



Zero Waste Strategy Project

Partnership between UNDP and Avfall Sverige

Realised in three pilot cities in China, Costa Rica and Rwanda

Final Report – Preliminary Conclusions

Contract RDB/BPPS/MPU/2020/12/28

June 30, 2021





THE GLOBAL GOALS

Disclaimer

This report was drafted by representatives from Avfall Sverige - Swedish Waste Management Organisation, and five of its members; Gästrike Återvinnare, VafabMiljö, Vakin, and Scavi, and edited by representatives from the City of Gothenburg.

The views expressed in this report are those of the authors and do not necessarily represent those of the United Nations, including UNDP, or the UN Member States

Acknowledgments

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EXECUTIVE SUMMARY

The *Zero Waste Strategy Project*, with the aim of advancing sustainable waste management, with the target of zero waste, has involved more than 25 municipalities on four different continents during the spring of 2021.

The project started as an agreement between the United Nations Development Programme (UNDP) and the Swedish Waste Management Organisation, *Avfall Sverige*, and set out to deliver expertise for the improvement of waste management in three pilot cities: Tianjin, in the Republic of China; five municipalities in the Great Metropolitan Area (GAM), Costa Rica; and Kigali, Rwanda.

Avfall Sverige was supported by five of its members who were responsible for the contact with representatives of the pilot cities: Scavi for the pilot city Tianjin, China; Vakin for the pilot municipalities in Costa Rica; Gästrike Återvinnare for the pilot city Kigali in Rwanda; VafabMiljö for issues regarding planning for training; and, the City of Gothenburg for the preparation of this report.

Unsurprisingly, the project result was affected by the Covid-19 pandemic and the digital constraints of the cooperation between countries. That being said, the project has been able to identify challenges and opportunities for a more sustainable waste management, as well as a brief analysis of relevant plans for the sector in all pilot cities.

Waste management in the pilot cities and municipalities still involves depositing large quantities of solid waste in landfills. The cities and municipalities have achieved varying degrees of controlled landfilling, meaning that the environmental consequences will be felt sooner for some and later for others. Issues with gas emissions, leachate, and other pollutants from landfills will have to be addressed in all pilot cities.

The effectiveness of the waste collection for different waste flows differs greatly between the cities and municipalities. The Tianjin Eco-City has been working towards becoming a Zero-Waste City for several years through measures like recycling points for the citizens. Meanwhile, collection coverage for different waste streams is low in the five cities municipalities in GAM, and even more so in the City of Kigali.

Waste Management Plans (WMP) are key to identifying waste flows, setting targets for waste reduction in accordance with the waste hierarchy, and to delegate responsibility between stakeholders. The existence of WMPs and their level of detail varies between the cities and municipalities.

Avfall Sverige suggests concrete projects to be considered for issues which have been identified in areas such as: inter-municipal collaboration, strategic waste management planning, transfer of experience, and enhancement of the competence in various institutional as well as societal sectors. Lastly, this *Final Report – Preliminary Conclusions* gives an insight into the establishment of a national waste management association.



A handwritten signature in black ink, appearing to read 'Viktor Olsson', written in a cursive style.

GLOSSARY

Unless stated otherwise, the terminology below is taken from the Waste Framework Directive (2008/98/EC) adopted by the European Parliament. However, it should be noted that waste terminology differs between countries and regions, depending on the legal framework and national contexts.

Hence, the terminology might not be interchangeable with definitions in the pilot cities.

Bio-waste.

Biodegradable garden and park waste, food and kitchen waste from households, offices, restaurants, wholesale, canteens, caterers and retail premises and comparable waste from food processing plants.

Energy recovery.

Utilisation of electricity and heat produced in a treatment facility for waste incineration or from gas emerging from organic elements, for example in an anaerobic digestion plant or at a landfill. (*Aufall Sverige, 2021*)

Food waste.

Biodegradable waste made up of food, or emerging from handling food, i.e. waste from the grocery chain (households, restaurants, large-scale catering establishments, boutiques, and the food industry). Includes both edible food (food loss) as well as non-edible food, for example bones and peels. (*Aufall Sverige, 2021*) Food waste emerging from kitchens in households, restaurants and hotels is also commonly called **kitchen waste**.

Leachate.

Fluid which runs through, from or contains waste during the process of landfilling, interim-storage, and transportation. (*Aufall Sverige, 2021*)

Municipal Solid Waste (MSW).

Waste collected and treated by or for municipalities. It covers waste from households, including bulky waste, similar waste from commerce and trade, office buildings, institutions and small businesses, as well as yard and garden waste, street sweepings, the contents of litter containers, and market cleansing waste if managed as household waste. The definition excludes waste from municipal sewage networks and treatment, as well as waste from construction and demolition activities. (*OECD, 2021*) MSW is sometimes written as **household waste, municipal waste, or domestic waste**.

Preparation for re-use.

Checking, cleaning, or repairing recovery operations, by which products or components of products that have become waste are prepared so that they can be re-used without any other pre-processing.

Re-use.

Any operation by which products or components that are not waste are used again for the same purpose for which they were conceived.

Recycling.

Any recovery operation by which waste materials are reprocessed into products, materials, or substances whether for the original or other purposes. It includes the reprocessing of organic material but does not include energy recovery and the reprocessing into materials that are to be used as fuels or for backfilling operations.

Solid waste.

Discarded solid materials. Includes agricultural waste, mining waste, industrial waste, and municipal waste. (*EEA, 2021*)

Waste collection.

The periodic or on-demand removal of solid waste from primary source locations using a collection vehicle and followed by the depositing of this waste at some central facility or disposal site. (*EEA, 2021*)

Waste generation.

The weight or volume of materials and products that enter the waste stream before recycling, composting, landfilling, or combustion takes place. Can also represent the amount of waste generated by a given source or category of sources. (*EEA, 2021*)

Waste hierarchy.

Order of priority for waste treatment measures which should be used to minimise environmental impact. The first order of priority is waste prevention, followed by preparation for re-use, recycling, other recovery measures such as waste incineration, and lastly landfilling. (*Aufall Sverige, 2021*)

Waste management.

The collection, transport, recovery (including sorting), and disposal of waste, including the supervision of such operations and the after-care of disposal sites, and including actions taken as a dealer or broker. Sometimes written as **Solid Waste Management (SWM)**.

Waste Management Plan (WMP).

Steering document with the main purpose of giving an overview of all waste generated (including imported, and by specific waste streams) and treatment options for waste within a nation, region, or local government. (*European Commission Directorate- General Environment, 2012*)

WMP usually contain goals and actions for waste management according to the Waste Hierarchy.

Waste minimisation.

Measures and/or techniques that reduce the amount of wastes generated during any domestic, commercial, and industrial process. (*EEA, 2021*)

Waste prevention.

'Prevention' means measures taken before a substance, material or product has become waste, that reduce:
(a) the quantity of waste, including through the re-use of products or the extension of the life span of products;
(b) the adverse impacts of the generated waste on the environment and human health; or
(c) the content of hazardous substances in materials and products.

Waste treatment.

The physical, thermal, chemical, or biological processes, which change the characteristics of the waste in order to reduce its volume or hazardous nature, to facilitate its handling or to enhance recovery. (*EEA, 2021*)

Zero waste.

Conservation of all resources by means of responsible production, consumption, re-use and recovery of products, packaging and materials without burning, and with no discharges to land, water, or air that threaten the environment or human health. (*Zero Waste International Alliance, 2018*)

1. Introduction



1.1 THE PROJECT

By the end of 2020 UNDP, the United Nations Development Programme, signed an agreement with the Swedish Waste Management Organisation, *Avfall Sverige* to deliver technical assistance considering the improvement of waste management in pilot cities in China, Costa Rica and Rwanda, contract number RDB/BPPS/MPU/2020/12/28.

The scope of the project consists of two deliverables, the *Brief Inception report*, and Work Plan due by 22 February 2021 and the *Final Report – Preliminary Conclusions* due by 30 June 2021.

The interchange of information and knowledge throughout the project has, of course, been restricted, given the global Covid-19 pandemic. Further challenges facing this project were language barriers, short time constraints and difficulties finding suitable meeting times for the participating pilot cities. This hampered the possibilities of obtaining in-depth, local, perspectives. Despite of these challenges, the participating parties have collaborated well and delivered material for the project.

Therefore, the following report is in part based on the material sent to the Swedish stakeholders and the meetings between the parties, but is also supplemented by academic articles, as well as media reports and other source material. Hence, the report acts as a tentative pre-study, with preliminary conclusions.

1.2 THE AIM

The overall aim of the project is to advance waste management regarding climate, environmental and economic aspects and aiming at zero waste in the three pilot cities.

The focal point and the limitations of this report is waste management of Municipal Solid Waste (MSW). Thus, specific waste related to e.g. hospital hazardous waste, is not included. However, information about waste other than MSW has been included wherever the parties have deemed it to be relevant.

The aim and ambitions of the project have been updated during the project phase, due to above mentioned challenges. However, the *Final Report – Preliminary Conclusions* will give insight into how the UNDP can improve its efforts within the sector of waste management. This report is a first examination from which to determine concrete projects and studies ahead.

1.3 PARTICIPANTS

UNDP (New York) and Avfall Sverige are the contractual parties within the partnership agreement for this project. The pilot cities are Tianjin in China, five municipalities in the Great Metropolitan Area (GAM), Costa Rica, and Kigali in Rwanda. Important participants from the UNDP are its country representatives and of course representatives from ministries and local authorities in the pilot cities and municipalities.

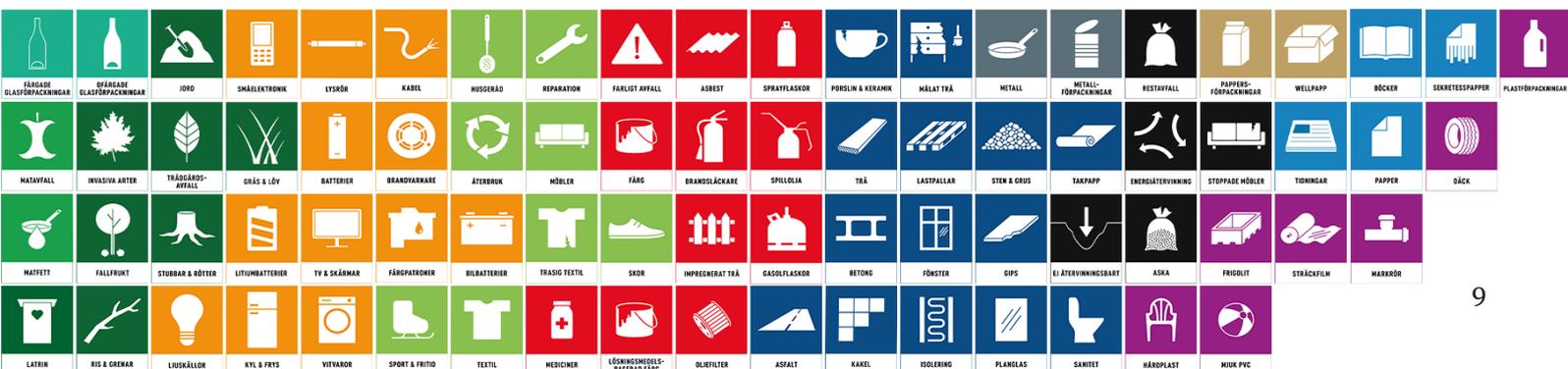
In this project, Avfall Sverige operates its activities jointly through efforts by its members:

- Scavi, Stockholm, directly involved in the case of Tianjin, China
- Vakín, the inter-municipal waste company in the Umeå area working with five municipalities in the Great Metropolitan Area, Costa Rica
- Gästrike återvinnare, the inter-municipal waste authority in the Gävle area working with Kigali, Rwanda
- VafabMiljö the inter-municipal waste authority in the Västerås area working with training issues
- Sustainable Waste and Water, City of Gothenburg preparing the Final report.

This report constitutes a partnering between ten different organisations and involves, on the local level more than 25 municipalities.



2. Stakeholders



Avfall Sverige

- Tony Clark, Managing Director, Contractual partner
- Anna Carin Gripwall, Communications Manager
- Weine Wiqvist, Senior Advisor

Overall responsible for project management, coordination and planning, graphic design and layout.

UNDP

- Xiaofang Zhou, Contractual partner, Director Montreal Protocol
- Weidong Zhang, Programme Director of UNDP China
- Shiyu Dong, UNDP Country representative China
- Jouancarlos Pinar, UNDP Country representative Costa Rica
- Kaspar Koefoed, UNDP Country representative Costa Rica
- Etienne Gonin, UNDP Country representative Rwanda
- Bernardin Uzayisaba, UNDP Country representative Rwanda

Pilot city Tianjin, China

- Kang Lei, Tianjin Academy of Environmental Sciences (TAES)
- Chen Rui, Tianjin Academy of Eco-environmental Sciences (TAES)
- Zhang Ning, Tianjin Academy of Eco-environmental Sciences (TAES)
- Cai Xiaodan, Tianjin Academy of Eco-environmental Sciences (TAES)
- Nils Lundkvist, CEO and Senior Expert, Scavi/Stockholm

Unless stated otherwise, supplementing, was found from the following sources:

- Power-point presentations and complementary documents on Overview of “Zero Waste City” Construction in China-Singapore Tianjin Eco-City, by TAES
- “Regulations on the Management of Domestic Waste in Tianjin” Announcement of the Standing Committee of Tianjin Municipal People’s Congress (No. 49)

Pilot cities in GAM, Costa Rica

- Alejandro Muñoz Rivera, Inspector at the department of Environment and Health, Municipality of Curridabat
- Ana Maria Lobo Calderón, lawyer, specialist in environmental law, UNDP
- Sofia Perez, Head of Environment and Health, Municipality of Curridabat
- Tomas Blomqvist, Managing Director, Vakin
- Karin Söderström, Sustainability Director, Vakin

The representatives in Costa Rica have contributed with text for this report.

Pilot city Kigali, Rwanda

- John Mugabo, Waste Management Officer, City of Kigali
- Per Olof Hallberg, International Relations Manager, Gästrike Återvinnare

Unless stated otherwise, supplementing information was found from the following sources:

- Assessing waste management services in Kigali, C-38435-RWA-1, 2019
- Singh, Ashbindu & Barr, Jane & Lund, Gyde & Rugege, Denis & Kironde, Elizabeth & Apindi, Eugene & Giese, Kim. (2018). Rwanda State of Environment and Outlook Report 2017 – Achieving Sustainable Urbanization.

Planning for training

- Thomas Nylund, Senior Strategist and Advisor, VafabMiljö

Building organizational capacity

- Weine Wiqvist, Senior Advisor, Avfall Sverige

Editor of Final Report

- Sandra Alm, Analyst, Sustainable Waste and Water, City of Gothenburg

3. Present conditions – challenges and opportunities



This chapter will briefly present the situation with regards to waste management in the three pilot cities. This includes some background data and legal conditions. Based on a first assumption the most important challenges and opportunities are presented for each city.

The development level of the waste management sectors differs between the participating pilot cities, both in terms of hard and soft infrastructure. This means that the cities should not be compared to each other but are unique cases with their own set of challenges and opportunities. Hence, overarching analysis has been replaced with a locally adapted analysis. Moreover, the amounts of background information available varies between the three pilot cities. Therefore, the subchapters will differ in their level of detail.

An important caveat for this chapter is that the Swedish project partners did not have the possibility of exploring the present conditions of each city in full detail. This is due to the digital format of this project, as well as the difficulties in obtaining all necessary and relevant information. Any missing data or misunderstandings of the present conditions will be explored in potential follow-up projects.

3.1 PILOT CITY TIANJIN, CHINA

Tianjin is a provincial administrative region and municipality directly under the Central Government of the People's Republic of China. The city has 16 districts (see figure 1) under its jurisdiction, with a total area of 11966.45 square kilometres. At the end of 2019, the permanent population was 15 million, the urban population was 13 million, and the urbanization rate was 83 percent. As of September 2020, Tianjin has 119 subdistricts, 125 towns, 2 townships, and 1 ethnic township. Totalling 249 township-level districts.

Map	No	District		Population	Area	Population density
District in city centre						
	1	Heping	和平区 Héping qū	470 000	10	47 000
	2	Hedong	河东区 Hédōng qū	680 000	39	17 436
	3	Hexi	河西区 Héxī qū	740 000	37	20 000
	4	Nankai	南开区 Nánkāi qū	790 000	39	20 256
	5	Hebei	河北区 Héběi qū	620 000	27	22 963
	6	Hongqiao	红桥区 Hōngqiáo qū	560 000	21	26 667
Suburban district						
	7	Binhaish new district	滨海新区 Bīnhǎi xīnqū	1 000 000	1 978	1 556
	8	Dongli	东丽区 Dōnglì qū	320 000	460	696
	9	Xiqing	西青区 Xīqīng qū	330 000	545	606
	10	Jinnan	津南区 Jīnnán qū	380 000	401	948
	11	Beichen	北辰区 Běichén qū	320 000	478	669
Rural district						
	12	Wuqing	武清区 Wǔqīng qū	840 000	1 570	535
	13	Baodi	宝坻区 Bǎodī qū	650 000	1 523	427
Jurisdictional district						
	14	Ninghe	宁河县 Níng hé xiàn	360 000	1 414	255
	15	Jinghai	静海县 Jìng hǎi xiàn	520 000	1 476	352
	16	Ji	蓟县 Jì xiàn	810 000	1 593	508

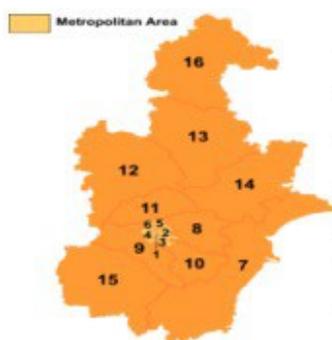


Figure 1: Map of administrative region Tianjin. Tianjin Eco-City is located in Binhai New Area.

Presentation Tianjin Eco-City project

The China-Singapore Tianjin Eco-City is located in the Binhai New Area of Tianjin and is a flagship project of the cooperation between the governments of China and Singapore. It is also the world's first eco-city developed jointly by two countries. The Tianjin Eco-City is 45 kilometres away from the downtown area of Tianjin, with a planned total area of 150 square kilometres.

The Eco-City aims to build a demonstration zone for scientific development, social harmony, and ecological civilization, a demonstration zone for a resource-saving and environment-friendly society, and a demonstration zone for innovative urban development models.

Importantly, the Tianjin Eco-City was built up from scratch as an Eco-City and not introducing the eco-city concept in an existing built area.

The eco-city project includes two parts: the “Zero-waste City” concept exploration, and demonstration of the “Carbon Neutral Town”:

- The China-Singapore Tianjin Eco-City will house the demonstration of “Zero-waste City”, by proving a jumping board for researching on the “zero-waste” initiative and exploration of a management mechanism. Based on the experience gained from the Eco-City, the development strategies for other 16 administrative regions of Tianjin according to their own conditions will be formulated.
- UNDP and Tianjin Academy of Eco-Environmental Sciences (TAES) will jointly develop China's the first “Carbon Neutral Town” demonstration project in the China-Singapore Tianjin Eco-City. The demonstration project will integrate domestic and foreign resources of UNDP and private enterprises, introduce green financial instruments, and adopt cutting-edge green building technologies and renewable energies.

The overall goal of the Eco-City project will advance the concept of “green transformation” and help accelerate the achievement of carbon neutrality in China's building sector and waste management sector. The implementation of the project will also contribute to the achievement of the Sustainable Development Goals (SDG's).

Legal framework

When developing the waste management in all districts in Tianjin the development must be in accordance with local laws and regulations. The experiences from the development in Tianjin Eco-City must influence the implementation of the development in all districts.

National Laws, Regulations and Plans

- a) Environmental Protection Law of the People's Republic of China (2014 Revision)
- b) Law of the People's Republic of China on the Prevention and Control of Environmental Pollution by Solid Waste (2020 Revision)
- c) Implementation Plan of Domestic Waste Classification System (2017)

Laws, Regulations and Regulatory Documents in Tianjin

- a) Tianjin Municipal Domestic Waste Management Regulations (2020)
- b) Tianjin Municipal Domestic Waste Classification Guide (2019)
- c) Tianjin Municipal Construction Waste Management Measures (Interim) (2018)

Relevant Plans and Implementation Programs of the Eco-city

- a) City Master Plan of China-Singapore Tianjin Eco-city (2008-2020)
- b) China-Singapore Tianjin Eco-City Infrastructure Special Plan- Environmental Sanitation Engineering Special Plan
- c) China-Singapore Tianjin Eco-City Index System
- d) China-Singapore Tianjin Eco-City Waste Classification Implementation Programs and Rules

At the Standing Committee of Tianjin Municipal People's Congress (No. 49) the *"Regulations on the Management of Domestic Waste in Tianjin"* was announced. The regulation was adopted on July 29, 2020. This regulation was hereby promulgated and shall come into force from December 1, 2020. The regulation contains 10 chapters with 78 articles describing the planned development of the waste management for the city.

This regulation is the most essential document for the development of the waste management in Tianjin and experiences from Tianjin Eco-City must be involved in the strategy and implementation of the future development.

Based on the *"City Master Plan of China-Singapore Tianjin Eco-city (2008-2020)"* and the *"China-Singapore Tianjin Eco-City Index System"*, the construction of a "Zero Waste City" is highly consistent with the Eco-City master planning and construction goals. The supporting measures proposed for the construction of the green development demonstration zone have laid the foundation for the pilot project of "Zero Waste City". The construction of a smart city demonstration zone provides an efficient supervision platform for the construction of "Zero Waste City".

Status of environmental sanitation facilities in Tianjin City

Tianjin's domestic waste removal and transportation volume was 4.33 million tons, the treatment volume was 4.3 million tons, and the average daily treatment volume was 11,771 tons.

At present, the boundary between waste collection stations and waste transfer stations in Tianjin is relatively blurred, and most waste transfer stations also serve as waste collection. Sanitation public facilities such as waste collection points and waste bins in the built-up area are basically covered.

The infrastructure for handling and treating waste in Tianjin is made up of the following:

- 2 municipal-level domestic waste transfer stations in Tianjin, which are responsible for cross-district transfer. Total transfer capacity of 1700t/d.
- Currently 4 waste landfills. Total processing capacity of 5100t/d by the end of 2020,
- 13 domestic waste treatment plants. 6 of 13 are pure incineration plants and the rest are the comprehensive treatment centres including incineration, and other physical/chemical treatment. Total treatment capacity of 17,450 t/d.
- 2 manure treatment plants. Total treatment capacity of 600t/d.
- 5 kitchen waste treatment facilities. Total designed operating capacity of 1150t/d.
- 1 harmless treatment facility for kitchen waste. Processing capacity of 300t/d.
- 5 construction waste disposal plants.
- 4 construction waste recycling plants. Consumption capacity of 9,640,000 m³ and a processing capacity of 2,310,000 t/d.
- 1 large-size waste treatment plant with a design capacity of 30,000 t/d. After the bulky waste is manually dismantled, the wooden products are transported to the furniture factory for plate making, the metal products are transported to the smelter for re-smelting, and the non-reusable materials such as textiles are transported to the safe incineration power plant for disposal.
- Currently 4 waste landfills. Total processing capacity of 5100t/d by the end of 2020 and the ecological restoration project for the landfills are planned to be completed in 2025.

The amount of waste collected from each district and where this waste is treated is known by the Tianjin City, but has not been available for the project.

Status of environmental sanitation facilities in Tianjin Eco-City

Presented below is the current situation for various waste flows in the Tianjin Eco City:

Domestic Waste	<p>In 2018, the total domestic waste output of China-Singapore Tianjin Eco-City was 18,990 tons, and the average daily domestic waste production was about 52 tons/day. The Eco-City divides domestic waste into recyclable waste, such as: paper, rubber and plastic, kitchen waste, hazardous waste, and other waste.</p> <p>For the recyclables the Eco-City has introduced a “point-system” where the citizens get points when deliver the recyclable to a recycling collection place. The points the citizens get for recycling can be used in the Tianjin Eco-City area.</p>
Food Waste	<p>In 2018, the average daily production of food waste in the Eco-City was about 7-8 tons (excluding kitchen waste). After the catering company signs a paid removal contract with a professional recycling company, the recycling company will carry out the removal, and finally a special disposal company will uniformly transfer and process.</p>
Hazardous Waste	<p>There are 5 companies that produce hazardous waste in the Eco-City. The industries that produce them are mainly biomedicine and chemical experiments, with an average annual output of about 4 tons.</p>
Medical Waste	<p>The Eco-City currently generates about 2.35 tons of medical waste per month, which is about 28.2 tons per year. The medical waste is transported by a qualified collection and transportation company to a designated professional treatment company for final harmless disposal.</p>
Construction waste	<p>As the Eco-City is undergoing rapid development, the amount of construction waste is increasing year by year. The construction waste is mainly cleaned and transported by a professional collection and transportation company entrusted by the Eco-City Urban Management Bureau, and finally collected and transported outside the district for unified disposal.</p>
Landscaping Waste	<p>In 2018, the average daily landscaping waste generated in the Eco-City was about 30 tons/day. The average daily output of landscaping waste in 2019 is about 36 tons/day. The fallen leaves and twigs produced in the Eco-City return to the green space naturally and will not enter the resource treatment system.</p>
Urban Sewage and Sludge	<p>In 2018, the average daily sewage treatment capacity of the Eco-City Water Treatment Centre was approximately 75,000 tons, and the average daily sewage sludge treatment capacity was approximately 33 tons. The main source of sewage is domestic sewage, and the sludge is uniformly transported outside the zone by professional companies for treatment.</p>
Industrial waste	<p>According to the master plan of the Eco-City, the Eco-City has no plans to introduce industrial enterprises in the short term, and no industrial waste will be generated in the area by 2025.</p>

The Eco-City’s “Zero Waste City” goals have an index system (see appendices A & B) for describing and follow-up of the development of waste management and progress of the Eco-City. This index system consists of first-level, second-level, and third-level indicators, including 5 first-level indicators, 8 second-level indicators, and 23 third-level indicators (including 3 optional indicators).

Challenges and opportunities

At the Climate Ambition Summit 2020, China announced its ambitious goals for carbon peaking by 2030 and carbon neutrality by 2060. By 2030, China's carbon dioxide emissions per unit of GDP will drop by more than 65 percent from 2005.

In the next few decades, however, this transition from “brown” to “green” will not be easy. The “China Carbon Neutrality Comprehensive Report 2020” issued by the Energy Foundation indicated that the vision of achieving carbon neutrality by 2060 will be challenging for the country. It requires China to formulate a robust long-term strategy while effectively identifying actions in key sectors and achieving cooperation from policy, financial and technology perspectives. Whether China can become carbon neutral by 2060 will therefore depend in part on the progress of the green transformation of its cities, including the promotion of green buildings in cities, recycling of waste and application of renewable energy.

In addition to the contribution of the construction industry to carbon emissions, the carbon footprint resulting from the municipal waste from consumption cannot be neglected in the progress of urban development. According to statistics from China's domestic waste industry, as of 2019, China's domestic waste output has reached 179 million tons. China's domestic household waste volume has always been higher than the controlled disposal capacity – including sanitary landfill, incineration, composting, etc. Although, the volume of waste had begun to fall year by year, there were still 17 million tons of untreated waste in 2019.

While controlled disposal methods have minimised the environmental consequences attributed with waste, they nonetheless increase the carbon burden of the planet to a certain extent. For example, sanitary landfill is the most widely used waste disposal method in China. The process will produce a large amount of carbon-containing gases while the waste is buried underground, and the leachate emerging from the landfill will also release nitric oxide and other carbon-containing substances in the regulating tank. The process of composting inevitably releases greenhouse gases (GHG) through microbial respiration.

Generally waste incineration has many advantages over sanitary landfilling and some advantages over composting, such as saving disposal land and thermal and energy recovery and no methane emissions. However, some incinerator plants are not specifically designed for the caloric value of the waste as fuel and sometimes need fossil fuels e.g. fossil coal and fuel oil added in the incineration processes to boost the efficiency of the combustion. For these incinerators the combustion auxiliaries will produce a certain amount of carbon dioxide gas along with the incineration of waste, which in turn causes an increase in carbon emissions. Experiences from Sweden is that waste incineration plants can be design in accordance with the caloric value of the waste that shall be incinerated and then do not need extra added fuel such as fossil fuels.

In addition, waste not completely classified beforehand for incineration will mean valuable resources might become lost through incineration. If waste flows are minimised through waste prevention measures, valuable materials are re-used before they reach waste treatment plants, and advanced recycling technology is adopted to create added value for the completely classified waste before incineration (i.e. biomass papermaking technology using waste paper pulp), it will not only meet the requirements of energy conservation and emission reduction, but also optimise resource management.

Since the China-Singapore Tianjin Eco-City started its waste classification in January 2013, it has learned from advanced concepts and technologies at home and abroad. In accordance with the “3R” principle (reduce, re-use, recycle), actively explored and implemented the waste management model of “classified placement, classified collection, classified transportation, classified treatment”.

In 2014, the Eco-City took the lead in establishing an intelligent waste sorting and recycling system. In 2015, Binhai New Area (with Eco-City as the main application) was approved as the first batch of national waste classification demonstration cities (districts). In July 2017, Eco-City Smart Classification APP went online. In November 2018, the waste classification work was extended to the entire industry and region of the Eco-City, and the assessment and management methods for each responsible department were clarified.

3.2 PILOT CITIES IN THE GREATER METROPOLITAN AREA (GAM), COSTA RICA

Five municipalities in Costa Rica are cooperating on a project towards a more circular economy. The initiative is led by the five local governments from Curridabat, La Unión, Desamparados, Montes de Oca and San José and is called “*Komūnitas*”. Here we will discuss the present conditions, challenges, and opportunities regarding waste management in the five municipalities.

Presentation of pilot cities

The five municipalities, or *cantones*, are in the east of the capital San José and form part of the Greater Metropolitan Area (GAM) of the Central Valley of Costa Rica, occupying a total area of 238,82 km² and with a population of approximately 826,475 people. In 2018, the total generation of household waste for the five local governments, was 183,071 tonnes, which represents 18 percent of the country’s overall waste generation.

Even though the five municipalities are all within the GAM, they have vastly different characteristics. They range from primarily agricultural to highly urban with government agencies, financial institutions, and universities. There are also large differences regarding the level of waste management. The working budgets for waste management, expressed as budget per citizen and year, also vary greatly, with the largest budget in the urbanised areas more than seven times greater than that of the lowest budget: 6,300 CRC and 45,650 CRC per citizen and year respectively. This said, the five municipalities have many common issues and challenges with their waste management.

Curridabat

Curridabat is a very densely populated and urbanised municipality where all inhabitants live in urban areas. Household waste is collected twice a week and recycling once a week. The waste collection covers 100 percent of the properties. The level of recycling is currently at 5 percent. Household composting exists, but only on a small scale (850 households). The municipality sees a lack of resources and technology as a problem. They wish to apply a weight-based tariff and to increase the level of producer responsibility. The annual budget for waste management is 1 245 million CRC (16,170 CRC per citizen and year).

La Unión

The people of La Unión live in both rural and urban areas. The area has traditionally been engaged in agriculture with a focus on coffee plantations. Waste collection is conducted by a mix of municipal (40 percent) and private companies (60 percent). The regularity of household waste collection is not stated, however, collection of recycling ranges from weekly to monthly. Irregular collection, along with low levels of household engagement in contributing to recycling, are identified as issues. The municipality has plans for large scale waste incineration: 20 percent of the household waste. The annual budget for waste management is 1,500 million CRC (12,760 CRC per citizen and year).

Desamparados

This is the third most populated municipality in Costa Rica. Desamparados is primarily an agricultural municipality with agriculture being the most important economic sector. Household waste and recycling are collected weekly. Recycling is held back by problems with household waste contamination of the recycling: 20 percent of the recycling volume is made up of household waste. The municipality sees the need to modernise the recycling chain, apply a weight-based tariff, and improve cooperation with the other municipalities. The annual budget for waste management is 4,000 million CRC (18,850 CRC per citizen and year).

Montes de Oca

The municipality is characterized by its high commercial development in the city centre, mainly in the service sector. The municipality is also characterized by the presence of several public and private universities, government departments, and financial institutions. Household waste is collected twice a week, recycling once a week and bulky/electrical waste once a month. The level of recycling is currently at 4 percent. Household composting exists, but only on a small scale (200 households). Alongside household collection of recycling, the municipality also has fixed recycling stations. The municipality wants to make more land available for recycling centres, increase the level of technology in their waste management, and invest in composting. The annual budget for waste management is 2,166 million CRC (35,600 CRC per citizen and year).

San José

The municipality of San José is an urban area with a population of 380 155 inhabitants. The municipality has a well-developed waste management system. Collection of recycling is made available by several methods. There is household collection by truck (weekly- monthly), mobile collection points and Eco-points (fixed recycling stations). Recycling is processed at a specific recycling centre and household waste is landfilled. Identified issues include an ineffective administration with a division between household waste and recycling, national plans for waste management that are too far from everyday reality, and that the level of household sorting is too low. A collection service for bulky, electrical, and hazardous waste would be desirable. The annual budget for waste management is 18,000 million CRC (45,700 SEK per citizen and year).

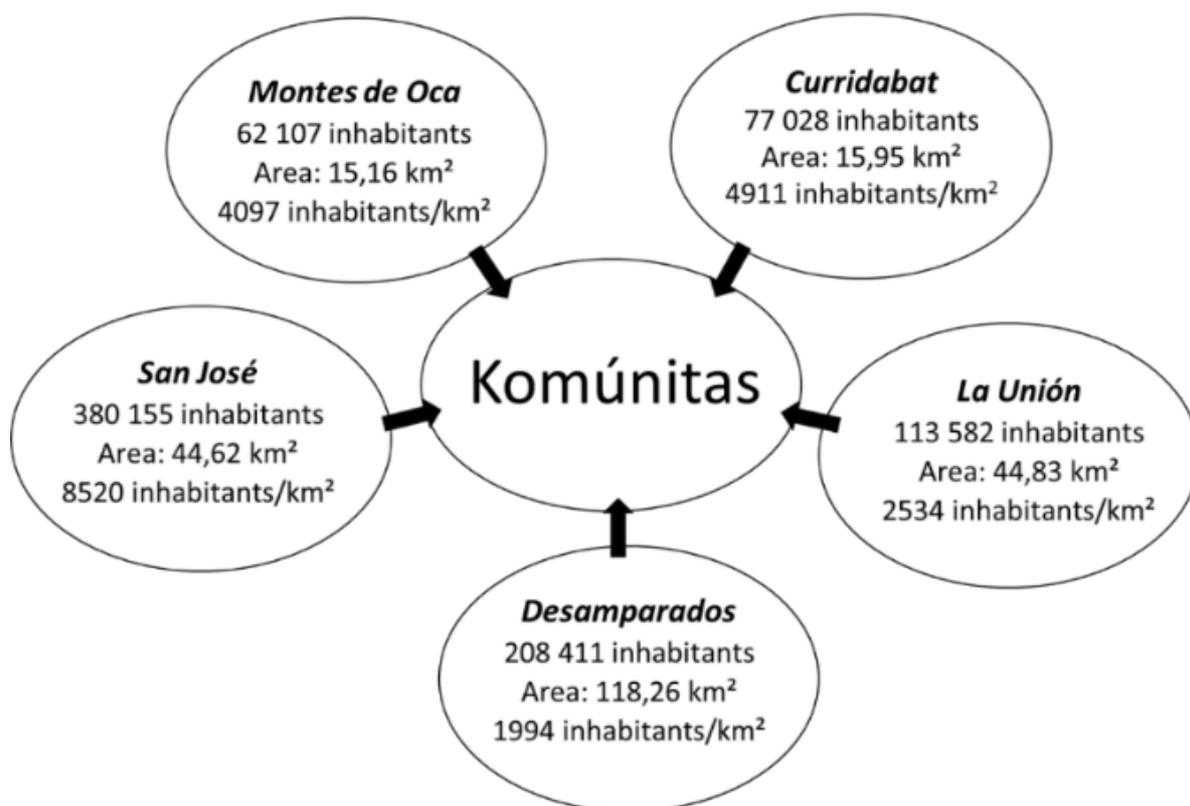


Figure 2. The five municipalities are cooperating through an intermunicipal project called *Komúnitas*

Challenges and opportunities

The intermunicipal project *Komúnitas* has been running for about three years. In this time, the household waste in the participating municipalities has been characterised and human and infrastructural resources linked to waste have been inventoried (such as number of employed, vehicles etc). Facilities for receiving materials (glass, plastics, packaging, metal, cardboard, paper, and electrical waste) for recycling have been identified.

About 97 percent of the household waste from the *Komúnitas* area is deposited in landfills. Currently, only about 2 percent of household waste is recycled. This is not only an environmental problem, but also a loss of potential resources.

The five municipalities deposit their waste in landfills run by private companies, and which have a limited lifespan left - approximately 10 years. There is a considerable amount of landfill gas emerging from these sites since the

household waste contains a large fraction of organic waste. This gas is flared and not used for energy production. Landfill gas emissions are a significant source of GHG and contribute to global warming.

The primary area of focus for the *Komūnitas* project is to find ways to collaborate between the five municipalities. The municipalities have vastly differing characteristics and resources, which is why it is central to the project to find a common platform for cooperation, on a practical, legal, and economic level. It is within this area that the *Komūnitas* project would like to gain insight and experience from Sweden. Several Swedish waste management actors are intermunicipal companies or organisations and therefore well placed to share best practices.

On top of this central issue of cooperation, there are five ongoing projects and important areas within *Komūnitas* linked to their challenges:

<p>Legal framework</p>	<p>A major issue is how to collaborate and the legal framework for this cooperation. The intermunicipal project opens for the possibility of benefiting from “economies of scale”. This can be, for example, in the form of shared costs for centralised treatment plants or shared costs for educational programmes. Also, there is a gap between the national plans and the local possibilities for achieving the plans due to legislation and financing. Some improvements have been made, such as the municipalities now being able to use the fees for waste management.</p> <p>Additionally, during the last quarter of 2021, three of the five municipalities of <i>Komūnitas</i> will be working on their first joint waste management plan with the support of UNDP and GEF. Joint waste management plans are allowed by law in the Municipal Code, but seldom used. It is expected that it will become a good practice that will help the collaborative work among municipalities.</p>
<p>Technological solution for better sorting of material for recycling</p>	<p>A major issue is the low level of household waste sorting that is currently undertaken by individual households combined with the poor sorting quality of the recycled material that is collected. <i>Komūnitas</i> have indicated that they think a technical solution for secondary sorting of the collected recycled material would be an appropriate method.</p>
<p>Educational training and communication</p>	<p><i>Komūnitas</i> are also highly aware of the need to educate their citizens to change behaviour regarding waste sorting. All five municipalities have some form of existing education programmes. There are good possibilities for cooperation between the municipalities.</p>
<p>Biogas treatment plant for organic waste</p>	<p>The organic waste is a significant part of the household waste. Home composting occurs but is not widespread since it is not well known to the public. To increase the treatment of organic material there are plans for a biogas plant. A technical feasibility study has been undertaken but there is no financing of the investments.</p>
<p>Facility to take care of plastics</p>	<p>Plastic is a big problem in society and there is an idea to build a plant that can convert plastics into composting bins, but it has not been properly structured and it has no budget.</p>

3.3 PILOT CITY KIGALI, RWANDA

Rwanda “the land of the thousand hills” has a growing population (13 million, 2020) and rapid urbanisation, with the capital city of Kigali (1,6 million) as the economic and growing centre. Nonetheless, Rwanda is still a rural country with around 74 percent of people living in rural areas.

Rwanda urban-rural (2017)

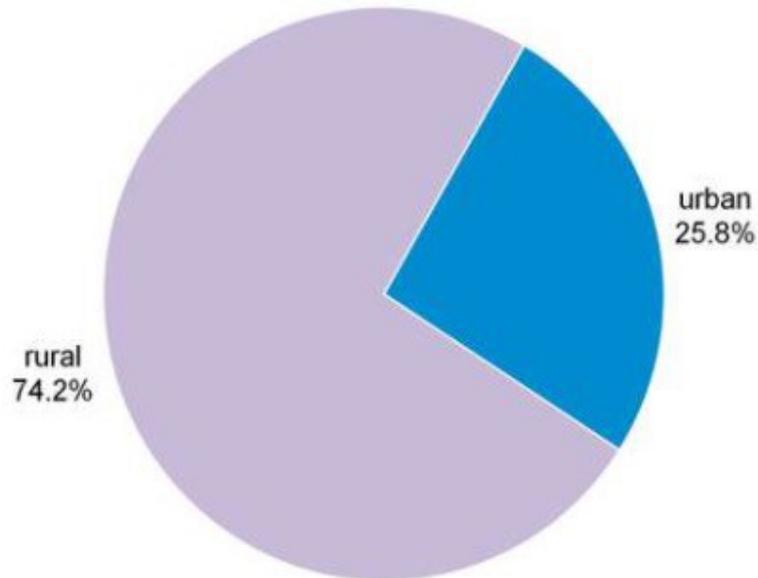


Figure 3: Distribution of urban and rural population in Rwanda, 2017. Source: Britannica, 2021

Rwanda’s rate of population growth is greater than the global average, but on the same level as that of neighbouring countries. The birth rate is among the world’s highest, leading to a young population, with about two-fifths of the population under age 15 and another one-third between ages 15 and 29 (Britannica, 2021).

Rwanda age breakdown (2018)

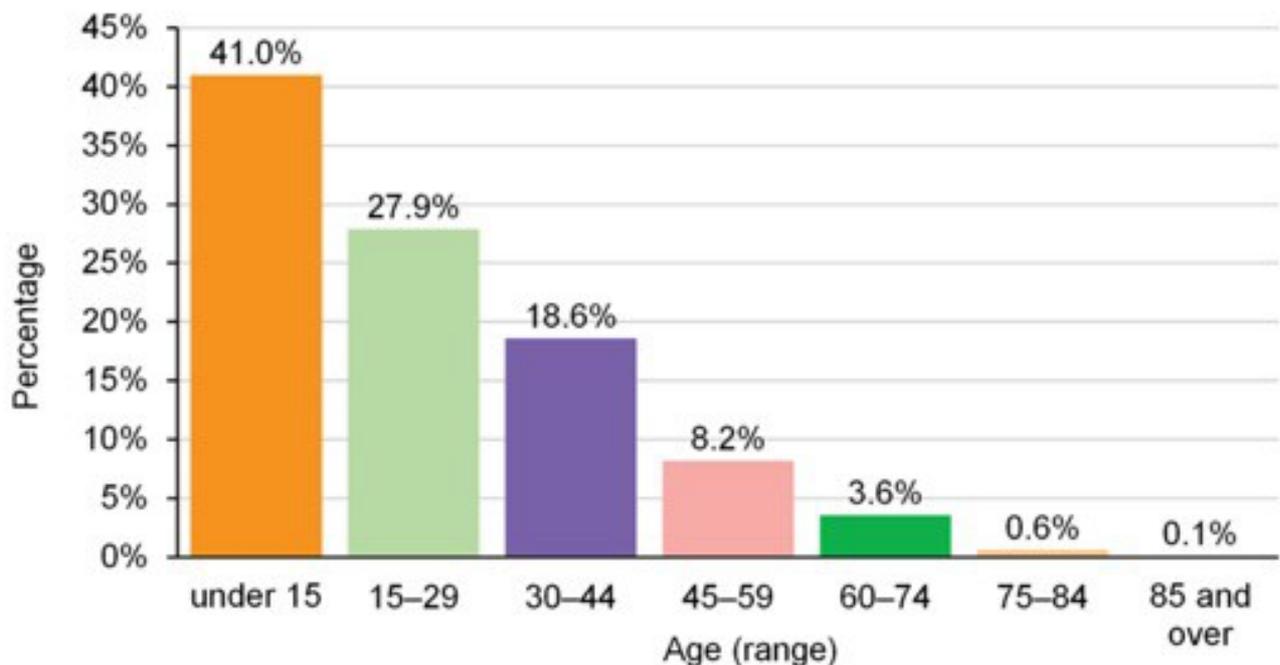


Figure 4: Age breakdown, 2018. Source: Britannica 2021

The rapid economic growth - 9,4 percent in 2019 (African Development Bank, 2021) - is naturally good for the country, but it is also a challenge to secure all necessary service and for the growing population in the capital Kigali. One major consequence are the growing volumes of MSW.

Institutional and Policy Framework

The overarching law governing waste management in Rwanda is the *Organic Law Determining the Modalities of Protection, Conservation, and Promotion of the Environment in Rwanda*. This law outlines the general principles that guide the environmental governance, such as the *protection principle* and the *polluter-pays principle*.

There are three additional levels of the legal hierarchy that govern waste management. These are: *The Law on the Environment of 2018*; *The National sanitation policy*; and *guidelines on solid waste collection, transportation, and recycling*.

The Law on the Environment of 2018, defines terms in the waste management sector, as well as sanctions and fines for unauthorised activities. Additionally, it also creates environmental protection committees at district, sector, and cell levels.

The National sanitation policy, sets the vision for the whole waste management sector and carves out specific interventions needed to achieve sustainable and equitable access to solid waste management (SWM) and sanitation. It aims at improving the efficiency of the SWM at the national level, while highlighting principles such as full cost recovery, and the financial stability of waste operators. The policy also calls for the principles of the waste hierarchy to be implemented.

The last level are the *guidelines on solid waste collection, transportation and recycling* which are largely determined by Rwanda Utilities Regulatory Authority (RURA), Rwanda Environment Management Authority (REMA) and the cities. These regulations and guidelines include:

- i. *Guidelines on Solid Waste Collection and Transportation (2014)*, drafted by RURA, which categorizes waste collection companies, sets out requirements and types of licenses, regulates the mode and frequency of waste collection and specifies the amount and deadlines of fees payable to RURA, and determines household tariffs;
- ii. *Regulations of Solid Waste Recycling in Rwanda (2015)* also drafted by RURA, which provides standards for a recycling site and recycling facility permitting process and requirements, recycling operational and working environment standards and recycling company license application process and requirements; and
- iii. *Guidelines on practical tools involving Solid Waste Management (2010)* by REMA, which provides detailed technical guidelines on the landfill and compost operations including: site slope requirements, soil and clay liners thickness standard, landfill gas management techniques, landfill closure plan and compost chemical composition.

It has however been noted that despite the many legislations and regulations on waste management, their enforcement is weak. One of the reasons identified is that current waste management arrangements are spread across a variety of different ministries and institutions, all of which follow waste management regulations that only form a small portion of their overall mandate thereby causing fragmentation and lack of coordination.

Organisation of waste management in Kigali

The waste management structure in Rwanda consists of national level policy making institutions, and a mix of national and local level implementation agencies and regulatory bodies. Ministries including the Ministry of Infrastructure (MININFRA), Ministry of the Environment (MoE), Ministry of Health (MoH) and Ministry of Commerce (MINICOM), are largely involved in drafting policies to be implemented by local administrative entities including the City of Kigali, Districts and Sector level local government bodies. RURA and REMA are responsible for setting out the guidelines that guide the way in which all implementation activities are carried out. Additionally, the Water and Sanitation Authority (WASAC) implement Solid Waste Management (SWM) through their involvement in landfill management (Assessing waste management services in Kigali, C-38435-RWA-1, 2019).

In the City of Kigali, waste is managed by the city, whereas in the other four remaining provinces waste is managed by the districts. The districts and sector officials are involved in both managing contracts with waste management companies as well environmental protection. Waste collection services are generally outsourced to private companies (Assessing waste management services in Kigali, C-38435-RWA-1, 2019).

According to surveys conducted by the municipality, Rwanda recognizes poor SWM as a key impediment to sustainable development and thus deems SWM as a priority sector in transitioning to greener urban development. However, the City's central role in waste management is not reflective of its resources or coordination capacity to deliver new strategies and projects that will improve the system in Kigali. At the city level, the responsibility for both the City's solid and liquid waste services vests in a single waste management officer. Responsibility for day-to-day operations leaves little capacity available for the waste management officer to conceptualize new strategies and projects and appoint specialists to carry out the necessary work. Additionally, responsibility for waste collection is managed at sector level by hygiene officers, and it is unclear whether there is any direct accountability or communication between the City and local officials. Moreover, with regards to data sharing it is unclear how much is done in terms of reporting contractor performance and collection data (households serviced and trips to landfill), all of which is vital for policy and strategy development at City level (Assessing waste management services in Kigali, C-38435-RWA-1, 2019).

Waste generation

Waste generation has increased over the last decade. Reports over the last 8 years have shown a steady increase in the amount of waste generated from around 400 tons per day to over 800 tons per day and a per capita solid waste generation rate of 0.57 kg/person/day (Assessing waste management services in Kigali, C-38435-RWA-1, 2019). Currently, there is no possibility to check the amount of waste at the Nduba landfill, which means that all figures in the different reports are estimates.

For example a report from 2017 states that Kigali City generates an average of 1,800 and 2,000 tonnes of solid municipal waste per day, however only some 400 tonnes per day of unsorted waste or 140,000 tonnes per year are collected and taken to the Nduba landfill (REMA, 2017).

It is important to note that waste generation does not equate to waste collection and the amount of waste that is collected is usually a fraction of what is generated. The State of Environment and Outlook Report 2017 by REMA, states that the urban population served by waste collection services is 35.8 percent. In Kigali, of the waste generated, only about 300-400 tons of waste per day is collected and transported to a single dumping site, the Nduba landfill in Gasabo district. Though there are still shortfalls in waste collection services, there has been a vast improvement in coverage over the years due to increased private sector involvement. Today most of the areas with highest generation of waste near the city centre and the in some of the districts have collection operation, however the increasing population and the resulting urban density must be considered when planning for collection.

Waste composition

There have been several reports of waste composition in Kigali, yet there has not been any analysis of the waste composition for characterisation. However, one estimate is that around 65-70 percent of the MSW is organic waste (Assessing waste management services in Kigali, C-38435-RWA-1, 2019). Hence, there is a high potential for reducing the amounts of waste to landfill if there is a strategy and plan for source separating the organic waste and treating it separately.

In a report from 2017, it is stated that many households no doubt purposely compost waste to create organic fertilizer for kitchen gardens, yet much of the biodegradable waste produced in the city either goes to the dump mixed in with the rest of the waste stream, or if not collected, is disposed of in vacant lots, roadsides and improperly managed informal dumps that create unsightly and malodorous surroundings (REMA, 2017). The lack of a waste management scheme to separate organics from other solid waste misses the opportunity to recycle many components of the city's garbage stream, which could create businesses and jobs, reduce the amount of waste that needs to be otherwise disposed of and relieve the environment from the impacts of improper waste disposal (Isugi & Niu, 2016, in REMA 2017).

A report from 2019, indicates that the amount of organic waste will decline to 50 percent when Kigali becomes more of a middle-income society. Nevertheless, the amount of organic waste will increase from 480 tons/day to 710 tons/day by 2030 (Assessing waste management services in Kigali, C-38435-RWA-1, 2019).

The number of recyclables in the composition is low, however, due to increasing incomes and the use of packaging it will grow to become a larger part in the future. If governmental goals are to be met it is important to indicate the future waste flows, both for the waste generation and collection service point of view but also for the change in composition of the waste.

The service

The collection of household waste in Kigali is outsourced to private companies. They work on 1 to 5-year contracts and collect waste and fees directly from the households. Today there are eleven private companies that operate in Kigali (Assessing waste management services in Kigali, C-38435-RWA-1, 2019).

To enter the waste collection market in Kigali you must have a license issued by RURA. The applicant company needs to fulfil various criteria including owning three trucks with capacity of 5 tons, ability to collect waste on weekly basis, submitting a business plan and pay the application fee of 100 000 RWF. If the company is selected, they are required to pay another 2,5 million RWF to RURA (5-year contract) and 0,3 percent of the quarterly turnover.

Waste collection services are determined on sector level:

1. Sector Executive Secretaries determining if a certain area has the adequate size to have waste service collection.
2. The service of collection is tendered.
3. The companies advertise their working experience, collection capacity and equipment but also competing on the tariffs they charge the households.
4. Executive Secretaries sign contracts with chosen company
5. Sector hygiene officers are responsible for overall monitoring and evaluation of the companies' activities (Assessing waste management services in Kigali, C-38435-RWA-1, 2019).

The number of households served by the collection companies is lower than the number of households that are supposed to be served (Assessing waste management services in Kigali, C-38435-RWA-1, 2019). There are several possible reasons for the disparity, wherefore monitoring and control are important mechanisms to secure the collection. Today, there are few options to ensure a contractor's ability regarding service quality, complaints, and timely collection. The companies can act and operate independently.

The fee for collection

Tariffs are progressive with households in lower *ubudehe* categories, or level of poverty, benefitting from lower service charges. Tariffs for households were set by RURA in 2012 using a 3-4 tier system that loosely corresponded to a household's *ubudehe* category; households within each band are charged different rates based on the distance of that household's administrative Sector from the landfill. Overall, the highest earning households pay RWF 5,000-11,200 per month; the middle-income households pay between RWF 3,700-7,500 and the lowest income households pay between RWF 1,700-2,300 depending on the Sector in which they live. A certain number of households across different Sectors are designated as indigent by Sector level authorities and are excused from paying tariffs. Moreover, waste collection companies are obliged to serve low-income households, regardless of their ability to pay.

The quality of the waste collection service is generally considered high but due to the condition of vehicles, formal planning, limited resources, and lack of astute the service in certain sectors were lower. There are also differences in reporting of percentage of households served from the investigations and the responsible manager for waste management in Kigali (Assessing waste management services in Kigali, C-38435-RWA-1, 2019).

Landfill

Waste management in Rwanda follows a "collect and dump" approach in most cities. In Kigali, waste is currently disposed at the Nduba landfill. Prior to this, waste was disposed at the Nyanza landfill in Kicukiro district from 1983 to 2012. Nyanza was closed due to several issues include spontaneous methane gas explosions, leachate flowing to nearby communities, unpleasant smells, groundwater pollution, the existence of vermin etc. UNDP, under the Consolidated Waste Management in Rwanda project, supported the rehabilitation of the Nyanza landfill (UNDP, July 20, 2015). The project, which was successfully completed in 2013, sought to rehabilitate the ecosystem, close the landfill, redesign the site to be safe and habitable, and increase awareness amongst the Rwandan population about the importance of proper waste management.

Similarly, to Nyanza, the Nduba landfill, which can be characterized as an open-air dumping site, is experiencing several issues with complaints from workers and residents alike.

The landfill site is situated on a plateau that is surrounded by steep slopes. Currently solid waste deposited in the landfill is compacted and covered with quarried laterite. However, waste material is spilling down the surrounding steep slopes as there is no retaining mechanism around the fill site (REMA, 2017). The amount coming to the landfill is not registered but its lower than the amount collected in the city, which means that it either goes to illegal dumpsites or to diverted recyclers. Three of the four cells constructed are also nearing full capacity and there are many untapped or insufficiently used opportunities to take advantage of the waste as a resource (Nkurunziza, September 2, 2019, *The New Times*). These include use of landfill gas (LFG) from waste methane to generate electric power, better onsite separation and sorting as well as improving sorting at household level to enable more recycling and recovery.

Until June 2018 the landfill was managed by a private company on concession. Thereafter, the company was dismissed and replaced by the Rwanda Reserve Force. Today, the landfill is managed by WASAC and the City of Kigali. There have been attempts to build a sanitary landfill, develop a compost plant and a waste to energy plant but all efforts have failed for various reasons.

The trouble for the management of the Nduba landfill is the financial shortfalls both in terms of revenue recovery and the cost of managing the site. The costs for the landfill are paid by WASAC and the City of Kigali, however, some of the costs should be paid by private through the deposit of waste on the site. The lack of a weighbridge leads to charging the fee based on the size of the lorry- regardless of the tonnage – meaning that there are no possibilities to measure and follow up the tonnage and the connection to the disposal fees. Reports indicate that the management of the landfill costs around 600 million RWF but the revenue from the is as low as 12-13 percent or 72-80 million RWF (Assessing waste management services in Kigali, C-38435-RWA-1).

Furthermore, according to a report from 2017, some industries do not treat industrial waste at site as required by the law but instead dump it at the landfill site (REMA, 2017).

Recycling and recovery

The State of Environment Outlook 2017 (REMA, 2017), reports that only 2 percent of solid waste is recycled with some plastics transferred to Uganda, Kenya, and Tanzania for recycling due to inadequate systems for recycling. These figures are very uncertain and other studies indicates that recycling is closer to 10-12 percent. The government target is 30 percent by 2019/2020 and 40 percent by 2029/2030.

Today, there are few companies which handle recycling, the majority of which centre around paper and plastics. One paper treatment and recycling plant, Trust Industries, transforms paper waste into toilet paper. Several plastic recycling organisations exist, the majority of whom turn a combination of high density and low-density plastics into furniture, household objects and industrial agriculture materials. At present, there is no recycling facility for PET bottles in Rwanda, meaning that most of these bottles are crushed and sold to recyclers abroad. There is one company that actively sorts waste at the landfill with its own personnel and which recycle approximately 20 ton/month (Assessing waste management services in Kigali, C-38435-RWA-1).

To improve the situation, the authorities want to implement an intelligent waste management system. As part of a partnership with Smart Africa Secretariat, an organisation of the African Union, the Rwandan Ministry of Information and Communication Technologies and Innovation (ICT) is looking for a company to set up an intelligent waste management system. In agreement with the municipality of Kigali, the government intends to sign a contract with the selected company to implement its intelligent waste management solution by December 2020. The system, whose pilot phase will cost \$100,000, will collect, transport, treat, recycle, and dispose of waste. Whether or not this system is implemented is not clear at this time of writing (Jean Marie Takouleu, 6 September 2020, *Afrik21*).

Moreover, the Portuguese firm, Mota Engil, has been selected to construct a waste recycling plant in Kigali. The company will be tasked with using sustainable technologies to turn the waste into different products. Thereto, Agruni Company, which collects and transports garbage to Nduba landfill have reportedly designed a 24 billion RWF project to turn waste into valuable products. Currently, the company takes some of the sorted waste from Nduba landfill and recycles it while others are taken to other recycling plants in the country (Michel Nkurunziza, September 2, 2019, *The New Times*).

Challenges and opportunities

Some challenges for the waste management in Kigali have already been mentioned above, but are also highlighted in the *Performance Audit Report on Management of Solid and Liquid (Sewage) Waste in the City of Kigali from 2016*:

1. Failure to install waste to energy plant.
2. No sanitary landfill or a recycling centre.
3. Failure to prepare a landfill plan.
4. No environmental impact assessment conducted before opening Nduba landfill.
5. Failure to manage leachate water from landfill.
6. There is no proper segregation of solid waste at Nduba.
7. Inappropriate solid and liquid disposal. There is no cover of the waste after each day's work.
8. Slow pace on the expropriation of neighbouring residents.
9. Bad working conditions at the landfill site.
10. Lack of inspection area at the landfill.
11. Failure to manage greenhouse gas emitted from landfill.
12. Lack of planning both on local and national level.
13. Low rate of recycling.

Although, many challenges remain, the situation is improving year by year. According to the project partners in Kigali the most successful developments are:

1. The percentage of residents and households who gain access to waste collection is increasing. Although, the city is developing and new areas are being built, it is believed that a large percentage of the population is covered by the waste management system. However, the precise number of the collection coverage is unclear. Numbers have varied between 50 percent coverage up to 95 percent coverage.
2. Public awareness, the awareness about littering and the importance of handling waste is improving. One part of the awareness is the Umuganda. The system were all citizens in Rwanda once a month clean the streets and neighbourhood to keep Rwanda tidy.
3. Collection points for E-waste in the city.
4. The procurement of an intelligent Waste Management System.
5. Collection of hazardous waste and incineration.

4. Analysis and review of existing plans



This chapter contains two main parts: presentation of existing plans, and review and analysis of these plans. The goal is to identify the current strategic foundation, of each pilot city, from which the initial strategy for a zero-waste situation will be elaborated on in the next chapter.

Relevant plans for waste management are primarily national, regional, and local plans. However, other plans relevant for the waste management sector will be mentioned where suitable.

Both the presentation of plans, as well as the review and analysis thereof, has been dependent on the amount of information available to the Swedish partners. Therefore, the level of detail and depth of analysis will differ between the subchapters for the pilot cities.

4.1 PILOT CITY TIANJIN, CHINA

Presentation of Plans: Eco-City as “Zero Waste City”

Here we present the parts of the Eco-City project framework which are relevant to waste management:

1. To research and explore the management philosophy of “zero-waste city”, and fully absorb international cutting-edge technologies and developmental experiences for customisation of the sustainable development strategy of “zero-waste city” in line with the regional characteristics of Tianjin. Through fully learning from and localizing the development concept and experience of zero-waste city in Sweden, integrating the existing Eco-city development experience in solid waste management, green building, sponge city, passive housing and other fields, to customize sustainable development strategy of “zero-waste city” in all regions of Tianjin.
2. To research and demonstrate on the path, system and mechanism construction and key links of the construction of “zero-waste city”. Taking promotion of green development and lifestyle as the starting point, to study and establish urban development mode, mechanism and supervision system that continuously promote the reduction of solid waste at source and resource utilization, minimize the amount of landfill and the environmental impact of solid waste. To analyze and summarize the key links in the construction process of “zero-waste city” to achieve the minimum production of municipal solid waste, full utilization of resources and biosafety disposal, so as to form an economic and technically feasible construction path of “zero-waste city” in line with the actual situation of the city.
3. To research and demonstrate of key disposal technologies for the construction of “zero-waste city” and waste resource utilization. With focus on the technology for storage and disposal of bulk industrial solid waste, technology for full utilization of major agricultural waste, technology for source reduction, resource utilization of municipal solid waste, and technology for comprehensive safety control of hazardous waste, to carry out research on the construction of “zero-waste city” and the key disposal technology of waste resource utilization, and develop a list of economically feasible, technologically mature and environmentally friendly technologies.
4. To cultivate green culture and carry out regular forums for exchange of solid waste management experience. To organize the summit forum, academic forum, and seminar with a theme of “experience sharing on municipal solid waste management”. Through UNDP and other academic platforms, combined with the management experience and development model of China’s “11+5” zero-waste cities, sharing domestic and international experience in solid waste management, community governance and environmental protection education, promoting the sustainable development of “zero-waste cities”, and advocating the evolution of society from a “consumer” that devours resources to a “recycling”.

The primary project partners which are laid out by the project framework, for the Eco-City, include but are not limited to: United Nations Development Programme (UNDP); UN-Habitat; Tianjin Academy of Eco-Environmental Sciences (TAES); Tianjin Low Carbon Development Research Center; Environmental Bureau of China-Singapore Tianjin Eco-City; Avfall Sverige; Embassy of Sweden in China; Tianjin; China Investment Association -Energy Investment Committee, etc.

Analysing the plans and reasoning the present status and deliverables of the plan

From the available documentation, it can be concluded that there is a functioning waste management in the Eco-City. However, it has not been examined in detail how the experience of the Eco-City could be transferred. Waste management solutions and infrastructure in other districts in Tianjin have been described, yet a more detailed examination has not been possible.

Tianjin has the legislation and the experiences from the Tianjin Eco-City, which together with international experiences, fulfils the requirement for a strategy to develop future waste management in all Tianjin districts. The “*Regulations on the Management of Domestic Waste in Tianjin*” in force since December 2020 with the 10 chapters and 78 articles describing the intended development of the waste management gives Tianjin City the tools to develop a “Zero-Waste city”. The 10 chapters and 78 articles describe what shall be done in the development of the waste management, but also who the stakeholders shall be and who is responsible for the implementation. The articles also describe the legal sanctions that can be put into force if a stakeholder or any other relevant part does not fulfil the intentions in the articles.

A pilot working group had been established for the construction of the “Zero Waste City” in the Tianjin Eco-City. Members in this group include: City Administration Bureau; Construction Bureau; Social Bureau; Commerce Bureau; Economic Bureau; Legal Affairs Bureau; Environment Bureau; Finance Bureau; Tourism Bureau; Human Resources and Social Security Bureau; Education and Sports Bureau; Smart City Development Bureau; and, Law Enforcement Brigade. An office is subordinated to the group and is located in the City Administration Bureau. This group will be a good source for discussing challenges and obstacles when preparing a zero-waste strategy and implementing the transfer of experiences from Tianjin Eco-City other districts.

We believe that there are opportunities to integrate experiences from Tianjin Eco-City when implementing the articles in the regulation, as the articles are so widely written.

4.2 PILOT CITIES IN GAM, COSTA RICA

Since the publication of the *National Law for the Integrated Management of Waste* (Ley para la Gestión Integral de Residuos N° 8839) in 2010, Costa Rica has been hard at work generating the necessary regulations that would allow for proper and comprehensive waste management, including electronic-, medical-, and hazardous waste, as well as waste requiring special treatment. Yet, there are currently no specific regulations for the management and disposal of organic waste, radioactive waste or for construction debris.

Presentation of Plans

This momentum has been accompanied by multiple national policies, plans, and strategies, which seek to align public and private stakeholders at the national and local levels, to tackle the challenge of appropriate waste management and disposal, including:

- Política Nacional para la Gestión Integral de Residuos 2010-2021 (National Policy for Integrated Waste Management)
- Política Nacional de Compras Públicas Sustentables (National Policy Sustainable Public Procurement)
- Política Nacional de Producción y Consumo Sostenibles 2018-2030 (National Policy for Sustainable Production and Consumption)
- Plan Nacional para la Gestión Integral de Residuos 2016-2021 (National Plan for Integrated Waste Management)
- Plan de Acción para la Gestión Integral de Residuos 2019-2025 (Action Plan for Integrated Waste Management)
- Plan Nacional de Compostaje 2020-2050 (National Composting Plan)
- Plan Nacional de Descarbonización Costa Rica (National Decarbonization Plan, lauded as one of the most ambitious on the planet)
- Estrategia Nacional de Separación, Recuperación y Valorización de Residuos 2016-2021 (National Strategy for the Separation, Recovery and Valorization of Waste)
- Estrategia Nacional para Sustituir el Consumo de Plásticos de un solo Uso por Alternativas Renovables y Compostables 2017 – 2021 (National Strategy to Replace the Consumption of Single-Use Plastics with Renewable and Compostable Alternatives)
- Estrategia Nacional de Cambio Climático (National Climate Change Strategy)
- Plan de Acción de la Estrategia Nacional de Cambio Climático (Action Plan for the National Climate Change Strategy)
- Programa Nacional de Educación en Gestión Integral de Residuos Sólidos (National Education Program in Integrated Solid Waste Management)

These documents are not currently available in English.

All five municipalities (Curridabat, Desamparados, La Unión, Montes de Oca and San José) have published

their municipal Waste Management Plan (WMP), and all five of these can be considered outdated in terms of what *Komūnitas* seek to achieve: a multi-municipality, zero-waste management scheme, towards a circular economy model.

The idea and subsequent work to establish *Komūnitas* happened after the drafting and publishing of the local WMPs, which date as follows:

Municipality	Time Scope of the Municipal Waste Management Plan
Curridabat	Published in 2013, not updated since
Desamparados	2016-2022
La Unión	Published in 2014, not updated since
Montes de Oca	2018-2022
San José	2018-2022

The Action Plans included in each WMP vary in their scope and level of detail but can be summarised in terms of the Strategic Objectives and Strategic actions proposed (see appendix C). All municipalities report similar needs, challenges, and overall goals.

During the last quarter of 2021, three of the five municipalities of *Komūnitas* (Curridabat, La Unión and Desamparados) will be working on their first joint waste management plan with the support of UNDP and GEF. Joint waste management plans are allowed by law in the Municipal Code, but seldom used. It is expected that it will become a good practice that will help the collaborative work among municipalities.

Analysing the plans and reasoning the present status and deliverables of the plan

As mentioned before, even though each municipalities has been working hard to improve their waste management capabilities, the initiative to join forces as *Komūnitas* is more recent than any of the available documentation produced by each of the individual municipalities. With the exception of the municipal WMP of San José, most of the municipal WMPs are structured more as documents that list necessary actions and how to achieve desired goals, rather than analysis of actions taken, and improvements achieved in comparison to previous plans. Hence, there is little documentation on the present status, however, the needs and shortcomings of each municipality are well presented in each municipal WMP.

There is an ongoing project, led by UNDP, which is helping Curridabat, Desamparados and La Unión in the drafting of a joint plan - Inter-municipal project for waste management: Towards a circular economy - which addresses the need for *Komūnitas*' members to harmonise their local regulations and plans in order for the collective to work as a cohesive unit. The focus of this new plan is to reach a circular economy and a zero-waste model. This plan considers that solid waste is the third largest generator of greenhouse gas (GHG) in Costa Rica and seeks to underline which Sustainable Development Goals are addressed.

Reasoning the achievements

The main struggle shared by all five cities reflects the national tendency of poor waste recovery trends. In 2018, the total waste generation of these five cities reached 183,071 tons, of which 60 percent was organic waste. Most of which, up to 97 percent, was disposed of in landfills.

Challenges for the five municipalities have been studied and are classified as follows:

Internal challenges	External challenges
<ul style="list-style-type: none"> • Administrative deficiencies • Human resources • Bureaucracy and institutional red tape, legislation, and jurisprudence • Budgetary problems • Tax collection (not all citizens pay the associated taxes, tax values are outdated and the process of solving these problems can be highly politicized) 	<ul style="list-style-type: none"> • Bad habits of the general population • Poverty and homelessness levels • Informality of waste collectors, fly-tipping • Clandestine recycling endeavours, outreach, awareness, and education of the general population • Illegal dumping sites

When it comes to strengths, each municipality has its own area of success, depending on the number of people who work in the individual Waste Management Offices and the collective set of skills of these teams.

The five municipalities can count on a rich experience in environmentally related projects such as: design of Waste Management Plans; characterization and waste composition studies; GHG Inventory under the scheme of Country Program 2.0; organic waste management with CRUSA-GIZ; composting web portal with CRUSA-GIZ; BID-Aliarse Green Asphalt; Waste Master Plan Costa Rica; and, Pre-Feasibility Study of the Energy Recovery Plant with the Korean Ministry for the Environment. In such projects, local governments have been working as Executing Units of foreign aid funds.

How well do the plans address the present challenges and opportunities?

The greatest challenges faced by all five municipalities can be said to follow this hierarchy:

1. Inadequate funding for general waste management collection due to outdated tax schemes, population growth and growing waste generation tendencies. Another issue is the large difference between the five municipalities in financing when viewed as waste management budget per citizen.
2. Partial and incipient implementation of differentiated routes for recyclable waste. The management and valorisation of recyclables is still an open question; solutions involve the participation and formalisation of local stakeholders to benefit from the trade of these materials. These initiatives also show low rates of citizen participation.
3. Partial and incipient implementation of differentiated routes for organic waste. Initiatives are smaller and more recent than those that tackle management of recyclable waste. These initiatives also show low rates of citizen participation and challenges with financing among other things.

For *Komūnitas*, the greatest challenge lies in the legal status of the joint effort planned by the five municipalities. To be successful, the model needs to have a legal grounding that can prove itself resilient to local political shifts. Elections for Mayors and Municipal Councils occur every four years, and issues like new or improved tax schemes for waste management can become hot electoral topics. Political support for tax scheme amendments at any point can hinder advance for any of the individual municipalities. Thus, a strong legal framework that can be supported and co-signed by all five Local Governments and allows for steady advance in the future is paramount.

How well does the plans adjust to the idea of zero waste landfill?

Existing plans do not mention the zero-waste concept. This derives from the fact that they were all written prior to the inception of *Komūnitas* in 2019. The most recent municipal WMPs date from 2018. The new direction proposed by *Komūnitas* and the joint plan currently being drafted with UNDP for Curridabat, Desamparados and La Unión does, however, focus on a circular economy and zero-waste models.

Lacking elements in the plans

The most important current challenge for the municipal plans and the *Komūnitas* proposal is how to correctly implement a circular economy model. The financing aspect of the project is key, so that cities can:

- Update current tax schemes and approve new financing instruments (for example, incentives for correct waste separation and disposal by citizens, businesses, large generators)
- Access foreign aid funds and other financing instruments, as a joint five-municipality consortium
- Find and develop Public-Private Partnership (PPP) opportunities
- Help local organisations to become formalised and access the benefits of a circular economy, as key stakeholders of this model
- To develop innovative eco-industries that can tackle the processing and valorisation of non-traditional waste that is currently not processed in Costa Rica due to lack of appropriate technologies

4.3 PILOT CITY KIGALI, RWANDA

The city of Kigali and Rwanda is working hard with development in several sectors connected to one another. This study has identified several investigations, pre-studies, audit reports and plans which are relevant to map out the vision for Zero Waste and MSW treatment in Kigali. The relevant documents found in this study are presented below.

Presentation of plans

Rwanda's vision 2050

Rwanda's vision 2050 highlights the need for all urban and rural areas to have sewage and disposal systems and for better SWM at household level. It aims to increase access to sanitation (86.2 percent in 2016/2017) and waste management systems to 100 percent by 2035, as well as to increase household onsite access to sanitation services from 2 percent (2016/2017) to 80 percent. It sets out plans to establish modern sanitation, sewage, and management services in urban areas as well as proper treatment, recycling, and disposal of waste. The NST – National Strategy for Transformation - also re-echoes the scaling up of access to sanitation and waste management systems in cities, towns, and rural areas in its priority area of “Moving Towards a Modern Rwandan Household”. It highlights investments to be made in: Construction of Kigali Centralized Sewerage System; Construction of Kigali faecal sludge treatment plant; Construction of modern landfills in all districts; and, putting in place waste treatment facilities, among others.

Green city Kigali

The Green city in Kigali is dealing with the question of urbanisation and climate changes in Rwanda. The vision is that building homes must go hand in hand with environmental protection and that a holistic approach is the key for success. The project will be grounded in three integrated and indivisible pillars:

- Sustainable urban development for social inclusion and reducing poverty
- Sustainable and inclusive urban prosperity and opportunities for all
- Environmentally sustainable and resilient urban development

Prestudy report Swedfund

A yet not published report, sponsored by Swedfund, has the purpose to investigate the possibility of closing the Nduba landfill, as well as investigating how a new and secure landfill could be developed.

Additional relevant documents and plans

- Assessing waste management services in Kigali, C-38435-RWA-1
- Rwanda Vision 2020
- Republic of Rwanda, REMA, National Implementation Plan for the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal 2014-2021, 2014
- Republic of Rwanda, RURA, Regulations Governing Solid Waste Recycling in Rwanda, 2015
- Medical Waste Management Plan (MWMP), 2017

Analysing the plans and reasoning the present status and deliverables of the plan

From the plans available to this project, it has been challenging to follow a clear line of ambitions, as well identifying what actions have been taken to achieve them. From what we have seen, there is currently no active WMP for the City of Kigali.

In newspaper articles it can be read that there have been ongoing procurements for both the diversion of waste from the landfill Ndubi, as well as technological solutions for smart waste collection, and others. We have not been able to clarify whether there has been a successful implementation of these procurements, or how they are connected to each other and the long-term planning.

However, there have been many achievements, such as collection and treatment of hazardous waste and medical waste, as well as better access to waste collection. It is our understanding that the municipality is very clear on the parts of waste management that have to be addressed and solved in the future. The question, however, is if the organisation is prepared with enough resources to work strategically.

Waste management planning is complex with financial, institutional, organisational and social aspects that need to be addressed simultaneously. It is important that the allocation of responsibilities between different stakeholders is clarified. Who is responsible for which part and for the decided goals? Who is responsible for evaluations and the following up of results and achievements at the different organisational bodies?

The government targets aim for zero waste to landfill. However, considering the amounts of waste going to landfill, and the comparably small amounts being diverted to preparation for re-use or collection for recycling, one can draw the conclusion that the strategic work with the plans and goals has not yet been successful.

Moreover, considering that there is a draft report mentioned above, focusing on the possibilities of constructing a new secure landfill, it seems that there is limited focus on source reduction through waste prevention policies and measures, and more focus on end-of-pipe measures.

5. The Initial Strategy Towards Zero Waste



This chapter will present the initial strategies aiming towards zero waste. Like previous chapters there will be three different subchapters, each covering one pilot city.

The purpose of the strategies is to point out possible directions for the pilot cities to consider. Where applicable, it will suggest decisions and actions needed, to reach the goal of zero waste. However, the initial strategies should not be read as an exact workplan.

Moreover, considering the waste management situation in the pilot cities, the zero-waste concept should be interpreted as working towards achieving the least amount of municipal waste going to landfills. Nonetheless, up-stream actions, such as waste reduction measures are an integrated part of the strategy.

5.1 PILOT CITY TIANJIN, CHINA

As the stakeholders from Tianjin have not been able to participate full out the strategy this will be a guideline for the final preparation of the strategy on transferring experiences from Tianjin Eco-City when developing the waste management for zero waste in remaining districts. The guide is according to the eco-city experience provided by Tianjin and the current problems faced and based on experiences from transferring know-how and experiences from City of Stockholm eco-district (Hammarby Sjöstad) to the other districts in the City of Stockholm.

From the project framework for the Tianjin Eco-City it is possible to formulate a strategy on how to transfer the experiences from the Tianjin Eco-City, together with experiences from Sweden, in all districts in Tianjin and to be a model for other cities in China.

The aim of the initial strategy is to serve as a tool to aid in:

- outlining waste characteristics and sufficient capacity for managing waste.
- defining, following up and controlling realistic technical measures.
- dialogue with decision-makers on all levels about the lack of/ or adjustment of laws and legislation for local waste collection and for regional treatment of waste.
- outlining requirements for financing and investments in waste management that contribute to a sustainable future.

Guideline for strategy

When formulating a strategy for transferring the experiences from the Tianjin Eco-City, it is important to keep in mind that the Eco-City district is an area built up from scratch based on an eco-focus. Whereas, the experiences are meant to be implemented in districts of Tianjin that are not built with a direct eco-focus. This can create challenges, such as lack of available land, lack of equipment and facilities, and lack of awareness and motivation within the none-eco-districts.

When formulating the strategy, it is necessary to define the stakeholders which will be responsible for the implementation of the waste management in the districts, as they are expected to do so in accordance with the strategy. This should be followed by clearly defining, and describing the targets originally set for the Tianjin Eco-City at its establishment, as it can aid as applicable and relevant experiences for the stakeholders. Furthermore, it is necessary to define the decided path of implementation and follow-up of the waste management.

The Eco-City's current waste management system must be described as detailed and complete as possible. Here, an option is to use the checklists in appendices D, E and F, as they can be a successful tool for the analysis of the present situation. It is also useful for finding challenges, problems, obstacles, as well as opportunities for the development of the waste management.

The next step is to present and define the obtained results of the targets set originally for the Eco-City, and where and how these can be implemented in other districts.

Thereafter, the status of waste management in the other districts must be described in a as complete way as possible. Again, using the checklists in the appendices can be a successful tool for accurately defining the present situation, challenges, problems, obstacles, and opportunities in each district. Including, the status of awareness and competence within the waste management organisation, the awareness of the decision-makers, as well as public awareness and motivation. This should be taken into consideration and adjusted for in each district.

Based on the know-how of the achievements from the Eco-City, and with a detailed review of the present situation

in each district, it is important to investigate how and where the experiences can support the legislative demands in the “*Regulations on the Management of Domestic Waste in Tianjin*”.

Experience from Sweden show that using the five questions *What, Where, When, Who and How* is a successful way to get the relevant information for finding and defining the challenges, obstacles, and opportunities when formulating the strategy.

Presented below are examples of questions to consider for each district included in the strategy. This is not a complete list of questions. Depending on the resulting answers, new question will come up and must be considered when formulating the strategy.

Example questions

- **Where** - in which district - to start the development of the future waste management?
- **What** are the differences between dense districts and rural district?
- **What** to do: which experiences are possible to learn from and to introduce, and in which order?
- **What** challenges have arisen during the development and operation of the Eco-City?
- **What** obstacles have arisen during the development and operation of the Eco-City?
- **What** is the available capacity at treatment facilities when developing the waste management?
- **What** are challenges and obstacles for introducing new treatment facilities?
- **What** capacities must be developed when introducing more preparation for re-use and collection of material for recycling?
- **What** are challenges and obstacles when introducing more preparation for re-use and collection of material for recycling?
- **How** to finance the development to the Zero Waste City for each district?
- **When** will the financing be available?
- **When** is it realistic to start?
- **Who** will be the stakeholder to decide on and implement the development of the waste management in the district?
- **How** shall the implementation be executed?
- **How** will the targets and results be followed up?
- **When** will the targets and results be followed up?
- **How** shall the strategy and the development of the waste management be revised?
- **When** shall the strategy and the development of the waste management be revised?

The questions above are a tool for formulating a relevant strategy. These are steps to establish a strategy for making use of and transferring the experiences from the Tianjin Eco-City to the surrounding districts in Tianjin and/or other cities in China.

Example on Checklist for finding present waste situation and experiences

A checklist is a successful way to find present situation, present experiences and define challenges, obstacles, and opportunities (see appendices D, E & F).

5.2 PILOT CITIES IN GAM, COSTA RICA

Understanding the initial strategy

Komūnitas' current strategy can be summarized as follows:

1. Find the legal route to allow a five-municipality joint effort to work as a unit, that can minimise political tension and allow for joint financing opportunities.
2. Synchronise the operation of the five participating cities, in order to lower waste management costs and capitalise on business opportunities derived from management of recyclable, organic and non-traditional waste.
3. Find appropriate mechanisms to monitor GHG emission reduction and overall economic, environmental, and social benefits from this initiative.
4. Generate green jobs to contribute to the economy of the local territories.

Understanding zero waste

Komūnitas has been built around the concept of reducing all types of waste as much as possible, and to create a blueprint for inter-municipal collaboration and economic sustainability that allows for the efficient management of urban waste in Costa Rica's Great Metropolitan Area. The Komūnitas concept paper defines this as:

“It is necessary to create a modular system that allows the implementation of a homogeneous differentiated collection scheme throughout the territory, with adequate management of solid waste by type, developing the concept that waste is no longer a problem but a resource.”

Understanding other factors such as climate, environmental and economic issues

The *Komūnitas* proposal wants to solve a problem inherent to a small country like Costa Rica: local governments oversee small towns. Any waste-based economy capitalises on volume, so the *Komūnitas*' local governments seek to maximise efficiency in order to establish a sustainable business model with a consistent financing that solves the main struggle that waste management faces in the country.

Access to the technology needed to correctly process waste has proven mostly beyond reach of any local government in Costa Rica, so it is imperative to seek a joint venture in order to establish a feasible model for collection, processing and trade of different types of waste, especially since Costa Rica has very small installed capacity for these types of activities. *Komūnitas* also seeks to include all stakeholders, especially those that currently benefit from waste sorting but do not have any legal support for their activities.

In this section of the report, we also want to highlight Sweden's experience of planning for zero waste in line with the SDG's.

Avfall Sverige's members have a long experience of municipal waste management planning and cooperation among municipalities. In 2020, six municipalities in the Umeå region decided on a joint waste plan for zero waste. This work has been led by Vakin and began in 2019 when a proposal of a common plan with focus on circular economy and resource management for a circular society was presented to the politicians. The zero-waste plan is a strategic document for the municipalities, not only focusing on waste collection and treatment but also on policy instruments such as municipal waste regulations and waste fees, education and information, circular procurement, and comprehensive planning. Similar plans have been developed in other Swedish regions, as the national legislation demands that targets for waste prevention are included in all MWP's.

The SDG's set the framework for the goals and actions presented in the zero-waste plan of the Umeå region. Moreover, Vakin is now reporting the company's impact on the climate as part of an annual report. As shown in figure 5, Vakin's climate benefits amount to 5,000 tons of carbon dioxide equivalents (CO₂-eq) per annum, due to re-use, recycling, and biological treatment of food waste. Vakin's negative impact amounts to about 2,000 tons CO₂-eq per year. All in all, this makes for a positive climate impact as a result of Vakin's waste management.

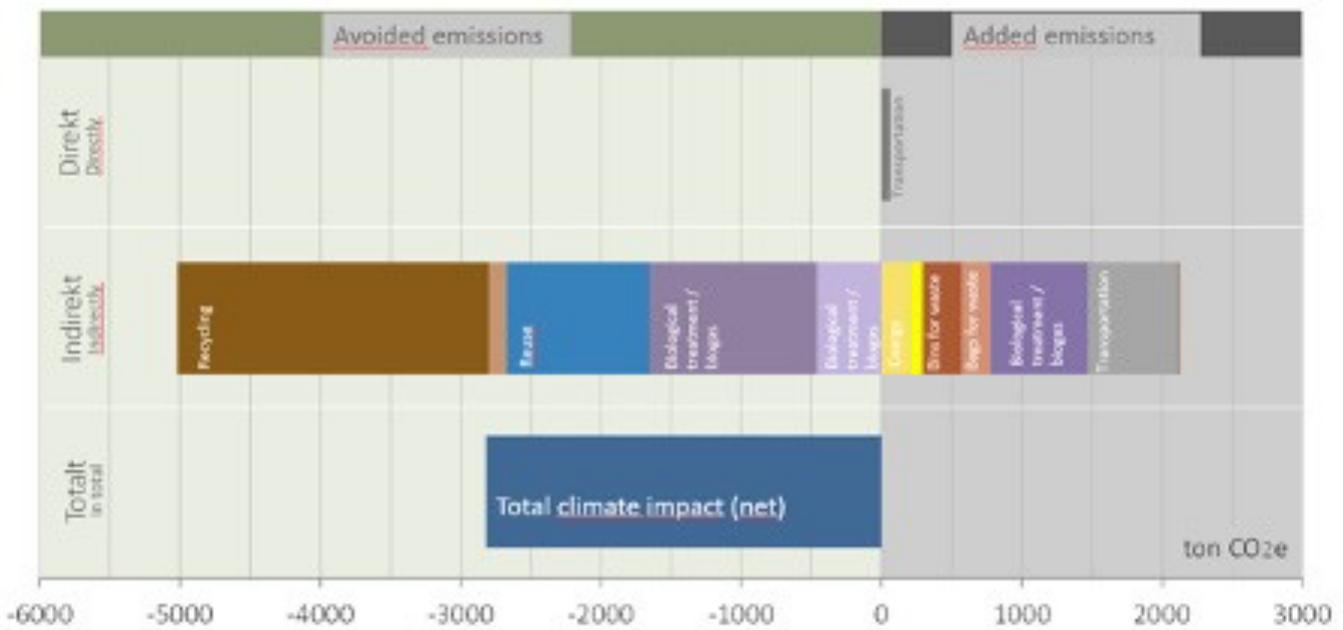


Figure 5. Result of monitoring climate impact of waste management at Vakin for the year of 2020. This figure shows added emissions (to the right) and avoided emissions (to the left) in a broad system perspective. The total climate impact of waste management at Vakin is positive; -2 800 tons of greenhouse gas emissions in 2020.

Presenting actual figures for both the negative impact (which would be very large if landfilling took place) and the positive opportunities for a sustainable waste management in the relevant community, is a good basis for decision making at both political and official level.

Setting targets

Costa Rica has worked hard at advancing environmental legislation and to live up to its leadership role as environmental stewards.

Policies, plans, and strategies include:

- National Plan for the Decarbonization of Costa Rica 2019-2050
- National Climate Change Strategy
- National Strategy for Waste Separation, Recovery and Valorization 2016-2021
- Action Plan for the Integral Management of Solid Waste 2019-2025
- National Plan for Integrated Waste Management 2016-2021
- Guidelines for the Municipal Carbon-Neutrality Program
- Law for the Integral Management of Waste N°8839.
- Law on the Use, Management and Conservation of Soil No. 7779
- National Composting Plan and the National Bioeconomy Strategy

Hence, national strategies are multiple and there is a clarity among government institutions that reducing GHG emissions and achieving the decarbonisation of Costa Rica's economy is the country's most profitable economic and political route. All these plans and strategies include municipalities as key stakeholders, since solid waste is the third largest contributor to their GHG emissions.

The conceptual support for adequate waste management exists all through Costa Rica's legal and institutional frameworks. The challenge is to steer local governments in this direction since they are mostly understaffed and underfunded when it comes to waste management. To enhance the skill level of people working with waste management throughout all the cities is key. This is also true for the rest of the stakeholders, like government institutions and the private sector. An effort like Komūnitas is necessary to forge a path, both legally and financially, that other local governments can follow, imitate, and adopt.

Systematic follow-up

Municipalities work under the logic of a five-year Strategic Plan (PEM, Plan Estratégico Municipal), and a yearly Operative Plan (POA, Plan Operativo Annual). Goals and indicators are set in the PEM and then organised in time through POAs.

The execution of these plans and the achievement of the proposed goals is mostly defined by the available budget and each city's staff and knowledge limitations.

The bureaucracy of institutional framework often hinders the implementation of these plans and the spending of the allocated budget. The financial means to achieve goals may be written into PEMs and POAs and then may be obtained by municipalities, but more often than not contractual difficulties and time constraints can prevent the complete spending of such budgets.

Follow-up mechanisms may focus on the budget-spending capacity of the waste-management departments instead of focusing on the social and economic impacts of the actions that these departments may have been able to achieve. The monitoring capacities and ambitions for goal and indicator achievement vary greatly from one local government to the next.

As a generalisation, the cities struggle to offer an efficient waste disposal service. They have however been able to implement either decentralised pilot-level recycling and organic waste management endeavours or provided basic but limited coverage of these latter services.

Potential action plan linked to the strategy

Factors within a model for an integrated waste management and environment system focus on: a) knowledge, b) legal framework, c) management and coordination, d) planning and e) financing. These five factors are related to governance and considered fundamental in relation to other factors within a model for an integrated waste management and environment system - factors such as communication, public awareness, waste prevention, reuse, recycling, recovery for energy purposes, management of landfill etc (figure 6). Based on the fundamental factors for success in relation to the goal of zero waste (see figure 6), the dialogue between Komūnitas and Vakin concluded that the area of cooperation that is of the highest priority.



Figure 6. Key success factors for an integrated waste system

We have concluded that issues in relation to working from the basis of the waste hierarchy, and with issues related to collection, source separation, littering and fly-tipping, will come as result of focusing on the fundamental factors (a-e). We have also concluded that *Komūnitas* need to start working with governance issues, building a foundation for success in relation to the zero-waste goal.

Vakin et.al has developed a tool for GAP-analysis that is can be used when analysing the situation of the *Komūnitas* in relation to the fundamental factors as well as other factors. A set of questions are defined for all factors, helping organisations to develop an integrated environmental waste management system. A number of these questions are already answered by *Komūnitas* and the Swedish partners through their work together in this project, as well as by *Komūnitas* prior to the project. Within a long-term partnership for zero waste, it would be possible to use this tool for GAP-analysis, and to build on the findings and conclusions that have been revealed during this phase of the Zero Waste Strategy Project. Avfall Sverige and its members could also provide external experts for this analysis, who are researchers and consultants with documented experience of analysis and project management in relation to issues of good governance, municipal partnerships, international development cooperation and sustainable waste and water management.

We have outlined a proposal for a concrete project for *Komūnitas* in Chapter 7.2. However, we will present some information from *Komūnitas* relating to communication, legal and economical instruments, organisational and financial issues in this section since these instruments and issues are fundamental when developing an integrated waste and environment management systems, and therefore important for *Komūnitas* and any stakeholders working together in the future.

Communication instruments

The need for adequate communication has been underlined by all *Komūnitas* municipalities.

Priorities include the following:

- The general public needs to have clarity on what the national regulations are (a new law in 2021 allows municipal officials, for the first time, to introduce fines for non-compliance).
- Municipalities need to communicate effectively that each local government has a local waste regulation, approved by the Mayor and the Municipal Council, that sets the rules for sorting, differentiated collection routes and the internal logic and capabilities of the waste-collection system (*Komūnitas* municipalities are working on the homogenisation of these local policies)

Komūnitas has been able to obtain the support of one of Costa Rica's major national broadcasters, Teletica, which is an asset for the project.

Legal and Economical Steering Instruments

Costa Rica has a clearly defined waste management law, which was recently modified to allow local governments to monitor compliance and charge fines (coming into effect in November 2021). This law has separate regulations for different types of waste. However, the regulation *Declaration of Special handling waste* only includes certain waste fractions. If there is no regulation for all types of waste which require special handling, then the municipalities cannot demand extended producer responsibility (EPR). This would limit them to promote the adoption of voluntary measures by producers and consumers. There is no proposed regulation to include construction debris and construction waste. Regarding plastics it is still far from EPR. The goal of zero waste must not only be accompanied by appropriate legislation for waste management, but also must incorporate a legal framework that creates, facilitates, develops, and requires a circular economy.

To be able to effectively follow and apply this law, municipalities have to write a local Waste Management Regulation, which has to be approved by the Mayor, the Municipal Council and then published. The *Komūnitas* municipalities are currently working on a joint regulation document that can be presented and approved by each local government, so that the internal logic that governs each municipality is the same.

Organisational issues

Issues regarding organisational challenges in Costa Rica have already been described in chapter 3. However, since these issues are of key importance for *Komūnitas* as well as for the Swedish partners, we have chosen to elaborate on how these issues are discussed in the scientific community, since it may provide the partners with insights that could guide decision-making in relation to municipal collaboration. This section needs to be considered as a short and brief introduction to this academic field with references to relevant research.

Collaboration between municipalities occur for different reasons and the extent and scope of collaborations varies. There are different kinds and types of collaborations ranging from more loosely coupled collaborations to the formation of a joint organisation for service provision (Hulst and Montfort, 2007; Jacobsen and Kiland, 2017). More loosely coupled collaborations are often restricted to the exchange of competence and experiences and the effects of these are limited, while the formation of joint organisations for service provision is a way to get access to critical resources, create economies of scale as well as scope.

More precisely, municipalities can share resources through collaboration. They can share financial resources and with that be able to invest in infrastructure, competence, and other critical assets. By collaborating, service production can be more efficient as the scale increases. This can in turn free resources for hiring more competence or make investments in new technologies, infrastructure, or other types of strategic investment. Municipalities can also collaborate when it comes to public procurement and by doing so become a more powerful player on the market. Collaboration between municipalities can therefore render them less vulnerable to fiscal constraints or limited access to other critical resources (Jacobsen and Kiland, 2017; Blaeschke and Haug, 2018; Kalu, 2012; Warner, 2011) as well as improve the quality of services provided (Jacobsen and Kiland, 2017). To collaborate might even be the only way for smaller municipalities to secure service provision (Holum, 2016). Collaborations between municipalities are therefore also often considered to be a good alternative to amalgamation, privatisation, and external contracts. Also, when municipalities collaborate, they can work in a larger geographical area and thus coordinate service provision, investment, and better plan how resources are used. To cover a larger geographical area is also important when working with issues related to sustainability. Environmental issues are, even if they emerge in the local setting, often something that has spill-over effects into neighbouring municipalities. Issues related to sustainability are therefore best solved on a more aggregated level.

There are however also some potential problems that can emerge when municipalities collaborate. Research shows, for example that different municipalities have different interests and it could therefore be difficult to align goals and find a common ground (Feiock et al., 2009). Hence, collaboration requires compromises. There is also a risk that the distance between the service provider and the citizens increases with collaboration as the smaller municipality when collaborating have to consider, not only the local interest, but the interest of a larger region (Johnston et al., 2010; Klijn et al., 2010; Jeffares and Skelcher, 2011; Edelenbos et al., 2012).

Financial issues

Each municipality runs its waste management departments through the charging of municipal fees. As stated earlier, these fees are often outdated and insufficient, and a major need for *Komūnitas* is advice on how to improve this situation, how to include fiscal incentives in current tax models and how to secure benefits from the implementation of an improved circular economy model.

The direct benefit of the *Komūnitas* project is to avoid the emission of 114,576.81 tons of CO₂ equivalents per year, from organic waste alone, and preventing further GHG emissions through the correct disposal of other types of waste. This can be considered as global achievement, connected to a better waste management and resulting in a better local environment for the 826,475 people who live in the *Komūnitas* territory (17 percent of national territory).

The field of waste management is linked, among others, to SDG 9, which translates into direct co-benefits in waste reduction, infrastructure, required services and new production and consumption opportunities, as well as the reduction of costs for waste treatment. Indirect benefits include reduction of environmental, soil, water, and air pollution, resilience to hydrometeorological events, improvement of soil fertility as well as being an example of a project that can be replicated at the regional level for the benefit of other municipalities and regions.

5.3 PILOT CITY KIGALI, RWANDA

Rwanda has made many commendable strides towards improving its waste management system over the years and currently has several ambitions to improve this sector. Despite the achievements made so far, gaps still exist. UNDP together with other partners can support the government of Rwanda in addressing some of these gaps. Some areas recommended for improvements are as follows:

Data collection	It is important to improve data collection, as to have more accurate analysis and undertake long term strategic planning. (Tonnage from different sectors, tonnage to the landfill, number of households that have waste service, collecting data from waste collection companies including data from waste stemming from companies and official buildings etc)
Improve the organisation	Today one person is responsible both for the day-to-day work as well as for the strategic planning. One of the ways the City of Kigali might seek to improve its capacity to deliver better MSW outcomes is by adding technical skills to a new MSW Department. Such a structure would effectively allocate responsibility along three functional lines: operations; projects; and waste minimisation. The organisation of waste management in Kigali is also spread across different ministries and institutions which makes it difficult to run an effective waste management.
Ndubia landfill	Currently, the management of the landfill faces major financial shortfalls, both in terms of revenue recovery and the cost of managing the site. The budgeted amount for the landfill is insufficient to operate a sanitary landfill. While mismanagement at the Nduba landfill has been a major issue, environmental degradation at the dumpsite has largely been caused by the fact that the site was never designed as a sanitary landfill. Installing a weighbridge at the landfill will make it possible both to ensure the amount of waste coming into the landfill and get the right income for the waste delivered to the site. The Nduba landfill faces several environmental problems including leachate, vermin, and spontaneous combustions. The City of Kigali ought to devise a phased landfill operation to closure plan. In the short term, it is critical that the City of Kigali prepares a landfill management turnaround plan that address operational deficiencies, installs groundwater monitoring infrastructure, develops a monitoring plan, and identifies new areas in which to developed sanitary landfill cells.
Develop a WMP	Focus on both the short term and long-term development of waste management. Elevating the prominence of waste management in the plan by developing a clearer policy and responsive institutional structure.
Financing	It is important to move towards a full-cost accounting of the waste service for the City of Kigali. Both in the collection system and in the running of a sanitary landfill.
Minimising Organic waste	Building on efforts to increase household waste separation, the City of Kigali ought to explore creative ways of dealing with organic waste. It is important to have a value chain from collection to the product and usefulness/selling phase. Start with markets, municipality, hospitals, schools, and public buildings and then move to the households that are more difficult.
Collection	It is important to follow up with entrepreneurs and encourage them to collect in new areas. Plan for the increasing amounts of waste which will need to be collected, as well as emerging areas in the developing city.
Plastic PET bottles	An important area that needs to be addressed in terms of inorganic waste recovery is PET bottles. Buy back centres?
Barriers for re-cycling	There are high costs for starting up and investing in recycling and maintenance such as energy/electricity. The quality of the recycled material needs to be high and that means that in a lot of cases it needs to be separated/sorted at source. The difficulties selling decreases profit which makes it hard to start up recycling businesses.

6. Planning for training



This chapter is focused on experiences and challenges concerning three areas: training of staff; education at schools (different levels); and, information and awareness-raising activities for the citizens.

The objective is to determine: the present status concerning the stated areas; ambitions for development and preferred content regarding that development; and, tools and media for such ambitions to be realised.

As there were challenges with receiving background information and material from the pilot cities, concerning the area of planning for training, Avfall Sverige suggests further investigations into these questions (see chapter 7.4).

Overall observations and approach

Needs and ambitions on development can be seen for all three participating cities in each of the areas listed above. Dialogues were held, aiming to describe the current situation and to identify the specific objectives, challenges, needs, and ambitions. This was done with the aim to outline a basis for more locally adapted capacity-building support for each city.

To establish a platform for benchmarking, examples were given on how Swedish cities work with training and awareness. From there, further analysis and consideration of what actions are suitable for each pilot city and target group was conducted.

Training of staff – basis for exchange

Vocational training	A validation model with the definition of professional skills needed for five different professions in waste management sector has recently been developed by the Swedish Public Sector employers' organisation Sobona (https://sobona.se/). This includes Recycling Yard workers and garbage truck drivers. The model can be used as a tool for skills development programs at work and the development of vocational education programs.
University level	The University of Gävle hosts a bachelor's program - Environmental strategist program - which includes courses on waste management.
Professional development	Shorter professional courses in different areas are given by Avfall Sverige, the main partner in the overall project.

Responses regarding the training of staff

From **Tianjin, China** interest has been stated regarding vocational education of technical character.

From the **Costa Rica** municipalities, special interest has been stated regarding the validation model and possibilities of enhancing the training of field workers to improve their professional status.

From **Kigali, Rwanda** we at this point lack information.

Education at schools for pupils

Commonly, Swedish Municipal entities responsible for waste management have environmental teachers and/or informers employed within their organisation. These are responsible for giving lectures, hosting study visits from schools, and arranging exercises on the impact on the environment from waste. The purpose is to raise awareness, from a young age, on how to prevent waste, re-use materials and how to recycle correctly.

Responses regarding education at schools

Similar activities seem to be going on in **China** and **Costa Rica**.

Exchange of experiences and examples of how such activities are carried out could be of great interest. In order to establish possibilities for waste sorting, recycling and re-use the connection between the waste management plan and public awareness activities should be investigated.

Public Awareness among citizens

Working with activities, campaigns, and events to increase public awareness about the harmful impact of waste on the environment and to influence attitudes and behaviour towards more sustainable consumption patterns, willingness to sort waste, etc. is a common feature in the waste management operations carried out by municipal waste management companies and associations. Collaborating with producers of packaging materials might be an option to consider for public awareness campaigns.

Responses regarding Public Awareness

Similar activities for raising Public Awareness as in Sweden seems to be going on to some extent in **China** and **Costa Rica**.

Exchange of experiences and examples of how such activities are planned and carried out could be of interest.

To establish the possibilities for waste sorting, recycling and re-use the connection between the waste management plan and public awareness activities should be investigated. This is strongly linked to willingness among the citizens to sort their waste and to recycle and re-use.

Additional remarks

A certain subject of interest, at least regarding **Costa Rica**, could be capacity building in matters concerning inter-municipal collaboration.

7. Concrete Projects ahead



7.1 ESTABLISHING A MODERN SUSTAINABLE WASTE MANAGEMENT SYSTEM – THE SWEDISH WAY

A modern sustainable Waste Management System, which enables a high degree of recycling, less impact on the environment, and developments towards a circular economy, must be built and developed with a holistic and integrated perspective. A perspective covering a variety of subjects, such as technological innovation, behavioural sciences, research on attitudes, public awareness, socio-economic features, laws and regulations, political goals, business opportunities etc. It is never enough to just establish a technical system for collection, transport, sorting and treatment of waste, even though this of course is a crucial element. Involvement and engagement with several stakeholders and with different areas of competences must be in place in order to establish and develop the waste management system and have it working properly in the long run.

The establishment of the Swedish Waste Management system with its current level of success - with less than 1 percent the household waste going to landfill, a high degree of recycling and future ambitions for zero waste - has taken more than 30 years of persistent and systematic work. Tellingly, it is not a quick fix. But by using the Swedish experiences and know-how within waste management planning the processes and timeframe for development of a modern and sustainable waste management system could be significantly improved and shortened.

A recommended starting point – as is done in this project – is to establish a perception of the current status of the waste management system and the existing WMP, and to analyse the circumstances and challenges as well as opportunities of the city, municipality, region or country in question.

It is important to emphasise that it is not a question of imposing the Swedish system on other countries, but rather to use the Swedish experiences and holistic perspective in a supportive way where possible, adjusted to the local circumstances, in order to be able to identify and formulate proper actions and priorities for the coming Waste Management Planning procedures and implementation of the plans.

Key words are open dialogue, mutual exchange of experiences and know-how and professional respect for each other.

7.2 PILOT CITY TIANJIN, CHINA

From the project framework and other information, it is possible to formulate a strategy on how to transfer the experiences from the Tianjin Eco-City together with experiences from Sweden into the development of the waste management in all districts in Tianjin.

From the guide on a strategy for transferring Eco-City experiences to promote the implementation of the Zero Waste City in chapter 5.1, examples on concrete projects are:

- Finalise the strategy for implementing experiences from Tianjin Eco-City in the development on all district of Tianjin.
- Form or update the Strategic WMP for Tianjin City
- Define technical, financial, and public possibilities for transformation of each district to the Zero Waste City concept based on the experiences from Eco-City.
- Timetable for each district to transfer their waste management to the Zero Waste City concept.
- Formulate implementation plan for each district.
- Formulate action plan for each district.
- Develop awareness and education for decision-makers, waste management staff, waste management workers, citizens, students, and children generally and in each district.

7.3 PILOT CITIES IN GAM, COSTA RICA

Komūnitas for Zero Waste

During the dialogue between representatives for *Komūnitas* and Vakin the main goal for a partnership is the consolidation of *Komūnitas* as an organisational figure for the joint management of MSW under a circular economy model.

The proposed name for the project is: Komūnitas for Zero Waste. The project is considered an organisational project, defined broadly since it includes legal and financial issues, alongside organisational development.

As described above, the project involves five municipalities in Costa Rica’s Great Metropolitan Area. It can be considered a pilot project since municipal partnerships are quite new for Costa Rica. It also has the potential of being an inspiration for other municipalities in Costa Rica and within the greater frame of UNDP.

In the process of working with the development of a project proposal, representatives for *Komūnitas* and Vakin have used the Logical Framework Approach (LFA) – a methodology used for designing, monitoring and evaluating international development projects – since we have not received clear guidelines from UNDP for project applications. LFA has been widely used by multilateral organisations and can be considered a practical tool for designing projects.

In this *Final Report – Preliminary Conclusions* we have attached the result of our dialogue – a matrix defining problems, goals, indicators, activities, and verification sources (see appendix G). The matrix is a summary of a complex analysis that can be used for the purpose of communication with stakeholders as well as monitoring, follow-up, and evaluation.

In the dialogue, the parties have also discussed roles and responsibilities for both a steering group consisting of representatives from the political sphere and managers/heads of the technical wing of the administrations, and for the teams from *Komūnitas* who will be working with the project, i.e. implementation.

The parties have also discussed other parts that need to be elaborated upon in a completed project application; stakeholder analysis, risk analysis, how the project will be disseminated, time-line, budget, attached documents such as a formal agreement between the parties, and how the partners will interact and communicate throughout the project.

The parties have also discussed how the project is related to environment, human rights and gender equality since these dimensions are pillars in Swedish policies and strategies for international development cooperation. The work must be in line with the Conventions for Human Rights and the 2030 Agenda for Sustainable Development. It must also be connected to enhancing local democracy and core values such as equity/inclusion, participation, transparency, and accountability. Even if the project is aimed at Zero Waste, there are several other dimensions that need to be considered if the project is to be successful, sustainable, and democratic.

Finally, the project group believe that a minimum of two years, but ideally three years, are needed for the parties to be able to deliver expected results.

Problems/causes	Goals	Indicators	Activities	Verification sources
Main problem: We do not have a clear legal framework, a viable financing structure and previous experiences in Costa Rica regarding joint MSW by several municipalities	Main goal: To consolidate Komūnitas as an organizational figure, for the joint management of MSW under a circular economy model	To have a consolidated legal figure for joint management To have a viable financing structure	A comparative analysis of the possible management figures and their benefits Development of financing analysis of the proposed structure	Statutes of the chosen legal figure Financing feasibility study A systematization document of the process and the structure that links participating municipalities and their roles
Cause 1: Lack of leadership from national institutions, which should guide local governments on how to consolidate these kinds of proposals	Immediate goal 1: To understand how joint MSW management is regulated in other countries, and to define strategies to achieve this model	Concrete recommendations on how to implement this kind of structure, based on experiences from Sweden	Development of a structured proposal on how to do effective joint MSW management, which can then be scaled to other groups of municipalities Knowledge exchange, especially lessons learned, among participating parties	A synthesis of recommendations
Cause 2: There is no legislative clarity	Immediate goal 2: To draft a clear legislation proposal for joint MSW management by fellow municipalities	A clear legislative proposal	Analysis of the legal framework Recommendations for improvement	Legislation improvement proposal draft
Cause 3: There is no financial feasibility study	Immediate goal 3: To do a financial study	A finalized financial study	Characterization of types of waste, as an input Analysis of the financial structure of each of the participating municipalities To relate legal feasibility to financial feasibility	Financial study document

Figure 7: A matrix defining problems and goals for project proposal (See appendix G)

7.4 PILOT CITY KIGALI, RWANDA

Like previous studies, this project has shown that there are still challenges for the city of Kigali regarding waste management and zero waste to landfill. In the discussion between Gästrike Återvinnare and the City of Kigali's representative, we have come to three possible challenges that could be worked on in the next phase of the project to work for zero waste to landfill.

Furthermore, we have seen that there are many Swedish stakeholders with interests in Rwanda. A meeting arranged by the Swedish Embassy with the aim of gathering the stakeholders and to present their work in Rwanda could result in common suggestion of work ahead.

Develop the waste management organisation

It is difficult to get a good picture of the system from the outside, but in the Swedish experience from working with other organisations and other African countries has shown that a partnerships with discussions, workshops, study visits, and WorkExchanges can contribute to the development of the waste management sector, not only for the Rwandan partner but also for Sweden. During our discussions it was also clear that only around 50-60 percent (although the exact number is unclear) of the population in Kigali have access to regular waste collection.

For this, Waste Management planning can be a base for the work, either working on developing an existing plan or, working for the development of a WMP in Kigali. Many Swedish MSW actors have backgrounds as legal representatives for municipalities, with knowledge in the building of waste organisations, as well as planning waste management for both municipality level but also for business level. There are also Swedish MSW actors who work with companies, organisations, public/private entities, and property owners on the market. Many have their own fleet, but also procure entrepreneurs. For example, Gästrike Återvinnare has also developed organisational structures for IT-solutions, communication, strategic planning, day to day work, environmental and legal regulation. Many also have international departments working in several countries with capacity building, logistics and organisational development, as well as with education and validation to increase capacity and knowledge.

Building recycling systems based on local economies and value chains

Kigali does have a recycling system in place today, however its effectiveness can be called into question. Figuring out how we can implement a system that comes to gain for the local economy, the development of businesses, and the user of the recycled material is a possible next step.

Avfall Sverige's members are working daily with the waste hierarchy, to reach the high demands of waste prevention, re-use, recycling, and energy recovery of waste. We are aware that the Swedish system is not a "one size fits all" solution and that our experiences must be put in the context of the partner country.

Collection system for organic waste from markets, restaurants, hotels, and businesses

This includes the whole value chain: from collection to the sale of biofertilizer. To reach success, it is of great importance to secure the system technically, but also with an organisation, effective communication, logistics, competences, and to ensure the quality of the final product so it can be commercialised.

Many Avfall Sverige members have built systems for collection of organic waste from households, companies, and municipalities. Some have their own biogas plants for producing biogas and biofertilizer. The biogas is used as vehicle fuel in the municipal bus fleet and in the MSW vehicle fleet but is also sold to companies and private individuals. The biofertilizer is transferred to farmers in the nearby regions.

7.5 PLANNING FOR TRAINING

Within the current project we have, to a limited extent, been able to investigate the matters of how to exchange experiences and to determine challenges concerning the three focus areas: training of staff; education at schools (different levels); Information and awareness rising activities to the citizens. All the three areas are equally important and should be of interest for future projects.

In order to form a way forward the objective for the next steps should be to, in more detail, determine the following: Present status concerning the stated areas; Ambitions for development; Preferred content, tools and media for such ambitions to be realised.

The suggestion is to benchmark the current status with the help of a questionnaire and evaluate the possibilities exchange and development.

Questions regarding training of staff

1) How would you describe the current situation and possible areas for exchange and development?
2) Current available forms and ways of training and education for staff involved in Waste Management operations? <ul style="list-style-type: none"> • On Academic level? • On Polytechnic/Vocational level? • On other levels?
3) Which parts of education and training for staff involved in Waste Management operations would you like to focus on for further exchange of experiences and knowledge?
4) On what level would that be preferable?
5) What needs do you find for development?
6) What kind of exchange and support would you like to receive?
7) What resources (economic, personnel) do you have/are needed to work with this?

Questions regarding Education at schools for pupils

1) How would you describe the current situation and possible areas for exchange and development regarding this matter?
2) Current available forms and ways of information, education, and training for pupils in schools regarding Waste and impact of waste on environment? <ul style="list-style-type: none"> • For different ages on different levels?
3) Which parts of education and activities for pupils would you like to focus on for further exchange of experiences and knowledge?
4) On what level or category of pupils would you like to focus?
5) What needs do you find for development?
6) What kind of exchange and support would you like to get in place?
7) What resources (economic, personnel) do you have/are needed to work with this?

Questions regarding Public Awareness among citizens

1) How would you describe the current situation and possible areas for exchange and development regarding this matter?
2) Current available forms and ways of information, communication, education, and training towards the public regarding Waste and impact of waste on environment? <ul style="list-style-type: none"> • For different groups of stakeholders?
3) Which parts of Public Awareness and influence on attitudes and behaviour would you like to focus on for further exchange of experiences and knowledge?
4) Some specific ways of communication or specific matters?
5) What needs do you find for development?
6) What kind of exchange and support would you like to get in place?
7) What resources (economic, personnel) do you have/are needed to work with this?

7.6 BUILDING ORGANISATIONAL CAPACITY

It is a common understanding that cooperation and joint efforts can create larger value than that of the sum of the work of individual parties. This is also true for municipalities and their waste management activities.

Avfall Sverige, the partnering association with UNDP in this project, is a member association for actors in the field of waste management in Sweden. Avfall Sverige is a good example of how municipalities, in practice, can cooperate on a national level to create a larger impact and value.

Thus, one part of this study has investigated how an association like Avfall Sverige could be established in each of the three pilot cities. This was done by transferring the Swedish experience, all the while taking into consideration the local and national conditions in China, Costa Rica, and Rwanda.

Below we present a summary of the basic questions and principles to be answered and discussed when investigating the potential establishment of a national waste management association, such as Avfall Sverige. Through the sharing of experiences and by joining forces more can be achieved than on an individual basis.

Why an association?

The first question to be asked is why, at all, there is a need for an organisation/association for the waste management sector. Here, it is essential to separate the issue of a knowledge-based association like Avfall Sverige and the need to form operational organisations by the merger of municipal entities.

Geographical uptake

Avfall Sverige has a national geographical uptake and a similar structure in China, Costa Rica and Rwanda could be possible. However, it could also be more local or regional if the conditions require it or if it is deemed more suitable.

The aim of the association

It is important to discuss the overall aim of an association. In the Swedish case, the aim can be understood to promote sustainable waste management and to promote the development of its members. The aim must be tailored for the conditions in each pilot city.

Members

Likewise, it is important to discuss and define the membership criteria. Since municipal waste management is a duty held by the municipalities, these may create the core member base.

However, the association can be opened to other members. Either with full membership or as associated members. These actors can be private contractors/operators, legal authorities, consultants, academia, and technical as well as service providers.

Organisation

Most associations similar to Avfall Sverige are independent and standalone waste management entities. This is the ideal situation since it makes it clear and focused. However, aims, tasks, and members within the field of waste management may be involved in other existing organisations. For example, within the larger field of technical services such as waste, sewage, energy, or even the larger municipal undertakings represented through an association for the municipalities. The proposed organisation will be discussed in the case of the three pilot cities.

Secretariat

When discussing the establishment of an association like Avfall Sverige, this should include issues on staffing and possibilities for a secretariat. This is of course linked to the tasks and financing.

Avfall Sverige has a secretariat in Malmö, Sweden, with around 20 employees. The secretariat manages day-to-day work related to the tasks and is available to support its members. Experiences from Avfall Sverige, and elsewhere, highlight the importance of a stable financial flow to the secretariat, as this is necessary for the sustainability of the organisation. A secretariat of 3-4 people is a good starting point.

Financing

Finally, different structures for financing of activities proposed for the association should be discussed. In most cases, a membership fee forms the basis for the association. Public grants and donations are likely to be linked to more specific projects and not aimed to cover running and operational costs over time. Therefore, it is essential to incorporate a sustainable structure for fees, so that the association can survive. The success of the association will eventually be measured by its members.

Tasks

The tasks for an association can vary. Below is a shortlist of activities, erected from the experience of Sweden, which gives an overview of the different tasks that can be carried through the association and jointly together with its members.

<p>Create platforms for exchange of experience in different areas of waste management</p>	<p>This typically engages several working groups with participants from the members.</p> <p>The subject of working groups can vary from waste prevention, to collection or disposal. There is a need for ongoing financial support of the secretariat of the association, otherwise, there is a large risk the activities will decline once the initial voluntary activities have ended.</p>
<p>Create manuals and research</p>	<p>Another task is to jointly conduct research and create manuals. This creates a common knowledge base. There will be a need for local adaption to context of the members, but much can be said to be general.</p> <p>Avfall Sverige delivers about 20 reports and guidelines each year, https://www.avfallsverige.se/kunskapsbanken/rappporter/.</p>
<p>Share best practices</p>	<p>The core task of an association, such as Avfall Sverige, is to spread experiences and best practices to its members.</p> <p>Avfall Sverige operates seminars, workshops, and meetings to share information, https://www.avfallsverige.se/utbildning/.</p>
<p>Create platform for communication</p>	<p>Communication is crucial and a newsletter for regular updates is a common first step. A website with basic information and where members but also external parties, such as authorities and parliament, can search for documents is useful. Sometimes communication can expand to joint campaigns on such issues as littering, waste prevention, etc to support its members.</p> <p>Avfall Sverige has a website (www.avfallsverige.se), newsletter, and magazine.</p>
<p>Provide training courses and conferences</p>	<p>A national association is a perfect body for distributing hands-on experience through training courses. Such training courses can be developed and conducted through a third party, but the association and its members can identify the needs. Training courses can span many different areas such as waste planning, coaches for waste prevention, and economic issues such as tariffs to technical issues concerning the operation of plants or collection services.</p> <p>Avfall Sverige operates 20-30 training courses, seminars, and conferences each year, https://www.avfallsverige.se/utbildning/.</p>
<p>Data collection and benchmark</p>	<p>Data of waste flows and economic data are essential tools for planning and operational follow-up.</p> <p>Avfall Sverige operates a web-based system for streamlining data used for following and planning. These data are also used for benchmarking between different municipalities and as background data for national data, https://www.avfallsverige.se/kunskapsbanken/avfall-web/.</p>

<p>Cooperate with other associations</p>	<p>Waste management is a vital infrastructure. In many ways, it cooperates with other infrastructures such as water, sewage, gas, electricity, or heat. Thus, it is important to coordinate efforts with associations representing such sectors. Moreover, it is important to join forces and cooperate with municipal associations, cities, and regions, since waste management coincides with general activities of cities, such as spatial planning, transportation system, etc.</p> <p>Avfall Sverige develops coordination with associations for water and sewage, energy, and general municipal issues.</p>
<p>International cooperation</p>	<p>A national association can also be a vehicle for contacts outside the country. This is important to collect common information and new practices. Also, the association can join multinational associations such as ISWA, the International Solid Waste Association. Avfall Sverige is part of a number of cooperation's through associations both in the Nordics, in Europe, and globally.</p>
<p>Spokesperson to the Government and legal authorities</p>	<p>Finally, a national organisation can act as the spokesperson to the government when it comes to proposals of new waste rules and thus in-depth knowledge from basic experience can be utilised. Thus, impractical, and inefficient regulations can be avoided. Avfall Sverige conducts a regular dialogue with decision-makers to protect and develop the interest of its members.</p>

Opportunities China

In China, there is already a national waste management association named CAUES, China Association of Urban Environmental Sanitation. CAUES is also a member of ISWA. This association is mainly subject to industrial and operators' interests. It is unknown if there are any additional associations primarily for the interest of municipalities.

Within CAUES there are more than 20 committees in different areas such as sanitation machinery, construction waste management, urban, rural sanitation, standardization, classification, operation facilities, and more. CAUSE develops its activities in the frame of six themes: development concept, industry governance, sanitation services, garbage disposal, emerging garbage, and public toilet management. There are some initial activities concerning staff training and more to come.

Opportunities Costa Rica

In the case of Costa Rica discussions took place with the Ministry of Environment and with IFAM, which is a governmental funded organisation with the goal to support local authorities in various activities, in particular when it comes to financing investments.

One can conclude that there is no platform or sector organisation, as described above, in Costa Rica. However, there is a large interest to set up such an organisation. The main subject would be to share knowledge and best practice to the responsible authorities for waste management, and the operators for collection and treatment facilities, both private and public. As noticed in another part of this report, the waste management sector of Costa Rica is under-financed and understaffed. Thus, one crucial issue will be to elaborate on the long-term financial stability of such a new platform.

One proposal could be to finance a project to organise the structure of the platform and the financial structure as well. The richer outcome and contribution from such a platform cannot be achieved or measured over a short project term, such as one or a couple of years. Per definition, it is something that builds on a long-term commitment and engagement. One option could be, as an intermediate solution, to enlarge the task of IFAM to include knowledge transfer in the field of waste management, until a separate unit, and/or association, has been created. However this may be in conflict with other duties for IFAM, which this study has not yet been able to oversee.

In the Latin America region, there are several national associations established, for instance in Chile, Columbia, and Mexico. Most of them are members of the international network of ISWA, which also includes a separate network for Latin America members. A Costa Rican national waste management association could join ISWA and the Latin American network and then quickly learn from others, not only their own local stake holders, but also from regional and global actors.

Opportunities Pilot city, Rwanda

There currently is no platform for knowledge transfer and exchange of experience in Rwanda. There are bodies for legal acts, regulations, and enforcement, and the municipalities are responsible for the operation. Regulators provide guidelines for operation but do not include day to day operation and maintenance issues. The operation is outsourced to private contractors. This has the consequence that the basic knowledge on how to operate waste management is partly missing amongst those who pay for and contract collection and disposal services. Furthermore, there is no platform for knowledge transfer and exchange of experience amongst the contractors or consultants.

One proposal could be to finance a project to organise the structure of the platform and the financial structure as well. The richer outcome and contribution from such a platform cannot be achieved or measured over a short project term, such as one or a couple of years. It is something that builds on a long-term commitment and engagement.

Lessons can be learned from Uganda where the association Uganda Waste Management and Administration Confederation (UWMAC) was set up five years ago with the goal to build a platform for the municipalities and operators. However, due to a lack of finance, it collapsed just after a few years. So long-term financial commitments are crucial.

The same as mentioned above for Costa Rica, a waste management body for Rwanda could join ISWA. There are very few national members of ISWA on the African continent so Rwanda joining would increase the possibilities for neighbouring countries to cooperate and share knowledge.

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APPENDIX A: “ZERO WASTE CITY” INDEX SYSTEM

First-level indicators	Second-level indicators	Third-level indicators	Current value	2020 target value
Source reduction of solid waste	Source reduction in the construction industry	Percentage of green buildings in new buildings	100%	100%
	Source reduction in life area	Daily production of domestic waste per capita ★	0.80kg/person/day	0.80kg/person/day
		Coverage rate of domestic waste classification collection and transportation system	60%	100%
Solid waste resource utilization	Source reduction in the construction industry	Domestic garbage recycling rate ★	6%	35%
		Utilization of kitchen waste resources	48%	90%
	Resource utilization of construction waste	Comprehensive utilization rate of construction waste ★	5%	40%
Final disposal of solid waste	Safe disposal of hazardous waste	Coverage rate of medical waste collection and disposal system ★	100%	100%
		Coverage rate of social source hazardous waste collection and disposal system	-	100%
Guarantee ability	System construction	Formulation of local regulations or policy documents for the construction of “Zero Waste city” ★	-	Complete formulation
		“Zero Waste city” construction coordination mechanism	Initially established	Basically established
		“Zero Waste city” construction results are included in the performance evaluation	-	Basically completed
	Technical system construction	Demonstration of domestic waste reduction and resource utilization technology ★	-	Three
	Supervision system construction	Solid waste supervision capacity building	-	Build an eco-city solid waste monitoring platform
		Qualified rate of random inspection of standardized management of hazardous waste	-	100%
		Number of criminal cases of solid waste environmental pollution discovered, disposed of, and detected ★	0	0
		Number of environmental pollution incidents related to solid waste (in the region)	0	0
		Completion rate of letters and visits, complaints and reports involving solid waste	100%	100%

People's sense of gain	People's sense of gain	Popularity rate of publicity, education and training in the construction of "Zero Waste city"	-	80%
		The degree of participation of the government, enterprises, institutions, and the public in the construction of "Zero Waste city"	-	better
		The public's satisfaction with the effectiveness of the construction of a "Zero Waste city" ★	-	satisfaction

APPENDIX B: “ZERO WASTE CITY” OPTIONAL INDICATORS

First-level indicators	Second-level indicators	Third-level indicators	Current value	2020 target value
Source reduction of solid waste	Source reduction in the construction industry	The proportion of prefabricated buildings used in new buildings	-	100%
	Source of life reduction	Number of companies practicing green lifestyle	-	Fifty
Guarantee ability	Supervision system construction	Coverage rate of solid waste smart supervision and management	-	80%

APPENDIX C: ANALYSIS OF PLANS, COSTA RICA

Strategic objective	Strategic Action	Curridabat	Desamparados	La Unión	Montes de Oca	San José
Culture change through education and accustomisation	Accustomisation of citizens, municipality employees, people in general Establishing education centres	X	X	X	X	X
	Fiscal incentives for good practices in waste management		X			X
Citizen participation	Involvement in regulatory processes undertaken by the central government (new laws and regulations)	X	X	X		
	Promotion of alliances with other stakeholders (fellow municipalities, public-private partnerships)		X	X	X	X
	Support of community-based initiatives and projects		X	X	X	X
	Identification of local waste management enterprises, entrepreneurs or informal initiatives			X		X

Solid waste valorisation and treatment	Improvement of waste collection routes	X	X	X	X	X
	Improvement of machinery and equipment for solid waste collection	X		X	X	
	Improvement of municipality staff, both in number of employees and in their skill level			X	X	X
	Strengthening of the storage capacity and commercialization of recoverable waste, including municipal sorting facilities for recyclable waste	X	X	X	X	X
	Valorisation and management of organic waste	X	X	X	X	X
	Valorisation and management of non-traditional waste	X	X	X	X	X
	Drafting strategies for the management of hazardous waste					X
	Minimization of littering and fly-tipping			X		X
	Procurement and management of funds	Resource allocation for waste management services improvements		X	X	X
Improvements in the collection of waste management fees (updating fee values, improving citizen responsibility in paying these fees)			X		X	X
Creation of new financing mechanisms for local waste management					X	X

Compliance with regulations	Updating local information on solid waste generators	X				X
	Updating and improving municipal regulations for waste management	X		X	X	
	Creation of indicators on the effectiveness of current waste management practices			X	X	X
	Effective outreach and acceptance of municipal and national rules for waste management	X	X	X		
	Fine-tuning of regulations for large waste generators (malls, trade plazas, etc.)	X	X	X		X
	Improving monitoring and control mechanisms of compliance with regulations		X	X	X	
Treatment and final disposal of waste	Treatment and final disposal alternatives	X	X		X	X
	Surveillance of the operation of the landfill where municipal waste is disposed		X	X		
	Analysis of possible local waste disposal sites			X		

APPENDIX D: CHECKLIST 1 FOR STRATEGY, TIANJIN

Name	Chinese	Pinyin	Local WMP	Municipal Solid Waste				Targets	
				Quantity (ton/day)	Collection model	Transportation to treatment	Treatment	Collection	Treatment
Heping	和平区	Héping qū							
Hedong	河东区	Hédōng qū							
Hexi	河西区	Héxī qū							
Nankai	南开区	Nánkāi qū							
Hebei	河北区	Héběi Qū							
Hongqiao	红桥区	Hōng-qiao qū							
Binhai New Area	滨海新区	Bīnhǎi xīnqū							
Dongli	东丽区	Dōnglì qū							
Xiqing	西青区	Xīqīng qū							
Jinnan	津南区	Jīnnán qū							
Beichen	北辰区	Běichén qū							
Wuqing	武清区	Wǔqīng qū							
Baodi	宝坻区	Bǎodǐ qū							
Ninghe	宁河县	Nínghé xiàn							
Jinghai	静海县	Jìnghǎi xiàn							
Ji	蓟县	Jì xiàn							

APPENDIX E: CHECKLIST 2 FOR STRATEGY, TIANJIN

Name	Chinese	Pinyin	Sorting			Targets			Waste management administration	Financing
			Material	Collection	Re-cycling	Material	Collection	Re-cycling		
Heping	和平区	Héping qū								
Hedong	河东区	Hédōng qū								
Hexi	河西区	Héxī qū								
Nankai	南开区	Nánkāi qū								
Hebei	河北区	Héběi Qū								
Hong-qiao	红桥区	Hōng-qiáo qū								
Binhai New Area	滨海新区	Bīnhǎi xīnqū								
Dongli	东丽区	Dōnglì qū								
Xiqing	西青区	Xīqīng qū								
Jinnan	津南区	Jīnnán qū								
Beichen	北辰区	Běichén qū								
Wuqing	武清区	Wǔqīng qū								
Baodi	宝坻区	Bǎodǐ qū								
Ninghe	宁河县	Nínghé xiàn								
Jinghai	静海县	Jìnghǎi xiàn								
Ji	蓟县	Jì xiàn								

APPENDIX F: CHECKLIST 3 FOR STRATEGY, TIANJIN

Name	Chinese	Pinyin	Training			Awareness		
			Administrative staff	Collectors	Staff at treatment facilities	Politicians and legislators	Children	Citizens in general
Heping	和平区	Héping qū						
Hedong	河东区	Hédōng qū						
Hexi	河西区	Héxī qū						
Nankai	南开区	Nánkāi qū						
Hebei	河北区	Héběi Qū						
Hongqiao	红桥区	Hōng-qiáo qū						
Binhai New Area	滨海新区	Bīnhǎi xīnqū						
Dongli	东丽区	Dōnglì qū						
Xiqing	西青区	Xīqīng qū						
Jinnan	津南区	Jīnnán qū						
Beichen	北辰区	Běichén qū						
Wuqing	武清区	Wǔqīng qū						
Baodi	宝坻区	Bǎodǐ qū						
Ninghe	宁河县	Nínghé xiàn						
Jinghai	静海县	Jìnghǎi xiàn						
Ji	蓟县	Jì xiàn						

APPENDIX G: MATRIX.

Defining problems, goals, indicators, activities, and verification sources

Problems/causes	Goals	Indicators	Activities	Verification sources
<p>Main problem: We do not have a clear legal framework, a viable financing structure and previous experiences in Costa Rica regarding joint MSW by several municipalities</p>	<p>Main goal: To consolidate Komunitas as an organizational figure, for the joint management of MSW under a circular economy model</p>	<p>To have a consolidated legal figure for joint management</p> <p>To have a viable financing structure</p>	<p>A comparative analysis of the possible management figures and their benefits</p> <p>Development of financing analysis of the proposed structure</p>	<p>Statutes of the chosen legal figure</p> <p>Financing feasibility study</p> <p>A systematization document of the process and the structure that links participating municipalities and their roles</p>
<p>Cause 1: Lack of leadership from national institutions, which should guide local governments on how to consolidate these kinds of proposals</p>	<p>Immediate goal 1: To understand how joint MSW management is regulated in other countries, and to define strategies to achieve this model</p>	<p>Concrete recommendations on how to implement this kind of structure, based on experiences from Sweden</p>	<p>Development of a structured proposal on how to do effective joint MSW management, which can then be scaled to other groups of municipalities</p> <p>Knowledge exchange, especially lessons learned, among participating parties</p>	<p>A synthesis of recommendations</p>
<p>Cause 2: There is no legislative clarity</p>	<p>Immediate goal 2: To draft a clear legislation proposal for joint MSW management by fellow municipalities</p>	<p>A clear legislative proposal</p>	<p>Analysis of the legal framework</p> <p>Recommendations for improvement</p>	<p>Legislation improvement proposal draft</p>
<p>Cause 3: There is no financial feasibility study</p>	<p>Immediate goal 3: To do a financial study</p>	<p>A finalized financial study</p>	<p>Characterization of types of waste, as an input</p> <p>Analysis of the financial structure of each of the participating municipalities</p> <p>To relate legal facility to financial facility</p>	<p>Financial study document</p>