

BEMED+ PROJECT

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Waste Management Sector: Evaluating the Municipal Waste System in Elbasan and Opportunities for Improvement

Authored by: JULIA DADO

Academic Advisor: Prof. Asoc. Dr. Perseta Grabova

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ABSTRACT:

This study explores how improving the waste management systems in the Elbasan and Librazhd municipalities of Albania, particularly when it comes to plastic recycling, can create both economic and environmental benefits. It evaluates how better waste sorting at the source, whether by households, institutions, or businesses, can help lower municipal disposal costs while also generating new revenue through recycling. By reviewing the existing waste management plans in both municipalities, the study maps out how the current waste management system works and identifies the key stakeholders involved in collecting, sorting, and processing waste. Special attention is given to the roles of public institutions, private companies, and informal sectors, as well as the types and volume of waste being handled in each area.

A critical part of the study is the assessment of economic benefits that could be realized through more efficient sorting practices: savings from reduced landfill use and clean-up operations, and potential income from selling sorted plastics to recycling companies rather than incinerating them. Municipality current situation is also analysed through qualitative interviews with municipal waste administrators and local recycling firms, yielding data on prices, demand, and logistical constraints. A cost-benefit analysis, based on local expenditure data and benefit valuation methods adapted from European literature is conducted to estimate the environmental and economic benefits of transitioning to a more circular model of waste management.

Overall, the study offers context-specific, economically viable recommendations to strengthen Elbasan and Librazhd waste management strategy. The findings are intended to inform policy-making, improve coordination between actors, and bring about a transition towards more sustainable and cost-saving municipal waste management practices.

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Disclaimer

The views and interpretations expressed in this study are those of the author and do not necessarily reflect the positions of BeMed, FFEM, IUCN, Surfrider Foundation Europe, INCA, or any other implementing partner. Responsibility for the content rests entirely with the authors.

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DICTIONARY

SDGs - Sustainable Development Goals

WTP - Willingness-to-pay

ML - Machine Learning

AI - Artificial Intelligence

LCA - Life Cycle Assessment

MSW - Municipal Solid Waste

LMIC - Lower Middle Income Country

DRS - Deposit Refund System

PET - Polyethylene Terephthalate

NPV - Net Present Values

ROI - Return On Investment

SCC - Social Cost of Carbon

EU - European Union

SEA - Strategic Environmental Assessment

EIA - Environmental Impact Assessments

CMD - Council of Ministers Decision

ERP - Extended Producer Responsibility

SECO - Swiss State Secretariat for Economic Affairs

URI - Urban Research Institute

CBA- Cost-Benefit Analysis

RCR - Benefit-Cost Ratio

NGO – Non Government Organizations

INTRODUCTION

Poorly managed municipal waste remains one of Albania's most pressing environmental issues, with Elbasan and Librazhd municipalities being this thesis main focus. Systems for collecting waste are frequently insufficient. In certain places, coverage is as low as 50%. This leads to open burning, illegal dumping, and rising environmental issues. Older infrastructure, low recycling rates, and a lack of source separation are among the gaps that still exist despite efforts to adapt to EU regulations. Additionally, limited public awareness leads to low participation in recycling programs and contributes to ongoing issues.

This thesis explores how improving municipal waste management systems with a emphasis on plastic recycling can produce both environmental and economic benefits for Elbasan and Librazhd. It explores how better sorting at the source (by households, institutions, and businesses) can reduce removal costs and create income through plastic recovery and recycling.

Waste management involves the collection, transport, treatment, and disposal of waste to protect public health and the environment. Traditionally, Albania has relied on linear systems like landfilling and incineration, which pose long-term environmental risks. In contrast, circular economy principles like reuse, recycling, and material recovery offer a more sustainable model. Plastic waste, in particular, is one of the main challenges for the environment, contributing to pollution and health risks if not properly managed.

This research provides a detailed assessment of how better plastic sorting can lead to cost savings (e.g., less landfill use, reduced clean-up) and new revenue (e.g., sale of recyclable plastics). It uses qualitative interviews with local officials and recycling firms, alongside cost-benefit analysis, to estimate the value of shifting toward a circular waste model. The study aims to propose practical recommendations for improving the waste management plans in Elbasan and Librazhd.

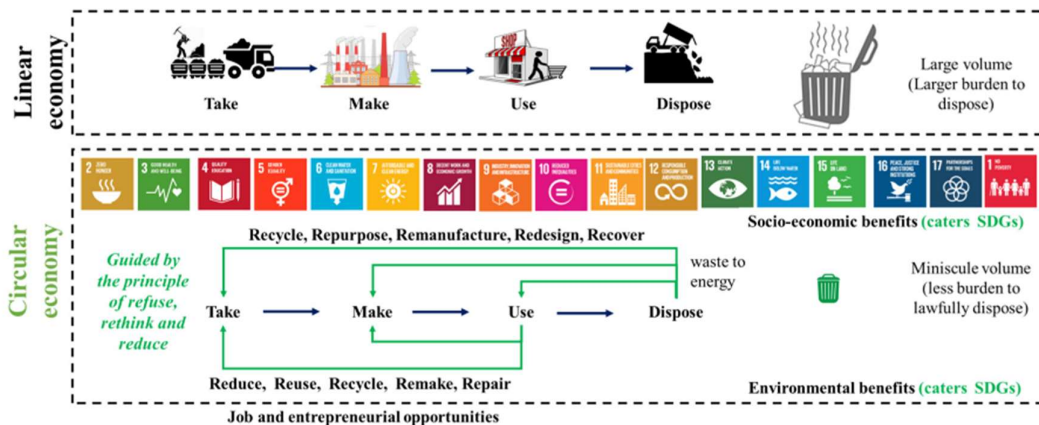
LITERATURE REVIEW

Core Concepts: Waste Management, Circular Economy, and Plastic Pollution

Waste management involves the organized processes of collection, transportation, treatment, and removal of waste products with the aim of reducing environmental impacts and protecting public health (Aiguoarueghian, I., Adanma, U. M., Ogunbiyi, E. O., & Solomon, N. O., 2024a). Traditionally, the processes have relied on linear systems such as landfilling and incineration. While these methods offer short-term solutions to waste disposal, they also have long-term consequences of contributing to resource depletion and environmental degradation. In response, there has been growing interest in a more sustainable alternative, namely the circular economy.

The circular economy offers a shift from the "take, make, use, dispose" model by encouraging the design of systems reducing waste at the source and recovering value from materials through reuse, recycling, and recovery (Aiguoarueghian, 2024b). The model attempts to keep materials and products in use in the economy for as long as possible, thereby achieving resource efficiency and reducing environmental harm. Simply explained with the 4 original Rs (reduce, reuse, recycle, and recover) the circular economy seeks to combine economic growth and sustainability through minimizing the need for extracting virgin resources. (Sharma, 2021).

Figure 1 The difference between linear and circular economy showing ways to achieve SDGs



Source: (Sharma, 2021)

One of the most pressing challenges within today's waste management systems is plastic pollution. Plastic waste refers to unwanted plastic materials, that due to their toughness and resistance to decomposition, have a tendency to stay in the environment for several decades (Pilapitiya, 2024). Because of this, plastic pollution and its widespread occurrence in natural

settings have grown to be serious issues that have an adverse effect on ecosystems, wildlife, and human health (Mihai, 2021). Plastic breaks down over time, which can potentially contaminate soil, water, and air. The particles can cause damage through ingestion by animals, leakage of chemicals, and potential transmission to the human food chain (Aiguoarueghian, I., Adanna, U. M., Ogunbiyi, E. O., & Solomon, N. O., 2024a). To address this issue, it requires effective waste management strategies and a deeper implementation of circular economy principles across all stages of the plastic value chain.

Plastic and waste management has a natural connection to the realization of many of the United Nations Sustainable Development Goals (SDGs) that address sustainable cities, consumption accountability, and protection of the marine ecosystem. SDG 11.6 calls for reducing the adverse environmental impact of cities by improving municipal solid waste collection and treatment in enclosed facilities. This objective targets the need to have cities improving their waste management system to have higher coverage and ecologically friendly treatment of plastic waste.

Furthermore, SDG 12.5 aims at substantially reducing waste generation through prevention, reuse, recycling, and recovery, three key principles of the circular economy. Since recycling occurs with just a fraction of the plastic waste around the world, this goal emphasizes shifting away from traditional linear waste management systems to more circular, effective reuse of resources. In addition, SDG 14.1 also aims to eliminate and prevent significantly marine pollution, specifically from land-based sources such as the mismanaged plastic waste. Since plastics break down into microplastics, they pose a great threat to aquatic life and human health. Therefore, the integration of circular economy principles into municipal waste systems is crucial to prevent plastic pollution at the source and minimize its other environmental impacts. (GIZ, 2020)

Figure 2 Adequate waste management is linked to a number of SDG indicators



Source: (GIZ, 2020)

Historical Evolution of Waste Management and Circular Economy

Waste management has changed dramatically over the years, moving from simple disposal methods to complex integrated systems motivated by sustainability and environmental concerns. The linear "take, make, dispose" models have historically dominated waste management, with a preponderance of conventional disposal techniques like landfilling and burning (Aiguobarueghian, I., Adanma, U. M., Ogunbiyi, E. O., & Solomon, N. O., 2024a). While these methods provided short-term solutions to the growing volume of waste, their long-term consequences included resource depletion, environmental degradation, and the production of unregulated dumping sites (Aiguobarueghian, 2024b).

A notable shift towards more integrated waste management approaches began to emerge with increasing environmental awareness. The concept of sustainable waste management, highlighting the interdependence of waste management and sustainable development, was formally classified at the 1992 UN Rio Conference (Moruf, 2020). This marked an essential moment, advocating for an all-inclusive strategy that recognizes the complexity of waste streams and the urgent need for systemic transformation (Aiguobarueghian, 2024b).

Key legislative indicators in Europe have gradually shaped this progress:

- **1970s–1980s: Environmental Legislation:** During this time, Europe's first legal frameworks relating to sustainable materials started to take shape, with the primary goal of the early policies being waste reduction at the source. An early focus on appropriate waste management was indicated by the introduction of the "Safe Disposal-Waste Policy" in the 1980s (Pilapitiya, 2024).
- **1990s: Introduction of Recycling Targets:** During the 1990s, recycling-specific policies were introduced. For example, a "Recycling Policy (1992–2003)" was implemented (Pilapitiya, 2024). These policies set the stage for future, more stringent goals, even though there were still obstacles in the way of reaching aggressive recycling rates (Caceres-Mendoza, 2023).
- **2010s: Rise of Circular Economy Frameworks:** The last decade, Europe has taken major steps toward adopting circular economy principles aiming to reduce waste and make better use of resources. A big milestone came in 2016 with the introduction of the "Resource Circulation Act", which laid the groundwork for a broader shift in policy (Pilapitiya, 2024). In early 2018, the EU implemented an inclusive "plastics strategy" with ambitious goals, including targets for all plastic packaging to be reusable or cost-effectively recyclable by 2030, and a significant increase in plastic waste recycling (Estefania Sanabria García, 2021). Reinforcing this commitment, the European Green Pact, introduced in March 2020, featured a circular economy action plan focused on advancing sustainable products and minimizing waste (Caceres-Mendoza, 2023). Most recently, the EU adopted the Packaging and Packaging Waste Regulation in November 2024. This legislation tightened targets for recycling and reusing packaging materials, further embedding circular economy principles into European law. These initiatives highlight a major shift towards keeping materials and products in use for as long as possible, emphasizing activities such as "sharing," "reducing," "reusing," "repairing," "renewing," and "recycling" (Caceres-Mendoza, 2023).

Socio-Cultural Scopes of Waste Management

As waste management has shifted from basic disposal to circular and integrated systems, socio-cultural factors have become gradually more crucial. While early efforts focused on infrastructure like landfills and incineration, modern strategies now depend just as much on public attitudes, social norms, and environmental awareness. Without community participation and behavioral change, even the most advanced systems are likely to underperform. Education, public engagement, and trust are therefore essential pillars of sustainable waste management today. (Aiguoarueghian, 2024b)

1. Public Awareness, Education, and Behavioral Change

Public education and environmental consciousness are the grounds upon which long-term waste management regimes are built. Awareness campaigns about the health and environmental impact of uncontrolled waste disposal such as plastic wastes in the oceans killing marine species are vital to generating a better understanding by the broader public and precipitating action (Aiguoarueghian, 2024b). These campaigns utilize a combination of traditional media, social media, and ground networks to shape attitudes and promote responsible behavior. But awareness alone is not enough. Long-term behavior change is guaranteed through the integration of social, psychological, and cultural aspects into programs (Brotosusilo, 2020). Training programs, or those that are integrated into school curriculum or company policies, prove effective to cultivate environmentally friendly behavior starting at childhood (Aiguoarueghian, 2024b). The overall performance of waste systems is significantly improved if citizens are sensitized and are actively engaged.

2. Social Acceptance and Community Involvement

Social acceptance and community involvement are vital for the implementation of waste policies that are effective and reasonable. If the citizens are made to feel involved in planning and establishment of waste services, they will be more inclined to follow sorting initiatives and participate in recycling schemes (Brotosusilo, 2020). Social cohesion and trust within communities enhance collective responsibility, and therefore the efficiency of community-led waste actions such as cleaning or recycling actions. These social dynamics must be integrated alongside technical and economic factors when assessing waste management interventions, allowing local communities to own their waste management responsibilities. Through awareness workshops, school competitions, or feedback at the household level, waste management can potentially mainstream green behavior in the long run.

3. Willingness-to-Pay for Waste Services

Willingness-to-pay (WTP) is the key driver of financial sustainability of waste services. It has been determined through research that individuals are willing to pay for recycling services, particularly when the environmental benefits are made widely known (Denne, T., Irvine, R., Atreya, N., Robinson, M., 2007). But translating this theory into actual payment behavior remains an undertaking, especially in low- to middle-income households. Research points out that unstable service quality, lack of trust in public institutions, and unclear tariff structures can decrease WTP and policy effectiveness. Transparency and value for money are crucial to increase public acceptance.

4. Cultural Norms and Recycling Barriers

Culture habits deeply ingrained can be a difficult obstacle to overcome in the success of waste management systems. Waste disposal habits in most environments are learned at a young age. Irregular sorting practices, misinterpretation due to differing regulation, and plain ignorance regarding recycling reflect a deeper policy of cultural delay that needs to be overcome. Altering such behaviors requires more than information campaigns, new social norms need to be constructed. This can be achieved by making it simpler, clearer through standardized signs, and using social influencers or rewards from the community to assist with beneficial behavior (Brotosusilo, 2020).

To put it simply, waste management's social-cultural dimension is not secondary it is primary. A coordinated, community-wide approach that includes awareness, education, participation, and incentives is essential to long-term success in sustainable waste systems.

Technological Innovations in Waste Sorting and Recycling

The fast global challenges regarding waste management has encouraged significant technological innovations aimed to improve the efficiency, effectiveness, and sustainability of waste sorting and recycling processes. These developments are crucial for transitioning towards a more robust circular economy.

1. Machine Learning , Artificial Intelligence , and Robotics in Waste Sorting

Machine learning, artificial intelligence (AI), and robotics are transforming waste sorting and management by introducing unique levels of automation and precision. AI and ML are improving sorting processes, optimizing resource use, and even extending product lifecycles through predictive maintenance (Sánchez-García, 2023). Digital modeling and Artificial Neural Network are being used to automatically sort and classify various waste types, significantly improving recycling efficiency and effectiveness (Szpilko, 2023). Automated waste recycling systems that use ML are designed to classify and separate materials in mixed recycling streams, significantly improving the accuracy and efficiency of the sorting process (Szpilko, 2023). For example, AI-powered sorting systems, increase the precision of material separation (Aiguobarueghian, 2024b). Beyond sorting, smart waste management systems, helped by AI, can even identify source material violations prior to waste collection, allowing for more effective enforcement and behavioral change (Szpilko, 2023).

2. Emerging Solutions: Chemical Recycling and Biodegradable Plastics

Outside traditional recycling practices, chemical recycling and biodegradable plastics represent developing solutions with unique potentials and challenges:

Chemical Recycling

Chemical recycling involves breaking down plastic into their fundamental monomers, which can then be reused as second-hand raw materials for new plastic products (Anwar, 2024). This cutting-edge method can process a wider range of plastics, including those considered challenging or impossible for conventional mechanical recycling methods. Chemical recycling

offers several benefits, such as reducing dependence on crude oil, creating new employment opportunities, and lowering plastic waste volume (Anwar, 2024).

Despite its potential, chemical recycling faces challenges. These include high operating costs, extensive investment requirements, the generation of chemical waste byproducts, and a substantial timeline to scale from pilot projects to industrial-level operations (Anwar, 2024).

Biodegradable Plastics

Biodegradable plastics are designed to decompose naturally, offering another end-of-life option like anaerobic absorption and composting, which are not feasible for traditional non-degradable plastics (Fayshal, 2024). They can even go through composting when dirty with food waste, an advantage over conventional plastics that would otherwise limit recycling efforts (Fayshal, 2024). These materials provide a path to reduce plastic pollution as they break down into simpler compounds like carbon dioxide, mineral salts, and water under appropriate environmental conditions (e.g., sufficient oxygen, humidity, temperature, and presence of microorganisms) (Pilapitiya, 2024).

The main challenge is related to their degradation rate, which is highly dependent on specific biotic and abiotic factors. This means that not all "biodegradable" plastics will break down effectively in all environments, leading to concerns about whether they truly solve the problem of plastic pollution in uncontrolled settings (Pilapitiya, 2024).

3. Improving Efficiency and Scalability through Innovation

Waste management systems' efficiency and scalability are being greatly increased by technological advancements. Robotics and AI improve the precision of material separation, leading to more effective recycling procedures and higher-quality recycled materials (Sánchez-García, 2023). Additionally, smart waste systems minimize fuel use and carbon emissions by optimizing collection routes (Sánchez-García, 2023). By anticipating consumption trends and enhancing material allocation, AI further promotes efficient resource use and increases return on investment (Sánchez-García, 2023). However, there are still concerns with the economic viability and general adoption of these new technologies (Aiguobarueghian, 2024b). Financial and robust regulatory support are needed for widespread implementation (Aiguobarueghian, 2024b).

Although mechanical recycling is efficient and economical, it can only be used for specific types of plastic. Despite being more adaptable, chemical recycling has higher expenses, more complicated processes, and a longer deployment period (Anwar, 2024). Therefore, balancing technological advancements with practical implementation and economic realities remains a key factor in realizing their full potential for waste reduction.

Economic Aspect of Waste Sorting and Cost-Benefit Analyses

Improved waste sorting at the source proposes considerable economic advantages for municipalities by decreasing the volume of waste directed to landfills and incineration. This not only reduces the financial burden of waste disposal but also creates new opportunities for revenue generation through the sale of sorted materials to recycling companies (Denne, T., Irvine, R., Atreya, N., Robinson, M., 2007). Such a transition is particularly important when considering that the long-term financial and environmental costs of mismanaged waste frequently surpass the initial investments needed for proper waste management systems (McGoodwin, 2018).

- **Cost Savings from Reduced Landfill Use and Cleanup Operations**

Cost savings are among the advantages that are most immediate and measurable financial benefits. By diverting large amounts of waste, landfill fees and operating costs can be significantly reduced for businesses and governments (Vokopola, 2024). Also the need for land used for garbage disposal are costs that can be reduced by reducing landfill use (Denne, T., Irvine, R., Atreya, N., Robinson, M., 2007). In many low-income nations, municipalities spend about 20% of their budgets on waste management, nonetheless, more than 90% of rubbish is still burned or dumped in the open (Sharma, 2021).

This disorganization suggests significant financial losses that could be eased through more structured waste sorting and improved infrastructure. Moreover, transitioning from open dumps to sanitary landfills has been shown to yield long-term savings by reducing environmental and public health risks (McGoodwin, 2018). These savings also extend to decreased spending on clean-up operations, especially when dealing with pollution from illegal dumping or unmanaged waste.

- **Revenue from Selling Sorted Plastics to Recycling Companies**

In addition to savings, there is an opportunity to earn additional funding through sorting and selling. Many municipalities can generate significant income by selling correctly sorted plastics to recycling companies. The revenue from such materials can somewhat or fully balance the costs related with collection and sorting activities. For instance, the market value of recycled plastics can range from 300\$ to 800\$ per ton, (Zaman, 2016) depending on quality and type. However, the profitability of recycling specific plastic types varies, as it is influenced by product yield, quality and market price. These values often vary with global oil prices, further linking the plastic recycling economy to broader commodity markets (Mihai, 2021).

- **Avoided Environmental Degradation Costs**

Finally, improved waste management reduces the indirect economic costs associated with environmental degradation. When waste is correctly sorted and diverted from landfills and incinerators, municipalities can avoid the consequences of pollution, including greenhouse gas emissions, soil contamination, and water and air pollution (Aiguobarueghian, 2024b). These impacts often result in hidden, or indirect, but substantial, costs related to public health and

environmental restoration. Calculating the benefits of avoided degradation can include, for example, evaluating reductions in carbon emissions and applying models that estimate the social cost of carbon (McGoodwin, 2018), offering municipalities a clearer picture of the economic value of sustainable waste practices.

Economic and Environmental Trade-Offs

Choosing a waste management method involves complex trade-offs, as recycling, incineration, and landfilling, each with specific economic and environmental impacts affecting both short-term finances and long-term sustainability.

1. Costs vs. Benefits of Different Waste Pathways

The economic feasibility and environmental impact of waste management strategies differ significantly depending on the approach:

- **Landfilling:** While often a low-cost disposal choice in the short term, landfilling carries considerable long-term environmental and economic consequences. The decomposition of waste in landfills, particularly organic materials, generates biogas composed primarily of methane and carbon dioxide, both potent greenhouse gases contributing to climate change. Open burning of waste in dumpsites further releases toxic substances and air pollutants. Poorly managed waste, often associated with landfilling and open dumping, results in higher downstream costs than proper waste management, highlighting a critical long-term financial trade-off. However, even within landfilling, improved practices such as energy recovery landfills combined with composting or recycling can lead to lower overall costs, especially in regard to the social cost of carbon (McGoodwin, 2018).
- **Recycling:** Recycling offers many benefits, including savings in landfill costs both direct financial costs and environmental externalities and reduced costs associated with waste collection for disposal (Torkayesh, 2022). The economic analysis of recycling often suggests a positive net benefit for most waste streams, indicating its financial advantages over disposal (Denne, T., Irvine, R., Atreya, N., Robinson, M., 2007).
- **Incineration:** Incineration, or waste-to-energy, is an alternative solution that converts waste into energy. While it reduces waste volume and can generate electricity, it also contributes to global greenhouse gas emissions (Sharma, 2021).

2. Long-Term vs. Short-Term Financial Trade-offs

Investing in effective waste management infrastructure and practices, while needing primary capital, leads to long-term cost savings. The immediate costs of proper waste management are typically lower than the eventual downstream costs of poorly managed waste (McGoodwin, 2018). Many of the benefits and costs linked with waste management, particularly environmental impacts, are not immediately apparent and necessitate a long-term perspective for accurate assessment (McGoodwin, 2018). For instance, the social cost of carbon considers long-term damages and benefits that might not be evident in short-term financial analyses (Torkayesh, 2022). Financial sustainability mechanisms for waste management systems must consider infrastructure, operational, maintenance, transportation, and recycling costs, as well

as revenue generated from energy recovery and recycling (Torkayesh, 2022). Life Cycle Costing is a common approach used to evaluate these economic impacts over time (Torkayesh, 2022).

3. Life Cycle Assessment Studies

Life Cycle Assessment is a crucial methodology for quantifying the environmental impacts of various waste management systems and pathways. LCA systematically assesses potential environmental impacts and resource consumption throughout the entire "cradle-to-grave" life cycle of a product or service (Torkayesh, 2022). It is widely applied in waste management studies to:

- **Quantify Environmental Impacts:** LCA identifies and quantifies environmental impacts across various categories, including human health, ecosystem quality, climate change, and resource depletion. This can include metrics like CO₂ emissions (contributing to climate change) and other environmental footprints (Torkayesh, 2022).
- **Assess Environmental Trade-offs:** LCA helps in understanding the environmental trade-offs between different waste management options. However, interpreting LCA results can be complex due to potential contradictions or trade-offs between different impact categories, making a holistic assessment crucial (Torkayesh, 2022).

Social and Environmental Benefits of Modern Waste Management

Transitioning from a traditional, landfill-oriented waste management system to a more sustainable, recycling-based model presents significant challenges. These include low levels of public awareness, poor infrastructure, and high initial investment costs, all of which can obstruct large scale implementation. However, when effectively designed and implemented, recycling oriented waste management systems contribute to environmental sustainability and public well-being by enhancing a range of benefits.

These services and benefits contribute to environmental health, public well-being, and economic prosperity:

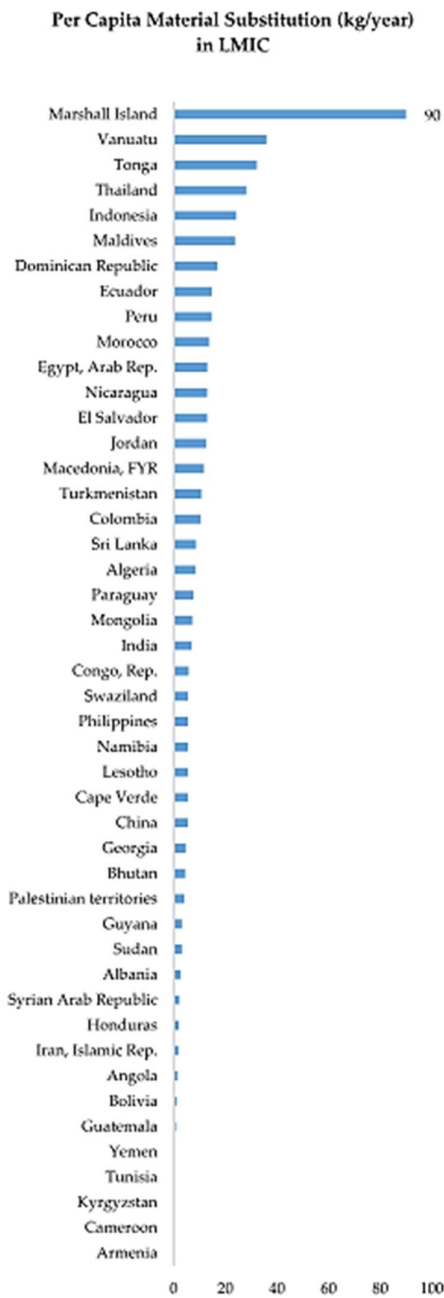
Table 1 Benefits of Modern Waste Management

Category	Ecosystem Services	Other Benefits
Climate Impact	Carbon sequestration via composting or restored ecosystems (e.g., reforestation).	Reduced methane emissions (~45% since 1990 in EU) from landfill diversion.
Public Health & Livability	Reduced environmental contamination supporting ecosystem health (e.g., cleaner water).	Improved urban livability, reduced disease vectors.
Resource & Energy Savings	Conservation of natural resources (e.g., forests, minerals) via reduced extraction.	193M metric tons CO ₂ -equivalent emissions avoided (2018).

Source: (Weng, 2011)

The transition to recycling oriented waste management systems offers several key benefits both in financial and environmental aspects:

Figure 3 Albania as a LMIC



Source: (Zaman, 2016)

The Economic Benefits:

- *Revenue from Materials and Energy:* Benefits can include earnings from electricity generation and revenue from material recovery (Weng, 2011).
- *Reduced Financial Costs:* Recycling programs have a direct effect on reducing financial costs for municipalities, helping to cut down the overall required budget compared to alternative waste treatment methods like incineration (Weng, 2011).
- *Mitigation of Environmental Damages:* Recycling activities are expected to significantly ease environmental damages and reduce environmental costs associated with municipal solid waste (MSW) treatment and disposal (Weng, 2011).
- *Reduced Externalities:* Promoting recycling rates decreases the external environmental costs of MSW management systems (Weng, 2011).

The Environmental Benefits:

- *Protection Against Environmental Degradation:* Reducing the quantity of MSW generation avoids environmental degradation (Weng, 2011)
- *Conservation of Resources:* Recycling conserves natural resources by reducing the need for raw material extraction and associated environmental costs (Weng, 2011)
- *Reduced Pollution:* It leads to a reduction in various forms of pollution, including air pollution from waste facilities and transportation (Weng, 2011)
- *Decreased Waste Discards:* Promoting the recycling rate of MSW generation contributes to a decrease in the quantity of MSW discards, which is the portion of waste that needs to be treated and disposed of by municipalities (Weng, 2011)

These kinds of systems demonstrate that not only does recycling reduce municipal costs but also minimizes harm to the environment by decreasing the volume of waste and conserving natural resources. Equally important is the need for an integrated assessment that incorporates ecosystem services and social equity so more comprehensive and wise decision making can occur in the long run.

Albania is categorized as a lower middle income country (LMIC), (Zaman, 2016) with a GDP per capita of between \$1,006 and \$3,975 and a mean generation of approximately 0.6 to 0.79 kg waste per capita per day, with an average of formal waste collection of 68%. With an understanding of Albania's position in this income bracket, more definitive consideration of the problems and opportunities besetting it is possible.

Table 2 highlights where improvements are most effective. Recycling, especially of metals and plastics, offers the highest potential for material substitution and energy savings, with metal recycling reaching up to 191.42 GJLHV/tonne and 17.8 CO_{2e}/tonne in GHG reductions. Composting also yields modest environmental benefits for organic waste. In contrast, incineration and landfilling, often used in LMICs due to lower costs, provide limited benefits and can even cause environmental burdens. This underscores the need for targeted investment in recycling and composting suited to local waste streams.

Table 2 Substitution factor in different waste streams and management options

Waste Management Systems	Waste Stream	Virgin Material Substitution (tonnes)	Energy Substitution Efficiency (GJ/t waste)	GHG Emissions Reduction (CO _{2e} /tonne)	Water Saving (kL/tonne)
Recycling	Paper	0.84–1.00	6.31–10.76	0.60–3.20	2.91
	Glass	0.90–0.99	8.94–19.42	0.18–0.62	3.90
	Metal	0.79–0.96	3.66–4.85	1.49–0.72	5.37–18.77
	Plastic	0.93–0.97	3.81–6.40	0.95–1.78	2.13–3.37
	Mixed	0.25–0.45	5.00–15.0 ⁿ	0.12–0.35	0.00
Composting	Organic	0.60–0.65	0.18–0.47	0.75–1.15	2.0–10
	Mixed MW ⁴	0.00	0.00	0.12–0.35	0.00
Incineration	Mixed MW ⁴	0.00	5.00–15.0 ⁿ	0.12–0.35	0.00
Landfilling	Mixed MW ⁴	0.00	-0.984–0.00 ⁿ	-0.42 to -1.2	0.00

ⁿ Heat capture efficiency of WTE technology 15–30%.

⁴ Mixed Municipal Waste (MW).

ⁿ Energy from the landfill facility. A positive value represents the savings, and a negative value represents the demand or depletion.

Source: (Zaman, 2016)

Table 3 provides the economic rationale for prioritizing certain waste streams. The high average market prices for recovered materials like metal (887 \$/ton) and compost (255 \$/ton) suggest that even limited recovery systems could become **financially viable** with the right market access and collection systems in place. When paired with monetized values for environmental savings such as 7.5 \$/ton for avoided GHG emissions and 0.92 \$/m³ for water this data supports **cost-benefit arguments** for investment in sustainable waste practices.

Table 3 Unit market price of the various virgin materials.

Materials	Unit Price (\$ US)	Average Price (\$ US)	Reference
Paper	80–875/t	477	WRAP 2015; Indexmundi, 2015b
Plastic	139–300/t	219	WRAP 2015; Indexmundi, 2015a
Glass	15–41/t	28	WRAP 2015
Metal	186–1589/t	887	WRAP 2015; Indexmundi, 2015a
Mixed	-	105	Minimum average price
Compost	100–410/t	255	Allbaida, 2015
Energy (GJ/UV)	20.3/kWh	55.6	ELUC, 2015
GHG (CO ₂ e)	1–14/tonne	7.5	APH, 2013
Water (kL)	0.52/m ³	0.52	ELD, 2010

Source: (Zaman, 2016)

In summary, while Albania as a LMIC currently experiences lower per capita benefits from recycling, the data in (Zaman, 2016) point to **opportunities for scaling up**. By investing in high-return waste streams (e.g., metals, compostable), improving collection infrastructure, and integrating environmental valuations into policy, Albania can move toward more sustainable and economically sound waste management systems.

Plastic Waste Value Chains in EU and International Studies

Numerous studies have applied cost-benefit analysis to evaluate waste management interventions, focusing on comparing the costs and benefits of recycling relative to landfill disposal. They may include a wide range of fiscal and environmental considerations. Main components usually involve savings gathered from reduced landfill dependency both explicit monetary expenses and wider environmental expenses and avoided collection expenses for waste to be discarded. In addition, they reflect the market value of the recovered materials due to recycling (Denne, T., Irvine, R., Atreya, N., Robinson, M., 2007).

For instance, an economic analysis of a Deposit Refund System (DRS) implemented in Menorca, Spain, was conducted to determine the economic viability and sustainability of raising the volume and quality of PET beverage bottles collected (Sanabria García, 2021). Similarly, research evaluating the profitability of mechanical recycling of various fractions of plastic waste in the EU market showed the complex interdependence between economic probability, price of oil, waste composition, and influence of local market conditions and recycling plants (Anwar, 2024). These studies consistently demonstrate that although certain

kinds of plastics can offer greater profitability in recycling, overall rates of recycling remain low due to underlying negative NPV and indicate a requirement for policy-supportive incentives to establish stronger secondary markets (Anwar, 2024). Furthermore, the economic feasibility of recycling is also hindered by the fact that recyclers are the weakest link in the value chain, and recycling for certain materials like soft plastic and mixed polyolefin is not economically feasible, and this raises the call for higher recovery and a more stable downstream market for plastics in order to reach recycling targets (Farooq, 2022).

Market Pricing for Recyclable Plastics and ROI in Sorting Infrastructure

The market for recyclable plastics is significantly influenced by various factors, primarily the global price of oil, which often dictates the value of plastics collected for recycling (Mihai, 2021). This linkage can lead to price fluctuations that strongly impact those at the beginning of the recycling value chain.

1. Challenges in Practical Recycling and Economic Possibility

The return on investment in sorting infrastructure is critical for the practicality of plastic recycling. While advanced post-separation techniques can deliver higher-quality recycled plastics, they are costly compared to options like incineration, with increased focus placed on improving design-for-recycling (Anwar, 2024). Recyclables often find themselves as a weak link in the value chain, as the recycling of soft plastic and mixed polyolefin is frequently not economically viable (Farooq, 2022). This process becomes more challenging by high processing costs, including collection, sorting, and transportation, which often require public grants to balance the low market price of recycled materials (Caceres-Mendoza, 2023).

The economic option of mechanical recycling depends on factors such as product price and profit, and external market conditions and the type of waste materials. Certain plastic types, like polystyrene rigid, can show greater profitability for recycling, but the overall economic practicality of plastics recycling remains challenging. This is partly why only 8% of all plastic waste is recycled, largely due to contamination, poor economic incentives, and technical difficulties (Maheshkar, 2025). More plastic packaging recovery and recycling, and a more stable plastic market, are critical steps for Europe's recyclables goals.

2. Achieving Positive ROI and Broader Benefits

To achieve a positive ROI in plastic recycling, incentives are often necessary to increase the recycling rates and strengthen secondary markets, especially given that current recycling rates may be lacking due to negative NPV (Anwar, 2024).

Despite the potential for economic value from efficient recycling systems, technical constraints or social awareness, can make recycling a costly endeavor. Beyond direct financial considerations, the SCC and the economic value resulting from reduced landfill capacity are significant drivers in waste management models, with recycling offering the highest benefit

among potential revenue metrics. Therefore, accurate estimations of waste diversion, land capacity requirements, and recycling rates are crucial for achieving high-value benefit outcomes and improving the overall ROI of plastic recycling initiatives (McGoodwin, 2018).

Global Policy Frameworks and International Commitments

The pervasive nature of plastic pollution, particularly its transboundary impacts, necessitates robust global policy frameworks and international commitments to effectively manage plastic waste.

1. Basel Convention and its Role in Plastic Waste Trade

The Basel Convention is an international treaty designed to control the transboundary movements of hazardous wastes and their disposal. Concerns about the global trade in plastic waste, especially after major importers like China banned plastic waste imports post-2017, have highlighted the challenges of illegal activities, such as mixing plastic wastes or mislabeling hazardous plastic waste to avoid international regulations (Mihai, 2021). This situation has led to calls for an international agreement on plastic waste management, akin to the Basel Convention for hazardous waste, to establish a unified framework for stringent environmental and social standards for plastic waste exports (Aiguobarueghian, 2024b).

2. UNEP's Global Partnership on Marine Litter and the Push for a Global Plastics Treaty

International cooperation plays a crucial role in tackling the marine plastic crisis, which is a transboundary issue (Pilapitiya, 2024). The UN Environment Programme is a key actor in this area. Its Global Partnership on Marine Litter serves as a coordinating forum for stakeholders involved in preventing and managing marine debris. UNEP has also passed resolutions, such as one in 2019, on marine plastic litter and microplastics, focusing on their long-term elimination and the prevention of plastic release from land-based activities (Pilapitiya, 2024).

The growing global tragedy of marine plastic pollution underscores the need for effective international cooperation beyond local efforts. This has fueled ongoing negotiations for a Global Plastics Treaty under the UN Environment Assembly. The aim is to create a legally binding instrument to address plastic pollution across its entire lifecycle, recognizing that the efficacy of current strategies is often diminished by a lack of globally binding standards, insufficient national monitoring, and a shortage of comprehensive data (Pilapitiya, 2024).

3. International Context and Linkages for Albania and the EU

Both Albania and the European Union are actively engaged in these global efforts and are linked to international commitments:

- **European Union:** The EU is committed to reducing the impact of certain plastic products on the environment and ensuring environmentally sound waste management to prevent and reduce marine litter (Pilapitiya, 2024). Directives such as the Marine Strategy Framework Directive aim to achieve a good environmental status for European marine environments

(Pilapitiya, 2024). The EU's robust legal framework sets waste hierarchy goals and recycling targets that member states and aspiring members must align with (Commission, 2025).

- **Albania:** Albania's policy ambitions reflect a commitment to address plastic pollution and align with EU standards. The country is working towards developing a comprehensive national strategy for reducing plastic waste, including promoting the adoption of alternatives to single-use plastics and encouraging circular economy models (Vokopola, 2024). While progress is being made, challenges persist, with significant amounts of plastic still ending up in landfills and a portion of the population lacking access to waste collection services. Field studies along Albania reveal alarming levels of plastic pollution, highlighting the urgent need for continued national action and collaboration with international partners.

Current Situation and Legal Standing

The global plastic waste management environment has witnessed revolutionary changes over the past four decades with a constantly changing policy and legal framework. Initially, efforts were to develop strategies for minimizing waste. However, the increasing problem of plastic pollution has spurred the global shift toward inclusive circular economy approaches that emphasize resource efficiency, waste prevention, and material recirculation (Pilapitiya, 2024).

EU's Legislation

Currently, all types of legislative moves, instructions, bans, and levies are being passed at international, regional, and domestic levels. All these are being done to minimize plastic production and pollution due to waste.

The EU has been a leader in this, developing a "European Strategy for Plastics in a Circular Economy" to reduce reliance on single-use plastics and promote sustainable, multi-use alternatives through regulatory and market measures. These legal and policy innovations signify an international recognition of the need to move beyond traditional waste management, fostering a transition to a more sustainable plastic economy by impacting production, consumption, and waste management practices. (Aiguobarueghian, 2024b)

EU waste management law is heavily grounded in circular economy principles, seeking to transition from a linear "take-make-dispose" approach to one where materials circulate (Aiguobarueghian, 2024b). The foundational Waste Framework Directive (2008/98/EC) outlines a waste hierarchy, prioritizing reduction, reuse, recycling, and material recovery. While its implementation faces challenges, the EU's "European Strategy for Plastics in a Circular Economy," adopted in January 2018, specifically targets plastic product design, manufacturing, use, and recycling. A key goal is to make all plastic packaging reusable or recyclable by 2030, significantly increasing plastic waste recycling rates. This strategy led to the Single-Use

Plastics Directive (2019/904), which bans specific single-use plastic items where alternatives exist and promotes waste prevention for others (Estefania Sanabria García, 2021).

Furthermore, the EPR principle is integral to this framework, holding producers financially and organizationally accountable for products throughout their lifecycle. EPR schemes encourage eco-friendly designs, reduce single-use plastic reliance, and boost recycling infrastructure, fostering a more sustainable, closed-loop plastic waste management system (Estefania Sanabria García, 2021).

Albanian's Legislation

In Albania, recent policy documents such as the "Integrated Waste Management Strategic Policy Document and National Plan 2020–2035" and the "National Sectoral Plan for Solid Waste Management" are critical for setting strategic objectives and targets for waste management, with a strong emphasis on aligning with circular economy principles.

Accompanying these strategic directives, the governance of waste management at the municipal level in Albania is reinforced by a robust legal framework. Key legislative acts and governmental decisions that define responsibilities and guide practices in this sector include:

- **Law no. 139/2015: "On Local Self-Government"**

This law defines the roles and responsibilities of municipalities, including their authority over public services such as waste collection and management. It legally obliges municipalities to ensure waste services for households and businesses and grants them autonomy in designing and implementing local waste strategies, in line with national goals.

While decentralization allows for modified local solutions, it also exposes major capacity disparities. Many municipalities lack the necessary technical expertise, human resources, and financial autonomy to develop sustainable waste systems. Additionally, inter-municipal cooperation is limited, making it difficult to plan regionally for infrastructure such as sanitary landfills or recycling centers.

- **Law no. 10 463, dated 22.09.2011: "On Integrated Waste Management," as subsequently amended by Law no. 156, dated 10.10.2013.**

This is the cornerstone legislation for waste management in Albania. Its primary purpose is to establish a comprehensive legal framework for the generation, collection, transport, treatment, and disposal of waste, based on the principles of environmental protection, resource efficiency, and public health. The law also formally adopts the waste hierarchy prioritizing prevention, reuse, recycling, recovery, and disposal mirroring EU Directive 2008/98/EC on waste.

While the law sets a strong legal basis, practical implementation remains weak. Many municipalities face resource and capacity limitations, making it difficult to enforce source separation or control illegal dumping. Moreover, monitoring and data collection mechanisms are underdeveloped, hindering transparent performance tracking and comparison across

regions. Although the law requires municipalities to draft local waste plans, in practice many of these remain outdated, incomplete, or unapproved, contributing to service fragmentation and planning inefficiencies.

- **Law no. 10 431, dated 09.06.2011: "On Environmental Protection."**

This law provides the broader environmental protection framework in which waste management is situated. It defines environmental quality standards, the principle of sustainable development, and the responsibilities of both public authorities and private actors in preventing and mitigating environmental harm. It aligns with EU Directive 2001/42/EC on strategic environmental assessment and promotes environmental impact assessments for waste-related infrastructure projects.

However, enforcement of this law suffers from institutional fragmentation and limited inter-agency coordination. Environmental permits, monitoring of landfill operations, and penalties for non-compliance are inconsistently applied. This creates a gap between legal standards and real-world practices, especially in smaller or rural municipalities where technical capacity is limited.

- CMD no. 319, dated 31.05.2018: "On the approval of measures for the cost of integrated waste management."
- CMD no. 175, dated 19.01.2011: "On the approval of the National Waste Management Strategy and the National Waste Management Plan."
- CMD no. 99, dated 18.02.2005: "On the approval of the Albanian Waste Classification Catalogue."

Linking National Law to EU Directives and Implementation Gaps in Albania

All three laws are broadly aligned with EU directives, especially the Waste Framework Directive (2008/98/EC), the Landfill Directive (1999/31/EC), and the Packaging and Packaging Waste Directive (94/62/EC) (Vokopola, 2024). However, significant implementation gaps remain:

- Source separation and recycling systems are legally required but unevenly applied across municipalities, with a lack of significant waste separation at the source and low recycling rates.
- Extended Producer Responsibility is included in legislation but not yet fully operationalized, particularly for packaging waste, and finalizing the draft law on extended producer responsibility is still needed (Vokopola, 2024).
- Waste data reporting and performance benchmarking are weak, impeding compliance monitoring and EU-aligned planning: This is due to a lack of a unified system for monitoring and reporting waste data, and incomplete municipality reporting (Vokopola, 2024).
- Financial sustainability mechanisms, such as cost-reflective tariffs, remain underdeveloped: While municipalities are responsible for setting tariffs to cover service

provision, the implementation of laws governing service delivery across the territory faces several challenges, implying struggles to recover service costs (Vokopola, 2024).

Until changes are made, municipalities hold the right and responsibility to organize waste collection, transport, treatment, and disposal services, including managing municipal waste from households, businesses, and other services. A new law on integrated waste management, is currently under public consultation in Albania and expected to be ready by December of 2025. The law proposes a National Agency for Waste Economy to coordinate efforts across central and local levels and including EU standards while in operation.

This legal framework emphasizes source separation as a responsibility of Local Self-Government Units and states that recycling systems for packaging should be established by producers under EPR schemes. (Vokopola, 2024). This evolving legal landscape reflects Albania's gradual but strategic shift toward EU-aligned, decentralized, and circular waste management systems grounded in shared responsibility across government, producers, and citizens.

Main Stakeholders and Key Parties Involved

Effective waste management requires the involvement of various stakeholders. Each party plays a distinct yet interconnected role in contributing to a sustainable waste ecosystem:

Governmental and Municipal Authorities

These entities are fundamental to establishing and enforcing the main legal and regulatory frameworks for waste management. They are responsible for organizing collection, transport, treatment, and disposal of municipal waste, establishing and operating local interest centers for separate collection, and levying service.

Producers and Industry:

With the increasing adoption of Extended Producer Responsibility schemes, producers are becoming central to the circular economy. This is a global trend that makes producers responsible for the entire life cycle of the product, including end-of-life management. For instance, the "Zero Plastic Waste" strategy features EPR, encouraging manufacturers to design products that are inherently easier to position within a circular value chain (Sharma, 2021). This shifts the responsibility of waste management from municipalities to producers, encouraging product redesign.

Citizens/Households:

Public participation is extremely important and unavoidable. Citizens play a crucial role in reducing waste generation, participating in household waste collection, recycling, recovery, and disposal systems, and providing service fees. Their adherence to sorting guidelines and

willingness to pay service fees directly impacts the efficiency and effectiveness of local waste management initiatives.

Recycling Companies:

As vital players in the waste management value chain, recycling companies are responsible for the processing of collected waste materials to extract valuable resources. This includes sorting, cleaning, and transforming waste into secondary raw materials that can be re-introduced into manufacturing processes.

NGOs (Non-Governmental Organizations):

NGOs contribute significantly by implementing projects focused on technical aspects and raising public awareness within the waste sector, assisting institutions and working with citizens and businesses to promote waste reduction, reuse, and recycling.

Academia and Research Institutions:

These bodies contribute through scientific research on various aspects of waste, including the environmental and health impacts of plastics, and by proposing new educational curricula and awareness campaigns.

International Partners and Donors:

International organizations and donors provide crucial financial support in the form of grants, loans, and project funding to support governmental initiatives in waste management, particularly in developing regions. (Brotosusilo, 2020).

Success Examples and Their Implementation Plans

Despite the challenges, several successful examples from cities and countries demonstrate effective plastic waste management and circular economy implementation:

- **Copenhagen and Amsterdam:** These cities have adopted holistic approaches to waste reduction, focusing on comprehensive waste sorting, efficient recycling systems, and public engagement. They have established waste-to-energy facilities that manage waste responsibly and generate energy (Aiguobarueghian, 2024b).
- **Germany:** Has significantly reduced plastic waste exports and increased its recycling rate through strategic steps (Pilapitiya, 2024).
- **Nagoya, Japan:** Implemented four strategies for a door-to-door recycling scheme for household solid waste, including increasing resident awareness, ensuring service provider insurance, expanding producer responsibility, and conducting in-depth research for proper treatment (Brotosusilo, 2020)

The Best Example of waste management in the world: Leading the Way with Best Practices, Nordic Countries

While the European Union has made strides in establishing robust waste management frameworks, a comparative analysis across different regions reveals significant disparities and highlights best practices.

In stark contrast, Nordic countries like Sweden and Denmark exemplify highly effective and sustainable waste management models. Their success is largely attributed to a strong commitment to waste-to-energy solutions and high recycling rates, demonstrating a circular economy approach in practice:

- **Waste-to-Energy:** Sweden has emerged as a global leader in waste-to-energy, with incineration accounting for a significant portion of its waste management (50%) (Fayshal, 2024). These facilities are often integrated into district heating systems, thereby efficiently converting waste into heat and electricity for homes and businesses (Fayshal, 2024). This approach not only minimizes reliance on landfills but also substantially contributes to the national energy supply (Aiguobarueghian, 2024b). Norway also utilizes waste-to-energy technologies, including incineration and anaerobic digestion, to recover energy from waste (Lu, 2022).
- **High Recycling Rates:** Denmark is known for its high recycling rates, driven by effective return systems (Lu, 2022). Similarly, Sweden boasts an impressive 85.9% return rate for PET beverage packaging through its Deposit Refund System, indicating highly effective collection and recycling mechanisms (Lu, 2022). Companies in Denmark are actively engaged in transforming waste into reusable resources, emphasizing sustainability and green energy projects (Farooq, 2022).

These leading examples from Nordic countries highlight the potential for waste management to transition from a disposal challenge to a valuable resource, underscoring the importance of robust policy frameworks, advanced technological infrastructure, and a strong societal commitment to circular economy principles.

The Best Example of waste management in Albania: Solid Waste Management project Berat City

In the case of Albania, the most recent and notably successful waste management initiatives have been implemented in two major tourism-oriented cities: Berat and Gjirokastrë. The project in Gjirokastrë marked the first successful effort of its kind, setting a precedent for future initiatives. It was followed by the implementation of a similar project in Berat, which is now being promoted as a model for effective waste management. The initiative in Berat focuses on the separation of plastic from organic waste at the source, demonstrating a hopeful step toward more sustainable and systematic waste practices. (Berat Municipality, 2024)

Until December 2024, the Swiss State Secretariat for Economic Affairs implemented the “Solid Waste Management in Berat” project, aimed at improving the quality, consistency, and sustainability of waste management services across the municipality of Berat (Vokopola, 2024). The project focused on institutional capacity building, technical assistance, and short-term measures to reduce environmental impacts associated with poor waste handling.

A total of approximately EUR 2 million was allocated to the project governed by the URI and the Berat municipality, covering the full range of interventions, including infrastructure upgrades, staff training, public awareness campaigns, and technical planning. These funds supported both operational improvements and long-term planning tools, such as feasibility studies and regional waste management strategies. An additional investment of nearly EUR 1 million went toward rebuilding the Berat dumpsite and supporting infrastructure.

Figure 4 Berat's new collection bins



Key outcomes included the rehabilitation of the Berat municipal dumpsite, the introduction of improved waste layering and suitable management techniques, and the establishment of source-separation practices particularly the separation of plastic from organic waste. Public education campaigns and technical training further enhanced service efficiency and local engagement. As a result, waste collection coverage increased to 89%, while operational cost recovery is expected to reach 96% by 2026 (Berat Municipality, 2024). Beyond service delivery, the project raised awareness among municipal authorities, civil servants, and the public on sustainable waste management. It also supported regulation enforcement and laid the foundation for Albania’s alignment with EU environmental standards.

Source: (Berat Municipality, 2024)

The success of the Berat project has positioned it as a model for future integrated solid waste management initiatives, particularly under broader Swiss cooperation efforts promoting circular economy principles, EPR, and modern recycling systems.

Figure 5 Berat's new collection trucks



Source: Authors photos (Berat Municipality, 2024)

Figure 6 Berat's municipal recycling clasification plant



Source: Authors photos (Berat Municipality, 2024)

Systemic Inefficiencies or Gaps in Sorting and Recycling at Source

Although modern waste strategies emphasize source sorting and recycling, many countries, including those in the Western Balkans, struggle with systemic inefficiencies. A core issue is often a lack of government attention in creating environmentally friendly policies that can empower private entities to provide the necessary infrastructure and technology for effective waste separation (Brotosusilo, 2020). Compounding this, inconsistent recycling regulations and guidelines across different regions and municipalities contribute to confusion among residents and businesses, thereby undermining recycling efforts (Aiguobarueghian, 2024b).

Another major obstacle is contamination, where non-recyclable materials mixed with recyclables compromise the quality and efficiency of processing facilities (Aiguobarueghian, 2024b). Furthermore, the evolving complexity of packaging materials, such as multilayer films, poses a significant challenge as many designs are not easily recyclable (Anwar, 2024). In rural areas, legislative mandates for source separation are often ignored: plastic waste is commonly mixed with general trash, burned in households, or disposed of in unauthorized sites (Mihai, 2021).

Despite the existence of legislation supporting modern waste practices, financial constraints present a significant barrier to implementation in developing countries. The transition to a circular economy demands substantial initial investments in infrastructure, labor, and technology, resources that are often in short supply (Sharma, 2021).

Moreover, limited public awareness and education impede effective waste management. Low levels of public education about waste prevention and management are noted, and without understanding how to participate properly in recycling systems, individuals can inadvertently contribute to contamination and disengagement (Vokopola, 2024).

Challenges in the Western Balkans and Albania

In rural parts of the Western Balkans, including Serbia and Albania, organized waste systems remain underdeveloped. In some areas, waste collection coverage is as low as 50%, leading to widespread illegal landfills and open waste burning (Mihai, 2021). Albania, despite its aspirations to align with EU standards, continues to face significant systemic gaps. These include inadequate equipment for waste collection and transport, minimal waste separation at the source, and generally low recycling rates (Vokopola, 2024).

Additional problems include a fragmented data-reporting system, lacking a unified and centralized platform for monitoring waste data. Insufficient infrastructure for integrated waste management also persists. These factors contribute to environmental damage, including marine pollution, which primarily results from waste accumulation along riverbanks and streams near urban areas (Vokopola, 2024).

One other mayor problem remains the public's lack of awareness regarding proper waste management and the environmental impact of inadequate disposal practices. Many municipalities in Albania also lack the capacity to deliver waste services across their entire

regions, with a significant portion of the population remaining unserved by waste management services creating the illegal dumping places (Vokopola, 2024).

Despite growing attention to waste management in Albania, significant gaps remain in the existing literature. There is limited publicly available data on actual recycling rates, and monitoring and reporting systems remain weak or fragmented. Few studies have applied economic modeling to assess the ROI of municipal waste interventions. Moreover, while circular economy principles are gaining ground in national policy, their integration at the household level remains minimal and underexplored.

METHODOLOGY

This chapter outlines the methodology employed in analyzing the mixed methods approach adopted to evaluate the plastic waste management systems in the municipalities of Elbasan and Librazhd. The aim is to identify gaps, opportunities for improvement, and alignment with national waste management goals. The research combines document analysis, main stakeholder (municipality) interviews, quantitative surveys, and a cost-benefit analysis (CBA) to provide a comprehensive assessment of plastic waste management performance and potential pathways forward with the context of municipal waste system along Shkumbin river bank.

Research Design

In this study, the integration of qualitative and quantitative methods was implemented. The results provided a complete understanding of the municipal waste management systems, especially the two-way sorting system, in Elbasan and Librazhd. Qualitative insights, derived from document analysis, stakeholder interviews, and public perception surveys, clarify the quantitative data on technical efficiency and financial performance, explaining underlying reasons for observed gaps. Conversely, quantitative data from technical assessments and the CBA will validate and provide scale to the qualitative observations. This integrated approach will facilitate the identification of actionable opportunities for improvement that consider both the technical aspects and the socio-political context, thus improving the municipalities' ability to meet set targets.

1. Qualitative Research Approach

The qualitative component of this study was designed to explore the public perception and policy alignment concerning plastic waste management across the municipalities of Elbasan and Librazhd. This approach provides in-depth insights into community behaviors, attitudes, and engagement with existing waste management initiatives.

- **Public Perception and Awareness:**

To assess public opinion and behavior, quantitative surveys were employed. These surveys, often in the form of open-ended interviews, were designed to evaluate residents' and business current understanding and practices related to waste management, including their views on the old and new methods. These interviews also measured public awareness regarding waste management fees and their perception of the municipality's efforts to manage waste. In Elbasan and Librazhd, interviews were held with different businesses and municipal officials to get their understanding on their municipality's waste management. The aim was to understand if current waste management schemes are suitable for citizens and if they are sufficiently informed about their operation.

- **Policy and Stakeholder Alignment:**

Qualitative data were also gathered through document analysis and stakeholder structured interviews to understand the position of local policies with national strategies and international frameworks related to waste management. This included examining legislative acts and regulatory measures that guide waste management practices in Albania. Discussions with stakeholders were crucial for evaluating the effectiveness of existing mechanisms for citizen feedback and addressing challenges like low public awareness that often negatively impacts urban cleanliness. This aspect is critical for assessing the broader governance and regulatory environment influencing the achievement of the regulatory standards placed by the state and highlights the importance of continuous communication between stakeholders.

2. Quantitative Research Approach

The quantitative component focuses on evaluating the technical efficiency of using a two-way plastic recycling waste management system across Elbasan and Librazhd. This approach involved collecting and analyzing numerical data to measure performance, identify challenges, and track expenses.

A Cost-Benefit Analysis was conducted to evaluate the financial implications of using a two-way plastic recycling waste management system. This includes calculating costs per inhabitant for services like collection and transport, assessing the financial performance of waste management sectors and revenue generation from tariffs and evaluating potential savings from diverting waste from landfills. The CBA also involves analyzing expenditures across key management categories such as collection, transport, amortization, and deposition and treatment at landfills.

This analysis was done using the same method and tool the municipalities use. This method was developed by Eduard Canaj as part of a project implemented by Regional Environmental Center (REC) in 2013 with the help of grantor Swiss agency for development and cooperation (dldp, 2013). The project delivered a simple model and manual, in the form of an Excel and a pdf, that calculates the total costs of waste management for a municipality using simple mathematical formulas and proposing methods to charge a fee to businesses and civilians. Since its creation, this document remains in effect and is the main source of the data for cost analysis, although each municipality makes certain adjustments according to their needs.

The quantitative data directly measure progress towards the completion of targets that municipalities have made for 5-year plans. These measurements also provide a broad picture of the benefits of having a recyclable waste management method and the types of improvements that could be made to achieve better results. The indicators include recycling rates, waste diversion rates, and the percentage of waste properly collected and treated.

Research Objectives

To evaluate the effectiveness of the two-way recyclable waste management system, the following research objectives have been established:

1. **To measure costs of the current waste management system**, by collecting and analyzing quantitative data on the types, volumes, and sources of waste, alongside qualitative insights from municipal waste managers and recycling companies. This objective aims to establish a clear understanding of collection costs, sorting, and disposal practices, as well as identifying key stakeholders and system inefficiencies.
2. **To evaluate the potential economic benefits of improving waste sorting at the source**, focusing on reduced collection and disposal costs, increased revenue from selling recyclable plastics, and savings linked to decreased landfill use. This will involve analyzing cost data from municipal records and market information from recycling businesses to quantify the financial impact of improved practices.
3. **To conduct a Cost-Benefit Analysis (CBA)** comparing the plastic waste management system with a scenario that incorporates enhanced source separation and recycling efforts. This quantitative analysis will measure both direct and indirect economic outcomes, providing a robust basis for policy recommendations.
4. **To identify and analyze the roles and incentives of key stakeholders** involved in plastic waste management, including municipal authorities, private waste collectors, recycling companies, and local communities. Understanding stakeholders' perceptions and motivations will help clarify barriers and opportunities for improved waste sorting and recycling.
5. **To investigate best practices in plastic waste management from high-performing European municipalities**, through a literature review and comparative analysis. This will provide a contextual benchmark and inform practical recommendations tailored to the socio-economic and institutional context of Elbasan.
6. **To identify gaps in the current plastic waste management system** by synthesizing findings from data analysis, stakeholder insights, and international best-practices. This objective aims to highlight weaknesses and areas needing improvement to support effective policy and operational interventions.

Data Collection Methods

This section describes the approaches used to collect and analyze data to evaluate waste management practices in Elbasan and Librazhd municipalities. A detailed content analysis was conducted on the following key documents to understand the regulatory, institutional, and operational frameworks:

- **Municipal waste management plans for Elbasan and Librazhd.** These plans often highlight challenges such as low public awareness and inefficient collection systems and aim to improve cleaning services and waste management in urban and rural areas.
- **The National Waste Management Strategy and National Plan for Waste Management (2020–2035).** This strategy, even as a draft and not officially approved, highlights enhancing efficient collection systems, modernizing infrastructure, and implementing deposit return schemes for plastic one time use items. It also aims for gradual progress toward national and international standards.

- **Relevant Albanian legal frameworks**, in regards to municipal planning and directives, ministry issued documents and NGO project materials relevant to waste management.
- **EU waste directives as adopted into Albanian law**. Albania's legal framework for waste management is partially aligned with EU acquis, with substantial efforts needed for full compliance, especially regarding the EU waste hierarchy goals and recycling targets.

Survey

A structured questionnaire was conducted with two key stakeholders and their representatives, including:

- Municipal waste department officials of Elbasan municipality
- Municipal waste department officials of Librazhd municipality

The purpose of the survey was to collect detailed institutional data on local waste management systems, with a particular focus on plastic waste handling. Key topics included:

- Waste collection methods and coverage rates
- Existence and effectiveness of plastic separation systems
- Recycling rates and end destinations of recyclable materials
- Initiatives for plastic waste reduction and reuse
- Collaboration with local businesses and community groups
- Budget allocation and data availability
- Identification of plastic pollution "hot spots" and key waste generators
- Perceived barriers to effective plastic waste management and proposed solutions

The survey responses provided critical insights into institutional practices, policy implementation challenges, and gaps in local capacity. These data were used to complement findings from interviews and document analysis and helped inform the cost-benefit analysis and final recommendations.

a. Qualitative Semi-Structured Expert Interviews

To add-on to the quantitative information obtained from municipal surveys, semi-structured interviews served as the qualitative method of obtaining deeper, context-dependent insights into the issues, opportunities, and institutional dynamics of plastic waste management within the Shkumbin River Basin. Including interviews was justified by the need to go beyond statistical analysis, to understand the day-to-day experience, constraints, and perceptions of key actors in the waste management system.

A total of nine interviews and meetings took place between June and July 2025 with a range of stakeholders at both the local and national levels. These included municipal officials from Elbasan, Librazhd, and Berat, national ministry and agency officials, and private sector and civil society actors. Interviews were semi-structured, led by a loose protocol specific to every category of respondent, but similar on broad themes. This approach allowed for both targeted

information gathering and the exploration of unanticipated but relevant topics that arose during conversation.

Interview Participants and Scope

The interviews included:

- **Municipal officials** responsible for the environment and waste services, including monitoring directors, deputy mayors, and procurement experts in **Elbasan** and **Librazhd** municipalities.
- The **Director of Waste Management** of **Berat**, a municipality considered a leading case for successful implementation of a source separation and recycling initiative.
- Experts from national institutions, including the **Ministry of Tourism and Environment**, and the newly restructured **National Environmental Agency (AKEM)**.
- Representatives from international cooperation projects such as **GIZ Albania**, **The Resource Environmental Center Albania (REC)** and the **Urban Research Institute (URI)**.
- **Private sector stakeholders**, including the head of the **Albanian Recycling Association** and personnel from recycling stations.

Each interview covered multiple aspects of plastic waste management, including planning and strategy, citizen awareness, institutional collaboration, economic costs, and implementation challenges. A particular focus was placed on understanding how municipal waste strategies are operationalized, and what barriers exist in translating national goals into local actions.

For example, in Elbasan, the municipal monitoring director emphasized that although a legal framework for waste management exists, enforcement remains weak due to fragmented responsibilities and a lack of accountability mechanisms (Sinanaj, 2025). Similar challenges were echoed at the Ministry of Tourism and Environment, where the Director of Circular Economy noted that institutional overlaps and limited enforcement capacity hinder effective implementation of new policies (Ramaj, 2025). Furthermore, insights from private actors revealed a strong demand for clearer policies and support mechanisms to encourage investment in recycling and reuse infrastructure (Haka, 2025).

Case Focus: Elbasan, Librazhd, and Berat

The three municipalities provided a varied picture of waste management practices. **Elbasan**, for instance, was described as having a relatively advanced waste collection coverage rate (approximately 95%) and a new five-year management plan using a four-way recycling system, emphasizing a 50% reduction of recyclable waste ending up in landfills. However, the municipality lacks its own recycling facilities and relies heavily on private companies or informal collectors (Sinanaj, 2025). The absence of long-term planning and funding mechanisms was also noted as a key limitation, with current initiatives seen as short-term and reactive in nature.

In contrast, **Librazhd** presented a draft plan still under development. The deputy mayor and the municipality's monitoring director confirmed that awareness and infrastructure remain underdeveloped, especially in rural areas (Allkaj, 2025).

Nevertheless, the municipality aims to embrace a simplified two-stream waste separation system (organic and recyclables) and expressed interest in learning from models implemented in other regions, such as Berat.

The **Berat municipality** emerged as a leading example, thanks to its pilot project on waste separation at source. Initiated in 2021 and scaled up during 2024–2025, the project involved door-to-door campaigns, investment in weighing stations, and partnership with recycling companies for the auction of separated materials. Between January and May 2025, the municipality reported collection of 21 tons of cardboard, 7 tons of plastic, and 3 tons of aluminum. Despite these achievements, awareness and behavior change among citizens remain a persistent challenge (Gjoka, 2025).

Insights to the interviews

Across interviews, several themes emerged:

1. **Separation at source** was widely seen as the most effective way to increase recycling rates and reduce landfill use. Taking Berat as a prime example, its two-way separating system at the source proved effective and simple to use by most of the population. However, this requires significant investment in infrastructure, community education, and consistent enforcement.
2. **Institutional fragmentation** and a lack of clear enforcement structures were identified as major barriers. Multiple interviewees called for the establishment of a single supervisory body for municipal waste management (Ramaj, 2025)
3. **Data gaps** persist, especially regarding operational costs and volumes of waste collected, processed, or recycled. Several municipalities noted reliance on outdated plans and insufficient data tracking (Allkaj, 2025)
4. **Economic incentives** for businesses and households were repeatedly mentioned as a potential lever for behavior change. Some interviewees suggested reducing cleaning fees for compliant businesses and households, while others pointed to fiscal support for recycling companies operating at low capacity due to restrictions on waste imports (Haka, 2025).

Integration with Overall Methodology

The interviews served not only to validate survey findings but also to fill in critical contextual gaps. They offered an understanding of how waste management policies are interpreted and implemented at different administrative levels, and how political, financial, and infrastructural constraints shape outcomes on the ground. These perspectives were crucial in identifying points of leverage for improving the overall system such as improving coordination, simplifying the waste stream, and providing targeted support to local actors.

Interview data were analyzed with both the structured municipal questionnaire and data research. All the interviews were recorded in note form and anonymized where necessary, though verbal informed consent was obtained in each case. Data gathered was central to informing the discussion and recommendations are explained in the final chapters of this research.

b. Cost-Benefit Analysis (CBA)

This study employed a CBA to evaluate the economic, environmental, and social implications of plastic waste management interventions in two Albanian municipalities: Elbasan and Librazhd. CBA was chosen due to its structured, evidence-based methodology, which enables decision-makers to assess whether the long-term benefits of proposed investments outweigh their costs. In contexts like Albania where limited financial resources, fragmented governance, and evolving regulatory frameworks hinder comprehensive waste strategies, CBA is a particularly valuable tool. It enables municipal authorities to prioritize interventions that are both cost-effective and aligned with broader sustainability objectives.

To evaluate the recycling system of separating in two different containers, one for paper and plastic recyclables and the other for other general waste, two complementary methodological frameworks were used. This dual-framework approach allowed for both international comparability and local policy alignment.

International Best Practices: Core steps from widely used CBA methodologies were applied, including scenario definition, cost estimation, benefit quantification, monetization of impacts, and comparative analysis using economic indicators. These steps are supported in the waste management literature (Zaman, 2016) particularly in urban infrastructure and environmental economics contexts. The following indicators Net Present Value (NPV), Benefit-Cost Ratio (BCR), and payback periods were used to assess economic feasibility and long-term sustainability (Denne, T., Irvine, R., Atreya, N., Robinson, M., 2007).

National Standardized Method (Albania): The study closely followed the Manual for Cost and tax calculation (dldp, 2013), a national guide issued for municipalities to standardize cost calculations across waste services. This method organizes costs into seven key blocks:

- Block 1: Administrative area characteristics (population, density, tourism impact)
- Block 2: Capital investments (vehicles, bins, infrastructure)
- Block 3: Operating costs (fuel, wages, maintenance)
- Block 4: Waste treatment and landfill costs
- Block 5: Depreciation and reinvestment
- Block 6: Administrative and communication expenses
- Block 7: Aggregated cost calculation (total cost per ton and per capita)

Cost Calculation

Cost data for each scenario were gathered using a combination of:

- Municipal budget reports
- Field surveys and waste audits
- Interviews with stakeholders, including municipal staff and private contractors

Costs were organized according to the seven blocks of the Albanian guide. For example:

- **Block 2 (Capital Costs):** Included vehicle procurement (e.g., 10-ton collection trucks for urban areas, 5-ton for rural), weighing stations, and eco-bin installations. These include enhanced collection systems, larger bin capacities, new trucks, and transition to sanitary landfills or improved transfer stations.
- **Block 3 (Operating Costs):** Covered truck maintenance, fuel consumption, driver wages, and equipment servicing. These costs were characterized by limited source separation, outdated infrastructure, and continued reliance on unregulated landfills or dumpsites.
- **Block 4 (Disposal Costs):** Calculated based on landfill fees, regional averages, and informal disposal impacts.
- **Block 5 (Depreciation):** Applied standardized asset lifespans (e.g., 3-5 years for vehicles) to allocate annual depreciation rates.
- **Block 6 (Administration):** Accounted for monitoring, public education, coordination meetings, and reporting obligations.

Benefit Calculation

The benefits associated with improved waste management were identified and quantified in both tangible and intangible categories:

- **Material Substitution:** Revenue from recyclables that are used in place of virgin raw materials for manufacturing new products. An example: Berat's municipal auction model provided empirical values for example, cardboard sold at 11 lek/kg (Gjoka, 2025) creating measurable income streams.
- **Avoided Costs:** Reduced landfill usage led to savings in tipping fees, transport costs, and environmental remediation expenses.
- **Energy Savings:** This refers to the amount of energy conserved by recovering resources from waste instead of producing new materials from virgin sources.
- **Overall Economic, Social & Environmental Benefits:** These included reduced greenhouse gas emissions, improved public health, and enhanced citizen satisfaction. In the absence of precise local valuations, proxy values were taken from literature (Anwar, 2024)

The cost calculations were obtained from official municipal planning documents, which detail operational expenses related to waste collection, transportation, and disposal. In contrast, the benefit calculations were obtained from the framework developed by (Zaman, 2016),

incorporating monetized values of resource recovery such as material substitution, energy savings, material substitution, and overall benefits.

By integrating internationally recognized economic evaluation techniques with Albania's official cost accounting model, this Cost-Benefit Analysis provided a structured, locally adapted methodology to guide municipal plastic waste management decisions. The use of the Manual for Cost and Tariff calculation (dldp, 2013) ensured consistency in data collection, while the inclusion of real-world pilot data and stakeholder insights enhanced both credibility and policy relevance. The CBA results offer practical, evidence-based tools for municipal actors to design more efficient, financially sustainable waste systems that align with environmental and public health goals.

Comparative Analysis of International Best Practices with Emphasis on Berat

To expand the understanding of effective waste management strategies in Albania, this study places particular importance on Berat as a leading example of waste management. Berat's current pilot projects in plastic waste separation and recycling infrastructure demonstrate promising results that align closely with the high standards observed in selected European Union municipalities from Slovenia, Germany, and Italy recognized for their exceptional plastic recycling rates, active citizen engagement, and comprehensive waste management planning. (Brotosusilo, 2020)

By comparing results such as plastic recovery rates, landfill diversion percentages, and cost efficiency metrics, this study evaluates how emerging sustainable practices reflect or diverge from internationally proven models. This comparative analysis not only highlights the benefits of a recycling system but also identifies areas where local adaptations can be strengthened by lessons drawn from EU experiences.

The insights gained through this focused benchmarking process serve to validate Berat's initiatives and guide tailored recommendations for further improvement. By bridging international best practices with the local context, this approach ensures that municipalities like Elbasan and Librazhd can build sustainable, scalable waste management systems that meet both national priorities and European environmental goals.

Limitations

This study meets several limitations that impacted data collection and analysis. First, incomplete or outdated municipal waste management plans, limited access to inclusive and current information. Gathering accurate data proved difficult due to limited transparency and unavailability of key records, with some key agencies being inaccessible during the study. Additionally, for the Cost-Benefit Analysis, certain assumptions had to be made such as applying unchanging data across the two municipalities due to gaps in specific localized information.

Time constraints further limited the depth of data gathering and prevented extensive field verification. The study was also restricted to using government-approved methodologies, which, while ensuring standardization, may have limited flexibility in adapting innovative analytical techniques. Lastly, reliance on some older data sources posed challenges for reflecting the most recent developments in waste management practices. Collectively, these factors contributed to inherent uncertainties and should be considered when interpreting the study's findings.

Additionally, further limitations to this study apply. These include potential mistakes in interviews and surveys, which may affect the objectivity of qualitative data. The scope was forced by resource availability, limiting the number of municipalities and stakeholders involved. Another limitation of this study is the potential for human error in data collection and waste categorization, which may affect the accuracy of reported quantities and classifications. Furthermore, the cross-sectional design captures a specific moment in time, which may not fully reflect longer-term trends or seasonal variations in waste management. Lastly, generalization beyond the selected municipalities should be approached cautiously due to unique local socio-economic and institutional factors.

RESULTS

This chapter presents the main findings of the study, organized around the key themes resulting from the mixed methods approach: public awareness, stakeholder alignment, technical efficiency, economic analysis through cost-benefit assessment, and best practices. The data gathered from stakeholder interviews, structured municipal surveys, document analysis, and cost modeling are synthesized to evaluate the current state and future opportunities of plastic waste management in the municipalities of Elbasan and Librazhd.

Overview of Municipal Waste Management Plan

Elbasan is one of the largest municipalities along the basin of Shkumbin River, and one of the bigger ones in all of Albania. This municipality has developed a 5-year municipal waste management plan that reflects a strong commitment to improving service delivery and environmental outcomes.

The current implementation of this waste management plan depends on a detailed study of the current waste management situation, identification of existing problems, and evaluation of available resources to establish priority measures to tackle. The most significant goal of such a plan is establishing a combined and efficient system of urban waste management that presents a 50% reduction in recyclable waste sent to landfills and broader implementation of waste separation at source, that will facilitate the application of the circular economy principles, green growth, and the rational use of natural resources.

Similarly, the Municipality of Librazhd has also prepared a 5-year plan, with the vision of ensuring a clean environment across its territory. The plan aims for full coverage of integrated waste management services through citizen cooperation and the involvement of recycling businesses. Its strategic objectives include expanding service coverage to underserved areas, including key tourist zones such as the Shebenik–Jabllanicë National Park; improving performance in waste collection, transport, and safe disposal; and enhancing operational efficiency.

A direct goal is to reduce by up to 20% the amount of urban waste, particularly plastics sent to the incinerator, through source separation and recycling initiatives. Nonetheless, Librazhd faces persistent challenges, such as illegal dumping in remote rural areas, limited recycling activity carried out mostly by informal collectors, and uneven coverage in rural territories.

Achieving these goals requires concentrated effort and participation from a diverse array of stakeholders, including local government authorities, waste companies, residents, private sector firms, and environmental education organizations. Some of the primary objectives include consolidation and ongoing improvement of cleaning, collection, and transport services. The plans address important areas such as public health and environmental protection, improve

separation of waste and volume reduction, and render cost-effectiveness in integrated waste management policies. The systematic planning of these plans would frequently involve an evaluation of the overall waste management situation, compliance with the law, developing operational strategy, and specific financial planning.

However, while the document of the plan is well-structured and aligns with national waste management objectives, practical implementation remains inconsistent and hard to implement requiring bigger budgets and immense public willingness from the general public.

Key Strategic Points of the Plans

The primary objective of the plans is to establish an integrated, efficient urban waste management system that aligns with the principles of the circular economy, environmental protection, and sustainable resource use. The following strategic priorities have been identified:

- **Service Consolidation and Expansion:** Strengthening and expanding waste collection services by improving the quality of cleaning, collection, and transportation, with the goal of achieving a 92% coverage rate across all accessible municipal.
- **Waste Hierarchy Implementation:** Ensuring waste management practices follow the waste hierarchy, and current laws. Moving toward sustainable waste handling through enhanced recycling and recovery initiatives.
- **Informal Sector Integration and Minimization:** Clearly defining the role and integration of informal waste collectors within the formal waste management system. Reducing environmental impacts by promoting waste minimization and improved resource use.
- **Data-Driven Optimization:** Creating and maintaining a robust database to support efficient service delivery and planning. Enforcing the “polluter pays” principle by increasing fee collection to adequately cover waste management service costs.
- **Landfill Management:** Ensuring ongoing monitoring and maintenance of the new landfill site, advocating for central government support for its second development phase, and implementing solid waste categorization and weight control measures.
- **Source Separation and Recycling:** Promoting waste separation at the source and throughout the waste generation chain via pilot programs, supporting progress toward national waste reduction targets at the local level.

Implementation Strategy

Effective achievement of the plan depends on the active collaboration of all relevant stakeholders, including local government bodies, waste service operators, community members, private sector entities, and institutions dedicated to environmental education. Essential to the implementation strategy is the development of a detailed action plan that clearly outlines the legal and institutional framework, strategic objectives, specific initiatives, leadership roles, stakeholder partnerships, and defined timelines. This action plan needs to be achievable and well-made to be executed in pilot zones and then in the entire local region,

always following the regulatory framework and introducing sanctions and penalties for non-compliance.

Community engagement and public awareness also play a critical role, achieved through targeted communication efforts and the organization of public hearings to ensure inclusive participation and support from diverse interest groups across the municipality. Continuous education and institutional support are vital to the community engagement efforts for building the capacity of stakeholders, with financial assistance and alignment with circular economy principles ensuring the long-term viability and success of the waste management system.

The operational planning is also important, designed to begin with urban cleaning activities, followed by structured waste collection and transportation, all of which are closely coordinated with urban infrastructure maintenance. Financial strengthening is the last key pillar of the plan, focusing on improved budget allocation, the establishment of service contracts based on performance standards, and the overall enhancement of financial sustainability.

Current problems for plastic waste management

In line with the municipal waste management plan, several challenges directly influence the performance of waste management systems with particular ramifications for plastic waste.

Firstly, operational and financial limitations continue to hamper the implementation of waste management services. Recycling rates are low for all categories of waste, including plastics, pointing to inefficiencies in sorting and recovery. High transport costs undermine economic viability, and service fees often fail to reflect operating costs, placing pressure on municipal budgets. Public awareness and education regarding the necessity to sort waste properly are also lacking, discouraging individuals from taking part in recycling initiatives. Lack of capital investment also constrains the development of necessary infrastructure and the adoption of improved technologies for waste processing. To these difficulties is added the incidence of informal waste collection, which besides distorting statistics on waste streams also fuels uncontrolled dumping in open areas.

In the second case, economic viability of recycling remains uneven across materials. While plastics and metals are being collected more and more given their higher market value, other materials such as paper and cardboard do not necessarily generate returns sufficient to cover collection and transport costs. This market-based feasibility volatility highlights the need for a more stable and integrated plastic waste management solution. Together, these forces represent significant challenges to creating an affordable, sustainable, and organized plastic waste management system.

Survey and interview results:

This part of the chapter presents the findings of the survey and interviews with Elbasan and Librazhd Municipality representatives. These primary sources of information capture further insights to practical aspects and opinions regarding plastic waste management at the

municipality level. The findings from the experiences and responses of the municipal stakeholders are also emphasized correspondingly.

- **Public Perception and Awareness**

One of the most long-standing issues that have risen both from surveys and interviews is poor public awareness and involvement in plastic waste management. Although efforts have been made to promote reuse, particularly amongst schools and youth activities, these have not yet been scaled up sufficiently to cover all aspects of the public. Citizens continue to purchase barred plastic bags on grounds of convenience. In addition, the absence of awareness campaigns aimed at the general public and inadequate education on waste separation have delayed the effectiveness of the municipality's reduction efforts.

Interviewees from other municipalities like the one in Berat agree that little public participation exists, especially in rural or dispersed areas. Changing behavior was always referred to as crucial to success, but municipalities typically lack resources and tools to support long-term awareness campaigns. Environmental issues are addressed for only a small segment of the school curriculum, so education is present but fragmented.

- **Policy and Stakeholder Alignment**

Although Albania has a law to guide waste management, policy enforcement is weakly established and fragmented. The same goes for the municipality of Elbasan, where waste services consist of a mixture of departments with related responsibilities, yet there is no overarching governing body that allows coordination of effort. Fragmentation in institutions leads to duplication of mandate as well as insufficient accountability, which greatly hinders national waste management objectives at the local level (Ramaj, 2025).

Interviewees also noted that the majority of the municipal waste management plans are either old or under preparation, the current example being Librazhd's municipal plan which has not changed for the past 8 years. Elbasan has a new plan, but the lack of internal recycling facilities and dependence on informal collectors pose serious challenges to realization of these goals. Budgetary constraints also hinder realization. Although budget strategies for recycling and reducing waste are in position, they are nonfunctional. Additionally, the lack of accurate and timely data concerning volumes of waste, their sources creates a challenge.

- **Stakeholder Roles and Incentives**

Shkumbin River Basin plastic waste management relies on collaborative initiative of different stakeholders with individual limitations. Municipal authorities need to plan and oversee but lack funding make them depend on unofficial or private actors for collection and sorting. Private waste collectors and recycling industries are constrained by law uncertainty with little incentives and capacity. Interview participants emphasized the need for fiscal support and more articulated policies in order to allow them to keep operating.

Residents and local communities, though vital to effective waste separation, show low engagement due to a lack of incentives and education. Economic tool such as tariff reductions were suggested as ways to encourage participation but they cause budget restraints. Different NGO and international partners contribute mainly through pilot projects and awareness campaigns, helping to fill institutional gaps. Understanding these erratic roles and motivations is essential for identifying leverage points to improve system-wide coordination and outcomes.

- **Institutional Data and Waste System Assessment**

The structured survey conducted aimed to gather baseline institutional data across key dimensions of the municipal waste system. The results indicate that waste collection occurs at designated locations, covering an estimated 51–75% of the municipality; however, there is no system in place for source separation. Plastic waste is not officially collected separately but is instead informally extracted from mixed bins by informal collectors to later be sold to collection centers to recycle.

Recycling efforts are inconsistent, with little to no data available on the quantity of materials processed or their final destination. Many recyclables are reported to end up in both sorting centers and landfills. Initiatives for waste reduction and reuse technically exist but lack effective implementation and scale. Collaboration with businesses and communities is limited, typically occurring on an informal basis. Although major sources of pollution and key waste generators, primarily citizens and businesses, are generally known, there is no systematic mapping of hotspots. Efforts from NGOs are being made to fix this problem.

The main barriers identified include a lack of infrastructure, limited human resources, low levels of citizen participation, and the absence of an official recycling system. When viewed alongside qualitative interview data, these institutional insights reveal a municipality with ambitious plans but constrained by systemic obstacles. While there is strong support for better waste practices, implementation is stalled by data limitations, unclear institutional responsibilities, and insufficient financial support.

Table 4 Interview Results

Thematic Area	Key Findings (Survey + Interview Data)	Main Gaps / Challenges	Implications for Policy & Practice	Priority
Public Awareness & Participation	Low public awareness and engagement.	No large-scale education campaigns.	Launch city-wide awareness campaigns.	High
	School/youth programs too limited in scope.	Inconsistent environmental curricula.	Integrate waste management topics into school curricula.	
	High use of single-use plastics persists.	Fragmented, underfunded awareness efforts.	Partner with media and influencers for outreach.	
Policy Enforcement & Institutional Coordination	Legal framework exists but is weakly enforced.	Overlapping mandates.	Create a central coordinating body.	High
	Responsibilities are scattered across departments.	Budget and capacity constraints.	Secure dedicated recycling budget.	
	New municipal plan faces implementation barriers.	Inadequate data on waste flows.	Strengthen data collection and monitoring.	
Stakeholder Engagement & Incentives	Dependence on informal and private collectors.	Lack of incentives.	Introduce fiscal incentives and subsidies.	Medium
	Private actors face legal and financial barriers.	Informal sector not integrated.	Formalize role of informal collectors.	
	Weak collaboration across stakeholders.	Limited institutional support.	Establish regular stakeholder forums.	
System Coverage & Infrastructure	Only 51–75% of urban area has formal collection.	Infrastructure gaps.	Expand collection coverage.	High
	No source-separation system.	Insufficient human resources.	Build infrastructure for source separation.	
	Recycling data not tracked.	Lack of recycling framework.	Implement tracking and reporting systems.	

Elbasan Municipality: Results and Analysis

Cost-Benefit Analysis (CBA)

The Cost-Benefit Analysis (CBA) was conducted to evaluate the economic efficiency and environmental value of potential improvements in plastic waste management across the two municipalities. The aim was to assess whether investments in improved waste infrastructure and services, such as plastic sorting, recycling programs, or awareness campaigns, would provide net positive returns over time, both financially and in terms of environmental and social benefits for the Residents and families living in this area.

Objectives of the CBA

The CBA is focused on comparing two primary indicators:

- **Costs:** current expenses for collection, transport, and disposal with those under a recyclable-oriented system, accounting for both increased initial investment and potential long-term savings from reduced landfill use and material recovery.
- **Benefits:** evaluates financial gains from selling recyclables, reduced landfill fees, and environmental gains such as lower emissions and resource conservation.

Using the assessed costs and benefits, the study aims to determine the financial feasibility of implementing the recyclable waste management system by calculating the NPV, which will indicate whether the long-term benefits outweigh the initial and ongoing expenses.

Steps in the CBA Process

This cost-benefit analysis relies on contextual data intended to represent the waste management system of Elbasan Municipality. However, due to data availability constraints, some input values were drawn from broader regional sources. This introduces a methodological limitation, as localized differences in waste composition, collection frequency, and operational costs may not be fully captured. While these sources provide a practical basis for estimation, the generalization of fixed contextual data such as service coverage, container capacity, and disposal fees may affect the precision of the model. This limitation is acknowledged as a trade-off between data availability and analytical scope, and should be considered when interpreting the results.

Understanding these limitations, this study constructs its CBA for the municipality of Elbasan based on one region of the entire municipality, treating it as a representative unit of analysis. The selected area reflects typical patterns of residential waste generation and service provision, allowing for a focused yet meaningful assessment of costs and benefits associated with improved waste sorting and recycling practices. While the findings may not fully generalize to all administrative zones within Elbasan, this localized approach enables a more detailed evaluation of economic and environmental outcomes within a manageable scope. Assumptions

made at this scale are transparently documented, and results are interpreted with caution regarding their applicability to the municipality as a whole.

Geographical Indicators

For this study the urban center of the municipality was chosen, that of Elbasan central unit. This area was chosen due to its higher population density, more consistent waste collection services, and relatively stable data availability compared to outlying rural units. As the administrative and economic core of the municipality, the central unit represents typical urban waste generation patterns and infrastructure capacity, making it a suitable substitution for assessing the impacts of improved source-sorting and recycling initiatives.

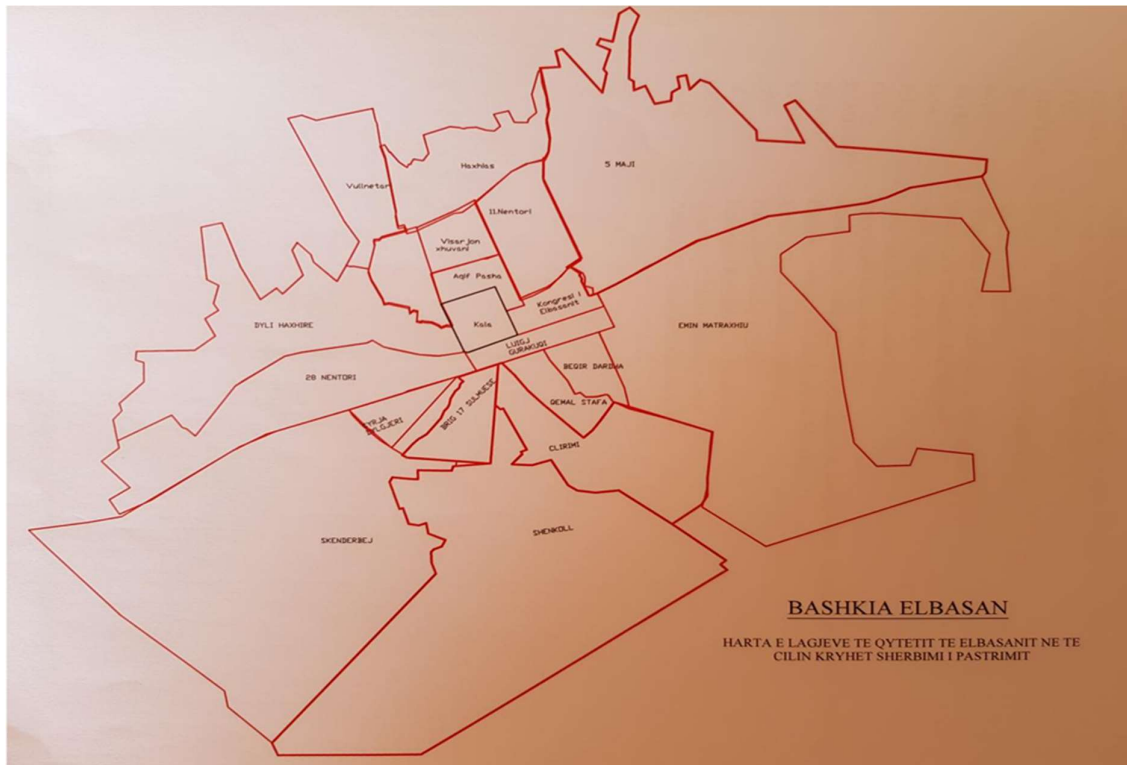
Figure 7 Municipality of Elbasan MAP



Source: Elbasans Municipal Plan

The chosen area is depicted as below:

Figure 8 Elbasan Urban area (central city)



Source: Elbasans Municipal Plan

The urban center of Elbasan has approximately 133,637 registered residents according to (Elbasan, 2025), with projections estimating the population will grow to around 136,200 between 2028 and 2030. Family numbers within the city vary slightly across sources, reporting between 44,383 and 46,466 registered families, likely reflecting different administrative boundaries or updates up to 2024. While the municipality of Elbasan expanded significantly in size from 8 km² to 872 km² following administrative reforms the specific geographical area of the urban center is less clear. However, the waste service contract area within the urban territory covers approximately 1,500 hectares, equivalent to 15 km².

Table 5 Elbasans city population

Urban zone	Nr. Neighborhoods	Families	Nr. Residents
zone 1	4	8233	25577
zone 2	4	8209	23378
zone 3	4	9107	28563
zone 4	4	8973	22230
zone 5	3	4767	14043
zone 6	1	7302	21456
Total		46446	135637

Source: Elbasans Municipal Plan

COST CALCULATION:

The municipality plan utilizes the "dldp model" for calculating overall expenses related to urban waste management services as explained in the methodology (dldp, 2013). The standard system for calculating total costs for integrated waste management in Local Self-Government Units is based on 5 main costs:

1.Capital Costs

Capital investments form a key component of the overall expenses and include infrastructure improvements aimed at establishing an effective differentiated waste collection system. Specific capital costs relate to the procurement of technological vehicles such as 10-ton and 3-ton trucks for urban areas, and 5-ton open vehicles for rural zones as well as the installation of eco-bins at strategic locations across the municipality. While the document outlines the types and quantities of necessary equipment and infrastructure, including containers and vehicles, the dldp model and vehicle pricing research helped to determine the monetary values for these capital assets.

2.Operating Costs

The total operational costs for urban areas in Elbasan, specifically for the city's urban waste transport, are projected to be 119,324,540 ALL for the period from 2025. The total cost was derived from the combined contributions of several specific categories. Waste transport expenses include household waste transport and the movement of voluminous waste as well as waste generated from container washing. Additionally, the transport of inert and recyclable waste along five designated routes. Other costs, such as additional fees and taxes, further contribute to the overall total, reflecting the comprehensive nature of the municipal waste management expenses. The initial costs of investment are around 85,587,200 ALL. This cost accounts for approximately 61% of the total waste management expenses for the Municipality of Elbasan.

3.Disposal Costs

This cost is calculated based on the quantity of waste delivered to the landfill and the entry fee nearing 43.5 ALL/per person. That makes a total of 5,813,209.50 ALL.

4.Depreciation Costs

Depreciation costs are calculated in accordance with the provisions of the law "On income tax". The calculation directly relates to the annual depreciation of urban waste transport vehicles and containers. A 5-year depreciation period is assumed, with an annual average depreciation rate of 20% of initial investments.

5.Administration Costs

These costs account for 0.09% of the total costs.

Table 6 Cost Calculations Elbasan

	2025	2026	2027	2028	2029	2030
1	85,587,200	0	0	0	0	0
2	119,324,540	122,307,654	125,365,345	128,499,478	131,711,965	135,004,765
3	5,813,210	5,958,540	6,107,503	6,260,191	6,416,696	6,577,113
4	17,117,440	17,117,440	17,117,440	17,117,440	17,117,440	17,117,440
5	205,058	130,845	133,731	136,689	139,721	142,829
Total	228,047,448 ALL	145,514,479 ALL	148,724,019 ALL	152,013,799 ALL	155,385,822 ALL	158,842,147 ALL

Note: The annual growth rate that was used to calculate the costs through the years is $g=2.5\%$. This rate the average rate of inflation for Albania's economy.

BENEFIT CALCULATION:

For calculating overall benefits related to urban waste management services we use the foundations as explained in the methodology (Zaman, 2016). The standard system for calculating total benefits for integrated waste management in this analysis is based on 4 main benefits:

1. Material Substitution

Based on municipal observations and measurements for 2024, the recycling percentages for plastic are 13.6% and paper 3%, but only 90 % of them get recycled to later be sold at auction.

Table 7 Percentage of Recycling in Elbasan

Nr.	Material	%
1	Organik	40.34
2	Wood	3.45
3	Paper	3
4	Carbord	7.95
5	LD-plastic	3.6
6	HD-plastic	10
7	Glass	6.99

Source: Elbasans Municipal Plan

Based on (Zaman, 2016) the average price for selling 1 ton of plastic is 220\$ or 17,914 ALL and for paper 470\$ or 38,446 ALL.

2. Energy Savings

The value of USD 5.68 or ALL 467 per capita per year reflects the reduced energy demand associated with using recycled materials instead of producing new ones from raw resources.

3. Avoided Costs

About 10% of the estimated environmental and economic benefits per person is being counted as a cost-saving. These avoided costs could include things like reduced landfill use, lower pollution-related expenses, or in this case lower transport expenses.

4. Overall Economic Benefits

The value USD 2.27 or ALL 186 per person per year represents the total estimated economic gain per capita from recycling activities in LMIC.

Table 8 Benefit Calculation Elbasan

	2025	2026	2027	2028	2029	2030
1	95,438,743	97,824,711	100,270,329	102,777,087	105,346,514	107,980,177
2	62,090,957	63,643,231	65,234,312	66,865,170	68,536,799	70,250,219
3	5,810,558	5,955,822	6,104,718	6,257,336	6,413,769	6,574,113
4	24,814,520	25,434,883	26,070,755	26,722,524	27,390,587	28,075,352
Total	188,154,778 ALL	192,858,648 ALL	197,680,114 ALL	202,622,117 ALL	207,687,670 ALL	212,879,862 ALL

Note: The annual growth rate that was used to calculate the costs through the years is $g=2.5\%$. This rate the average rate of inflation for Albania's economy.

NPV AND BCR CALCULATIONS:

By following the above steps, the respective costs and benefits for each year have been calculated. Now, the next step is to compute their totals across the years.

Table 9 Total in years Elbasan

Total/Years	Costs	Benefits
2025	ALL 228,047,447.65	ALL 188,154,778.37
2026	ALL 145,514,478.51	ALL 192,858,647.83
2027	ALL 148,724,019.33	ALL 197,680,114.03
2028	ALL 152,013,798.67	ALL 202,622,116.88
2029	ALL 155,385,822.49	ALL 207,687,669.80
2030	ALL 158,842,146.91	ALL 212,879,861.54

Equation 1 To calculate the PV of costs, the following formula is used:

$$PVcosts = C_0 + \sum_{t=1}^n \frac{C_t}{(1+r)^t}$$

Equation 2 To calculate the PV of benefits, the following formula is used:

$$PVbenefits = \sum_{t=1}^n \frac{B_t}{(1+r)^t}$$

- C₀ = Initial investment (cost at time 0)
- C_t = Cost incurred in year t
- B_t = Benefits incurred in year t
- r = Discount rate 5 %
- t = Year (from 1 to n)
- n = Total number of years

Note: The base discount rate (r=5%) used in this paper is taken from the European Commission (2025) reference for Croatia in the Eurozone as the closest reference to Albania's economy. (Commission, Croatia (Eurozone) Directorate-General for Competition, 2025)

Table 10 The PV of costs and benefits after calculations:

PV cost	ALL 885,138,248.90
PV ben	ALL 1,063,826,076.40

RESULTS FOR ELBASAN:

The net NPV calculates the difference between the present values of benefits and costs over time. It shows the overall value a project adds after considering both inflows and outflows discounted to today.

Equation 3 NPV formula

$$NPV_{net} = PV_{ben} - PV_{cost}$$

NPV gives you the actual value created (in money terms).

The Benefit-Cost Ratio (BCR) compares the present value of benefits to the present value of costs. A BCR greater than 1 means the benefits outweigh the costs, indicating a worthwhile project.

Equation 4 BRC formula

$$BCR = \frac{PV_{ben}}{PV_{cost}}$$

BCR gives you a ratio how many ALL of benefit you get per ALL of cost.

If **NPV > 0**, it means the project or our system generates more value than its cost. When **BCR > 1**, the benefits exceed the costs, showing the project or our system is financially beneficial.

Table 11 Viability

NPV	178,687,827.5 ALL	viable
BCR	1.20188	viable

In the initial two years, the Net Present Value (NPV) is negative, indicating that the costs associated with establishing and operating the recycling system surpass the benefits during this early period. However, by the end of the five-year evaluation horizon, the NPV becomes positive, demonstrating that the cumulative discounted benefits surpass the total costs, and therefore, the system is financially viable and adds economic value over the long term.

This indicates that, in the long term, the recycling-based waste management system proves to be more economically beneficial than the traditional landfill-based approach. The positive NPV achieved over time reflects not only the recovery of initial investment costs but also the generation of net economic benefits. Compared to landfilling, the recycling system allows for resource recovery, reduction of disposal costs, and potential revenue from recyclable materials, making it a more sustainable and financially sound option for waste management.

Librazhd Municipality: Results and Analysis

Cost-Benefit Analysis (CBA)

Geographical Indicators

For this study, just like the Elbasan case I have chosen the urban center of the Librazhd municipality. This area was chosen due to its higher population density, more consistent waste collection services, and relatively stable data availability compared to outlying rural units.

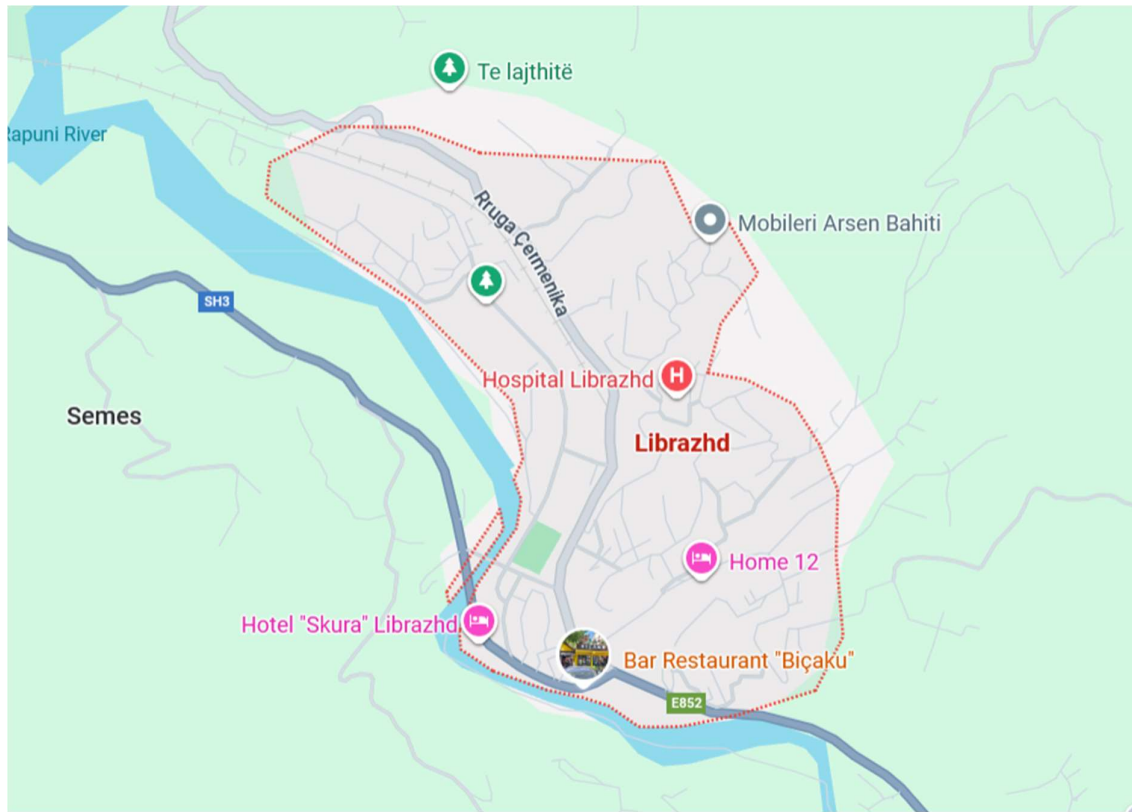
Figure 9 Municipality of Librazhd



Source: Librazhd municipal plan

The chosen area is depicted as below:

Figure 10 Librazhd Urban Area



Source: Librazhd municipal plan

The urban center of Librazhd has approximately 10,990 registered residents according to INSTAT's 2023 census (Instat, 2024) and (Bashkia, 2019), with projections estimating the population will grow to around 12,000 between 2028 and 2030. While the municipality of Librazhd expanded significantly in size from 129 km² to 872 km² following administrative reforms, the specific geographical area of the urban center is less clear. However, the waste service contract area within the urban territory covers approximately 120 hectares, equivalent to 1.2 km².

COST CALCULATION:

Following the Elbasan's calculations, the Librazhd plan utilizes the "dldp model" for calculating overall expenses (dldp, 2013). The system for total costs is based on 5 main costs:

1.Capital Costs

Capital investments, the overall expenses and infrastructure improvements.

2.Operating Costs

The total operational costs for urban areas in Librazhd, specifically for the city's urban waste transport, are projected to be 13,083,322 ALL for the period from 2025. The total cost was

derived from the combined contributions of several specific categories. While the investment costs total around 6,846,976 ALL due to the small area coverage.

3. Disposal Costs

The cost calculated based on the quantity of waste delivered to the landfill and the entry fee nearing 100 ALL/per person. This number is nearly double that of Elbasan due to the large distance from the nearest landfill located in Elbasan. That makes a total of 1,099,000 ALL.

4. Depreciation Costs

Depreciation costs are calculated in accordance with the provisions of the law "On income tax". Is assumed an annual average depreciation rate of 20% of initial investments.

5. Administration Costs

These costs account for 0.09% of the total costs.

Table 12 Cost Calculations Librazhd

	2025	2026	2027	2028	2029	2030
1	7,846,976	0	0	0	0	0
2	10,115,785	10,368,680	10,627,897	10,893,594	11,165,934	11,445,082
3	1,099,000	1,126,475	1,154,637	1,183,503	1,213,090	1,243,418
4	1,569,395	1,569,395	1,569,395	1,569,395	1,569,395	1,569,395
5	18,568	11,758	12,017	12,282	12,554	12,832
Total	20,649,724 ALL	13,076,308 ALL	13,363,945 ALL	13,658,774 ALL	13,960,973 ALL	14,270,727 ALL

Note: The annual growth rate that was used to calculate the costs through the years is $g=2.5\%$. This rate the average rate of inflation for Albania's economy.

BENEFIT CALCULATION:

Again, following the Elbasan's calculations, calculating the benefits related to urban waste management services in Librazhd we use the foundations as explained in the methodology (Zaman, 2016). The system for total benefits is based on 4 main benefits:

1. Material Substitution

Due to missing information from the municipality plan we will use the observations of the recycling percentages of Elbasan: plastic are 13.6% and paper 3%, but only 90 % of them get recycled to later be sold at auction.

2. Energy Savings

The value of USD 5.68 or ALL 467 per capita per year reflects the reduced energy demand associated with using recycled materials instead of producing new ones from raw resources.

3.Avoided Costs

About 10% of the estimated environmental and economic benefits per person is being counted as a cost-saving. These avoided costs could include things like reduced landfill use, lower pollution-related expenses, or in this case lower transport expenses.

4.Overall Economic Benefits

The value USD 2.27 or ALL 186 per person per year represents the total estimated economic gain per capita from recycling activities in LMIC.

Table 13 Benefits Calculation Librazhd

	2025	2026	2027	2028	2029	2030
1	7,693,028	7,885,353	8,082,487	8,284,549	8,491,663	8,703,955
2	5,106,218	5,233,873	5,364,720	5,498,838	5,636,309	5,777,217
3	477,847	489,793	502,038	514,589	527,454	540,640
4	2,040,689	2,091,706	2,143,999	2,197,599	2,252,539	2,308,852
Total	15,317,782	15,700,726	16,093,244	16,495,575	16,907,965	17,330,664
	ALL	ALL	ALL	ALL	ALL	ALL

Note: The annual growth rate that was used to calculate the costs through the years is $g=2.5\%$. This rate the average rate of inflation for Albania's economy.

NPV AND BCR CALCULATIONS:

By following the above steps, the respective costs and benefits for each year have been calculated. Now, the next step is to compute their totals across the years.

Table 14 Total in years Librazhd

Total/Years	Costs	Benefits
2025	ALL 20,649,724.24	ALL 15,317,781.54
2026	ALL 13,076,307.92	ALL 15,700,726.08
2027	ALL 13,363,945.43	ALL 16,093,244.23
2028	ALL 13,658,773.87	ALL 16,495,575.34
2029	ALL 13,960,973.03	ALL 16,907,964.72
2030	ALL 14,270,727.16	ALL 17,330,663.84

Table 15 The PV of costs and benefits after calculations:

PV cost	79,691,020.90 ALL
PV ben	86,606,652.12 ALL

RESULTS FOR LIBRAZHD:

Table 16 Viability

NPV	6,915,631.22 ALL	Viable
BCR	1.086780557	Viable

This calculations reinforces the previous conclusions derived from the calculations of Elbasan Municipality, which had similarly indicated that initial investments in waste management infrastructure, such as recycling systems, often result in a negative NPV due to high setup and operational costs. However, as the system matures and benefits like reduced landfill fees, increased revenue from recyclable materials, and environmental cost savings accrue, the long-term financial viability becomes evident thus a positive NPV. The alignment with Elbasan’s findings emphasizes the importance of a five-year horizon for assessing such projects, providing a robust framework for municipalities like Librazhd to justify and plan similar initiatives.

Transition CBA Possibility Analysis

The NPV above showed if the municipalities of Elbasan and Librazhd would have it beneficial for them to use a two-way stream recyclable waste management system. The results told that **YES** it would be beneficial to have this system. **BUT**, can we actually implement this system, is it possible to transition. The analysis below will determine if the benefits outweigh the costs.

Transitioning to Recyclables in Elbasan

The table evaluates the economic possibility of transitioning waste management in Elbasan chosen zone. Each calculation was made using costs from the municipality plan that would be needed to transition to a recyclable waste system based on the recyclability, waste volume and population for each material.

The total cost for diverting recyclables from landfill to recycling is 124,390,000 ALL over a 5-year period.

Table 17 Transitioning cost Elbasan

Category	% Waste	Tons/Year	Capex (ALL)	Opex (ALL)	Total (ALL)
Paper	10.95%	2,496	7,934,000	31,736,000	39,670,000
Plastic	13.6%	3,099	9,854,000	39,416,000	49,270,000
Glass	6.99%	1,594	5,061,000	20,244,000	25,305,000
Metal	2.8%	639	2,029,000	8,116,000	10,145,000
Total	34.35%	7,829	24,878,000	99,512,000	124,390,000

Note: Capex (costs for transitioning infrastructure); opex (costs for transitioning collection, transport, processing). Costs scaled by volume; Albanian inflation (2.5%/year,2025-2030); 81.8 ALL/USD.

Transitioning to Recyclables in Librazhd

The table evaluates the economic possibility of transitioning waste management in Librazhd chosen zone. Calculation were made using data from Librazhd municipal plan.

The total cost for diverting recyclables from landfill to recycling is 6,782,000 ALL over a 5-year period.

Table 18 Transitioning cost Librazhd

Category	% Waste	Tons/Year	Capex (ALL)	Opex (ALL)	Total (ALL)
Paper	13.8%	211	511,200	2,044,800	2,556,000
Plastic	15.4%	236	571,200	2,284,800	2,856,000
Glass	4.2%	64	155,200	620,800	776,000
Metal	3.2%	49	118,800	475,200	594,000
Total	36.6%	561	1,356,400	5,425,600	6,782,000

Note: Capex (costs for transitioning infrastructure); opex (costs for transitioning collection, transport, processing). Costs scaled by volume; Albanian inflation (2.5%/year,2025-2030); 81.8 ALL/USD.

NPV RESULTS

The table below presents the Net Present Value (NPV) analysis for transitioning recyclable waste management systems (paper, plastic, glass, metal) from landfill to recycling in the urban centers of Elbasan and Librazhd. The benefits are taken from the prior analysis as total economic benefits that derive from the two-way stream recyclable waste system.

Table 19 Viability

Metric	Elbasan	Librazhd
Total Transition Cost (ALL)	124,390,000	6,782,000
Total Benefits (ALL)	1,063,826,076.40	86,606,652.12
NPV	939,436,076.40	79,824,652.12
Viability	Viable	Viable

Calculations show a positive NPV. This supports the economic justification for transitioning to recyclable systems in both cities, with Elbasan showing a significantly larger net gain.

CONCLUSIONS

Based on data and literature review, the cost-benefit analysis, surveys, and stakeholder interviews, the following conclusions appear. Municipalities like Elbasan and Librazhd face deep systemic challenges in waste management, limited infrastructure, not enough public engagement, weak institutional organization, and defective data systems. But, despite these challenges, both municipalities hold strong potential to change toward sustainable waste practices.

For Elbasan, the lack of dedicated recycling facilities and dependence on informal collectors creates inefficiency. Low participation in source separation and fragmented institutional responsibilities continues to be an obstacle, but the success of Berat's pilot programs offers hope that practical and replicable pathways are possible.

Librazhd, while sharing similar limitations, has outlined a promising draft plan for a two-stream collection system. Its progress, however, is stalled by poor awareness, lack of infrastructure, and overreliance on informal systems. Stakeholders emphasize that fiscal incentives, collaborations, and stronger data systems are crucial to translate plans into functioning practice.

The cost-benefit analysis provided clear financial and environmental benefits to continue the implementation of the two-way recyclable waste management system. Even if early investments are high and create financial strain for the municipal budgets, the shift to recycling and source separation generates positive returns. The CBA, based on Albania's cost model and monetized benefits, shows a negative NPV in years one and two due to upfront costs. By year five, NPV turns positive with a BCR >1, driven by landfill savings, recyclable revenues, and environmental benefits. The analysis reflects both Elbasan's and Librazhd's projections. This confirms that recycling, particularly plastics, is both a sustainable and cost-effective that aligns with EU circular economy policies.

In conclusion, while Elbasan and Librazhd reflect the systemic challenges of Albania's waste sector, they also prove the opportunities of recyclable systems. By implementing proven models, investing in infrastructure, and fostering citizen engagement, these municipalities can move from fragmented systems toward circular, and benefit while also contributing to national and global sustainability goals.

RECOMMENDATIONS

Improvements in Policies and Legislation

To improve plastic waste management, legal frameworks and their enforcement must be strengthened by updating current plans with a unified framework in line with EU standards, implementing strict measures, establishing a central oversight body to address institutional fragmentation, and improving laws such as the Waste Framework Directive. EPR must be fully operationalized for packaging, transferring costs to producers to encourage eco-design and strengthen recycling infrastructure. The national strategy must be harmonized with EU goals by advancing the 2020–2035 plan, with a focus on alternatives to single-use plastics to support the circular economy.

Investments in Infrastructure and Technology

Investments in source separation are essential to reduce reliance on informal sectors and increase diversion rates, by funding bins, trucks, transfer stations, and local recycling facilities, based on the Berat model with targeted improvements and two-way flows for paper and plastic. Successful pilots like the Berat partnership should be scaled to Elbasan and Librazhd to improve coverage, cost recovery, and recycling efficiency, building a more integrated and sustainable system.

Public Engagement and Education

For sustainable changes, awareness campaigns through media and community networks are essential to educate about waste impacts and the benefits of separation, including door-to-door efforts for behavioral change. Integrating environmental education into school curricula is necessary for long-term effects. Encouraging community involvement should be done to engage citizens in waste service planning, increasing participation and trust in local initiatives, and strengthening the link between policies and practice.

Economic and Financial Strategies

Financial sustainability is achievable by implementing fees and incentives such as cost-reflective payments¹, reductions for compliance, and fines for violations by polluters. Completing and improving data systems is equally important and would be possible through a unified monitoring platform for accurate waste information, facilitating evidence-based planning and policy evaluation, for a continuous improvement cycle.

¹ Cost-reflective fees are charges set to fully cover the actual expenses of operating and maintaining a waste management system, ensuring financial transparency and sustainability.

Long-Term Vision

A long-term waste management vision for Albania, in this case, would aim to establish an integrated circular economy that transforms waste into resources, promoting sustainable development. This approach focuses on the principles of reduce, reuse, recycle, and recover to minimize resource extraction and pollution, especially regarding plastic contamination. It builds on local successes in waste separation and seeks to enhance infrastructure for recycling. Environmentally, it would aim to support sustainable cities and reduce gas emissions; economically, it could create jobs and generate savings; socially, it emphasizes public education and community engagement to foster environmental stewardship and improve public health.

While the journey to achieve this vision is long and implementation involves high initial costs, adopting recyclable methods now will yield substantial benefits for future generations, ensuring economic resilience, environmental integrity, and social equity. Through innovation, collaboration, and sustained investment, Albania can emerge as a regional leader in circular waste management, contributing to global efforts against plastic pollution. By adopting these strategies, inspired by models like Berat, Elbasan and Librazhd can develop efficient, sustainable waste management systems that reduce environmental harm and unlock economic opportunities, advancing Albania's transition to a circular economy and supporting national and global sustainability goals.

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