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Smart Waste Management for SDG Localization in **Aqaba**: A Policy Framework for Integration, Alignment, and Partnerships

Policy Paper – 2026



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3 GOOD HEALTH AND WELL-BEING

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Smart Waste Management for SDG Localization in Aqaba: A Policy Framework for Integration, Alignment, and Partnerships

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PREFACE

Achieving the 2030 Agenda requires more than translating global goals into national targets — it demands that sustainable development be rooted in the realities, needs, and capacities of local territories. Local and regional governments are indispensable actors in this process: they deliver essential services, address inequalities on the ground, and turn policy commitments into concrete actions. Yet this critical role is only fully effective when backed by strong evidence, meaningful knowledge exchange, and coherent governance across levels.

The Local2030 Knowledge and Scientific Network (KSN) was established within the UN Local2030 Coalition precisely to respond to this need. As a dynamic global platform, KSN connects young researchers, policymakers, community leaders, and practitioners around a shared mission: to harness science for sustainable development with local impact. It does so by aligning academic inquiry with the specific priorities of local development stakeholders, while amplifying research findings as inputs to SDG-related global processes.

Central to this approach is the understanding that research must not only be produced — it must be translated into policy and action. KSN promotes a more dynamic and responsive model of academia, one that co-creates scalable solutions rooted in scientific evidence and community priorities, and that empowers local actors with the skills, tools, and institutional support needed to engage in evidence-based decision-making and influence policy. Through its Country Pilots — sponsored by the Italian government and implemented by UN-Habitat and the Centro Studi di Politica Internazionale (CeSPI ETS) — and Innovation Labs, the network operationalizes this vision by connecting universities and students with local policymakers, enabling interdisciplinary collaboration and capacity-building in territories across Africa, Asia, and Latin America and the Caribbean.

Action-research is the methodological backbone of this work. Territories are engaged not as passive subjects of study, but as spaces for experimentation and learning, where sustained interaction between researchers, local governments, civil society, and communities drives learning, adaptation, and co-creation. By combining quantitative and qualitative methods — data analysis, spatial assessments, stakeholder engagement, and participatory approaches — this process generates a comprehensive and grounded understanding of local dynamics, inequalities, and

development opportunities.

This policy paper is the result of that process. It reflects the outcome of collaboration between academic research, territorial analysis, and multi-stakeholder dialogue, in the spirit of the KSN's core objective: translating research into policy and action. Its aim is to offer context-sensitive analysis and practical policy recommendations that can inform SDG localization at the local level – bridging the gap between global agendas and the communities that will ultimately determine their success.

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EXECUTIVE SUMMARY

Aqaba's waste collection service provides broad territorial coverage; however, service quality varies across zones and seasons. Collection is organized through fixed routes and scheduled pickup times under a contractor-led model supervised by the Aqaba Special Economic Zone Authority (ASEZA). While this approach ensures coverage, it does not reflect variable demand patterns. In tourism and commercial corridors, containers can reach capacity before the next scheduled collection, while in lower demand residential areas, vehicles may service partially filled bins. This mismatch reduces operational efficiency, increases fuel and labor costs, and creates visible cleanliness risks in high profile coastal areas.

Waste generation in Aqaba is shaped by a mix of household, commercial, tourism related, port, and industrial activities. Demand therefore differs by location and season: waterfront and commercial districts experience sharp fluctuations linked to tourism peaks and economic activity, while other neighborhoods generate more stable daily volumes. Applying a uniform service approach across these diverse waste streams contributes to recurring overflow hotspots and inefficient vehicle movement.

As Jordan's only coastal city and a gateway for tourism and trade, Aqaba has a direct interest in maintaining high environmental standards consistent with national Blue Economy priorities. Waste management is therefore not only a municipal service function, but also a strategic pillar for protecting the marine ecosystem, safeguarding the city's image, and supporting sustainable local development.

This policy paper proposes a structured transition toward demand-responsive waste management focused on operational improvement rather than complex technological overhaul. The objective is to strengthen visibility of waste conditions in priority areas, support adaptive scheduling, and enhance route planning through integration with ASEZA's existing GIS and regulatory oversight tools.

Three priority actions are recommended:

- Launch a targeted pilot in two to three priority zones, including a tourism/commercial corridor and a dense residential area, to measure zone level waste patterns and test demand-responsive service adjustments.

- Establish a municipal operations dashboard integrating container status, vehicle movement, collection performance, and citizen complaints to enable routine oversight and faster response.
- Update procurement and contracting clauses to formalize data sharing, performance reporting, and responsiveness standards within the existing private sector service framework.

To strengthen actionability, implementation should start with a cost contained pilot supported by a preliminary cost estimate and affordability assessment. The pilot should be assessed against baseline indicators such as cost per ton collected, vehicle kilometers per route, overflow incidents per week, and response time, allowing ASEZA to evaluate whether operational gains justify scaling.

ASEZA is institutionally positioned to lead this transition by aligning contractor performance requirements with municipal oversight mechanisms and strengthening internal coordination across sanitation, environmental regulation, GIS/IT, and finance units. With phased implementation and structured monitoring, Aqaba can position itself as a scalable pilot model for smart, accountable municipal waste management in Jordan.

1. PURPOSE AND TERRITORIAL CONTEXT

1.1. Purpose and scope of the policy paper

This policy paper supports localization of Sustainable Development Goals (SDG) by presenting a practical framework for modernizing municipal solid waste management in Aqaba. It focuses on strengthening service responsiveness and data-informed decision-making within the existing municipal governance structure, moving beyond static, scheduled collection toward demand responsive operations. Waste management is treated as a core urban service that contributes directly to environmental quality, economic competitiveness, and alignment with national climate and green growth commitments.

The analysis is informed by consultations with ASEZA departments and a review of existing planning and regulatory instruments. It translates operational and spatial observations into implementable recommendations that can guide municipal teams, national counterparts, and development partners. Particular attention is given to leveraging ASEZA's existing Geographic Information System (GIS) capacity, strengthening monitoring practices, and adjusting operational routines so that collection frequency and routing reflect actual demand patterns.

From an implementation perspective, the paper concentrates on areas where ASEZA can act directly within its mandate. This includes urban corridors, waterfront tourism zones, commercial streets, port districts, and dense residential neighborhoods where waste pressures are highest and most variable. The focus remains on operational improvements container placement, service frequency, routing logic, data reporting, and oversight mechanisms while large-scale infrastructure questions such as landfill engineering or national recycling markets remain outside the scope.

The document does not constitute a detailed feasibility study. Rather, it provides a strategic and actionable framework that clarifies the problem, defines measurable objectives, and outlines institutional roles and partnership pathways. It is intended to support ASEZA and national stakeholders in developing a scalable smart waste management initiative aligned with SDG localization and national environmental priorities.

1.2. Aqaba's urban, economic, and environmental role

Aqaba occupies a strategic position in Jordan's territorial and economic landscape. As the country's only coastal city and seaport, and a designated Special Economic Zone under the mandate of the Aqaba Special Economic Zone Authority (ASEZA), it functions as a gateway for trade, tourism, and logistics. Port operations, industrial activities, hotels and resorts, commercial centers, and expanding residential districts coexist within a compact coastal geography. Seasonal tourism peaks, cruise arrivals, and holiday traffic add temporary but significant pressure to this permanent urban base.

This mix of functions generates differentiated waste streams across the city. Residential areas primarily produce household waste, while tourism and commercial districts generate higher volumes linked to visitor flows and service activity. Port and industrial zones contribute operational and commercial waste associated with logistics and economic activity. A study on municipal solid waste in Aqaba reported that the city generates approximately 120 tons of municipal solid waste per day, reflecting both the resident population and tourism-related activities such as hotels, restaurants, and port services. This figure corresponds to roughly 54,000 tons of waste annually, based on municipal estimates and waste characterization studies conducted for the city.

Waste generation patterns vary considerably by land use intensity, time of year, and economic activity. Residential neighborhoods typically produce relatively stable daily volumes linked to household consumption, whereas tourism and commercial areas generate higher and more variable quantities associated with visitor activity and service industries. Seasonal tourism peaks, cruise ship arrivals, and holiday periods can create temporary surges in waste generation in waterfront and commercial districts. Tourism destinations often experience significantly higher waste production because visitors generate additional consumption and packaging waste through hospitality and leisure activities. As a result, containers located in high-activity areas such as the Corniche, hotel zones, and commercial streets may be filled much faster than those in lower-density residential neighborhoods.

Aqaba's location on the Gulf of Aqaba also places environmental responsibility at the center of municipal service delivery. The marine ecosystem is a national asset for

tourism, biodiversity, and fisheries. Cleanliness, waste containment, and pollution prevention are therefore directly linked to the city's economic resilience and to national Blue Economy priorities. Improper waste management can contribute to marine pollution, affect coral reef ecosystems, and reduce the attractiveness of coastal tourism areas. At the same time, air quality and emissions concerns associated with port operations, industrial activity, and urban traffic reinforce the need for efficient and environmentally responsible service systems.

Waste management is a strategic enabler of urban development, environmental protection, and economic sustainability. Ensuring reliable collection services and preventing waste overflow in high-visibility areas such as tourism corridors and waterfront zones is essential to maintaining Aqaba's reputation as a clean coastal destination while protecting sensitive marine environments and supporting long term economic development.

1.3. Basis for the analysis

The analysis builds on ASEZA's existing planning instruments, regulatory framework, and GIS capabilities. It examines how current service delivery implemented through private-sector operators under ASEZA supervision can be strengthened through improved oversight, data integration, and performance management.

The policy paper identifies practical mechanisms to enhance responsiveness, monitoring, and adaptive service planning. It proposes focused monitoring in priority zones, integration of operational data into ASEZA's GIS environment, and the development of a simplified operations dashboard to support routine management decisions. The approach is designed to work within current institutional mandates while progressively introducing more evidence-based service optimization.

2. MUNICIPAL WASTE MANAGEMENT CHALLENGE IN AQABA

This section assesses current service performance under the existing contractor led collection model and identifies operational and institutional gaps. It also clarifies how these challenges affect environmental protection, economic performance, and alignment with Sustainable Development Goals (SDG) and national priorities.

2.1. Service model and performance gaps

2.1.1. Fixed schedules versus variable demand

Municipal solid waste collection in Aqaba is currently managed through a fixed route schedule and scheduled pickup times delivered by contracted private-sector service crews under ASEZA supervision. Whilst this approach ensures basic service delivery, but it does not account for variable waste generation patterns across zones and seasons.

Aqaba serves a population of more than 150,000 and experiences seasonal tourism peaks that create sharp changes in daily waste volumes. Demand also varies by waste stream and land use, including household, commercial/tourism, and port/industrial activity areas. In popular tourist and commercial streets, containers can overflow long before the next pickup, while in low density residential areas trucks may arrive to find bins only partially filled.

Zone level magnitude (pilot baseline): To strengthen evidence on scale differences (Zone A tourism/commercial corridor vs. Zone B dense residential area), the proposed pilot will record tons/day (or trip load estimates), overflow incidents/week, complaints/week, and collection frequency in each pilot zone to quantify demand

and service mismatch.

2.1.2. Spatial hotspots and inefficient resource use

The fixed route collection system does not respond to spatial disparities in waste production. High-density and high-activity zones (e.g. the Corniche beachfront and downtown markets) produce substantially more waste and require more frequent attention, particularly during weekends and peak tourist seasons. However, without an adaptive system, these areas may receive the same service frequency as quieter neighborhoods. The result is overflowing bins and litter in hotspot areas and underutilized collection capacity elsewhere. Crews spend time and fuel servicing locations that may not yet need collection, which represents an inefficient use of resources. In Aqaba, municipal solid waste collection and transport cost approximately 3.3 million Jordanian Dinars annually, while the city generates around 150 tons of waste per day (UNEP, 2019). Inefficient routing and unnecessary collection trips therefore increase operational costs through additional vehicle kilometers, fuel consumption, and labor hours, reducing the overall cost-effectiveness of the service. Over time, these imbalances strain the operational budget, as vehicles travel unnecessary distances and labor hours are spent on low-yield routes, while high-demand areas may still experience service gaps. Operational evidence indicators that can be tracked during the pilot include vehicle kilometers per route, fuel use per cycle, and the share of visits where bins are below 50% capacity.

2.1.3. Limited monitoring and decision feedback

Limited use of monitoring and data for daily decision-making is a critical gap in the current system. Supervisors typically learn of overflowing containers through field reports or citizen complaints rather than structured alerts. Route planning remains dependent on static routines rather than updated demand signals. This reduces situational awareness and limits ASEZA's ability to adjust collection frequency or routes when demand increases in specific zones.

Opportunities for adaptive, data informed management

The performance gaps outlined above indicate where practical smart tools can support improvement. Table 1 summarizes opportunities for adaptive and data informed management.

Table 1: summarizes opportunities for adaptive and data-informed management.

Operational challenge	Current practice	Smart opportunity	Expected benefits
Uniform schedules vs. variable waste	Same daily collection frequency across all areas, regardless of actual waste	Introduce adaptive scheduling (higher frequency in high waste zones, lower in low waste zones)	Preventing overflow in busy areas, reduce unnecessary trips, align service levels with real demand
Fixed routes and collection inefficiencies	Trucks follow fixed routes even when some bins are empty or under used	Use route optimization and dynamic routing based on real time or predicted bin status	Shorter travel distances, lower fuel use and operating costs, trucks only visit locations that need service
Lack of real time monitoring	Limited or no use of smart bins, sensors, or GPS tracking for waste operations	Deploy digital monitoring tools (bin sensors, vehicle tracking systems)	More responsive pickups, better oversight of contractor performance, faster identification of problem points
Limited data driven decision making	Decisions based on static plans	Establish a data management model with a central dashboard analyzing records and complaint logs	Evidence adjustments to routes, manpower and bin locations, more strategic investment and planning

2.2. Impacts on tourism, environment, and costs

The operational performance of the current waste management system has broader implications for tourism, environmental quality, and municipal cost efficiency in Aqaba. These impacts are discussed below in relation to city image, public health, and economic performance.

Tourism and city image:

Aqaba's attractiveness as a tourist destination relies heavily on the cleanliness of its public spaces. Overflowing waste containers in prominent streets, beachfront areas, and commercial zones can significantly reduce visitor satisfaction and undermine the city's image and competitiveness as a tourism hub.

Environmental quality and public health:

Overflowing containers and illegal dumping increase the risk of coastal pollution and affect a sensitive marine ecosystem that includes coral reefs. This is particularly relevant for Aqaba's coastal development priorities and national Blue Economy direction. Unmanaged waste also attracts pests and raises public health risks, while practices such as open dumping or burning release harmful pollutants.

Local development and economic efficiency:

Uneven service quality can weaken public trust and quality of life. Unnecessary trips and emergency cleanups place pressure on municipal budgets. Cost drivers in the current model are primarily vehicle movement (km), fuel, labour hours, and unplanned response trips, which is why improving routing efficiency and preventing overflow is directly linked to cost control.

2.3. SDG and national targets linkages

The challenges and opportunities in Aqaba's municipal waste management are directly linked to broader sustainable development objectives. Improving collection reliability, reducing overflow incidents, and strengthening efficiency supports SDG

localization through measurable municipal performance.

The proposed pilot and monitoring framework can also be aligned with UN-Habitat's Waste Wise Cities Tool, which provides a standardized methodology for measuring municipal solid waste generation, collection, and controlled management under SDG indicator 11.6.1. This would strengthen the comparability of Aqaba's waste data and support future reporting and benchmarking.

Alignment with the sustainable development goals:

Improving collection reliability and reducing overflow contributes to SDG 11 (Sustainable Cities and Communities). Expanding diversion and service efficiency supports SDG 12 (Responsible Consumption and Production). Reducing unnecessary vehicle movements contributes to SDG 13 (Climate Action) through lower emissions, while improved sanitation supports SDG 3 (Good Health and Well-being).

Contributing to national plans and commitments:

Jordan's development and green growth strategies treat waste as a key sector for environmental protection and climate action. ASEZA's Strategic Plan (2024-2028) prioritizes integrated waste management, creating a mandate for phased modernization. By generating zone-level operational indicators through the pilot, Aqaba can strengthen SDG monitoring (including indicator 11.6.1) and provide transferable lessons for national scaling.

3. GOVERNANCE, PLANNING, AND POLICY ENVIRONMENT

3.1. ASEZA mandates, bylaws, and GIS tools

ASEZA's authority over waste services:

Municipal waste management in Aqaba is managed by the Aqaba Special Economic Zone Authority (ASEZA), which functions as the city's local governing body with delegated national authority. This institutional model differs from most other Jordanian municipalities. ASEZA is directly responsible for planning, contracting, and supervision of waste collection and disposal. Collection and street cleanliness services are delivered through contracted private-sector operators, while ASEZA retains regulatory authority, contract management, and performance oversight. Operationally, ASEZA's City Services Directorate coordinates with a contracted cleaning company to maintain city cleanliness, provide and place waste containers, and carry out daily waste collection and disposal. ASEZA also operates inspection and public health units, demonstrating its operational authority to enforce environmental rules and sanitation bylaws within the Zone.

Bylaws and service standards:

Waste collection in Aqaba is governed by local service bylaws and regulations issued by ASEZA's Board of Commissioners. These instruments define collection requirements, set contractor performance expectations, and establish environmental and cleanliness standards, including in tourism areas. ASEZA's environmental regulation (2001) prohibits haphazard waste dumping and requires appropriate facilities and permits for waste disposal activities. These regulations provide the legal framework for current practices, but they were developed in the context of manual monitoring and fixed schedules. As a result, existing bylaws leave limited room for real time operational adjustments and do not yet reflect the use of sensors, digital reporting, or dynamic routing. This creates a practical opportunity to strengthen contractual requirements for data sharing and performance indicators that measure responsiveness and cleanliness outcomes.

Role of GIS and spatial tools:

ASEZA's Planning and Geographic Information System (GIS) unit maintains spatial datasets and zoning maps that support a range of urban management functions. The existing GIS platform has the potential to strengthen waste management by enabling mapping service areas, identifying recurring waste accumulation hotspots, and linking field reports to priority locations. However, consultation feedback suggests that GIS is still underutilized in the sanitation sector. A practical measure is to integrate an operational waste layer into ASEZA's GIS, including container status reporting, route coverage, and overflow reports. A GIS linked dashboard can flag locations with repeated overflows and support adjustments to collection frequency and routing, particularly in high pressure zones.

ASEZA has also begun exploring the use of drone monitoring systems to support urban management and environmental observation. Such tools could complement GIS waste monitoring by identifying illegal dumping sites, monitoring container conditions in remote areas, and supporting spatial pattern recognition for waste generation and service gaps.

3.2. National waste, climate, and digital transformation frameworks

This framework aims to align Aqaba's smart waste modernization with Jordan's national priorities on waste management, climate action, and digital transformation. It translates national strategies into actionable steps at municipal level, while strengthening data reliability, improving service efficiency, and enhancing monitoring and reporting in line with the Sustainable Development Goals (SDGs). The alignment between national frameworks and local actions is summarized in Table 2.

Jordan has also begun introducing Extended Producer Responsibility (EPR) approaches to improve waste recovery and recycling. Initiatives such as the Amman Vision recycling programme, which recently signed a cooperation agreement with Aqaba focusing initially on packaging materials, demonstrate how producer responsibility schemes may complement municipal waste management systems over time.

Table 2: Alignment with national waste, climate, and digital transformation frameworks

National framework (mandate)	Strategic direction (national level)	What the Aqaba initiative contributes (local action)	National counterpart
National Waste Management Strategy and related solid waste plans	Improve service efficiency, increase recycling and resource recovery, strengthen data reliability	Modernizes collection operations, reduces inefficiencies, and improves data availability for future recovery actions	Ministry of Local Administration (MoLA), Ministry of Environment (MoEnv)
Green Growth National Action Plan (GG-NAP) 2021-2025	Promote resource efficiency and greener public services	Strengthens operational efficiency and supports cleaner public spaces, improving the enabling conditions for circular economic initiatives	MoEnv, MoLA
National Climate Change Policy and NDCs (Paris Agreement)	Mitigate emissions from key sectors including waste, reduce pollution and improve environmental performance	Reduces unnecessary trips and fuel use through optimized service planning, supports improved urban air quality and climate targets	MoEnv
Digital Transformation Strategy 2021-2025	Modernize public services through data integration, transparency, and responsive governance	Introduces data municipal service management (monitoring and dashboard to enable decision making) that can be replicated by other cities	Ministry of Digital Economy and Entrepreneurship (MoDEE)

National SDG coordination and reporting	Strengthen SDG localization and improve national indicator reporting	Generates city level service data that can support reporting on waste related indicators and urban environmental performance	Ministry of Planning and International Cooperation (MoPIC)
Environmental regulation and compliance oversight	Ensure environmental standards and monitoring of waste operations	Strengthens local compliance monitoring and improves availability of operational/ environmental data for national oversight	MoEnv
Municipal service governance and coordination	Ensure coherence of municipal service delivery models across Jordan	Positions Aqaba as a pilot model with lessons that can inform national programs	MoLA
First National Strategy for Blue Economy	Protect marine ecosystems, reduce coastal pollution risks, and support sustainable coastal development	Strengthens waste containment and cleanliness in coastal and tourism zones, reducing leakage risk to the Gulf and supporting Blue Economy objectives	MoEnv, MoPIC (and relevant national stakeholders)

3.3. Partnerships and SDG 17: Local National Global Coordination

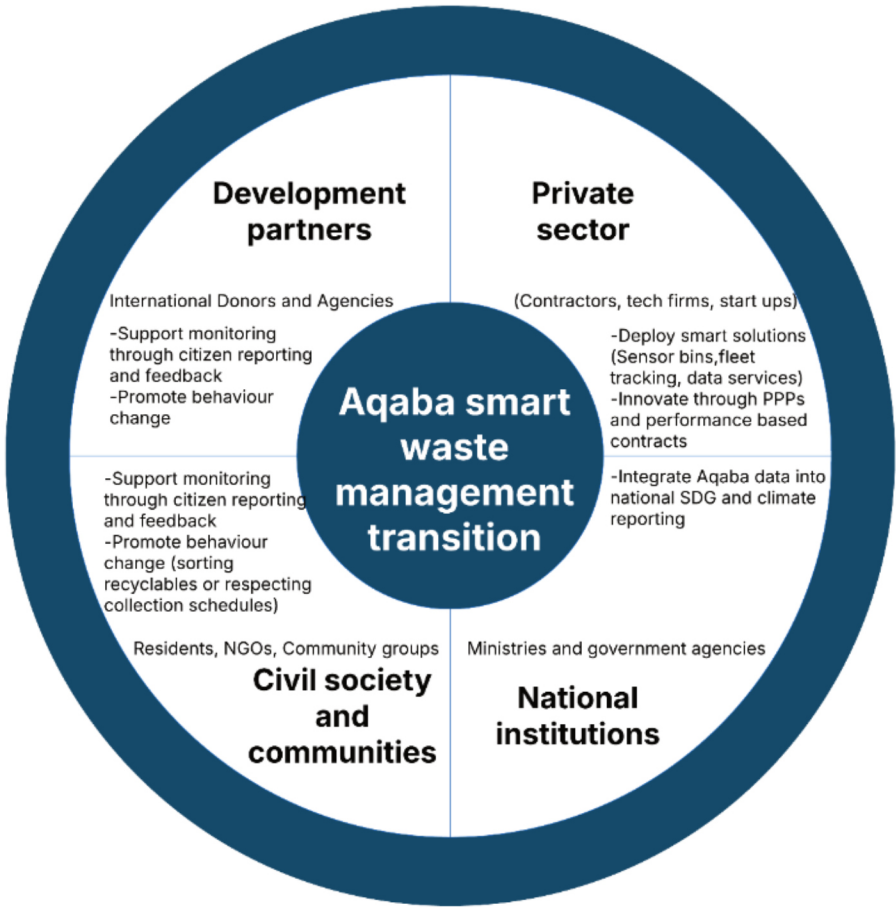
Achieving Aqaba's smart waste development and SDG localization requires coordinated partnerships across local, national, and international levels aligned with SDG 17 (Partnerships for the Goals). ASEZA leads city level implementation and ensures policy alignment and reporting, while international partners can provide targeted technical assistance and financing. Table 3 outlines the partnership ecosystem by clarifying leadership, roles, and contributions across actors, while Figure 1 illustrates the multi-stakeholder structure and relationships supporting the

smart waste transition.

Table 3: SDG 17 partnership roles and contributions

Partner group	Role in the initiative	Contribution (policy level)
ASEZA (local authority)	Lead and coordinator	Strategic oversight, operational decision making, integration with municipal planning and GIS, coordination across departments and contractors
Private sector (contractors, technology firms)	Service delivery and innovation	Technology waste services, performance operations, data provision under contractual arrangements
National institutions (MoEnv, MoLA, MoDEE, MoPIC)	Policy alignment and scaling	Regulatory guidance, integration with national waste, climate, and SDG reporting frameworks, pathways for replication in other cities
Civil society and communities	Participation and accountability	Citizen feedback, awareness and behavior change support, community level service monitoring

Figure 1: Multi stakeholder partnership ecosystem for Aqaba’s smart waste transition



This structured partnership model enables ASEZA to lead implementation while ensuring national alignment, community inclusion, and access to international support. It positions Aqaba as a scalable pilot for municipal service modernization and SDG localization in Jordan.

4. FINDINGS AND STRATEGIC INSIGHTS

4.1. Operational and technological opportunities

The analysis identifies three operational findings that explain current performance gaps and indicate where practical smart tools can improve service reliability, efficiency, and oversight.

Finding 1: Collection operations are not aligned with real demand.

Waste collection is organized around fixed routes and set schedules, even though waste generation differs by zone, land use, and season.

Evidence indicators (pilot): collection frequency by zone, container fill rate, and the share of visits where bins are below 50% capacity.

Finding 2: Hotspots drive most complaints and cleanliness risks.

Tourism and commercial areas experience repeated overflow incidents and complaints because containers reach capacity before the next scheduled pickup.

Evidence indicators (pilot): overflow incidents per week by zone, complaints per week by zone, and response time to overflow events.

Finding 3: Inefficiencies increase operating costs and reduce reliability.

Unnecessary trips and uniform routing increase vehicle kilometers, fuel consumption, and labor hours, particularly when demand rises in peak periods.

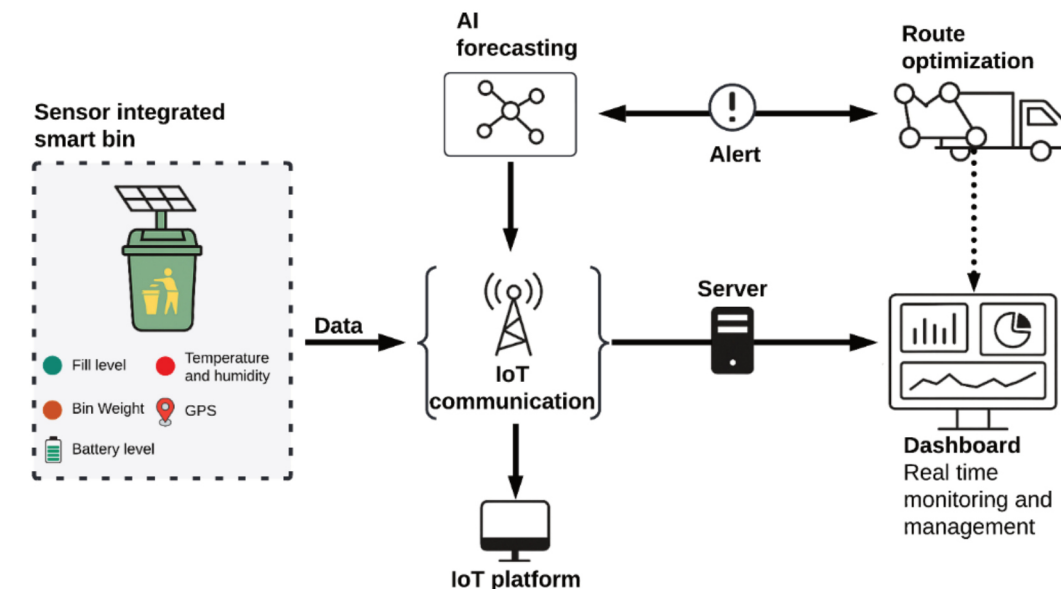
Evidence indicators (pilot): vehicle kilometers per route, fuel consumption per cycle, and overtime hours linked to unplanned response trips.

Strategic insight and opportunity

These findings support a shift from schedule collection to demand responsive

operations supported by routine service visibility. Initial improvements can be achieved through practical measures such as container status reporting in priority zones and fleet tracking for route oversight. Integrating these inputs into a GIS linked operations dashboard would provide ASEZA with a consolidated view of container conditions, vehicle movement, and service performance, supporting faster response, better resource allocation, and more reliable service during seasonal peaks. As illustrated in Figure 2, this process links sensor-based data collection, IoT communication, predictive analysis, and operational decision-making into an integrated management workflow.

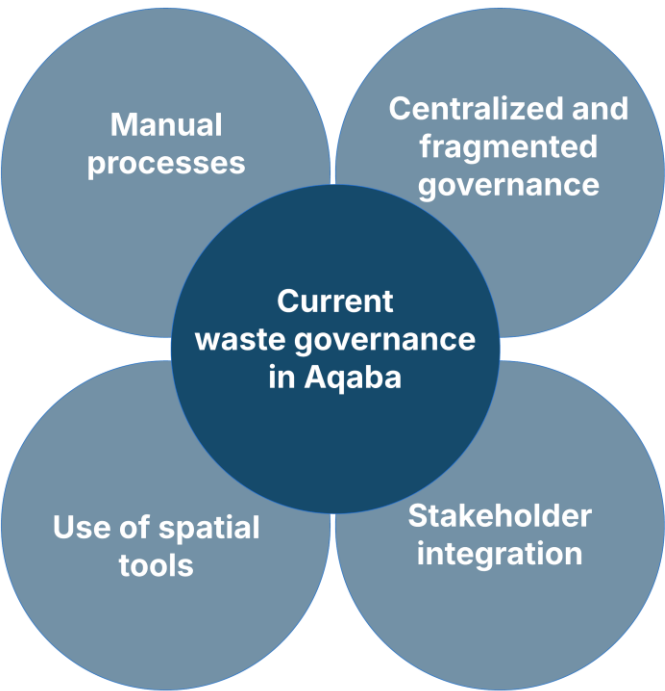
Figure 2: Conceptual flow of waste collection and decision support in real time



4.2. Institutional and coordination gaps

Despite the operational opportunities identified above, Aqaba faces institutional and coordination gaps that limit effective waste governance, as illustrated in Figure 3. These gaps relate to the clarity of roles, consistency of data reporting, and coordination between ASEZA units and contracted service providers.

Figure 3: Institutional and coordination gaps



4.3. Strategic lessons for a smarter waste system

A smarter and more adaptive waste system in Aqaba requires that operational modernization is matched by institutional coordination and accountability. International practice indicates that technology improves service delivery when governance arrangements, performance management, and staff procedures develop in parallel. Aqaba should embed participation through accessible feedback channels that allow residents and businesses to report service gaps and support ASEZA in prioritizing responses, while ensuring equitable service improvements across neighborhoods.

Linking operational performance to national priorities strengthens continuity and political support. ASEZA can align key performance indicators with SDG and national targets by tracking overflow incidents, service reliability, and fuel efficiency so that local improvements support national waste, climate, and SDG reporting. Structured

data sharing arrangements with relevant ministries and routine performance reviews can support consistent implementation.

A phased approach is recommended. Aqaba should start with pilots in a limited number of zones, document operational gains, and scale progressively based on evidence and capacity. Early phases should adopt a hybrid approach that combines smart monitoring with existing field practices to improve reliability and cost efficiency while strengthening staff readiness and procedures over time.

5. POLICY DIRECTIONS AND RECOMMENDED ACTIONS

5.1. Strategic objective and guiding principles

This policy presents a practical transition toward demand responsive waste collection in Aqaba that improves service reliability and cost efficiency and aligns with national climate priorities and Sustainable Development Goals. Table 4 outlines guiding principles for implementation.

Table 4: Guiding principles

Guiding principle	Description
Scalability	Design solutions that are able to expand from pilot projects to full city wide implementation. The approach should be viable in the long term and replicable in other cities and positioning Aqaba as a national model for smart waste management.
Responsiveness	Ensure that the system can adjust to real time conditions and feedback. Dynamic routing and decision making should be able to rapid responses to overflowing bins or service complaints by improving service speed and reliability.
Sustainability	Priority for environmental and financial sustainable practices. The initiative should reduce fuel use and emissions through efficient routing, support recycling, and explicitly link local performance metrics to SDG targets (improving collection coverage for SDG 11.6, lowering emissions for SDG 13.2) and Jordan’s Green Growth and climate strategies.

5.2. Institutional strengthening and governance reforms

Strengthening ASEZA’s institutional arrangements is essential to implement the smart waste initiative. Table 5 outlines reforms to improve coordination,

accountability, and alignment with national goals.

Table 5: Institutional strengthening and governance reforms

Reform area	Key actions (institutional)	Institutional / SDG benefits
Cross-department coordination	Establish a formal ASEZA waste management committee under ASEZA Include sanitation services, environmental regulation, IT/GIS, and finance units Use the committee to jointly plan routes, bin locations, and use of new technologies, with clear roles and communication channels.	Eliminates siloed efforts and overlap. Speeds up operational decisions. Ensure that operational, technical, and financial decisions are aligned.
Data governance and reporting	Create a central waste data platform integrated with ASEZA’s GIS. Log bin fill levels, collection times, vehicle routes, and citizen complaints in (near) real time. Produce regular management dashboards (monthly) and map indicators to SDG 11.6.1 (collection coverage) and 12.5.1 (recycling rate).	Enables data route and resource adjustments. Provides structured evidence for national SDG and climate reporting. Increase transparency and performance monitoring of contractors and municipal teams.
Policy alignment and oversight	Update ASEZA internal policies and bylaws to support adaptive scheduling and innovation. Require the waste committee to report quarterly to ASEZA leadership on progress and challenges. Coordinate with the Ministry of Environment and other national agencies to align with national waste management guidelines and secure technical advice or funding.	Provides a clear mandate and oversight framework for the smart waste initiative. Ensures consistency with national waste, climate, and Green Growth strategies. Strengthens political support and access to national and international funding.

Contractual implications (private operator): Because waste collection is delivered through contracted private sector operators, implementation requires limited contractual adjustments. The pilot phase can be delivered through a targeted contract addendum covering selected zones, defining data sharing requirements (e.g., route logs, timestamps, complaint response records) and performance indicators based on cleanliness outcomes and responsiveness. This reduces transition risk while maintaining continuity of service delivery.

The proposed dashboard should be managed by ASEZA as the lead municipal authority, with operational input provided by the contracted private service operator and technical support from ASEZA’s GIS/IT unit. This arrangement would allow ASEZA to retain oversight of hotspot identification, service performance monitoring, and response prioritization across zones.

5.3. Operational and technological upgrades

Aqaba will pursue targeted operational improvements and selective technology adoption to modernize waste collection. Key upgrades are presented in Table 6.

Table 6: Operational and technological upgrades

Upgrade area	Practical actions	Expected operational benefits
Smart collection tools	Introduce demand-driven collection management by adopting real-time service visibility in priority areas, supported by container status monitoring, fleet tracking, and a city operations view linked to ASEZA GIS; establish minimum data reporting requirements for service operators.	Reduces overflow incidents and unnecessary trips, improves fuel and labour efficiency, supports cleaner public spaces and lower emissions through better route planning.

Pilot high-demand zones	Launch a targeted pilot in 2-3 high-pressure zones (tourism or commercial corridor and a dense residential area) to test routing, monitor service reliability, and document operational gains before city-wide scaling.	Demonstrates value in visible areas; reduces risk through phased adoption; generates local evidence to guide expansion and informs investment decisions.
Innovation-friendly procurement	Update procurement and contracting clauses to require technology reporting, service performance standards, and data sharing with ASEZA; introduce performance incentives linked to cleanliness outcomes, response time, and efficiency improvements.	Aligns private operators with modernization goals, strengthens accountability, embeds innovation in contracts, improves service reliability and operational efficiency.
Capacity building	Build operational and digital capacity within ASEZA and contractors by establishing a routine training programme on data use, response protocols, and performance management, and by assigning clear institutional ownership for system oversight and continuity.	Improves adoption and consistent use of tools, strengthens decision-making, reduces service disruption, and institutionalizes data operations within daily workflows.

5.3.1. Pilot budget and financial assessment

To ensure the proposal is actionable, the pilot phase should be accompanied by a preliminary cost estimate prepared by ASEZA and the contracted operator. This estimate should cover the minimum requirements for implementation, including monitoring and reporting tools, dashboard integration with ASEZA GIS, training and operational procedures, and monitoring and evaluation activities.

Affordability should be assessed by comparing pilot performance against the current baseline. The comparison indicators include cost per ton collected, vehicle kilometers per route, fuel use per collection cycle, overflow incidents per week,

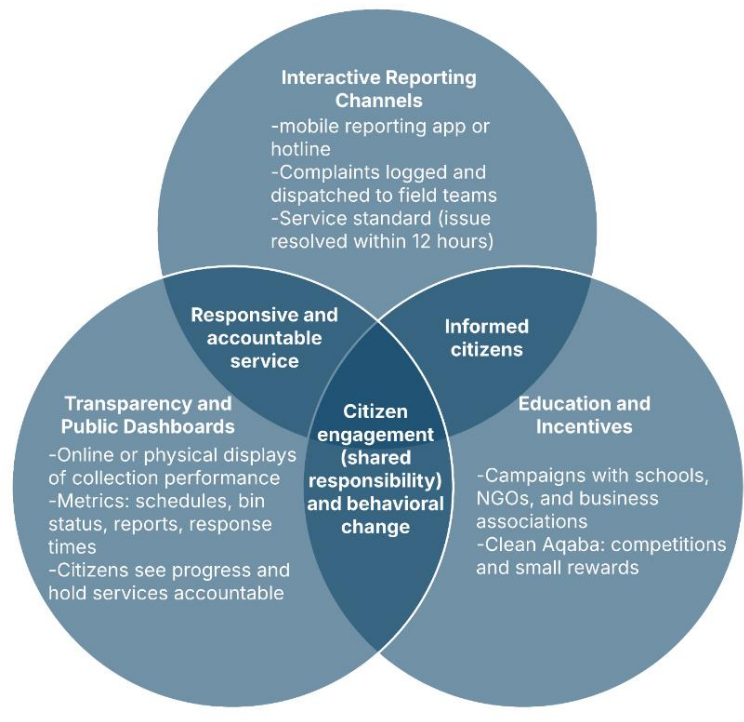
complaints per week, and average response time. This approach enables ASEZA to determine whether operational gains (reduced unnecessary trips and fewer reactive cleanups) offset implementation costs before scaling to citywide deployment.

Comparable demand-responsive waste collection approaches have been implemented through phased pilots in other cities, typically combining route visibility, performance dashboards, and targeted monitoring before broader rollout.

5.4. Citizen engagement and behavioral change

Active participation from residents and local businesses supports long-term service improvement, as illustrated in Figure 4. Engagement mechanisms should provide accessible channels for reporting overflow and service gaps, strengthen accountability through feedback loops, and support gradual behavior change in waste disposal practices. These measures reinforce service responsiveness and support equitable improvements across neighborhoods.

Figure 4: Citizen engagement and behavioral change



6. CONCLUSION

Aqaba’s municipal waste system covers most of the city. However, coverage alone does not guarantee a clean, cost efficient, and reliable service. The current collection model applies a largely uniform approach across the city, even though waste generation varies by zone and season. Tourism corridors, commercial streets, port districts, and residential neighborhoods produce different volumes at different times. This creates uneven service outcomes: high demand locations can overflow and generate repeated complaints before the next scheduled pickup, while some lower demand areas may still receive collection when containers are not yet full. Over time, these mismatches reduce service reliability and weaken public confidence in municipal service delivery.

Three operational issues explain these performance gaps. First, collection is organized around fixed routes rather than observed demand, limiting the ability to respond when conditions change across zones. Second, hotspot areas generate a disproportionate share of overflow incidents and complaints because container capacity is reached quickly between scheduled pickups. Third, unnecessary vehicle movement increases fuel and labor costs and reduces overall efficiency.

These issues reflect weak feedback loops between day to day data operations and the city’s spatial planning and oversight tools. ASEZA is positioned to respond because it holds the mandate for municipal services, regulatory authority, and GIS capacity, and it supervises contractor-led collection delivery. Measurable improvements can be achieved through targeted pilots in high-demand zones, a GIS linked operations dashboard for daily oversight, and governance measures that strengthen coordination and enable adaptive service planning.

To make the policy direction actionable for institutions and partners, the recommendations can be implemented as a focused package with four elements. First, a pilot should be launched in two to three zones, including a tourism or commercial corridor and a dense residential area, to quantify zone-level demand patterns and test demand responsive adjustments. Second, an operations dashboard should be linked to ASEZA’s GIS to consolidate container status reporting, collection performance, and citizen complaints for routine monitoring. Third, procurement and contracting clauses should be updated to formalize data sharing and responsiveness requirements within the existing service model. Fourth, a

monitoring framework should link service performance to SDG indicators and national reporting priorities, supported by clear reporting routines.

The pilot has three main values. It helps protect Aqaba's tourism image and the quality of public spaces in high visibility areas, while supporting coastal environmental protection consistent with national Blue Economy priorities. It can also improve cost efficiency by reducing unnecessary trips and strengthening operational control. In addition, it generates city-level evidence that supports SDG localization and strengthens national reporting on waste and urban environmental performance. A preliminary pilot cost estimate and affordability assessment based on baseline operational indicators should be prepared to support scaling decisions and partner engagement. Development support can focus on capacity building, dashboard integration, monitoring design, and phased deployment in priority zones, including performance partnerships with private operators.

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