Making value of plastic waste

Reduce, reuse and recycling of plastic wastes in Jewi and Nguyenyiell refugee camps in Gambella, Ethiopia
Project

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Project Team

Team members: Camilla Louise Bjerkli
Alexander Borg
Summary

Ethiopia is the largest refugee hosting country on the African continent with more than 928 663 registered refugees. Gambella region have the largest number of refugees in the country with a total number of 401 593 refugees settled in 7 refugee camps.

NCA is today responsible for WASH activities in two of the refugee camps; Jewi and Nguenyyiel. There are increasing challenges related to solid waste management in the refugee camps as well as in the host communities. NCA is therefore seek to address the issue of plastic waste. The objectives of the report therefore to; identify the best appropriate solutions to reduce, reuse and recycle plastic waste in two refugee camps in Gambella region; Jewi and Nguenyyiel. Moreover, to provide refugees and, if relevant the local community with sustainable income generating opportunities through activities related to collection, reuse or recycling of plastic waste.

The data collection was conducted in Gambella and Addis Ababa from the 15 to the 23 of May 2019. The methods used were mainly semi-structured interviews, observation and literature reviews.

Today citizens in Gambella town do not have access to a solid waste management system for collection, transport and disposal of solid waste in Gambella town. This has resulted in increased accumulation of solid waste in the urban environment. The solid waste situation is much better in the refugee camps where the WASH coordinator (NCA) is responsible for the management of solid waste. Their focus is on activities related to storage, collection and disposal of solid waste as well as cleaning of streets and open spaces. Even though there is waste collection in both camps, there is still a lot of waste accumulating in the public spaces. The main type of waste identified littering the camps are plastic bags, small plastic packaging and broken plastic bottles.

The solid waste generation in the camps is based on the packaging generated from the distribution centers. The estimate is therefore the minimum volume of waste generated in the camps and the refugee’s most likely produce more waste. In total 3,7 tons of jerry cans and 17 700 pieces of PP sacks are produced monthly in the camps.

Today the refugees collect all the jerry cans generated in the camp and sell them to traders in the towns close to the camps. Estimation based on the waste generation in the camps indicates that the refugees are collecting and trading jerry cans for a value of 932 000 ETB/yearly ($32 260). The activity is well established in both camps, it works as one cannot see any jerry cans lying around and it goes into the recycling chain being transported to Addis Ababa for recycling. The system is working well in terms of collection and sale so we recommend not interfering in the activities. However, metal generated and collected in the camps that do not have any value today. Our recommendation is therefore to invest in a few manual compression sticks to compress the metals and contact traders in the city to come and collect metal waste on a monthly basis from the camps.

When it comes to recommendations related to reduction and reuse of solid waste we recommend phasing of the use of plastic bags in the camps. The plastic bags is one of the main item littering the camp and is not collected. Instead, broken UN tent or PP sacks can be reused to make shopping bags. Moreover, some of the waste generated in the camps are organic and is suited for making compost that can be used as fertilizer. Starting with source separation of organic and inorganic waste at household level one could reduce the amount of wastes needed to be disposed at the communal pits and instead reusing the organic waste to make fertilizer to farm vegetables in the camps.

Our main recommendation for the collection of plastics and the creation of jobs for both the refugees and the residents of the host community is the collection of water bottles. These are currently not collected and constitute a large proportion of the plastic that accumulates in both the camps and the cities in the region. We therefore recommend establishing cooperatives for collecting and compressing water bottles for sale to plastic factories in Addis Ababa.

The recommended activities have the potential to reduce the amount of waste generated and needed to be collected. Further, it will contribute to collection of plastic waste that is not collected today and will
therefore lead to a cleaner and greener environment for both the refugees and the host community. Moreover, these activities will generate income for the refugees and the citizens in the host community and will lead to reduction in poverty, job creation, increased awareness and capacity and integration of the refugees in the host community.
Acknowledgement

We are deeply thankful to Norwegian Church Aid for the job they did in preparing the field visit, for arranging meetings with key informants and for their tremendous support and assistance during the field visit. The work with this report have not been possible without your assistance.

A special thanks to ARRA and UNHCR for providing us with information about the organization of the camps and for assisting us to get the permission to be able to conduct the study in the camps.

We offer our thanks and appreciation to the incentive workers for setting up and organizing the waste collection for the waste analysis and for answering our many questions.

Lastly, we are grateful to all the participants in the study who graciously shared their views, thoughts and experiences and used their time to discuss the topics with us.
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<table>
<thead>
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<th>Abbreviation</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>AAC</td>
<td>Action Against Hunger</td>
</tr>
<tr>
<td>ANE</td>
<td>Aid for the Needy in Ethiopia</td>
</tr>
<tr>
<td>ARRA</td>
<td>Administration for Refugee and Returnee Affairs</td>
</tr>
<tr>
<td>CRRF</td>
<td>Comprehensive Refugee Response Framework</td>
</tr>
<tr>
<td>DCA</td>
<td>Danish Church Aid</td>
</tr>
<tr>
<td>EPS</td>
<td>Expanded Polystyrene</td>
</tr>
<tr>
<td>ETB</td>
<td>Ethiopian Birr (1 ETB=$0.035 USD)</td>
</tr>
<tr>
<td>IMC</td>
<td>International Medical Corps</td>
</tr>
<tr>
<td>MSF</td>
<td>Medicines Sans Frontiers</td>
</tr>
<tr>
<td>NCA</td>
<td>Norwegian Church Aid</td>
</tr>
<tr>
<td>NGO</td>
<td>Non-Governmental Organization</td>
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<tr>
<td>NRC</td>
<td>Norwegian Refugee Council</td>
</tr>
<tr>
<td>PET</td>
<td>Polyethylene Terephthalate</td>
</tr>
<tr>
<td>RADO</td>
<td>Rehabilitation and Development Organization</td>
</tr>
<tr>
<td>UNCHR</td>
<td>United Nations High Commissioner for Refugees</td>
</tr>
<tr>
<td>UNDP</td>
<td>United Nations Development Project</td>
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<tr>
<td>WVI</td>
<td>World Vision International</td>
</tr>
</tbody>
</table>
1. Introduction

With more than 928,663 registered refugees, Ethiopia is the largest refugee hosting country on the African continent. Currently, Gambella region is hosting the largest number of refugees in Ethiopia with a total number of 401,593 settled in 7 refugee camps in the region. The estimated population of the Gambella region was around 436,000 in 2017, with 74,000 living in Gambella town. It is projected that the population will grow the coming years due to natural population growth and migration from rural areas.

Solid waste management has been receiving more attention due to the increased visibility of solid waste in the refugee camps and the surrounding towns. The large number of refugees and the increase in population in the host community has resulted in increased production of solid waste facing both the refugees and the citizens in the host community.

Poor solid waste management has multiple negative consequences on the refugee camps and the host community as it adversely affects both human health and the environment. In the refugee camps, there were initially no solid waste management systems in place, requiring immediate plans for collection and disposal to be made. Humanitarian responses also generate large volumes of waste from packaging of emergency supplies and from the activities performed by the various aid organisations in the camps. In many cases, solid waste management is a neglected area of environmental sanitation due to other issues that often are considered more serious and acute.

The solutions for solid waste management are technically simple but managerially complex. Waste technology exists but what is often the challenge is how to organize the collection as well as to raise awareness and change behaviour among the population. Moreover, in many cases there exist both formal and informal systems for waste collection. It is therefore important to have a good understanding of how solid waste is managed in the local context. This to ensure that existing practices and value chains in the e.g. informal sector are not destroyed or interfered with, when planning and setting up a new system for collection of solid waste.

There is today an increased awareness of the negative effects that poor management of solid waste have on the refugee camps and the surrounding towns. The emphasis today is that solid waste is a resource and an opportunity for income generation among the refugees and citizens in the host communities. Activities related to solid waste management can also contribute as a link between the refugee camps and the citizens in the host communities, in line with the Comprehensive Refugee Response Framework (CRRF) in Ethiopia.

1.1 Terms of reference

NCA is aware of the increasing challenges related to solid waste management in the refugee camps and in the host community. NCA is currently responsible for WASH activities in Jewi and Nguenyyiel refugee camp. Their focus has mainly been on traditional solid waste management approaches such as avoiding accumulation of waste to prevent vector borne diseases. However, NCA now seeks to address the issues of plastic waste, where plastic waste is seen as a resource and an opportunity for activities that will generate income for the refugees residing in Gambella refugee camps and the citizens in the host community.

1.2 Objectives of the assignment

The overall objectives of this assignment is to:

1. Identify the best appropriate solutions to reduce, reuse and recycle plastic waste in two refugee camps in Gambella region; Jewi and Nguenyyiel.
2. Provide refugees and, if relevant, the local community with sustainable income generating opportunities through activities related to collection, reuse or recycling of plastic wastes in the region.

1.3 Specific goals
In order to reach the overall objectives the project has the following goals:

1. Gain a good understanding of the current solid waste management situation in the region and in the camps, when it comes to waste generation, composition, collection, reuse, recycling and disposal practice.

2. Develop a value chain of existing business operating in the plastic sector.

3. Based on the findings in goal 1 and 2, evaluate and recommend approaches for reduction, reuse and recycling of plastic wastes in the refugee camps and in the host community.

4. Conduct an analysis of plastic waste value chains to assess best appropriate technology/solutions with emphasis on economic sustainability, social and environmental impact for the refugees and the host community.

5. Assess the acceptability of the proposed solution to local, regional and national level and review how this is in line with government regulations and strategic plans concerning solid waste management.

6. Assess the sustainability of the proposed solution i.e. ongoing waste supply, the potential market for finished products and the availability of other revenue streams and highlight expected challenges.
2. Methodology

This report is based on a data collected during a fieldwork conducted in Gambella from 15 – 19 of April, as well as company visits, observations and interviews in Addis Ababa from the 22 to 23 of April 2019.

The main method used was semi-structured interviews with key informants arranged by NCA before the field study. Through the interviews, we were able to gain information about; type and volume of waste, how solid waste management was organized in the camps and in the city and what kind of activities that had been conducted in order to improve solid waste management in the camps. We conducted interviews with key informants, which was central in the administration of the refugee camps, waste producers such as NGOs and households and those responsible for the management of solid waste. In addition, we had some informal talks with actors involved in the informal recycling sector in the region. Here, our aim was to collect information about the organization of the system, type of waste items collected for reuse and recycling, and price of waste items at different stage in the value chain from collection to recycling. Table 1 gives an overview of the interviews conducted during the field study.

<table>
<thead>
<tr>
<th>Monday, April 15th 2019</th>
<th>ARRA Coordinator</th>
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<tbody>
<tr>
<td></td>
<td>ARRA Program Officer and WASH Officer</td>
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<td></td>
<td>UNHCR WASH</td>
</tr>
<tr>
<td>Tuesday, April 16th 2019</td>
<td>Gambella Region Urban Development and Construction Bureau</td>
</tr>
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<td></td>
<td>Gambella Town Municipality</td>
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<tr>
<td></td>
<td>ARRA Jewi Camp coordinator office</td>
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<td></td>
<td>Jewi camp refugee committee</td>
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<td></td>
<td>Jewi camp, households</td>
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<tr>
<td></td>
<td>Jewi camp, nutrition center (IMC)</td>
</tr>
<tr>
<td>Wednesday, April 17th 2019</td>
<td>Informal recycling sector, wholesalers and collectors</td>
</tr>
<tr>
<td></td>
<td>ARRA Nguenyyiel Camp coordinator office</td>
</tr>
<tr>
<td></td>
<td>Nguenyyiel camp refugee commitee</td>
</tr>
<tr>
<td></td>
<td>Nguenyyiel camp, households</td>
</tr>
<tr>
<td></td>
<td>Nguenyyiel camp, nutrition centre (AAH)</td>
</tr>
<tr>
<td></td>
<td>Nguenyyiel camp, fresh food market</td>
</tr>
<tr>
<td>Thursday, April 18th 2019</td>
<td>Jewi camp, metalworker</td>
</tr>
<tr>
<td></td>
<td>Jewi camp, NCA field staff</td>
</tr>
<tr>
<td></td>
<td>Visiting Itang Town</td>
</tr>
<tr>
<td>Monday, April 22th 2019</td>
<td>COBA Impact (PET factory in Addis Ababa)</td>
</tr>
<tr>
<td></td>
<td>Visiting Menalish terra (local recycling market in Addis Ababa)</td>
</tr>
<tr>
<td></td>
<td>Penda Paper (Paper collection company in Addis Ababa)</td>
</tr>
<tr>
<td>Tuesday, April 23th 2019</td>
<td>UNCHR (Addis Ababa)</td>
</tr>
<tr>
<td></td>
<td>Local factory producing recycling machines (Zummit)</td>
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<tr>
<td></td>
<td>Solid Waste Management Addis Ababa, City Council</td>
</tr>
</tbody>
</table>

Table 1: Overview of the interviews and field activities conducted during the field visit.
Our intention was to conduct a waste analysis at household level and at some of the NGOs operating in the camps. Our aim was to get some indication of type and amount of waste generated, in order to be able to evaluate the potential for sorting out plastics for reuse or recycling. Four household and two NGOs in each camp agreed to store their plastic waste for one week. The intention was to sort the plastic into different categories (e.g. jerry cans, plastic bottles, soft plastic, EPS and plastic not suitable for recycling). Then each of the plastic categories would be weighted separately (the total weight of each category should be the same as the total weight of the plastic generated). However, in the field we became very uncertain whether households had understood it correctly. In one household, it seemed that there was too much plastic waste for one single household. We therefore suspected that the plastic collected was not only from one household but was collected from several sources. In addition, some of the plastic products were in good condition, so we suspected that the households in fact did not consider some of the products as waste. We therefore decided to base the waste generation on waste generated from the distribution centers, as this would give us data that were more precise on plastic waste generated in the refugee camps. This is also the main source of products for consumption for the refugees, as most of them do not have the economic capacity to buy goods outside the camps. However, this will give us a minimum estimation of waste generated in the camps, as it is assumed that other wastes are produced in the camps as well.

Moreover, other methods such as personal observation and document reviews were also used. Observation was used every day during fieldwork. Solid waste management is one of the most visible services and through observation one can collect a lot of information about type of waste being produced and it is a good indicator of the performance of the management of solid waste. While walking around in the camps and in the city, we observed the amount and type of waste in the streets, rivers, and open fields. Observation was essential for gaining an understanding of the everyday practices of solid waste and to compare our personal observations with the narratives told by the various participants. Document reviews were conducted both before going to the field and after. This has been important in order to collect background information about the refugee situation in the region, the organization of the camps and the central actors operating in the camps. Moreover, literature review has been essential to gain a good overview of the solid waste management in refugee camps in general and especially in Gambella region.
It was essential to combine the methods in order to collect different types of information and to compare and crosscheck the data collected. For instance, when we were talking to the beneficiaries in the refugee camps and looked at the waste generation (waste sample), we were told that jerry cans were a major component of the waste streams. However, leaving the waste sample after talking to the beneficiaries and turning back, the jerry cans were removed from the waste sample. This indicates that the jerry cans are not regarded as waste but are collected and sold to the informal recycling sector for reuse or recycling.
3. Background of the region

Gambella National Regional State is one of nine member states of the Federal Democratic Republic of Ethiopia. Located in the southwestern Ethiopia on the border to South Sudan in the west, the Oromia Regional State from the northeast and the Southern Nations Nationalities and Peoples Regional State in the southeast, as shown in the map below.

![Map of the location of Gambella region and the 13 woredas.](image)

The estimated population of the Gambella region was around 436,000 in 2017, with 74,000 living in Gambella town.

Gambella has both municipal and administrative status and it is the seat for the regional government. Gambella town is the capital in the region and serves as the administrative center for the Gambella Peoples National Regional State. The town also serve as a commercial center for the region. The Gambella region is divided into 4 administrative zones, further divided into 13 woredas and kebeles that are the smallest administrative unit.

Most of Gambella is flat and its climate is hot and humid. The climate in the region has mainly two seasonal periods. The dry season from November to April with low rainfall and high temperatures, especially in February and March. The wet season from May to October, have heavy rainfall and high temperatures. Annual rainfall averages about 1148 mm while the average annual temperature is 27.6°C. Annual rainfall averages about 600 mm while the minimum/maximum temperatures are approximately 21.1°C and 35.9°C respectively.

Gambella is one of Ethiopia’s poorest regions in terms of infrastructure and social services. Historically, the region and its peoples have been among the most marginalized communities politically, economically and socially in Ethiopia. Despite the introduction of a new political system (ethnic federalism), the people in Gambella still remain marginalized from government services such as access to education, health care, clean water, access to solid waste management and security.
The town is provided with 24 hours power supply from the Sor Dam (Illubabor). As the volume of water from the Sor Dam decreases during the dry season from January to May, the town has a diesel generator that supply the town with energy when needed. The electricity coverage of Gambella town is about 50%, and about 65% of the population have in-house water supply. The main reasons for the lack of water and electricity coverage are budget issues after rapid expansion of the town, lower than planned water production and high levels of poverty, resulting in that many of the households are not being able to afford the fee for installation of electricity network.

3.1 Refugee camps in the region

Ethiopia is one of the largest refugee hosting countries globally, with a population close to one million refugees. The majority of the refugees in Ethiopia are located within the four Emerging Regions of Ethiopia. Gambella is part of the four emerging regions, which are Ethiopia’s least developed regions, characterized by harsh weather conditions, poor infrastructure, low capacity of local government, high level of poverty and poor development indicators.

The South Sudanese are the largest group of refugees with 422 240 persons and 75 447 new arrivals in 2017, and over 86% of the population comprised of women and children. The majority reside within the Gambella Region, while new arrivals have been relocated to the Menishangul-Gemuz Region to ease the pressure on Gambella. The population remains vulnerable with many children arriving unaccompanied and separated, low vaccination coverage, high risk of epidemics and ongoing cholera outbreaks in South Sudan. Figure 2 gives some basic information about the refugee situation in Gambella.

As of 2018 there are seven refugee camps in the region with a total population of around 400 000 people, almost equalling the native population of the Gambella region. The estimated population distribution in the different camps in 2016 and 2018 is shown in Table 2.

<table>
<thead>
<tr>
<th></th>
<th>Nguenyyiel</th>
<th>Pugnido 1</th>
<th>Pugnido 2</th>
<th>Tierkidi</th>
<th>Kule</th>
<th>Jewi</th>
<th>Leitchuor</th>
<th>Okugo</th>
</tr>
</thead>
<tbody>
<tr>
<td>Numbers of refugees</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>in the different</td>
<td>–</td>
<td>~62 800</td>
<td>–</td>
<td>~54 750</td>
<td>~49</td>
<td>~42</td>
<td>~4 480</td>
<td>~</td>
</tr>
<tr>
<td>camps 2016</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>410</td>
<td>570</td>
<td>~4 480</td>
<td>~</td>
</tr>
<tr>
<td>Numbers of refugees</td>
<td>~83 660</td>
<td>~66 400</td>
<td>~17 300</td>
<td>~71 100</td>
<td>~53</td>
<td>~60</td>
<td>~13 630</td>
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<td>in the different</td>
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<td>340</td>
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<tr>
<td>camps 2018</td>
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</tbody>
</table>

Table 2: Refugee camps and estimated population in each camp, 2016 and 2018.

The largest number of refugees arrived in 2014 with 191 698 refugees. However, as shown in Figure 2, additional refugees were arriving every year with 54 739 in 2016 and 2 292 arriving so far this year (2019). The factsheet below gives some basic information about the refugee situation in the region.

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1 Source: UNHCR (https://data2.unhcr.org/en/situations/southsudan/location/1840)
Figure 2: Overview of numbers, arrivals and demography of the refugee population in Gambella 2019.
3.2 Refugee framework and policy

Ethiopia was one of the first countries to apply for the Comprehensive Refugee Response Framework (CRRF) in February 2017. The new refugee proclamation was adopted the 17th of January 2019. Due to this, Ethiopia will receive 350 million USD to support the government to shift their focus from an encampment policy towards activities that promote refugees welfare and inclusion in the country’s socio-economic structures. The government of Ethiopia made the following nine pledges to improve the lives of refugees:

- To expand the “out-of-camp” policy to benefit 10% of the current total refugee population.
- To provide work permits to refugees and those with permanent residence ID.
- To provide work permits to refugees in the areas permitted for foreign workers.
- To increase enrolment of refugee children in preschool, primary, secondary and tertiary education, without discrimination and within available resources.
- To make 10,000 hectares of irrigable land available, to enable 20,000 refugees and host community households (100,000 people) to grow crops.
- To allow local integration for refugees who have lived in Ethiopia for over 20 years
- To work with international partners to build industrial parks to employ up to 100,000 individuals, with 30% of the jobs reserved for refugees.
- To expand and enhance basic and essential social services for refugees.
- To provide other benefits, such as issuance of birth certificates to refugee children born in Ethiopia, and the possibility of opening bank accounts and obtaining driving licenses.

While the CRRF builds on existing UNHC and Government commitments for inclusion of refugees, the new Refugee proclamation represent major achievements and opportunities and a shift in Ethiopia’s refugee response and legal policy framework. Refugees are now included in the national systems of Ethiopia and the host communities which will encourage their access to national services. This will hopefully enhance the socio-economic opportunities of the refugees to ensure that refugees have access to education and other basic and social services, can move around freely within the country, as well as work and learn new skills. This could stimulate economic opportunities and job creation for refugees and host communities in Ethiopia.

3.3 Jewi and Nguenyyiel refugee camps

The refugees are provided with food, shelter, water, sanitation, education, healthcare and protection from UNHCR and their partners. The camps are divided in zones and blocks. There is a leader in each zone who are elected by the refugees. The leaders of the zones form the refugee committee in the camps. The refugee committee represent the refugees in the camps were the refugee are able to make a complaint and to have their concerns addressed and communicated to the camp managers and the NGOs operating in the camps.

There is a monthly distribution of food in the camp organized by ARRA.

Various NGOs are operating in the camps and are involved in different activities as shown in Table 3 below.

2 www.globalcrrf.org_country/eth/
<table>
<thead>
<tr>
<th>Activities</th>
<th>Implementing partner</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hygiene and sanitation</strong></td>
<td>NCA</td>
</tr>
<tr>
<td></td>
<td>NCA (zone A only)</td>
</tr>
<tr>
<td></td>
<td>OXFAM (zone B-E)</td>
</tr>
<tr>
<td><strong>Health</strong></td>
<td>ARRA</td>
</tr>
<tr>
<td></td>
<td>MSF/ARRA/IMC</td>
</tr>
<tr>
<td><strong>Water</strong></td>
<td>ANE</td>
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<tr>
<td></td>
<td>ANE</td>
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<tr>
<td></td>
<td>OXFAM</td>
</tr>
<tr>
<td><strong>Education</strong></td>
<td>WVI</td>
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<td></td>
<td>Plane international/NRC</td>
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<tr>
<td><strong>Protection</strong></td>
<td>ARRA/UNHCR</td>
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<tr>
<td><strong>Shelter</strong></td>
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<tr>
<td><strong>Gender Based Violence/SGBV/RH</strong></td>
<td>IMC</td>
</tr>
<tr>
<td><strong>Nutrition</strong></td>
<td>IMC</td>
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<tr>
<td></td>
<td>IMC/AAH/Help age (for elders)</td>
</tr>
<tr>
<td><strong>Disabled/Vulnerable</strong></td>
<td>RADO</td>
</tr>
<tr>
<td><strong>Vocational Training</strong></td>
<td>NRC/Plan International</td>
</tr>
<tr>
<td><strong>Reforestation</strong></td>
<td>UNDP</td>
</tr>
<tr>
<td><strong>Fresh food/Livelihood</strong></td>
<td>DCA</td>
</tr>
</tbody>
</table>

*Table 3: Overview of the various NGOs operating in the camps and their activities.*
4. Solid waste management in the refugee camps

In both camps, the UNHCR has the main responsibility for environmental infrastructure and environmental health. Whereas, NCA is responsible for implementing, operating, and managing the WASH activities in the camps including collection of solid waste.

The aim of the solid waste system is to have storage, collection and disposal of solid wastes, as well as cleaning of streets and public spaces.

The main objective of NCAs work on WASH activities is to ensure that the refugees in the camps have safe access to quality sanitation and hygiene.

The following strategies are followed to achieve this objective:

- Involve the affected community in the design, implementation and management of SWM programs.
- Organise environmental clean-up campaigns (weekly).
- Consider the potential small-scale business opportunities or supplementary income from waste recycling.
- In consultation with the community, organize a system to ensure the household waste is collected and stored in containers for regular collection and appropriate disposal.
- Ensure that there is a regular refuse waste management system in place by raising awareness, providing personnel who are involved in the collection and disposal of waste, and creating an environment for income generating activities.
- Target identified problems through conduction of extensive hygiene promotion activities.

4.1 Reuse and recycling

There are no formal organized activities for reuse or recycling in the refugee camps. However, reuse is very common. Jerry cans used for oil are commonly reused to carry water by the children, as they are a bit smaller than the regular cans. Plastic sacks from the food distribution are used to store food or waste and water bottles are reused for storing e.g. oil.

Regarding recycling, the incentive workers collect jerry cans at the distribution center and sell it to traders in the informal recycling sector in the town.

The community has also started to collect metal lying around in the camp and storing it in open spaces. Today, nothing is done with the metal collected and it should be protected, as it could be a risk of injury and infection for children playing around the waste pits.
Metal waste collected and stored in open spaces by the refugees at Jewi refugee camp.

One can also see some metalworkers in the camp using scrap metal to make household items and equipment such as spoons and knives.

Metalworker in Jewi camp making household items such as spoons and tools.
4.2 Jewi refugee camp
Jewi camp was established in 2014 and is one of the oldest camps in the region. In total, 64,000 refugees are living in the camp.

Norwegian Church Aid (NCA) is responsible for solid waste management in Jewi camp. At household level, the refugees are responsible for keeping their own compound clean and for storing their waste in their personal waste pit. Households are responsible to bring their waste to one of the 74 communal waste pits in the camps, which are managed by the WASH coordinators. The communal pits are constructed with fences that protect the waste from the surrounding areas and to protect children to entering the pit. The waste in the communal pits is burned regularly. During rainy season, some of the pits are filled with water, making them difficult to manage. In these cases, other areas are used to collect, store, and burn the waste.

![Private and communal waste pits in Jewi refugee camp.](image)

NCA have engaged 80 community outreach agents in Jewi Camp. 60 incentive workers are doing routine hygiene promotion activities and 20 workers collect solid waste from the campsite and burn it by the roadside. Materials like cans and other metal objects are collected and stored it in one place. The waste collectors collect waste daily and manage the communal waste pits. The incentive workers receive 500-700 ETB/month. ($17, 3-$24, 3)

The hygiene promotion activities consist of three focus areas: safe excreta disposal, hand washing and safe water chain, with special attention given to children and mothers with small children.

**Safe excreta disposal** consists of teaching the population to use and maintain latrines as well as properly disposing excreta if a latrine is lacking in their area.

**Hand washing** teaches the population proper hand washing, and the critical times where hand washing is especially important (e.g. before preparing or consuming food).

**Safe water chain** involves teaching the importance of properly collect and store water, as well as simple water treatment procedures.
In addition, NCA has given special attention to waste disposal at household level where weekly awareness campaigns have been implemented with the following key messages:

- Always keep your compound and neighboring area clean by safely handling and disposing waste.
- Clean environment, safe life.
- Encourage the community to avoid open defecation.
- Encourage and teach the community to use the waste pits properly.
- Collection of organic and inorganic waste for final disposal.

These campaigns focus on public spaces that are prone to the accumulation of solid wastes. Where the community is given collection tools like a wheelbarrow, spades and rakes to collect wastes and clean the areas.

Jewi camp appears relatively clean. However, one can find solid waste and litter in public/open spaces. It is especially plastic bags and litter from small packing products sold at the market as well as broken water bottles one can see lying around in open spaces in the camp.

4.3 Nguenyyiel refugee camp

Nguenyyiel camp is a relatively new camp compared to Jewi and was established in 2016. In 2018, 83 660 refugees were living in the camp.

It was obvious that the camp was relatively new during our visit, as the implementation of solid waste management infrastructure and routines was not in place. As of recently, NCA is responsible for solid waste management of part of Nguenyyiel camp.

The household at Nguenyyiel camp does not have a private pit for storage of waste and there is only one communal pit constructed in the camp. This has resulted in that many informal waste pits have been created without any fences protecting the waste from spreading around.

NCA has recently engaged incentive workers for waste collection and awareness campaigns in Nguenyyiel camp with similar objectives as in Jewi camp. As of today, they are only responsible for zone A of the camp, and the work is currently in an early phase. From observation, we can see these activities have worked well in Jewi camp, and it is recommended that this work continues in Nguenyyiel and is extended to the whole camp.

Nguenyyiel camp is relatively dirty with solid waste accumulating in open spaces. Especially, one can see many plastic bags from the nearby markets accumulating in nature in the outskirts of the camp.
Picture 5: Nguenyyiel refugee camp close to the households where one cannot see any waste lying around.

Picture 6: An open space in Nguenyyiel camp that is clearly littered.
4.4 Plastic waste generation and composition

The solid waste generated in the camps is mainly coming from the distribution centre and the various NGOs that are operating in the camps. The waste estimation is based on data on the amount of waste packaging the refugees receive from the distribution centre and other NGOs in the camps. This represent the minimum volume of waste generated in the camps and the refugees produce most likely more waste.

The rations are shown in Table 4. This information was received from the Nguyyyiel camp manager (ARRA) and confirmed to be the same in Jewi by NCA.

<table>
<thead>
<tr>
<th>Product</th>
<th>Container</th>
<th>Monthly rations per person</th>
<th>Rations per container</th>
<th>Weight of container (kg/pc)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil</td>
<td>jerry can</td>
<td>0.50 l</td>
<td>5 l</td>
<td>0.25</td>
</tr>
<tr>
<td>Maiz/sorgoum</td>
<td>PP sack</td>
<td>1.35 kg</td>
<td>50 kg</td>
<td>0.08</td>
</tr>
<tr>
<td>Salt</td>
<td>PP sack</td>
<td>0.15 kg</td>
<td>75 kg</td>
<td>0.10</td>
</tr>
<tr>
<td>Bean/palse</td>
<td>PP sack</td>
<td>1.50 kg</td>
<td>50 kg</td>
<td>0.08</td>
</tr>
<tr>
<td>CSB++</td>
<td>PP sack</td>
<td>1.50 kg</td>
<td>25 kg</td>
<td>0.04</td>
</tr>
</tbody>
</table>

Table 4: Monthly rations and type of waste for refugees in Jewi and Nguyyyiel camps.

Based on the population in the camps, one can thereby calculate the monthly waste generation of these containers and PP sacks.

<table>
<thead>
<tr>
<th>Type of waste</th>
<th>Total amount of containers</th>
<th>Total packaging, kg</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Jewi</td>
<td>Nguenyyiel</td>
</tr>
<tr>
<td>Oil</td>
<td>Jerry can</td>
<td>6 400</td>
</tr>
<tr>
<td>Maiz/Sorgoum</td>
<td>PP sack</td>
<td>1 728</td>
</tr>
<tr>
<td>Salt</td>
<td>PP sack</td>
<td>128</td>
</tr>
<tr>
<td>Bean/palse</td>
<td>PP sack</td>
<td>1 920</td>
</tr>
<tr>
<td>CSB++</td>
<td>PP sack</td>
<td>3 840</td>
</tr>
</tbody>
</table>

Table 5: Estimated amount of monthly waste from regular food distribution in Jewi and Nguenyyiel camps.

From Table 5, we see that the majority of generated waste is in the form of jerry cans, with 3.7 tones. In total, about 1 tons of PP sacks or 17 700 pieces are generated in the refugee camps each month. The pictures below shoes the PP sacks and the jerry cans distributed in the camps.
Waste is also produced through some of the activities the NGOs in the camps are doing. One example is the nutrition center of Action Against Hunger (AAC) in Jewi camp, which deliver nutrition supplements to pregnant and lactating mothers, as well as malnourished children. In order to make sure that the wastes are collected the refugees have to take care of the packaging they received last time in order to get a new supply of chicken meat and nutrition supplements. In the nutrition centre in Jewi camp hands out 4000 packets of supercereal each day for five days a week. This nutrition supplement is packed in plastic-aluminium laminate which makes it hard to recycle. Chicken meat is also given to malnourished children, packed in metal boxes. Total waste generated varies and we don’t have a total estimate of the volume of these cans. Today, they have stored the metal cans in a tent because they don’t know what to do with it. The laminate and cardboard are burned on a daily basis. Nutrition centers exist both in Jewi an Nguenyyiel camps. However, the distribution of metal cans is only for Jewi camps and are not used in Nguenyyiel. The pictures below show the metal cans and the tent filled with stored metal.
For the waste remaining in the camp that is not sorted out for sale is; paper, organic waste, thin plastic bags, water bottles and small packaging.

### 4.5 Environment and Health Risks in the camps as a result of the solid waste situation

The current management of solid waste in the camps pose risks to both health and safety for the refugees living in the camps. The risks identified include:

- Injuries and infection from direct contact with solid wastes: especially sharp items such as metal wastes.

- Contaminated air: Irritants and pathogens can be inhaled directly from fine-grained refuse material at open collection points and during waste transfer. In addition, burning waste generates a large amount of smoke, which can cause respiratory problems.

- Spread of disease by vectors: Heaps of discarded waste provide a breeding ground for flies and rats. These vectors can transmit disease and pathogenic microorganisms from solid waste and excreta to the household. Water in tyres, old tin cans, or other containers encourages the breeding of mosquitoes, which also transmit diseases such as dengue, yellow fever, and malaria.

- Diseases: Diseases that can spread through poor SWM include dysentery, viral and bacterial diarrhoea, gastro-enteritis, typhoid, trachoma, plague, typhus, salmonella, leptospirosis, filariasis, malaria, tapeworm, and trichinosis.

- Groundwater contamination: Groundwater can become contaminated by polluted water (i.e. leachate) from unsatisfactory disposal sites.
5. Solid waste management in Gambella town

Visitors to Gambella get an impression that the disposal of solid waste is a serious problem in the city. Entering the town, one sees waste disposed along the roads and in most open spaces as shown in the picture below.

![Picture 10: One of the informal waste dumps along the road entering Gambella town.](image)

The solid waste situation in the city is characterized by increasing waste generation due to increased levels of consumption, growing immigration from the rural areas and the city's own demography. Further, the poor solid waste situation is worsened by lack of technical and institutional capacity to deal with the increasing generation of waste in the city. Currently, there are no formal systems for waste collection, transport and disposal of solid waste in the city. Based on interviews with officials responsible for solid waste management at the municipality and the regional bureau, the main reasons for lack of a solid waste management service is lack of resources from the central government. Without any solid waste management system for collection, transport and disposal, solid waste accumulates in the urban environment, causing bad odors and clogging the drainage channels. It is also common to see people burning the waste as shown in the picture below in order to reduce the volume of waste generated. Such insufficient handling of solid waste is polluting the urban environment and making the city and its surroundings unhealthy places for the citizens.
During fieldwork, we were able to identify some of the informal waste dumps in the city. These sites are marked on the map below. However, it should be mention that these are only some of the sites and that most areas along the main roads entering Gambella town is littered with uncollected or illegally dumped solid wastes.
5.1 Solid waste generation and composition in Gambella town

Based on the estimations done by Afewerk (2015) the waste generation of the town was 0.229 kg/capita/day at household level. Based on these estimations the total daily generation of waste in the city is 14 885 kg/day. Of the waste generated in the city it is estimated that around 86, 63 % of the waste generated from the households is biodegradable. The main producers of solid wastes in the town include; household refuses and commercial as well as institutional (schools, health centres and other government Offices) wastes.

The data on waste generation and composition is not accurate as this study was conducted by a master student and is therefore limited both in scope and time and does not take into account seasonal variations and waste produced by the commercial and public sector. Nevertheless, it provides an indicator of waste generation in the city and coincides with waste generations conducted in other cities in Ethiopia3. However, one should be aware of the fact that valuable items such as jerry cans and metal scrap are being sorted out and collected for reuse and recycling and do not enter the waste stream.

Based on these data, the generation of waste per capita is low compared to cities in other parts of the world. However, with the urbanization processes taking place, improvement in living conditions and the adoption of modern lifestyles, problems related to solid waste management will most likely become more serious and increase in the years to come.

Based on observation plastic bottles and small packaging are the major plastic wastes that are not collected and are accumulating in the urban environment.

5.2 The informal recycling sector in the region

Solid waste is seen as a valuable resource for many people that make a living by collecting waste for reuse and recycling. It has been estimated that as much as 1% of the urban population in developing countries depends on waste collection for reuse and recycling as part of their daily livelihood (Medina, 2007). In most cities in developing countries, the informal recycling sector has developed highly organized systems for the collection, trade, and recycling of solid waste (Bjerkli, 2005; Gutberlet, 2010; Kaseva & Gupta, 1996; Nzeadibe, 2009; Ojeda-Benitez, Armijo-de-Vega, & Ramirez-Barreto, 2002; Sembiring & Nitivattananon, 2010; Troschinetz & Mihelcic, 2009). Studies shows that the informal recycling sector contributes to improved solid waste management by reducing the quantities of waste needed to be collected, transported, and disposed of. Moreover, the sector is also contributing by supplying industry with raw materials at a low cost, by reducing the demand for raw materials needed to be imported from abroad, by supplying the market with recycled products at a lower price, and by creating jobs and livelihoods for the citizens.

The informal recycling system in Gambella is similar to other informal recycling systems found in urban areas in developing countries. It consists of different actors who are involved in activities related to the collection, trade, reuse, and recycling of waste. The system is highly organized and consists of; households, commercial shops, Qorgoro alleh/collectors, wholesalers, small-scale artisans, and local industries. The figure below gives an overview of the organization of the informal recycling system and the actors involved.

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3 When comparing the estimations of 0,229 kg/d in Gambella with other towns in Ethiopia such as Mekele (0,267 kg/d), Bahirdar (0,227), Debre Markos (0,267), Adama (0,250) and Addis Ababa these data are in line with waste generations in other Ethiopian towns.
The collectors *Qorqoro alleh*\(^4\), buy materials mainly from households and commercial shops before they enter the waste stream. The *Qorqoro alleh* have a strong upward link in the system to the wholesalers which constitute the main link between the various actors.

Through observation and interviews with the *Qorqoro alleh* and wholesalers, the main materials collected by the informal recycling system are: jerry cans, other hard plastic items made of PP, HDPE, and metal. Other items such as thin plastics bags and water bottles (PET) are not collected. There is a market and demand for water bottles and the plastic factories in Addis Ababa pays 7 ETB/kg ($0.24). The main problem with the water bottles is that they are too so that the transport costs eat up the profits. For this to be economically profitable there is a need for a compression machine or shredder to reduce the volume in order to make the transportation more cost efficient.

Based on interviews with the *Qorqoro alleh* in Gambella town the collectors said that they collected 40-50 kg of plastic every day. They buy jerry cans from the household or commercial shops for 12 ETB/kg ($0.42) and sell it to a wholesaler for 21 ETB/kg ($0.73). This means that the collector earns around 12 000 ETB ($415) a month. According to a wholesaler, he employs four permanent *Qorqoro alleh*, but he also buys material from other *Qorqoro alleh*, which are not employed by the wholesaler. The wholesaler then stores the material collected and sells it directly to plastic factories in Addis Ababa or nearby cities such as Debra Ziet.

---

\(^4\) In Amharic meaning: do you have any scrap metal to sell.
Collectors on their way to sell their jerry cans to the wholesaler in Gambella town.

Around half of the jerry cans on the picture is jerry cans being distributed in the refugee camps and shows that these are commonly sold by the refugees to traders in the town.
The wholesaler buy plastic such as jerry cans for 21 ETB/kg ($0.73) from the collectors and sell it to plastic factories in Addis Ababa for 31 ETB/kg ($1.07). Interviews with wholesalers in Gambella informed us that the prices might vary depending on the demand in the market but that the prices today were good and increasing. On average, the wholesaler is able to send one or two trucks of plastic wastes to Addis Ababa a month. The average volume of waste for one truck is 4 tonnes. The price for transporting the plastics to Addis Ababa is around 17 000 ETB ($588). This means that a wholesaler is able to earn 25 000 – 50 000 ETB ($865-$1730) a month buying and selling plastics in Gambella town.

Additionally, the wholesaler buys scrap iron of differing quality to sell to factories in Addis Ababa and nearby towns. The wholesaler buys metal from the collectors for a price of 5-21 ETB/kg, ($0.17-$0.73) depending on the quality of the metal. The material such as metal cans is then compacted using a long rod, stored, and transported for sale.

There are many plastic factories in Addis Ababa and surrounding towns such as Debra Ziet. Some of the plastic factories use plastic waste in their production of plastic products or shred and sell the raw materials. Through interviews with plastic factories in Addis Ababa, the demand for plastic waste were high and several sources informed us that the demand for plastic is increasing. Coba Impact who are buying water bottles (PET) for export of the raw material, informed us that they were running on 50 percent capacity due to lack of supply of water bottles. For factories who are producing plastic products, we were informed that it is common to use plastic in the production with around 35% plastic waste and 65% virgin materials.
Based on information collected through interviews with the collectors and the wholesalers in Gambella town, it is assumed that all Jerry cans that are broken are collected through the informal recycling system and sold for recycling in Addis Ababa or nearby towns. Metal is commonly collected for reuse and recycling in the towns but not in the refugee camps.

Reuse of plastic is common and one can see used jerry cans and water bottles being sold or reused at the local market. Walking around the market and talking to the traders, we were told that they buy the used water bottles (3 pieces) for 1 ETB ($0.035) and sell two for 1 ETB. However, the demand for water bottles is not high since one can see water bottles in the streets and open spaces all around the town.

**Picture 16: The storage of PET bottles at Coba Impact’s compound.**

**Picture 17: Plastic water bottles are also collected/bought by the local traders who sell them for reuse or are using them to sell oil at the local market.**
6. Recommendations

We will in this chapter recommend activities to be conducted in order to reduce plastic waste in the refugee camps as well as recommendations related to the collection, reuse and recycling of plastic waste generated in the camps and in the host community. The table below shows an overview of the different plastic waste items found in the camp, their current treatment and possible treatment.

<table>
<thead>
<tr>
<th>Waste stream</th>
<th>Current treatment</th>
<th>Possible treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jerry cans</td>
<td>Sold to wholesale traders</td>
<td>Organized sale</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Shred and sell</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Recycle into new products</td>
</tr>
<tr>
<td>Plastic bottles</td>
<td>Reused</td>
<td>Compress and sell</td>
</tr>
<tr>
<td></td>
<td>Burned</td>
<td>Shred and sell</td>
</tr>
<tr>
<td></td>
<td>Littering</td>
<td>Recycle into new products</td>
</tr>
<tr>
<td>PP plastic sacks</td>
<td>Reused</td>
<td>Reuse for waste collection</td>
</tr>
<tr>
<td></td>
<td>Burned</td>
<td>Reuse for making tote bags</td>
</tr>
<tr>
<td></td>
<td>Littering</td>
<td>Sell for recycling</td>
</tr>
<tr>
<td>Organic waste</td>
<td>Disposed and burned</td>
<td>Compost</td>
</tr>
<tr>
<td>Metallic waste</td>
<td>Collected and stored</td>
<td>Organized sale to wholesalers</td>
</tr>
<tr>
<td></td>
<td>Reused by metal workers</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Littering</td>
<td></td>
</tr>
<tr>
<td>Plastic Bags</td>
<td>Littering</td>
<td>Ban</td>
</tr>
<tr>
<td></td>
<td>Disposed and burned</td>
<td>Collect and burn</td>
</tr>
</tbody>
</table>

Table 6: Summary of waste generation and treatment in the refugee camps.

6.1 Possible solutions and initiatives to reduce plastic waste

Any efforts to reduce the amount of waste that is generated in the refugee camps can reduce the amount of waste needed to be collected, transported and disposed. Due to poverty, it is common to reuse materials in the refugee camps. However, through interviews and observation during the field visit several incentives were identified in order to prevent plastic from scattering around in the camps.

1. UNHCR and the WASH coordinators should first ensure that items that are distributed to the refugee do not have any unnecessary packaging.

2. One of the visual wastes lying around in the camps that are not collected are plastic bags. These are not collected and do not have any value when it comes to collection for reuse or recycling. Our recommendation is to phase out the use of plastic bags in the camps. Instead, broken UN tents or the plastic bags (PP sacks) used for storing wheat could be collected and sewn into tote bags. The refugees in the camps who are working as tailors could do this or one could organize e.g. women groups who will be responsible for collection and making of these tote bags. Even though it could prove difficult to completely ban plastic bags, a good place to start is the DCA food market in Nguenyyiel camp. Other sources of plastic bags originating from the NGOs would also be easier to restrict than an immediate complete ban.

3. Moreover, some of the waste generated are organic and could be composted instead of being burned. The WASH coordinators could consider constructing a demonstration compost plant in the camps and start with source separation at household level, were organic and inorganic wastes are separated. The plastic bags used for wheat (PP sack) could also here be used at household level to store organic and inorganic wastes. This would reduce the amount of waste in the communal pits, will increase the awareness of the refugees and at the same time
increase their knowledge in how to make a compost that in turn could be used to farm vegetables in the camps. Moreover, in Jewi camp some of the toiles constructed for the refugees are EcoSan toiles, which aims to safely reuse excreta in agriculture. Currently, the excreta from these toiles are not used and could be included in the compost activities. This is also inline with the CRRF where one of the government pledges is to; make 10 000 hectares of irrigable land available, to enable 20 000 refugees and host community households (100 000) to grow crops.

6.2 Current value chains in the camps and the region
As described earlier, jerry cans dominates the plastic waste generation in both camps. Totally, around 15 000 Jerry cans (3, 7 tons) are being generated in the camps monthly. Jerry cans is collected by the incentive workers and sold to traders in the towns near the refugee camps as an additional income. Estimation based on the waste generation in the camps indicates that the refugees are collecting and trading jerry cans for a value of 932 000 ETB/yearly ($32 260). The figure below shows the volume of jerry cans from the camps and the existing value chain with prices of jerry cans.

![Diagram of the value chain of jerry cans from refugee camps to factories](image)

Figure 4: The waste stream of jerry cans from the refugee camps to the factories - showing the volume and prices in the value chain.
This shows that the refugees have seen the value of jerry cans and organized themselves to collect and trade the cans in order to generate some additional income. Figure 4 shows the estimated total value generated from jerry can collection in the refugee camps. The activity is well established in both camps, it works as one cannot see jerry cans lying around and it goes into the recycling chain being transported to Addis Ababa for recycling. The cash earned by the refugees involved in collection of jerry cans, is a maximum estimated based on the sale price of 21 ETB/kg. ($0, 73) It is possible that the refugees get a lower price than waste collectors do in Gambella, or that they have to buy the jerry cans from other refugees, but this has not been confirmed.

**Recommendation:** this system is working well in terms of collection and sale so we recommend not interfering in the activities.

There is some metal generated in the camps, but it was not possible to estimate the amount. By compressing the metal cans with a metal stick, it should be possible to arrange an agreement with a trader in Gambella to collect the metal once a month from the camps. The wholesalers in the informal recycling sector collect metal, where they pay around 8-9 ETB/kg ($0, 28-$0, 31) depending on the quality of the metal. Since we do not know the waste generation of metals, it is not possible to estimate potential income. However, collection and compression will generate some income for the refugees and in addition reducing the amount of wastes in the camps.

**Picture 18: Manual metal compressor.**

**Recommendation:** Invest in a few metal sticks in each camp. The metalworkers in the camps could make these. In Jewi, metal is already collected and we recommend doing the same in Nguenyyiel. Organize some of the refugee to compress the metal and arrange an agreement with a trader in Gambella in order to collect the metal.

Any collection of metal and jerry cans should be done in cooperation with existing informal recycling sector. There are already existing value chains for plastic and metal in the informal recycling sector in the region. The sector is not perfect in terms of being informal and not registered, not paying tax and following working/labor regulations. Nevertheless, the system has developed over time and is adapted to the local context, it is efficient since all jerry cans and most of the metals in the city are collected for reuse and recycling. Moreover, it creates jobs, generates income and collects waste that otherwise would not have been collected as well as supplying the industry with raw materials. To establish a new system for collection of these items and a new value chains will interrupt and compete with the existing structure that may lead to loss of jobs, income and deterioration of the efficiency of the system. However, there is a need for a project focusing on formalizing the informal sector in order to improve working conditions in the sector.
6.3 Collection of water bottles as a way to create additional income for the refugees and the host community

Through observation both in the camps and in the cities, the main source of plastics disposed in nature is water bottles, plastic bags and small plastic packaging from groceries bought in the small shops.

In the camps, the refugees are not buying water bottles and most likely, these are bottles brought to the camps by NGOs, through various activities.

Our suggestion is to start with collection and compression of water bottles (PET) as these today don’t have a value and are therefore not collected and constitute one of the major littering problems in the camps and the host community. Based on interviews with plastic factories in Addis Ababa, we know that there is a demand for buying water bottles and it is therefore possible to establish a value chain for collection in the refugee camps as well as in Gambella town.

It is not possible to estimate the amount of water bottles generated in the camps and the cities. We have however done calculations to secure that there are enough water bottles for a collection system to be profitable.

<table>
<thead>
<tr>
<th>Population in Gambella town</th>
<th>74 000</th>
</tr>
</thead>
<tbody>
<tr>
<td>PET bottle needed</td>
<td>7 000  kg/mo</td>
</tr>
<tr>
<td>PET bottle per pop</td>
<td>0.095  kg/mo</td>
</tr>
<tr>
<td>Weight of one plastic bottle</td>
<td>0.03  kg/1,5 l</td>
</tr>
<tr>
<td>Bottles needed per person</td>
<td>3,15   pc</td>
</tr>
</tbody>
</table>

Table 7: PET bottles needed per person to supply PET shredding and selling in Gambella town.

As seen in Table 7, the calculations is based on the total population in Gambella town which is 74 000. For the collection of water bottles to generate profit, one must have 7000 kg per month. To supply a monthly amount of 7000 kg/mo around 3, 15 PET bottles per capita are needed. It is fair to assume that this amount is generated in Gambella and could be collected. Additionally, compared to the monthly total waste production of 14 000 kg per day, 7000 kg of PET bottles should be attainable. Taken into consideration the total number of refugees living in the area in addition to the host community, this is a moderate estimate and most likely the collection will be higher.

6.3.1 Investment costs

The main investment costs for this operation would be a baling machine, strips to pack the compressed materials, plastic bags for storage of the water bottles and a weight to measure the amount of kg of the compressed plastic. Investment costs are given in Table 8.

<table>
<thead>
<tr>
<th>Products</th>
<th>Costs, ETB</th>
<th>USD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baling machine</td>
<td>60 000</td>
<td>$2077</td>
</tr>
<tr>
<td>Sacks for waste collection</td>
<td>6 000</td>
<td>$207</td>
</tr>
<tr>
<td>Strips for packing</td>
<td>1 000</td>
<td>$35</td>
</tr>
</tbody>
</table>

Table 8: Overview of investment costs.

The baling machine can be bought online. The baling machine should be relatively small and able to collect liquid waste residues from the bottles to ensure low maintenance and longevity of the machine. The picture below shows an example of one baling machine.
It should be investigated if the recycling company e.g. Coba Impact can supply baling machines and strips needed to pack the compressed materials for a good price. The specific machine used for baling could also be chosen in consultation with Penda Paper recycling, as they already use baling machines for their paper transport. The machine must probably be ordered from abroad, but Penda Paper should be contacted to help with choosing the right machine.

Based on available baling machines on-line the estimated power consumption of the baling machine is 7,5 kW. Running time for one bale is estimated to two minutes for 40 kg of PET bottles (1 bale). Total running time per month for 7000 kg of PET: 6 hours. The total energy consumption is estimated to be 45 kWh, with electricity costs of 0, 5-1 ETB/kWh ($ 0,017-$0,035). Energy costs are therefore negligible and are estimated to be around 50 ETB/month ($ 1,73).

The monthly expenses and income from baling and selling PET bottles are shown in the table below. We have based the calculations on that one pay 1 ETB ($ 0,035) for 1 kg of water bottles. This is equal to 10 bottles. In order to transport 7000 kg of compressed PET bottles there is a need for two trucks and the market price for transport of one truck from Gambella to Addis Ababa is currently 17 000 ETB ($ 588). The market price for one kg of PET today is 7 ETB ($ 0,24) and with a collection of 7000 kg this gives a monthly expense of 40 000 ETB ($ 1 385) and a monthly income of 49 000 ETB ($ 1 696) giving a total profit of 9 000 ETB ($ 311) a month. The profit should go to paying the cooperative with a monthly salary of 750 ETB ($ 26) this will employ maximum 12 employees.

<table>
<thead>
<tr>
<th>Monthly operating costs</th>
<th>Expenses ETB/kg</th>
<th>Expenses ETB/mo</th>
<th>Income ETB/kg</th>
<th>Income ETB/mo</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buying PET bottle from collectors</td>
<td>1</td>
<td>7 000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transport costs</td>
<td>4,6</td>
<td>32 000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other costs: Electricity, strips and sacks</td>
<td>0,14</td>
<td>1000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Selling PET bottle to recycling</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SUM</td>
<td>5,7</td>
<td>40 000</td>
<td>7</td>
<td>49 000</td>
</tr>
<tr>
<td>Profit</td>
<td>1,7</td>
<td>9 000</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Picture 19: Example of a baling machine.*
Table 9: Monthly expenses and income from baling and selling PET bottles.

However, NCA should take the time to contact several factories who are buying PET in order to be sure to get the highest price for the material. During field visit, we only had time to visit Coba Impact and there could be something to gain from hearing with other factories to ensure the highest possible price for the raw materials.

NCA should also investigate the possibilities of using own cars or enter into an agreement with other NGOs in the area for transporting the raw materials to Addis Ababa. Most likely, some trucks drive with an empty load back to Addis Ababa. The cost of transport is the highest expense of 32,000 ETB ($1,108) and it will be a great saving if one could exploit this opportunity. This could be used to transport PET-bales as a start-up solution, to accumulate cash and ease the start-up of the project. It is not recommended to keep this as a permanent solution, in order to ensure the financial sustainability and independence of the project.

Shredding is not recommended at this stage due to that the plastic factories in Addis Ababa want to shred the PET bottles themselves to ensure a uniform quality of their final product. Moreover, one need to secure that the collection of water bottles are in place and to ensure that enough water bottles are collected. Over time when the collection system is established and one can make sure that the collection is working, one can consider going further to invest into shredding, and recycling of plastic (PET) into new products. For a detailed report and assessment on recycling of plastic into new products we recommend to study the report: “Plastic recycling and reuse in refugee camps recycling of plastic waste in Melkadida and Jijiga refugee camps, Ethiopia” by EWB and UNHCR.

6.3.2 Organization and ownership

Our recommendation is to establish a cooperative for collecting and compression of PET bottles for sale to factories in Addis Ababa. This should be a cooperative consisting of refugees from the camps and residents of Gambella town, in line with the CRRF. The cooperatives will be registered at Ethiopia Bureau of cooperatives as a community based business enterprises. A cooperative strategy is essential as this will most likely result in a business that is sustainable over time. It is important that the employees feel ownership to the business and in that way will do the extra effort needed to keep the business running successfully for many years.

The idea is that everybody can collect PET bottles and bring it to the collection points in the refugee camps or in Gambella town. They will then receive direct payment for the PET bottles they have collected from the shop (1 ETB/kg). The workers in the cooperative will then handle the PET bottles, sort them by color, compress them and store it for transportation to Addis Ababa for recycling.

We recommend that the main base for collection and compression of PET bottles is in Gambella town, as the volume of water bottles are much higher in the town than in the camps. Moreover, NCA is already in contact with a local organization connected to the Mekane Yesus Church in Gambella town that could serve as a facilitator of this cooperative. This organization also have a compound in Gambella town available for use to store and handling of plastic bottles. This affiliation could provide credibility to the project and help relations with the local population. For security measures, the compound must be in a closed off area, with a lock to avoid theft of expensive equipment and cash. However, collection stations should be created in the refugee camps to ensure the collection of water

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7 Definition of a cooperative: Firm owned, controlled, and operated by a group of users for their own benefit. Each member contributes equity capital, and shares in the control of the firm on the basis of one-member, one-vote principle (and not in proportion to his or her equity contribution).
bottles in the camps as well. The plastic collected in the camps must then be transported to the facility in Gambella town for compression and storage.

In order for the cooperative to work properly, it is imperative that employees are involved in the planning and implementation of the project. The cooperatives should therefore appoint a board of directors who will in turn appoint a managing director. Moreover, there should be a sale and marketing manager, quality control manager, personnel manager and a financial accountant.

In order to ensure that this is done in a sustainable way, emphasis should be placed on training the members of the cooperative in order to ensure ownership and increase the capacity of the employees. This entails training on the importance of collecting and recycling plastic waste and the entire value chain in recycling, sales, marketing, finance and the daily operations of the cooperative. Moreover, emphasis should also be given to working environment and health by giving awareness related to health risks and to provide the workers with necessary protection equipment such as gloves and proper working clothes.

It is important to save money monthly to afford repairs, and unforeseen low-income periods. There should always be enough cash in the cooperative to afford maintenance of the baling machine, or buy a new machine in case the existing machine breaks down, as it is a critical part of the operation. Additionally, critical spare parts for the machine should be purchased and a stock of spare parts must be available, to avoid long periods of downtime in case of machine malfunction.

This project has the potential to give the refugees and the host community the opportunity to participate in Environmental protection and livelihood self-reliance programs that will reduce poverty levels in line with the Ethiopian Governments National Development plans, UN sustainability development goals and CRRF. This is also in line with the Ethiopian Government Transformation plan that aims to spur economic structural transformation and sustain accelerated growth towards the realization of the national vision to become a low middle-income country by 2025.

6.3.3 Critical points to ensure the sustainability of the collection of plastic bottles for recycling

There are some risk areas associated with the project. Firstly, estimates of the PET bottle recycling are based on current market prices. Even though several of our informants confirmed that the demand for PET is increasing, there will always be a risk that prices will change and be reduced. This will affect the estimated profit in the project.

Another element of uncertainty is the cost related to transport of the plastics from Gambella to Addis Ababa. Transport costs can increase compared to the prices we have calculated with which are the current market price. Increasing gasoline prices can lead to increase in the cost of transportation and affect the estimated profit in the project.

There is always a risk associated with whether people will be willing to collect PET bottles for a price of 1 ETB/kg. However, we know that this works well in other cities such as Addis Ababa and Mekele so we assume that this will also be the case for Gambella.

A final risk is linked to the establishment of the project as a collaborative project between the refugees and the host community. To avoid any disagreements between the refugees and the local residents it is recommended to emphasize collaborative activities that ensures ownership, common interests and a common understanding of the project in order to ensure a good working environment.
7. Environmental and social impact

The environmental benefits of the recommendations given in this report have the potential to contribute to a significant reduction of plastic waste in the refugee camps and in Gambella town.

First, by prohibiting or phasing out the use of plastic bags and start to collect PET bottles for recycling the plastic litter in both the camps and in the city will be significantly reduced. This will further lead to a reduction in burning of plastic waste, which in turn will reduce the risk of inhaling contaminated air.

A reduction in plastic waste will also have a positive impact on the environment reducing the risk of clogging drainage channels and reduce the risk of diseases relating to accumulation of solid waste in the environment.

If one further decides to initiate a project to collect plastic tent or plastic bags to make tote bags, the project will create awareness about reuse in addition to creating income-generating activities for the refugees.

Collection of PET bottles will also lead to awareness and a change in attitude from looking at a product as valuable rather than waste. This will, in addition to increased awareness, increase knowledge about collection and recycling as well as increased knowledge about marketing, sales and basic finances. The recommendations will provide income-generating activities to the refugees as well as residents of Gambella and will thus help to reduce poverty and increase their awareness and capacity.

The creation of pet bottle collection is also in line with CRRF and will likely lead to a better integration of the refugees into the host community.
8. Possible funding

We have looked at some possibilities for applying for funding to carry out the project. The most appropriate opportunity is to apply to Norad and their business support for business development\(^8\). The purpose of the scheme is to help create jobs in priority developing countries through viable business start-ups. Grants are given to reduce risk ahead of an investment decision. This includes support for feasibility studies, partner search, trial production, local employee training, local vendor management, and local infrastructure investment.

*ike Foundation* also focus on job creation and waste reduction and could be another opportunity of getting funding for the project.

*Innovasjon Norge* previously had several projects focusing on job creation and waste recycling. However, currently there are no program related to this on their website. We therefore recommend to take a phone call and ask if they have funding opportunities for the project.

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\(^8\) [https://norad.no/tilskudd/sok-stotte/naringsutvikling/bedriftsstotte-til-naringsutvikling/](https://norad.no/tilskudd/sok-stotte/naringsutvikling/bedriftsstotte-til-naringsutvikling/)
9. Conclusion

The objective of this project was to identify the best appropriate solutions to reduce, reuse and recycle plastic in Jewi and Nguenyyiel refugee camps as well as in the host community in Gambella region. Further, the project aimed to provide refugees and the local community with a sustainable income generation opportunities through activities related to collection, reuse or recycling of plastics in the region.

In order to reduce waste produced in the camps we recommend to prohibiting/phasing out the use of plastic bags in the camps and rather focusing on making shopping bags of broken tents from the UN or the plastic bags (PP sacks) from the distribution center. Further, it is also possible to start with source separation at household level for organic and inorganic waste. The organic waste is very suitable as a compost, which could be used as fertilizer to crow crops in the camps or in the host community.

The report show that jerry cans constitute the largest flow of plastic waste in the refugee camps. However, these are already collected by the refugees and sold to traders in the host community. Our recommendation is therefore not to interfere with this value chain as it proves to be effective in the form of collection and that it already generates income for both the refugees and other actors in the value chain. Some metal waste is generated in the refugee camps, which today have no value. These can be easily collected and compressed manually and sold to merchants in the cities, which will generate some income for the refugees.

Our main recommendation for the collection of plastics and the creation of jobs for both the refugees and the residents of the host community is the collection of water bottles. These are currently not collected and constitute a large proportion of the plastic that accumulates in both the camps and the cities in the region. We therefore recommend establishing cooperatives for collecting and compressing water bottles for sale to plastic factories in Addis Ababa.

The recommended activities have the potential to reduce the amount of waste generated and needed to be collected. Further, it will contribute to collection of plastic waste that is not collected today and will therefore lead to a cleaner and greener environment for both the refugees and the host community. Moreover, these activities will generate income for the refugees and the citizens in the host community and will lead to reduction in poverty, job creation, increased awareness and capacity and integration of the refugees in the host community.
10. References


Appendix A: What is plastic? Description of different plastic types

The information in this chapter has been obtained from the Precious Plastic\textsuperscript{9} manual on plastic recycling. Plastics are synthetic chemicals extracted mainly from petroleum and made of hydrocarbons (chains of hydrogen and carbon atoms). Most plastics are polymers, long molecules made up of many repetitions of a basic molecule called a monomer. This structure makes plastic particularly durable and long lasting. Plastic is causing serious environmental concerns regarding its slow decomposition rate (recent studies say 500 years) due to its strong bonding molecules.

**Thermosets and Thermoplasts**

There are two main categories in the world of plastics: thermoplastics and thermosets. Thermoplastics are the plastics that can be recycled. Thermoplastics can be melted back into liquid and moulded multiple times. Thankfully, thermoplastics make up to 90% of global production. Thermosets can melt and take shape only once; after they have solidified, they stay solid forever. In the thermosetting process, a chemical reaction occurs that is irreversible.

**Plastic types**

Thermoplastics are further grouped in seven different subcategories often referred to as plastic types. Each plastic type has its specific chemical composition, properties and applications and is given a specific number, called SPI code to differentiate between them. Today, most manufacturers should follow this coding system and place the SPI code on their products, usually moulded at the bottom of the product. Knowing what plastic type you’re working with is crucial when working with plastic recycling. The different plastic types with their corresponding notation are:

\begin{center}
\includegraphics[width=\textwidth]{plastic_types}
\end{center}

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\textsuperscript{9} [www.preciousplastic.org](http://www.preciousplastic.org)
1. PET (polyethylene terephthalate)

This is a very strong plastic that can be easily recognised for its transparent look. All beverage bottles containing sodas are PET. This plastic is also used in many other products like jars, combs, bags, tote bags, carpets and ropes. Items made from this plastic are commonly recycled. Most recently, PET is often recycled into yarns to make clothes.

2. HDPE (high-density polyethylene)

This plastic is often used for food or drink containers. Items made from this plastic include containers for milk, motor oil, shampoos, soap bottles, detergents, and bleaches. Many toys are also made from this plastic.

3. PVC (polyvinyl chloride)

This is toxic and we do not work with it. PVC is most commonly found in plumbing pipes and releases chloride when heated up. Do not use with when recycling plastics.

4. LDPE (low-density polyethylene)

Plastic wrap, sandwich bags, squeezable bottles, and plastic grocery bags all are made from LDPE. Usually, LDPE is not recycled from the industry but works rather good with the recycling recommended in this report.

5. PP (polypropylene)

This is one of the most commonly available plastic on the market. This type of plastic is strong and can usually withstand higher temperatures. Among many other application, it is consistently used for products that get in contact with food and drink (Tupperware, yoghurt boxes, syrup bottles etc.).

6. PS (polystyrene)

PS is most commonly known as Styrofoam. PS can be recycled, but not efficiently; recycling it takes a lot of energy, which means that few places accept it. Disposable coffee cups, plastic food boxes, plastic cutlery and packing foam are made from PS.

7. Other mix

This code is used to identify other types of plastic that are not defined by the other six codes. ABS, Acrylic or Polycarbonate are included in this category and can me more difficult to recycle.
### Appendix B: To do list

<table>
<thead>
<tr>
<th>To do:</th>
<th>Responsible</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apply for funding</td>
<td></td>
</tr>
<tr>
<td>Contact local authorities</td>
<td></td>
</tr>
<tr>
<td>Get price quotes on baling machine</td>
<td></td>
</tr>
<tr>
<td>Secure compound space for the cooperative</td>
<td></td>
</tr>
<tr>
<td>Location of collection points in refugee camps shop and storage</td>
<td></td>
</tr>
<tr>
<td>Investigate the plastic market for more price on PET/kg</td>
<td></td>
</tr>
<tr>
<td>Agreement with a plastic factory in Addis Ababa</td>
<td></td>
</tr>
<tr>
<td>Arrange initial transportation with NCA or partners</td>
<td></td>
</tr>
<tr>
<td>Buy the equipment needed such as baling machines, plastic bags, weight and strips</td>
<td></td>
</tr>
<tr>
<td>Interview potential workers in the cooperative both in the refugee camps and in the city</td>
<td></td>
</tr>
<tr>
<td>Managers responsible for the different positions</td>
<td></td>
</tr>
<tr>
<td>Plan for training program for the cooperative</td>
<td></td>
</tr>
<tr>
<td>Start setting up the shops and start collecting</td>
<td></td>
</tr>
<tr>
<td>Use time to marketing the new shop</td>
<td></td>
</tr>
<tr>
<td>Arrange for transport with a transport company</td>
<td></td>
</tr>
<tr>
<td>After one year do an assessment of the business viability and make necessary adjustments</td>
<td></td>
</tr>
</tbody>
</table>