning it to move decisively from pilots to scale. When cities take action and invest seriously in organic processing and business development, countries like Indonesia can transform wasted food from a climate and food security liability into a solution for people, nature, and the economy. Jayapura and Merauke have shown that delivering on SDG 12.3 and methane mitigation is not theoretical—it is already underway, and Indonesia is positioned to show the world what accelerating that progress looks like. ■

Lake Sentani, Jayapura

together possible

PHOTO CREDITS

COVER: © Tim Laman / naturepl.com / WWF

PAGE 2: © Osorio Embulaba / WWF

PAGE 3: © Brent Stirton / Getty Images

PAGE 4: © Osorio Embulaba / WWF

PAGE 5: Top © istock / Sony Herdiana; Bottom © Osorio Embulaba / WWF

PAGE 6: top © Tim Laman / naturepl.com / WWF; bottom © naturepl.com / Alex Mustard / WWF; circles top to bottom © Brent Stirton / Getty Images / WWF, © Brent Stirton / Getty Images / WWF, © WWF / Tim Flannery, © William Geif Iwanggin / WWF, © Pete Oxford / naturepl.com / WWF

PAGE 7: © Brent Stirton / Getty Images

PAGE 8: © Osorio Embulaba / WWF

PAGE 9: © WWF

PAGE 11: © Osorio Embulaba / WWF

PAGE 13: © Allie Hines / WWF

PAGE 16: © iStock / Indra Arya Pratama