# Developing Zaatari

## Solid waste management in a Syrian refugee camp, Jordan


VNG
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City of
Amsterdam

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# Executive summary

**Currently Jordan is hosting around 1.5 million Syrian refugees. Many of them find shelter in the Northern regions of Mafraq and Irbid. Al Za'atari (Zaatari) is the largest of refugee camps in the region. It is located near the Syrian border and accommodates an estimated population of around 80,000 people.**

## Waste management

Camp Zaatari deals with the typical challenges and problems of a medium-sized city, including basic services concerning water supply, sanitation and hygiene – together known as WASH. Responsible for all WASH-services in the camp is UNICEF. One of these services concerns solid waste management. According to UNICEF, current solid waste handling leaves room for improvement in terms of economic and environmental sustainability.

## Assessment

In 2016 UNICEF invited the City of Amsterdam to assess the present collection and transport of solid waste inside the camp, aiming to explore more sustainable and economic viable solutions. Amsterdam is widely known for its experience in efficient waste management in dense urban environments. UNICEF provided Amsterdam with three research questions:

1. What can be a suitable **organisation** model for solid waste management in camp Zaatari?
2. What are the best opportunities to improve the **economics** of solid waste management?
3. How to improve the **quality** of solid waste (management) in terms of sustainability and relations with surrounding municipalities?

The scope of the assessment was not limited to camp Zaatari. It covers three municipalities in the neighbourhood of the camp as well: Al-Khalidiya, Zaatari village and Umm-al-Jimal.

## Programme setting

The setting for the involvement of Amsterdam can be found in the LoGoRep Programme[1] of VNG-International. This programme supports municipalities with capacity building and training to improve services like waste management and food production. The assessment has been done in close cooperation with the Jordanian consultancy company Green Future Sustainable Solutions in Amman. Their report *Solid Waste Management in the Za'atari Syrian Refugee Camp and neighbouring Host Communities* has delivered valuable input for this assessment report.

## Recommendations

Both the structure of this report and the recommendations follow the three main research questions as stated above. The recommendations are summarized on the next pages.

[1]) Local Governance Resilience Programme for the Middle East and North Africa

*Waste collection in camp Zaatari leaves room for improvement*

## Organisation

*Research question: what are suitable organisation models for solid waste management in Zaatari?*

**1. Leading role.** The most suitable and viable option for the future waste management is a leading role for UNHCR, with ample support form NGO's within the districts. For instance, Oxfam has relevant expertise in waste separation and recycling and could support these activities. There are four conditions to this organisation model: a decrease in the daily costs, additional funding for UNHCR, development of waste management knowhow, and a settlement between UNHCR and UNICEF on the transition period.

**2. Cooperation with municipalities.** Intensified cooperation with nearby municipalities might be fruitful. A suggestion is to start a pilot on waste collection in one or a few camp district(s), together with the community of Umm-al-Jimal. The pilot will clarify the capacity of the municipalities and the quality of their operations. Additionally, the municipalities get familiar with new methods of separation and recycling. Finally, the refugees might provide a valuable contribution to (inter)communal waste management.

**3. Quality control.** As the Green Future team noted, the quality of waste collection and transport in Jordan leaves room for improvement. Improving waste management in camp Zaatari and surroundings might set an example for Jordan in general. In terms of organisation, three improvements on a local/regional scale are highly recommendable: 1. More comprehensive guidelines and proper rules, 2. Instructions on deliveries both in the camp and the municipalities, 3. Higher level of control by the leading authorities. Such improvements could be part of the pilot mentioned above.

## Economics

*Research question: what are the best opportunities to improve the economics of solid waste management in and around Zaatari in terms of costs/income and new jobs?*

**4. Cash-for-work.** The cash-for-work programme on keeping the streets clean is relatively expensive (1,8 million JOD/year) and exhausts most of the year budget for solid waste management. These costs can be reduced substantially by replacing part of the clean-up work with jobs that actually add value: collection and sorting of waste into marketable fractions. Selling these fractions (resources) can partly compensate for the job salaries.

**5. Waste collection.** The operational costs for waste collection and transport are 0,4 million JOD/year and yield 750 m3 solid waste collected each day. This budget seems to be well spent; cutting the budget will most probably result in loss of quality.

**6. Less overhead.** The estimated costs of overall management (0,6-1,2 million JOD/year) should be looked into more depth: what is the exact amount, and where is it spent on? It is likely that, with a simpler organisation model, the costs of waste management can be reduced substantially, without loss of quality.

**7. Business case and donors.** It is recommended to build a business case for one or more recycling activities, based on the economic value of waste fractions. Additionally, it is needed to look for potential donors, interested in funding this business case for recycling. Candidates are for example Germany and Australia.

## Quality

*Research question: what are the opportunities to improve quality of solid waste management in terms of sustainability (recycling, litter) and relations with surrounding municipalities?*

**8. Upscaling district 7 pilot.** The pilot for separated collection of recyclables in district 7 requires upscaling to the whole camp. Benefits are: profit from economy of scale (less costs and more income per unit), more jobs for collection and sorting of waste, and a stable production of marketable quality recyclables. Therefor it is advisable to develop a business model for large scale recycling (equipment, finance, employment, expertise). For the initial investment in upscaling, donor aid is probably necessary.

**9. Sorting station.** A good start for upscaling is to design an upgraded sorting station. Plans should include a larger location for the station, finance, new equipment and improved business relations with recyclers and surrounding municipalities. Best approach is to find a few recyclers per waste fraction, who are willing to pay a proper price. Find additional buyers for high value fractions, such as metals and textiles.

**10. Cooperation with municipalities.** It is definitely worthwhile to search for options to work together more closely. For example, run a pilot in the joint collection of waste in both camp Zaatari (start with one district) and a municipality, or run a joint pilot in processing organic waste;

**11. Compost pilot.** The largest part of residual waste is organic material. Setting up a facility to transform separately collected organic waste into compost has several advantages: it reduces the amount of residual waste (and costs for transport to the landfill), it improves the quality of soils and decreases the necessity for using chemical fertilizers. A safe approach is to start a small scale pilot for processing organic waste into compost, in close cooperation with nearby farmers;

**12. Regional facilities.** Improve regional recycling facilities for cardboard, paper and plastics. These facilities will boost separation and recycling activities in the whole region, including camp Zaatari. Additional advantages: more jobs for Jordanians and Syrians and better quality of recycled products. To assess the threats and opportunities, a feasibility study (SWOT analysis) can identify promising entrepreneurs and the needs they might have in terms of support and/or incentives;

**13. Additional options.** A variety of additional options have been identified, which can be explored further along the road, such as reversed logistics, improved procurement, incentives and the awareness of households.

1

# Introduction

## 1.1 Camp Zaatari and waste management

The Syrian crisis poses a huge burden for the kingdom of Jordan. Since 2012 large numbers of refugees entered Jordan to find safe shelter for themselves and their families. According to recent data Jordan presently hosts at least 1.5 million Syrian refugees. Due to the influx of refugees, the population of the Northern governorate of Mafraq has been more than doubled. The refugees are accommodated in a number of host-communities and in refugee camp Zaatari (Al Za'atari). This camp, with a population of around 80,000 people, is the largest refugee camp in Jordan, and the second largest camp in the world.

Responsible for the overall management of camp Zaatari is the UN organisation UNHCR, supported by other UN-institutions like UNICEF and a number of international NGO's represented by Oxfam, Acted, JEN and NRC. They all assist on health care, education and basic services like water supply, sanitation and hygiene – the latter three also known as WASH. Responsible for all WASH-services is UNICEF, while daily operations are executed by the NGO's in cooperation with private contractors. One of these services is the management of solid waste in camp Zaatari.

## 1.2 Research questions

In 2016 UNICEF invited the City of Amsterdam to assess, in close cooperation with VNG-International, the day-to-day operations concerning solid waste, and consult on ways to achieve more economic viable and sustainable solutions. Amsterdam was invited because the city has a lot of experience in waste management, especially in a dense and heavily crowded environment, with all known forms of waste, litter and pollution. Amsterdam also practices a wide variety of waste collection, –separation and –recycling methods, aiming to achieve additional revenues and more sustainability.

UNICEF provided Amsterdam with three research questions:

1. What can be a suitable **organisation** model for solid waste management in camp Zaatari?
2. What are the best opportunities to improve the **economics** of solid waste management in and around Zaatari, in terms of added value, reducing costs, increasing income and new jobs?
3. What are the opportunities to improve the **quality** of solid waste (management) in terms of sustainability and relations with surrounding municipalities?

The scope of the assessment was not limited to camp Zaatari. It covers three municipalities in the neighbourhood of the camp as well: Al-Khalidiya, Zaatari village and Umm-al-Jimal.

### Programme setting

The setting for the involvement of Amsterdam can be found in the programme *International assistance to Zaatari and local governments in Al Mafraq Governorate*. This programme is part of the LoGoRep Programme[2] of VNG-International and aims at supporting municipalities with capacity building and training to improve services like waste management and food production.

[2]) Local Governance Resilience Programme for the Middle East and North Africa

*Plastics sorted out at the Oxfam waste station in camp Zaatari*

## 1.3 Methodology

The assessment has been done in close cooperation with the Jordanian consultancy company Green Future Sustainable Solutions in Amman, directed by Mr. Majed Jaber. Their report *Solid Waste Management in the Za'atari Syrian Refugee Camp and neighbouring Host Communities* has delivered very valuable input for this assessment report. In order to answer the research questions the following activities have been conducted:

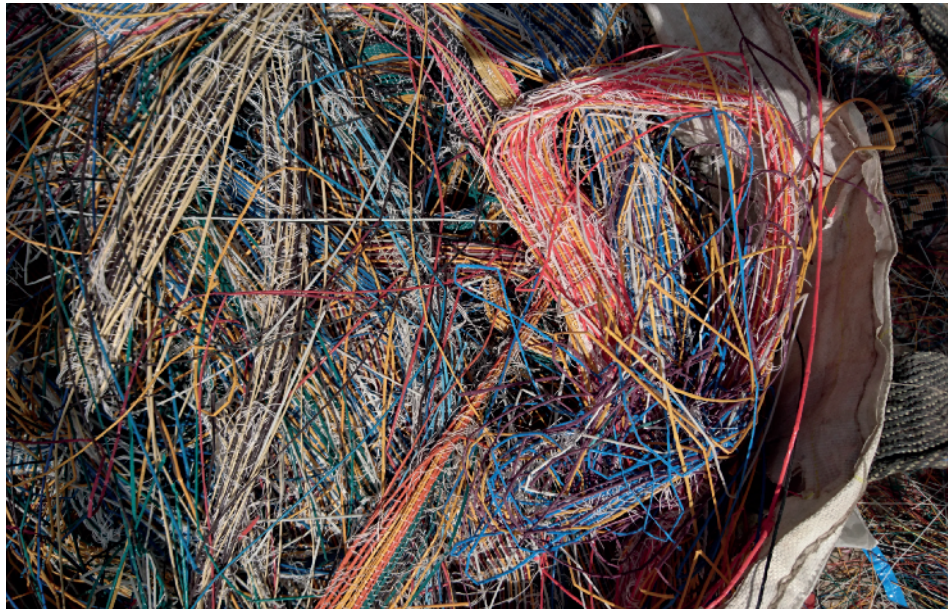
1. **Assessment:** Green Future consultants assessed the current waste handling situation in camp Zaatari and in three surrounding municipalities;
2. **Interviews:** eight main stakeholders have been interviewed (see Appendix 1);
3. **Field research:**
    - on site assessment of the current waste management situation;
    - on site assessment of the waste pilot (sorting for recycling) in camp district 7;
    - field trip to several recyclers in Jordan, with focus on the Northern region.
4. **Desk research:** study of reports and data (see references and appendices);
5. **Peer review:** peers commented on the draft report before sending to UNICEF.

## 1.4 Outline of the report

The report has been structured according to the three research questions stated by UNICEF. Each of the three questions will be addressed in a separate chapter: organisation (chapter 2), economics (chapter 3) and quality (chapter 4). Each chapter opens with a brief description of the present day situation, continues with identifying feasible options for the future, and concludes with a set of practical recommendations.
Waste analysis data and background information can be found in the appendices.

*Waste is being collected separately by handcart*

*And shredded...*



*And sorted...*

*And reused: pellets being fed into the plastic recycler*

# 2

# Organisation

## 2.1 Current situation

The organisation and management of solid waste in camp Zaatari is a common responsibility of a number of public and private stakeholders.

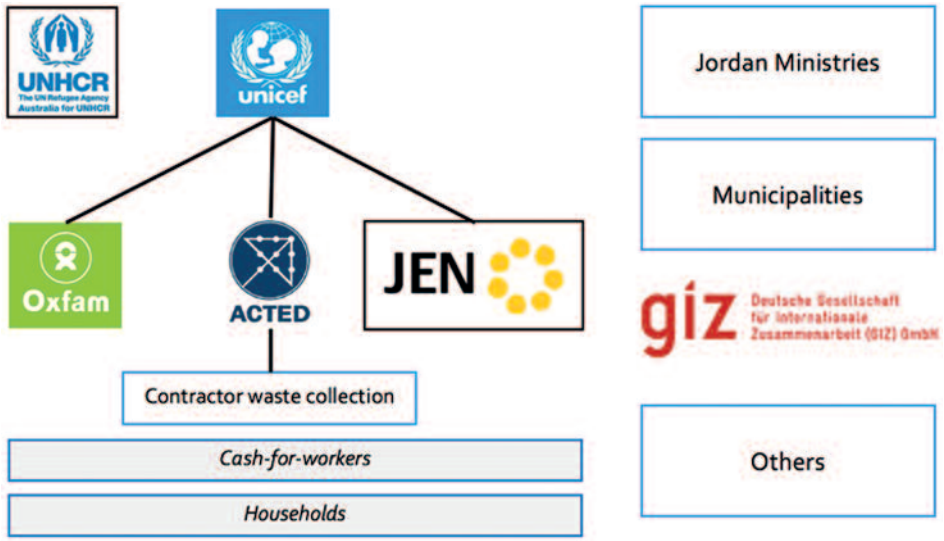
### Management

The general responsibility for the establishment and the overall management of the refugee camp belongs to UNHCR. The UN sister organisation UNICEF is responsible for WASH-activities, such as drinking water supply and sewerage. The UNHCR has given UNICEF full mandate to organize solid waste management as well.

Day to day waste handling is executed by three NGO's, each responsible for a number of districts: Oxfam (British) for the districts 6,7,8. ACTED (French) for districts 1,2,9,10,11 and JEN (Japanese) for districts 3,4,5. ACTED occupies a special position, as it is responsible for almost half the districts. Due to this position ACTED is responsible for contracting the private company collecting and transporting waste to the landfill. Oxfam plays an important role as well, as it started a pilot on waste separation and recycling in one of the districts.

### Operational workers

The operational workers, collecting the waste throughout the camp and cleaning the streets and other public spaces, are paid for by a special programme 'Cash-for-Work'. This programme, ranging wider than only waste management, is managed by the three NGO's and funded by UNICEF.




*Current organisation structure for solid waste management*

### Government

The Jordanian government is not actively involved in the (waste) management of the camp, as it considers emergency aid as a prime responsibility of the UN-organisations. However, the Ministry of Environment is setting the environmental standards for the collection and recycling of the different waste fractions, while the Ministry of Municipal Affairs and its Joint Services Council is responsible for the management of the landfills. The Ministry of Municipal Affairs also supports the nearby municipalities in the collection and transport of waste by supplying equipment and yearly funds.

*At the sorting station paper and cardboard are compressed into packages*


*Local communities, camp Zaatari and landfill Al-Husseinyyat*

### Municipalities

The three municipalities around the camp, Al-Khalidiya, Al Za'atari and Umm-al-Jimal are not involved in waste management inside the camp yet. However, they do pass the camp on their daily routes to the landfill Al-Hussainyyat, as can be seen on the regional map printed above. For the three municipalities, solid waste management is becoming an increasingly urgent challenge, as the volume of solid waste is almost doubled due to the influx of Syrian refugees.

### Consultants

The Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) is a NGO worth mentioning in particular, as it is developing a regional waste plan for Northern Jordan and has already started a few pilots on waste separation in villages near Irbid. GIZ also assessed current waste practices in a number of municipalities and presented methods to improve waste management quality. GIZ can be considered as one of the most experienced consultants on solid waste in Jordan.

## 2.2 Options

The overall responsibility for solid waste handling is a burden for UNICEF, as waste management is not the core business. As a result, UNICEF is financing the operations, but without having the knowhow, capacity and tools to actually lead and control. All necessary expertise is supplied by external parties, like NGO's and consultants. Understandably, UNICEF is keen to explore other organizational models. Therefore, in our assessment we considered a better allocation of responsibilities as well.

The most important consideration is that the overall responsibility for waste management in camp Zaatari should belong to one authority. This is desirable, because waste management needs one clearly defined representation to the Jordanian authorities, municipalities, residential focus groups, donor countries, UN institutions, private contractors and other external parties. Secondly, an equal quality of waste handling and cleaning throughout all the districts of the camp is best served under the management of one authority.

Theoretically, there are four potential candidates for taking the lead responsibility:

- **Government.** It is the policy of the Jordanian government to respect the autonomy of UN-organizations during the Syrian crisis. This means they don't intervene in the UN refugee camps;
- **Municipalities**. The nearby municipalities Al-Khalidiya, the village of Zaatari and Umm-al-Jimal have expressed their willingness to cooperate with camp Zaatari. However, they are not prepared to take over general responsibility at this moment. Their equipment is relatively modern, but the infrastructure and operational systems are not up to the task. Based on the report of the Green Future team, Umm-al-Jimal might qualify for the task in the future;

- **NGO.** Oxfam, ACTED and JEN have shown their concern and their capacity to run the daily operations, but a structural involvement and responsibility would require a long term financial foundation, and the readiness to operate under the command of one these NGO's;
- **UNHCR.** The UNHCR could take back overall responsibility for waste management from UNICEF, as it is part of their basic services in other refugee camps worldwide. An important condition however is the (re)allocation of funds, because UNHCR has no waste management budget for camp Zaatari in the coming years.

### Model with three pillars

Apparently there is no easy solution for a better organizational model, because all candidates are bound to specific restrictions, conditions and requirements. But considering all pro's and con's the UNHCR is probably the most suitable candidate for taking over general responsibility for waste management in camp Zaatari.

A shift of responsibility from one party to another will not guarantee a more economic and sustainable management of waste. In terms of organization, two additional improvements present itself in the current situation of camp Zaatari:

- As mentioned, the nearby municipalities Al-Khalidiya, the village of Zaatari and Umm-al-Jimal have expressed their willingness to cooperate more closely with camp Zaatari. Intensified cooperation is a logical step indeed, that might develop as a win-win situation for both camp Zaatari and the municipalities. A suggestion is to start a pilot on waste collection in one camp district, together with the community of Umm-al-Jimal;
- Solid waste handling in camp Zaatari has reached a certain degree of 'maturity'. In the first years of the camp UNHCR had to deal with very basic priorities of hygiene and waste removal. In present day solid waste handling is organised effectively and routinely, and attention might shift to improving quality control. As the Green Future team noted, the quality of waste collection and transport in Jordan leaves room for improvement. Improving waste management in camp Zaatari and surroundings might set an example for Jordan in general.

## 2.3 Recommendations - Organisation

*Research question: what are suitable organisation models for solid waste management in Zaatari?*

**1. Leading role.** The most suitable and viable option for the future waste management is a leading role for UNHCR, with ample support form NGO's within the districts. For instance, Oxfam has relevant expertise in waste separation and recycling and could support these activities. There are four conditions to this organisation model: a decrease in the daily costs, additional funding for UNHCR, development of waste management knowhow, and a settlement between UNHCR and UNICEF on the transition period.

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**3. Quality control.** As the Green Future team noted, the quality of waste collection and transport in Jordan leaves room for improvement. Improving waste management in camp Zaatari and surroundings might set an example for Jordan in general. In terms of organisation, three improvements on a local/regional scale are highly recommendable: 1. More comprehensive guidelines and proper rules, 2. Instructions on deliveries both in the camp and the municipalities, 3. Higher level of control by the leading authorities. Such improvements could be part of the pilot mentioned above.

# 3

# Economics

## 3.1 Current situation

The UNHCR and UNICEF provide all the basic services (shelter, health care, education, water, food and sanitation) inside camp Zaatari. Syrian refugees face many legal obstacles for performing any income generating activity in Jordan or in the camp. Instead, UNICEF offers a so called 'Cash-for-work' programme inside the camp, that delivers important economic support and is actually the only cash assistance.

### Cash-for-work

Currently there are around 740 Cash-for-work jobs in camp Zaatari for solid waste services. Cleaners pick waste in the streets (paper, bread and plastics). On a daily basis 50 to 60 Cash-for-workers and foremen are involved in the process of waste collection in streets and other public space.

| Role | Number | JOD/week | JOD/year |
|---|---|---|---|
| Leader | 60 | 75 | 0,2 million |
| Cleaner | 680 | 45 | 1,6 million |
| **Total** | **740** | | **1,8 million** |

*Operational costs of Cash-for-work jobs in camp Zaatari (Green Future, 2016)*

### Hiring private contractor

The waste collection system is operated by a private contractor from Mafraq, formerly known as El-Motakhasesah Company for Trade Services (SCTS). The contractor runs 3 compactors and 4 rental-trucks with different volumes and operates its own maintenance station. The contractor for waste collection also hires a number of Cash-for-workers. The crew of each truck consists of one Jordanian driver and three Cash-for-workers. At the waste compactor there is one Jordanian driver and two Cash-for-workers.

### Management costs

Roughly speaking we can split the total costs of solid waste management in camp Zaatari into 'operational costs' and the overhead or 'management costs'. The operational costs of actual collection, cleaning, transport and dumping are approximately 2,2 million JOD[3] per year. Street cleaning by Cash-for-Workers accounts for the most important part of operational costs: 1,8 million JOD per year.

| Cost type | JOD/year | JOD/year |
|---|---|---|
| Total reported operational costs | | 2,2 million |
| Collection and transport | 0,4 million | |
| Cash-for-work | 1,8 million | |
| Management costs (assumed) | | 0,6-1,2 million |
| **Overall costs as reported by UNICEF** | | **2,8-3,4 million** |

*Estimated waste management costs in camp Zaatari (Green Future, 2016)*

Although total operational costs account for 2,2 million/year, UNICEF reports an overall expense of 2,8-3,4 million JOD per year. This 'gap' consists of a variety of costs that are neither specified nor exactly traceable, but it is safe to assume these costs are current overhead costs of various stakeholders.

[3]) JOD = Jordanian Dinar (value of 1 JOD roughly equals 1,4 US Dollar or 1,25 Euro)

*Making of cardboard from recycled paper*

## 3.2 Options

Paragraph 3.1 shows that the costs of solid waste management are considerable, without any benefits to balance these costs. UNICEF has therefore decided to reduce the budget for Cash-for-work jobs in camp Zaatari. ACTED/JEN already managed to reduce the number of Cash-for-workers gradually from March 2016 onwards. The following options suggest additional ways to reduce solid waste costs, and ways to raise financial benefits.

### Change Cash-for-work programme

A substantial cost reduction of the Cash-for-work programme can be realized when the activities within this programme change: there is a need for jobs which actually create an added value. This added value will be created when recycling activities are expanded: new jobs will emerge in collection and sorting of recyclables which can (partly) compensate for job losses due to possible budget cuts in the Cash-for-work programme. Another effect of the expending recycling activities is lower amounts of residual waste to be transported to the landfill. This results in lower costs for transport to and gate fees at the landfill site.

### Business case and donors

Several waste fractions have an economic value as recyclable if handled properly. Based on this economic value, a business case can be built for one or more of the recycling activities. Additionally, it is needed to find donors who are willing to invest in the business case. Germany and Australia already expressed their interest in funding solid waste management projects.

### Reduce overall management costs

The current management costs, up to 1,2 million JOD/year, are high and it is recommendable to check these data. Request more precise financial information from the NGO´s, label and reduce the overhead budget for 2017 and decide who will be accountable for what costs.

## 3.3 Recommendations - Economics

*Research question: what are the best opportunities to improve the economics of solid waste management in and around Zaatari in terms of costs/income and new jobs?*

**1. Cash-for-work.** The cash-for-work programme on keeping the streets clean is relatively expensive (1,8 million JOD/year) and exhausts most of the year budget for solid waste management. These costs can be reduced substantially by replacing part of the clean-up work with jobs that actually add value: collection and sorting of waste into marketable fractions. Selling these fractions (resources) can partly compensate for the job salaries.

**2. Waste collection.** The operational costs for waste collection and transport are 0,4 million JOD/year and yield 750 m3 solid waste collected each day. This budget seems to be well spent; cutting the budget will most probably result in loss of quality.

**3. Less overhead.** The estimated costs of overall management (0,6-1,2 million JOD/year) should be looked into more depth: what is the exact amount, and where is it spent on? It is likely that, with a simpler organisation model, the costs of waste management can be reduced substantially, without loss of quality.

**4. Business case and donors.** It is recommended to build a business case for one or more recycling activities, based on the economic value of waste fractions. Additionally, it is needed to look for potential donors, interested in funding this business case for recycling. Candidates are for example Germany and Australia.

*'New' cardboard*

*Putting cardboard and foil together*

*Cutting to size*

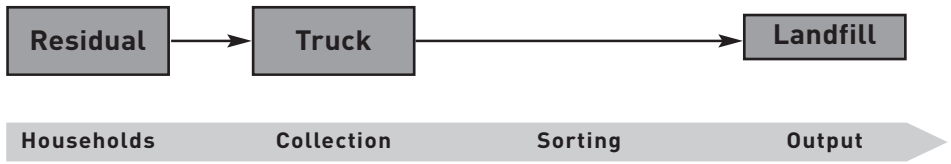

4

# Quality

## 4.1 Current situation

Present day, households and shops in camp Zaatari dump their solid waste in 1.1 m3 containers on the side of the street. Pick-up trucks (5 m3) collect the containers on a daily basis, bringing them to larger compactors with a volume of 16 m3, which are subsequently transported to the landfill. It is estimated that about 750 m3 of commingled solid waste is collected every day, of which 100% is transported to the landfill. According to Al Hussainyyat landfill records, each day trucks from camp Zaatari deliver 60 – 80 tons of solid waste to the landfill. There is no separate collection of recyclables that can be reused.

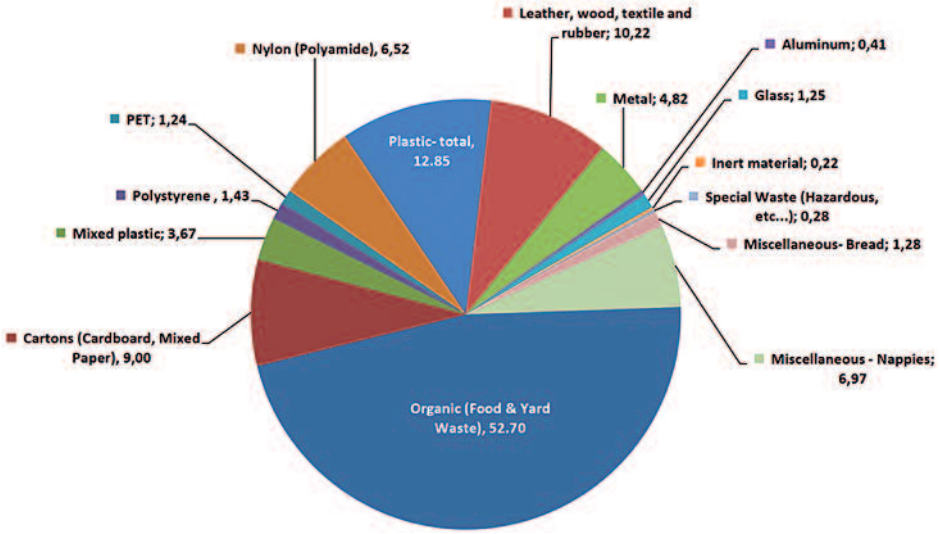
The collection system is operated by a private contractor from Mafraq, formerly known as El-Motakhasesah Company for Trade Services (SCTS). The contractor runs 3 compactors and 4 rental-trucks with different volumes and operates its own maintenance station.




*Current waste collection system*

### Composition of waste

In 2014 Oxfam analysed the composition of solid waste from camp Zaatari (Figure 4.2). The pie chart shows that organics (52%), cartons and plastics are relatively large fractions.

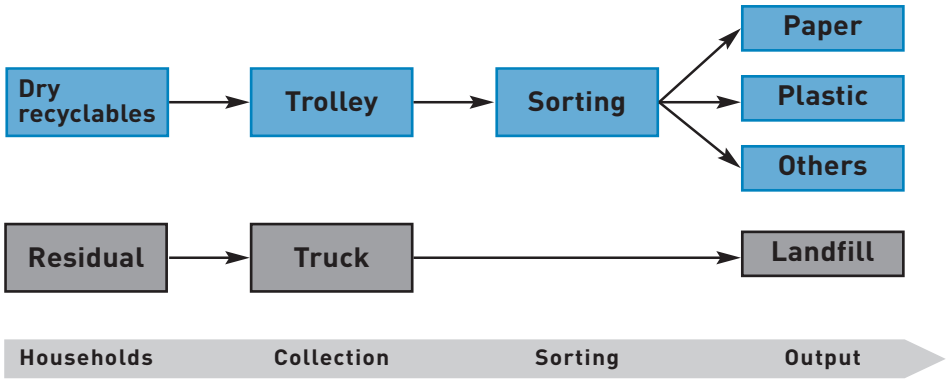



*Composition of residual waste in Camp Zaatari.*
*Note: Nylon is HDPE and/or LDPE film grade*

### Separation pilot in district 7

Oxfam recently launched a pilot in district 7 on the separation and recycling of solid waste. The pilot involves 7.250 people, with a participation of more than 95% of the refugees in the area. Inhabitants separate their dry and wet waste on household level. Every day, cash-for-workers collect the dry waste by trolley and cart the waste to a sorting station in the south-east corner of the camp. At this sorting station paper and cardboard are compressed to packages, plastics are grinded and other materials like metals, aluminium, glass, textiles and fabricants are sorted out. The products are sold to buyers in Amman.
The profits are low due to the small and unstable deliveries, and the long distance to Amman. Nevertheless, the intermediate results are promising and have significant future potential.

*Recycled plastic put to new use*




*Pilot in separate waste collection in district 7*

### Recycling plants

There is one cardboard-factory located in Al-Khalidiya, producing 3.5 ton cardboard daily for the local market (70%) and export to Iraq and Saudi-Arabia (30%). The factory intends to expand and requested an area of 15 donum[4] from the municipal government, where investments will be done by the present owner. It employs 45 workers, both women and men, both Syrian and Jordanian. At the gate they pay around 35 JOD/tonne for a mixed stream of carton and plastics. Another factory at Umm-al-Jimal has been closed some years ago.

Plastic recyclers are mainly located in or near Amman. They mainly focus on post-industrial and retail waste. Visited facilities are operated with outdated equipment and should be considered as an informal sector. There are hardly any plants for composting of organic waste in Jordan. There used to be one recycler of glass, which has been closed.

## 4.2 Options

The boundaries of the current waste management system leave room for minor improvements only. The containers could be emptied and cleaned more often to prevent littering and vermin, and thus improve health conditions. Secondly, adding a hydraulic lift on the pick-up trucks would be an improvement because the containers are very heavy.

### 4.2.1 Boost recycling

Such minor improvements will not substantially increase the quality of waste management though. Real quality improvement depends on a more advanced method of waste management, collection, separation and marketing. The pilot in district 7 is an excellent starting point, but the scale is too small to become economically viable. Upscaling the pilot to the whole camp (and even beyond) might change that perspective significantly, because it will be possible to generate a stable output of marketable materials, especially for compost, glass, metals and plastics. Upscaling demands 4 resolute measures and investments, in order to provide the necessary economical and technical basis:

**1.** Upscaling collection of recyclables
**2.** Upgrading the sorting station
**3.** Cooperating with surrounding municipalities
**4.** Improving regional infrastructure for recycling

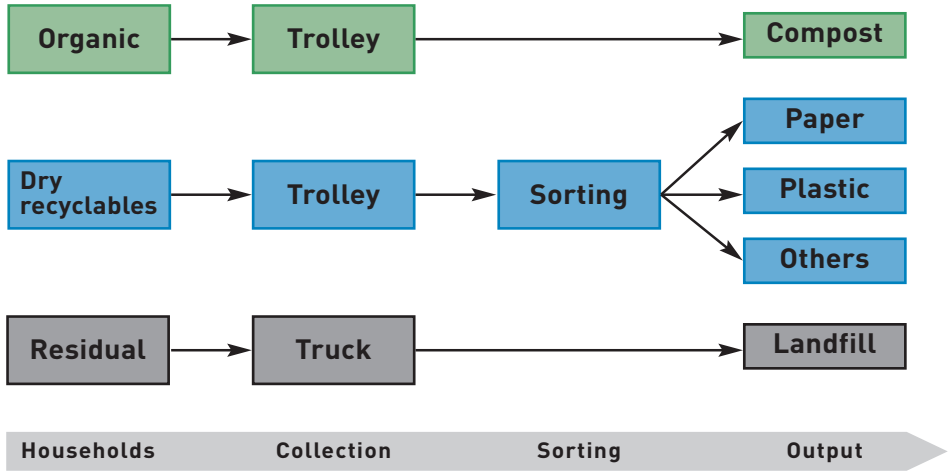
#### 1. Upscaling collection of recyclables

Expanding the pilot in district 7 to the whole camp will induce the desired 'economy of scale', with lower costs and higher income:

- Lower costs: handling costs per unit of waste decline rapidly. Less residual waste has to be transported to the landfill. Less littering;
- More income: production of recyclables becomes larger and more stable in terms of output and quality. This increases the market potential for recyclables. As a result more jobs are created for the collection and sorting of waste (Cash-for-work), that are partly paid for by selling recyclables.

[4] ) Traditional Ottoman unit of area. 1 donum = roughly 1,000 $m^2$

Paper, plastics, glass, metals ('dry recyclables') and organic waste have the most potential as recyclables. Therefore it is advisable to start a pilot with separate containers collecting paper/cardboard, plastics and separate containers for organic waste. The remaining is still to be transported to the landfill.




*Waste collection with separate collection of organic waste*

### 2. Upgrading the sorting station

Upscaling recycling from district to camp will require a larger, more sophisticated sorting station. This will enable the possibility to produce better quality recyclables and accommodate the larger input of waste containers. Even better, it will be possible to create simple 'new' products out of the recyclables, which are relevant for the camp itself (compost, packaging). Surrounding municipalities might be interested to use the sorting station in the future as well, or learn and set-up a similar station in their municipality. Upgrading the sorting station for camp Zaatari needs a new facility that meets the following requirements:

- **Plot.** The new plot is preferably outside residential areas, easily accessible for partners and clients from outside the camp. There should be enough room to accommodate the input of waste from the whole camp and to process different waste fractions, like composting organic waste. A location next to water treatment enables a washing street and/or composting;
- **Building.** The sorting station needs hard floors (steel, concrete) and windbreakers to improve the quality of sorted materials. Gravel on the current station floor causes problems with the rotor of the grinder. Improved quality of sorted materials will lead to better prices on the recycling market. In addition, it is recommended to build a roof to improve working conditions;
- **Machinery.** The new station needs additional machinery such as: a second grinder (to prevent risk of downtime), washing street (to improve quality), spike (to lift heavy items), weighing equipment (to be able to measure). Take into account that delivery times for new equipment can be 6-12 months;
- **Training.** Employees need training in using the machinery and improve the quality of sorting.

### 3. Cooperating with surrounding municipalities

It is highly recommendable to look into the possibility of closer cooperation with surrounding municipalities. Waste collection, transport and recycling can be much more efficient when done in close cooperation.
Advantages are for instance: more frequent collection, better funding for newer equipment, better trained staff and eventually more jobs for both Syrians and Jordanians. For surrounding municipalities cooperation with camp Zaatari can be profitable because municipal trucks for collecting and transporting waste can be utilized more efficient (routing, extra hours, fill half empty trucks). Furthermore, municipalities can easily participate, without high investments, in the new recycling system of camp Zaatari.

Closer cooperation might be easier said than done. The first ground-breaking steps could be:

- A pilot for collection and transport of waste in one district of camp Zaatari, in close cooperation with one adjacent municipality. Umm-al-Jimal might be a good candidate, because they have the largest capacity, the camp is mainly located on

their territory, cooperation is already good, and the municipality is already nominated for the GIZ maintenance programme;

- Another opportunity is to share a repair unit for collection equipment, in cooperation with GIZ;
- Improvement of municipal waste management with training on fleet management, routing, maintenance, implementation of GIS-infrastructure, cooperation between the municipalities.

#### 4. Compost pilot

The largest part of residual waste is organic material. Setting up a facility to transform organics into compost has some serious advantages: it reduces the amount of residual waste (and costs for transport to the landfill), it improves the quality of soils and decreases the necessity for using chemical fertilizers.

In Jordan the market for compost from organic waste is uncharted territory, but with high potential. The potential quantity is significant as well. Camp Zaatari only produces about 30 to 40 tonnes of organic waste each day, and samples in district 8 have shown (see appendix 4) that the quality is good. The mayor of Al Khalidiya reported a yearly production of 400.000 ton of organic waste (manure and agricultural waste). The mayor also suggested to start a composting facility inside his municipality. In this line of thought we can make three recommendations:

1. Identify the most promising approach: the right scale and technique (composting and/or digestion);
2. Set up a small scale pilot plant for processing of organic waste, in cooperation with surrounding farmers and municipalities;
3. An alternative might be a cooperation with greenhouses near Amman, Mafraq or the Jordan Valley, and with initiatives like 'greening the dessert'.

One of the perceived problems is a lack of awareness. To address this issue it might be interesting to run a pilot or 'test' with farmers (in greenhouses too) which demonstrates how compost works. This might decrease cultural barriers for using waste and waste water in the food chain. Meet up with local farmers to analyse what fertilizers they are using now and their potential interest in compost.

#### 5. Improving regional infrastructure for recycling

The last but crucial part of the recycling chain processing the reusable waste fraction into a marketable product. The regional recycling infrastructure in Jordan is still young and relatively undeveloped. The table below briefly summarizes the regional recycling facilities for the processing of compost, paper and plastics

The table reveals that the region is in need of a good compost facility for organic waste and a new plant for the processing of plastics. For paper it seems that expansion of the existing plant in Al-Khalidiya might be sufficient in the short term. Appendix 3 analyses the situation in more depth.

| | Compost | Paper | Plastics |
|---|---|---|---|
| **Potential** | Promising | Good | Good |
| **Recycling plants** | Not available in the region | One facility in Al Khalidiya | Basic facilities near Amman |
| **Recommended action** | Pilot with small scale processing plant, together with municipalities around camp Zaatari | Support expansion of existing plant | Start a new regional recycling facility |

*Recycling infrastructure around camp Zaatari*

### 4.2.2 Additional options

In the long term, some additional options are worth being explored:

- Reversed logistics: currently about 50% of total waste handling costs are spent on transport. Using empty cargo space of returning delivery trucks for sending recyclables to buyers in Zarqa or Amman can significantly reduce these costs. A good strategy is to start a pilot with paper, plastics or metals because these are 'clean'. Find out return destinations of leaving trucks, how much space they offer and involve their management;
- Procurement: identify opportunities to lower potential amounts of waste in the camp, for example by stimulating reusable packaging;

- Other materials: when recycling of paper, plastics and organics gathers momentum, expand the recycling programme with glass, metals and textiles;
- Incentives: in the long run solid waste separation and the purity of fractions can benefit from implementing an incentive scheme for households, for example via a reversed vending system;
- Awareness: communicate to households on the importance of waste separation via the collection trollies. Empower change of behaviour with education, competition between districts, art-from-waste et cetera.
- Creative solutions: reward out-of-the-box thinking, for example by giving awards for smart solutions like a greenhouse made of PET bottles et cetera.

## 4.3 Recommendations - Quality

*Research question: what are the opportunities to improve quality of solid waste management in terms of sustainability (recycling, litter) and relations with surrounding municipalities?*

**1. Upscaling district 7 pilot.** The pilot for separated collection of recyclables in district 7 requires upscaling to the whole camp. Benefits are: profit from economy of scale (less costs and more income per unit), more jobs for collection and sorting of waste, and a stable production of marketable quality recyclables. Therefor it is advisable to develop a business model for large scale recycling (equipment, finance, employment, expertise). For the initial investment in upscaling, donor aid is probably necessary.

**2. Sorting station.** A good start for upscaling is to design an upgraded sorting station. Plans should include a larger location for the station, finance, new equipment and improved business relations with recyclers and surrounding municipalities. Best approach is to find a few recyclers per waste fraction, who are willing to pay a proper price. Find additional buyers for high value fractions, such as metals and textiles.

**3. Cooperation with municipalities.** It is definitely worthwhile to search for options to work together more closely. For example, run a pilot in the joint collection of waste in both camp Zaatari (start with one district) and a municipality, or run a joint pilot in processing organic waste;

**4. Compost pilot.** The largest part of residual waste is organic material. Setting up a facility to transform separately collected organic waste into compost has several advantages: it reduces the amount of residual waste (and costs for transport to the landfill), it improves the quality of soils and decreases the necessity for using chemical fertilizers. A safe approach is to start a small scale pilot for processing organic waste into compost, in close cooperation with nearby farmers;

**5. Regional facilities.** Improve regional recycling facilities for cardboard, paper and plastics. These facilities will boost separation and recycling activities in the whole region, including camp Zaatari. Additional advantages: more jobs for Jordanians and Syrians and better quality of recycled products. To assess the threats and opportunities, a feasibility study (SWOT analysis) can identify promising entrepreneurs and the needs they might have in terms of support and/or incentives;

**6. Additional options.** A variety of additional options have been identified, which can be explored further along the road, such as reversed logistics, improved procurement, incentives and the awareness of households.

# 5

# Next steps

The previous chapters on improving organisation, economics and quality of the waste management system concluded with a variety of recommendations. Looking over these recommendations, it is possible to identify some practical steps worth taking in the short term:

### Organisation of waste management

1. Taking decisions on the overall responsibility for waste management in camp Zaatari would be a rational and important first step;
2. It might pay off to explore the willingness of a surrounding municipality (or multiple ones) on taking a role in waste collection and -transport in the camp;
3. Thirdly, it is recommendable to make an action plan for improving the quality of waste collection in the camp, in cooperation with surrounding municipalities.

### Economics and quality of waste management

1. A detailed assessment of the costs of waste collection, including overhead costs, can identify in better detail where to cut unnecessary costs;
2. It is desirable to start with expanding and upgrading the waste sorting station, making it possible to improve the quantity and quality of recycling;
3. For generating additional income it is sensible to redesign the Cash-for-work programme into a cleaning-and-recycling programme;
4. Given the good potential for compost as regional fertilizer, a pilot on composting organic waste would be a most promising step, involving nearby farmers and communities;
5. Finally, we recommend to discuss the feasibility of expanding and upgrading regional facilities for recycling cardboard, paper and plastics.

*Greenhouse made from plastic bottles*

### Support available

If desired, the City of Amsterdam in cooperation with VNG-International, kindly offers to support several of these 'next steps', for example in an advisory role or by performing assessments focussed on:

- Improving waste collection practices in the camp and surrounding municipalities, in close cooperation with GIZ consultants;
- How to upgrade the waste sorting station, including design, construction, equipment and funding;
- Setting up a pilot on organic waste composting, in cooperation with farmers and other stakeholders;
- Help developing plans for upgrading regional recycling facilities in Northern Jordan.

*Compost produced at the Oxfam waste station in camp Zaatari*

# References


- European Union (2016, July 7). *Mogherini at EP: EU help to Lebanon / Jordan on Syrian refugees, Venezuela crisis & West Bank.* Retrieved from European Union External Action: http://www.eeas.europa.eu/top_stories/2016/110516_ep-plenary_en.htm

- Eurostat (2016, June 6). *Glossary: Recycling of waste.* Retrieved from Eurostat -Statistics Explained: http://ec.europa.eu/eurostat/statistics-explained/index.php/. Glossary: Recycling of waste.

- Green Future Sustainable Solutions (2016). *Solid Waste Management in the Za'atri Syrian Refugee Camp and neighbouring Host Communities.* Amman/The Hague, VNG International.

- Oxfam (2015). *Oxfam Za'atari Refugee Camp Recycling Project - Feasibility Study.* More than Shelters.

- Google Maps (2016, August 6) http://www.google.nl/maps

- UNICEF (2016). *Cash for work in the WASH sector – Zaatari camp*, Jordan. UNICEF.

# Colophon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*August, 2016*

# Appendices

1. List of interviews
2. Waste management in surrounding municipalities
3. Market opportunities for reusables
4. Compost sample analysis, camp Zaatari

# Appendix 1 List of interviews

- UNICEF, Mr. Esmaeil Ibrahim
- UNHCR, Mr. Hovig Etyemezian and Mrs. Jill Lauren Hass
- Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), Mr. Ralf Senzel
- Ministry of Environment, Mr. Mohamed Khashashneh
- Embassy of the Kingdom of the Netherlands, Mrs. Lina Baj
- Municipality of Al-Khalidiya, Mayor Mr. Aid Al-Khaldi
- Municipality of Al Za'atari, Mayor Mr. Abdulkarim M. Al-Khaldi
- Municipality of Umm-al-Jimal, Mayor Mr. Hassan Fahd Al-Rahiba
- Paper recycle plant Al-Khalidiya, Mr. Abu Raed Al-Khaldi
- Sahab Plastic Company, Mr. Saeed Al Jawabreg
- LDK Consultants, Mr. Constantinos Nicolopoulos
- Oxfam, Mr. Wesam Al Sharafat
- ACTED, Mr. Shavkat Iminov
- Ministry of Agriculture, Mr. Awni Shdaifat
- Ministry of Municipal Affairs, Mr. Rakez al Khalaileh

# Appendix 2 Waste management in surrounding municipalities

| Al-Khalidiyah | |
|---|---|
| Population | 35.000 |
| Workers | 30, 7 with special needs, 1 foreman, 3 guards. |
| SWC Compactors | 6 compactors + 1 not operational. 6-8-16 tons |
| Crew of each Compactor | driver + 2 workers |
| Working Shift | 6 hours / day |
| Distance to Landfill | 15 km |
| Fuel Consumption | 14 – 20 / compactor / day |
| Daily Waste Tonnage | 24 tons / day |
| No. of MSW containers | 280 1,1 m3 bins + 90 L used oil barrels |
| Costs maintenance | 40.000 JD / year |

| Al-Za'tari + W Al-Manshieh | |
|---|---|
| Population | 21.000 |
| Workers | 12. |
| SWC Compactors | compactors 6-8-16 tons |
| Crew of each Compactor | driver + 2 workers |
| Working Shift | 6 hours / day |
| Distance to Landfill | 5 km |
| Fuel Consumption | 300 liters / compactor / day |
| Daily Waste Tonnage | 30 tons / day |
| No. of MSW containers | 800 1,1 m3 bins + used oil barrels |
| Costs maintenance | n.a. |

| New Oum Al-Jemal | |
|---|---|
| Population | 45.000 |
| Workers | 26 - 30. |
| SWC Compactors | 9 compactors 6-8-16 tons |
| Crew of each Compactor | driver + 2 workers |
| Working Shift | 4 hours / day |
| Distance to Landfill | 12 km |
| Fuel Consumption | 667 liters / compactor / day |
| Daily Waste Tonnage | 40 tons / day |
| No. of MSW containers | 2000 1,1 m3 bins + used oil barrels |
| Costs maintenance | 12.000 JD / year |

**Source: Green Future, 2016**

# Appendix 3 Market opportunities for reusables

### Market for recycling organics

In Jordan the market for compost from organic waste is uncharted territory, but with high potential. The potential quantity is significant as well. Camp Zaatari only produces 30 to 40 tonnes of organic waste each day, and samples in district 8 have shown (see appendix 4) that the quality is good. The mayor of Al Khalidiya reported a yearly production of 400.000 ton of organic waste (manure and agricultural waste). Making use of compost has some serious advantages: it reduces the amount of residual waste, it improves the quality of soils and decreases the necessity for using chemical fertilizers.

The mayor of Al Khalidiya also suggested to start a composting facility inside his municipality. Setting up good composting facilities in the region is important. Three recommendations:

1. Identify the most promising scale and technique (composting and/or digestion);
2. Set up a small pilot plant for processing organic waste, in cooperation with surrounding farmers and municipalities;
3. An alternative might be a cooperation with greenhouses near Amman, Mafraq or the Jordan Valley, and with initiatives like 'greening the dessert'.

For a successful pilot it is recommendable to carefully involve local farmers. For example by transferring knowhow (increasing awareness), demonstrations on how compost works, and local 'field tests' in which the use of compost is compared to the use of chemical fertilizers. This might reduce hesitations to use 'waste' in the food chain as well. As a start, meet up with local farmers to see what fertilizers they are using now and their potential interest in compost.

### Market for recycling paper

There are some regional facilities for cardboard and paper recycling, but they leave room for improvement. The development of new (and optimise existing) recycling facilities in the region will boost the separation and recycling activities in Zaatari Camp and in the surrounding communities. Advantages are: more jobs for Jordanians and Syrian refugees, and better quality of recycled paper and cardboard.

Entrepreneurs need support to improve the quality (and price) of their output. Support might focus primarily on optimising internal logistics, pre-sorting at the paper mill and water treatment. This will lower the amount of production waste and increase the supply of high quality recycled cardboard and paper. To assess the threats and opportunities, a feasibility study (SWOT analyses) can identify the most promising entrepreneurs.

### Market for recycling plastics

The potential production of plastic waste in camp Zaatari alone is 875 tonnes per year. These plastics can be sold to recyclers or convertors in Jordan. An opportunity is to improve (regional) facilities for plastic recycling and possibly open a new factory. A modern recycling plant in the region will induce a strong 'pull effect' on the surrounding communities to supply the plant with plastic waste. Such a plant should be placed preferably nearby a water treatment facility (plastic recycling needs washing) and the plant could produce goods for local farmers and/or camp Zaatari. Advantages are: more jobs for Jordanians and Syrian refugees, better quality of recycled plastics and less need for new plastics.

To assess the threats and opportunities, a feasibility study (SWOT analyses) can identify the most promising entrepreneurs. Possible needs they might have: financial incentives and technical support. Support will improve the quality (and price) of their output. This will increase demand for high quality plastics at their gate.

# Appendix 4 Compost sample analysis, camp Zaatari

### Oxfam compost pilot

In 2016 Oxfam took on a trial with the organic matter fraction from solid waste in camp Zaatari. A relatively small amount of organic waste was collected separately and composted by the Oxfam team at the sorting station. In the process a small amount of chicken manure from the flock held at the sorting station was added to the organic matter as well. This might be a good strategy, but if larger amounts are to be composted there will be a growing demand for additional (chicken) manure.

### Biochemical analysis

Later in 2016, a representative sample of this compost has been analysed by the Eurofins Agro Laboratories in Wageningen, the Netherlands. This gave the following results:

| | | |
|---|---|---|
| Dry matter | g/kg | 895 |
| Crude ash | g/kg dry matter | 714 |
| Organic matter | % of dry matter | 28,6 |
| Acidity | PH | 8,0 |
| C-inorganic | % | 1,44 |
| Carbonate lime | % | 11,0 |
| Conductivity | mS/cm 25C | 8,48 |

### Nutrients

| | | |
|---|---|---|
| Nitrogen (N) | g/kg dry matter | 13,6 |
| Phosphorus (P) | g/kg dry matter | 7 |
| Phosphate (P2O5) | g/kg dry matter | 16 |
| Potassium (K) | g/kg dry matter | 24 |
| Potassium (K2O) | g/kg dry matter | 29 |
| Sulphur (S) | g/kg dry matter | 3,9 |
| Magnesium (Mg) | g/kg dry matter | 9,8 |
| Magnesium (MgO) | g/kg dry matter | 16 |

### Micro Nutrients

| | | |
|---|---|---|
| Chloride | g/kg dry matter | 7,7 |
| Cadmium (Cd) | mg/kg dry matter | 0,69 |
| Chromium (Cr) | mg/kg dry matter | 55 |
| Copper (Cu) | mg/kg dry matter | 37 |
| Mercury (Hg) | mg/kg dry matter | ← 0,04 |
| Nickel (Ni) | mg/kg dry matter | 39 |
| Lead (Pb) | mg/kg dry matter | 8,7 |
| Zinc | mg/kg dry matter | 187 |
| Arsenic (As) | mg/kg dry matter | 4,5 |

### Interpretation

Main nutrients for plants are Nitrogen, Phosphorus and Potassium. The compost seems to be rich for these nutrients and that makes the compost an excellent fertilizer for all agricultural activities. Even better, because unlike artificial fertilizer compost also contains several micro-nutrients. Furthermore, compost increases the organic matter content of the soil, which makes the soil a better water retainer. Two additional remarks in respect to the analysis should be made:

- In the Zaatari compost sample the amounts of Chromium and Nickel exceeded the (very strict) Dutch legal standards, but they still comply with European standards. The amounts of Chromium and Nickel in compost can be reduced relatively easy with improved solid waste separation, specifically regarding batteries;

- The chemical influence of the chicken manure, as mentioned before, is almost untraceable as there were only a few chickens at the sorting station.

The original analysis report also indicates the used extraction methods and this report can be obtained from the Amsterdam Waste Team.

eurofins agro
LABORATORIES

BLGG

Quality analysis
Compost
compost al za'atari

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Copy

**Analysis**

Research-/ordernumber: 2016900743/003831812
Date report: 01-07-2016

Type sample:
Date sampling: 17-05-2016
Date receiving: 02-06-2016

compost al za'atari

**Results**

| | Unit | Result | Limit value | Conclusion | Result in product (g/kg) |
|---|---|---|---|---|---|
| Dry matter | g/kg product | 895 | | | |
| Crude ash | g/kg dm | 714 | | | |
| Org. matter | % van de ds | 28,6 | 10,0 | | |
| Nitrogen (N) | g/kg dm | 13,6 | | | 12,2 |
| Phosphorus (P) | g/kg dm | 7 | | | |
| Phosphate ($P_2O_5$) | g/kg ds | 16,0 | | | 14,3 |
| Potassium (K) | g/kg dm | 24 | | | |
| Potassium ($K_2O$) | g/kg ds | 29 | | | 26 |
| Sulphur (S) | g/kg ds | 3,9 | | | 3,5 |
| Magnesium (Mg) | g/kg dm | 9,8 | | | |
| Magnesium (MgO) | g/kg ds | 16 | | | 14 |
| Chloride | g/kg ds | 7,7 | | | |
| Acidity (pH) | | 8,0 | | | |
| C-inorganic | % | 1,44 | | | |
| Carbonate lime | % | 11,0 | | | |
| Conductivity | mS/cm 25°C | 8,48 | | | |
| Cadmium (Cd) | mg/kg ds | 0,69 | 1,00 | | |
| Chromium (Cr) | mg/kg ds | 55 | 50 | ? | |
| Copper (Cu) | mg/kg ds | 37 | 90 | | |
| Mercury (Hg) | mg/kg ds | < 0,04 | 0,30 | | |
| Nickel (Ni) | mg/kg ds | 39 | 20 | ? | |
| Lead (Pb) | mg/kg ds | 8,7 | 100 | | |
| Zinc | mg/kg ds | 187 | 290 | | |
| Arsenic (As) | mg/kg ds | 4,5 | 15 | | |

**Contact & info**

Sample was taken by: Third party
Contact sample taking: Dick Huiberts: 0652002131



900743, 01-07-2016



compost al za'atari

**Method**

| | | |
|---|---|---|
| Dry matter | * | Em: LDS2 |
| Crude ash | Q * | Em: VAS1 |
| Org. matter | Q * | Em: VAS1 |
| Nitrogen (N) | Q * | Em: REW2 |
| Phosphorus (P) | Q * | Em: FOS1 |
| Phosphate ($P_2O_5$) | | derivative value |
| Potassium (K) | Q * | Em: ICP2:(Gw NEN 6966) |
| Potassium ($K_2O$) | | derivative value |
| Sulphur (S) | * | Em: STT6:(Gw NEN 6966) |
| Magnesium (Mg) | Q * | Em: ICP2:(Gw NEN 6966) |
| Magnesium (MgO) | | derivative value |
| Chloride | Q * | Em: CHL1 |
| Acidity (pH) | Q * | PHK1: Cf NEN ISO 10390 |
| C-inorganic | * | Em: CAN6 |
| Carbonate lime | | derivative value |
| Conductivity | Q * | Em: GVM5 |
| Cadmium (Cd) | Q * | Em:KNW6(Cf:CSS99025B/990) |
| Chromium (Cr) | Q * | Em:KNW6(Cf:CSS99025B/990) |
| Copper (Cu) | Q * | Em:KNW6(Cf:CSS99025B/990) |
| Mercury (Hg) | Q * | Em:KNW6(Cf:CSS99025B/990) |
| Nickel (Ni) | Q * | Em:KNW6(Cf:CSS99025B/990) |
| Lead (Pb) | Q * | Em:KNW6(Cf:CSS99025B/990) |
| Zinc | Q * | Em:KNW6(Cf:CSS99025B/990) |
| Arsenic (As) | Q * | Em:KNW6(Cf:CSS99025B/990) |

Q Method accredited by RvA
Em: Method Eurofins Agro, Gw: Equivalent of, Cf: In conformity with
* For this procedure the maximum shelf life between sampling and analysis has been exceeded. This may have affected the reliability of the result.
The reported results only refer to the material supplied to Eurofins Agro.


BEST