



**YEMEN**

# Emergency Waste Assessment

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August 2015



**United Nations Development Programme, Yemen**

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## ACRONYMS

BAU	Business as usual	MoPWH	Ministry of Public Works and Housing
C&D	Construction and Demolition	MoLA	Ministry of Local Affairs
CBO	Community Based Organization	MRE	Mine Risk Education
CCCM	Camp Coordination and Camp Management	MSW	Municipal Solid Waste
CCIF	City Cleaning and Improvement Fund	MSWM	Municipal Solid Waste Management
DWR	Disaster Waste Recovery	NFI	Non-Food Item
ELV	End-of-Life Vehicles	NGO	Non Governmental Organization
EPA	Environmental Protection Agency	OCHA	Office for the Coordination of Humanitarian Affairs
ERW	Explosive Remnant of War	ODA	Official Development Assistance
FSD	Fund for Social Development	O&M	Operation and Maintenance
GHG	Greenhouse Gas	PPP	Public-Private Partnerships
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit	SWM	Solid Waste Management
HCW	Healthcare Waste	TFPM	Task Force on Population Movement
H&S	Health and Safety	UNEP	United Nations Environmental Programme
ICRC	International Committee of the Red Cross	UNICEF	United Nations Children Fund
LFG	Landfill Gas	USD	United States Dollar
MC	Mercy Corps	UXO	Unexploded Ordnance
MEA	Multilateral Environmental Agreement	WASH	Water Sanitation and Hygiene
MIRA	Rapid Multi Cluster Assessment	WB	World Bank
MoF	Ministry of Finance	WEEE	Waste Electronics and Electric Equipment
YSMO	Yemen Standardization, Metrology and Quality Control Organization	YEMAC	Yemen Executive Mine Action Centre
MoPHP	Ministry of Public Health and Population	YSMO	Yemen Standardization, Metrology and Quality Control Organization



## EXECUTIVE SUMMARY

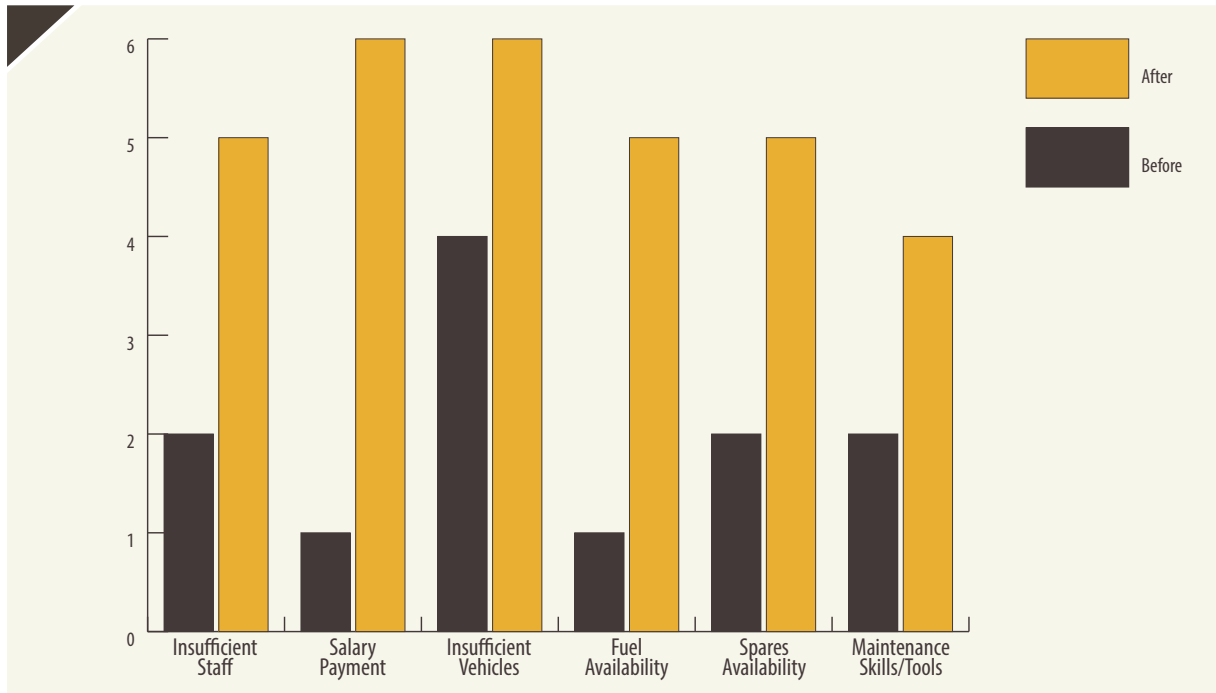
The on-going conflict in Yemen is dramatically affecting Yemenis, with over 20 million people in need of humanitarian assistance and 1.4 million displaced; women and children are disproportionately affected by the armed conflict and increasingly vulnerable to the consequences of the humanitarian crisis.

Due to the economic structure of the country, the impossibility to import basic goods such as food and fuel resulted in the widespread disruption of markets, and the provision of basic public services, such as electricity, water supply, and waste management. Accumulated waste provides the ideal breeding ground for vectors such as rats and mosquitoes, contributing to the deterioration of public health and the spread of vector disease such as dengue.

During the month of July 2015, Disaster Waste Recovery and UNDP Yemen conducted an emergency waste assessment in six governorates to investigate the impact of the current crisis on the waste management cycle and identify possible entry points for immediate intervention. The governorates of Aden, Amran, Hadramaut, Hajjah, Sa'ada, and Sana'a were targeted during the assessment, which was severely limited by access and security constraints. The survey targeted four different stages of the waste management cycle, from generation to disposal, through four different questionnaires: 1) the Neighbourhood Assessment Tool, for assessing waste collection status in the cities; 2) the Infrastructure Assessment Tool, to evaluate disposal sites; the 3) Local Authorities Assessment Tool, to appraise the capacity of Cleanliness Funds to deliver waste management services; and 4) the Private Sector Survey, to evaluate state of the recycling sector in light of the crisis.

The findings highlight the reduction in capacity by local authorities to provide waste collection services due to lack of resources to pay for staff salaries, vehicle repair and fuel for transport; furthermore, the state of collection coverage was already insufficient before the crisis, with a general lack of resources for investments and effective operation and maintenance of the vehicle fleet. Furthermore, some vehicles were reported stolen or damaged by the warring parties during the conflict.

This led to a reduction waste collection frequency in the assessed cities, as well as the use of improvised alternative disposal sites in light of the reduced fuel availability. Many traditional disposal sites are not currently operational, with those still working being operated as open dumps. Open fires, presence of scavengers on site, damaged infrastructure and vehicles are common features of the assessed disposal sites, some of which have also been directly targeted during the fighting.



## Operational Challenges

In spite of the many challenges it faces, namely the impossibility to access international markets and the general lack of fuel and electricity, the recycling sector is still active, albeit to a much reduced scale.

Informal recycling activities are carried out at street and disposal site level by waste pickers, who usually belong to the Al Muhamasheen community; informal recycling is carried out mostly by men, but women headed households and children are also reported. PET bottles, hard plastics, aluminium and other metals are commonly recovered, in some cases alongside green (garden) waste and paper products. The informal sector is still active, but its extent has been dramatically reduced, especially at disposal sites.

The formal recycling sector is, at the moment, mostly inactive. This is due to the impact of the conflict on both internal market and exports; lack of electricity and fuel; and the incurred damages to machinery and infrastructure. Notwithstanding that, there are still some companies operating at a reduced level that still buy recovered materials from the informal sector.

Finally, during the assessment it was possible to visit the healthcare waste treatment facility in Sana'a: the plant was due to come online when the conflict started, and is currently not working due to lack of electricity. Healthcare waste in the capital and likely in the rest of the country is currently disposed of mixed with municipal waste, thus creating a serious health hazard and exposing all those handling waste to great risk.

Location		Landfill waste pickers						
Site name	City	Before	Still active	Men	Women	Boys	Girls	Total
Al-Azraqain	Sana'a	Yes	Yes	4	0	0	0	4
Transit station	Sana'a	Yes	Yes	12	0	3	0	15
Kudam	Hajjah	Yes	No	0	0	0	0	0
Ber Al-Na'ama	Aden	Yes	Yes	n/a	n/a	n/a	n/a	4
Al Ghalila	Al Mukalla	No	Yes	20	15	15	5	55

Source: Local Authority and Infrastructure Assessment questionnaires

Based on the identified needs and the support provided to local authorities by other humanitarian actors such as UNICEF, ICRC, Mercy Corps and GIZ, the study identifies several entry points for interventions.

First, extraordinary waste collection operations and continued support to day-to-day operations of local authorities through fuel provision, cash-for-work and the payment of salaries to local waste collection staff will allow for a rapid solution to waste accumulating in the streets.

Second, to re-establish the capacity to provide waste collection by local authorities, the repair and rehabilitation of broken down vehicles through the provision of spare parts and tools.

Third, the improvement of disposal sites by extinguishing landfill fires, repairing the perimeter fencing, and the rehabilitation of broken down heavy machinery.

Fourth, the establishment of a safe handling and treatment cycle for healthcare waste by the provision of a power generator and fuel to Sana'a treatment plant, along with container provision and training of medical staff on segregation practices.

Finally, the reactivation of the recycling sector by providing power generators, grants for the substitution of damaged machinery and buildings, and the support of informal recycling sector through their organization in associations and cooperatives.

These actions are just an immediate response to the most pressing needs and have an envisaged timespan of six months; additional responses with a longer temporal horizon are still needed in support of the solid waste management cycle in Yemen. Views expressed in this report do not necessarily reflect those of the UN or the United Nations Development Programme.

## 1. CONTEXT ANALYSIS

### 1.1. Introduction

Considering the current crisis situation in Yemen, UNDP Yemen is assessing entry points for interventions to support the conflict-affected communities, including solid waste management support. Taking into consideration Municipal Solid Waste Management and Debris Management being signature products for UNDP globally, UNDP Yemen has requested the support of Disaster Waste Recovery (DWR) in assessing the current solid waste and debris situation in Yemen.

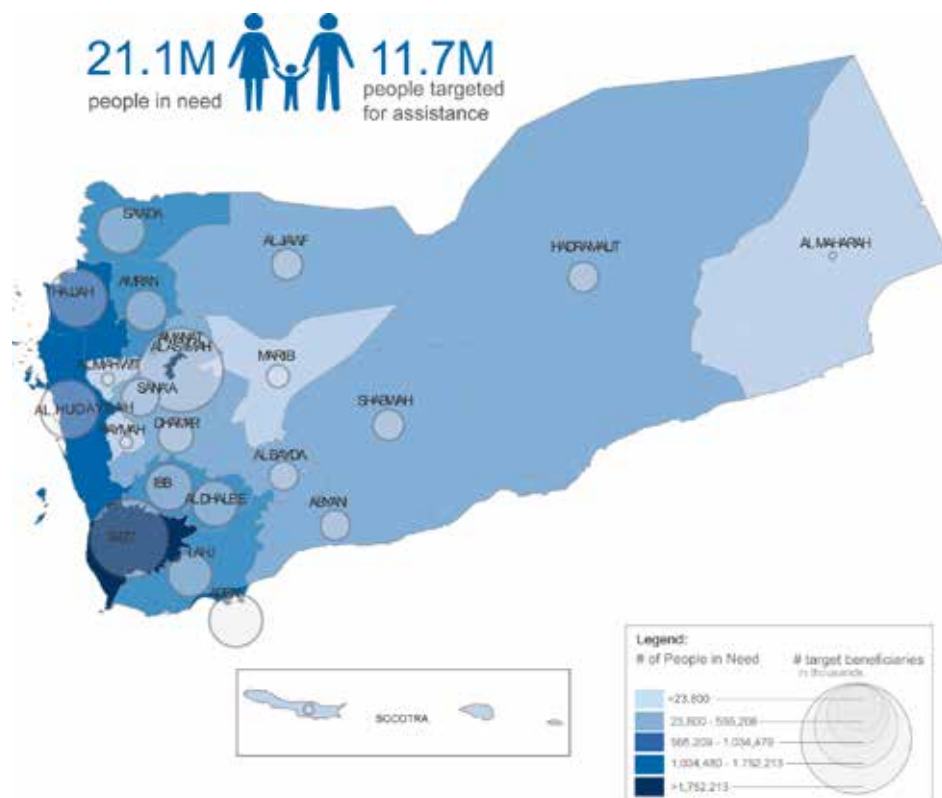
This Interim Report presents findings from the first work phase of the assessment concerning stakeholders and establishment of data/information gathering activities.

### 1.2. Background

Yemen was reunited in May 1990 after over 20 years of being divided in two separate entities, the Yemen Arab Republic (also referred to as North Yemen) and the People's Democratic Republic of Yemen (or South Yemen). The reunification process brought Northern Yemen President, Ali Abdullah Saleh, to become the head of state of the new country, Yemen Republic. Since its birth in 1990, Yemen has experienced a short lived civil war in 1994 after the independence declaration of the South; the establishment of the most powerful branch of Al Qaeda (Al Qaeda in the Arabic Peninsula – AQAP); and a revolt in the North led by Shia cleric Hussein al-Houthi in 2004 (BTI, 2014).

In 2011, in the wake of the Arab Spring, protests hit the country, eventually leading to President Saleh resigning from power and to Abdrabbuh Mansour Hadi being elected as new President in February 2012. Since 2012, Yemen Republic experiences increasing tensions and escalating acts of violence, ultimately leading to the Houthis faction taking control of Sana'a in September 2014 (BTI, 2014). The continuous advance of the Houthis towards the former Southern capital, Aden, leads to the beginning of a Saudi-led aerial-bombing campaign and naval blockade. For a country importing most of its food and fuel, the interruption of all trade has resulted in lack of water, electricity, food and fuel for most its population (OCHA 2015a).

The current crisis impacts over 21 million Yemeni, who are currently in need of humanitarian assistance: the armed conflict has led to over 1.3 million internally displaced persons (IDPs) fleeing from fighting and bombings; 20.4 million people currently lack access to clean water and at least 12.9 million Yemeni are food insecure. Women, in particular, are disproportionately affected by the conflict, with an increase of female-headed households, which are especially vulnerable. Lack of fuel has particularly affected the level of basic public services provision such as electricity and water supplies, healthcare provision, and solid waste collection (OCHA 2015b).



**Figure 1** Yemen population humanitarian needs (OCHA, 2015a)

### 1.3. Legal and Institutional Framework

There are several laws and regulations governing solid waste management (SWM) in Yemen:

- Law N°20 of 1999: established City Cleaning and Improvement Funds and following amendments: to collect and administer revenue for providing SWM service
- Law N°26 of 1995 “the Environmental Protection Law”: defines waste, hazardous waste, handling of hazardous waste, and environmental damaging activities including pollution crimes
- Law N°39 of 1999 known as the Public Cleaning Law: defined the roles, responsibilities, and ways of dealing with various types of waste
- Law N°4 of the year 2000 “the Local Authorities Law”: modified the institutional structure of SWM
- The Republican Decree of 2004 establishing the General Authority for Environmental Protection
- Law N°9 of 2005 for the ratification of the Rotterdam Convention
- Presidential Decree 262/2006 transferring all responsibilities for SWM from the Ministry of Public Works and Housing to the Ministry of Local Affairs

This body of laws is relatively developed in defining institutional roles and responsibilities for solid waste collection and disposal, as well as introducing the notions of environmentally damaging activities, hazardous waste, and the “polluter pays” principle.

However, neither hazardous waste nor healthcare waste are the object of any specific provision, other than laws ratifying Multilateral Environmental Agreements (MEAs), such as the Rotterdam and Basel Conventions, and the 2004 National Strategy for Integrated Management of Hazardous Waste for the Implementation of Basel Convention. Consequently, there are currently no specific legal provisions regarding the safe storage, handling and disposal of hazardous and healthcare waste. Such waste streams are currently being transported and disposed of along with household waste and without previous treatment, and therefore are a serious threat to all waste collection workers, waste pickers, and the Yemeni population in general.

Furthermore, the government approved two key documents on waste management: the National Strategy for SWM (2009 – 2013) and the Investment Plan for SWM (2010 – 2013).

The strategy sets to improve overall sector performance: increase waste collection coverage; improve healthcare waste collection, treatment and disposal; set up data collection and monitoring systems; increase cost recovery and available finances; foster coordination among different institutional stakeholders; and upgrade existing disposal sites. The investment plan identified the required investments to achieve such objectives in about USD 270 million. As the political crisis developed since the start of the Arab Spring, the implementation of the plan came to a total halt.

## 2. STAKEHOLDERS ANALYSIS

In order to gain an understanding of the past and current solid waste management actors in Yemen, this stakeholder analysis identifies those organisations that are relevant to solid waste management as baseline knowledge for developing potential entry points for UNDP Yemen.

The primary responsibility for waste management resides with public institutions, and in local authorities specifically. These are responsible for providing waste collection and disposal services through the financial support of the local City Cleaning and Improvement Fund. Both entities work under the supervision of the Ministry of Local Affairs, whose mandate over SWM is mainly related to legislation development and coordination between central and local government.

Other central and local government bodies also play a complementary role, mostly pertaining to specific types of waste or crosscutting responsibilities, such as monitoring and financing.

### 2.1. Institutional Actors

#### Primary Stakeholders

##### Local Authorities

Local authorities are mandated to provide waste collection services, financed through the local City Cleaning and Improvement Fund. Local institutions also have the authority to set up a Construction Waste Department, which is specifically charged of identifying Construction and Demolition (C&D) waste collection, sorting and recovery, identification of disposal sites, and issue C&D permits.

##### City Cleaning and Improvement Funds (CCIFs)

CCIFs are charged with financing MSWM service provision through local taxation and central government transfers. Service fees are collected through a 5% surcharge included in the electricity bills and other 24 types of fees and levies, such as mobile credit surcharge. As most revenues come from local taxation rather than transfers, there is a great variability in the resources available among the various CCIFs.

##### Ministry of Local Affairs (MoLA)

MoLA is to provide national coordination and guidance, including drafting and approving policies, regulations, etc.; supervision of local authorities and liaising with other central government agencies and international donors.

Within MoLA the Department for Waste Management was created in 2008 to work on SWM specific issues, including:

- Drafting and amending SWM laws, by-laws, regulations, and guidelines;
- Issuing the National Waste Strategy and follow up in its implementation and updating;
- Supporting the establishment of new CCIFs and supervising CCIFs activities;

- Coordinating donor support to SWM;
- Coordinating resource and equipment for SWM from central government to local authorities;
- Coordinating and liaising between local authorities and central government; and,
- Drafting and delivering training and disseminating guidelines and best practices.

### **Ministry of Finance (MoF)**

The MoF provides transfer of funds to Local Authorities and CCIFs, and to oversee CCIFs and local authorities financial performance through the Central Organization for Control and Auditing.

### **Ministry of Public Health and Population (MoPHP)**

MoPHP is in charge of all activities related to healthcare waste management, including setting up policies and guidelines for source segregation, safe storage and handling, treatment and disposal.

### **Ministry of Public Works and Housing (MoPWH)**

MPWoH is responsible for collecting and disposing of C&D waste.

### **Environmental Protection Agency (EPA)**

EPA is mandated to monitor implementation and adherence to environmental laws and regulations, including the respect of health and safety regulations, pollution and emission standards, quality standards, and the safe storage, transport and disposal of hazardous substances and waste.

### **Yemen Standardization, Metrology and Quality Control Organization (YSMO)**

To define production quality standards, including food grade packaging quality and material standards, and packaging specifications standards, albeit with limited monitoring and enforcement capacity.

### **Fund for Social Development (FSD)**

To finance capital investment in healthcare waste through loans and grants by national and international donors, with the latter providing the majority (over 80%) of capital investments. Latest intervention in SWM was the provision of healthcare waste dedicated trucks, financed by the World Bank (WB), and set up treatment facilities.

## **2.2. Private Sector**

The private sector plays an important role in solid waste management by providing the bulk of the recycling infrastructure and activities in the country.



## Recycling companies

There are over 50 registered recycling plants throughout the country, which receive recyclables through an informal network of waste brokers, junkshops and ultimately a vast number of waste pickers recovering valuable materials in the streets and at the dumpsites. The recovered material is mostly exported, and there is a high variability in the level of professionalization of such exporters, who range from import-export businesses trading recycled material as a secondary business, to well established recycling firms offering a variety of quality and processed materials in line with international commodity trade standards.

Plastic, paper and carton, and metals are all recycled, as well as waste motor oil and lubricants. Main source of these materials is municipal solid waste and industrial waste, with the notable exception of metals, where e-waste (i.e. Waste Electrical and Electronic Equipment: WEEE) and end-of-life-vehicles (ELV) provide a relevant source of copper, lead and steel. Waste tyres, heavy fuel oil and exhausted lubrication oils that are not exported for recycling are being used as alternative fuel by cement kilns.

The informal sector employs individuals coming from the most vulnerable and marginalized sections of society: In Yemen waste pickers belong predominantly to the Al-Muhamasheen community, literally meaning “the marginalized ones”. Before the conflict informal recycling provided livelihoods to hundreds individuals in several dumpsites across the country: women headed households and children were common amongst waste pickers.

**Picture 1** Child labour amongst waste pickers



### Public Private Partnerships (PPP)

PPPs were tried in the past for waste collection provision, but failed mostly due to the lack of expertise and capacity within the private sector, poor planning, and delays and inability to provide regular payments. There is generally a poor track record of PPP implementation in the country.

Prior to the conflict, there was nonetheless one private contractor dedicated to sorting and collecting recyclable material from various municipalities and disposal sites across Yemen.

### 2.3. Development Actors

Waste management in Yemen was supported by several international organization and development agencies. Development actors were mostly working at central government level by funding Yemen FSD for capital investments or working with MoLA to improve institutional capacity. On the other hands, various interventions were directly implemented at governorate, city or village level. Most international development assistance ceased after 2011, with the exception of limited interventions.

#### *The World Bank*

The WB supported the development of MSWM in Yemen since the 1990s through financing studies on solid waste management in 48 cities and the development of two pilot projects in the coastal zones of Balhaf Burum and in Sharma Jethmun. In recent years, the WB funded the infrastructure investments for SWM through the FSD. Other interventions included the feasibility study for MSWM systems in Sana'a and Taiz in 2010 and the promotion of household and village biogas plants for the treatment of fecal sludge, manure and kitchen waste in 2012 (the project was discontinued in 2014).

#### *Japan International Cooperation Agency (JICA)*

JICA supported MSWM capital investments through the FSD from 2005 to 2010; such intervention included USD 5 million for waste collection vehicles at municipal level; USD 5 million for heavy machinery for disposal sites; and an additional USD 5 million for vehicle fleet rehabilitation and set up of maintenance facilities.

#### *Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH*

GIZ waste related activities revolve around three key areas of interventions: the creation of the Regional Network for integrated waste management in the MENA Region (SWEEP-Net); the decentralization of waste management; and private sector development. GIZ worked with MoLA to draft the National SWM Strategy, and worked on capacity building at governorate and municipality level piloting the set-up of integrated solid waste management systems. The Private Sector Development project focused on supporting the development of the sector through access to finance, facilitation of public-private sector dialogue, and generally creating an enabling environment.

### *United Nations Development Programme*

UNDP interventions have focused on environmental aspects of sustainable development. Past interventions at capacity building level include the finalization of the National Environmental Action Plan in 2001 and the establishment of the Ministry of Water and Environment in 2003. On a local level, UNDP launched two projects in 2008 promoting composting of fish offal and waste collection in Bier Ali village and Hawf Protected Area respectively.

### *United States Agency for International Development (USAID)*

USAID promoted several interventions related to SWM between 2011 and 2012, mostly focusing on extraordinary waste removal campaigns targeting Sana'a Old City and other World Heritage sites. Additional interventions targeted local authorities capacities by financing salary payments for waste collection workers and emergency employment for unemployed youth and women in Sana'a, Taiz, Marib, and Aden.

### *Mercy Corps (MC)*

MC led a livelihood intervention supporting the Al-Muhamasheen community in Taiz to improve living conditions amongst the most vulnerable segments of the community.

## **2.4. Humanitarian Actors**

### *WASH Cluster*

The WASH Cluster has the primary mandate for solid waste management, however the government agency leading the cluster, the Emergency Unit of the General Authority for Rural Water Supply Projects has no mandate over waste management and, for the time being, over sanitation.

Current key interventions are support to local authorities in emergency clean ups and support to routine waste collection activities through fuel and spare parts provision. It is envisaged to support CCIFs and local authorities by providing up to 300,000 litres of fuel in Sana'a, Aden, and Taiz governorates. These in kind contributions are expected to cover the fuel requirements for a period of three months, and are based on WFP capacity to provide fuel to other humanitarian actors.

### UNICEF

UNICEF is mandated to coordinate WASH interventions and be the agency of last resort for identified gaps. UNICEF already provided 50,000 litres of fuel to Sana'a Cleaning Departments. Planned interventions in Taiz and Aden through Mercy Corps are to support respective CCIF by providing fuel and tools, and in Sana'a by providing fuel to CCIF.

### Mercy Corps

UNICEF Implementing Partner (IP) supporting Aden and Taiz CCIFs through fuel and tools provision.

### International Committee of the Red Cross

ICRC is planning the provision of maintenance support and spare parts in Aden. Planned support to Sana'a and Aden CCIFs will consist in extraordinary collection (single day) in Aden to remove accumulated garbage and the transport of accumulated trash from Sana'a collection site (transfer station) to disposal site.

### Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

GIZ was historically engaged in waste management in Yemen through its Decentralization of Waste Management Programme and Private Sector Development Project. In light of the conflict the organization is now implementing emergency clean-ups and waste collection in Sana'a (shattered window glass removal), Aden and Taiz. The interventions in the latter two areas are nonetheless on hold, subordinate to the security conditions; a further intervention is planned in Al Mukalla, but still not operational.

### United Nations Development Programme

UNDP promoted an emergency clean-up in Enma neighbourhood, Aden, through the Star Foundation, to remove accumulated waste and to create communal storage containers.

### *Health Cluster*

The Health Cluster has mandate over healthcare waste management. At the moment the main focus of the cluster is the provision of fuel and medical supplies to Yemeni hospitals. Healthcare waste management interventions have not been mentioned in any official document or tracking matrix by the cluster, however it is likely these may be included as per following Sphere humanitarian standards for healthcare provision.

### *CCCM/Shelter/NFI*

The Camp Coordination and Camp Management Cluster, in Yemen merged with Shelter and NFIs, is traditionally the cluster overseeing IDP and refugee movements and settlements, with a mandate to monitor service provision from all other clusters. As there are only few IDP settlements within Yemen, as it appears from the Displacement Tracking Monitoring system (DTM) which is the tool set to monitor all cluster activities related to IDP locations.



**Picture 2** Waste accumulated in Sana'a, July 29th 2015

### 3. MSWM IN YEMEN CRISIS

#### 3.1. Methodology

The emergency waste assessment was carried out through an initial desk review and stakeholder mapping, followed by an emergency waste assessment.

The initial findings highlighted the need for better information regarding the current status and capacity of Cleanliness Funds and local authorities to provide SWM services throughout the waste management cycle. To address the very fluid security and logistics constraints, DWR developed a tiered system for the assessment, in order to create the best possible snapshot of the state of the system in the country.

All facts and figures provided in this section are derived from the findings of the emergency waste assessment unless stated otherwise.

#### *Questionnaires*

DWR produced four questionnaires for UNDP Yemen and IPs to allow for a rapid assessment, with each questionnaire targeting a different stage and stakeholder within the waste management cycle. These are: (i) the Neighbourhood Assessment tool, (ii) the Infrastructure Assessment tool, (iii) the Local Authority Assessment tool and, finally, (iv) a Private Sector Assessment tool. The questionnaires are available in Annex 3 – Questionnaires.

Two of the questionnaires, the Neighbourhood Assessment and Infrastructure Assessment tools, were developed into an offline ubiquitous platform, a handheld-device-based application. The neighbourhood survey enabled to identify the status of waste collection, including waste accumulations. The infrastructure survey targeted temporary dumping areas, transfer stations and official dumpsites, to identify and map current disposal practices. The current capacity of CCIF was assessed through a dedicated questionnaire for local authorities, aiming at providing a pre-conflict baseline of SWM and its current state. Finally, private sector actors actively involved in recycling activities prior to the crisis were contacted via a telephone-based survey to assess the impact of the on-going conflict on the sector.

<b>Table 1 Emergency waste assessment sampling targets</b>			
<b>Target number of surveys</b>			
<b>Location</b>	<b>Neighborhood</b>	<b>Disposal</b>	<b>CCIF</b>
Sana'a	8	2	1
Sa'ada	4	1	1
Hajjah	4	1	1
Aden	1	1	1
Taiz	1	1	1
Abyan	1	1	1
Hudeydah	1	1	1
<b>TOTAL</b>	<b>20</b>	<b>8</b>	<b>7</b>

### Sampling Strategy

Initially, 7 governorates were chosen for the assessment: five governorates are UNDP identified areas of intervention – Aden, Abyan, Hajjah, Al Hudaydah, Sa'ada, and Sana'a – and two additional ones – Taiz and Amran. The choice of the areas to assess was based on the availability of UNDP staff or UNDP IPs on the ground, allowing nonetheless a great amount of flexibility in regard of the geographic scope of the assessment. Table 1 highlights the initial Survey Plan, a full copy of which is provided in Annex 2.

Targeting different stakeholders at the various stages of the waste management cycle required distinct questionnaires as well as a diverse set of frames<sup>1</sup> and sampling strategies.

<sup>1</sup> Frame is a set of the target population to be investigated out of which the sample is taken, it can coincide with the target population as a whole, or segments of it, depending on the type of sampling strategy used.

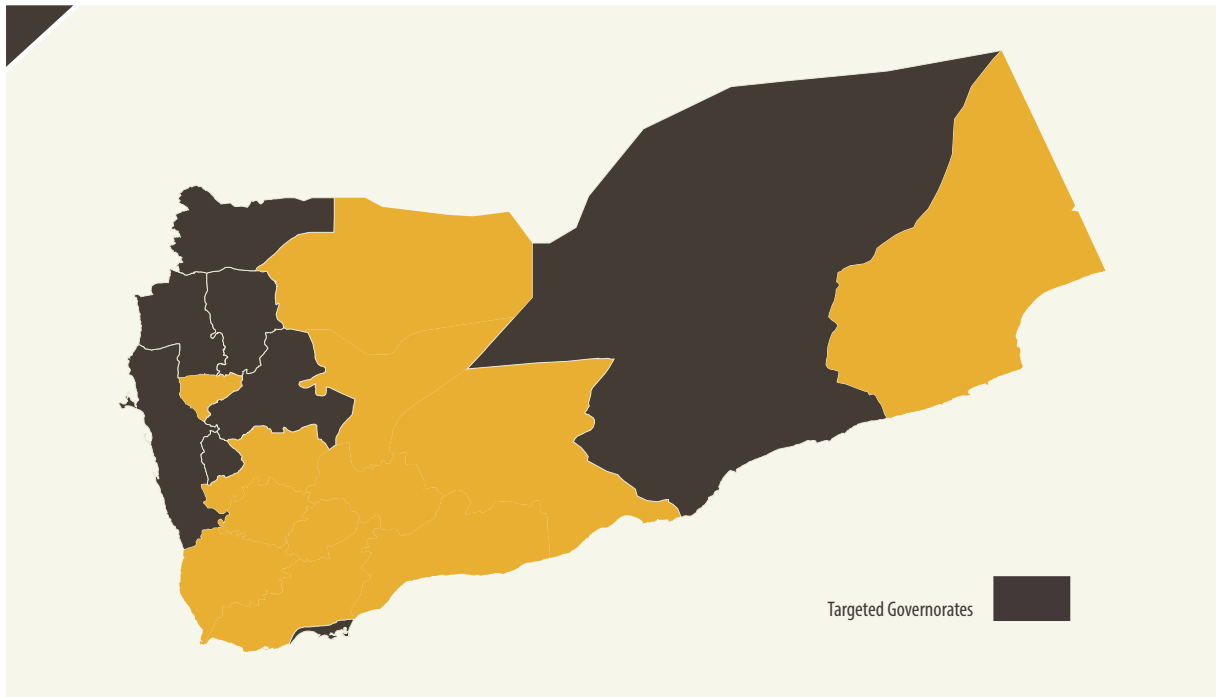
The Local Authorities survey consisted in a census of CCIFs and local administrations capabilities prior and following the start of the hostilities. As such, the relevant institutions involved in waste management in the target governorates have been contacted with a 60% reply rate.

**Table 2 Final sample numbers by locations**

Final number of surveys			
Location	Neighborhood	Disposal	CCIF
Sana'a	10	2	1
Sa'ada	3	0	1
Hajjah	2	1	1
Aden	1	1	1
Taiz	0	0	0
Amran	0	0	1
Al Mukalla	1	1	1
<b>TOTAL</b>	<b>17</b>	<b>5</b>	<b>6</b>

Both Neighbourhood and Infrastructure surveys, on the opposite, followed a non-probability, convenience sampling strategy. Movement restriction, security constraints and limited time availability drove the choice of this methodology for the neighbourhood assessment. Convenience sampling was chosen for the infrastructure assessment for its suitability in light of the reduced target population of 21 official disposal sites nationwide.

Finally, after developing a frame of 60 known industries and entrepreneurs actively exporting processed and semi-processed recycled waste prior to the conflict, a simple random sample of 35 companies was identified. The choice of such an extended sample compared to the target population was to allow for an expected non-response rate of 60% or greater. This would result in 14 respondents to the telephone-based survey, for an expected 26% margin of error with a 95% confidence level assuming an unknown population size. The final response rate was much lower than expected, with only 5 reachable respondents willing to take the survey, for a 43% at a 95% confidence level.



**Picture 3** The governorates targeted by the assessment

### *Limitations*

The data collection process was affected by several factors: limited access due to the on-going hostilities, limited data validation and triangulation, and the use of a non-randomized sampling strategy.

Access and security constraints have been the main limiting factor to the data collection strategy in terms of total number of surveys and ability to validate and triangulate the data. Reduced access particularly impacted the Neighbourhood Assessment, where data collection was concentrated mostly to Sana'a neighbourhoods, and disposal sites, where the number of sampled sites was halved from the planned quota.

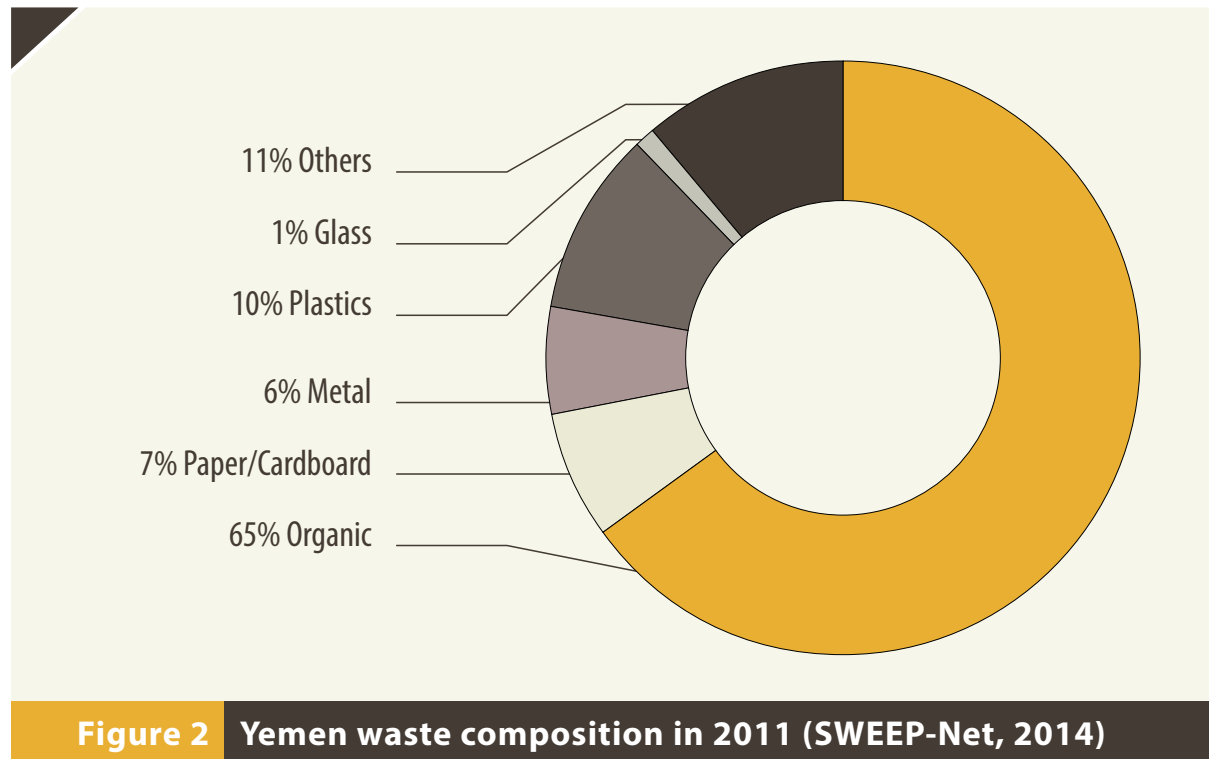
Data validation was addressed by using a diversified set of tools and targets for the emergency assessment, which allowed for triangulation of selected data; similarly, this strategy allows for extrapolation of required information not available from one tool from the data collected through the other ones. Figures pertaining to total waste generation and waste collection, nonetheless, are better understood as estimates provided by interviewed staff, as there is, at present no systematic monitoring system.



The use of a non-randomized sampling strategy is mainly impacting the neighbourhood assessment data: this results in the available information being representative on a local, rather than a national level. The reduced size of the disposal sites sample, rather than the sampling strategy, had an impact on the data collection for waste infrastructures, which was nonetheless partially balanced by the information recovered through the Local Authorities Assessment tool. The choice of convenience sampling allowed adapting the data collection to the evolving situation on the ground.

The very low response rate for the private sector survey puts the representativeness of the results in jeopardy, as only 1 in 7 businesses contacted was reachable and willing to answer the survey. The reason for such a low number of replies is attributable to three reasons: first, the contacts retrieved dated from before the crisis; secondly, the status of the mobile phone network meant many contacts could simply not be reached; finally, many landline contacts in Aden and Taiz could not be reached either because businesses closed down or due to population displacement. As such, the findings from the private sector survey can shed some light into the impact of the conflict on the recycling industry, but should not be generalized given the high margin of error (43%).

Finally, given the very fluid and volatile situation in Yemen, it is important to highlight how the present study can only provide a snapshot of the state of the waste management cycle.



### 3.2. Impact of Yemen crisis on waste management

Daily waste generation in Yemen was estimated to be 0.55 – 0.65 kg per capita in urban areas and 0.3 – 0.4 kg per capita in rural areas, with an expected yearly increase of 3% on a national level deriving from population growth and increased rural – urban internal migration flows. On average, waste collection rates reached 65% in major cities and 5% in rural areas. (SWEEP-Net 2010; SWEEP-Net 2014)

The political crisis and the subsequent armed conflict affected the waste management cycle in several ways stemming from the retreat of donors, the closure of maritime and land trade routes, neighbourhood and vehicle access, and the general reduction of available resources.

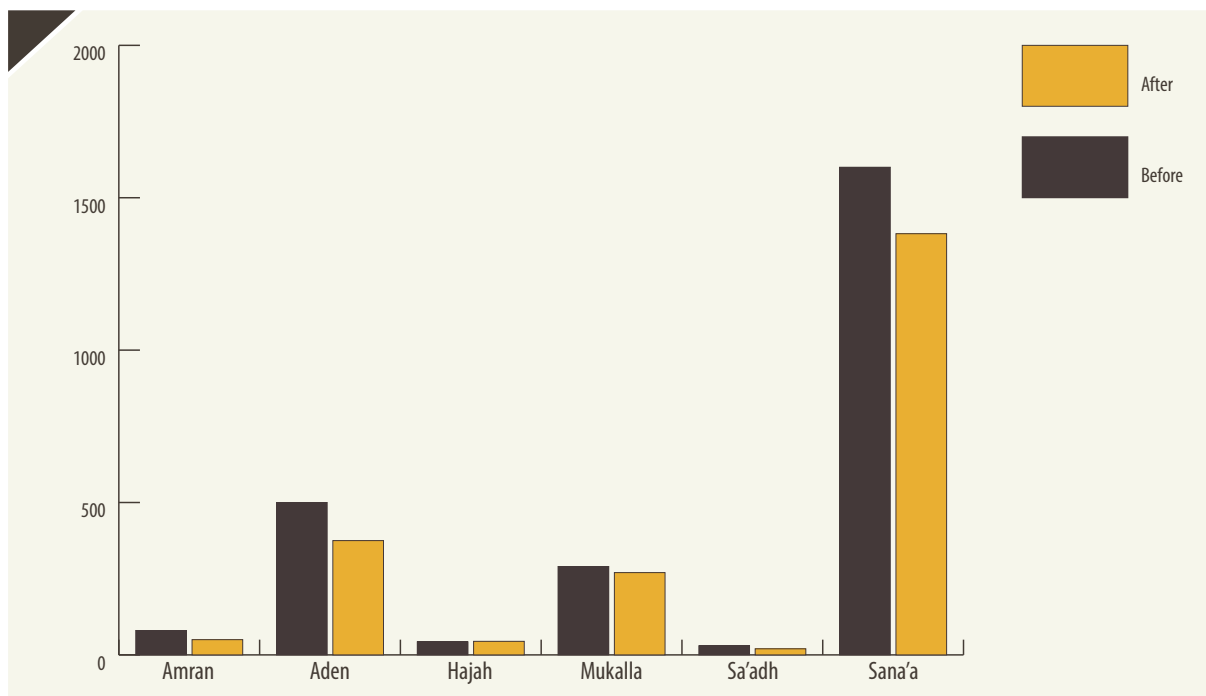
First and foremost, the institutional deadlock following civil strife in 2011 resulted in many international donors to withdraw and, ultimately, in the investment plans outlined in the National Strategy for Solid Waste Management 2009 - 2013 to come to a standstill.

Secondly, import restrictions had a dramatic impact in terms of food and fuel availability, with market prices for basic commodities skyrocketing, if available at all. (OCHA, 2015a; WFP, 2015a, 2015b, 2015c) This resulted, among others, in reduced waste generation rates, fuel shortages, reduced electricity and water provision, decreased waste collection and use of alternatives to disposal sites.

Airstrikes and armed confrontations in the urban areas further affected waste management by resulting in damaged and stolen vehicle, as well as preventing access to the areas where active fighting takes place. The military struggle also drove massive population displacement, resulting in about 1.3 million IDPs fleeing the combat zones. Additionally, unexploded ordnances (UXOs) and explosive remnants of war (ERWs) are present throughout the country, with reports of ERW being found in waste accumulations in Aden.

Finally, the repercussions of the conflict in terms of water and electricity availability, mobile phone network coverage, and the disruption of banking services reduced the revenues of local authorities and CCIF from collected taxes, resulting in serious challenges for the provision of all public services, included waste management.

All these factors had a profound impact on the waste management sector in Yemen: they affected the overall waste generation; they conjured to impair CCIF and municipalities ability to provide for waste management services, from collection to disposal; and they had negative repercussions on both formal and informal recycling sector.



**Figure 3** Variation of waste generation

### Waste generation

The data collected through the Local Authorities Assessment tool highlighted a consistent reduction in daily waste generation from the levels prior to the conflict across the 5 municipalities assessed, shown in Figure 3. While these figures provided by the interviewees must be taken with caution in the absence of a city specific waste characterization study, they show a consistent trend in the total waste arising currently generated.

There are two concurring reasons behind such finding: a general reduction in per capita generation rates and population displacement.

First and foremost, the current humanitarian crisis and the reduction of most imports created acute market shortages and the inability by humanitarian agencies to acquire and distribute relief aid to populations in need. The resulting reduced levels of consumption across the whole country therefore ensue in lowered waste generation rates.

A decline in consumption, however, is not sufficient in itself to explain such a sharp decrease in Aden. IDP movement within and across governorates, on the other hand, can, by crosschecking the assessment results with the existing data from the Yemen Protection cluster Task Force on Population Movement (TFPM).

It indeed results that Hajjah Governorate hosts the majority of IDPs within Yemen, that is about 50,000 households or 227,000 individuals, which account for 23% of total IDPs. With such a dramatic increase in resident population of over 15% of the total governorate population, such a faint increased total daily generation can then only be explained by a concomitant reduction in per capita generation (TFPM, 2015a; 2015b)

Similarly, Aden experienced massive internal migration, both within and across the Governorate, and is the first governorate of origin within the country: over 39,000 households have been displaced, of which 13,000 moved to another governorate. This results in a net population reduction of 90,000 people, with an additional 190,000 IDPs still living within the governorate (TFPM, 2015a; 2015b). As such, the former capital of South Yemen experience a net loss of about 10% of its population, which paired with a general reduction in per capita waste generation explains the overall 20% reduction reported in daily waste arisings.<sup>2</sup>

<b>Table 3 Impact of crisis on waste collection frequency</b>			
<b>City</b>	<b>Collection Frequency*</b>		<b>Number of Collections**</b>
	<b>Before</b>	<b>After</b>	
Amran	3 times / day	1 time / week	n/a
Aden	n/a	n/a	2
Hajjah	5 times/day	4 times/day	120
Al Mukalla	3 times / day	2 times/day	15
Sa'ada	Daily	Daily	2
Sana'a	n/a	n/a	30

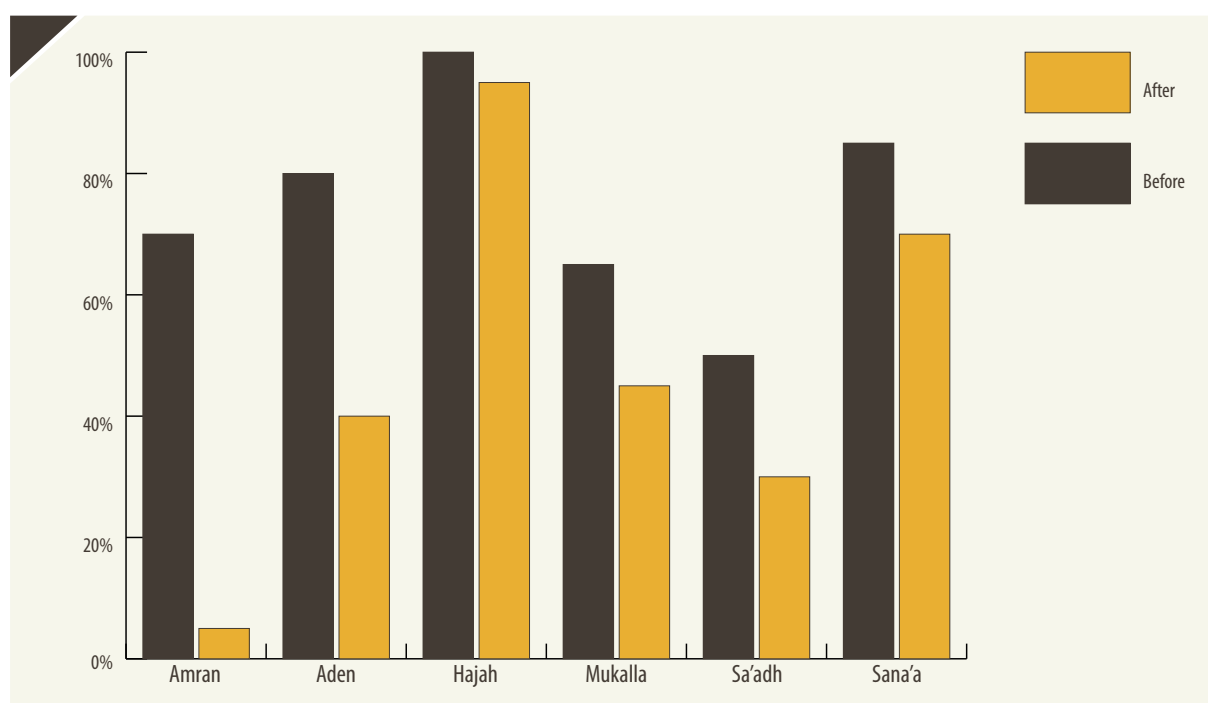
\*From CCIF and Local Authorities questionnaires  
\*\*Average in past 30 days in assessed neighborhoods

2 71,000 IDPs left Aden governorate. The estimated population for the governorate in 2010 was 751,000, which adjusted for an estimated 5% urban population growth every 5 years makes the 2015 population levels 788,000. Consequently, 11.4% of Aden residents left the governorate.

## Waste collection

The on-going hostilities exacerbated previously existing issues affecting municipalities and CCIFs, albeit to a different degree, all of which are ascribable to the block of imports and the cessation of most revenues.

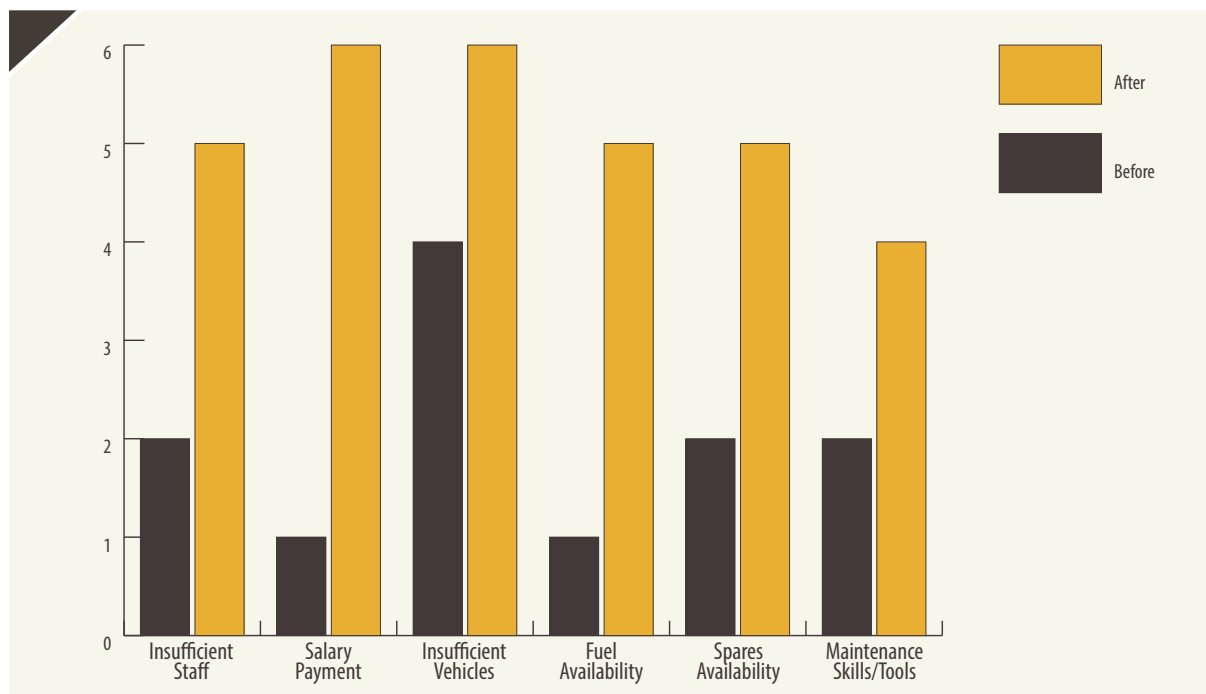
This resulted in a considerable reduction in service level both in term of working times as well as collected quantities, as displayed in Figure 4. The collection frequencies reported by the CCIFs, and the number of monthly collections in the assessed neighbourhoods are both shown in Table 3.



**Figure 4** Waste collection rates before and after the crisis

The discrepancies between the figures can be explained by the actual coverage of waste collection. While the number of collection shifts can remain unscathed by the conflict, this figure does not measure the actual range of collection paths nor the level of service provided to different neighbourhoods and, within the same location, to different areas.

Waste collection provision then focuses on the major routes and market areas, thus leaving minor roads and, sometimes, entire neighbourhoods entirely under-served.



**Figure 5** Impact of the conflict on WM operations

Reduced waste collection is symptomatic of the broader difficulties afflicting waste management authorities, whose evolution since the beginning of the conflict is summarized in Figure 5. Salary payment and insufficient number of vehicles are the most pressing issues, with all respondents reporting them as problems. Import restrictions (and to a minor level the lack of funds) are largely behind fuel and spares availability issues, reported by 4 out of 5 respondents, followed by problems in available maintenance skills and tools. Once again, the availability of spare parts and of the necessary tools and skills for maintaining the equipment already existed before the crisis, but were made worse by the conflict.

The availability of working collection vehicles was already a problem for most authorities prior to the conflict, but it was worsened in light of access constraints due to armed confrontation, theft, destruction and lack of maintenance. As of the end of July 2015, almost 45% of vehicles in the fleet of the six governorates assessed were inaccessible, broken or stolen, as highlighted in Figure 6, although there is a great variability across the different locations assessed.

Figure 6 displays the status of collection fleet: Sa'ada and Amran are the most heavily affected cities with 3/4 and 2/3 of broken vehicles respectively; in Al Mukalla, only 50% of transports are operational. In Aden, on the other hand, only 1/6 of the vehicles were available and working at the time of the assessment, with 15% circa broken or stolen and 2/3 inaccessible due to the on-going fighting.

**Table 4** Status of waste collection fleet

City / CCIF	In Working Order	Out of Order but Repairable	Damaged beyond repair	Stolen	Currently Inaccessible	Total
Amran	6	13	0	1	0	<b>20</b>
Aden	20	12	1	6	79	<b>118</b>
Hajjah	7	0	0	0	0	<b>7</b>
Al Mukalla	12	10	0	2	0	<b>24</b>
Sa'ada	4	7	4	0	0	<b>15</b>
Sana'a	303	52	94	5	0	<b>454</b>
<b>Total</b>	<b>352</b>	<b>94</b>	<b>99</b>	<b>14</b>	<b>79</b>	<b>618</b>

**Table 5** Staffing level reduction after the crisis

City	Sweepers	Drivers	Collectors	Mechanics	Supervisors
Amran	100%	100%	100%	100%	100%
Aden	3%	18%	22%	6%	7%
Hajjah	51%	100%	100%	100%	50%
Al Mukalla	100%	100%	78%	50%	100%
Sa'ada	100%	100%	100%	100% *	100%
Sana'a **	100%	100%	100%	100%	100%

\*In Sa'ada no mechanics were reported working prior the crisis

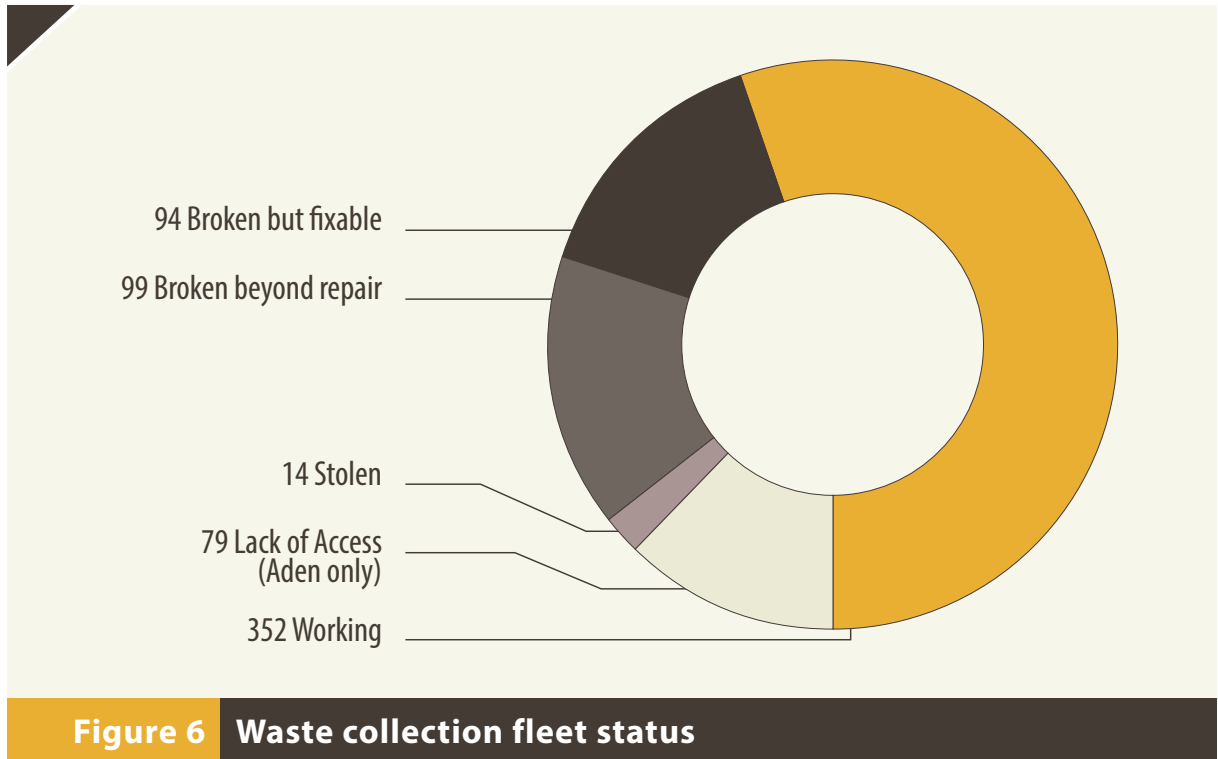
\*\* In Sana'a staffing levels are maintained, but during bombings there were workers reduction up to 25%

Source: CCIF and Local Authorities questionnaires

The interruption of electricity and water supply, and the consequent inability to bill the customers, lead to a reduction in CCIF finances collected through taxes and fees, in which combination with the shutdown of formal banking channels, is behind the challenge faced to pay staff wages. It is not surprising then, that over 80% of respondents also identified insufficient staffing levels as an operational challenge.

The impact of the crisis on the overall number of employees once again varies deeply among the various cities Table 5.

Aden is most affected, with a reduction in staff ranging between 80% for waste collection crews to 97% for street sweepers. Hajjah, the second city in terms of impact, saw a reduction of 50% for street sweepers and supervisors, while lost 1/3 of the collection crews and half the mechanics. In the capital, staff number formally maintained to pre-conflict levels, but absences among waste workers are common, and on days following aerial strike and bombings they can reach up to 25% of staff.





## **Healthcare Waste Treatment Facility in Sana'a**

The initial survey plan included the investigation of the state of healthcare waste management in the Emergency Waste Assessment. This responsibility falls within the Health Cluster mandate and there are clear and well established standards for HCW management in humanitarian settings (such as the Sphere Minimal Humanitarian Standards). After contacting the Sana'a Cleanliness Fund, however, the data collector received the request to visit the HCW treatment facility, located in a separated area of the principal disposal site at Al Azraqain disposal site.

The plant was developed after an agreement with the SDF and Sana'a CCIF: the former would provide the capital investment required for the acquisition of the machinery and set up of the facility, while the CCIF would run the site and fund the O&M costs. The treatment plant was ready to open in March 2015 when the conflict broke out. As a consequence, the facility never started operating.

Currently, the treatment centre dotation is of one autoclave with a volume capacity of 2 m<sup>3</sup> and a treatment cycle of 400 kg/hour, one washing machine for the waste containers, and two dedicated trucks for transporting HCW from other hospitals and medical facilities.

The CCIF staff reported several challenges preventing the treatment facility to operate: lack of funds and of electricity availability are the main challenges, followed by the lack of two additional trucks for the transfer of HCW to the site. Additionally, healthcare facilities are not currently operating any form of source segregation, resulting in vast amounts of refuse being contaminated by hazardous waste streams and being disposed as MSW.

No other similar HCW treatment plants have been reported to exist in Yemen.

**Picture 4** A brand new autoclave in Sana'a HCW treatment centre



## Waste infrastructure

Waste disposal sites in Yemen were already problematic before the crisis: of the 21 officially identified locations, 15 were operated as open dumpsites, with the remaining 6 working as controlled dumps (SWEEP-Net, 2014). However, the National Strategy for SWM identified 21 controlled and semi-controlled dumpsites and 27 open dumpsites, the difference between the two being the official designation as disposal site (MoLA, 2009).

The data retrieved from the Local Authorities Assessment questionnaire and the entries of the Infrastructure Assessment tool allows for a better understanding of the current situation and use of the disposal sites in Amran, Aden, Hajjah, Al Mukalla, Sa'ada and Sana'a Table 6 provides a general overview of the status of the sites serving different location; Table 7 and Table 8 provide a characterization of the four assessed sites.

Two sites serving Amran city are currently not operational with a third, Al Azraqain, being operational but not used; a similar faith is shared by Al Masab dumpsite, one of the three locations serving Aden: all sites are currently too far from to be used with the current fuel constraints.

<b>Table 6 Status of the disposal sites</b>					
City	Disposal Site		Waste Pickers		
	Sweepers	Drivers	Collectors	Mechanics	Supervisors
Amran	Al-Azraqain	Sana'a	No	n/a	Yes
Amran	Trench in Al-Hajz	Amran City	No	No	No
Amran	Temporary disposal site	40 Metres Road	No	No	No
Aden	Ber Al Na'ama	Ber Al Na'ama	Yes	Yes	Yes
Aden	Caltex Temporary	Caltex	Yes	No	Yes
Aden	Caltex Al Masab	Caltex	No	No	No
Hajah	Kudam disposal site	Hajjah, Kudam	Yes	Yes	No
Al Mukalla	Al Ghalila	Al-Dais	Yes	No	Yes
Al Mukalla	Al-Sheikyan	Fuh	Yes	No	Yes
Sa'ada	Althaseen dumpsite	Kohzah	Yes	Yes	Yes
Sana'a	Al-Azraqain	Sana'a	Yes	n/a	n/a
Sana'a	Transfer Station	60 Meters Road	Yes	Yes	Yes

Source: CCIIF and Local Authorities questionnaires; Infrastructure Assessment tool



**Picture 5** Stray dogs and seeping leachate in Al Azraqain dumpsite

**Table 7** Disposal site fleet status

Site	Quantities (tons/day)	Trucks		Excavator		Loader		Bulldozer	
		Total	Work	Total	Work	Total	Work	Total	Work
Al-Azraqain	1500	20	15	1	0	0	0	5	2
Kudam	42	8	8	0	0	0	0	2	2
Ber Al-Na'ama	350	0	0	1	0	0	0	1	0
Al Ghalila	230 - 370	3	0	0	0	1	1	1	0

Source: Infrastructure Assessment tool

Al Azraqain traditionally served not just Amran, but Sana'a CCIF too as the normal destination for waste disposal. However, at the moment it is not operating at full capacity: waste from selected neighbourhoods that are closer to the site is directly brought there, but most of the collected waste ends up in the capital's transfer station, where only part of the collected waste finds its way to Al Azraqain.

The assessment identified several issues affecting the proper operation of disposal site as a controlled dumping ground, which are summarized in Table 7 and Table 8: machinery breakdown, missing or broken weighbridge, absent or damaged perimeter fence, landfill fires, presence of vectors and scavengers, leachate accumulations, and signs of terrain subsidence and flooding.

Non-working heavy machinery is an issue creating a cascade of problems: without bulldozers and excavators it is neither possible to compact the waste nor to cover it on a regular basis. This in turn has several negative consequences in terms of water infiltration during the rainy season and, in general in the production rates of leachate and potential groundwater pollution.

Similarly, non-compacted waste without soil cover enhances the emission of landfill gas (LFG) and in particular prevents the oxidation of methane, which is a powerful greenhouse gas (GHG). Waste compaction and grading is also a crucial step for preventing collapse of the terrain and landfill landslides: Picture 6 clearly displays the potential risk for such an event occurring at Al Ghalila.<sup>3</sup> This is especially worrisome since the dumpsite is also the only one with reported flooding signs, thus making the risk of a landslide increasingly likely.

**Picture 6** Underground fire and subsiding ground in al Ghalila dumpsite



<sup>3</sup> On July 10, 2000, in Payatas, Philippines, a dumpsite experienced a structural failure. The resulting landslide caused 1.2 million m<sup>3</sup> of waste to swoop on the nearby settlement, resulting in 220 people dying with 200 – 800 still missing.



**Picture 7** A recycling plant destroyed by an airstrike in Al Azraqain

Finally, regular cover of dumped waste is a key element to prevent the proliferation of vectors, and consequently prevent the spread of vector borne diseases such as dengue, malaria, rabies and leishmaniasis.

Missing or damaged fencing is also contributing to the presence of scavengers (mainly stray dogs), livestock and unauthorized persons on the site premises: other than fostering the spread of vector borne diseases, this facilitates thefts and acts of vandalism. Picture 7 shows the potential consequences of an open perimeter. When asked about the burned down structure situated within the site, the staff working at Al Azraqain could not provide an explanation neither of what the building was, nor how the fire started.

Open burning and underground fires have been consistently reported in three of the four sites assessed, with only Al Azraqain dumpsite not being affected. Landfill fires can start spontaneously as a result of the rising internal temperatures, or may be of human origin, either as a measure to reduce waste volumes or for the recovery of metal within the waste.

<b>Table 8</b>		<b>Engineering features of disposal sites</b>							
<b>Site</b>	<b>Engineering and operational aspects</b>								
	<b>Weigh-bridge</b>	<b>Fencing</b>	<b>Leachate Pond</b>	<b>Cover soil</b>	<b>Fire</b>	<b>Collapse</b>	<b>Vectors</b>	<b>Flooding</b>	
Al-Azraqayn	Working	Broken	Yes	Not enough	No	Yes	Yes	N/a	
Kudam	N/a	No	N/a	N/a	Yes	N/a	Unknown	N/a	
Ber Al-Na'ama	Working	Broken	Yes	Not enough	Yes	N/a	N/a	N/a	
Al Ghalila	Not working	Broken	N/a	Not enough	Yes	Yes	Yes	Yes	

Source: Infrastructure Assessment tool

Burning waste leads to acute respiratory affections, irritation of the eyes, and the development of chronic disease of the respiratory system, skin irritations and gastro enteric disturbances. On the long term, the toxic substances released in the air by the combustion of plastics and composite materials can provoke cancer and disruption of the endocrine system; the heavy metals contained in the ashes can also seep and contaminate groundwater sources. Deep-seated (underground) fires are particularly problematic for another set of reasons. To begin with, they are particularly tenacious and difficult to put off, and if unchecked can burn for an extremely prolonged period of time. In second stance, the fire cause soil subsidence, and facilitate the collapse of dumpsite lateral structure, ultimately leading to an increased risk of landslides at the dumpsite.

Finally, the absence of leachate collection systems, no matter how basic, has major implications for both human health and the environment. Leachate can contaminate soil and, eventually, reach the groundwater table. Leachate is produced from the percolation of the moisture contained within the waste, and the seeping of rain and runoff water through the layers of waste.



**Picture 8** Leachate accumulating in Al Azraqain

### Recycling industry

Informal recycling formed the backbone of resource recovery in Yemen, and provided livelihoods to hundreds of individuals. The assessment documented that the sector is still active, but at a much reduced scale, both in the streets, at the transfer stations, and in the dumping grounds.

The impact of the conflict on the recycling sector is widespread but not unequivocal or unidirectional. Recovery of valuable materials from the streets appears indeed to be reduced, but scrap dealer and other intermediaries are still active in the cities of Al Mukalla and Sana'a. This seems to be in contradiction with the reportedly reduced or ceased picking activities in the two towns, but not necessarily. As there are very limited import activities but the national productive system is at a standstill, recycled material may be the only available export; furthermore, with virgin raw materials becoming scarcer, it is possible recycled waste became the only available substitute input, especially for plastic manufacturers.

**Picture 9** A waste picker still active in Sana'a



Even though the recycling marketplace is not frozen, it is clear its dimension is clearly reduced, as portrayed by Table 6 and Table 9; the variability of materials collected for recycling also hints at the logistic constraints imposed by the conflict hindering trade.

The state of the informal sector in the disposal sites is exemplary of this ambivalent situation: all recovery activities stopped at Kudam site, near Hajjah, and are continuing, but at incredibly reduced levels, in Al Azraqain and Ber Al Na'ama, in Amran and Aden respectively. Al Ghalila dumpsite, conversely, is reported not to have had any recovery activities taking place on its premises before the conflict, but now it does, and with a considerable number of pickers.

**Table 9** Waste picking at disposal sites

Location		Landfill waste pickers						
Site	City	Before	Still active	Men	Women	Boys	Girls	Total
Al-Azraqain	Sana'a	Yes	Yes	4	0	0	0	4
Transit station	Sana'a	Yes	Yes	12	0	3	0	15
Kudam	Hajjah	Yes	No	0	0	0	0	0
Ber Al-Na'ama	Aden	Yes	Yes	n/a	n/a	n/a	n/a	4
Al Ghalila	Al Mukalla	No	Yes	20	15	15	5	55

Source: Local Authority and Infrastructure Assessment questionnaires

The waste value chain, which starts with waste pickers, feeds into a network of junkshops, waste brokers and intermediaries eventually leading to recycling businesses and, ultimately, for the recovered material to be either exported or fed back into the national manufacturing processes. The Private Sector Survey provided further details on the current state of the recycling industry in Yemen.





**Picture 10** Informal recycling at Sana'a transfer station

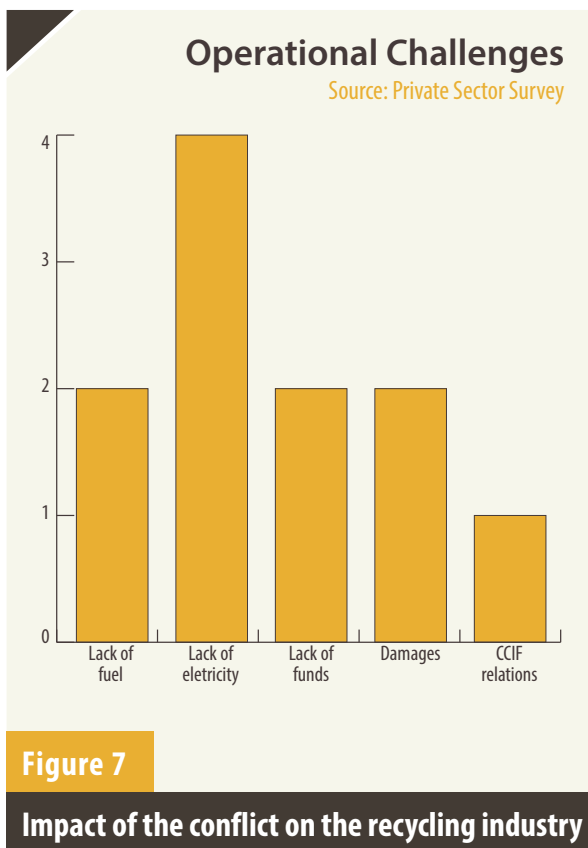
The armed struggle has had a major toll on the formal businesses just as on the informal sector: of the five companies who responded, only two are still active and running. Both businesses are export-oriented, which is not surprising as most recycling companies in Yemen sell their products on the global markets (Figure 8); but this could also be an indicator that recycled material has not substituted imported inputs of national manufacturers.

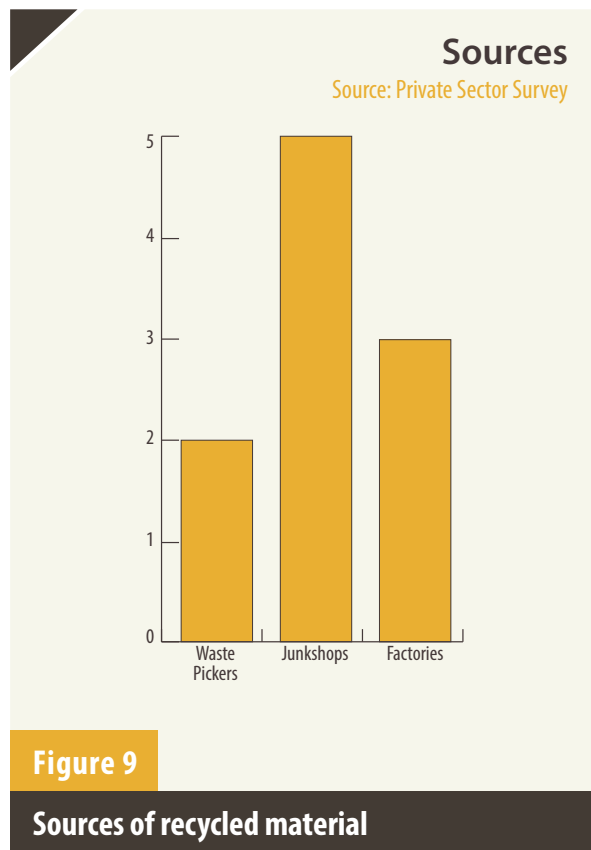
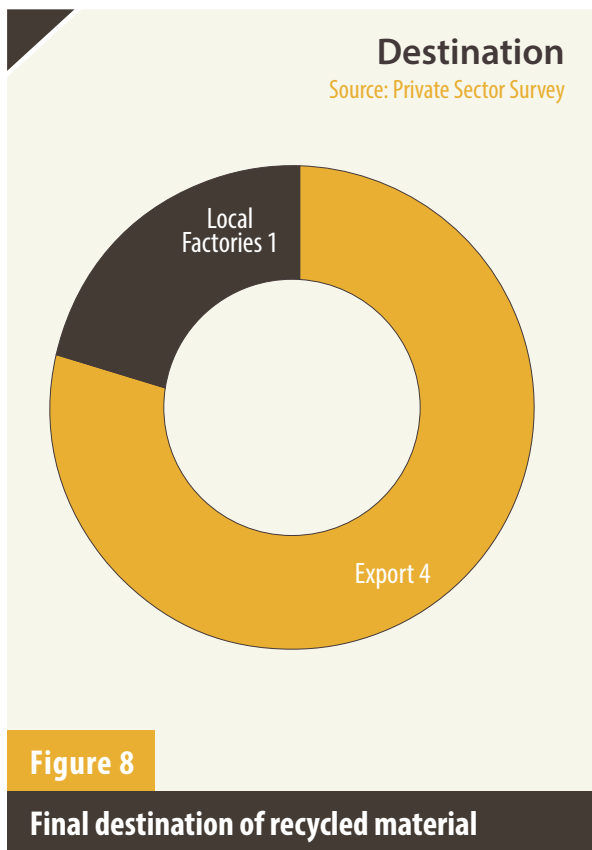
While this finding should be taken with caution in light of the size of the sample, the challenges reported by the interviewees seem to support this conclusion. Figure 7 shows the challenges the respondents face as a consequence of the on-going hostilities: lack of electricity is identified in 80% of the responses, followed by lack of funds, fuel, and damages to equipment and infrastructures. As lack of electricity has been consistently identified in several assessments as a pressing issue, it is likely the national productive capacity has been crippled by such constraint, consequently being prevented from substituting the external demand for recycled material with the internal one.

As export was, and still appears to be, the main driver for recovery of recyclable materials from waste, the downsizing of the formal sector at the top of the waste value chain has had a cascade effect on all other actors sustaining it. While not specifically addressed by the assessment, experience suggests that junkshops and scrapyards have similarly been affected by the current market shock, as by key informants consistently identified them as a source of recycled waste.

Location		Materials Recovered				
Site	City	Plastic	Metal	Paper	Rubber	Wood & Yard waste
Al-Azraqain	Sana'a	Yes	No	No	No	No
Ber Al-Na'ama	Aden	Yes	Yes	Yes	Yes	Yes
Al Ghalila	Al Mukalla	Yes	Yes	Yes	No	Yes

Source: Infrastructure Assessment surveys





**Picture 11** Sana'a waste transfer station used as temporary dumpsite

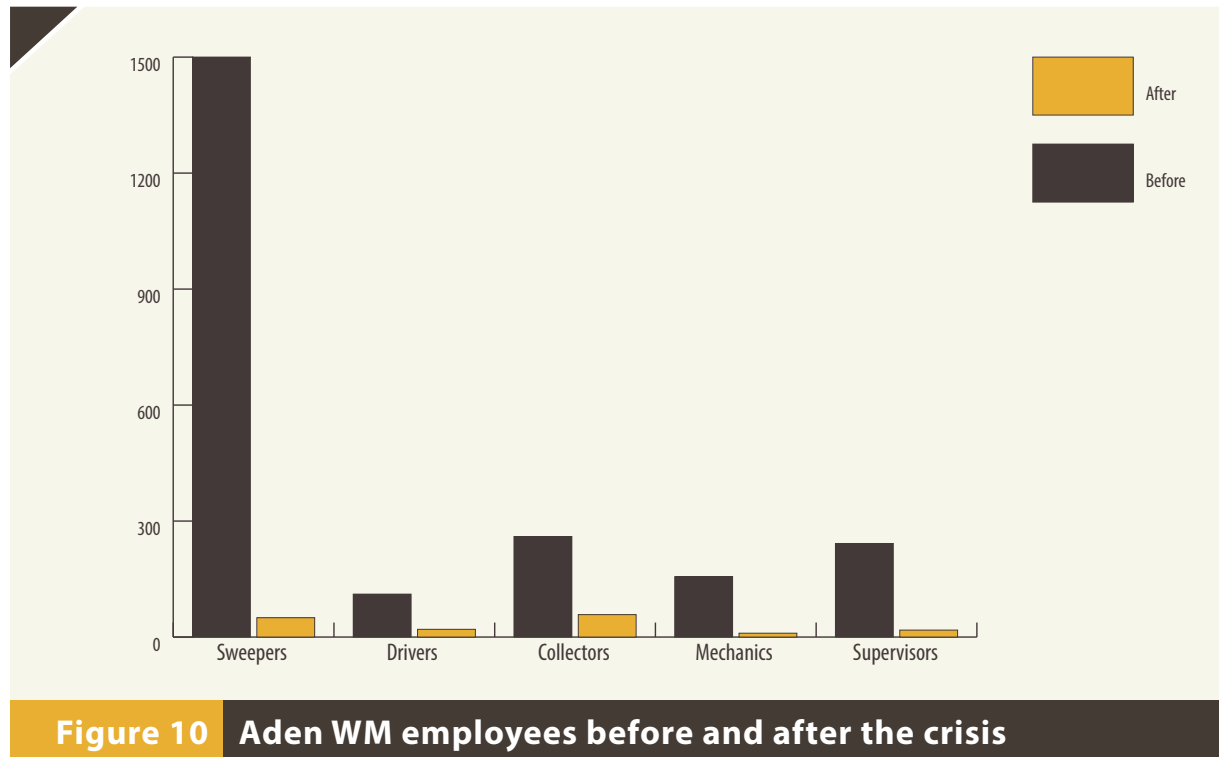


## 4. SWM ENTRY POINTS

Waste collection has been highly impacted by the conflict. The low number of working vehicles and reduced access to many inhabited areas decreased waste collection thus resulting in waste accumulations, spread of vectors and increase of vector borne diseases. Furthermore the reduced revenues resulted in decreased employment levels within waste management authorities and difficulties in paying salaries and retrieving the necessary spare parts, impacting both collection and disposal activities. Finally, lack of electricity and the blockage of export routes affected the recycling sector, with informal waste recovery activities still present but at a reduced level.

### 4.1. Identified gaps

The existing interventions in response to the growing waste crisis in Yemen revolve around two axes: extraordinary clean-up of waste accumulations and the provision of fuel to local authorities. Such activities are indeed providing an immediate relief to the pressure posed by mounting waste quantities, but they don't address other needs identified through the Emergency Waste Assessment. Furthermore, the support provided to CCIFs and municipalities is not homogenous, focusing on the four cities of Taiz, Aden, Sana'a and Al Mukalla.



**Figure 10** Aden WM employees before and after the crisis

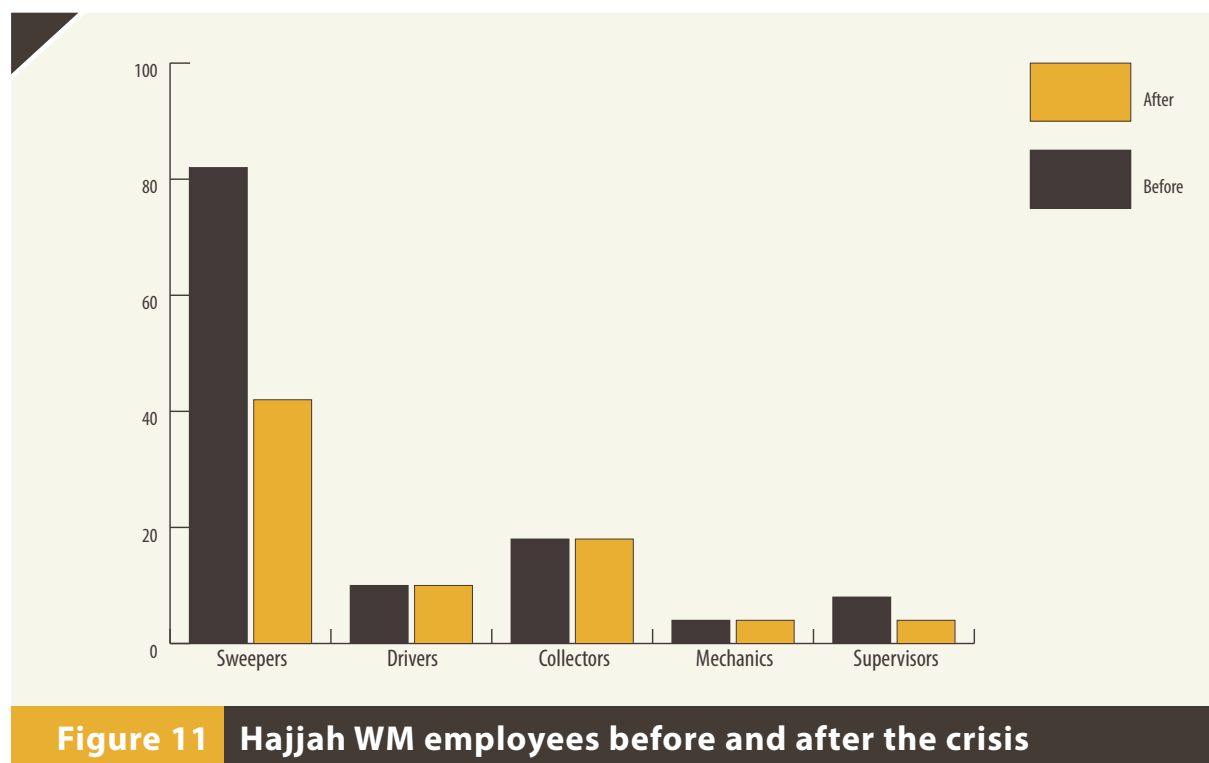
The gaps in the activities pertain predominantly to the rehabilitation of the capability of local authorities to provide affective waste management services in the long term and the support of waste collection in minor cities.

The three main needs not currently addressed are the need for the rehabilitation of the waste collection fleet; the provision adequate staff levels and for the payment of its salaries; the upgrade of disposal sites; the safe management of healthcare waste; and the reactivation of the recycling sector.

There are nonetheless further gaps that have been identified, that would need to be addressed in the medium term: supporting CCIF capital investments for fleet expansion and equipment acquisition, and the manufacturing and distribution of waste bins in the areas lacking them.

#### 4.2. Suggested interventions

Based on the identified needs and gaps, DWR recommends the following activities to provide for safe and effective solid waste management in Yemen. This entry points are understood as emergency activities to be implemented within a 6 month timeframe; additional activities and interventions are therefore possible within a longer horizon.



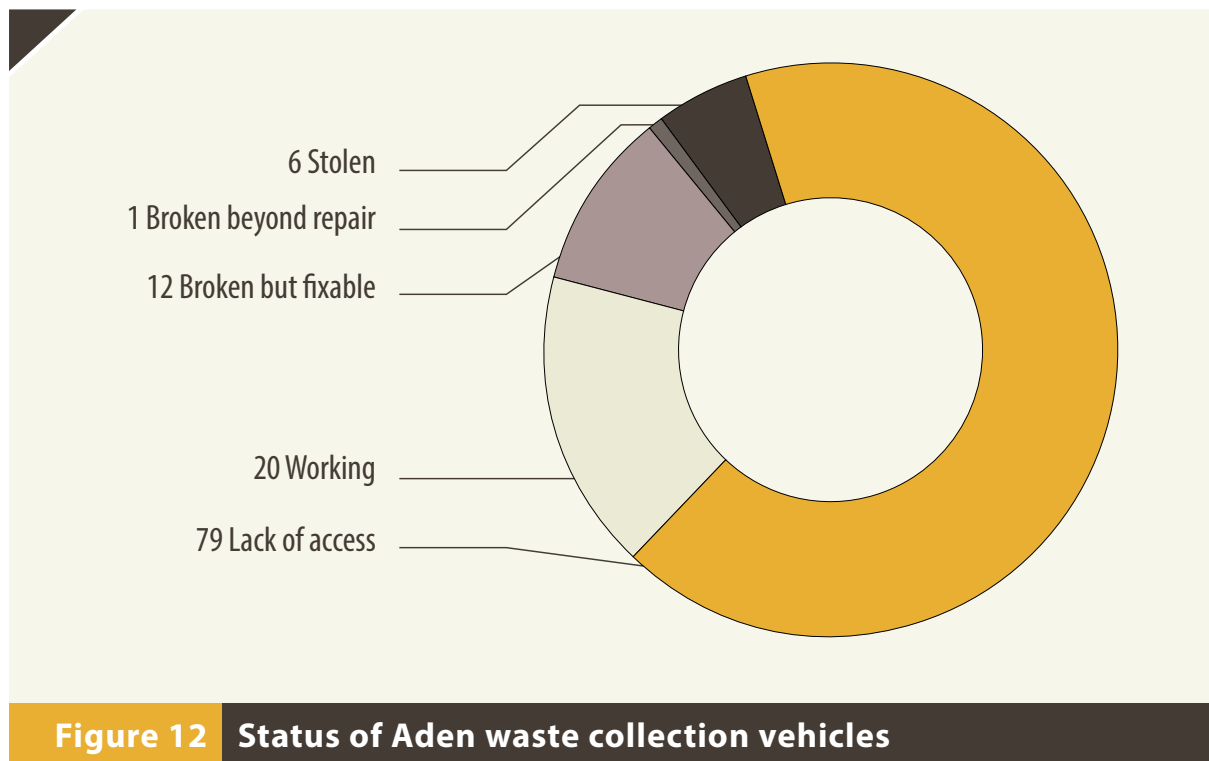
**Figure 11** Hajjah WM employees before and after the crisis

### Emergency Employment

Waste collection services improvement can first and foremost take the form of emergency employment. This should follow two pillars of intervention: Cash-for-Work, or whether more appropriate Food for Work; and support of CCIFs most impacted by staff shortages to regain previous employees.

The first type of intervention addresses the refuse accumulated due to insufficient collection, providing a swift response in light of the reactivation of the service. In cities that have not been object of other support actions, this activity would be most beneficial if paired with fuel distribution. The selection of Cash-for-Work beneficiaries should be structured to provide for the inclusion of vulnerable categories: women, especially women headed households, and marginalized groups such as the Al-Muhamasheen and people with disabilities.

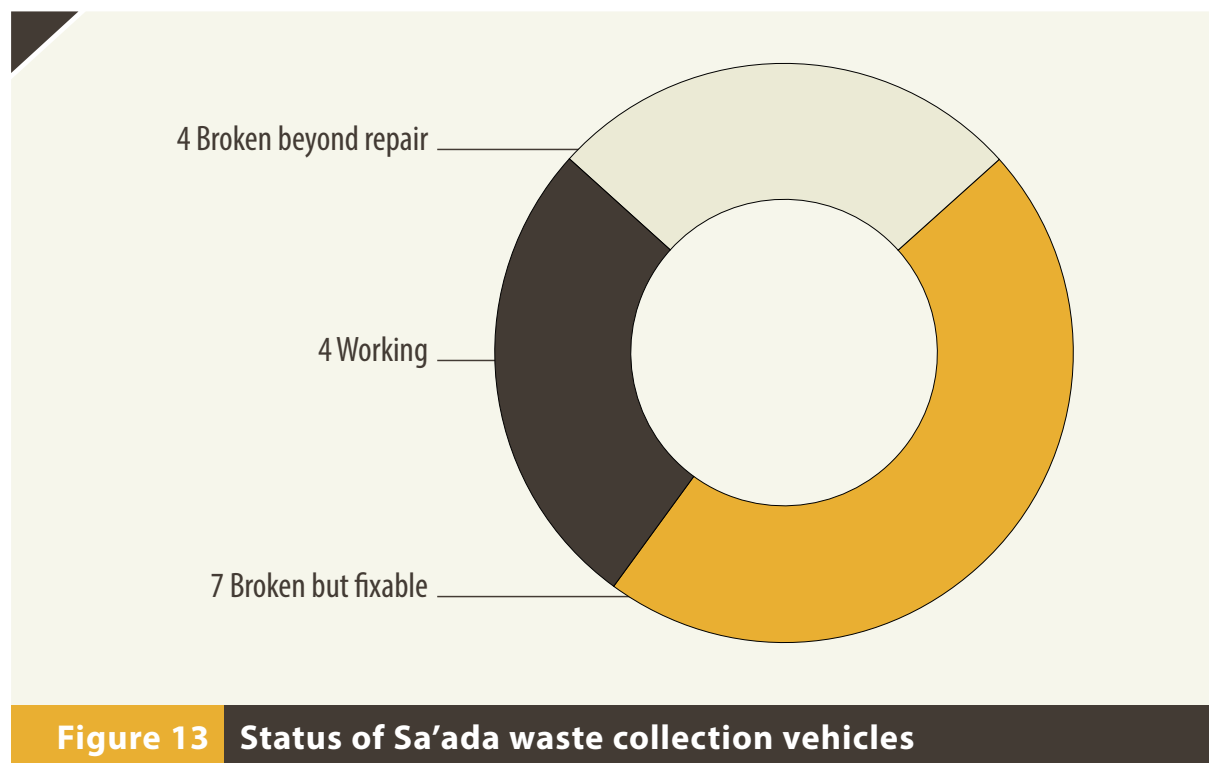
Targeting individuals from the Al Muhamasheen community would be especially beneficial for their traditional involvement in informal recycling, which has now almost stopped, and the opportunity of their integration, in the longer term, into the formal waste collection services.



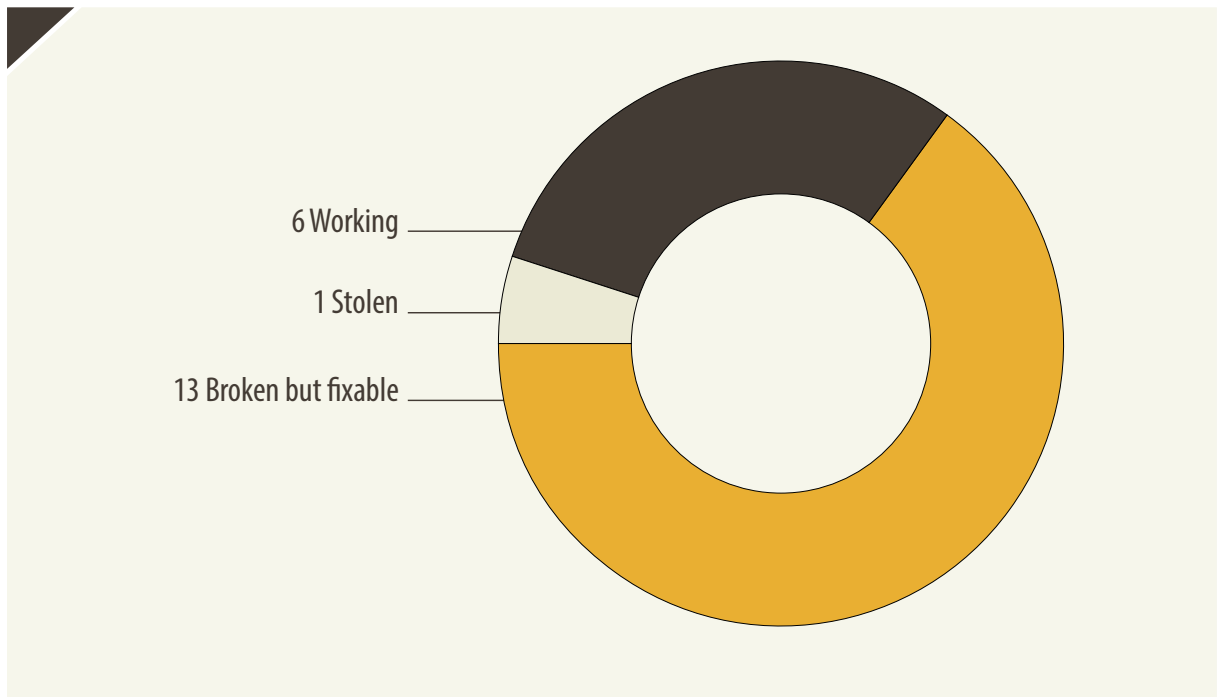
By targeting women-headed households and Al Muhamasheen members in Cash-for-Work activities might also contribute to reduce child labour by reducing the need for additional income and by allowing an entry point for children right advocacy and further protection actions.

The second activity aims at restoring the necessary amount of workers required for the provision of waste collection, bridging the financial needs of CCIFs and municipalities until the reactivation of normal financing channels. Among the five assessed cities, Aden and Hajjah would benefit most from such intervention since they have been the most impacted by a reduction in staff, as delineated by Figure 10 and Figure 11.

The suggested entry point would also be instrumental in improving workers health and safety (H&S): working in waste management is characterized by plenty of occupational hazards, which are amplified by the conflict. Lack of adequate personal protective equipment (PPE) has been highlighted amongst street sweepers and waste collectors, thus exposing all personnel to injuries and disease transmission. The intervention would then allow for the provision of protective equipment and even a voluntary vaccination campaign for selected diseases. PPE alone, however, are not enough to protect CCIF employees from the risks they face.



**Figure 13** Status of Sa'ada waste collection vehicles



**Figure 14** Status of Amran waste collection vehicles

It is therefore paramount that all workers involved with waste collection activities receive a induction training. This should cover an introduction to standard occupational hazards, proper use of PPE, as well as mine awareness and mine risk education (MRE) from the Yemen Executive Mine Action Centre (YEMAC). Given the documented risk of waste being contaminated with UXOs and ERWs, MRE is a crucial component that should be implemented systematically across the governorates that have experienced air strikes and armed clashes.

#### Vehicle rehabilitation

Only about half of the total motorized vehicle fleet for waste collection is currently operational and in working, as highlighted by Figure 6 in the previous section. Besides the majority of Aden equipment was inaccessible by local staff at the time of the assessment (Figure 12): their current status is unknown but it is to be expected damage and theft to have occurred during the recent battle for the control of the city.

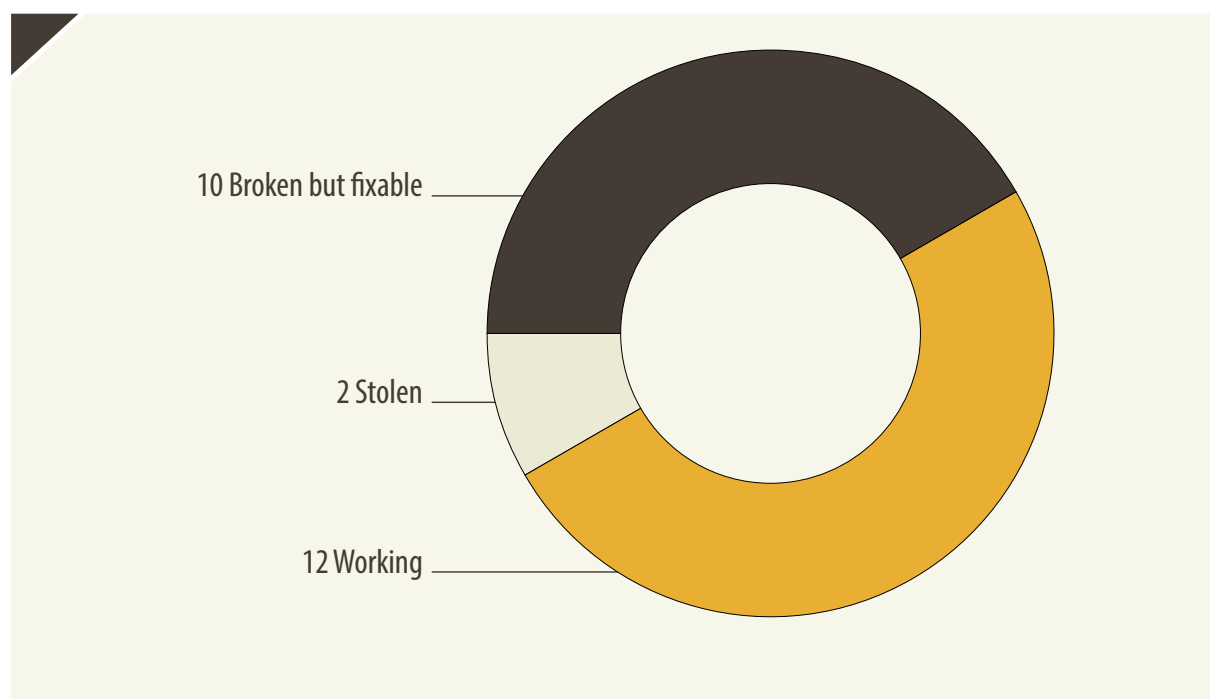
The survey found lack of spareparts as the main obstacle towards an effective maintenance of vehicles, with lack of maintenance skills and tools as a secondary issue. The rehabilitation of collection capacity should therefore pass through the rehabilitation of CCIF and local authorities vehicles. The priority cities identified are Amran, Al Mukalla, and Sa'ada, as these are the localities where most of the vehicles in need of repair are located.



The first pillar of the intervention is centered around the procurement and provision of the required missing parts to the relevant authorities: this would allow for an increased capacity in the short term and restore the ability of CCIF staff to provide waste collection.

The second pillar aims at increasing the resilience and long term capability to provide effective O&M for collection vehicles within the CCIFs, and to address the lack of maintenance skills and equipment. Building such capacity through the provision of specialized training for both the mechanics and managers will ensure an increased lifespan of the rehabilitated collection vehicles, as well as lower extraordinary maintenance costs decreased depreciation rates and consequently, reduced capital investment requirements in the long run.

It is worth noting, however, that there are just as many vehicles beyond repair as those that can be fixed. Therefore, CCIF will require the support of international donors for the acquisition of new vehicles and equipment.



**Figure 15** Status of Al Mukalla waste collection vehicles

### Disposal site improvement

The four assessed sites provide a good overview of the problem likely affecting most of dumpsites in Yemen; however, any intervention should be site specific and planned after an in depth assessment.

Open and underground fires provide an immediate threat to all workers on site, as well as providing acute and chronic health conditions and environmental damages. Furthermore, fire compromise the stability of the waste in the landfill, and increase the risk of landslides and mudslides. Consequently, it is highly advised to take immediate action to put off the fires in the dumpsites of Kudam, Ber Al Na'ama, and Al Ghalila.

Fencing is either absent or damaged in all four assessed sites providing free access to non-authorized personnel, livestock and scavengers: it is therefore recommended to repair the perimeter delimitations of the site.

Finally, similar to the intervention to improve waste collection, daily disposal operations would benefit from the rehabilitation of the heavy machinery currently not working: such equipment would allow for the compaction and daily cover of disposed waste, with immediate benefits in terms of leachate production, LFG generation and emissions, and vector breeding. These improvements in the overall site performance would also provide long terms benefits by reducing the impact of the dumpsites on groundwater sources, GHG emissions, and operational lifespan.

### Healthcare waste management

Waste from medical facilities is, for the most part, non-hazardous and can be assimilated to MSW. The lack of segregation of the hazardous components and the likelihood of hazardous healthcare waste ending up within the normal MSW stream poses a serious threat to all those in entering in contact with waste, waste pickers and waste collection crews through to local inhabitants unknowingly exposed to the risks of the transported waste.

Currently, the only HCW treatment facility, located in Sana'a, is not operational due to lack of fuel and O&M funds. The provision of a power generator, and the provision of fuel and temporary funds to run the facility would therefore allow for the safe treatment and disposal of hazardous waste from medical facilities.

These measures, nonetheless, must be accompanied by a concurrent capacity building exercise in the capital hospitals to address the underlying issue of source segregation implementation. This should consist in training the staff of medical facilities on the principles of HCW management, segregation at source and H&S paired with the provision of the required containers, and PPE for the safe storage and handling of HCW on the premises.

The set-up of an effective HCW management system in Sana'a would provide a pilot run and allow building a know-how in country to be disseminated, providing the basis for a broader intervention on a national scale.

### Recycling sector reactivation

Recycling is an important economic sector and a source of livelihoods for many among the most vulnerable sectors of society, such as marginalized groups and women-headed households. As such, the reactivation of the sector would provide a trickle-down effect.

Challenges posed by export restrictions, the lack of electricity, and collateral damages of the armed clashes have dramatically reduced the scope of recycling activities in Yemen, affecting the livelihoods of hundreds of people and disproportionately affecting the most vulnerable.

Even in the eventuality of the enforced import and export closure being lifted, the damages suffered by equipment and infrastructures and the lack of capital to buy the recyclables would not allow for an expedite recovery of the sector.

A business rehabilitation and business support intervention is therefore highly recommended to promote the reactivation of the now limited recycling market and promote the reestablishment and creation of livelihood among the Al Muhamasheen.

Formal businesses previously engaged in recycling should be offered grants for the restoration of damaged equipment, for the rebuilding of damaged sites, and seed funding for the purchase of recyclables from junkshops, factories, and waste pickers. The reestablishment of the recycling marketplace will be

**Picture 12** Damaged infrastructure at a recycling plant



especially important for the reactivation of other economic sectors, as it will provide salvage value from damaged equipment.

A second intervention to re-activate the market for recycled waste is to address the lack of electricity. This action is to target those industries that have maintained an intact processing capacity but that are still unable to operate due to lack of electricity;

Stimulating the demand for recycled materials will provide in itself the re-establishment of previously lost livelihoods amongst waste pickers. However, additional actions should be taken to ensure the integration of the informal sector within municipal waste collection, as this would allow for improved working conditions and access to social services, an increased recognition (and less stigmatization) and above all higher incomes.

The creation of waste pickers associations and cooperatives would respond to these objectives, with the additional benefits of improving the overall performance of local authorities in providing waste collection. Furthermore, this form of support to the informal sector would provide an entry point for building trust, a necessary condition for addressing other issues common among waste pickers, such as child labour.

Ensuring gender inclusion measures at consultation and implementation level is particularly important in this regard, as this is a male dominated activity where the women engaging in it usually come from particularly vulnerable households.

**Picture 13** A child picking up waste at Sana'a transfer station



## 5. PROVISIONAL BUDGET

The identified projects should target the localities where they can have the biggest impact in terms of public health and livelihood generation, therefore different cities will be object of differentiated interventions, as displayed in Table 11.

The provisional budget for the six projects is of US\$ 10,402,674; Table 12 provides a breakdown of the expenditure by intervention, whose details are provided in the following pages, in Tables 13 to 18.

Location/ Project	Cash-for-Work	CCIF Salary Payment	Vehicle Rehabilitation	Disposal Site Improvement	HCW Management	Recycling Reactivation
Aden	X	X		X		X
Hajjah	X	X		X		
Amran			X			
Al Mukalla	X		X	X		X
Sa'ada			X			
Sana'a					X	X

Activity	Locations	Beneficiaries	Duration	Cost
Cash for Work	Aden, Hajjah, Al Mukalla	Women, Al Muhamasheen	6 months	\$1,767,093
Salary Payment Support	Aden, Hajjah	Aden and Hajjah CCIF workers	6 months	\$2,740,465
Vehicle Fleet Rehabilitation	Amran, Al Mukalla, Sa'ada	Amran, Al Mukalla, and Sa'ada CCIFs	3 months	\$420,000
Disposal Site improvement	Aden, Hajjah, Al Mukalla	Aden, Hajjah, Al Mukalla CCIFs	3 months	\$314,418.6
Healthcare waste management	Sana'a	Sana'a hospitals and CCIF	6 months	\$1,044,651
Recycling sector reactivation	Aden, Al Mukalla, Sana'a	Recycling companies, waste pickers	6 months	\$3,170,348
Management & Administration	Aden, Amran, Hajjah, Al Mukalla, Sa'ada, Sana'a	-	6 months	\$945,697
<b>Total Budget</b>				<b>\$10,402,674</b>

<b>Table 13</b>		<b>Cash for work budget breakdown</b>			
Item	Units	Quantity	Unit Price (USD)	Total	
Daily workers wages	Person days	72,000	\$16.28	\$1,172,093	
PPE and tools provision	PPE and Toolkits	700	\$250.00	\$175,000	
Training (H&S & MRE)	Trainings	24	\$3,000.00	\$72,000	
Logistics (storage of tools, transport of workers etc)	Person days	72,000	\$5.00	\$60,000	
<b>Sub Total</b>				<b>\$1,767,093</b>	

<b>Table 14</b>		<b>CCIF salary payment support budget breakdown</b>			
Staff	Months	Beneficiaries	Salary (YER)	Salary (USD)	Total
Street Sweepers	6	1500	40,000	\$186.05	\$1,674,418
Drivers	6	90	65000	\$302.33	\$163,255
Collection workers	6	200	40000	\$186.05	\$223,255
Supervisors	6	230	70000	\$325.58	\$449,302
Mechanics	6	150	55000	\$255.81	\$230,232
<b>Sub Total</b>		<b>2170</b>			<b>\$2,740,465</b>

<b>Table 15</b>		<b>Vehicle fleet rehabilitation budget breakdown</b>		
Voice	Unit	Quantity	Unit Price (USD)	Total
Vehicle spare parts	Vehicles to repair	30	\$10,000.00	\$300,000
Workshop toolkit	Toolkits	3	\$25,000.00	\$75,000
O&M Training	Training courses	3	\$15,000.00	\$45,000
<b>Sub Total</b>				<b>\$420,000</b>

<b>Table 16 Disposal site improvement budget breakdown</b>				
Item	Units	Quantity	Unit Price (USD)	Total
Fire extinguishing	Heavy machinery	6	\$5,000.00	\$30,000
Vehicle rehabilitation	Vehicles to repair	16	\$15,000.00	\$240,000
Fencing repair	Mesh wire & poles	400	\$50.00	\$20,000
Labor	Person days	1,500	\$16.29	\$24,418
<b>Sub Total</b>				<b>\$314,418</b>

<b>Table 17 Healthcare waste management budget breakdown</b>				
Voice	Unit	Quantity	Unit Price (USD)	Total
Power generator (300kw)	Generator		\$30,000.00	\$30,000
Diesel	Liters	144,000	\$6.98*	\$1,004,651
O&M (lubricants, spares)	Kit	1	\$10,000.00	\$10,000
<b>Sub Total</b>				<b>\$1,044,651</b>

\* Based on highest diesel market price

<b>Table 18 Recycling sector reactivation budget breakdown</b>					
Activity	Unit	Quantity	Unit Price (YER)	Unit Price (USD)	Total
Equipment rehabilitation	Grant	50		30,000.00	\$1,500,000
Site renovation	Grant	20	15,000,000	69,767.44	\$1,395,348
Electricity supply					
(100 kw)	Generators	10		15,000.00	\$150,000
Pickers associations	Association	5		25,000.00	\$125,000
<b>Sub Total</b>					<b>\$3,170,348</b>

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