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NIRAS

Enablers for a sustainable solid waste management system in Lebanon

Strategic study 1

EUD to Lebanon

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Waste Governance project team: Sophia Ghanimeh (Team Leader) and Patrick Chemali with contributions from Cynthia Kreidy and Bassam Al Aamil.
This report was quality assured and proof-read by Nathalie Pano nathalie.pano@niras.se and Ana Gajicic vas@niras.com

ABBREVIATIONS

AT	Adjustment Time
AUB	American University of Beirut
CDR	Council for Development and Reconstruction
EPR	Extended producer responsibility
EU	European Union
EUD	Delegation of the European Union to Lebanon
E-waste	Electric and electronic waste
FC	ForeCast
FGDs	Focus Group Discussions
HIST	Historical
IMF	Independent municipal fund
ISWM	integrated solid waste management
IW	industrial waste
MoE	Ministry of Environment
MoE&T	Ministry of Economy and Trade
MoF	Ministry of Finance
MoI	Ministry of Industry
MoIM	Ministry of Interior and Municipalities
MoT	Ministry of Transport
MSW	municipal solid waste
MSW	Municipal Solid Waste
OMSAR	Office of Minister of State for Administrative Reform
ProMARE	Protection and sustainable development of maritime resources in Lebanon
RDF	Refuse derived fuel
SS	Secondary Sorting
SS1	Strategic study #1
SW	Sorted Waste
SWM	solid waste management
t/y	Metric tonnes per year
TDF	Tire derived fuel
UNDP	United Nations Development Programme
UW	Unsorted Waste
WB	The World Bank

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1. INTRODUCTION

1.1 CONTEXT

Since 2010, Lebanon has benefitted from the EU assistance in Municipal Solid Waste Management for an amount exceeding € 73.5M. The results of this assistance can be described as "mixed", at best, especially in light of recent criticism and negative coverage in the media. In the process of learning and following the evaluation of its portfolio in the sector (2018- 2020), the EU assigned to NIRAS the project "SIEA-2018-4313 Waste Governance: Technical Assistance to the EUD (EU Delegation) (Expected Result 2)" to enhance the contribution of the EU to structural reforms in the waste sector in Lebanon (municipal waste and special streams).

This present document is the first of three strategic studies that constitute the output of the assignment undertaken by NIRAS. The ultimate goal of this strategic study #1 (SS1) is to generate a recommendation framework and a roadmap of priority interventions that will help the EU to position itself from a policy and governance perspective in the waste sector, with a view to carrying out informed and targeted dialogue and programmatic actions throughout the lifecycle of this present intervention and beyond.

1.2 VISION & OUTCOMES

1.2.1 Vision

This project aims at assisting the EU in inducing the changes needed to achieve a sustainable integrated solid waste management system that mitigates the risks of volatile and environmentally unsound waste management activities in Lebanon.

Specifically, this study aims at generating a recommendation framework and highlighting priority support areas to be considered by EU as strategic entry points to the SWM sector in Lebanon.

1.2.2 Components and outcomes

- **Component #1:** Data collection

  Outcome #1 – An extensive dataset that accounts for the perception of local authorities and citizens across the country, as well as the opinion of national authorities, experts, consultants, service providers, researchers, international donors, and activists.

- **Component #2:** Problem definition

  Outcome #2 – A comprehensive list of major contemporary problems and needs in SWM in Lebanon, segregated into generic "topics" where EU support is highly needed.

- **Component #3:** Setting priorities

  Outcome #3 – A recommendation framework and a "preliminary" roadmap for priority-based support –based on the importance of the topic and the availability of efficient solutions and the likelihood of implementing them, as well as the need for and interest in policy dialogues.

- **Component #4:** System dynamics modelling

  Outcome #4 – A quantitative model of the current SWM scheme in Lebanon – taking into account the impact of SWM enablers on final performance of the system and allowing for future scenario testing and analysis.

2. EXECUTIVE SUMMARY

2.1 METHODOLOGY

The approach adopted in strategic study #1 (SS1) consists of six main components:

1. *Field data collection and analysis,* whereby one-to-one interviews were performed with **80 heads of local authorities**, and 25 focus group workshops across the country (meeting **420 citizens** in total) – in addition to visits to informal recycling facilities.
2. *Problem definition,* which consisted of three steps:
   a. one-to-one interviews with **41 experts** including governmental entities, international donors, consultants, scholars, contractors, startups, NGOs, and activists. The experts were asked to define SWM problems that they consider a priority to the country
   b. Synthesis of experts' feedback that grouped the major SWM problems in Lebanon into 16 generic topics
   c. Breakdown of generic topics into specific actions and validation against the findings of the field data collection activities
3. *Setting priorities*, whereby the previously interviewed experts were asked to participate in a six-question survey for the purpose of prioritizing the 16 SWM problems and eliminating those of lowest-priority. This follows the guidelines of the "SURE Guides for Preparing and Using Evidence-Based Policy Briefs" – a project funded by the European Commission's 7th Framework Programme: www.evipnet.org/sure[1]
4. *Recommendation framework,* whereby the recommended priority themes are broken down into specific support actions and placed in a framework structure.
5. *Exiting initiatives* were identified and explained for the purpose of pinpointing potential synergies and avoid redundancy in future interventions.
6. *System dynamics modeling,* whereby a preliminary model was developed to represent Lebanon's municipal solid waste management system. The current version of the model provides a better understanding of the complex interactions among the different components of the system. It can also be used in future studies to run scenario analyses. The final version of the model would be used to facilitate stakeholder engagement and dialogues by providing a visual representation of the system which enhances communication and supports the discussion of different perspectives and assumptions.

[1] The SURE Collaboration. SURE Guides for Preparing and Using Evidence-Based Policy Briefs. Version 2.1 [updated November 2011]. The SURE Collaboration, 2011. Available from www.evipnet.org/sure.

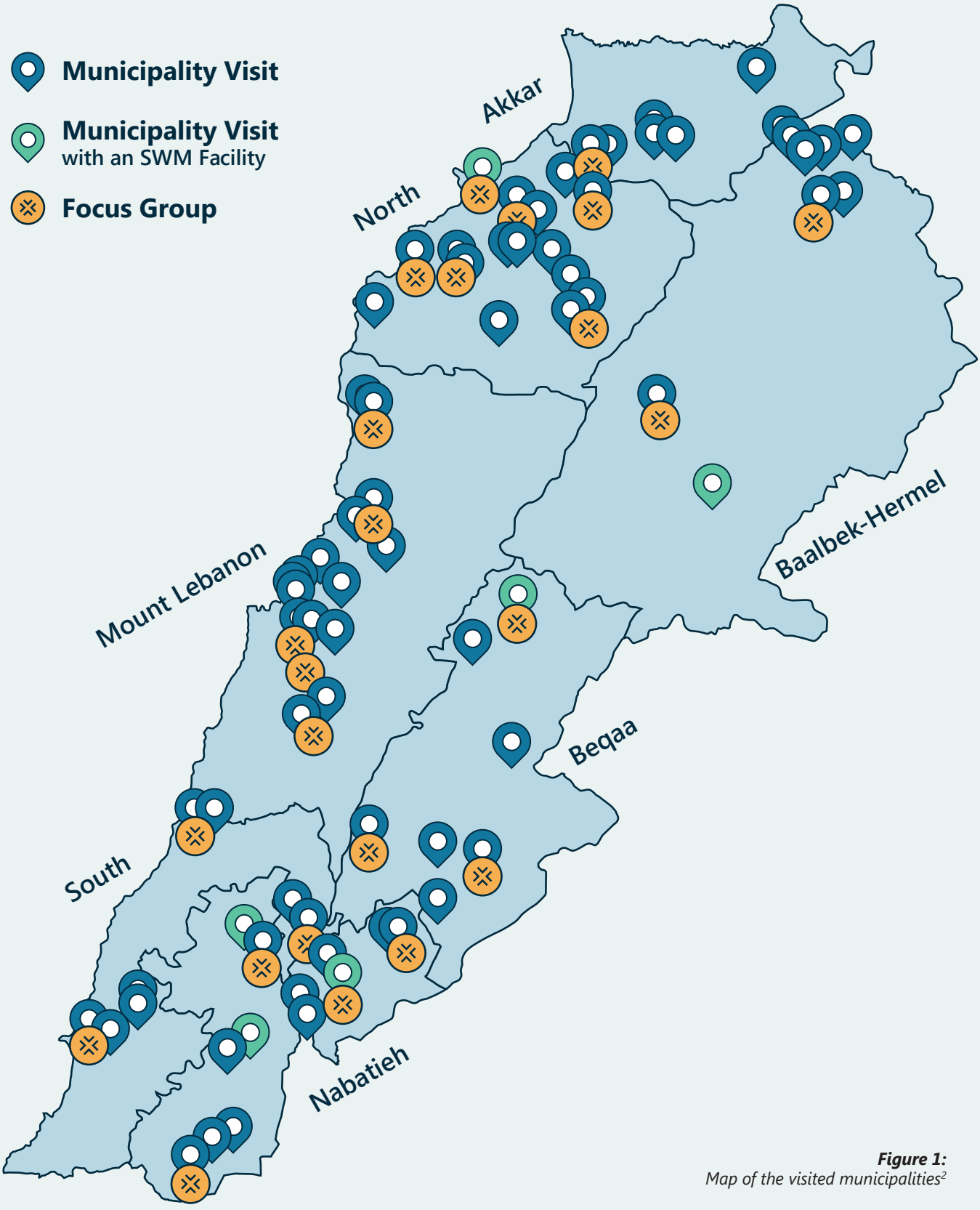


Figure 1:
Map of the visited municipalities[2]

[2] A live map can be accessed here: https://www.google.com/maps/d/u/0/edit?mid=11-W1E2w7scde8IUgwxDuwqG8h1dkoUc&usp=sharing

2.2 PROBLEM DEFINITION

Based on the synthesis of the experts' interviews, and upon validation with the findings of the various data collection activities, the major SWM in Lebanon were classified as follows:

A. Structural & functional reforms

1. Solid waste management agency
2. National strategy and national masterplan
3. Waste Diversion
4. Alternative fuel
5. Redefining landfilling
6. Robust cost recovery system
7. Institutional capacity & law enforcement
8. Pre-Requisites for Local Implementation
9. Valorizing special wastes
10. Achieving circularity of industrial waste
11. Limiting hazardous contamination
12. Stopping sporadic sludge disposal

B. Infrastructure & operational sustainability

13. Optimizing existing infrastructure & completing interrupted initiatives
14. Transitional handover plan
15. Support for environmental protection
16. Support to the Recycling Industry

2.3 SETTING PRIORITIES

Six topics were found to be of least priority and were omitted: alternative fuel, stopping sporadic sludge disposal, valorizing special waste, limiting hazardous contamination, transitional handover of MSW facilities, achieving circularity of the industrial waste.

The remaining 10 topics were retained and further analyzed to develop the following recommendation framework. Those were categorized into three categories: (1) prerequisites, which are mandatory for a successful integrated solid waste management system; (2) structural and functional reforms, consisting mostly of soft interventions; and (3) infrastructure and operational sustainability, requiring funding for infrastructure components.

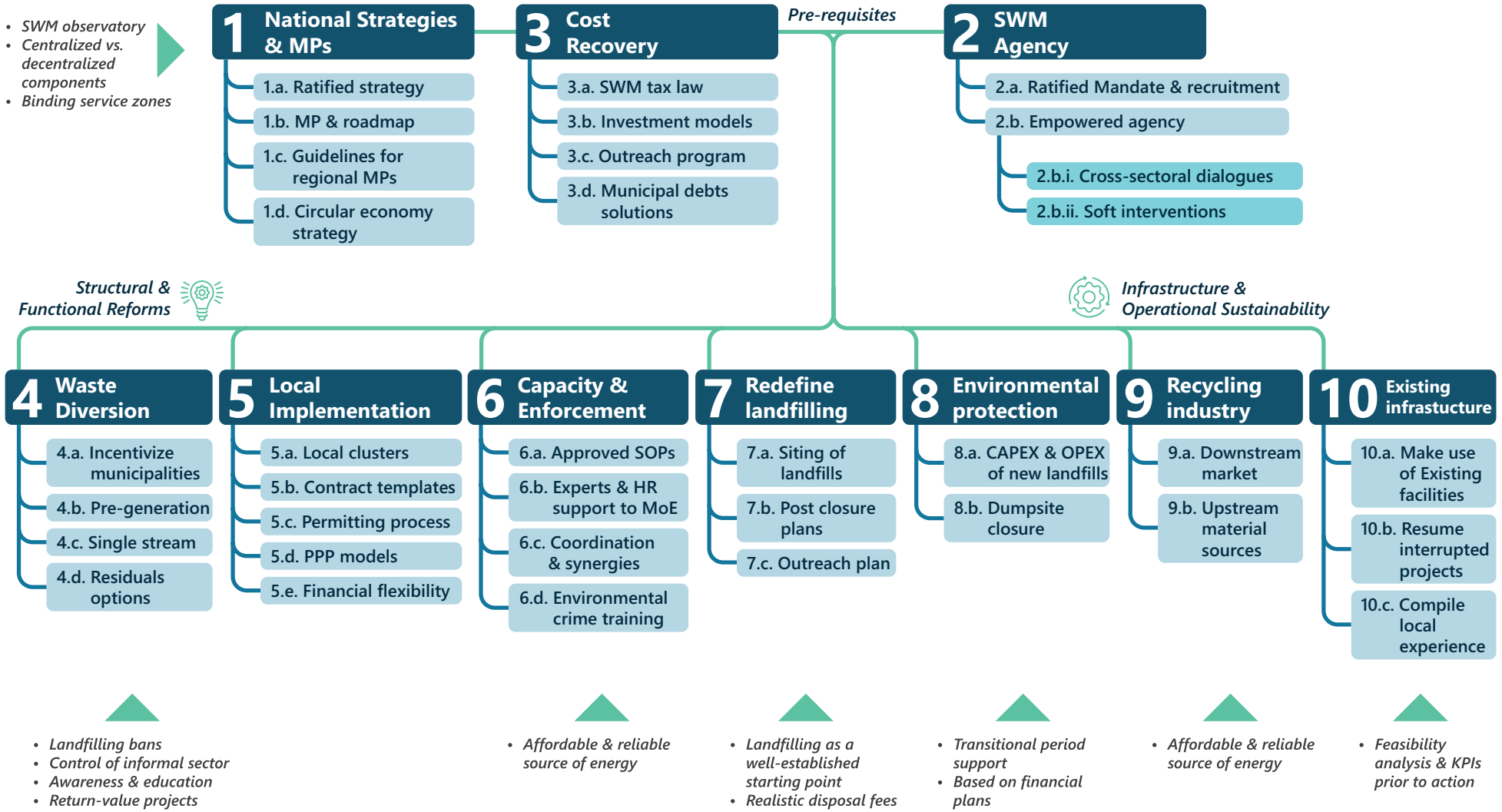


Figure 2:
Recommendation framework

2.4 EXISTING INITIATIVES

The recent (last than 5 years) initiatives that are considered relevant to this strategic study, and have a wide effect (e.g. cover a large area or address national-level issues). Localized interventions (in municipalities, institutions, etc.) were identified as shown in the table below.

Table 1: *Existing Initiatives*

Area of support	Donor	Implementing party	Donor	Year
MSW	EU	OMSAR	Upgrading the Solid Waste Management capacities in Lebanon (SWAM 2)	2018 - interrupted
MSW	EU	OMSAR	Technical support for development of solid waste management capacities in Lebanon (6 regional SWM plans)	2018 - interrupted
MSW	EU	ACF	PROMARE: Complementary support to SWM in al Zahrani area	2018 - Interrupted
MSW	EU	Iqlim AlToufah Union of Municipalities, AUB, Union of Jezzine Municipalities, MONEERA NGO, University of Cagliari	PROMARE: Developing integrated Municipal Solid Waste Management Program for the Protection of the Saniq River Basin in Southern Lebanon	2018 - on hold
MSW	EU	COOPI, StudioAzue & DRI	PROMARE: SWaM Akkar: Supporting Sustainable SWM in Jurd el-Kaytee, Akkar	2018 - present
MSW	EU	ACCD	Solid Waste Management in Oussat wa Sahel al Qaytaa	2021
MSW	World Bank	CDR	Lake Qaraoun Pollution Prevention Project	2016 - 2023
MSW	World Bank	ESFD	Green Agri-food Transformation for Economic recovery in Lebanon (GATE)	
MSW		UNDP (LHSP)	Support the Solid Waste Management Sector In Koura Cluster	
MSW/ Environmental Protection	Kuwait Fund	UNDP	Design a landfill in the south of Lebanon and capping of a landfill cell in the Bekaa	2022
MSW /	USAID	ECODIT-Berytech-Compost Baladi	DAWERR	2021-present (2025)
Science-policy-citizen	World Bank	MoE	Reduction of Unintentional POPs through Waste Management in a Circular Economy	2022 - present
Special Waste	EU	World Vision	PROMARE: Establishing an integrated slaughterhouse waste management system in the city of Choueifat	2018 - Interrupted
Special waste/ recycling/ Central	EU	UNDP	Towards a Decentralised Waste Management Integrated Response in Lebanon (TaDWIR)	2022 - present
Special waste	UNIDO	UNIDO	Baseline Assessment of E-Wastes in Lebanon	2019
Environmental protection	Italian Agency for Development Cooperation	UNDP	Sustainable solid waste management within Protected Areas under STEPping up Nature Reserves Capacity – STEP4Nature Project	2022
Environmental protection	EU	Lebanon Eco Movement and Lebanese Environment Forum	Lebanese Civil Society combating for a plastic free Mediterranean Sea # Bahr Bala Plastic	2018 -2020

Environmental protection	German Ministry of Environment – BMU	UN-HABITAT	Reducing Marine Litter in the Mediterranean through Waste Wise Cities Lebanon (ReMaL)	Planned to start in May 2023
Environmental protection	EU	UNDP	Qaraoun Depollution Programme (QaDePro)	2019 - present (2025)
Environmental protection/ Recycling	EU	UNDP	Beirut Critical Environment Recovery, Restoration and Waste Management Program (BERP)	2022 - present (2025)
Recycling	EU	UNIDO	Private Sector Transition to a Green and Circular Economy in Lebanon	2022 - present (2025)
Recycling	EU	LDK Consultants Global EEIG	Water and Environment Support (WES) in the ENI Southern Neighbourhood Region (providing policy support to address single-use plastic items in Lebanon)	2022 - present

2.5 SYSTEM DYNAMICS MODEL

2.5.1 Description

The system dynamics model of the solid waste management system in Lebanon consists of several interconnected components, including waste generation, collection and transportation, recycling and recovery, and landfilling. Each component is represented by stocks, flows, and feedback loops, which capture the dynamics of the system. The model represents the flow of municipal solid waste on a national scale and runs simulations from the year 2010 until 2040.

The main sector is the solid waste chain sector, which forms the core structure of the model with three defined waste chains:

- the unsorted waste (UW) generation that gets collected and treated through formal methods including material recovery, composting, energy recovery and sanitary landfilling.
- solid waste that is immediately dumped (in the absence of other treatment methods). The model also captures waste that piles up and eventually gets dumped or burned.
- waste that is sorted at the source – including informal recycling and waste pickers.

The model would allow a scenario analysis that shows the impact of different policy options and support in identifying the most effective strategies for improving solid waste management in Lebanon. The outcome would be a valuable tool for policymakers and stakeholders. The model can help to inform decisions about allocation of resources, implementation of policies, and improvement of the solid waste management system.

2.5.2 Limitations

The current preliminary version of the model was developed using secondary data sources. It helped identifying data gaps and uncertainties in the system which were addressed through initial calibration and model testing. As such, this version serves as a basis for further model development and refinement to improve the robustness of the forecast trends. This will be achieved through a second round of calibration using primary data collected through this study and through model testing and validation.

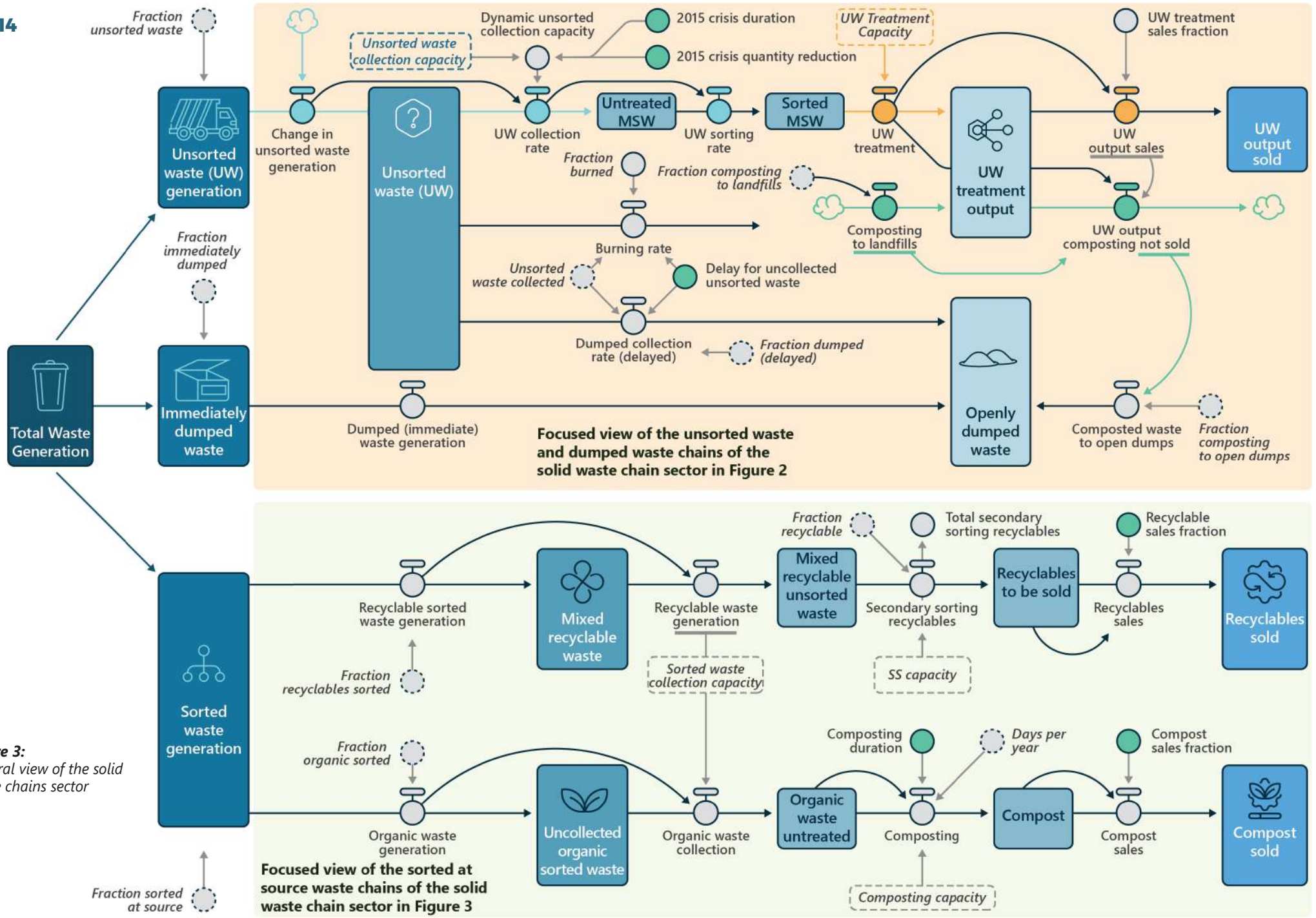


Figure 3:
General view of the solid waste chains sector

2.6 CONCLUSIONS AND RECOMMENDATIONS

This first strategic study (SS1) of the project "SIEA-2018-4313 Waste Governance: Technical Assistance to the EUD (EU Delegation) (Expected Result 2)" identified 16 generic SWM problems in Lebanon. Out of those, 10 were pinpointed as priority areas where EU is advised to provide support to the solid waste sector in Lebanon. Those were categorized into: (1) short- and medium-term interventions and (2) long-term interventions, based on urgency, the need for policy dialogues and potential success rate.

Next, a pool of recommended themes was developed, from which the content of SS2 and SS3 will be selected. Most of the themes (under SS1 and SS2) require the development of a policy brief, followed by a policy dialogue event, based on which a framework of EU support is developed separately. Some of the themes require a field data collection campaign and a scenario analysis (via the system dynamics model developed in SS1).

3. METHODOLOGY

3.1 FIELD DATA COLLECTION AND ANALYSIS

3.1.1 Mayor Interviews

One-to-one interviews were conducted with the **mayors of 80 towns,** covering the 25 districts of Lebanon. The input was stored and statistically analyzed. The interview (Appendix 1) covered the following aspects of SWM:

- Technical: waste generation, collection, treatment, Institutional: action plan, management, human resources, monitoring, capacity building, and international support
- Financial: income and support, costs, challenges
- Legal: regulation gaps
- Environmental: community practices and impacts
- Social: community engagement, awareness, and willingness to change and pay
- Political: sources of influence
- Others: similarity with the surroundings and open discussions.

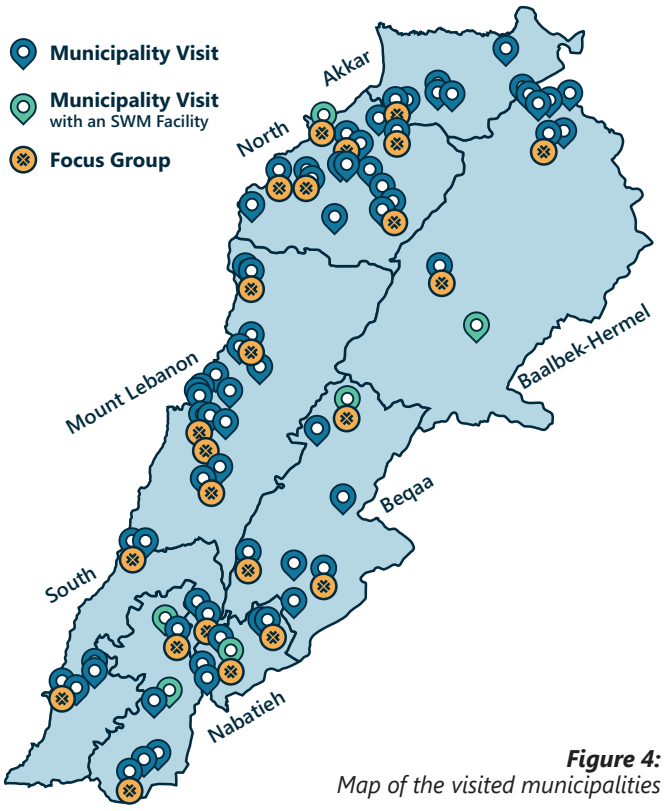


Figure 4:
Map of the visited municipalities

3.1.2 Citizens Focus Group Meetings

Focus group **events were organized in 25 districts** in the country (one meeting per district). The focus group consisted of 15-20 participants each (total of **420 citizens**), representing a variety of socio-economic groups of the community. The discussions aimed at understanding the perspective and behavior of the citizens and identify potential areas to implement the "theories/ pathways of change" identified in the Political Economy Analysis (PEA). Also, we attempted to test the impact of awareness and communication on citizens attitude by including a short awareness session prior to asking the final question. **The input of the community, from 25 districts, was summarized and combined in Appendix 2.**

The discussions were performed using dynamic group methods in two sessions (1-2 hour each), separated by a coffee break followed by a short awareness session. The following topics were raised:

- daily waste-related problems faced by the citizens,
- observations and comments on previous initiatives on waste,
- acceptance of landfills and waste facilities within the town,
- willingness to change their behavior,
- willingness to pay SWM service fees,
- perception of the capacity of the local authority to properly manage the waste.

The intermediate awareness session focused on:

- Storage and Collection: bins and vehicles; mixed waste vs. sorted waste; impacts of sorting (positive & negative); financial challenges & limited municipal resources,

- Treatment: sorting and composting methods; causes of failure (idling putrescibles, mixed waste, etc.); successful examples (Zahle, Beit Mery, Manara, Aintoura, Bkesin, etc.),
- Disposal: dumpsites vs. engineered landfills; causes of failure (overload, poor sorting & recovery, etc.); successful examples (Zahleh, Beit Mery, etc.).







Figure 5: *Part of the conducted focus groups*

3.1.3 Informal sector visits

Given the reported high impact of the informal sector, and the repeated complaints from both the mayors and the citizens, we visited and interviewed owners of informal sorting plants. They collect, sort, and mechanically process various recyclable materials, mainly plastic and metals. The facilities lack environmental and health protection measures. As to scavengers, they can be easily depicted on the roads and most of them come on motorcycles.

Figure 6: *Informal sector activities*

3.2 PROBLEM DEFINITION

3.2.1 Selected approach

The "SURE Guides for Preparing and Using Evidence-Based Policy Briefs" were identified as the methods and tools to be used in this project. SURE is a collaborative project that builds on and supports the Evidence-Informed Policy Network (EVIPNet) in Africa and the Regional East African Community Health (REACH) Policy Initiative. The project involves teams of researchers and policymakers in seven African countries and is supported by research teams in three European countries and Canada. SURE is funded by the European Commission's 7th Framework Programme: www.evipnet.org/sure[3].

Following the SURE guides methodology, we identified two steps to prioritize topics for policy briefs:

1. Problem definition, whereby the major problems of SWM in the country are identified.
2. Setting priorities, whereby the identified problems are prioritized for the purpose of selecting those that will be carried on for policy dialogues.

3.2.2 Expert Interviews

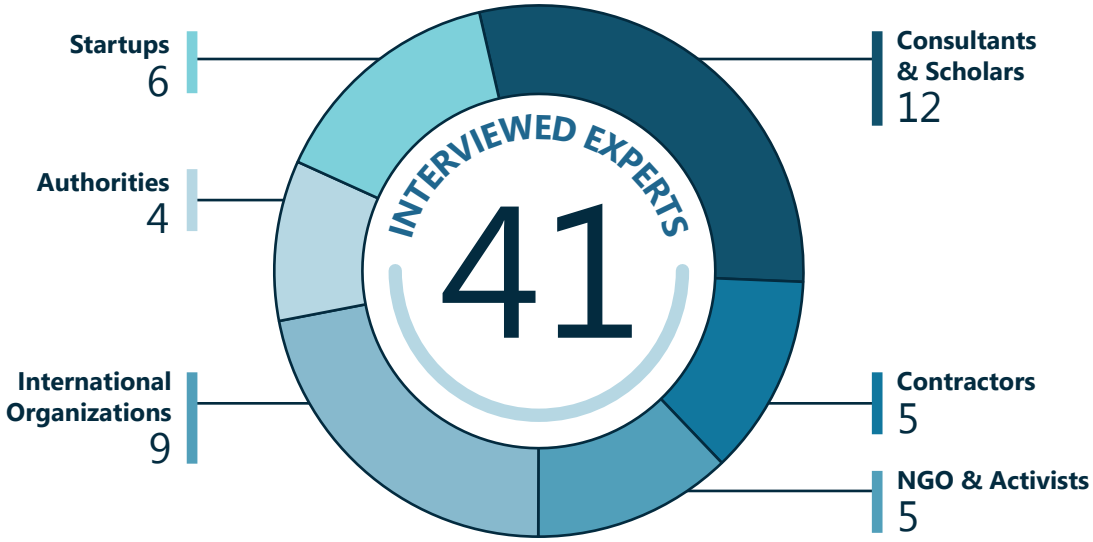
We conducted one-to-one interviews with 41 experts including governmental entities, international donors, consultants, scholars, contractors, startups, NGOs, and activists. The experts were asked to list SWM problems that they consider a priority to the country, including:

- Infrastructure
- Planning and implementation
- Financial instruments
- Private sector participation
- Regulations and enforcement
- Awareness/communication.

For each of the listed problems, the expert was asked to provide:

- Causes and/or comparisons[4]
- Options and opportunities
- •Implementation challenges

Figure 7: *Interviewed Experts*



[3] The SURE Collaboration. SURE Guides for Preparing and Using Evidence-Based Policy Briefs. Version 2.1 [updated November 2011]. The SURE Collaboration, 2011. Available from www.evipnet.org/sure.

[4] Examples of appropriate comparisons:
- Comparisons over time within a country
- Comparisons between countries
- Comparisons against plans
- Comparisons against what policymakers and/or stakeholders predicted or wanted

3.2.3 Synthesis of Experts' Feedback

The problems identified by the experts were **segregated into 16 generic topics,** which are split into 2 categories and numbered as follows:

A. Structural & functional reforms

1. Solid waste management agency
2. National strategy and national masterplan
3. Waste Diversion
4. Alternative fuel
5. Redefining landfilling
6. Robust cost recovery system
7. Institutional capacity & law enforcement
8. Pre-Requisites for Local Implementation
9. Valorizing special wastes
10. Achieving circularity of industrial waste
11. Limiting hazardous contamination
12. Stopping sporadic sludge disposal

B. Infrastructure & operational sustainability

13. Optimizing existing infrastructure & completing interrupted initiatives
14. Transitional handover plan
15. Support for environmental protection
16. Support to the Recycling Industry

3.2.4 Validation and break down of topics

Each of the 16 generic topics was broken down into specific support areas/actions and was validated (wherever possible) using:

- the statistical analysis of 80 mayor interviews
- the output of the focus group discussions with the community.

3.3 SETTING PRIORITIES

3.3.1 Experts survey

A survey of six questions was developed and converted into a digitized form (using SurveyMonkey) and circulated to all 41 experts that were interviewed during the "problem definition" stage. The questions are related to each of the topic identified above and were as follows:

Q1 – Is it important?
A topic is considered important if it is associated with a high burden on public health and the environment, large gaps in access to waste management services, large expenditures, important inefficiencies, or major inequities.

Q2 – Are effective solutions available?
There must be at least one feasible policy option that is potentially effective and presents substantial improvement to the status quo.

Q3 – Is there an opportunity to change?
Is there a window of opportunity (or a possibility to open one) to adopt/apply the proposed a policy option? The higher the possibility to change, the higher the potential usefulness of the proposed option.

Q4 – Are there considerable uncertainties?
Are there conflicting opinions about this problem and/or related solutions? Not all opinions have to be science or evidence based to be considered. They can be as natural as the NIMBY or BANANA[5] syndromes, or as trivial as political opposition against an incumbent party.

Q5 – Is evidence available?
How clear is it to the stakeholders and citizens that this problem exists and requires policy solutions?

Q6 – Is there interest in informed dialogues?
Are stakeholders and policymakers genuinely interested in discussing the problem and its potential solutions? The lack of interest in deliberation about the problem might have various reasons, e.g. decision already taken, implementation is not expected

3.3.2 Analysis of results

The 30 received responses were analyzed. The score for each topic was assessed relatively to the others on a question-by-question basis. The six topics that were found to be of the least priority were excluded. The remaining 10 topics were retained for further analysis.

3.4 RECOMMENDATION FRAMEWORK

The 10 retained topics were further analyzed and broken down into specific support actions. They were placed into a recommendation framework under three categories:

[5] "Not In My Backyard" (NIMBY) or "Build Absolutely Nothing Anywhere Near Anything" (BANANA)

- Prerequisites, which are mandatory for a successful integrated solid waste management system,
- Structural and functional reforms, consisting mostly of soft interventions,
- Infrastructure and operational sustainability, requiring funding for infrastructure components.

3.5 EXISTING INITIATIVES

The records of Ministry of Environment (MoE) and the main international organization involved in the waste sector in Lebanon were reviewed for **recent** (last than 5 years) initiatives. Those that are considered **relevant** to this strategic study and have a **wide impact** (e.g. cover a large area or address national-level issues) were reported under three categories: Initiatives funded by EU, initiatives funded by WB, and initiatives funded by other international donors

The initiatives were then grouped according to "areas of support" into: (1) support at central level, (2) support to MSW, (3) support to special waste streams, (4) support to recycling industries, (5) support for environmental protection, (6) support to science-policy-citizen interface.

3.6 SYSTEM DYNAMICS MODELLING

A system dynamics model was developed to represent Lebanon's (national level) municipal solid waste management system. Subsequently, the model input and output will be linked to waste management enablers and key performance indicators (KPIs). The model can be used for scenario analysis to help policymakers and stakeholders identify the most effective actions and strategies for managing solid waste in the country.

The results of this model can help policymakers and stakeholders identify the most effective strategies for managing solid waste in the country.

4. PROBLEM DEFINITION

4.1 STRUCTURAL & FUNCTIONAL REFORMS

4.1.1 Topic #1. Solid waste management agency/authority

Ongoing efforts

The mandate of the SWM Agency (referred to below as "the Agency") was drafted by MoE[6].

Context

The Agency will constitute the first and only national technical unit that is dedicated exclusively to the waste sector. When operational, it requires empowerment to be able to act as THE professional institutional leader.

Areas of Support

i. Support on cross-sectoral dialogues and collaborations, both between authorities and with donors
ii. Support with soft interventions that help limiting sporadic, chaotic, expensive, and sometimes counter-productive initiatives.

Relevant Feedback from Local Authorities and Citizens

i. The mayors and citizens showed resentment against the government attitude to throw the ball in the municipalities' court in the absence of one leading entity to provide the needed support.
ii. In the absence of a leader for the sector, various political and other entities are interfering (>32%) in the waste management at the local level:

INFLUENCE ON LOCAL WASTE MANAGEMENT - % MUNICIPALITIES

Political Parties Influence

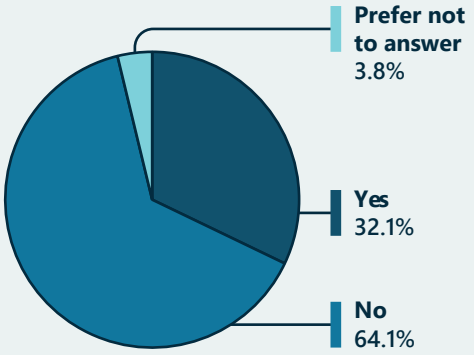


Figure 8: *Political Parties Influence*

Other Influencing factors

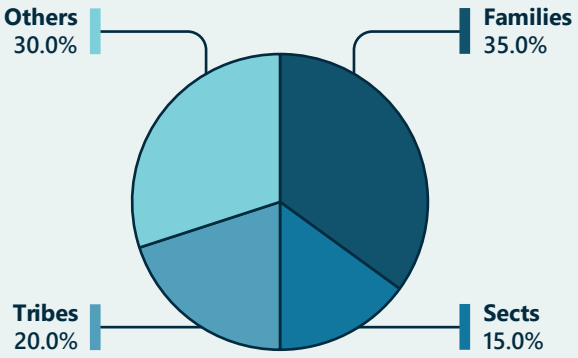


Figure 9: *Other Influencing Factors*

[6] "Being a draft, not much has been communicated by MoE as to who will recruit members of the agency, availability of a sufficient budget and whether the agency's mandate will include implementation aspects.

iii. About 67% of the interviewed mayors perceive the political interference as positive, mostly because it brings in financial support and improves public acceptance of the local authority's decision (namely when most of the citizens are followers of the same political party and the latter is supporting the mayor).

iv. A professional leader is needed to limit the waste of resources. In fact, despite the availability of international funds (55%) and local waste management plans (71%), implementation remains low (24%):

EFFICIENCY OF INTERNATIONAL SUPPORT IN REACHING IMPLEMENTATION STAGES - % MUNICIPALITIES

Support from international donors

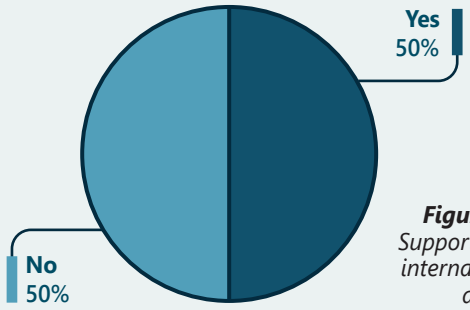


Figure 10: *Support from international donors*

Availability of an action plan

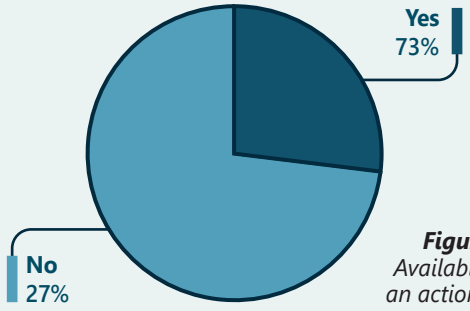


Figure 11: *Availability of an action plan*

Ability to implement the available action plan

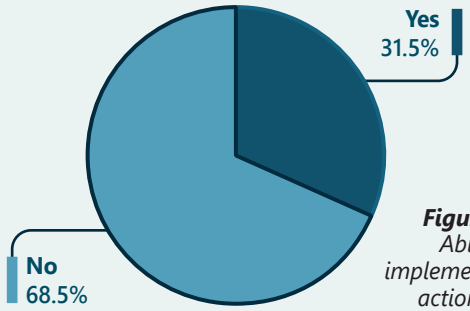


Figure 12: *Ability to implement the action plan*

4.1.2 Topic #2. National Strategies and Plans

Ongoing efforts

The approval of the national strategy for integrated waste management (referred to below as "the Strategy") is pending the approval of its strategic environmental analysis (SEA). The World Bank team, upon an agreement with the MoE, is currently developing the SEA and reviewing/updating the national strategy. Also, UN-HABITAT is planning for a national observatory for SWM with a fund from the German Ministry of Environment (BMU) under Reducing Marine Litter in the Mediterranean through Waste Wise Cities (ReMaL) project. Earlier, OMSAR has developed regional masterplans (through EU funding) that remain to be reviewed and approved by MoE. Even if not fully adopted, they may constitute a reliable starting point.

Context

The Strategy is the starting point and prerequisite for the development of waste-related plans and the implementation of circular economy principles. Once endorsed by the Lebanese government, a national masterplan shall be developed, along with a roadmap (including a feasibility analysis) and investment opportunities. The latter should address regulatory gaps, financing mechanisms (funds, taxes, etc.) and private sector opportunities. The masterplan shall be conceived as a "binding" document that ensures "continuity" of MoE vision and actions – to avoid major strategic shifts with succeeding ministers.

Areas of Support

i. Development of the national masterplan for ISWM, as well as the main guidelines for regional masterplans and local implementation. International experience is needed to bring in a "politically neutral" opinion on the table; along with local expertise to guide the solutions toward practically applicable and easy-to-implement options.

ii. Develop a circular economy national strategy and an action plan.

iii. Build SWM databases to feed the masterplan, feasibility analysis, road map and circular economy strategy and action plan, and make them publicly available.
The current lack of reliable data makes it impossible to produce data-driven planning, often resulting in inefficient (or non-applicable) decisions and regulations. Examples include some PPP requirements that are too complicated for small businesses and

common-size municipalities to implement; and the latest ELV regulations requiring continuous exhaust monitoring which is too expensive for small-scale applications.
The databases should be made available to the public. This gives room for (1) realistic consultancy studies and contracting projects leading to more successful implementation of SWM projects in the country, and (2) higher research activities leading to innovative (yet realistic) solutions. Noting that data sharing is almost inexistent between firms, companies, and research institutions.

iv. Identify centralized vs. decentralized components of the masterplan. This aspect is considered a mandatory component for the development of the masterplan and should include an optimization analysis that consider technical, social, economic and environmental factors. Centralized components should aim for efficient use of limited public resources and reduced unnecessary costs and environmental risks.
The perception of "absolute decentralization" being the best pathway should be questioned. It didn't work earlier, i.e., before the economic crisis, when the operational cost was embedded through different means (subsidies and others). Even though cost recovery is a major milestone it's not THE ONLY reason for failure. Some aspects of "centralization" (e.g. centralized management of service zone treatment and disposal) may be mandatory for social, economic, and environmental sustainability.
For instance, Individual municipality-level (or even union-level) landfills would be economically, technically, and environmentally "disastrous". Similarly, a large number of small-scale facilities is practically impossible to supervise, and (mostly because of high cost per ton) most of the facilities will become inefficient.

v. Conceptualize and regulate centralized components to incentivize good practices, through a comprehensive set of legal, social, and economic instruments. For instance, regional landfills (run by a central authority) with a gate fee provides financial benefits for municipalities to reduce their waste and push them toward reduction and diversion. But it has to be accompanied with a dumping ban, otherwise the municipalities may opt for open dumping. Law #80 includes relevant penalties, but they require adequate implementation tools.

vi. Set the "size" of a decentralized unit or a service zone (SZ) (population, number of municipalities, unions, district, etc.), taking into consideration towns that don't have municipalities. All requirements to have legally/administratively binding and functional SZ should met.

Relevant Feedback from Local Authorities and Citizens

i. The data collected from municipalities clearly shows that some components can be properly managed at the local level, whereas others cannot. For instance, collection is mostly done by local authorities (municipality or union of municipalities) or by a local contractor (82% total), with a sufficient weekly collection frequency: 2-3 times (46%) and 5 times or more (41%) and with no accumulation of waste on the streets (83%).

ii. As a result, most mayors think that the best entity to be in charge of waste collection is the municipality (directly or through a contractor, 95% total) – despite the reported financial, social and technical challenges.

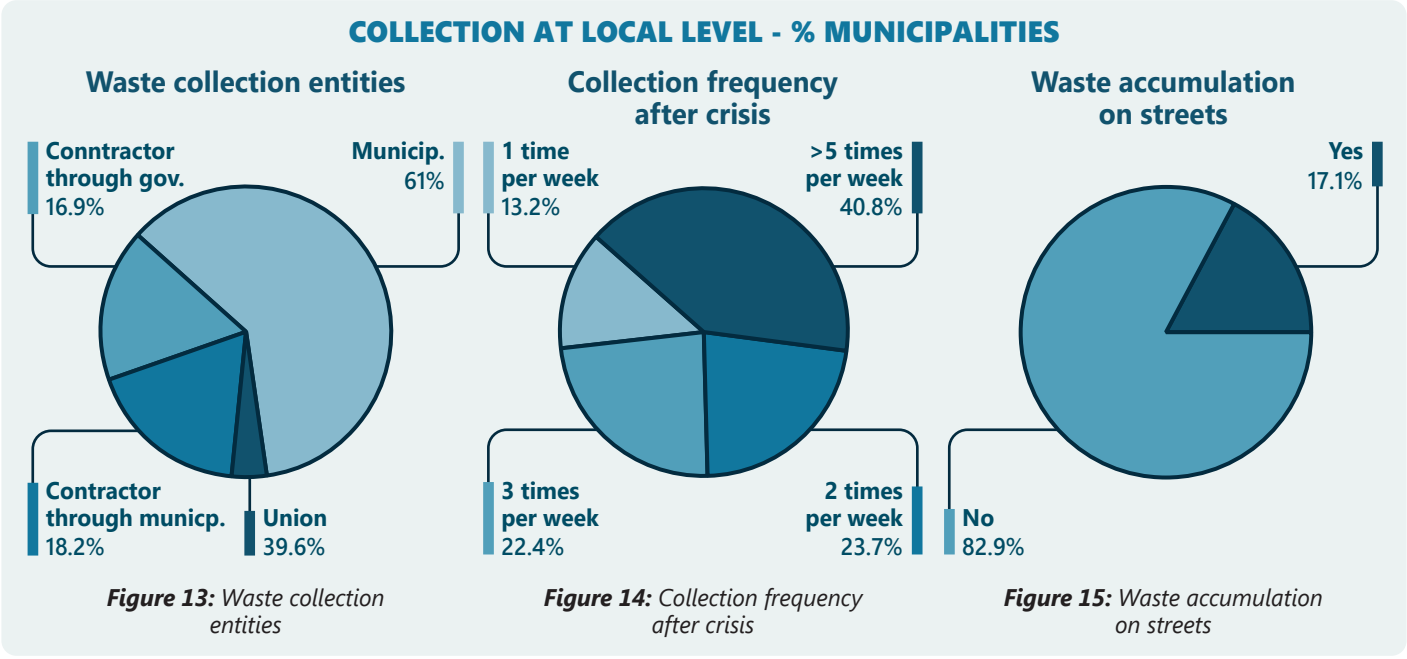


Figure 13: *Waste collection entities*

Figure 14: *Collection frequency after crisis*

Figure 15: *Waste accumulation on streets*

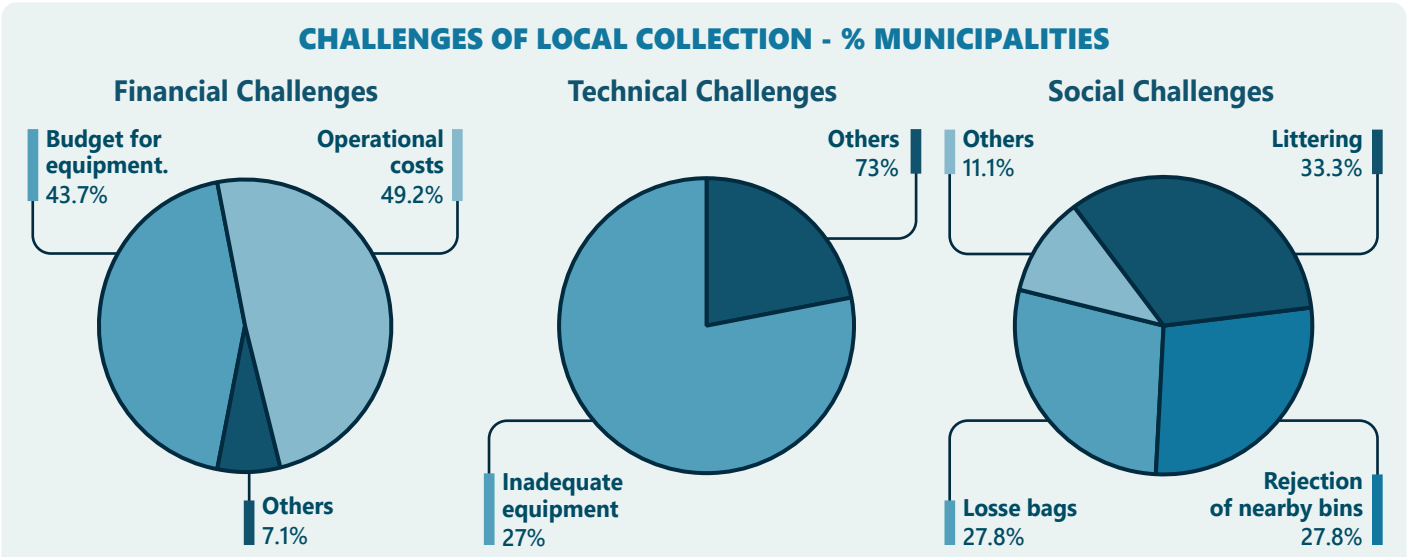


Figure 16: *Financial challenges of local collection*

Figure 17: *Technical challenges of local collection*

Figure 18: *Social challenges of local collections*

iii. In comparison, only 31% of the local authorities have sorting/treatment facilities within their municipalities or union of municipalities. Among those, 80% need upgrade and most of them face financial, technical or energy problems (77% in total).

EXISTENCE AND CHALLENGES OF TREATMENT AT LOCAL LEVEL - % MUNICIPALITIES

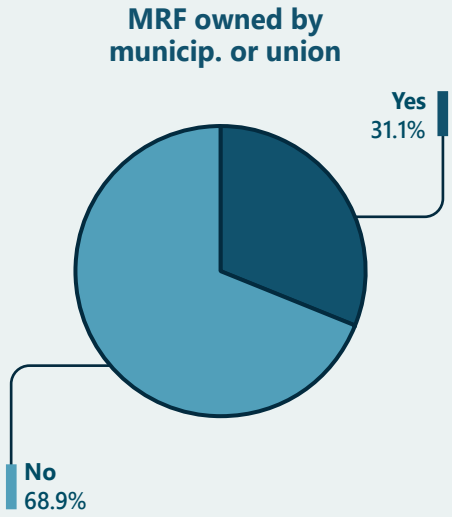


Figure 19: *MRF owned by municip. or union MRF*

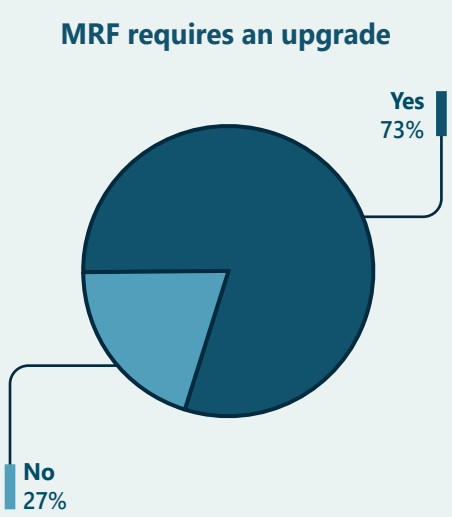


Figure 20: *MRF requires an upgrade*

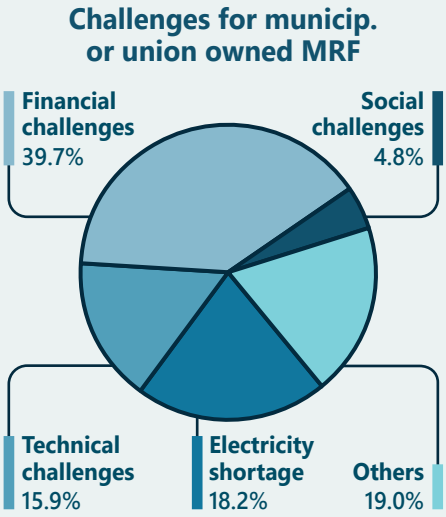


Figure 21: *Challenges for municip. or union owned MRF*

i. On the other hand, only 22% of the municipalities treat their waste locally; the rest send their waste for treatment outside the union (16%) or for direct disposal (i.e., without any treatment, 62%). Also, half of the studied municipalities have no resources at all to build future treatment facilities.
These observations indicate the incapability of local authorities to take care of the treatment stage of waste management.

LOCAL MANAGEMENT METHODS AND RESOURCES - % MUNICIPALITIES

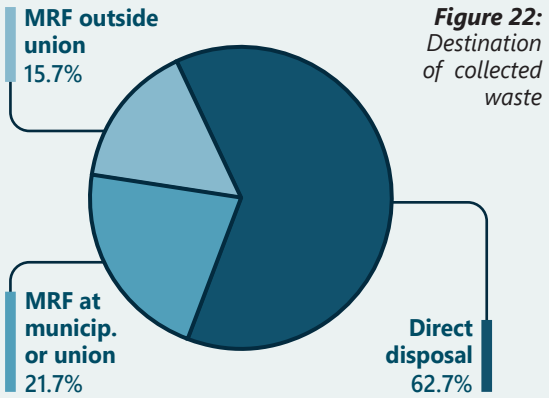


Figure 22: *Destination of collected waste*

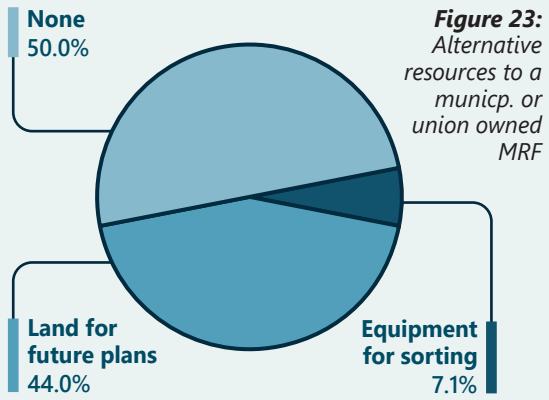


Figure 23: *Alternative resources to a municp. or union owned MRF*

4.1.3 Topic #3. Waste Diversion

Ongoing efforts

The 2023 roadmap of MoE, developed with the support of the World Bank team, puts special focus on initiatives for waste diversion. In addition, circular economy projects are funded by EU and implemented by UNDP (e.g., TADWIR) and UNIDO. Those address special types of waste, e.g. healthcare waste, e-waste, among others. USAID is also funding projects that aim to establish sustainable and replicable integrated solid waste diversion solution in rural areas of Lebanon (e.g. DAWERR).

Context

The current SWM setup does not provide any interest for the municipalities nor the service providers (e.g., collectors) to incentivize the community to reduce or sort their waste. On the contrary, collection service providers are paid per ton of waste. Thus, they have interest in higher waste generation and landfilling. Source sorting is almost solely dependent on startups and community initiatives – with a very limited impact.

Areas of Support

i. Introduce the "polluter pays" principle through economic and regulatory instruments to incentivize the municipalities and the service providers to reduce the waste going to disposal sites. In turn, those will encourage local communities through waste diversion initiatives.
   Material recovery is best controlled at the local level (i.e., by the municipalities). If they have enough interest, and are properly equipped, they have the capacity to do close inspection and give indirect incentives (e.g., lower collection fees on sorted waste compared to mixed waste). Municipal council members are "closer" to the people than national authorities: they know the local setup and the specificities of the community – that they are part of.
   Yet, prior to asking the people to sort their waste, and prior to awareness and training, the municipality and service providers need to invest in new bins (or facelift the existing ones) and adopt their collection equipment and procedures accordingly. Collective bin systems have failed in various towns in Lebanon for various reasons (e.g. stealing by scavengers, inability to penalize because it's not possible to identify who threw what, etc.). The municipalities that succeeded in achieving some material recovery have opted for a door-to-door (or building-to-building) system (e.g. Aintoura).

ii. Initiate dialogues between national stakeholders (MoI, MoE&T, Lebanese customs, etc.) to control pre-generation of waste, through regulations and decisions that favor the production and import of goods with low waste generation potential.

iii. Support initiatives for separate collection of single-stream sources, such as food waste from restaurants, paper waste from institutions, etc.

iv. Support solutions for the residual waste generated from sorting and treatment facilities, which is commonly dumped or landfilled. The very few facilities that are producing compost or RDF end up with low-quality unmarketable product. Incentives may include, for instance, certification and product grading systems, whereby the quality is reflected in the price of the product; thus creating a financial interest in producing high quality output.

v. Issuing landfilling bans on waste material that has a downstream recycling industry in Lebanon. Waste components that may be used as secondary raw material by the Lebanese industry should not be allowed in landfills. This pushes the waste generators and service providers to recover them and sell them to the local industry (as cheap alternative raw materials).

vi. Firmly "control" or "institutionalize" (incorporate) the informal sector. Even though the scavengers achieve some divergence, they devaluate the MSW stream and affect the financial feasibility of formal waste facilities[7]. Equally important, their activities do not meet environmental, social, or human rights requirements.
   To note that most of the scavengers are kids (below 18 years) and work without any personal protection. In addition to the impact on their health, they litter the area around the waste bins and don't abide by any environmental protection principles (e.g. dumping any non-sellable items, burning tires to extract steel, emptying batteries to recover lead, etc.).
   In some countries, scavengers were institutionalized in various ways. For instance, in Irbid governorate (Jordan), the informal activities were organized through a third party (NGO) that acts as intermediary. In contrast, in some other countries (e.g. KSA), efforts are in place to stop scavenging activities and provide alternative full-fledged formal waste treatment centers.

[7] In some instances (e.g. Ras El Metn), scavengers pass a couple of hours before the collection truck, causing more than 50% reduction of returns from selling of recyclables – which has detrimental effects on the sorting facility.

vii. Develop awareness & education policies (focusing on social behavioral change) and deliver/showcase success stories. In parallel, there's an immediate need for easy-to-implement penalties to draw people's attention and start introducing behavioral change.
To keep in mind the risk that Lebanese people would consider source sorting the least of their concerns (with the heavy burden of the economic crisis and political instability). Enforcing minor penalties that can be implemented with the help of local authorities (e.g. littering on beaches or in public areas, where usually a municipal police exists) would help initiating behavioral change in terms of waste.

viii. Implement projects for return-value of waste (e.g. pay-back centers, reverse vending machines, turn-back initiatives, startups, etc.). These have proven highly successful in rural and rather poor areas (e.g. Akkar region).

ix. Plan for long-term consistent efforts in order to reach a perceptible impact. The emergency response mindset doesn't apply. Implementation should happen gradually (in phases).

Relevant Feedback from Local Authorities and Citizens

i. The data displayed below, along with focus group discussions, **reflect high readiness of the ground, both local authorities and citizens,** to participate in waste management programs, only if the following is provided: **transparency, continuity, good planning, and sound management.**

ii. About 61% of the studied towns have attempted to reduce their generation of waste, through various initiatives, such as reduction of packaging materials, clothes and food donations, home composting and others. Out of those, 60% did not manage to reach successful results.
The citizens (in focus group meetings) blamed the failure of most NGO initiatives to inadequate planning and lack of continuity (e.g. premature interruption of external support or absence of follow up by local authorities). Yet, most of those initiatives had a good kick-off because of the high community interest – be it for environmental or financial reasons.

LOCAL ATTEMPTS TO REDUCE WASTE GENERATION - % MUNICIPALITIES

Attempt to decrease generation

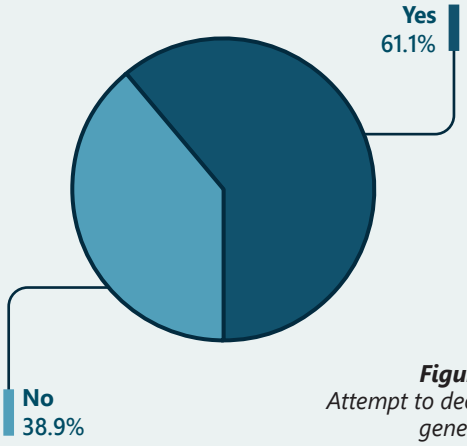


Figure 24: *Attempt to decrease generation*

Methods to decrease generation

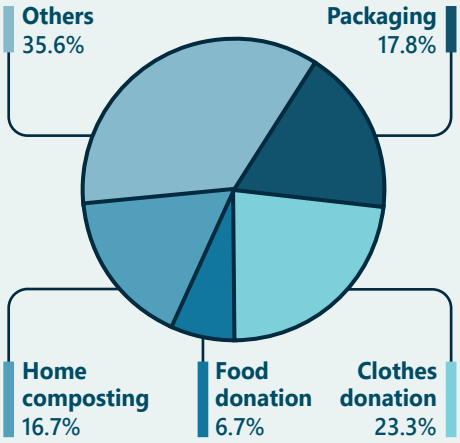


Figure 25: *Methods to decrease generation*

Successful Outcomes

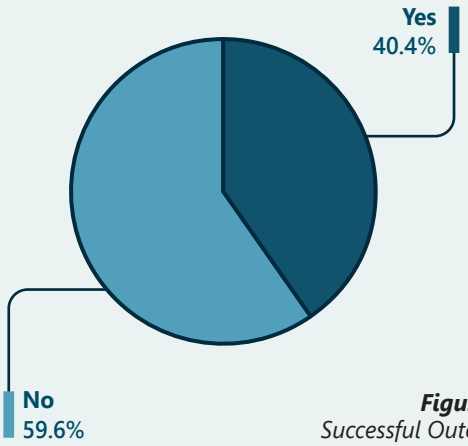


Figure 26: *Successful Outcomes*

iii. About 56% of the studied municipalities have attempted to recover materials from MSW through various means: source sorting (25%), sorting at the waste treatment facility (25%) and separate collection of single-source streams (13%). In addition, 37% of the municipalities reported that the only recovery means are through the informal sector – with a minority (2%) working under the umbrella of the local authority.

Overall, only 30% of the municipalities receive any returns from the material recovery activities. To note that the mayors strongly expressed the negative impact of scavenging on returns from recyclables & their incapacity to control them. Also, during the focus group meetings, the citizens expressed their concern about visual and health impacts of littering caused by bins scavenging.

MATERIALS RECOVERY AND RETURNS - % MUNICIPALITIES

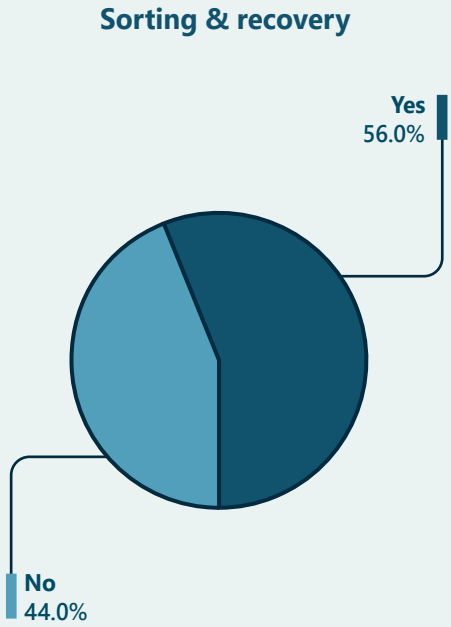


Figure 27: *Sorting & Recovery*

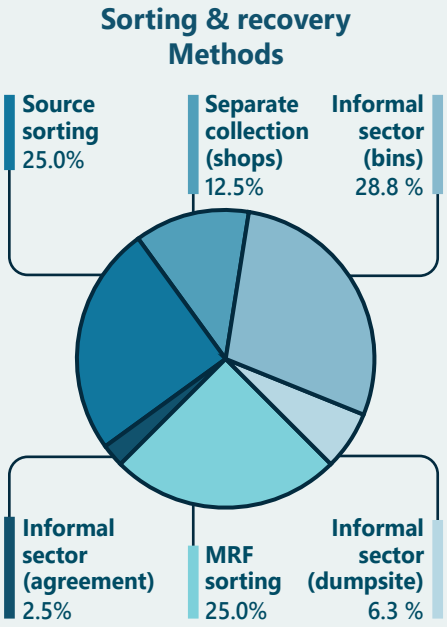


Figure 28: *Sorting & Recovery Methods*

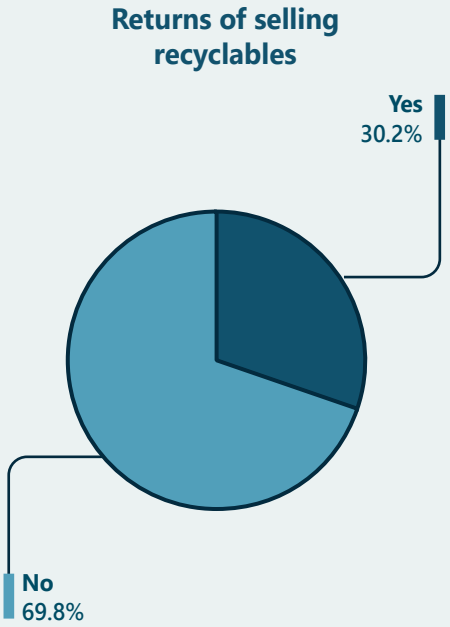


Figure 29: *Returns of selling recyclables*

iv. Awareness and training:

- The majority (97%) of the interviewed mayors agree on the importance of public awareness and 84% of the visited towns have implemented some sort of waste awareness campaigns. Most (60%) of the mayors rate the level of awareness of the community to be "medium" (score of 2 on a scale of 0 to 3, where 0 is no one, 1 is marginal, 2 is medium and 3 is outstanding).
- Also, most (81%) of the visited municipalities implemented waste-related training (mostly on source-sorting). Out of those, 62% were found useful.
- Citizens across the country have repeatedly identified "lack of continuity" as the main reason behind the failure of awareness raising initiatives. They attributed this phenomenon to various reasons, including termination of the funded project,

lack of follow up by the local authority, inadequate initial planning (to allow self-sustainability of the project), assigning incompetent people to follow up, among others.

COMMUNITY AWARENESS AND TRAINING INITIATIVES - % MUNICIPALITIES

Is awareness important?

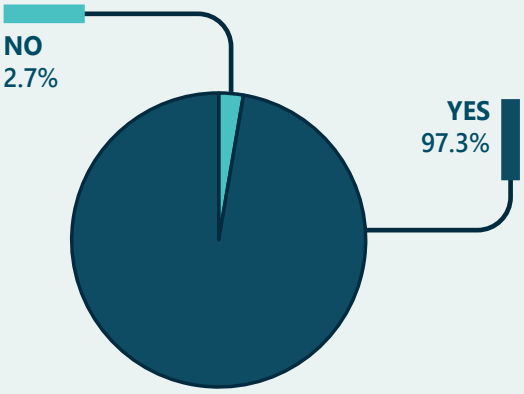


Figure 30: *Is awareness important?*

Level of awareness

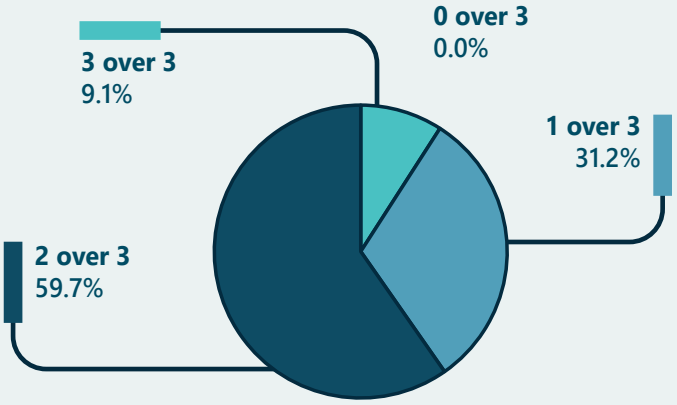


Figure 31: *Level of awareness*

Were community training initiatives conducted?

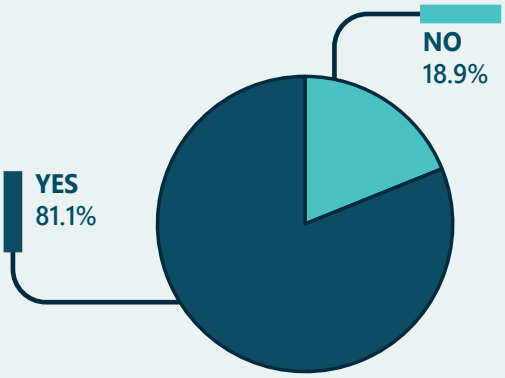


Figure 32: *Were community training initiative conducted?*

Were the conducted community training initiatives useful?

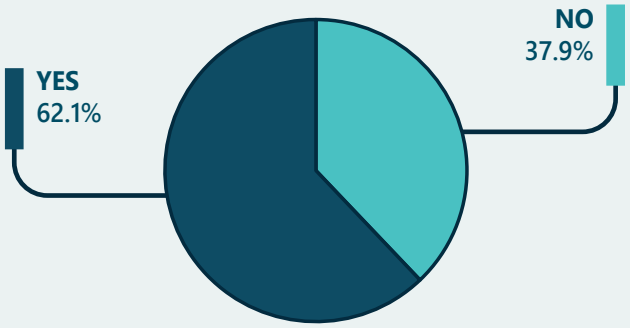


Figure 33: *Were the conducted community training initiatives useful?*

v. Community involvement:
   - About 57% of the local municipalities have tried projects that involve the citizens at various levels: informing, consulting, inclusion, collaboration, and empowerment.
   - Only 31% of the municipalities had support from local NGOs and community-based entities; but they all (99%) showed their willingness to collaborate with such entities.

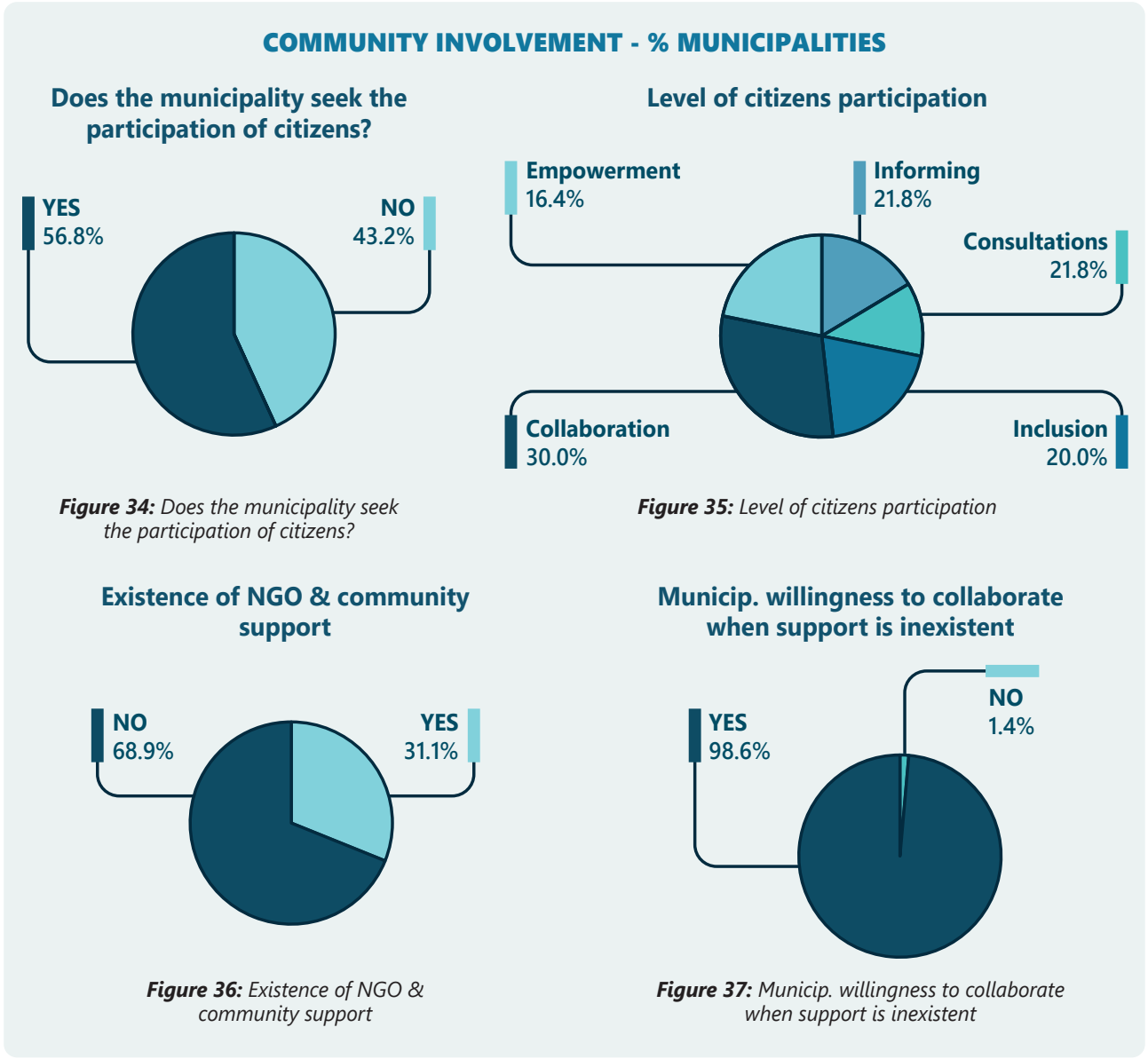


Figure 34: *Does the municipality seek the participation of citizens?*

Figure 35: *Level of citizens participation*

Figure 36: *Existence of NGO & community support*

Figure 37: *Municip. willingness to collaborate when support is inexistent*

4.1.4 Topic #4. Alternative Fuel

Ongoing efforts

MoE developed Decision 58/1/2020 on the classification of refuse-derived fuel (RDF), allowing the use of various types of waste-derived fuel[8]. Studies on Refuse Derived Fuel (RDF) options are initiated under TADWIR.

Context

RDF is a cheaper and more environmentally friendly alternative to petcoke fuel used in cement factories. Also, energy generation by burning tire waste in cement kilns (known as Tire Derived Fuel, TDF) is among the most common tire waste management methods. Yet, RDF burning in cement kilns faces public and political opposition because it makes cement factories (associated with quarries) indispensable for offtake of waste products.

Areas of Support

i. Develop regulations (and incentives) for alternative fuel production, use and environmental protection
ii. Policy dialogues and communication plan on the use of RDF/TDF in cement kilns.
iii. Develop varied offtake markets

[8] As a result, Siblin cement factory has modified the fuel feeding system and is ready to receive RDF as a (cheaper and more environmentally friendly) partial replacement of petroleum coke. However, they cannot find at the moment a reliable source of RDF in the Lebanon.

Relevant Feedback from Local Authorities and Citizens

i. About 39% of the studied municipalities do send their waste to a waste treatment facility (inside or outside the union of municipalities). Providing the necessary legal, technical and market requirements for RDF, creates incentives to those facilities to upgrade their systems into RDF generation. This would extend the lifespan of the disposal sites, of which 40% are expected to last for no longer than 1-3 years (and 27% don't know).

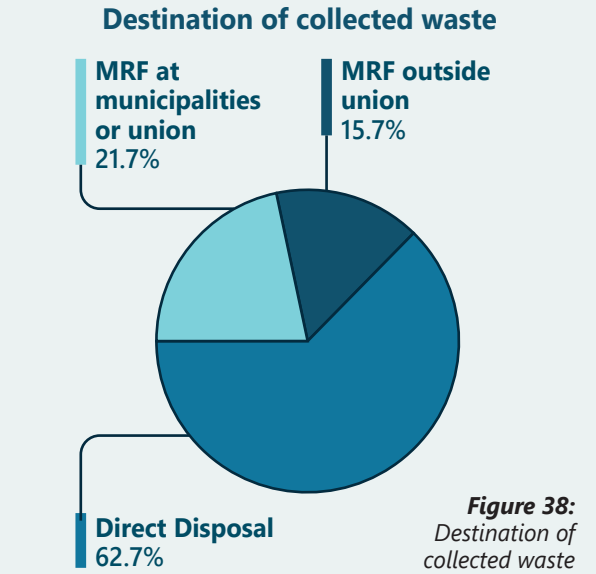


Figure 38: *Destination of collected waste*

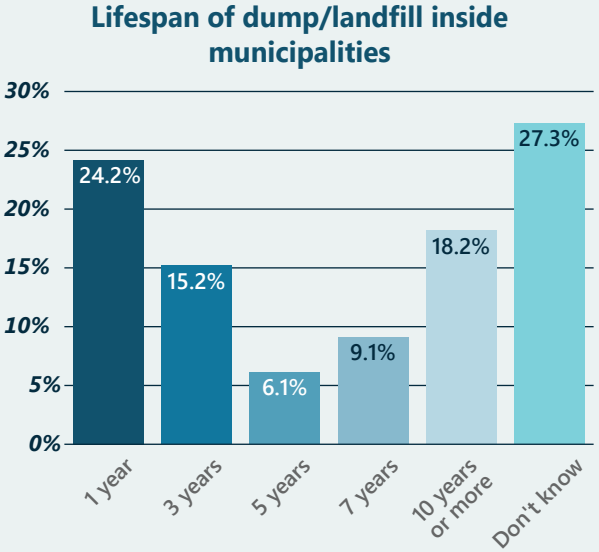


Figure 39: *Lifespan of dump/landfill inside municipalities*

4.1.5 Topic #5. Redefining landfilling

Ongoing efforts

Operational standards for landfills were developed and submitted to the state council (majles shura el dawleh) - approval pending translation to Arabic.

Context

Landfilling is a well-established and acceptable starting point. A sufficient and adequately performing land-fill network should be established. Only then, it makes sense to invest in treatment technologies, starting with the most low-tech and low-cost options and gradually moving to more complex solutions.

Areas of Support

i. Define locations and land plots for landfills at service zone (SZ) level, following internationally adopted landfill siting methods while considering local socio-economic challenges. International experience is needed to provide a "reliable" scientific source; it has to be complemented with local expertise to fine-tune the outcomes into "clever" clustering to minimize public opposition.

   People would favor open dumps over sanitary landfills because the latter will be considered a "permanent" destination for waste coming from the whole surrounding region. Consequently, municipalities are kind of "blackmailing" the government to agree on hosting landfills in their cities.

   Mega landfills (> 5000 t/d) have been proposed as an alternative to regional landfills (e.g. one or two mega landfill in the eastern mountain range). The advantages include: solves the public opposition problem, long life span (around 50 years), can be fully controlled and managed by a highly skilled team, one location that is easier to monitor and supervise by MoE, high methane generation potential making energy generation economically feasible (might favor the emergence of industrial cities in the area). The main disadvantage is high transportation cost, which can be reduced by using transfer stations – and might be a driver to build a train rail (which can have the added benefit of transporting agricultural products from Bekaa at a low cost).

ii. Develop a post-closure "vision" and plan, lifespan, and maximum allowable waste quantities and types for proposed landfill locations. For this to be achievable, it should be realistically reflected in the disposal fee. The current average of $8 per ton is too low to achieve adequate environmental

protection – even when considering the low labor cost (common international average is around $40).

iii. Communication plan to overcome NIMBY[9] & BANANA[10] syndromes due to: (1) bad experience, (2) lack of trust in authorities, (3) erroneous messages by social media and activists/politicians, (4) lobbying by illegal businesses.

Illegal businesses, e.g. dump land owners individual waste collectors, etc., have interest in maintaining businessas-usual. Furthermore, politicians and activists often make public statements that convey wrong messages and block useful interventions. For example, a project to dispose of pharmaceutical waste in Holcim, using rotary kilns, was interrupted because of strong public opposition. The people were terrified by rumors on anticipated health impacts, despite the fact that the results of the trial test came out very promising.

Relevant Feedback from Local Authorities and Citizens

i. About 86% of the studied municipalities dispose of their waste in open dumps, vs. only 14% in sanitary landfills. About 91% did highlight the negative impacts of open dumping.

ii. Despite the above, 77% of the mayors stated that the citizens won't approve building a sanitary land-fill in their town for various reasons, including[11]: fear of propagation of bad odors (17%), potential unsustainability of the project which might turn the landfill into a large dump (14%), lack of confidence in authorities (14%), fear of health problems (12%), among others.

IMPACTS VS. ACCEPTANCE OF LANDFILLS - % MUNICIPALITIES

Disposal of waste

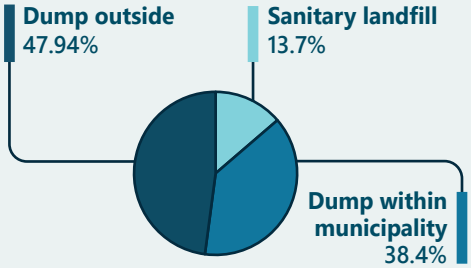


Figure 40: *Disposal of Waste*

Lifespan of dump/landfill inside municipalities

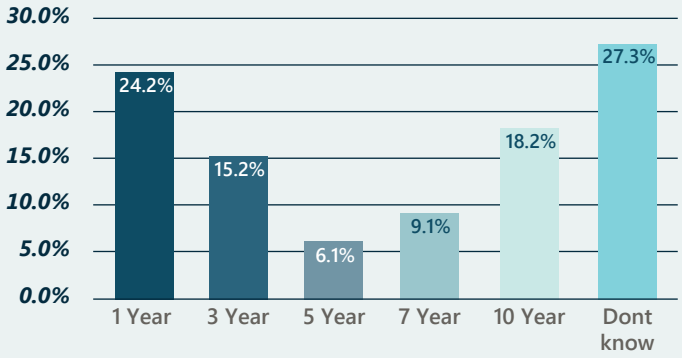


Figure 41: *Lifespan of dump/landfill inside municipalities*

Citizen acceptance of landfills

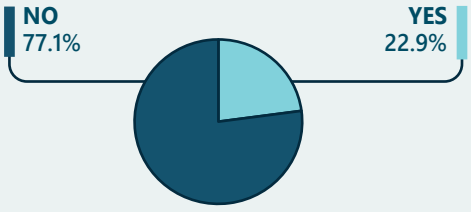


Figure 42: *Citizen acceptance of landfills*

Reasons for citizens lack of acceptance of landfills

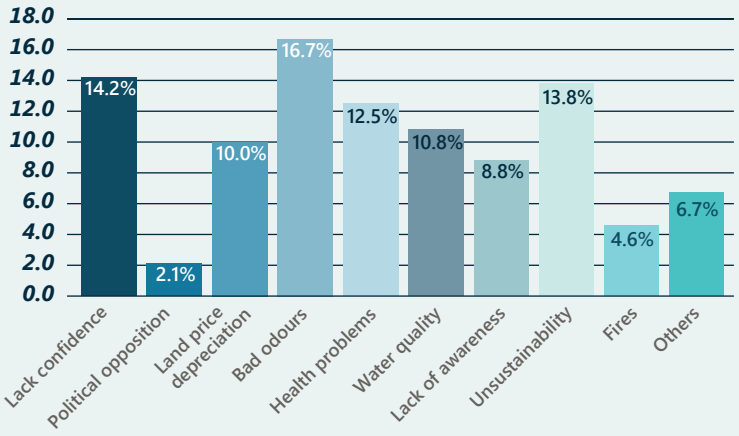


Figure 43: *Reasons for citizens lack of acceptance of landfills*

[9] Not in my backyard
[10] Build absolutely nothing anywhere near anything (or anyone)
[11] The results are not exclusive, i.e. mayors were given the possibility of choosing more than one reason

4.1.6 Topic #6. Robust cost recovery system

Ongoing efforts

A solid waste tax law was drafted by MoE and submitted recently to the parliament; but the ratification remains pending. Cost models are being developed by The World Bank (WB) & UNDP (under LFF & TADWIR) and studies on financial optimization of selected facilities are being tendered by UNDP, under TADWIR. A draft law to neutralize the outdated debts of municipalities (related to Sukleen activities) was submitted to the parliament.

Context

MoE is working on two parallel pathways to achieve a cost recovery system: (1) the tax law, which is based on rough estimations, and (2) the more detailed cost analysis studies managed by the WB and UNDP/EU. Once the law is approved, it will be subsequently amended by a decree based on the outcomes of the cost modeling studies.

Areas of Support

i. Put pressure on the Lebanese parliament to ratify the tax law. Implementing new taxes for solid waste management is not appealing to the politicians who would face public resentment and loss of voters.

ii. Develop and implement an intensive national outreach program to achieve public acceptance and willingness to pay for waste management services.

iii. Implement, for selected facilities, a well-rounded financial solution that incorporates a realistic business model and all mandatory social and technical interventions.

To note that service fees have to be flexible and resilient, e.g. based on actual cost, technology adopted and location (land cost) and cover (along with any governmental subsidies) return on investment, maintenance and upgrading (not only operational costs)

iv. Find a definitive solution for the long-term debt of municipalities. Old SWM debts lead local authorities to make decisions based on "cash flow" rather than a sound cost-benefit analysis. For them, IMF money is "virtual" (not readily available), so better using it to alleviate the SWM burden through central plans – rather than paying from their "real" (collected) money, irrespective of efficiency and benefits.

Relevant Feedback from Local Authorities and Citizens

i. The interviewed mayors identified the lack of a cost recovery system as one of the three main legal gaps in the waste management sector[12].

ii. About 70% of local authorities depend on IMF as their main source of income[13] – despite the fact that the delays in payments and the current drop of the value of the Lebanese pound. As a result, 85% are not capable of paying the current expenses of waste management.

[12] The other two gaps being implementation decrees and adjustment of the purchase limit of municipalities (as defined by the Ministry of Finance).

[13] To note that all municipalities receive IMF money, but only 30% have other sources as well: international and local donations, OMSAR, political parties and others

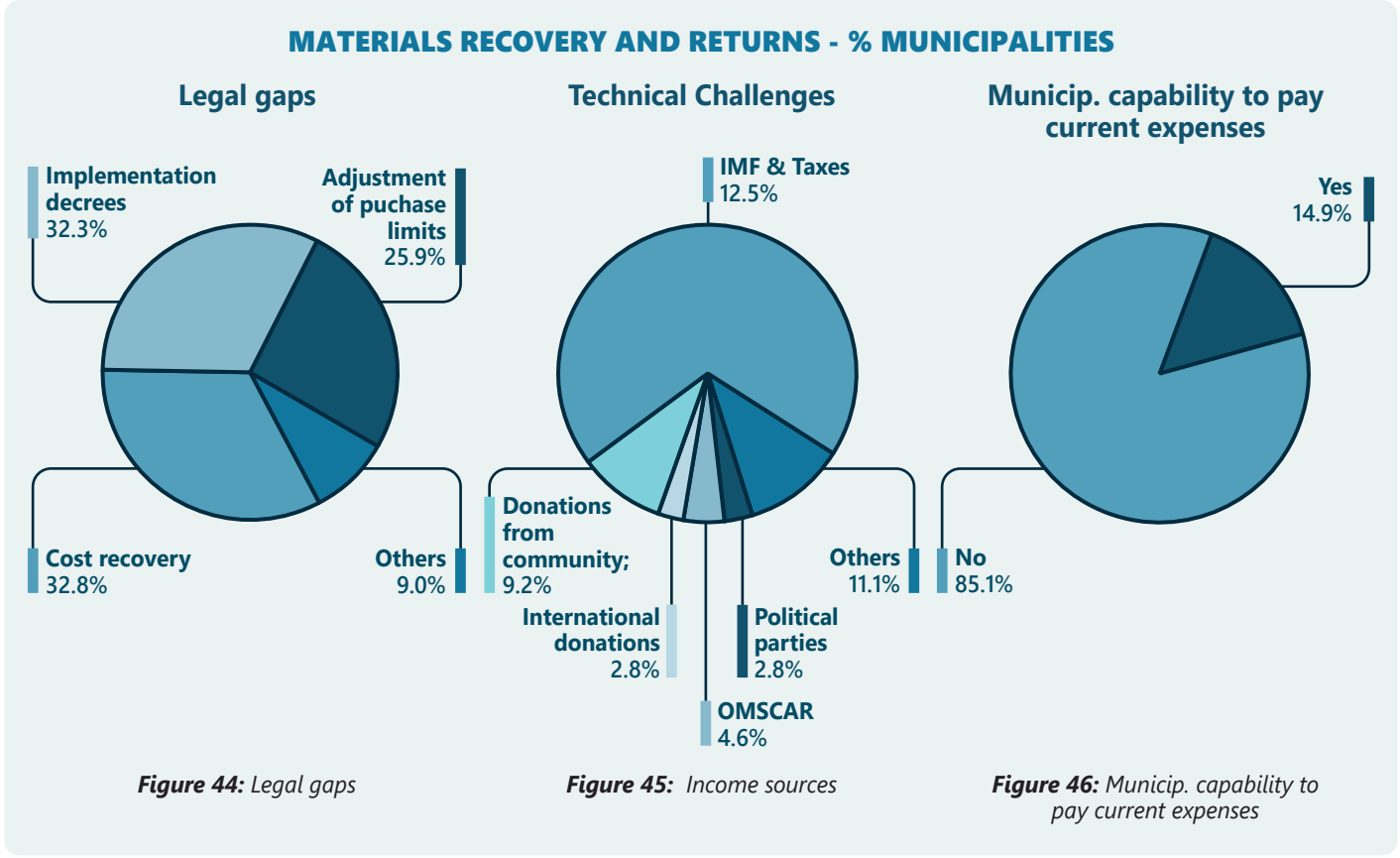


Figure 44: *Legal gaps*

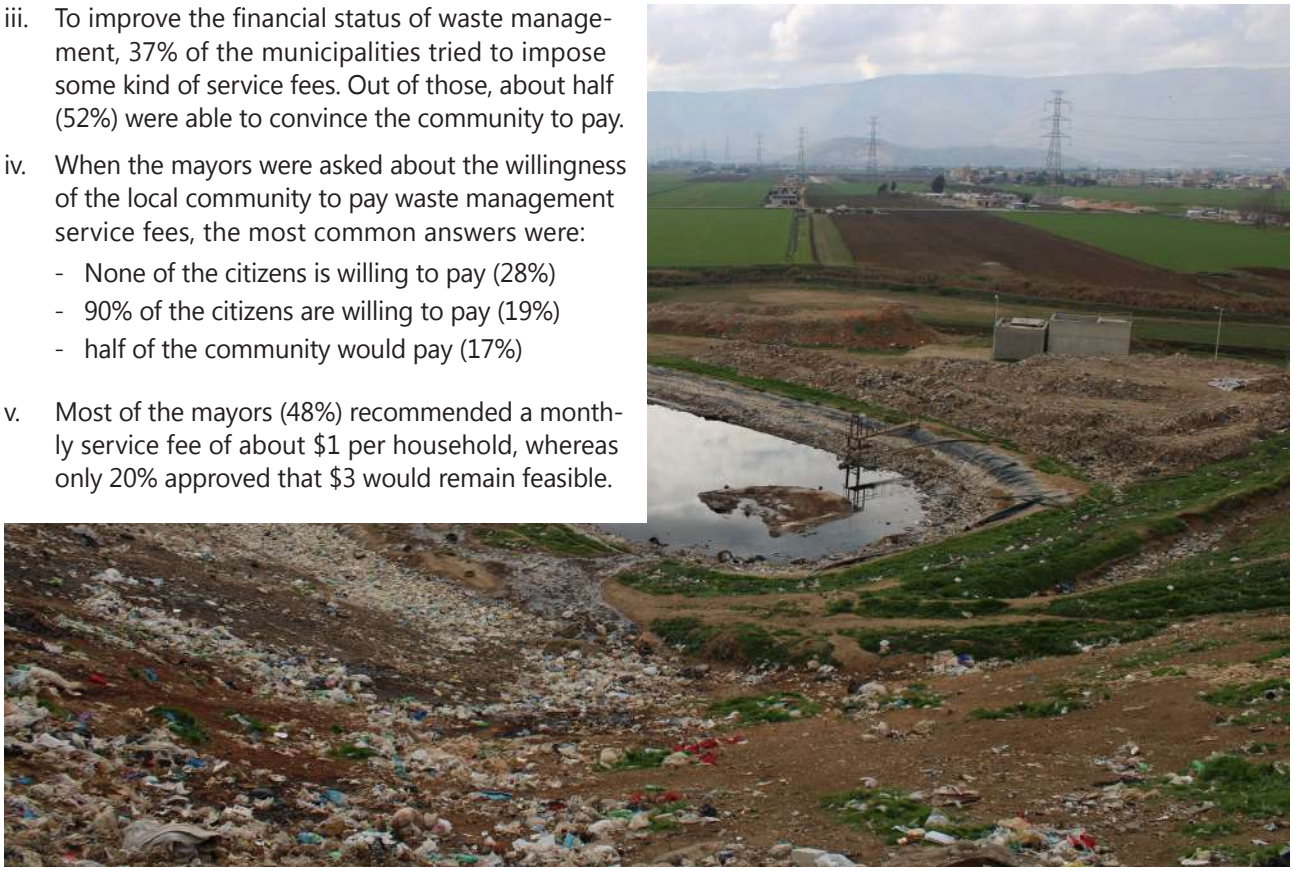
Figure 45: *Income sources*

Figure 46: *Municip. capability to pay current expenses*

iii. To improve the financial status of waste management, 37% of the municipalities tried to impose some kind of service fees. Out of those, about half (52%) were able to convince the community to pay.

iv. When the mayors were asked about the willingness of the local community to pay waste management service fees, the most common answers were:
   - None of the citizens is willing to pay (28%)
   - 90% of the citizens are willing to pay (19%)
   - half of the community would pay (17%)

v. Most of the mayors (48%) recommended a monthly service fee of about $1 per household, whereas only 20% approved that $3 would remain feasible.



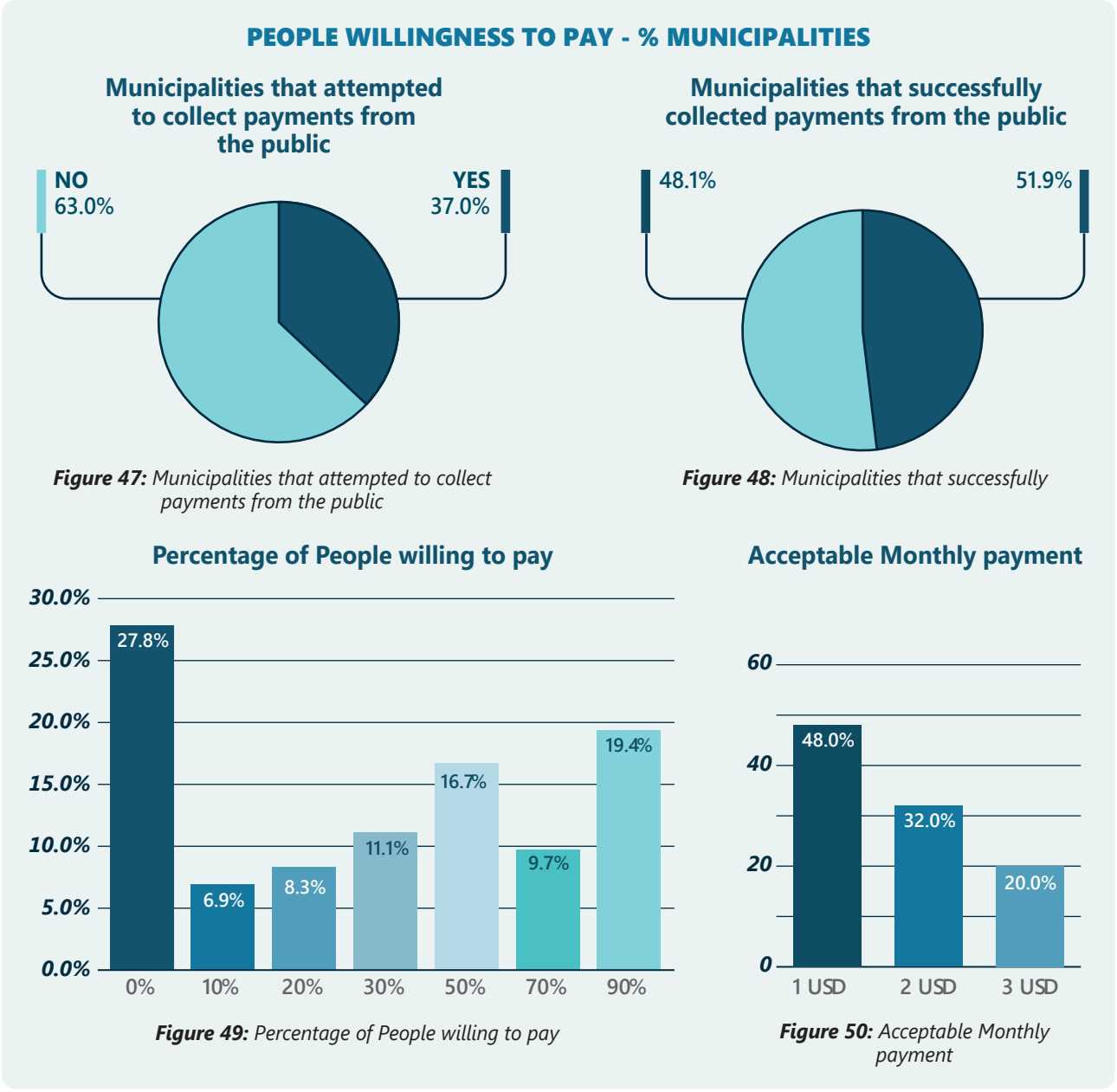


Figure 47: *Municipalities that attempted to collect payments from the public*

Figure 48: *Municipalities that successfully*

Figure 49: *Percentage of People willing to pay*

Figure 50: *Acceptable Monthly payment*

4.1.7 Topic #7. Institutional capacity & law enforcement

Ongoing efforts

This topic is considered in MoE roadmap for 2023, developed with the support of WB; but no tangible plans or funds are available so far.

Context

The ministry is incapable of performing crucial activities[14] because of: (1) lack of staff (more pronounced during the economic crisis), or (2) need for specialized or international expertise.

Areas of Support

i. Push to get the Standard Operational Procedures (SOPs) approved.

   SOPs (for sorting, composting, landfilling, etc.) were finalized and submitted to 'Majles Shoura el Dawleh". The latter's approval is pending translation to Arabic.

[14] starting with high-level strategic studies, all the way to inspection and implementation actions.

ii. Provide support to the ministry on crucial activities (that would complement the actions of WB and UNDP).

iii. Devise a framework for coordination between different players (between authorities on one hand, and with donors on the other) to allow synergies and boost the capacity of individual authorities.

A full-fledged participatory approach may be needed to achieve this target. Otherwise, there's a risk of undermining some authorities/departments (e.g. those with weak political support).

iv. Strengthen the capacity of the security forces and municipal police as well as legislative body on environmental crimes.

Relevant Feedback from Local Authorities and Citizens

i. About 80% of the interviewed mayors confirmed the presence of various actions that pose risks to the environment and the public health, including: uncontrolled dumping of MSW (14%), CDW (15%) and tires (8%), dumping of waste in waterways (12%) and burning of MSW (10%), tires (8%) and green waste (8%).

ii. About 87% of the mayors perceive penalties sand incentives as viable means to ensure public abidance. They were almost split half-half in choosing penalty or incentive to be the most efficient approach.

LOCAL INADEQUATE ACTIONS AND PERCEIVED IMPACT OF PENALTIES AND INCENTIVES - % MUNICIPALITIES

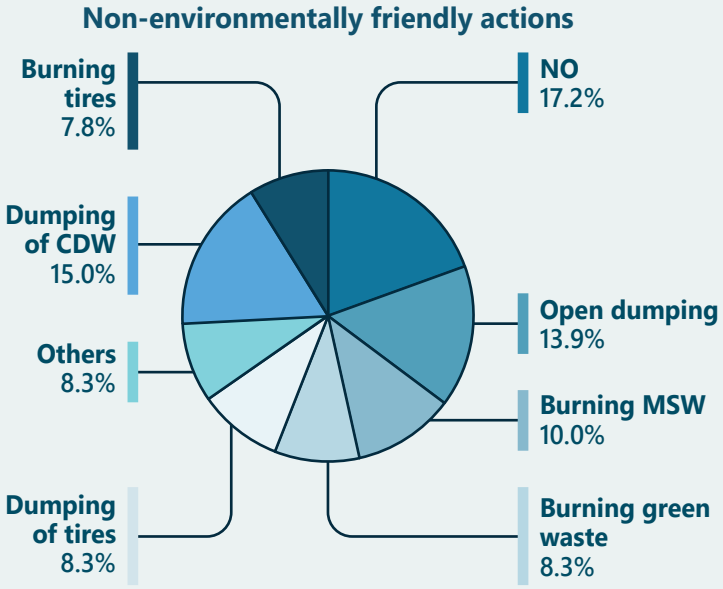


Figure 51: *Non-environmentally-friendly actions*

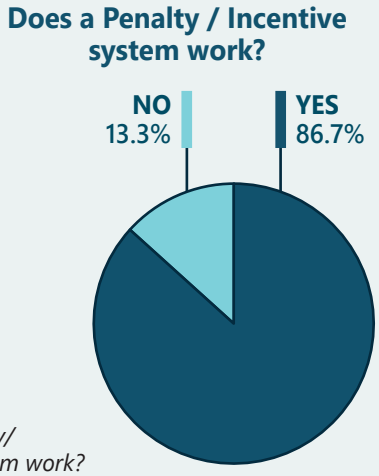


Figure 52: *Does a Penalty/ Incentive system work?*

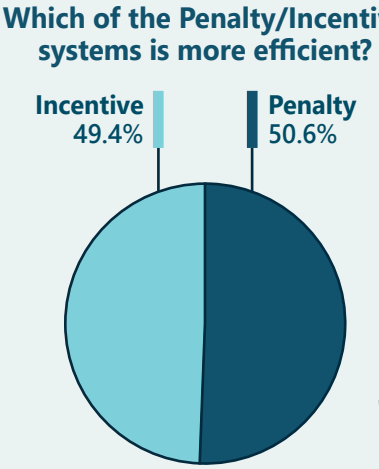


Figure 53: *Which of the Penalty /Incentive systems is more efficient?*

4.1.8 Topic #8. Pre-Requisites for Local Implementation

Ongoing efforts

In addition to the limited capacity and resources, local authorities (municipalities and union of municipalities) have their hands tied because: (1) they are not provided the technical, legal and economic implementation tools, and (2) are bound by rigid (often obsolete) regulations and heavy bureaucracy.

Areas of Support

i. Establish local clusters for collaboration on SWM. This would favor inter-municipal cooperation, capacity building (e.g. HR) and customer inclusivity. It is especially important to capture towns that don't have municipalities.

ii. Develop "binding" action-plans that ensure continuity across successive municipal councils.

iii. Push toward higher financial flexibility and assist achieving creative alternatives to bypass bottlenecks, such as:
   - amendment of budget-related regulations (e.g. ceiling for purchases that require central approval, allowing addition of a budget item for SWM services), and law amendments to allow municipalities to recruit – which is currently forbidden by the law.
   - "legally approved" template for organizational decisions (arar tenfizeh) that allows collection of waste management fees in the absence of (or while waiting for) a ratified cost-recovery law.
   - partnering with NGOs to assist in planning, fund raising and technical implementation, in the presence of a law that forbid any hiring at the municipal level (e.g. VNGI[15] and Manara municipality).

iv. Technical capacity building, such as competent technical units for clusters, updated environmental management guidelines, monitoring system, incentives/penalty system, etc.

v. Templates for procurement documents (dafetir el shourout) and contracts with service providers. Those shall include clauses requiring material recovery, rather than a flat fee per ton of waste.

vi. Well-defined and realistic permitting process for local-scale waste sorting facilities. Currently, there's no permitting process specific for waste facilities in Lebanon (not even in Law #80). The Ministry of Industry places them under category 2 as "production of compost". So it has to be located in industrial zones, larger than 5000 m2 land and has a composting facility. This makes it mission impossible for rural areas wishing to have a "legal" sorting facility. Most are built on the basis of an EIA only.

vii. Simplified PPP models as some requirements are too complicated for small businesses and common-size municipalities to implement. Creative suggestions have been made by experts, such as models that allow the municipality to rely on a third party (e.g. a bank). For instance, a partnership project may be developed between the municipality and a service provider and funded through a bank loan. The latter will scrutinize the business plan prior to approval, thus doing the professional review job that the municipality is not usually qualified to do.

Relevant Feedback from Local Authorities and Citizens

i. Local authorities that are hosting their own waste treatment facility are facing various challenges, mostly financial (40%), technical (16%) and energy related (20%). These burdens can be alleviated by moving to bigger clusters and making use of the economies of scale and combined resources.

ii. About 92% of the addressed mayors stated that the nearby towns do share similar waste management burdens and challenges. Out of these, 91% confirm that the "majority" of the close by municipalities are indeed in a similar position. This data proves the possibility of creating homogenous clusters in most of the country.

[15] VNG International is the International Cooperation Agency of the Association of Netherlands Municipalities (VNG)

LOCAL TREATMENT CHALLENGES AND SIMILARITIES WITH THE SURROUNDING AREA - % MUNICIPALITIES

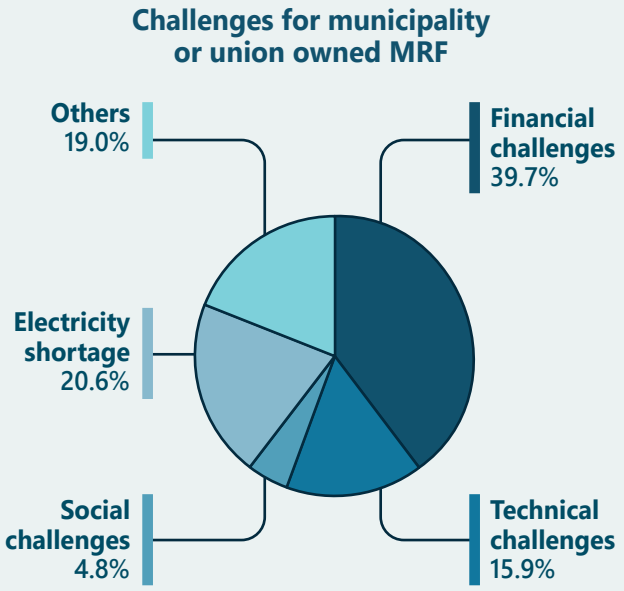


Figure 54: *Challenges for municip. or union owned MRF*

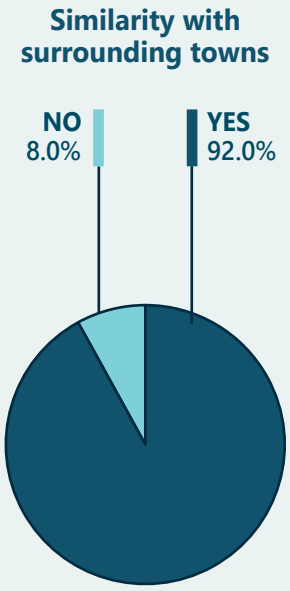


Figure 55: *Similarity with surrounding towns*

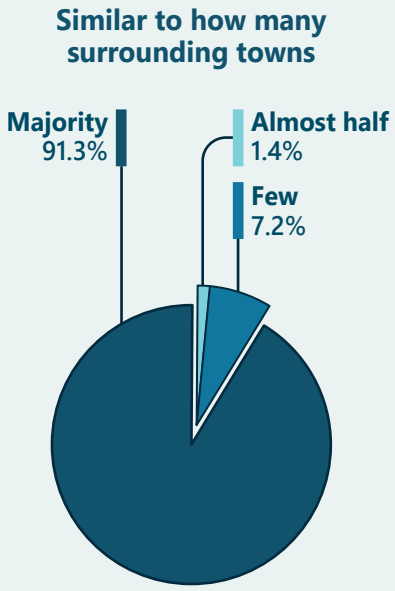


Figure 56: *Similar to how many surrounding towns*

4.1.9 Topic #9. Valorizing special wastes

Ongoing efforts

In 2019, UNIDO developed a baseline assessment of E-Wastes in Lebanon. The study identified several challenges, leading to poor management of the sector, including: absence of E-waste legislation, absence of data, poor knowledge about E-waste collectors and recyclers, poor infrastructure for recycling, high transportation costs and logistic difficulties, poor awareness and no tracking of e-wastes. UNDP are managing on-going studies on EPR options in the e-waste sector under TADWIR (funded by EU).

Context

Most of the collection and treatment activities are taking place by the informal sector, without any monitoring or supervision.

Areas of Support

i. Launch actions to divert special waste streams from landfills. These actions have a high rate of success because:
   - most of the sources are "localized" businesses and institutions,
   - the implementation is faster implementation,
   - the financial efficiency is higher, and
   - the impacts are easily noticeable.

ii. Develop business models, forecasts and investment opportunities for valuable types of waste: e-waste, batteries, end-of-life vehicles, waste tires, used oil, etc.

iii. Develop EPR systems to protect "specialized" recycling investments in this sector and ensure a sustainable inflow of waste.

In addition to the challenges that the informal sector set (with lower overhead cost, no requirements to abide by any regulation and higher profit), the formal businesses are facing the new challenge of not being able to "specialize" in one type of special wastes. Under the current economic crisis, recyclers are collecting "anything that they come across" even if it's not within their area of specialization (e.g. plastic recyclers collecting e-waste); then sell it to the informal sector to increase their range of profit. Even institutions (universities, schools, banks, hospitals, etc.) who used to give away their waste for free, are asking for a return.

iv. Put in place clear and effective administrative procedures for permitting and monitoring of special waste recycling businesses.

Currently, the procedure to start a "formal" (officially recognized) business in recycling of special wastes does not exist. Developing and running a business in this area is subject to lengthy and subjective administrative procedures – making some of the actions impossible to implement (at least officially).

v. A plan for waste from solar energy systems (batteries, PV panels and others). These are expected to increase drastically in the coming years, given the sudden growth in PV market in the country – as the only reliable and economically affordable source of electricity.

Relevant Feedback from Local Authorities and Citizens

The data collected from municipalities and citizens do not cover aspects related to this topic.

4.1.10 Topic #10. Achieving circularity of industrial waste

Ongoing efforts

The "Private Sector Transition to a Green and Circular Economy in Lebanon", implemented by UNIDO and funded by EU, aims at introducing circular economy principle to Lebanon's Food and Beverage (F&B) industrial sector – among other objectives.

Context

Even though the industrialists see the long-term return on investment, they are often not capable to provide the investment budget to make the modifications needed to shift into circular economy – more so nowadays under the current economic crisis.

Areas of Support

i. Develop an inventory of industrial waste (IW), followed by an action plan for waste prevention to alleviate the overburden on MSW. Many of the factories operate outside industrial cities and send their waste with MSW, creating an overburden to the hosting municipalities.

   The action plan should be accompanied by (total or partial) financial support for implementation. A previous attempt by MoI to identify synergies has failed because the industrialists didn't carry out the implementation.

ii. Develop a framework for implementing circular economy principles, focusing on potential synergies between industrial activities (waste of one industry used as input by another) to reduce the cost of raw material. The framework should be accompanied by (total or partial) financial support for implementation.

iii. Support solutions to reuse non-recyclable IW as alternative fuel in high-energy demanding industries. A successful example would be SICOMO paper recycling factory. They use their own waste, as well as high calorific value waste from nearby industries (and waste management facilities) to fuel their on-site waste-to-energy facility (with a capacity of 2.5 MW thermal energy, converting about 80-100 tons of waste daily to energy).

iv. Run a data-driven analysis to guide MoI on options for local reuse of (currently exported) "scrap".

   Precious materials (Al, Cu, steel, plastic, paper/cardboard, etc.) are being exported as "scrap" upon approval of MoI. The latter has no information on which (and how much) of these "scraps" are needed for (can be reused by) the local industry. So they end up approving all submitted requests.

v. Develop an Integrated IW management strategy and action plan that differentiate between industries within and outside industrial cities and takes into account the end-user waste generation:
   - IW is often considered second priority compared to other streams (e.g. healthcare waste), which is delaying the development of targeted policies and actions.
   - Management of the waste generated from industrial cities would be easier because: (1) they are contained in specific locations; (2) data is available at MoI; and (3) they are managed by one entity (MoI). In comparison, factories outside industrial cities are scattered and under the responsibility of various municipalities.
   - Beyond the waste generated from the industrial process itself, the waste generated at the consumer level should be considered (e.g. containers of paint and dairy products, bottles of detergent and personal care products, etc.). A life-cycle approach should be adopted, and economic instruments need to be introduced.

vi. Initiate functional reform to make all industrial activities (and the corresponding waste) under the jurisdiction of MoI.

Relevant Feedback from Local Authorities and Citizens

The data collected from municipalities and citizens do not cover aspects related to this topic.

4.1.11 Topic #11. Limiting hazardous contamination

Ongoing efforts

UNDP is targeting hazardous waste (especially health-care waste and E-waste), under TADWIR. They are working toward developing the storage capacity and export procedures for cytotoxic and pharmaceutical waste and examining the possibility of treating them in Lebanon using incineration. MoE, with the support of the World Bank team, is working on policy development and national capacity building to reduce the release of unintentional POPs.

Context

In the absence of treatment and disposal facilities (which are often very expensive for this type of waste), the only available environmentally sound solution for chemical wastes is storage followed by export for treatment/disposal abroad. The main problem is that a large quantity of waste is needed to make the shipping cost reasonable. This might require several years of storage, which creates other risks. Also, common storage (by more than one company) is not practically feasible for various reasons (logistics, management, etc.). In addition, for the waste to be accepted for shipment, it should be adequately segregated, stored and labelled. This requires specific technical expertise that is rarely found in factories. Thus, a clear and easy-to-implement storage/shipment system should be put in place. Alternatively, hazardous waste landfills should be constructed.

Areas of Support

i. Establish an inter-authority initiative to prioritize the management of hazardous materials in waste and put in place a system for well-coordinated actions.

   Lack of coordination led to the failure of earlier initiatives. For instance, when MoE was running a campaign to phase out mercury, the MoE&W was advocating mercury containing economy bulbs and MoH was distributing mercury thermometers.

ii. Devise a practical system to manage waste from the chemical industry including:
   - a detailed inventory of chemical wastes,
   - phasing out harmful chemicals,
   - develop a practically feasible storage/export or disposal system.

   There exist no accurate (primary data based) assessment of types and quantities of chemical waste produced in Lebanon. There was only one study on PoPs conducted by MoE but it lacked primary data and was based on many assumptions.

   Currently, chemicals regulated by international conventions are the only ones that are banned. Other harmful chemicals need to be phased out as well (provided they are determined and quantified first). Those end up most of the times in MSW bins, thus contaminating the MSW stream (making the resulting compost hazardous) and reach the soil, air and water (e.g. though open dumps).

Relevant Feedback from Local Authorities and Citizens

The data collected from municipalities and citizens do not cover aspects related to this topic.

4.1.12 Topic #12. Stopping sporadic sludge disposal

Ongoing efforts

An earlier study, by UNDP, recommended low-cost treatment of the sludge from Zahleh plant, such as solar drying followed by landfilling. The study was not implemented.

Context

Most of the sludge is being disposed openly on land or to the sea (e.g., Ghadir river). The problem will increase with future operation of the large coastal wastewater plants.

Areas of Support

i. Provide low-tech low-cost solutions for the municipal sludge from currently operating plants, with (total/partial) financial support for implementation.

ii. Provide technically and economically feasible solutions for the industrial sludge, and incentives for on-site treatment of industrial wastewater.

   Even though some factories do treat their liquid effluents, they have no environmentally sound solutions for the disposal of the generated sludge. In many instances, it creates disincentives to the industrialists to treat their wastewater in the first place.

Relevant Feedback from Local Authorities and Citizens

The data collected from municipalities and citizens do not cover aspects related to this topic.

4.2 INFRASTRUCTURE & OPERATIONAL SUSTAINABILITY

4.2.1 Topic #13. Optimizing existing infrastructure & completing interrupted initiatives

Ongoing efforts

A call for proposals was launched by UNDP, under TAD-WIR, for the optimization of 10 MBTs for the treatment of MSW.

Context

Many of the existing waste sorting and treatment facilities in the countries are designed for less than 10 t/d. Most of those small-scale facilities are not operational for various reasons – mostly lack of financial sustainability. Potential alternatives can be provided to make use of those structures (for the same or different purposes). On the other hand, many of EU funded initiatives have been interrupted by the donor because of technical and financial concerns. Attempts to address those concerns are needed to increase the chances of resuming the (partially completed) projects.

Areas of Support

i. Make use of existing structures, e.g. rehabilitate them, upgrade them for RDF production, convert them into transfer stations, etc.

ii. Resume interrupted projects as they are even more needed now – even under less-than-optimum conditions (such as lack of sanitary landfills).

   Yet, to give the donor a reason to consider re-initiation of a certain project, a feasibility study (or a cost-benefit analysis) should be performed prior to embarking on execution plans. This should be accompanied by a "realistic" cost estimation by the donor. Historically, some donors used to price the same project (same size and objectives) in a European city way higher than they price it in a Lebanese city, necessitating the use of less performing technologies and skipping complementary activities (e.g. awareness).

   Equally important, before implementing any project, KPIs should be clearly identified – avoiding retrofitting of assessment parameters and indicators after implementation.

iii. Develop technical notes that compile local experience and previous technical failures/mistakes in small-scale applications.

   Many of the small-scale facilities implemented by OMSAR had similar technical designs (e.g. in-vessel composting), so a failure in one led to a failure in all. OMSAR could have benefitted from pilot testing and a capacity building period before building/operating every facility.

Relevant Feedback from Local Authorities and Citizens

The data collected from municipalities and citizens do not cover aspects related to this topic.

4.2.2 Topic #14. Transitional handover plan (for selected clusters)

Ongoing efforts

The 2023 road map of MoE includes fund raising activities (under LFF, UPOP, UNDP, GATE) to rehabilitate and operate eight existing facilities.

Context

Most small-scale waste management facilities are facing technical and financial challenges that are hindering their operation. They need rehabilitation, optimization and upgrading, followed by temporary support until reaching a mature stage of self-sustainability.

Areas of Support

i. Fund the O&M of selected operating facilities over a transitional period, until a fully functional cost recovery system is established and technical challenges are resolved[16].

ii. Fund a storage and collection system that meets the targets of the operational plan.

iii. Support local awareness and training programs. Unlike previous attempts, it should not be a one-shot or ad-hoc activity, but a continuous program. Citizens across the country have repeatedly identified "lack of continuity" as the main reason behind the failure of awareness raising initiatives.

Relevant Feedback from Local Authorities and Citizens

i. Storage and Collection:

[16] Provided a cost recovery law is endorsed and a viable implementation plan is put in place.

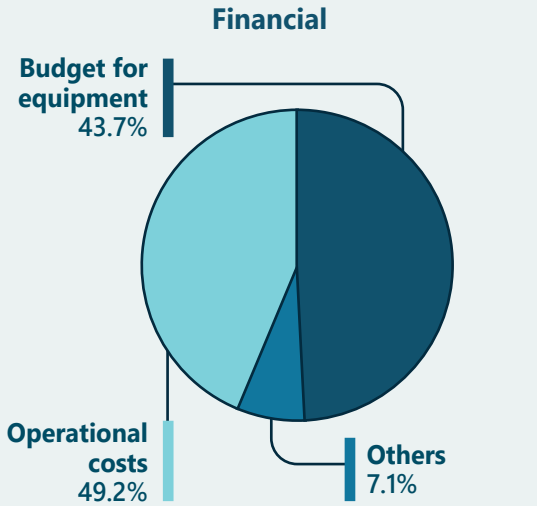


Figure 57: *Main challenges for collection: Financial*

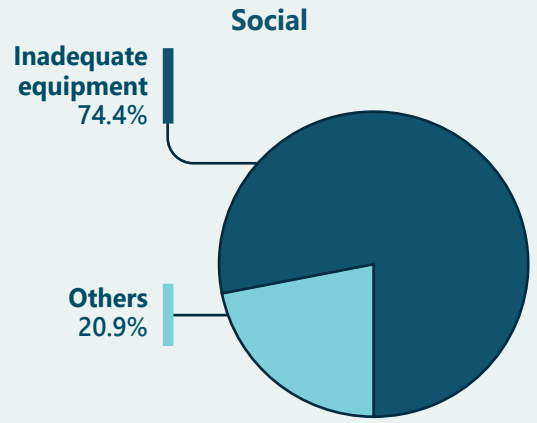


Figure 58: *Main challenges for collection: Technical*

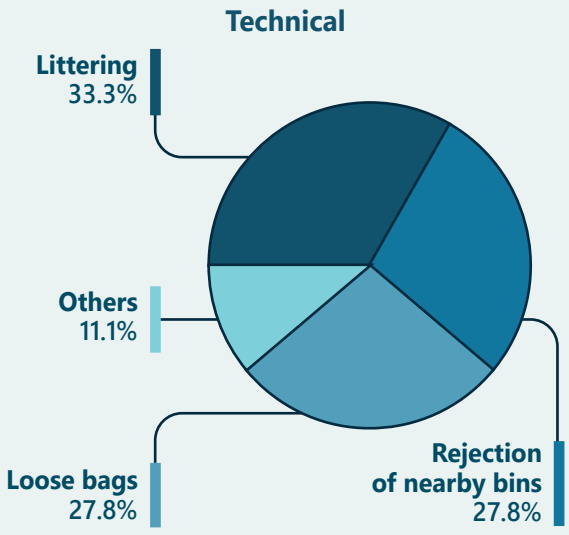


Figure 59: *Main challenges for collection: Social*

- Local authorities are facing various financial and technical challenges, mostly related to the cost and adequacy of the storage and collection equipment and operational costs.
- Social challenges include: littering, inadequately sealed waste bags and rejection of nearby waste bins.

ii. Treatment:

- About 85% of local authorities are not capable to pay the current expenses of waste treatment.
- About 80% of the local waste treatment facilities need upgrading and are facing multiple financial, technical and social problems.

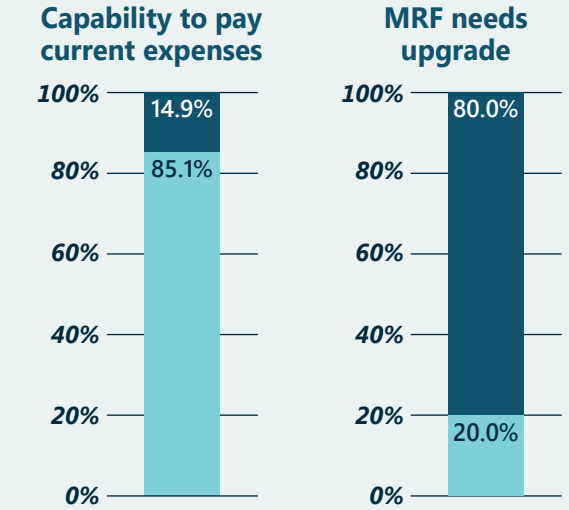


Figure 60: *Capability to pay current expenses*

Figure 61: *MRF needs upgrade*

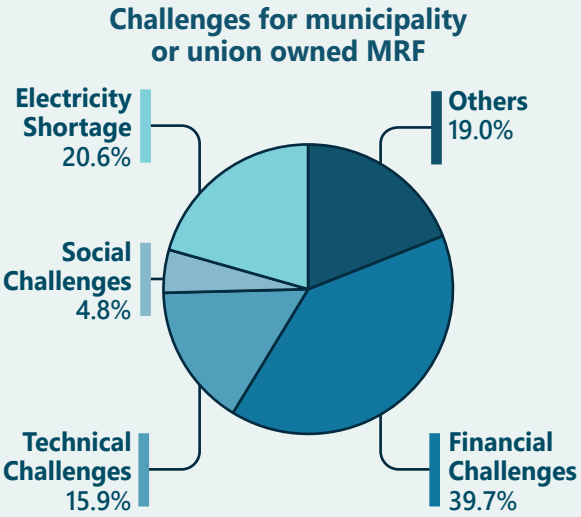


Figure 62: *Challenges for municip. or union owned MRF*

4.2.3 Topic #15. Support for Environmental Protection

Ongoing efforts

In 2017, MoE and UNDP published the "Updated Master Plan for the Closure and Rehabilitation of Uncontrolled Dumps in Lebanon".

Context

The 2017 study is considered obsolete, given the chaotic conditions following the economic crisis. The open dumping activities has increased, mainly because of the high cost of transportation. On the other hand, MoE lacks the resources needed to build and operate new sanitary landfills.

Areas of Support

i. Financial support for CAPEX and transitional period OPEX of new engineered landfills[17]

ii. Update dumpsite closure studies and support implementation.

Relevant Feedback from Local Authorities and Citizens

The same observations and exhibits of Topic #5 (Redefining Landfilling) apply here.

4.2.4 Topic #16. Support to the Recycling Industry

Ongoing efforts

The scope of TADWIR project mentions support for the construction of new specialized recycling centers for e-waste and medical waste.

Context

Most recycling industries suffer from the lack of a stable and affordable source of energy, a good quality waste inflow and a limited market for their products (usually because of high competition with imported goods (e.g. glass jars from China).

Areas of Support

i. Fund affordable and reliable sources of energy (solar, wind, RDF, etc.)

ii. Assist in establishing a stable downstream market (e.g. decisions by MoI, MoE&T and MoT among others; EPR; environmental tax, etc.)

iii. Assist in securing a stable high-quality upstream sources of material.

Relevant Feedback from Local Authorities and Citizens

The data collected from municipalities and citizens do not cover aspects related to this topic.

[17] Provided a cost recovery law is endorsed and a viable implementation plan is put in place.

5. SETTING PRIORITIES

This chapter aims at setting priority themes of intervention. This is achieved by analyzing the feedback of SWM experts and practitioners (consultants, service providers, international organizations, researchers and activists), through a survey that covers the main prioritization criteria.

5.1 PRIORITIES AS IDENTIFIED BY EXPERTS

The topics were classified, according to their appearance within the first six priorities identified by the experts into three levels: high, medium and low priority.

Table 2: *Priorities as identified by experts*

Level	Topic*	Survey Score**
Highest Priority	6. Robust cost recovery system	**83%**
	2. National strategies and masterplans	**78%**
	3. Waste Diversion	**67%**
	1. Solid waste management agency	**61%**
	7. Institutional capacity of MoE & law enforcement	**56%**
Medium Priority	5. Redefining landfilling	**44%**
	8. Pre-requisites for local implementation	**33%**
	15. Environmental protection	**33%**
	16. Support to the Recycling Industry	**33%**
	13. Optimizing existing infrastructure & completing interrupted initiatives	**28%**
Low Priority	4. Alternative fuel	**17%**
	12. Stopping sporadic sludge disposal	**11%**
	9. Valorizing special wastes	**6%**
	11. Limiting hazardous contamination	**6%**
	14. Transitional handover of MSW facilities	**6%**
	10. Achieving circularity of industrial waste	**0%**

* *The topic numbers refer to the numbers in the previous chapter*

** *Percent of respondents that placed it within the first six priorities*

5.2 RESULTS OF EXPERTS SURVEY

The survey data is segregated according to each of the six survey questions, indicated as Q1 to Q6 in the table below. Results are shown in the table below as low, medium or high, with "low" and "high" representing, respectively, the lowest and highest importance, effectiveness, availability, and interest. Where considered meaningful, the percentage of respondents is provided.

Table 3: *Results of Experts Survey*

Topic	Q1 - Is it important?	Q2 - Are effective solutions available?	Q3 - Is there an opportunity to change?	Q4 - Are there considerable uncertainties?	Q5 - Is evidence available?	Q6 - Is there interest in informed dialogues?
Robust cost recovery system	Highest score (76%)	Among the highest (72%)	Low to medium High by compost producers & MoI[18]	Medium to high	Inconclusive	Inconclusive
National strategies and masterplans	Among the highest (67%)	Among the highest (67%)	Medium	Inconclusive (47% high, 35% low) Medium/high by agencies close to MoE[19]	Low[20]	Inconclusive
Waste diversion	Among the highest (67%)	Highest score (78%)	Medium High by private facility operators[21]	Medium	Inconclusive High by focus groups[22]	Inconclusive High by governance experts[23]
SWM agency	High	Medium to high	Medium	High[24]	Low to medium[25]	Inconclusive
Institutional capacity of MoE & law enforcement	Among the highest (62%)	Medium to high	Low to medium	Inconclusive	Inconclusive	Low to medium
Redefining landfilling	Medium to high	Medium to high	Low[26]	Highest score (76%)[27]	Inconclusive	Low High by 30%[28]
Pre-requisites for local implementation	High	High	Medium	High	Low to medium	Low to Medium
Support for Environmental protection	Among the highest (67%)	High	Low to Medium	High (71%)[29]	Inconclusive	Inconclusive

[18] Compost producers (Compost Baladi, Cedar Environmental) and MoI see a high opportunity to implement cost recovery solutions. This may be attributed to the ease of making returns from waste management in these two sectors. This implies also that compost production and IW recycling may provide potential support to overall cost recovery.

[19] The representatives of UNDP and WB, currently working very closely with MoE, consider the SWM Agency issue to be (highly to moderately) subject to conflicting opinions.

[20] This is expected because the impact of the national strategy on the health of the SWM system is perceivable only to the experts in the sector.

[21] Operators of private facilities (IBC, Cedar Environmental, Compost Baladi) all agree on the high opportunity divert waste from landfills/dumps.

[22] The focus group discussions showed that the lack of waste diversion is a very (if not the most) evident problem to citizens.

[23] Representatives of organizations engaged in waste governance projects (DRI, UN-Habitat, WB) see a high interest in dialogues about waste diversion – excluding UNDP.

[24] This result implies a considerable difference in the points of view regarding the need for (and maybe the mandate of) the agency.

[25] This is expected because, like the national strategy, the impact of the SWM Agency is perceivable only to the experts in the sector.

[26] This result is expected given political and social challenges; It reveals the need to reach political consensus (or put political pressure) first, followed by an extensive outreach program.

[27] This is expected given political and social opposition, justifying the highest need for policy dialogues

[28] 30% of the respondents consider the interest in dialogue is high for this topic.

[29] In accordance with highest uncertainties observed for topic #5 (siting and public acceptance of landfills)

Support for recycling industry	High Among the highest by MoI, startup and industrialists[30]	Among the highest (67%)	Medium	Inconclusive	Medium to High	Medium to High
Optimizing infrastructure & complete interrupted initiatives	High	Medium to high	Medium	Medium to high	Low to medium	Low to Medium
Alternative fuel	Inconclusive	Medium	Low	Among the highest[31]	Low	Low
Stopping sporadic sludge disposal	High	High	Low	Inconclusive	Low	Low
Valorizing special wastes	Medium to high	Medium	Medium	Low to medium	Inconclusive	Inconclusive
Limiting hazardous contamination	Among the highest (71%)	High	Low	Low to medium	Low	Low to medium
Transitional handover of MSW facilities	Medium to high	High	Medium to High	Medium to high	Inconclusive	Low to medium
Achieving circularity of industrial waste	High Among the highest by industry players and activists[32]	Medium to high High by industry players and activists	Inconclusive	Medium	Low to medium	Low

Note: *inconclusive results correspond almost equal votes for "low" and "high" scores, or votes that are almost equally split between the three levels.*

5.3 ELIMINATED TOPICS

Even though all 16 defined topics are considered of high importance to Lebanon, the experts and practitioners survey was used to narrow the list into those of highest priority. The results showed that, under the current conditions in the country, six topics may be considered of lower-priority (compared to the others) and were excluded from the subsequent analysis:

5.3.1 Alternative Fuel

- Considered of "low" importance (Q1) by 7 experts (compared to 0-3 experts for all other topics)
- Likelihood of implementing the solutions (Q3) is the lowest (considered low by 11 out of 16 respondents)
- Considered the least evident problem (Q4)
- Low interest in dialogue (Q6)

5.3.2 Stopping sporadic sludge disposal

- Low evidence, mostly because the major plants (in coastal cities) that are expected to produce sludge will not be operational in the short term.
- Industrial sludges are not common because most industrial wastewater is being discharged into the environment without treatment. Only after solving the

[30] MoI, Green Mount Recycling, Sicomo, Cedar Environmental
[31] Despite the converging views about the "importance" of alternative fuel solutions (Q1), this topic had one of the highest scores in terms of presence of uncertainties (Q4).
[32] Considered of highest priority by industry stakeholders (MoI, UNIDO, SICOMO, Cedar Environmental) and activists (TERRE, Waste Coalition), among others.

wastewater problem that the sludge will be perceived as a problem.
- Low interest in dialogue (Q6)

5.3.3 Valorizing special waste:

- Not considered as high priority by experts
- It is partially (e-waste and batteries) tackled under TADWIR

5.3.4 Limiting hazardous contamination:

- Even though considered of highest priority, only very few (6%) experts selected it among the 6 priorities to be addressed first.
- It is partially (healthcare waste and batteries) tackled under TADWIR

5.3.5 Transitional handover of MSW facilities

- Not considered as high priority by experts
- Addressed by various funds: TADWIR, LFF and others

5.3.6 Achieving circularity of industrial waste

- Even though considered of highest priority by industrial stakeholders, none of the experts selected it among the first 6 priorities
- It is partially (food sector) addressed by UNIDO
- Low interest in dialogue (Q6)

5.4 RETAINED THEMES

The retained themes are categorized into three categories: (1) prerequisites, which are mandatory for a successful integrated solid waste management system; (2) structural and functional reforms, consisting mostly of soft interventions; and (3) infrastructure and operational sustainability, requiring funding for infrastructure components. For a detailed description of each of the themes below, refer to the previous chapter.

5.4.1 Category 1. Prerequisites

Theme 1: National strategies and masterplans (ref. topic #2 of previous chapter)

a. Get ISWM strategy ratified
b. Develop an ISWM **masterplan (MP)** with feasibility analysis and roadmap
c. Provide **guidelines for regional MPs** and local implementation
d. Develop a **circular economy national strategy** and implementation plan

Fundamentals of Theme 1

i. Initiate a SWM observatory to feed the masterplan, feasibility analysis and road map
ii. Identify centralized vs. decentralized components of the masterplan.
iii. Finalize legally/administratively binding and functional service zones.

Theme 2: Solid waste management agency (ref. topic #1 of previous chapter)

a. Get the mandate **ratified** & recruitment completed
b. Empower the agency to act as THE professional institutional **leader**
   i. Support the agency on **cross-sectoral dialogues** and collaborations
   ii. Support the agency with **soft interventions,** e.g. tools needed to facilitate their job.

Theme 3: Robust cost recovery system (ref. topic #6 of previous chapter)

a. Get the SWM tax law **ratified & updated** according to ongoing studies
b. Develop **investment models & opportunities**
c. Develop and implement an aggressive **outreach** program to achieve public acceptance
d. Find a solution for **the long-term debt** of municipalities.

5.4.2 Category 2. Structural & functional reforms

Theme 4: Waste diversion (ref. topic #3 of previous chapter)

a. Introduce the "polluter pays" principle through economic and regulatory instruments to **incentivize the municipalities and the service providers** to divert the waste from landfills
b. Initiate dialogues between national stakeholders to control **pre-generation** of waste
c. Support initiatives for separate collection of **single-stream** sources
d. Support solutions for **residuals** of solid waste facilities.

Fundamentals of Theme 4

i. Develop landfilling bans on waste material that has a downstream recycling

ii. Firmly "control" or "incorporate" the informal sector
iii. Develop awareness/education policies, with easy-to-implement incentives/penalties
iv. Implement projects for return-value of waste (e.g. pay-back centers)
v. Plan for long-term consistent efforts (in phases).

Theme 5: Pre-requisites for local implementation (ref. topic #8 of the previous chapter)

a. Create local **clusters** for collaboration on SWM with capacity building, binding action plans and successful **pilot tests**
b. Develop **templates** for procurement documents 'dafetir el shourout' and contracts
c. Establish a well-defined and realistic **permitting** process for local-scale waste sorting/treatment facilities
d. Develop **simplified PPP models;** or other models that allow the municipality to rely on a third party
e. Provide higher **financial flexibility** and creative alternatives to bypass bottlenecks.

Theme 6: Institutional capacity & law enforcement (ref. topic #7 of previous chapter)

a. Get the Standard Operational Procedures (SOPs) **approved**
b. Provide **support to MoE** on crucial activities that cannot be achieved because of: (1) lack of staff, or (2) need for specialized or international expertise
c. Devise a framework for **coordination** between different players to allow **synergies** and boost the capacity of individual authorities.
d. Train the security forces as well as legislative body on **environmental crimes**

Theme 7: Redefining landfilling (ref. topic #5 of previous chapter)

a. Define **locations** for landfills at **service zone** level
b. Develop a **post-closure** "vision" and plan and a defined lifespan for each location
c. Develop and implement a **communication** plan to overcome NIMBY & BANANA syndromes

Fundamentals of Theme 7

i. Agree that landfilling is a well-established and acceptable **starting point**
ii. Set **Realistic disposal fees** that reflect the "vision" set for a landfill

5.4.3 Category 3. Infrastructure & operational sustainability

Theme 8: Support for environmental protection (ref. topic #15 of previous chapter)

a. Build **new engineered landfills** with technical support and financial support for **CAPEX** and transitional period **OPEX**
b. Update **dumpsite closure** studies and support **implementation**

Fundamentals of Theme 8

i. Transitional period defined based on a well-structured financial plan

Theme 9: Support to the Recycling Industry (ref. topic #16 of previous chapter)

a. Assist in establishing a stable downstream **market** (e.g. decisions by MoI, MoE&T and MoT among others; EPR; environmental tax, etc.)
b. Assist in securing a stable **high-quality upstream** sources of waste **materials**

Fundamentals of Theme 9

i. Affordable and reliable sources of **energy** (solar, wind, RDF, etc.)

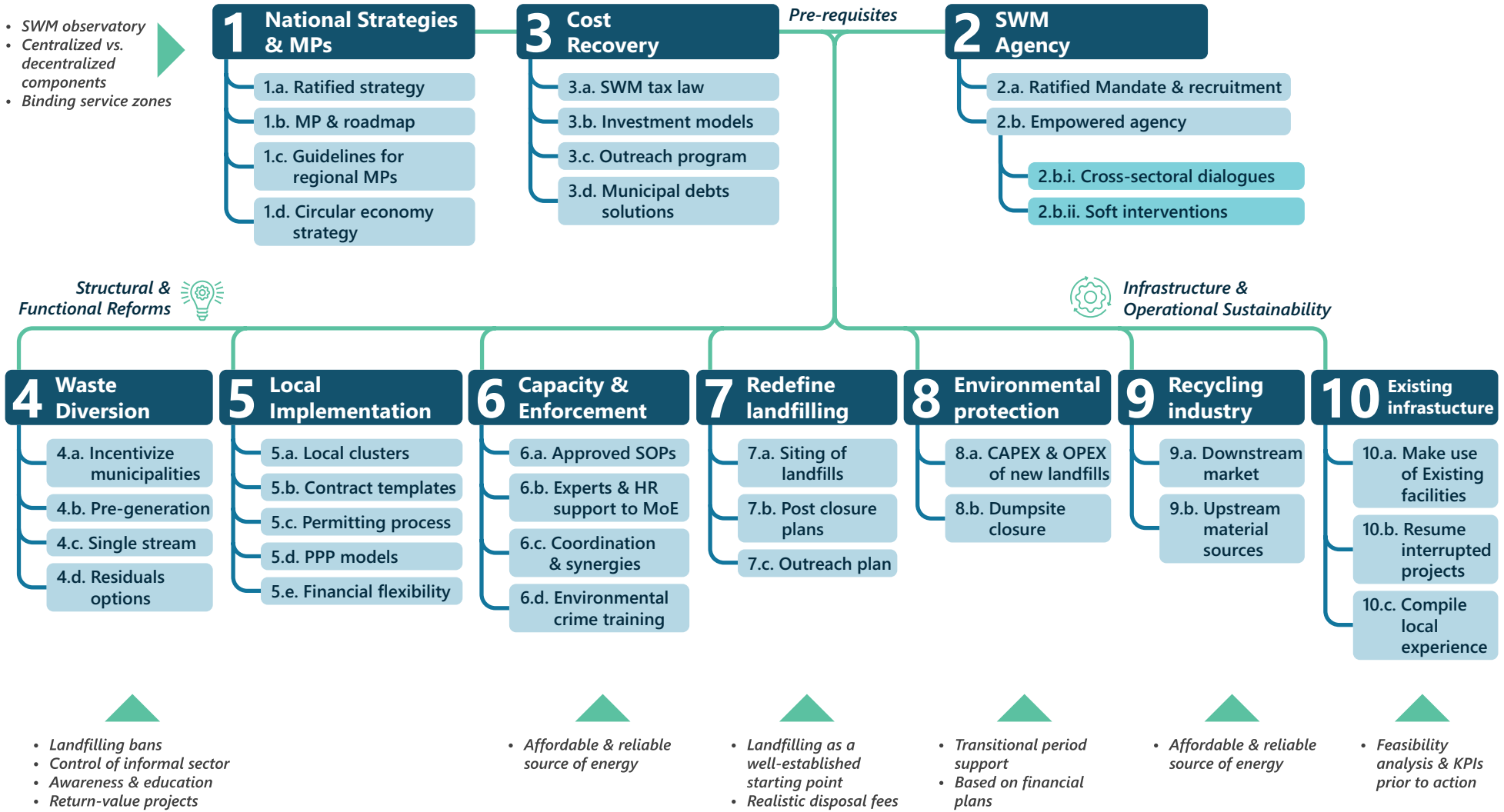
Theme 10: Optimizing existing infrastructure & completing interrupted initiatives (ref. topic #13 of previous chapter)

a. Make use of **existing structures** (rehabilitate, RDF production, transfer stations)
b. Resume interrupted projects – even under **less-than-optimum** conditions
c. Develop **technical notes** that compile local experience and previous technical failures/mistakes in small-scale applications

Fundamentals Theme 10

i. Perform a **feasibility study** or a cost-benefit analysis, along with a realistic cost estimation and clearly defined **KPIs, prior to embarking** on execution plans.

5.5 RECOMMENDATION FRAMEWORK



6. EXISTING INITIATIVES

This section covers only recent (last than 5 years) initiatives that are considered relevant to this strategic study and have a wide impact (e.g. cover a large area or address national-level issues). Localized interventions (in municipalities, institutions, etc.) are not considered.

6.1 INITIATIVES FUNDED BY EU

6.1.1 Protection and sustainable development of maritime resources in Lebanon (ProMARE)

In 2018, several grants were approved under the €19 million project, with the aim of contributing to the protection of Lebanon's coastal zones and maritime resources by reducing land-based sources of pollution. Those include:

i. ISWM in Iqqlim AlToufah Union of Municipalities (implemented by AUB) – The total budget of the project is €4,666,280 which consisted of supporting the development and implementation of an integrated SWM plan and creating a circular economy model in the target area. This was anticipated to increase waste prevention and recycling, while limiting open dumping – which is negatively impacting the Sainiq River. The project examined open dumps in the area to identify the ones with the highest impact on the Sainiq River. The target is to remediate up to 30,000m3 of waste in line with lessons learned from MoE, UNDP, and other remediation efforts across Lebanon. A plan was also created to treat and close all remaining open dumps in the area.

   The project aimed at establishing a Green Economic Cluster (GEC) that encompasses a Material Recovery Facility (MRF) and a composting plant. Effective and tailored communication and outreach activities were also developed for the STA area using multiple methods and tools. In addition, innovative technology like the Nadeera application, was developed to improve solid waste management efficiency and effectiveness.

ii. Sustainable SWM in Jurd el-Kaytee Union of Municipalities (Implemented by COOPI - SWaM Akkar) – The SWaM project comprises several activities, such as designing the "Participative Waste Management Master Plan" in collaboration with local authorities of the Union of Municipalities of Jurd el-Kaytee (UMJK). The plan is currently undergoing validation by central authorities. It also involves implementing the "Don't waste your waste" awareness campaign that includes teacher training, student workshops on littering and recycling, as well as outdoor activities such as planting walnut trees and organizing cleaning days. In addition, the project holds public sessions with key community actors to disseminate the campaign's message and conducts a Land Character Assessment to address issues related to landscape protection and the management, planning, and monitoring of local development activities.

   The project is being executed by a consortium led by the Italian NGO COOPI, along with the UMJK, AUB, Studioazue consulting firm, Cooperation for the Development of Emerging Countries (COSPE), Coop Erica, and Mada Association. COSPE and Mada association are responsible for the implementation of the awareness campaign while Coop Erica is in charge of defining the communication strategy and tools.

iii. Integrated slaughterhouse waste management system in the city of Choueifat (implemented by the World Vision) – The Project was terminated for feasibility concerns related to non-availability of land. The main aim of the project was to minimize the exposure of the population in Choueifat, Mount Lebanon governorate, to the health hazards associated with slaughterhouse waste, and to prevent the spread of diseases related to water, sanitation, and hygiene. The project had two specific objectives: (1) to contribute to the development and enhancement of comprehensive waste management schemes at the municipal level, and (2) to enhance slaughterhouse waste management practices among the targeted population.

iv. Complementary support to SWM in al Zahrani area (implemented by Action Against Hunger, ACF) – Baseline, master plan and feasibility study were conducted. The Project didn't achieve its results for feasibility concerns related to cost recovery especially during the financial crisis in Lebanon that affected the financial capacities of the local authorities.

v. Solid Waste Management in Oussat wa Sahel al Qaytaa

This project was implemented in 2021 by Catalan Agency for Development Cooperation (ACCD) within MASAR (Maintaining Strength and Resilience for Local Governments in Iraq and Lebanon) program in close collaboration with the Union of Municipalities of Oussat wa Sahil Al Qaytaa to improve the solid waste management system. The project aimed to increase collection capacity and efficiency, raise community awareness, and reduce the amount of waste generated. A new waste collection system was developed using Geographic Information System. MASAR provided steel and plastic waste containers of various sizes to increase collection capacity of the union of municipalities.

Initially, training sessions were held for the Heads of Municipalities and waste collection crews. Additional workshops were organized for local NGOs and community representatives, including schools and hospitals, with a total of 90 participants. These workshops covered all aspects of the waste management cycle, including generation, storage, collection, sorting, treatment, and landfilling. An intensive awareness-raising campaign was conducted to educate citizens on waste reduction and proper waste sorting and disposal practices, which reached 3,200 households.

6.1.2 Technical support for development of solid waste management capacities in Lebanon

Under "Technical support for development of solid waste management capacities in Lebanon" which was implemented by OMSAR, six regional solid waste management plans have been developed and submitted to the Ministry of Environment and the European Union for review and approval. Several addenda were provided based on EU's requests; but no feedback was received from MoE. The masterplans cover the following regions:

- District of Tyre
- District of Nabatieh
- District of Bint Jbeil and some areas of Marjeyoun
- Districts of Zgharta, Koura and Becharreh
- District of Al Minieh – Dennieh
- District of Tripoli

6.1.3 Upgrading the Solid Waste Management capacities in Lebanon (SWAM I & II)

The EU provided OMSAR with a €35 million grant for the implementation of SWAM I and II. This project was supposed to construct or extend 8 sanitary landfills and 8 solid-waste treatment plants and to provide disposal and collection equipment (bins, trucks and compactors). SWAM 2 was terminated by the funder for various concerns.

6.1.4 Private Sector Transition to a Green and Circular Economy in Lebanon

This project, which is implemented by UNIDO, will support the reform, recovery, and reconstruction framework for Lebanon (3RF) with the aim of building a better economy, creating jobs, and promoting growth. This framework was developed by the EU, WB, and UN in consultation with the government, donors, and civil society following the Beirut explosion in August 2020. UNIDO is collaborating with the EU to strengthen the private sector and support sustainable, socially responsible, and gender-responsive business models, particularly for startups, micro and small enterprises, and women-led enterprises. The allocated budget is $3,802,867.

The project, which started in 2022, aims to transition to a green and circular economy by transferring environmentally sound technology, promoting resource-efficient production, and encouraging sustainable consumption. This will involve mobilizing investments and utilizing renewable energy resources to support the growth of Lebanon's Food and Beverage (F&B) industrial sector and generate more jobs. A wide range of stakeholders, including public sector organizations, international financing and development organizations, private sector organizations, and academia, are involved in ensuring effective deliverables and ownership at a national level.

6.1.5 Lebanese Civil Society combating for a plastic free Mediterranean Sea #Bahr Bala Plastic

With a budget of € 994,993, the "Bahr Bala Plastic" project was co-managed by the Lebanon Eco Movement and Lebanon Environment Forum. The project started in 2018 and aimed at raising awareness about the dangers related to plastic and reducing its use. It also aimed at supporting small non-profit and for-profit organizations to receive financial support for local initiatives to combat marine litter, its causes and effects, and fight plastic pollution all along the Lebanese coast. The project had three components tackling: (1) land-based sources of pollution, (2) sea-based source of pollution, and (3) socio-economic impacts.

6.1.6 Water and Environment Support (WES) in the ENI Southern Neighbourhood Region: Providing policy support to address single-use plastic items in Lebanon

This initiative is implemented by LDK Consultants Global EEIG, under the WES project (which is a 7,917,200 EU grant). The aim of the initiative is to provide technical support to the Ministry of Environment in addressing Single-Use Plastic (SUP) – excluding plastic bags. The specific objectives of the initiative, which started in 2022, include: (1) enhancing access to precise information on the production and recycling of plastics, as well as the pertinent industries involved, (2) examining the socio-economic consequences of policy measures such as reducing or prohibiting specific single-use plastic products, or promoting alternatives such as non-plastic, single-use options or reuse alternatives, (3) encouraging sector dialogue with key stakeholders, and (4) creating a nationwide plan for the gradual phase-out of SUPs.

6.1.7 Towards a Decentralised Waste Management Integrated Response in Lebanon (TaDWIR)

In 2022, the UNDP started implementing the TaDWIR project. The estimated cost of the project is EUR 21,000,000. The purpose of this project is to enhance the environmental and financial sustainability of waste management system in Beirut and Mount Lebanon Governorates. The TaDWIR project aims to achieve three main goals: (1) decrease the amount of waste that is sent to landfills, (2) enhance the quality of waste that is handled in waste facilities, and (3) upgrade the national systems for managing municipal solid waste, including governance and cost coverage.

The project is currently planning actions in 4 areas:

i. *Hazardous waste with a special focus on healthcare waste, E-waste and batteries* – With respect to the healthcare waste, UNDP is currently targeting Beirut and Mount Lebanon areas and attempting to purchase a mobile sterilizing facility for the hospitals. They are also supporting in the development of relevant policies and regulations. In addition, they are working toward developing the storage capacity and export procedures for cytotoxic and pharmaceutical waste and examining the possibility of treating them in Lebanon using incineration. As for the E-waste and batteries, they are currently in the tendering phase for the development of a baseline assessment and to advise on adequate management through the introduction of Extended Producer Responsibility (EPR) principle.

ii. *MSW with a focus on RDF and green waste* – The goal is to assess potential quantity and quality of RDF produced in Lebanon, the impact of source sorting and the availability of local and foreign markets. The assessment will also cover financial considerations and the necessary upgrades to the current infrastructure. With respect to green waste, UNDP is currently in the bidding phase for a detailed baseline assessment of the green waste stream in Lebanon and identification of the most appropriate approach for the treatment of the green waste in 2 pilot locations/facilities. In addition, a project was launched for optimization of current operational and non-operational waste treatment facilities in Lebanon.

iii. Industrial waste with a focus on cardboard and paper waste and slaughterhouse waste – In both streams, UNDP is currently in the bidding phase for the development of a national baseline assessment study and a national masterplan.

iv. *Cost recovery* – UNDP aims to create cost-recovery strategies and to identify potential tools to recover operational, maintenance, and capital costs of waste management activities, including financial, legal and social instruments. The initiative will address ten EU-funded facilities, exploring possible means for improving operational costs and optimizing energy sources, energy consumption, workforce, and other relevant factors.

6.2 INITIATIVES FUNDED/ MANAGED BY WORLD BANK (WB)

6.2.1 Beirut Critical Environment Recovery, Restoration and Waste Management Project (BERP)

In response to the Port of Beirut explosion that occurred on August 4, 2020, UNDP, in coordination with MoE, is implementing the Beirut Critical Environment Recovery, Restoration and Waste Management Project (BERP) with financing from the Lebanon Financing Facility (LFF) through the World Bank Fund. The LFF, managed by the WB, facilitates the pooling of grants under the Reform, Recovery and Reconstruction Framework (3RF), a program jointly developed by the EU, UN, and WB. The 3RF aims to provide a comprehensive, short-term reform, recovery, and reconstruction program following the Beirut explosion. The project has received a grant of US$10 Million from the LFF.

The project, which started on 2022, focuses on urgent and critical environmental issues arising from the explosion and aims to minimize public health and environmental risks. The project's interventions are designed to rehabilitate the damaged solid-waste infrastructure, including the Karantina and Coral facilities, and provide technical assistance measures for their sustainable operation. The project also aims to develop a master plan for Beirut and Metn and to manage and dispose of demolition waste generated from the damaged buildings and asbestos-contaminated waste. Additionally, the project supports planning for longer-term environmental restoration efforts in Beirut City.

6.2.2 Lake Qaraoun Pollution Prevention Project:

In 2016, the Lebanese Government received a 50.5 million USD loan from the World Bank toward the cost of the Lake Qaraoun Pollution Prevention Project. The project is implemented through CDR and aims to rehabilitate four SWM facilities in Baalbeck, Zahle, Barr Elias, and Joub Jannine through urgent interventions to prevent their collapse and the development of SWM master plans for West Bekaa-Rashaya, Zahle, and Baalbeck-Hermel.

6.2.3 Reduction of Unintentional POPs through Waste Management in a Circular Economy

On 20 December 2022, MoE received a US$8.86 million grant from the World Bank, financed by the Global Environment Facility (GEF). This project aims to tackle the obstacles that prevent sustainable waste management in Lebanon and decrease the release of UPOPs through promoting circular economy and reduce open dumping. The plan involves policy implementation, capacity-building, and circular economy applications, specifically the 3Rs (reduce, reuse, and recycle) approach to waste management. Additionally, it focuses on rehabilitating open dumpsites using the best available techniques (BAT) and best environmental practices (BEP) advised by the Stockholm Convention.

6.2.4 Green Agri-food Transformation for Economic recovery in Lebanon (GATE)

The Lebanese Government has requested a loan of US$200 million from the International Bank for Reconstruction and Development (IBRD) for the GATE project to meet Lebanon's developmental needs in the agriculture sector and stimulate the economy. The GoL's request was approved by the IBRD on the 28th of June, 2023 and the project will be kicked off by the beginning of 2024 by CDR through a project coordination unit and will have national coverage with special focus on under-developed rural areas in Akkar, North, Baalbek-Hermel, Bekaa, and South and Nabatiyeh areas. The project aims to strengthen the resilience and competitiveness of the Lebanese agri-food sector, promoting the inclusion of small farmers and medium-size producers and enterprises with modern value-chains. It will directly benefit around 15,000 farming households, 315 small and medium enterprises (SMEs), and 2,000 microenterprises and farmers, as well as other ecosystem stakeholders, including aggregators, traders, exporters, and Lebanese consumers. The project has four components and will be implemented over a period of five years. The components include capacity building and financial support to farmers and agribusinesses, greening and improving access to services, enhancing the institutional enabling environment, and project management. Component 2 of the project "Climate-Smart Infrastructure and Services for Agri-food Development" aims to finance investment in public rural infrastructure development and public services to enhance compet-

itiveness and sustainability of the agri-food sector. The investment includes optimization of existing wastewater and solid waste management systems (which includes composting and biogas production from manure) to reduce pollution.

6.2.5 Technical Assistance

The World Bank also offers technical support that complements the aforementioned initiatives. One such project, titled "Reducing marine litter with a focus on the plastic pollution", is supported by a $650,000 grant from the PROBLUE Trust Fund. The objective of the project is to examine the origins and routes of marine litter and establish connections with the wider framework of solid waste management in Lebanon. The project will assist in creating a marine litter action plan that will serve as a guide for reducing and preventing marine litter, with potential impacts on climate change, poverty, and livelihoods. In addition, the "Climate proofing the SWM strategy and SWM local plans for Beirut and Mount Lebanon and for Zahle" project received a $150,000 grant from the CSF Trust Fund. WB is also supporting the MoE in developing a cost recovery models which will help in assessing operational funding requirements and cost-recovery options for waste collection, treatment, and disposal in local master plans for SW service zones.

6.3 INITIATIVES FUNDED BY OTHER INTERNATIONAL DONORS

6.3.1 Kuwait Fund for Arab Economic Development:

UNDP released in 2022 a tender to design a sanitary landfill at Naffakhiyeh quarry site in Tyre Caza (South Lebanon Governorate). The aim is to close the dumpsite of Ghazze in West Bekaa Caza (Bekaa Governorate) and construct the new landfill at Naffakhiyeh quarry site.

6.3.2 Kreditanstalt für Wiederaufbau (KfW) Bank:

Construction of a new landfill cell at Zahle's SW facility in addition to potentially financing a sanitary landfill cell in Hbaline by UNDP.

6.3.3 Italian Trust Fund:

The Italian Government provided funding through UNDP for two projects: the first to address the leachate management challenges of Zahle's Solid Waste while the second to close and rehabilitate Hazzerta's dumpsite.

6.3.4 Italian Agency for Development Cooperation

STEP4Nature Project aims at conducting a thorough assessment of the solid waste present in all protected areas and their immediate surroundings (buffer zones). The aim is to create a sustainable waste management system that includes strategies like the 3Rs (reduce, reuse, recycle), a waste collection plan (with sorting at the source, where relevant), material recovery, education and awareness, and final disposal.

6.3.5 German Ministry of Environment

Reducing Marine Litter in the Mediterranean through Waste Wise Cities Lebanon (ReMaL) project| was signed by the German Ministry of Environment and Wuppertal Institut für Klima, Umwelt, Energie gGmbH (WI). The UN-Habitat Lebanon Country Programme and Technische Universität Berlin, Habitat Unit (TU Berlin) are the implementing partners; Originally, ReMaL was planned to kick-off at the beginning of 2023 but due to the unforeseen agreement delays, it is temporarily postponed until May 2023. The UN-Habitat budget for the project overall is € 3,669,347. The project's first-year activities include designing and establishing a National Waste Observatory in consultation with the Ministry of Environment, training officials of 13 targeted universities on the Waste Wise Cities Tool, implementing the tool with the universities, analyzing collected data to establish a baseline on solid waste, developing Waste Flow Diagrams, identifying intervention areas and infrastructure gaps, developing project proposals, designing and implementing a national awareness-raising campaign on integrated solid waste management and marine litter prevention, reviewing ISWM financing mechanisms and regulations, and researching and examining policy and legislation options for Lebanon.

6.3.6 UNIDO

In 2019, UNIDO developed a Baseline Assessment of E-Wastes in Lebanon (funded by UNIDO). The purpose of the study was to calculate the quantities of E-waste

and to determine its fate. In order to be able to quantify E-waste, UNIDO implemented surveys with around 619 households and 31 businesses/institutions. Based on the results, the study developed recommendations to improve E-waste management based on the circular economy principles in order to ensure environmental and health protection, e-waste valorization, and job creation.

6.3.7 USAID

USAID is implementing the DAWERR project (Diverting Waste by Encouraging Reuse and Recycling). This is a five-year activity with the goal to establish sustainable and replicable integrated solid-waste diversion and valorization solutions in rural areas of Lebanon. DAWERR aims to develop composting value chains for organic waste and strengthen existing recycling value chains (RVC) for recyclable materials and solid-waste diversion pilots. Recently, the project selected the following municipalities as clusters for implementing sustainable joint integrated SWM solutions: (a) Ansarieh, Loubieh, Saksakiye, and Sarafand; (b) Ras El Metn, Deir El Harf, and Qortada; and (c) Anfeh, Bichmezzine, Fih, and Kfarhazir. At a later stage, DAWERR will integrate learning from its interventions in individual municipalities and build on success stories to implement integrated SWM solutions at cluster level (8 to 12 municipalities). Through its Community Support Program, USAID also established in 2022 a database of operators that collect recyclables; this database consists of 56 private initiatives (NGOs or private-sector entities).

6.3.8 Government of Lebanon (GoL)

UNDP is implementing the Qaraoun Depollution Programme (QaDePro) project (financed by the Government of Lebanon according to Law 63/2016) which provides support to the operation and maintenance of solid waste facilities through upgrades and installation of solar power systems. The main objective of this project is to put the Litani River on a sustainable path through the improved environmental governance in the sectors of solid waste, industrial waste and agriculture.

6.3.9 Government of Japan

Assessment of waste streams of plastics and tires and the use of small-scale magneto-pyrolysis technology in Lebanon.

6.3.10 Japan International Cooperation Agency (JICA)

Supporting small-scale SWM facilities at the level of villages and small cities

6.4 SUMMARY

The existing initiatives are summarized below according the "areas of support". Those are classified, as per the findings of the EU evaluation mission inn 2018, into: (1) support at central level, (2) support to MSW, (3) support to special waste streams, (4) support to recycling industries, (5) support for environmental protection, (6) support to science-policy-citizen interface.

Table 4: *Initiatives summary by areas of support*

Area of support	Donor	Implementing party	Donor	Year
MSW	EU	OMSAR	Upgrading the Solid Waste Management capacities in Lebanon (SWAM 2)	2018 - interrupted
MSW	EU	OMSAR	Technical support for development of solid waste management capacities in Lebanon (6 regional SWM plans)	2018 - interrupted
MSW	EU	ACF	PROMARE: Complementary support to SWM in al Zahrani area	2018 - Interrupted
MSW	EU	Iqlim AlToufah Union of Municipalities, AUB, Union of Jezzine Municipalities, MONEERA NGO, University of Cagliari	PROMARE: Developing integrated Municipal Solid Waste Management Program for the Protection of the Saniq River Basin in Southern Lebanon	2018 - on hold
MSW	EU	COOPI, StudioAzue & DRI	PROMARE: SWaM Akkar: Supporting Sustainable SWM in Jurd el-Kaytee, Akkar	2018 - present
MSW	EU	ACCD	Solid Waste Management in Oussat wa Sahel al Qaytaa	2021
MSW	World Bank	CDR	Lake Qaraoun Pollution Prevention Project	2016 - 2023
MSW	World Bank	ESFD	Green Agri-food Transformation for Economic recovery in Lebanon (GATE)	
MSW		UNDP (LHSP)	Support the Solid Waste Management Sector In Koura Cluster	
MSW/ Environmental Protection	Kuwait Fund	UNDP	Design a landfill in the south of Lebanon and capping of a landfill cell in the Bekaa	2022
MSW /	USAID	ECODIT-Berytech-Compost Baladi	DAWERR	2021-present (2025)
Science-policy-citizen	World Bank	MoE	Reduction of Unintentional POPs through Waste Management in a Circular Economy	2022 - present
Special Waste	EU	World Vision	PROMARE: Establishing an integrated slaughterhouse waste management system in the city of Choueifat	2018 - Interrupted
Special waste/ recycling/ Central	EU	UNDP	Towards a Decentralised Waste Management Integrated Response in Lebanon (TaDWIR)	2022 - present
Special waste	UNIDO	UNIDO	Baseline Assessment of E-Wastes in Lebanon	2019
Environmental protection	Italian Agency for Development Cooperation	UNDP	Sustainable solid waste management within Protected Areas under STEPping up Nature Reserves Capacity – STEP4Nature Project	2022
Environmental protection	EU	Lebanon Eco Movement and Lebanese Environment Forum	Lebanese Civil Society combating for a plastic free Mediterranean Sea # Bahr Bala Plastic	2018 -2020
Environmental protection	German Ministry of Environment – BMU	UN-HABITAT	Reducing Marine Litter in the Mediterranean through Waste Wise Cities Lebanon (ReMaL)	Planned to start in May 2023

Environmental protection	EU	UNDP	Qaraoun Depollution Programme (QaDePro)	2019 - present (2025)
Environmental protection/ Recycling	EU	UNDP	Beirut Critical Environment Recovery, Restoration and Waste Management Program (BERP)	2022 - present (2025)
Recycling	EU	UNIDO	Private Sector Transition to a Green and Circular Economy in Lebanon	2022 - present (2025)
Recycling	EU	LDK Consultants Global EEIG	Water and Environment Support (WES) in the ENI Southern Neighbourhood Region (providing policy support to address single-use plastic items in Lebanon)	2022 - present

7. SYSTEM DYNAMICS MODEL

This chapter describes the data collection, methodology, model structure, and calibration process for this model. Also, it discusses the implications of the model for solid waste management in Lebanon and provides recommendations for future works.

7.1 DATA COLLECTION

The data used for developing the system dynamics model of solid waste management in Lebanon was obtained from various sources. During phase I, primary data was collected through interviews and Focus Group Discussions (FGDs) with key stakeholders. Secondary data was obtained from published reports, studies, and statistical databases.

The interviews and FGDs were conducted in 25 districts to capture the variations in solid waste management practices across the country. The stakeholders were asked about their roles and responsibilities in the solid waste management system, the challenges they face, and their perceptions of the system's strengths and weaknesses. Since the data was collected in parallel to the model development, only secondary data sources were used to develop the model's preliminary structure and parameter values. The primary data will be used to validate the model in upcoming phases. Secondary data sources included reports and studies from the Ministry of Environment, the Central Administration of Statistics, and international organizations such as the World Bank and the United Nations (provided in the references section). These sources provided data on waste generation rates, waste composition, waste collection and transportation, recycling rates, and landfill capacity. These data were used to perform an initial calibration and validation of the model.
The data collection process faced several challenges, including the lack of reliable and consistent data, and the absence of a centralized database on solid waste management. These challenges were addressed by cross-checking and validating the data obtained from different sources and using assumptions and expert judgments where necessary. Model calibration also allowed to fill some data gaps; more on this can be found in the Calibration section.

7.2 METHODOLOGY

System dynamics modelling was used to develop a comprehensive and integrated model of municipal solid waste management scheme in Lebanon. System dynamics is a modelling approach that emphasizes the feedback loops, delays, and non-linear relationships that characterize complex systems and chronic problems. This approach is well-suited for analyzing the dynamics of the solid waste management system in Lebanon, which is characterized by a complex web of interrelated factors, including waste generation rates, waste collection and transportation, recycling and recovery rates, and treatment capacity.

Modeling is an iterative process. It kicked off with the development of a conceptual model, which identified the key variables and relationships that govern the behavior of the solid waste management system in Lebanon. This conceptual model was then translated into a mathematical model that simulates numerical data using differential equations, which was implemented using the system dynamics software Stella Architect.

In system dynamics models, stocks, flows, and auxiliary variables are key components used to describe the behavior of dynamic systems. Stocks represent accumulations or levels of material, energy, or information in a system. Flows describe the rate at which these stocks change over time. Auxiliary variables are intermediate variables that are used in the process of calculating other variables within a system such as constants or intermediate equations. They are used to simplify the calculations and equations involved in a model by breaking down complex relationships between different variables into simpler components. The figure below depicts the graphical representation of each type of variable.

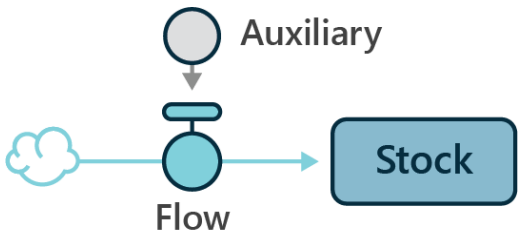


Figure 63: *Key modeling components used in system dynamics*

The model was developed in several stages, beginning with the identification and definition of the system's boundaries and components. The model's structure was then developed by specifying the stocks and flows of the system, the structure that governs its behavior, and the parameters that define its relationships. The model was then calibrated and validated using data from various sources.

After developing the model, it was important to perform an initial test of the robustness of the model and assess its accuracy. Preliminary model testing involves modifying different input values to see how changes in input affect the output. Specific parameters were chosen to test the sensitivity of the model. To test its accuracy, the values generated by the model are compared to actual data. More details can be found in the Calibration section.

7.3 DESCRIPTION OF THE MODEL

The system dynamics model of the solid waste management system in Lebanon consists of several interconnected components, including waste generation, collection and transportation, recycling and recovery, and landfilling. Each component is represented by stocks, flows, and feedback loops, which capture the dynamics of the system. The model represents the flow of municipal solid waste on a national scale and runs simulations from the year 2010 until 2040.

The model is divided into several sectors, each with a specific function:

- The main sector is the solid waste chain sector, which forms the core structure of the model with three defined waste chains: unsorted waste, immediately dumped waste, and waste sorted at source. This sector takes into account waste generation, collection, transportation, and treatment. It differentiates between three waste streams[33] (Figure 64): the unsorted waste (UW) generation that gets collected and treated through formal methods including sanitary material recovery, composting, energy recovery and landfilling. The second stream is solid waste that is immediately dumped (in the absence of other treatment methods). The model also captures waste that piles up and eventually gets dumped or burned. The third waste stream shows waste that is sorted at the source – including informal recycling and waste pickers.
- The GDP data sector provides information on the economic growth of the country and serves as an input for the model.
- The waste generation data and calculation sector take into account various factors such as population growth, and the effect of GDP on consumption patterns.
- The initial stock values sector provides the starting values for the model. It considers the existing waste management infrastructure, such as collection and treatment capacities, as well as the amount of waste already present in the system.
- There are also separate sectors for each waste chain, showing the structure of collection and treatment capacities and their associated costs. These sectors allow for a more detailed analysis of each waste chain, and for the model to take into account specific characteristics and challenges associated with each chain.

The components of the model are interconnected through feedback loops that capture the impact of one component on the others. For example, an increase in waste generation leads to an increase in waste collection and transportation, which in turn leads to an increase in landfilling and open dumping. The model also includes exogenous variables that represent external factors that affect the solid waste management system, such as population growth, economic activity, and policy interventions.

[33] The waste material flow streams are based on the Material Flow Analysis shown on page 365 of "Lebanon State of the Environment and Future Outlook: Turning the Crises into Opportunities" (SOER 2020).

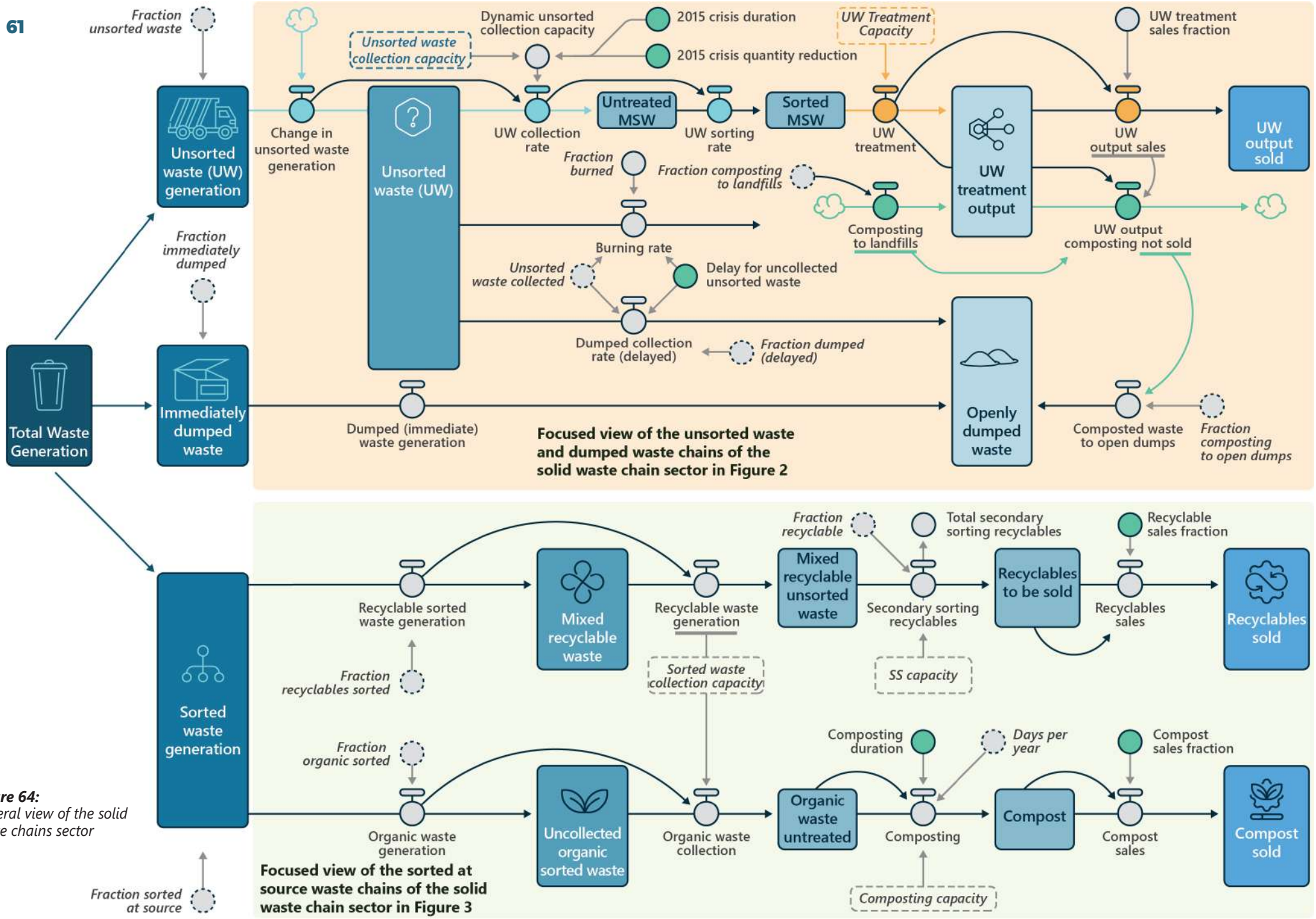


Figure 64:
General view of the solid waste chains sector

7.4 CALIBRATION

Calibration is a crucial aspect of modeling, and it serves a dual purpose by enabling us to estimate model constants within a predetermined range which is especially useful whenever there are gaps in the data. It also serves as a tool for validation by either confirming or refuting parts of the model structure; in the latter case, this happens when the structure is unable to replicate a historical trend.

The calibration process involves adjusting the parameters of the model to ensure that it accurately represents the dynamics of the solid waste management system in Lebanon. The calibration process was conducted using historical data from the period between the year 2000 and 2020.

Step 1 – The first step in the calibration process was to identify the key parameters of the model that needed to be calibrated and for which historical data is available. These parameters include GDP, population, UW collection rate, UW Landfilling.

Step 2 – The second step was to collect data on the historical trends of these parameters along with other exogenous parameters in the model to run the first simulation. The data was collected from various sources; the values and sources are shown in Table 5. The data was then analyzed to identify trends and patterns

Table 5: *Key parameters for model calibration*

Year	UW collection rate[34] (t/y)	UW treatment [Landfilling][35] (t/y)	GDP[36] (USD)	Population (People)
2010	1,702,293	N/A	45,147,473,284	4,995,800
2011	1,827,119	N/A	45,539,055,324	5,045,056
2012	1,959,338	N/A	46,707,037,070	5,178,337
2013	2,077,609	N/A	48,494,923,364	5,678,851
2014	2,162,879	1,762,875	49,699,566,408	6,274,342
2015	1,731,252	1,363,883	49,929,337,837	6,398,940
2016	1,829,000	1,356,764	50,705,514,064	6,258,619
2017	2,160,283	1,378,824	51,102,038,283	6,109,252
2018	2,474,908	1,642,066	50,232,192,261	5,950,839
2019	2,315,407	1,651,699	46,636,950,152	5,781,907
2020	1,459,935	1,078,296	36,656,689,492	5,662,923

Step 3 – The third step was to adjust the key parameters of the model to fit the historical data both manually and automatically using the model optimization tool in Stella Architect. This was done by performing a series of tests from Sterman (2000) and Barlas (1996) for model analysis. For each of the key parameters shown in Table 5, a set of optimization parameters were identified. The optimization parameters are those that affect the key parameters from Table 5 and to which the latter are particularly sensitive. All values for the parameters were initially calculated from secondary data sources and then adjusted during the calibration process.

[34] Source: SOER report (2020), "Waste Received" Figure 8-2, page 356
[35] Source: SOER report (2020), "Landfilled Waste" Figure 8-2, page 356.
[36] Source: World Bank

The optimization parameters were adjusted, and several iterations of the model were simulated to reach behavior trends that are as close as possible to the historical trends for the parameters shown in Table 5.

The results for the calibration are shown in the figures below:

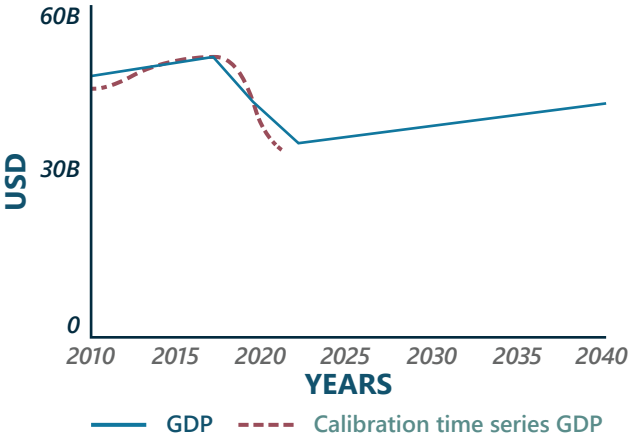


Figure 65: *Graph showing GDP historical data in red versus calibration results in blue*

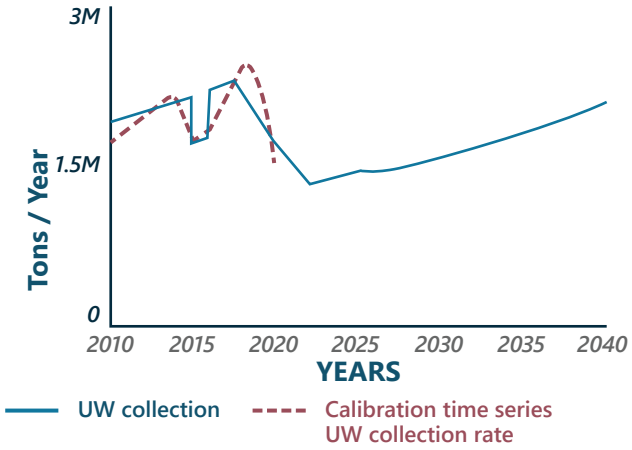


Figure 66: *Graph showing UW collection rate historical data in red versus calibration results in blue*

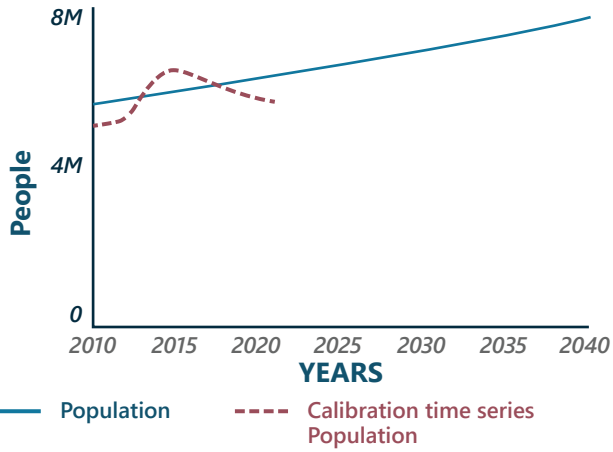


Figure 67: *Graph showing population historical data in red versus calibration results in blue*

Overall, the calibration process resulted in a preliminary model that represents the dynamics of the solid waste management system in Lebanon. More data is needed, and validation needs to be conducted to increase the robustness of the model. It can afterward be used to simulate different scenarios and test the impact of policy interventions on the system and facilitate policy dialogues.

7.5 NEXT STEPS

The model must undergo several tests to ensure that it produces reasonable behavior for the right reasons. In the upcoming phases of the project, formal testing must be prioritized using the collected primary data, followed by scenario testing. This will be done by engaging selected experts to improve model validity vis-à-vis the scenario elements. This is particularly important to validate the forecasted trends of key parameters. The results from interactions with key stakeholders would be compared to those generated by the model to confirm the adequacy of the model structure or further improve it.

Once the model is calibrated and validated, it can be used to simulate the behavior of the solid waste management system under different scenarios for defined KPIs and policy parameters. The results of these simulations would be used to analyze the system's behavior and identify the most effective strategies for improving solid waste management in Lebanon. This is done by performing a sensitivity analysis to investigate leverage points in the model to help design more robust policy interventions and scenarios.

The model then would be ready to simulate different scenarios and test the impact of policy interventions

on the solid waste management system in Lebanon. The model would also serve as a tool to facilitate policy dialogues which would be an opportunity to keep it updated with new data and ensure that it remains valid over time.

7.6 MODEL FILES

The model files are provided separately. The model file with a .stmx extension can be viewed and run using iSee Player. For information on iSee Player, please follow this link to download it: https://www.iseesystems.com/softwares/player/iseeplayer.aspx

The .stmx file needs to be placed and launched from the same folder that contains all the other files e.g. all .csv, .xlsx, and the .isdb files.

7.7 REFERENCES

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8. CONCLUSIONS AND RECOMMENDATIONS

This first strategic study (SS1) of the project "SIEA-2018-4313 Waste Governance: Technical Assistance to the EUD (EU Delegation) (Expected Result 2)" identified 16 generic SWM problems in Lebanon. Out of those, 10 were pinpointed as priority areas where EU is advised to provide support to the solid waste sector in Lebanon. It is recommended that EU intervention to the identified problems be applied in stages. Therefore the 10 priority areas were split into two categories, based on urgency, need for policy dialogues and/or potential success rate:

Short- and medium-term interventions

Out of the 10 priority themes, three are considered as **pre-requisites for ISWM** in Lebanon:

- ***National strategies and masterplans*** – which includes: (1) ratification of the national strategy; (2) developing an ISWM masterplan with a feasibility analysis, investment opportunities and a roadmap; (3) developing regional masterplans and guidelines for local implementation; and (4) developing a circular economy strategy.

  This theme requires fundamental basic actions including initiating a SWM observatory, identification of centralized vs. decentralized components, and finalizing legally binding service zones.
- ***Solid waste management agency/authority*** – which requires: (1) ratification of the SWM agency mandate and hiring its members; and (2) empowering the agency to act as the sector leader through cross-sectoral dialogues and other soft interventions
- ***Cost recovery*** theme is considered a **national urgency** and the cost recovery law has already reached an advanced stage. EUD is participating to consultancy meetings. Furthermore, it is recommended that the EU assists in the design and implementation of the communication and awareness program – to be initiated soon.

Furthermore, it is recommended to focus on the following four areas that are considered mandatory for the **sustainability** of the SWM system, and require efficient **policy dialogues and advocacy** and/or present the **lowest risk of failure:**

- ***Waste diversion*** – which requires EU support to: (1) incentivize the municipalities and service providers; (2) control pre-generation; (3) separately collect single-stream wastes; and (4) find options for residual waste.

  This theme has fundamental actions, including: de**velopment of landfilling bans, control of the informal sector, awareness campaigns, and return-value of waste initiatives, among others.**
- ***Pre-requisites for local implementation*** – which includes: (1) creating local clusters; (2) providing templates for procurement and services; (3) establishing a realistic permitting process; (4) providing simplified PPP models; and (5) allowing higher financial flexibility.
- ***Redefine landfilling*** – which covers: (1) defining landfilling locations; (2) developing a post-closure vision for landfills; and (3) implementing a communication plan. As pre-requisites, this theme requires acceptance of landfilling as a viable solution and setting realistic disposal fees.
- ***Support to the recycling industries*** – which requires (1) establishing a stable downstream market; and (2) securing a stable high-quality upstream sources of materials. As a fundamental, a reliable source of energy is required.

Long-term interventions

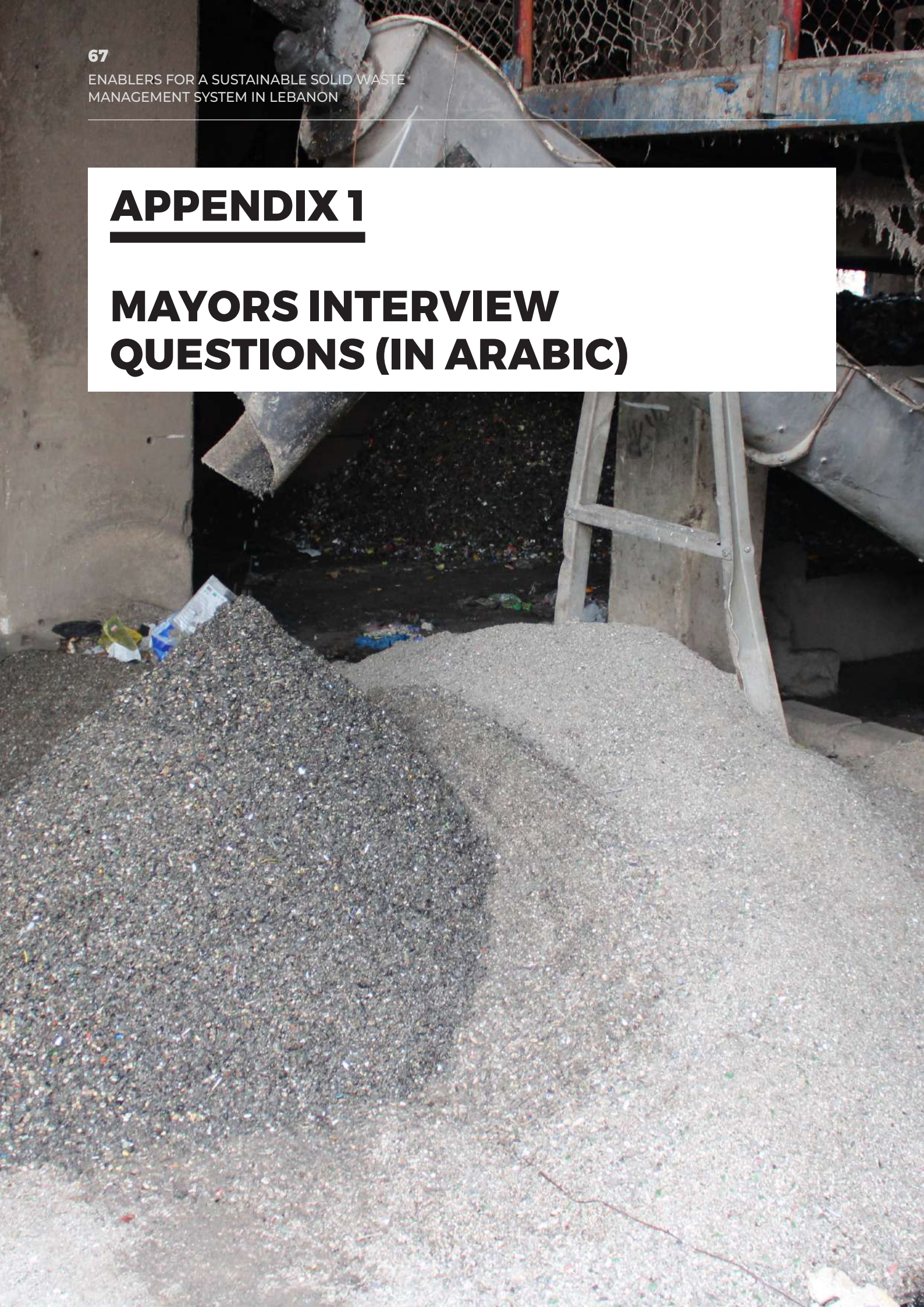
- ***Support for environmental protection*** – which includes building new engineered landfills and closing dumpsites. Transitional periods, based on accurate financial analysis, are needed.
- ***Optimizing existing infrastructure & completing interrupted initiatives*** – including making use of existing infrastructure, resuming interrupted project (under less-than-optimum conditions), and compiling local experience into technical notes. A cost-benefit analysis and clearly defined KPIs should be developed prior to embarking on execution plans
- ***Institutional capacity & law enforcement*** – which includes ratification of the SOPs, providing essential support to MoE, develop a coordination framework

between different players, and train the security forces as well as legislative body on environmental crimes.

Next stages of the project

Following the findings of SS1, the next step is to **select the themes to be thoroughly addressed in the next two strategic studies (SS2 and SS3).** The themes will require the development of policy briefs, followed by policy dialogue events, based on which a framework of EU support is developed (separately for each studied theme). Some of the themes require a field data collection campaign and a scenario analysis (via the system dynamics model developed in SS1).

The list above shall be used as guidance to select the themes to be addressed in the short-term (and studied in SS2 and SS3). The remaining themes will constitute a pool of options to be considered by EUD at a later (medium- or long-term) stage.



APPENDIX 1

MAYORS INTERVIEW QUESTIONS (IN ARABIC)

مقابلة مع السلطات المحلّيّة

معلومات عامّة	
الاسم: البلدة: الصفة:	رقم الهاتف: البريد الإلكتروني:

الأستبيان

على الصعيد التقني

توليد (انتاج) النفايات

عدد المواطنين:
عدد النازحين:

١. ما أنواع النفايات الموجودة في بلدتك/ قريتك؟

- صناعي
- رعاية صحية/استشفاء
- مواد خطرة
- مسلخ أو محل جزارة (لحّام)
- تشحيل الشجر
- مواد أخرى .....

٢. هل لاحظتم أي تغيير في كمية النفايات مقارنةً بسنة ٢٠١٨؟ ـ نعم ـ كلا
كيف؟ ـ زيادة ـ نقصان **بكم (تقريباً)؟** .....
ما هو السبب؟ ـ الضائقة الاقتصادية اسباب أخرى .....

٣. هل حاولت البلدية تقليل كمية النفايات؟ ـ نعم ـ كلا

كيف ؟

- الحد من استعمال مواد التغليف في محلات السوبرماركت والمتاجر (أكياس بلاستيكية، كرتون، إلخ)
- التبرع بالألبسة والأقمشة
- التبرع بالطعام
- التسميد المنزلي أو طمر بقايا الطعام في الأرض
- سبل أخرى .....

هل نجحت البلديّة في ذلك؟ ـ نعم ـ كلا

يرجى شرح أسباب أو ظروف نجاح البلديّة أو عدمه

جمع النفايات

٤. من يقوم بجمع النفايات الصلبة؟
- البلدية نفسها
- اتحاد البلديات
- البلدية من خلال متعهد
- الحكومة المركزية من خلال متعهد

٥. هل يوجد بتصرف البلدية أي من التالي؟
- عمال للقيام بجمع النفايات
- حاويات
- شاحنات عادية
- شاحنات الضاغطة

٦. كم مرة في الأسبوع كان يتم جمع النفايات قبل الضائقة الاقتصادية ؟ (1، 2، 3، 5 أو أكثر)

كم مرة في الأسبوع يتم جمع النفايات بعد الضائقة الاقتصادية ؟ (1، 2، 3، 5 أو أكثر)

٧. هل هناك تراكم للنفايات في الشوارع بصورة دائمة ؟ - نعم - كلا

٨. ما هي التحديات الرئيسية لجمع النفايات الصلبة المحلية؟
- تحديات مالية: - ميزانية للمركبات والحاويات - نفقات تشغيلية - تحديات أخرى
- تحديات تقنية: - مركبات آو حاويات غير مناسبة - تحديات أخرى
- تحديات اجتماعية: -رمي النفايات بطريقة عشوئية - رفض المستوعبات القريبة
  - عدم ربط الاكياس - تحديات أخرى

٩. برأيكم، من هو الأنسب لجمع النفايات في بلدتكم ؟
- البلدية نفسها (او الاتحاد)
- البلدية من خلال متعهد
- الحكومة المركزية من خلال متعهد

معالجة النفايات (فرز)

١١ . هل تملك البلدية (او الاتحاد) معمل لفرز النفايات؟ - نعم - كلا

اذا كان الجواب كلا، هل تملك:
- عقار للتخزين او لبناء معمل فرز
- بعض معدات المعالجة (أحزمة الفرز، الضواغط، آلة التسميد، إلخ.)

١٢. كيف يتم التصرّف بالنفايات التي تم جمعها؟
- تنقل فوراً الى مطمر او مكب (من دون فرز)
- ترسل إلى معمل فرز تابع للبلدية (او الاتحاد)
- ترسل إلى معمل فرز خارج الاتحاد

١٣. في حال وجود معمل فرز تابع لبلديّتكم (او اتحادكم)، ما هي التحديّات التي تواجهونها؟

- تحديّات مالية
- تحديّات تقنية (مثلاً معدات غير مناسبة، سماد ذات نوعية رديئة)
- تحديّات اجتماعية (مثلاً معارضة السكان)
- تأمين الكهرباء
- تحديّات أخرى .....

هل المعمل بحاجة إلى تحسين أوتحديث؟ ـ نعم ـ كلا

١٤. من هي برأيكم الجهة الأنسب لمعالجة النفايات الصلبة في بلدتكم/قريتكم؟

- البلدية نفسها (او الاتحاد)
- البلدية من خلال متعهد
- الحكومة المركزية من خلال متعهد

طمر النفايات

١٥. أين يتم طمر النفايات؟

- مطمر صحي للنفايات
- مكب (غير صحي) داخل نطاق البلدية
- مكب (غير صحي) في نطاق بلدية اخرى

١٦. في حال وجود مطمر داخل نطاق البلدية:

ما هي المدة الاستيعابية للمطمر (او المكب) ؟

- سنة ٣ سنوات ٥ سنوات ٧ سنوات ١٠ سنوات او اكثر
- لا اعرف

ما هي الآثار السلبية التي تعانيها بلدتكم ؟

- لا توجد آثار سلبية على بلدتنا
- تؤثر على جمال المنطقة
- تدهور قيمة الأراضي
- روائح مزعجة
- روائح الحريق
- مشاكل صحية
- تؤثر على جودة المياه
- تؤثر شاحنات النفايات على حركة المرور
- آثار أخرى .....

١٧. هل يتقبل المواطنين فكرة بناء مطمر صحي في مدينتهم (يستقبل نفايات بلديات اخرى)؟

ـ نعم ـ كلا

في حال كانت الإجابة "لا"، فلماذا؟

- عدم الثقة بالسلطات
- المعارضة السياسية
- تدهور قيمة الأراضي
- الروائح
- مشاكل صحية
- جودة المياه
- عدم الوعي
- خوف من عدم استمرارية المشروع
- الحرائق المفتعلة
- أسباب أخرى .....

استرداد وتدوير النفايات

١٨. هل يُسترد (او يُدور) أي جزء من النفايات؟ - نعم - كلا

في حال كانت الإجابة "نعم"، فكيف؟

- فرز منزلي من المصدر
- فرز داخل معمل الفرز
- القطاع الغير الرسمي من خلال نبش المستوعبات
- القطاع الغير الرسمي من خلال نبش المطمر (من دون اتفاق معين مع البلدية)
- القطاع الغير الرسمي مع اتفاق مع البلدية (مثلا مردود للبلدية، دعم من البلدية، الخ)
- جمع مستقل لبعض المواد من المؤسسات (كرتون، ورق، بلاستيك، معادن، الخ)

١٩. هل تستفيد البلدية من بيع المواد مسترجعة؟ - نعم - كلا
ما هو المدخول الشهري ؟

على الصعيد المؤسساتي

خطة العمل

٢٠. هل لدى البلدية (أو اتحاد البلديات) خطة عمل لإدارة النفايات؟ - نعم - كلا

في حال كانت الإجابة "نعم"، هل باستطاعتكم تنفيذ الخطة؟ - نعم - كلا

في حال كانت الإجابة "لا"، فما هي الاسباب؟

- أسباب مالية (CAPEX، OPEX)
- أسباب تقنية (نقص في الخبراء، نواقص أخرى...)

- أسباب اجتماعية (معارضة شعبيّة، معارضة سياسية، أسباب أخرى ...)

الإدارة / الموارد البشرية

٢١. ما هو عدد الموظفين المسؤولين عن تخطيط وإدارة النفايات؟ (0، 1، 2 أو أكثر)

مراقبة

٢٢. هل تتم مراقبة أنشطة وكميات النفايات ؟ - نعم - كلا

كيف؟

- توثيق كميات النفايات
- توثيق المصاريف
- مراقبة عمليات الجمع
- مراقبة حسن الفرز والطمر
- طرق أخرى .....

التدريب وبناء القدرات

٢٣. هل كانت هناك مبادرات سابقة لتدريب موظفي وعمال البلدية؟ - نعم - كلا

في حال كانت الإجابة "نعم"، فهل كانت مفيدة؟ - نعم - كلا

٢٤. هل كانت هناك حملات توعية سابقة للمواطنين؟ - نعم - كلا

في حال كانت الإجابة "نعم"، هل نجحت؟ - نعم - كلا

على صعيد الأمور المالية

الدخل

٢٥. ما هي مصادر دخلكم؟

- الصندوق البلدي المستقل و الجباية
- تبرعات من السكان والمجتمع
- تبرعات دولية
- وزارة التنمية الإدارية (تدفع لمشغل المعمل)
- جهات سياسية
- مصادر أخرى .....

٢٦. هل أنتم قادرون على دفع تكاليف إدارة النفايات ؟ - نعم - كلا

التكاليف

٢٧. ما هي التكلفة الشهرية للنشاطات التالية؟

- الجمع
- المعالجة
- الطمر

الدعم الدولي

٢٨. هل تلقيتم دعماً من الجهات المانحة ؟ ـ نعم ـ كلا

ما نوع الدعم ؟

- معدات، حاويات او شاحنات
- تدريب وبناء القدرات
- حملات توعية
- معمل فرز
- مساعدات أخرى .....

هل كان ذلك كافياً ؟ ـ نعم ـ كلا

على صعيد الحوكمة والشؤون القانونية

٢٩. ما هي الثغرات في القوانين والأنظمة لإدارة النفايات الصلبة على المستوى المحلي؟

- قانون استرداد الكلفة
- مراسيم تطبيقية
- تعديل قوانين نسب الصرف
- ثغرات أخرى .....

٣٠. كيف يستطيع المواطنون الوصول إلى المعلومات والبيانات حول إدارة النفايات؟ (على سبيل المثال: ماذا يحدث لنفاياتهم، كميّة النفايات الناتجة، وما إلى ذلك)

- تقديم طلب الى البلدية
- منصة على الإنترنت
- وسائل التواصل الاجتماعي
- رسائل نصية قصيرة(SMS)
- الاجتماعات العامة
- المواد المطبوعة (مثل النشرات)

٣١. هل تنفذ البلدية مخططات تشاركية لإدراج المواطنين في مشاريع النفايات؟ ـ نعم ـ كلا

في حال كانت الإجابة "نعم"، فما هو مستوى الادماج:

- إبلاغ (هذا ما نقوم به)
- استشارة (تقديم الخيارات وطلب التعليقات)
- إدماج (عرض المشكلة وطلب الحلول)
- التعاون (العمل معًا لحل المشكلة)
- التمكين (دعم المجتمع المدني والمواطنين الذين لديهم حلول يريدون تنفيذها)

٣٢. هل هناك أي منظمات مجتمع مدني او منظمات غير حكومية تدعم إدارة النفايات الصلبة؟
- نعم - كلا

في حال كانت الإجابة "نعم"، من هم وماذا يفعلون؟

في حال كانت الإجابة "لا"، فهل البلدية مستعدة للتعاون معهم؟

على الصعيد البيئي

٣٣. هل توجد أي ممارسات غير صديقة للبيئة في إدارة النفايات الصلبة؟
- المكبات العشوائيّة
- حرق النفايات السكنية
- حرق النفايات الخضراء (او الزراعية)
- رمي الإطارات بطريقة عشوائية
- حرق الاطارات
- رمي مخلفات الهدم و البناء بطريقة عشوائية
- رمي النفايات في المجاري المائية
- ممارسات أخرى .....

على الصعيد الاجتماعي

الانخراط والمشاركة

٣٤. هل توجد مشاريع سابقة تم فيها إشراك المجتمع (ليس بالضرورة في إدارة النفايات الصلبة)؟
- نعم - كلا

ما كان مستوى المشاركة؟ 0% 10% 20% 30% 50% 70% 90%

ما هي الأسباب التي دفعت الأشخاص الى عدم المشاركة؟
- أسباب مالية (اقتصادية)
- تجربة سيئة مع المنظمات غير الحكومية
- عدم الثقة في السلطة المحلية
- معارضة السياسية
- لا مبالات او موضوع خارج اهتمامهم
- أسباب أخرى .....

الاستعداد لدفع ثمن خدمة النفايات

٣٥. ما هي نسبة الأشخاص التي على استعداد للدفع مقابل خدمة إدارة النفايات ؟ .....٪

ما هي قيمة البدل المادي الذي هم مستعدين لدفعه؟ 50,000 100,000 150,000

هل مررتم بتجربة سابقة في هذا الموضوع؟ - نعم - كلا

هل كانت ناجحة؟ - نعم - كلا

٣٦. هل باعتقادكم أن اعتماد نظام المكافأة أو العقوبة يدفع المواطنين للالتزام ببرامج إدارة النفايات الصلبة (مثل فرز المصادر أو غيرها)؟ - نعم - كلا
أيهما برأيكم هو الأكثر فعالية؟

- نظام المكافأة
- نظام العقوبة

الوعي المجتمعي

٣٧. ما هو تقييمكم للوعي المجتمعي لمواطني بلدتكم/قريتكم على مقياس من ٠ الى ٣؟ .....

هل قمتم بأي نشاط للتوعية في بلدتكم/قريتكم حول إدارة النفايات الصلبة؟ - نعم - كلا

هل باعتقادكم أن الوعي يلعب دورًا رئيسيًا في كفاءة نظام إدارة النفايات الصلبة؟ - نعم - كلا

على الصعيد السياسي

٣٨. هل تؤثر الأحزاب السياسية على إجراءات إدارة النفايات الصلبة في بلديتكم؟

- نعم
- لا
- أفضل عدم الإجابة

في حال كانت الإجابة "نعم", كيف؟ - سلبا - إيجابا

٣٩. ما هي الجوانب الأخرى التي تؤثر على إدارة النفايات؟
- العائلات - الطوائف - عشائر - أخرى .....

على باقي الصعد

٤٠. هل تواجه البلديات الأخرى في القضاء تحديات مماثلة؟ - نعم - كلا
ما هي نسبة البلديّات في منطقتكم التي تواجه تحديات مماثلة؟

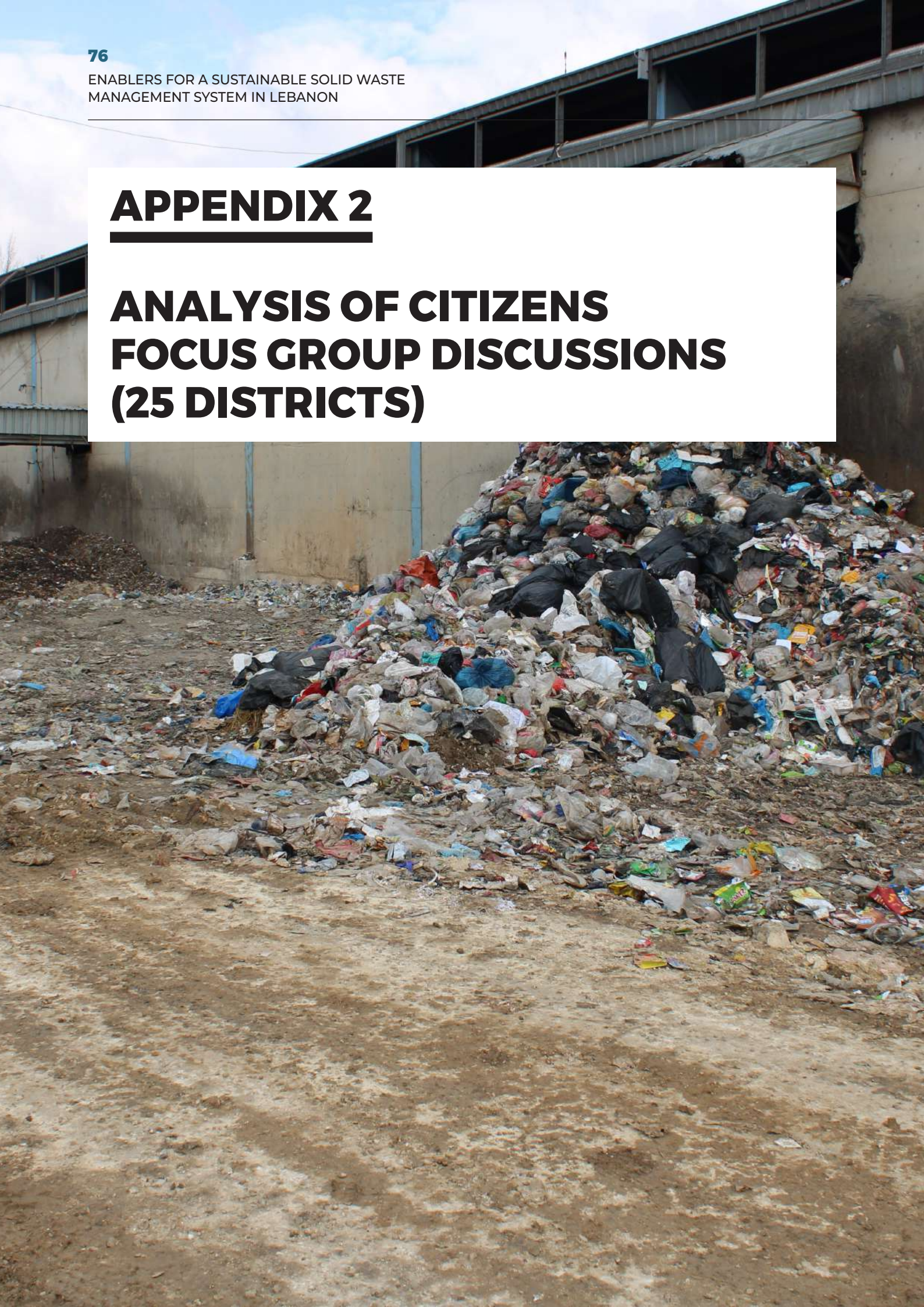
- البعض القليل
- حوالي النصف
- معظم البلديّات

٤١. لماذا برأيكم توجد مشكلة في إدارة النفايات الصلبة في لبنان؟

ما هو الحل برأيكم؟

APPENDIX 2

ANALYSIS OF CITIZENS FOCUS GROUP DISCUSSIONS (25 DISTRICTS)



A. ROUND 1 QUESTIONS – SWM CHALLENGES

A.1. What are the daily waste-related problems you are facing? List your first 3 priorities.	
A.1.1 Collection	• Waste accumulation [24] • Lack of adequate distribution/use/type of bins (weatherproofing) [24] • Lack of regular collection (timing/frequency) [21] • Mixing sorted waste together when collecting them • Stray animals that scatter waste • Dumping without bags – lack of bags - torn bags
A.1.2 Treatment	• Absence of sorting at source/lack of commitment to sorting [18] • Lack of bags for sorting at home • Lack of hygienic behavior • Garbage thrown on the snow • Mixing sorted & sorted waste
A.1.3 Administrative	• Lack of a qualified technical team • Waste & hardware scavengers [4] • Inadequate equipment & logistics • Some towns do not have municipalities to collect the waste • Lack of awareness campaigns [3] • Lack of funding for garbage bags for sorting [5] • Lack of planning • Bin theft [3] • Random dump sites • Dumpster fires • Rodents & stray animals • Vicinity to residential areas • Smells from the treatment plants • Disputes arising from waste accumulation or disposal • Garbage workers on strike
A.1.4 Disposal	• Open burning of waste [7] • Open dumping [5] • Environmental and health impacts • Waterway dumping • Visual pollution & olfactory pollution [7] • Littering (teenagers & poor neighborhoods) • New Waste (masks, gloves…) • Agricultural waste dumping [3] • Construction waste dumping • Littering • Pests & strays • Diaper Disposal • Waste decomposition under the snow
A.2. What are your observations and comments on previous initiatives on waste? Provide the 3 most relevant/ important ones	
A.2.1 Causes of failure (social)	• Lack of Awareness/public commitment/Sorting [14] • Lack of incentives for citizens • Lack of trust • Theft of containers [2] • Refugees and their refusal to cooperate with initiatives. [2] • Conflicting personal interests • Citizens preoccupied by the pandemic and the economic crisis • Lack of coordination

A.2.2	**Causes of failure (administrative)**	• Lack of planning/commitment/ follow up/interruption or end of project [23] • Lack of accountability [2] • Lack of communication [3] • Municipalities got what they wanted (e.g. new bins), and don't care about the rest of the initiative • Lack of follow-up with non-citizens/refugees • Hiring incompetent staff to follow up • Lack of government support • Lack of market for recyclables • Lack of transport means (for recyclables) • Absence of laws for compulsory sorting at source • Inadequate contracts between municipality and collection company • No citizen committees for follow-up • Too much focus on awareness at the expense of other steps. • Corruption of the administration in charge
A.2.3	**Causes of failure (financial & technical)**	• Lack of funds/resources [13] • Lack of human resources [2] • Applying models that do not take into account local specificities • Absence of needed equipment (e.g. recyclables compactor/containers) [9] • Insufficient market for recyclables • Not utilizing the landfill scientifically to its full potential (electricity – composting…) • Lack of electricity [2] • Lack/cost for transportation [11] • Objection to the use of incinerators • Collection method of Sorting initiative was inadequate • Lack of treatment facilities
A.3.	**Would you accept that a waste treatment facility or landfill (for the district) be built in your city? Explain why yes or why no.**	• **No:** – Lack of Trust [5] – No suitable location within the town area [7] – Absolutely Not[7] – Not for the district [3] – The town is a touristic and historical destination [2] – We can reach zero waste – No to landfill, yes to treatment plant – No added benefit to the city – Fear of smells and negative impact – Pre-existence of polluting industrial facilities – Lack of Green Spaces • **Yes, if:** – With proper specifications/follow-up [2] – Away from homes/residential areas [2] – Part of an integrated plan – With incentives to the city • **Yes (unconditional) [4]**
A.4.	**Are you willing to change your behavior to follow a waste management program initiated by the municipality?**	• **No:** – Lack of Trust [5] – What's in it for me? – Pessimistic Outlook/Projected Failure -- Requires too much effort – Due to economic circumstances and lack of proper financial incentives – Lack of resources at the municipal level – Realistically it's harder to implement these changes – If the outcome is visibly heading towards failure – Apply penalties for those who do not commit to sorting – Incentives are required – I was not consulted regarding the improvement steps

		• **Yes, if:** – It is applied equally to Syrian refugees [4] – It is managed by the municipality – Serious initiative with continuity/municipality commits to the plan [2] – Penalizing those who do not commit [3] – With awareness campaigns [4] – Proper material is provided to assist in sorting – Bag are provided for sorting – Trust needs to be rebuilt and concrete results shown – Results are evident and oversight is available – Equipment is provided – Incentives are provided • **Yes [24]**
A.5.	**Are you willing to pay to improve the waste management system in your municipality? What would be the monthly service fee you are willing to pay?**	• **Yes [22]** • **Yes but/if:** – If fees are relative to income/if within capacity [18] – If firmly and equitably implemented on citizens and refugees [8] – If there is authority is more transparent [6] – If co-funded with municipality – If enough planning/follow-up is done [4] – If accompanied by awareness campaigns – If reliable and regular service can be ensured/concrete results [7] – Only for initial funding so that the facility can self-sustain itself later.[3] – Only if decentralization of waste management is implemented by the state. – Yes if assistance is provided – Yes to the private sector [2] – Yes with support to sorting at source • **No:** – Waste treatment generates money[8] – No Trust [5] – We already pay fees to the municipality [4] – Because this is a public service that should be provided to us – No financial capacity [4] – Apply penalties for those who do not commit to sorting – Give incentives to people instead – No need, the municipality is doing a good job [2] – Politicization

B. ROUND 2 QUESTIONS - SWM SOLUTIONS

B.1.	**Do you think that the municipality is able to take care of all waste management activities with the current resources?** **If yes, justify it. If the answer is no, what do you suggest as solutions?**	• **Not Able [24] - solution:** – Service fee to be paid by the citizen – reduce other unnecessary expenses; invest in waste management – Establish a unit of experts – develop an action plan in collaboration with the community (participatory approach) – be more "serious" about waste management – Working with NGOs, donors or expats [19] – Impose Fees, incentives & penalties [12] – Awareness campaigns [3] – Assistance from community, private sector, activists and volunteers [7] – Solve Refugee situation [2] – Imposing/encouraging sorting at source[3] – Support from the state/central government [4] – Privatization [4] – Collaboration between adjacent districts/towns or foreign municipalities[3] – Providing equipment [3] Use religious institutions to promote sorting at source – Austerity measures for expenditures by the municipality

- Transparency
- Aids & grants from political parties,
- Providing treatment facilities and landfills alongside composting
- As part of a global waste management plan
- Start by Public Private collaboration for Awareness
- Small incinerators to work in various areas.
- No solution due to corruption
- Better Monitoring.
- Finding alternative power/energy sources.
- Resale of sorted waste
- A waste management law that gives the municipality more prerogatives

- **Able - because:**
  - It's the only entity allowed to collect money (from government and donors) for the management of waste
  - Obtain resources (tax, international donors , diaspora...) [7]
  - Resale of sorted waste/use of existing facility [5]
  - Compulsory Sorting at Source Directive [6]
  - Create Zoning for easier sorting at source
  - Through awareness campaigns
  - Because it can introduce privatization

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