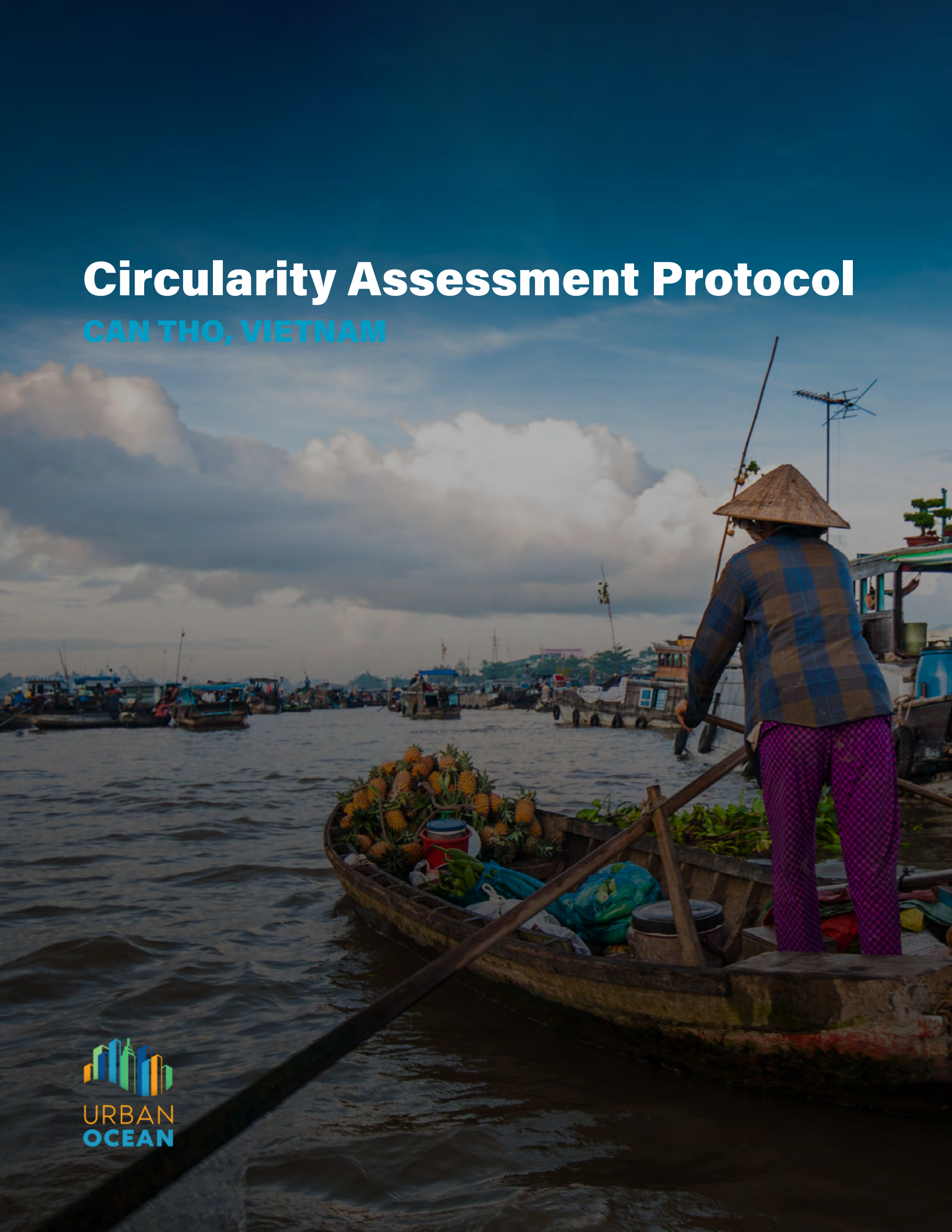
Circularity Assessment Protocol

CAN THO, VIETNAM



URBAN OCEAN

Foreword

The Circularity Assessment Protocol (CAP) was born out an effort to define the concept of the circular economy in our cities and communities. While plastic pollution continues to be discussed at the highest levels of government and global organizations, cities and communities are the front lines. CAP is conducted where requested, where a city is engaged in the process. Local knowledge and expertise are the foundation of the information that the community uses, with additional data collected in partnership with CAP collaborators. Partners and teams build capacity through learning methods together. Open data collection is an important part of the process; leakage data contributes to a global open dataset. Trends across cities, countries and regions can illuminate global narratives.

Data is power to communities and enterprising individuals who are recognized for their role in materials management through CAP but are often marginalized in society. CAP data can catalyze economic development through business opportunities and subsequent interventions. The issue of plastic pollution is not for outsiders to solve in other locations, but for communities to address by collaboratively collecting data to lead themselves through the context-sensitive design of their own desired circular economy. Communities are empowered by local and global CAP data to inform their decisions about what is working, or where and how to intervene to increase circularity. Communities that participate in CAP can better define resource needs and participate in knowledge exchange.

Urban Ocean, a partnership of The Circulate Initiative, Resilient Cities Network and Ocean Conservancy, works with city leaders to bring new ideas, partners and resources together to solve interrelated problems around materials management, including addressing key priorities such as public health and economic development. A critical step in the Urban Ocean process is the Gap Assessment, which maps challenges, risks, and vulnerabilities within materials management systems and helps to develop a unique, integrated picture of the materials and circular economy related challenges and opportunities faced by each city. The CAP, developed in our Circularity Informatics Lab (CIL) at the University of Georgia, was chosen as the ideal tool to deploy as part of the Urban Ocean Gap Assessment.

The interconnected nature of complex urban systems and the value of circular economy in building resilient cities was starkly evident when the COVID-19 pandemic began just following the launch of the first Urban Ocean cohort. As a team, we immediately transitioned to online global work, with our local implementation partners becoming even deeper collaborators, conducting all field work with virtual training. This allowed for embedded ownership of the data at the local level and ultimately a powerful network of collaborators and supporters across learning cities to drive scientifically informed decision making. Local implementation partners have then continued to work with the Urban Ocean team through stakeholder workshops and into the proposal phase, as advocates for the science and key contributors in their own cities.

Urban Ocean and its partnerships provide an ideal platform to support resilient cities. CAP data can help guide interventions, create a baseline to measure success, and put essential data in the hands of the local community to drive change. We believe piecemeal solutions that are not contextually grounded are insufficient to create a systemic shift. Communities need to be involved, not just as stakeholders, but as the powerful change-makers they are.

— Jambeck Research Group, Circularity Informatics Lab, University of Georgia

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The Circularity Informatics Lab at the University of Georgia is committed to information sharing, data analytics, empowering communities, and systems change related to circular materials management.

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New Materials Institute
UNIVERSITY OF GEORGIA

URBAN OCEAN

The Circulate Initiative

Ocean Conservancy

RESILIENT CITIES NETWORK

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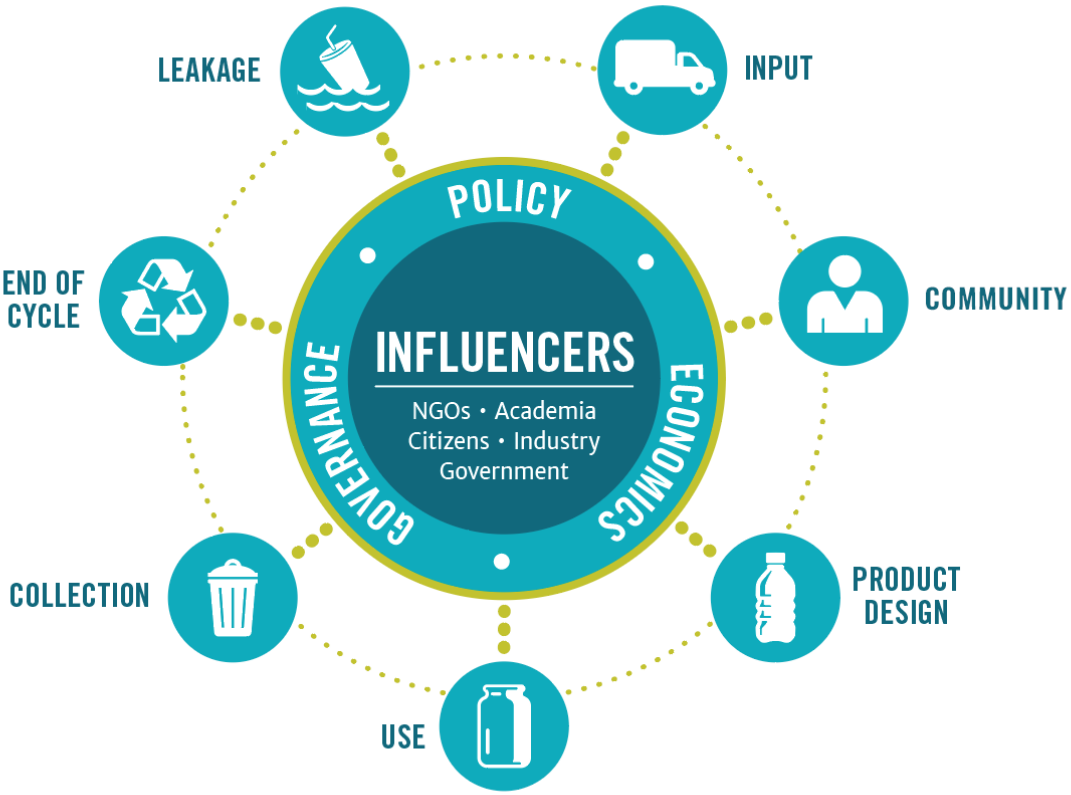
Executive Summary

Developed by the **Circularity Informatics Lab** at the University of Georgia (UGA), the Circularity Assessment Protocol (CAP) is a standardized assessment protocol to inform decision-makers through collecting community-level data on plastic usage and management. Grounded in materials flow and systems thinking concepts, the CAP uses a hub-and-spoke model to holistically characterize how consumer plastic flows into a community, is consumed, and flows out, either through waste management systems or leakage into the environment. The model, shown below, consists of seven spokes: input, community, material and product design, use, collection, end of cycle, and leakage. At the center, the system is driven by policy, economics and governance with key influencers including non-governmental organizations, industry, and government.



Between October and November 2020, a team from the Initiatives for Regional Development and Environmental Management (IRDEM) at Diponegoro University, with guidance and support from the Circularity Informatics Lab, conducted fieldwork in the city of Semarang, Indonesia. The CAP was conducted with support from the city's local government, the Chief Resilience Officer (a top-level advisor in the city that is responsible for leading, coordinating and developing a city's resilience strategy and policy), and the larger Urban Ocean team. Field work included prod-

uct and packaging assessments in stores across the city; key stakeholder interviews with government, industry, and non-profit organizations; material type characterizations for consumer plastic items; cost analysis of reusable products and alternatives to plastic available in the city; visual audits of recycling contamination; identification of public waste and recycling collection bins; and litter transects in three categories of population. Key findings from each spoke are summarized in the table below.

Urban Ocean Program

Urban Ocean is a three-way cooperative partnership among The Circulate Initiative (TCI), Ocean Conservancy (OC), and Resilient Cities Network (R-Cities) that works with city leaders to bring new ideas, partners, and resources together to solve interrelated problems around waste management. It aims to demonstrate how actions to improve waste management and recycling can provide holistic, resilient, and sustainable solutions that not only reduce ocean plastic pollution but also address key city priorities such as improving public health, promoting innovation, supporting economic development and job growth, and reducing greenhouse gas emissions through a capacity building and accelerator program for cities.

Can Tho is one of six cities in the initial cohort of Urban Ocean learning cities. The CAP in Can Tho, coupled with the upcoming Opportunity Assessment Tool, represents Stage 2 of the Urban Ocean Initiative which involves a comprehensive Gap Assessment to map challenges, risks and vulnerabilities within the cities' critical waste management systems. The data gathered from the CAP in Can Tho will contribute to three workshops where stakeholders will discuss findings and develop proposal(s) for interventions that will then be brought to an Accelerator Summit for review and support, as showed by the timeline of the program below:

Get to know the partners:

Ocean Conservancy is working to protect the ocean from today's greatest global challenges. Together with our partners, we create science-based solutions for a healthy ocean and the wildlife and communities that depend on it. Since the formation of the International Coastal Cleanup in 1986, Ocean Conservancy has mobilized millions of volunteers to remove trash from beaches and waterways around the world while pioneering upstream solutions to the growing ocean plastics crisis. Ocean Conservancy invests in cutting-edge scientific research, implements on-the-ground projects, and works with conservationists, scientists, governments, the private sector and members of the public to change the plastics paradigm. To learn more about our Trash Free Seas® program visit oceanconservancy.org/trashfreeseas, and follow Ocean Conservancy on Facebook, Twitter and Instagram.

The Circulate Initiative is a non-profit organization committed to solving the ocean plastic pollution challenge by supporting the incubation of circular, inclusive and investible waste management and recycling systems in South and Southeast Asia. We achieve this by collaborating with key stakeholders across the sector, and by producing insights to support and accelerate investment and scale across the value chain.

The Resilient Cities Network consists of member cities and Chief Resilience Officers from the former 100 Resilient Cities — pioneered by The Rockefeller Foundation program, sharing a common lens for holistic urban resilience. The Resilient Cities Network in partnership with its global community continues to deliver urban resilience through knowledge sharing, collaboration, and creative action, seeking to inspire, foster and build holistic urban resilience around the world.

Key Findings and Opportunities

INPUT

Findings: The majority (92%) of top convenience store items are in plastic packaging, largely multilayer plastic film which is not readily recyclable. All of the tobacco, beverage, and personal care products sampled had manufacturers domestic to Vietnam.

Opportunities

- Work with domestic manufacturers on the extensive amount of multilayer plastic film products that are sold in convenience stores in Can Tho, either to redesign product packaging, promote reused schemes or bulk sales, foster extended producer responsibility for local re-collection, or increase the local market for capture and recycling of those items.

COMMUNITY

Findings: The city has a strong plan in the coming years to improve waste management and public awareness. Convenience and cost are barriers to behavior change that should be addressed to maximize the effectiveness of new systems. The public seems receptive to interventions from local government to communicate and enforce policies and increase education. Collection and management of waste are reported to be confusing for some community stakeholders (timing and methods of collection, especially), which results in household waste not being sorted or collected as efficiently as possible. The younger generation in Can Tho seems enthusiastic about initiatives that reduce single-use plastic and increase the use of alternative and reusable items.

Opportunities

- Partners in this program should work together to develop and sustain targeted communication campaigns to reach certain demographics with clear messaging, including primary and secondary students to support the next generation.
- With an excited younger generation of entrepreneurs interested in this issue, engaging them may bring economic growth and opportunities to invest in new businesses.
- Create a campaign around targeted single-use items, such as plastic bags, and raise awareness for and availability of alternatives and reusable items. This must be coupled with economic incentives to sustain long-term behavior change among consumers and business owners.

PRODUCT DESIGN

Findings: 100% of top candy and personal care products and 83% of all top products from convenience stores are packaged in multilayer plastic film. Most to-go products from vendors and restaurants were packaged in PET, which is often readily recyclable.

Opportunities

- Further examination of the recycling of PET and this packaging from food vendors could be explored and/or enhanced, such as through existing data in the “Full Circle” report (GA Circular, 2019) or in future phases of Urban Ocean in Can Tho. This recycling may present an additional opportunity to increase the connection between local food vendors and informal recyclers to manage that waste stream.

USE

Findings: Lack of clear policies on the use of biodegradable products, higher costs for plastic alternatives, and the convenience of plastic items have led to fewer vendors and stores offering alternatives. Reuse happens when possible, and the younger generation is energized about this topic.

Opportunities

- Develop and enforce new rules that would incentivize behavior changes in individuals and businesses in Can Tho.
- There may be opportunities for new reuse and alternative product businesses with younger entrepreneurs.
- Oxo-degradable plastic bags should not be sold as “self-destructing” or “degradable” bags — they simply make bags fragment into microplastic faster.

COLLECTION

Findings: While household waste collection rates are high and the service is readily available, there is still confusion surrounding the system. The relatively high number of informal dumpsites in the city may be another indication that people are confused about how to manage their waste or be limited in their choices for management by economics or logistics. Waste sorting initiatives have recently been attempted but not readily adopted or enforced.

Opportunities

- There appears to be an opportunity to 1) design the optimal collection system in collaboration with the city and both private and informal collectors and 2) to engage the community in this system through education and outreach to reduce illegal dumping.
- Improve collection through procurement of advanced transport vehicles.
- The city should incorporate recyclable categories in its separation strategy. This also provides an opportunity to upgrade the city’s Transfer Stations with recyclable waste sorting facilities.
- Increase the number of public waste bins in the city, coupled with increased efforts to communicate proper disposal of waste.

END OF CYCLE

Findings: Plastic is a relatively small percentage of the household waste stream (6-9%), but it still ends up in landfills or open dumps. Composting occurs in rural areas but there is no existing market for compost. Previous attempts at larger-scale and formalized recycling have also failed due to a lack of market value. The local incineration facility may be hampering motivation for source separation and recycling.

Opportunities

- Provide additional resources and standardize the informal recycling sector so that the informal workers can increase their collection and optimize the recycling system in Can Tho, including exploring new technologies that can help increase waste collection and management for physically hard-to-reach areas, and to support waste picker communities and cooperatives.
- Policy development (and enforcement) in coordination with national waste management and plastic pollution plans.
- There is a small but dedicated recycling/reuse community in Can Tho that could be further supported and developed. Implement a material recovery facility to recover/recycle materials that are segregated, and explore opportunities to partner with Industry to find Innovative treatment solution for dealing with Hazardous and Unburnable waste
- Look into closing the old landfill sites that are filling up and expanding to a 'Waste Treatment Hub' project while exploring household composting.
- Incineration should be the last component of an integrated and hierarchical waste management system with recycling maximized and only residuals being combusted for energy.

LEAKAGE

Findings: Litter densities were relatively low in Can Tho (0.95 – 1.29 items/m) when compared to similar sites (2.95 – 3.39 items/m in Semarang), although 56 dumpsites were documented. Food plastic and tobacco products together constituted about 60% of the material found in litter items. Plastic food wrappers, plastic bags, cigarettes, and straws were among the top litter items in each population count area, which were largely made of non-recyclable plastic.

Opportunities

- Solutions above, particularly around policy and outreach, should be targeted to the most problematic litter items that are found in the city, such as certain tobacco products and food products.
- If there is a desire to measure impact from interventions targeting opportunities to reduce plastic leakage, conducting transects over time, and at later periods in time is recommended.
- Targeted catchment devices, while typically a last resort for preventing waste from entering or perpetuating in the environment, should be explored in Can Tho.

Urban Ocean is a three-way cooperative partnership among The Circulate Initiative (TCI), Ocean Conservancy (OC), and Resilient Cities Network (RCNRCities) that works with city leaders to bring new ideas, partners, and resources together to solve interrelated problems around waste management. Can Tho is one of five cities in the initial cohort of Urban Ocean learning cities. The CAP in Can Tho, coupled with the upcoming Opportunity Assessment Workshops, represents Stage 3 of the Urban Ocean Initiative which involves a comprehensive Gap Assessment to map challenges, risks, opportunities, and vulnerabilities within the cities' critical waste management systems. The data gathered from the CAP in Can Tho will contribute to an Opportunity Assessment Workshop where stakeholders will discuss findings and develop a proposal(s) for interventions that will then be brought to an Accelerator Summit for review and support.

Strengths

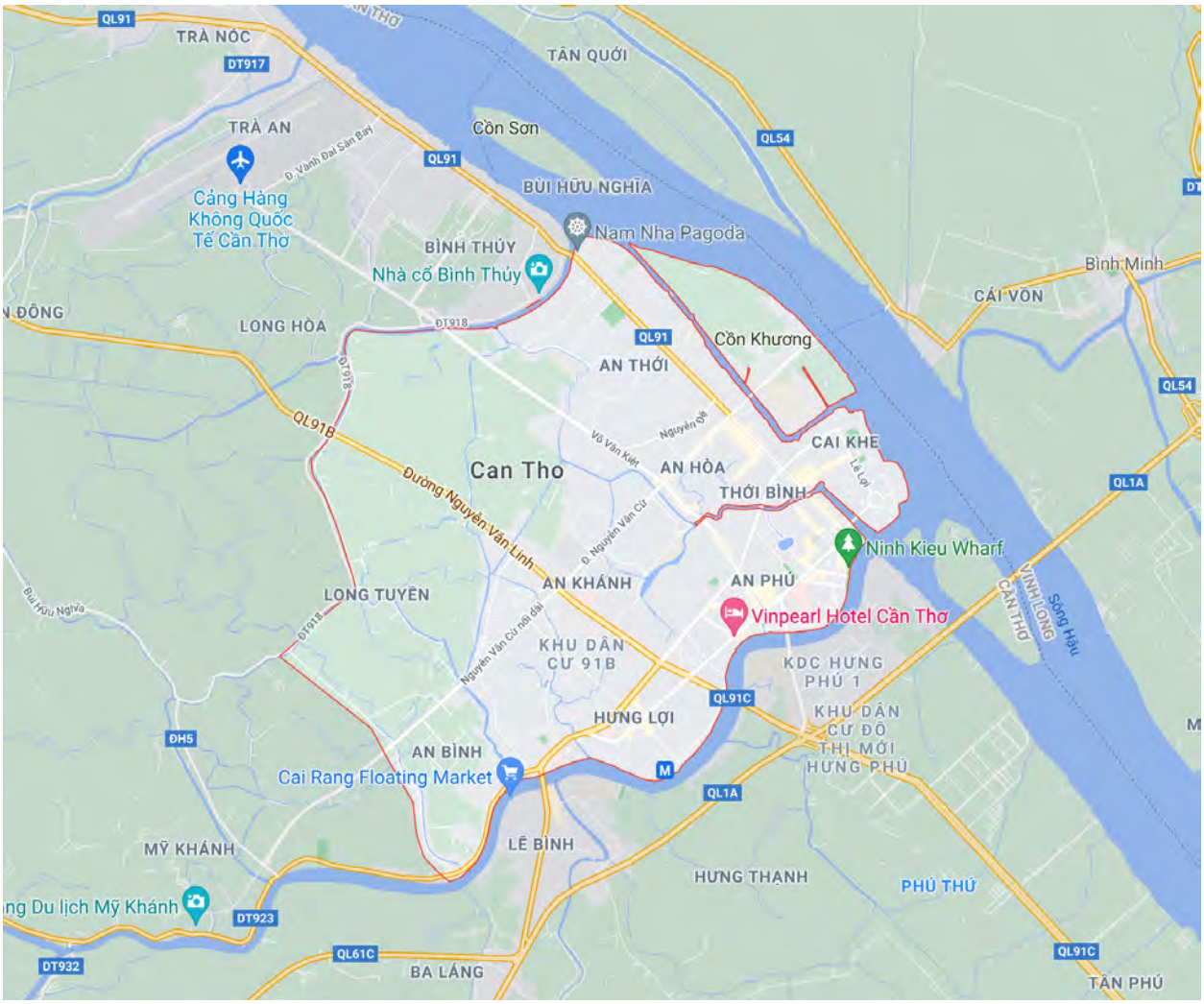
- According to the data collected in this study, the city has a low litter density overall
- Can Tho has a reportedly high household waste collection rate, despite reported confusion over the collection protocols
- There are strong management plans, regulations, and strategic planning processes in place for solid waste management
- The city has set ambitious goals and visions for the coming decades, within the national strategy for solid waste management and infrastructure
- Enthusiastic youth in the city may be an engine for driving alternatives and reuse models
- Relatively low amounts of plastic exist in the municipal solid waste stream in the city

Glossary of Acronyms and Abbreviations

CAP – Circularity Assessment Protocol
CE – Circular Economy
CIL – Circularity Informatics Lab
HDPE – High Density Polyethylene
GDP – Gross Domestic Product
IWC – Independent Waste Collector
LIP – Local Implementing Partner
MPs – Microplastics
MSW – Municipal Solid Waste
MSWM – Municipal Solid Waste Management
NMI – New Materials Institute
OC – Ocean Conservancy
OMSW – Ordinary Municipal Solid Waste
PE – Polyethylene
PET – Polyethylene terephthalate
PP – Polypropylene
PPE – Personal Protective Equipment
PS – Polystyrene
RCities – Resilient Cities Network
SWM – Solid Waste Management
TCI – The Circulate Initiative
UGA – University of Georgia

Introduction

Vietnam is home to a population of over 97 million people and has an average per capita waste generation rate of 0.33 kg/person/day (Kaza et al. 2018; CIA Factbook 2020). Given that, it has been estimated that the total waste generation in Vietnam may be over 11 million metric tons annually. However, it is worth noting that there are also significant regional variations in waste generation throughout the country. While the major urban centers of Ho Chi Minh City, Hanoi, Haiphong, Da Nang, and Can Tho accounted for 22% of the country's total population in 2017, they were estimated to collectively generate 70% of the country's total waste (World Bank Open Data 2019; Schneider et al. 2017).



Can Tho, Vietnam

Can Tho city is the largest city in the Mekong Delta and is located in the Hau riverbank with a total area of 1,438.96 km^2. Its location at the center of the Long Xuyen quadrangle, Ca Mau peninsula, Dong Thap Muoi, and Ho Chi Minh city has led to its establishment as a trade hub for the Mekong Delta area, particularly for agricultural products. The city is estimated to have a population of around 1.25 million and likely mirrors the national population growth in Vietnam, which is 9.81% (Overview 2017). Previous studies have reported that household waste generation rates in Can Tho are around 0.29 kg/person/day with high proportions of compostable and recyclable materials (Thanh et al. 2010). It has been estimated that the solid waste collection rates in urban areas of Vietnam such as Can Tho are quite high, around 84-85%, though in contrast the waste collection rates in suburban areas have been reported at 60%, 40-55% in the countryside, and 10% or less in rural areas with the lowest population density (MONRE 2015).

As one of the five cities in the initial Urban Ocean cohort, Can Tho has set out to characterize and understand its materials flow and waste management systems and identify associated opportunities for collaborative solutions. As a first step in the Urban Ocean process, UGA partnered with a local implementing partner (LIP) in Can Tho — DRAGON Institute at Can Tho University — to conduct CAP in the city.

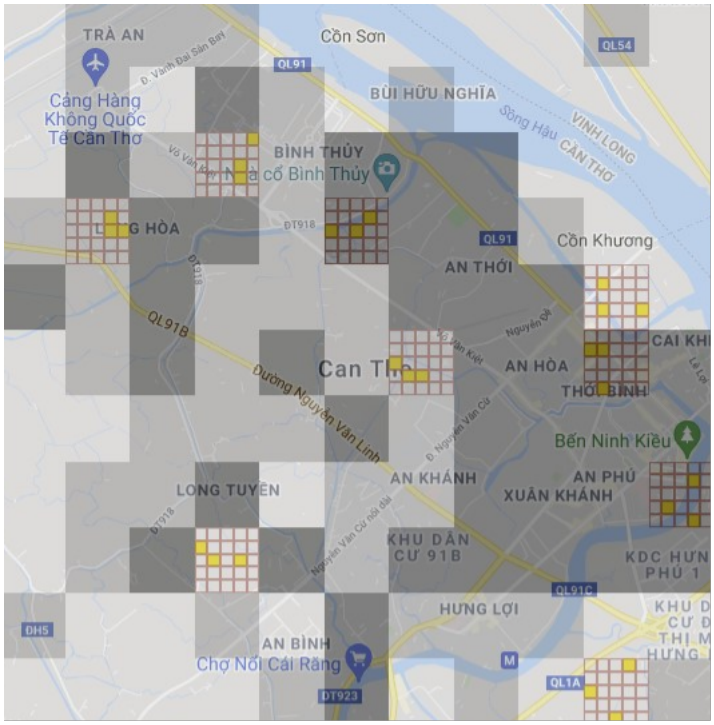
The Circularity Informatics Lab at the University of Georgia (UGA) developed CAP in 2018, which is a standardized assessment protocol used to collect community-level data to inform decision-makers. The CAP characterizes seven community components:

1. **Inputs —** What products are sold in the community and where do they originate?
2. **Community —** What conversations are happening and what are the stakeholders' attitudes and perceptions?
3. **Product design —** What materials, formats, and innovations are found in products, particularly packaging?
4. **Use —** What are the community trends around use and reuse of product types?
5. **Collection —** How much and what types of waste are generated? How much is collected and what infrastructure exists?
6. **End-of-cycle —** How is waste disposed? What is the fate of waste once it is properly discarded? How is it treated?
7. **Leakage —** What waste ends up in the environment? How and why is it getting there?

Various influencing factors drive this system including governance, economics, policy, and legislation (e.g., bans, taxes). Furthermore, multiple stakeholders exist at every level of the CAP influencing the complex system, and these include the public, government, industry, NGOs, consumers, and academia. While the hub and spoke model illustrates the CAP, it is a complex system with components inherently interconnected to each other and life cycle impacts beyond each spoke. The CAP is a framework approach to the flow of materials, in this case focusing on plastic and packaging, and the quantity and characterization of leakage from this sector will be characterized during litter assessments that can inform upstream interventions in the rest of the systems model. As of early 2021, CAP has been conducted in 26 cities in ten countries.

This report documents work conducted by the Circularity Informatics Lab at the University of Georgia (UGA) and the DRAGON Institute at Can Tho University as part of the Urban Ocean Initiative. Background information and a literature review were conducted in September 2020. Fieldwork was conducted from October 2020 — January 2021. The CAP report is split into the following sections, which include results and discussion of each: Input, Community, Product Design, Use, Collection, End of Cycle, and Leakage, followed by Opportunities to support the forthcoming System Studio workshop for Urban Ocean cohort cities.

Figure 1: Map of the 10x10km sample area within the city of Can Tho.



Population densities are shaded in gray. The 1km² sample areas for product data are shown in red and 200m² areas for litter transects are shown in yellow.

CAP Results

Input

To get a snapshot of the characterization, scope, and source of common plastic packaged items that are entering Can Tho, samples of common convenience items were sampled within nine 1km^2 transects in Can Tho — three within each tertile of the population count. The LIP selected 3 convenience or grocery shops to sample within each 1km^2 transect area, except for one transect area that only had 2 shops available, totaling 26 sampled. For each shop, the LIP collected the most popular brands of candy, snacks, beverages, personal care products (largely shampoo sachets), as well as the most popular brands of tobacco products where possible. The "most popular brand" was determined as the most purchased brand based upon shelf space taken up and/or the shopkeeper's input. This yielded 76 product samples total, 13 of which were candy, 41 snacks, 12 beverages, 3 tobacco products, and 7 personal care products. The weight of both the plastic packaging and the product itself were measured for each item using the analytical balances in the university laboratory.

For each of the top products documented, the LIP noted the type of packaging (including polymer, if possible), the brand, and the parent company. From there, the team was able to determine the manufacturing location, which was determined from manufacturing locations listed on product packaging or desktop research, as well as the headquarters location for the parent company of the brand (largely determined by desktop research). Table 1 contains the minimum, maximum, and average distance to both the manufacturing facilities and parent companies, vehicle Figures 2-4 show maps of both manufacturer and parent company locations.

Table 1: Distances to Parent Company Headquarters and Manufacturing Facilities for Popular Products

	Distance Store to Parent Company (km)				Distance Store to Manufacturer (km)			
	Minimum	Maximum	Average	Median	Minimum	Maximum	Average	Median
Candy	199	25,609	13,359	12,550	152	5,380	1,205	244
Snacks	0	25,609	6,276	2139	0	3,657	559	290
Beverages	199	23,269	8,734	1,844	199	416	272	290
Tobacco Products	279	12,965	8,736	12,964	198	279	225	198
Personal Care Products	12,965	12,965	12,965	12,964	199	290	260	290

*Note: Distances were projected using an Azimuthal Equidistant projection. Values have been rounded to nearest km.
**Most of the manufacturing locations in Vietnam are at province-level rather than city-level.

Figure 2: Location of parent company headquarters of common brands of convenience products in Can Tho

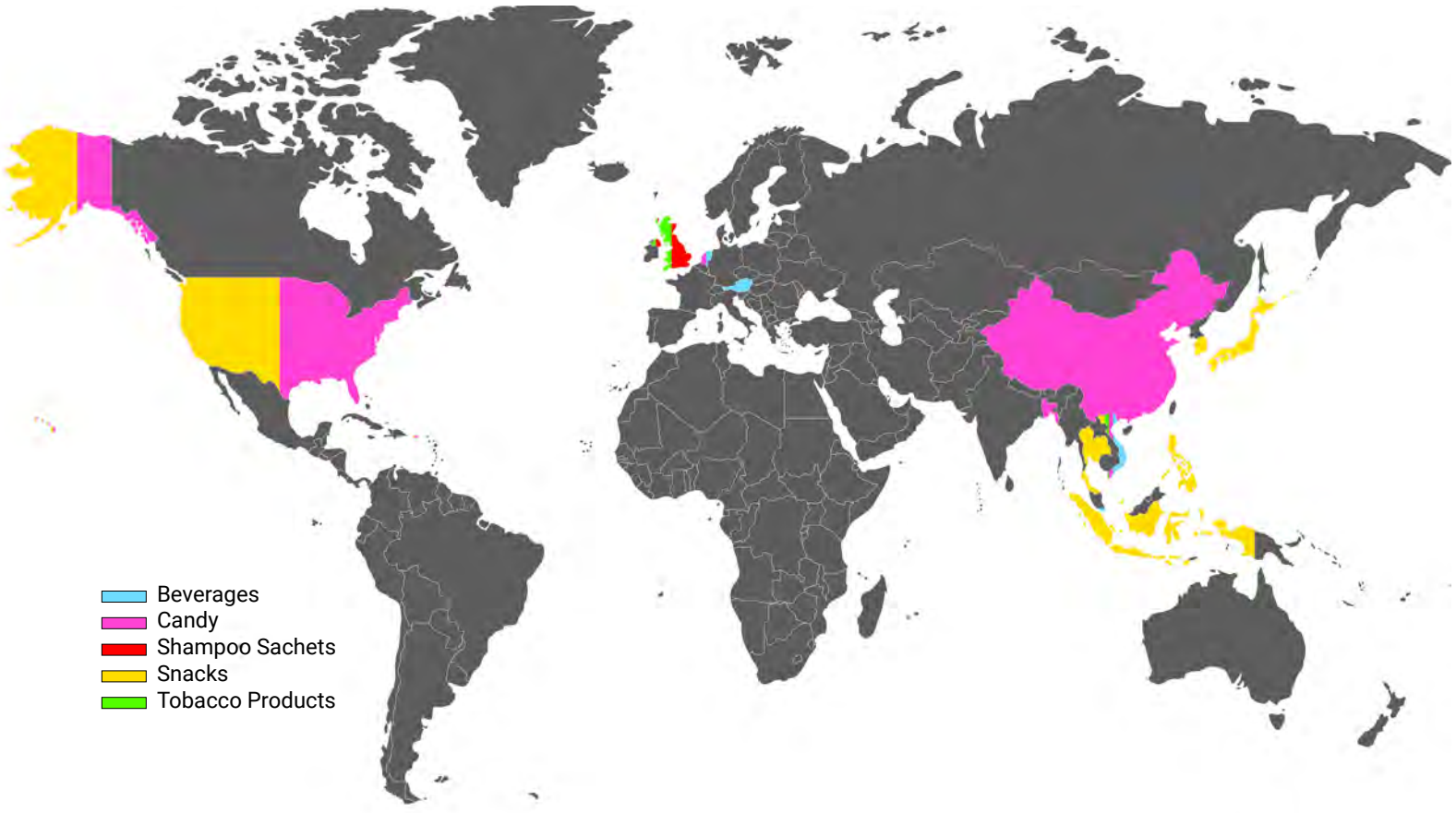


Figure 3: Location of manufacturing facilities of common brands of convenience products in Can Tho

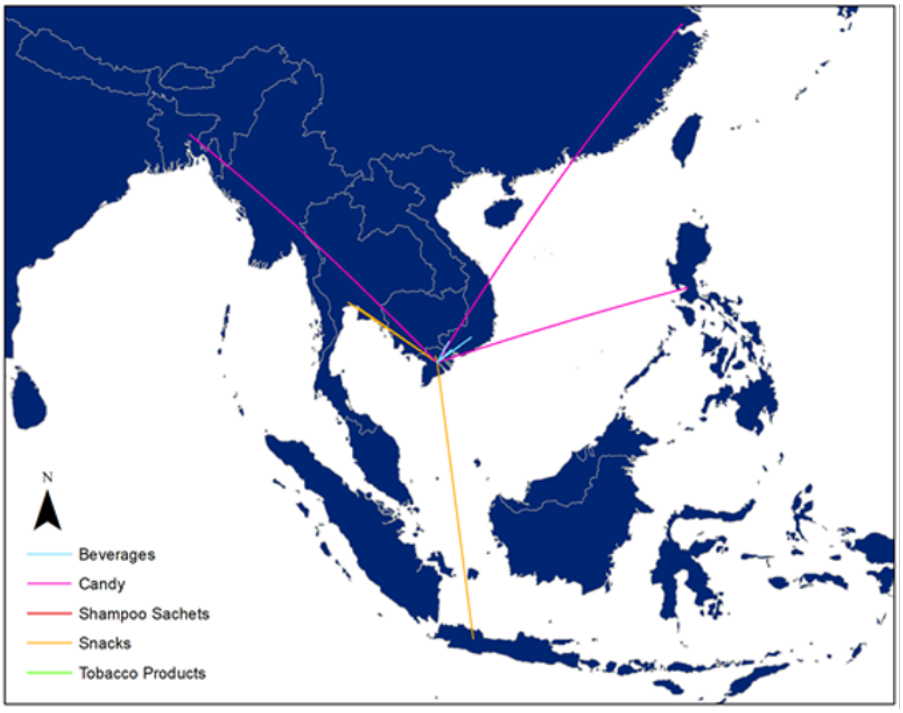
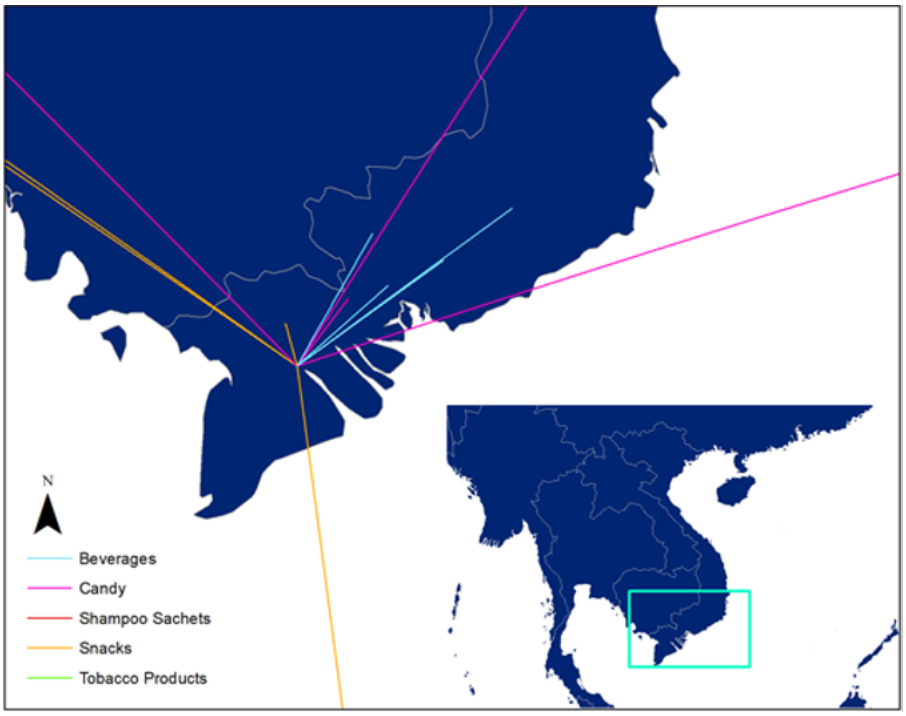


Figure 4: Location (in South Vietnam only) of manufacturing facilities of common brands of convenience products in Can Tho



As is often the case, parent company locations are further away on average than the manufacturing sites; 49% of the parent companies were located outside of Vietnam. The parent companies for the snack products were the closest on average, but still far in comparison to manufacturing, at 6,200km away, followed by beverages and tobacco products both at an average of 8,700km away. Personal care products and candy were furthest away at 13,000 and 13,300km, respectively. The farthest parent companies were located in Europe (Austria and the UK) and the USA.

For manufacturing, sites were much closer and 81% of manufacturers were domestic to Vietnam. The locations for manufacturing beverages, tobacco products, and personal care products were on average less than 300km away and were all domestic to Vietnam. The average distance for snack manufacturing was over 500km and candy was the furthest away at an average of 1200km, but all manufacturers were still located in South Asia.

Of all the products sampled, the vast majority were packaged in plastic, 92% were sold in plastic with the remaining 8% sold in paper or aluminum packaging. Most of the non-plastic packaging was aluminum cans, largely for soft drinks. All the personal care products that were sampled, mostly shampoo and detergents, were packaged in multi-layer film sachets.

Community

To understand current attitudes and perceptions of plastic waste, semi-structured interviews were conducted by the DRAGON Institute with 32 key stakeholders (Table 2). Among those interviewed, five were grocery or convenience store staff, five were private waste hauling, landfill, or recycling companies, five were informal recycling aggregators, four were food vendors, four were companies using or producing plastic alternatives, three were from local government, two were from local NGOs, two were from academia, and two were from local plastic packaging product companies.

Table 2: List of Stakeholders Interviewed for CAP

Stakeholder Group	Number of Interviews
Grocery or Convenience Store Staff	5
Private Waste Hauling, Landfill, or Recycling Companies	5
Informal Recycling Aggregators	5
Food Vendors	4
Companies Using or Producing Plastic Alternatives	4
Local Government	3
Local NGOs	2
Academia	2
Local Plastic Packaging Products Companies	2

Stakeholders were asked about their thoughts on the impact of plastic on the environment. They expressed basic, yet significant concerns that could already be seen throughout their community. Some were concerned with the animal interference that resulted from stagnant waste piles, others mentioned the visible pollution in the rivers, and some added that the trash caused flooding:

> **"This whole thing right there. We'd like to remove it… It's full of snakes [nest there during the rainy season]. Our current problem is how to remove those two piles. Right, Han? They're just left there, untouched…Lots of snakes come out when it's flooded. We'd like to find a way to request the removal of those two piles and put up a "no trash" sign."**
>
> **— Food vendor**

> **"Plastic pollution is a big issue at the moment because we can see a lot of plastic waste along rivers, canals and roads. I came back from Con Dao yesterday. Con Dao is considered very clean but when entering the mangrove area, there are plastic, plastic bottles, plastic caps floating everywhere. How sad it is."**
>
> **— Company using plastic alternatives**

> **"I think [the impact of plastics is] high because… It's full of trash. You can see lots of trash every time it's flooded."**
>
> **— Grocery Store Owner**

Many stakeholders noted that door-to-door household waste collection is available to the majority of the population in the urban areas on a daily basis, and there is now a standard fee for waste collection per household. However, the timing for collection is not always convenient or known, particularly in more rural areas, which is not uncommon during initial collection schemes. In some areas there are no collection or sorting guidelines, however for districts where waste segregation is being piloted, it was reported that the protocols are communicated to residents through meetings and residents receive informational brochures. Guidelines are also often shared through TV adds, radio stations, through cultural houses for each ward, as well as through networks such as the Womens Union and Youth Union.

Figure 5: Pamphlets handed out with instructions on household waste segregation during Can Tho Resilience Office activity

(Photo Credit Can Tho City Government So Sen La)

For restaurants and food vendors, collection times and costs can depend on the type of waste. Some businesses reported that they were unsure of the collection frequency and types of waste allowed. It is our understanding that collection service contracts for the households and businesses of the core urban area of Can Tho run exclusively through URENCO, which only accept household waste and require a set payment every month. In contrast, other waste (e.g., bulky waste) may need to be paid and addressed separately through a separate collection event (usually also URENCO but there may be 1 or 2 other collectors operating in each district), which people may not be willing or able to do.

> **"They put a single trash can on the whole length of the street for everyone to stuff their trash in and then complain about litters."**
>
> **— Grocery store owner**

> **"They only come when you call them. They will not come by themselves. Like going around and collecting when seeing it."** **[may be referring to other types of waste not regularly collected]**
>
> **— Freelance businesswoman**

> **"Because there's a lot of trash here. They don't collect things like construction waste, debris, furniture, and bottles. They don't collect them, so people sneak their trash into other people's spots. That's how it is."**
>
> **— Food vendor**

In addition to some challenges surrounding access to waste collection, the recycling system in Can Tho is informal, according to stakeholders. Community members do sort some recyclable items (of value) and sell them directly to an informal collector that will purchase them from the home. The informal collector will take the materials and sell them to scrap dealers and recycling centers, which are privately operated and often located closer to Ho Chi Minh City. It is not known how many informal collectors operate in Can Tho, but Ho Chi Minh City (population about 9 million) has over 4,000 collectors, so Can Tho (population 1.2 million) likely has several hundred, at least. Informal collectors work very long hours with whatever resources they have, and often without any training on health or safety. According to one collector, their use of bicycles limits their efficiency:

> **"On average, I go from the morning and come back when it's very late at night, at one or two o'clock just for 30,000 to 100,000 VND."**
>
> **— Informal bottle collector**

> **"With a bicycle [a tricycle cart], I can't collect much."**
>
> **— Informal bottle collector**

With every informal worker using differing business methods, the residents struggle to reliably send away their recyclable materials. It is unknown when the collectors will come to collect, at what frequency they will collect, and who the collectors are:

> **"There's a cart, they push it around twice a day, once in the afternoon and once in the evening. They push it here, collect the [recyclables], then leave. I pay the fee, but I don't know who they are."**
>
> **— Business owner**

> **"They come back once they've sold everything. I don't know if they should do it or not. I don't really understand their line of work."**
>
> **— Food vendor owner**

> **"They just distributed flyers without anyone to actually collect [recyclables]."**
>
> **— Freelance businesswoman**

The LIP reports that waste collectors and waste pickers all work in the same waste stream, basically competing for the valuable materials in it. The collectors buy from the household level, pickers may pick from public cans and other public areas, at the aggregation/transport sites, the valuable material may also be picked, and then finally at the landfill anything left will be picked and taken to sell. Because poverty can be a driver in the waste collection and picking activities, the stakeholders view the workers with pity. With waste collection and picking often considered dirty and the perception being that the work may be conducted out of desperation, the work is viewed by others as "lesser-than".

> **"I already have a source of income. Paying the collectors to take care of them is the best choice."**
>
> **— Grocery store owner**

> **You can see her on this street early in the morning. It's a heart-wrecking sight, so I give her whatever scraps I have. They aren't worth much anyway. I can only get about 20,000 VND for a big pile, so I'd rather give it away for free."**
>
> **— Grocery store owner**

> **"I think it's a second source of income for some people. They have a bag on the ready to pick whatever they can find."**
>
> **— Food vendor owner**

Despite the social status of informal recyclers, the stakeholders generally appreciate the work they do and recognize its importance. They acknowledge that the waste stream is reduced by recycling, and that people are earning an income in the process.

> **"I think it is necessary. Because leaving so much trash around can affect us. Therefore, we sell them away for them to earn from recycling."**
>
> **— Grocery store owner**

While some stakeholders have expressed discontent with the current waste and recycling treatment systems, change

in these systems has proven to be difficult. Among the general public, awareness of pollution issues seems to be fairly low or scattered. Some of the stakeholders were concerned that waste pollution was affecting their surrounding environment while others thought that their current surroundings are live-able and manageable. It could be described as an "out of sight, out of mind" perspective.

> **"I think it's very severe because there are plastics everywhere. You can see lots of them floating in the rivers."**
>
> **— Grocery store owner**

> **"Looks like everyone throws trash into trash cans without littering so it's not polluted... Yes. Everybody ties their waste bags properly ... it's generally not too polluted to live."**
>
> **— Food vendor**

These differing perspectives lend themselves to the idea of hyper-localized perception. For instance, the severity of plastic pollution could be experienced in one part of Can Tho, but completely unrealized in another part of the community.

> **"Oh my God, it's been a problem for 10 years, but it's coming to the surface now. I used to work on a waste separation project. Do you know Cai Rang Landfill?"**
>
> **— Business Owner**

Another instance of hyper-localization is the apparent focal point of plastic bags as the main plastic pollutant. While plastic bags are a large portion of pollution, other sources may be equally as important. For both ideas on policy and alternatives, stakeholders suggested targeting these bags:

> **"The only thing that we can do now is start using reusable bags like Con Co bags. If we can switch to using those bags, then we'll be able to limit the usage of plastic bags."**
>
> **— Grocery store owner**

> **"I usually wash the plastic bags that I get from the market once I'm home. I make sure to use each plastic bag for about 10, 15 times. However, other people wouldn't spend that much energy to wash and reuse them, so the bags add up. To recycle or not to recycle depends on each person."**
>
> **— Business owner**

Social pressures within communities in Can Tho are both enabling changes in plastic perceptions and creating barriers to change. Topics related to plastic pollution are now included in the primary and secondary school curriculum, and the city holds an annual celebration for Environment Day on June 5th with a different theme every year. Social

media seems to be a potentially valuable tool for change and proves to be amplifying the issues and impacts of plastic pollution to some by circulating images and sentiments. Partners in Can Tho noted that the city has run several social media campaigns about the negative impacts of plastic pollution, but it hasn't led to much change in terms of littering. It was also noted that typically the younger generation is more receptive to behavior change and understands the impacts of pollution more so than the older generations, but that the younger generations are typically responsible for more plastic consumption, particularly with beverage items. Stakeholders in the interview process mentioned that striations in each generation's attitudes were slowing the proliferation of awareness:

> **"When surfing Facebook every day, we can see the impact of the environment, the environment is affected by those issues but they don't see that. That's why when we ask them to use cloth bags or shopping bags, they say "So annoying".**
>
> **— Alternatives business owner**

> **"For young people, it's pretty good. I see that the youth performs very well. As for middle-aged people, they haven't seen any benefits of doing so."**
>
> **— Alternatives business owner**

There is a distinct community of businesses committed to changing consumer behavior. The Central Government encourages and promotes public campaigns to expand environmental awareness, but there is not always the ability to implement change at the local level. This is in part due to the separation between policies and their associated budgets. The budgets from the Central Government related to policies can be delayed at the local level, leading to delays in policy implementation. Some believe this encouragement is enough effort, but others desire more governmental action, such as better communication, increased education, taxes on plastic, and implementation of waste sorting.

> **"It's effective. People do listen to what they say. Nobody leaves out any stagnant water. Take coconut shells for example. When we throw them out, they even told us to turn the shells up-side down so as not to let water build up inside."**
>
> **— Grocery Store Owner**

> **"Unfortunately, our people have a low educational level. They should have been more straightforward with their words because our people have a low educational level."**
>
> **— Grocery store owner**

> **"… they must use actions, like what I've just told you, a law regarding environmental protection, or at least, taxes on plastic bags and plastic manufacturers. If the cost is pushed higher, the market ladies won't use plastic bags because they're no longer**

> **cheap. They won't use them if the taxes are high. They should encourage people to bring their bags with them when they go grocery shopping, just like in the old days"**
>
> **— Business owners**

> **"Set up waste-sorting waste bins."**
>
> **— Freelance businesswoman**

Finally, most stakeholders expressed that they desired change, but did not have the power to start this change. Many of their quotes indicate that there is a lack of public resources and support to engage the community in these environmental efforts. There is a lack of awareness, which could be attributed to lagging education efforts or public awareness campaigns. The community seems to be waiting for the government to push for change as well. They feel that change must happen from the top, down:

> **"… the household next door has poor awareness and its next-door household copies its behavior. Take the households near my house as an example, they are not clean but when seeing me and my daughter-in-law, they become cleaner and neater … "**
>
> **— Informal scavenger**

> **"The only solution is for the government to get tough on this issue. I think the government needs to put a foot down on this and implement taxes on plastic manufacturing companies. Then, the problem will be solved. Honestly, I think we need to address the root of every problem. Our problem doesn't come from the consumers nor the providers … "**
>
> **— Business owners**

> **"In general, whatever you want to do, you need people of high positions. Their voices have value. They have a say in the matter. They only let me use this bag after I called the manager over."**
>
> **— Business owner**

From these stakeholder interviews, attitudes and perceptions surrounding the current waste treatment system in Can Tho become apparent. Most are concerned with the current state of the system, while a few see no issues. Within these expressions of opinion, several barriers to waste management and behavioral change can be identified. These barriers include communication, finances, logistics, physical aspects, habits, education, and government action. It is clear that some interviewees are frustrated with the current state of waste treatment; however, they are prepared with ideas to make progress in creating a cleaner city and recognize the importance of bottom-up support to complement top-down policies. This study indicates that once these ideas can be coordinated and implemented with the required resources, this change will begin to accelerate.

Product Design

Figure 6: Example of Convenience Stores in Can Tho

(Photo Credit: DRAGON Institute)

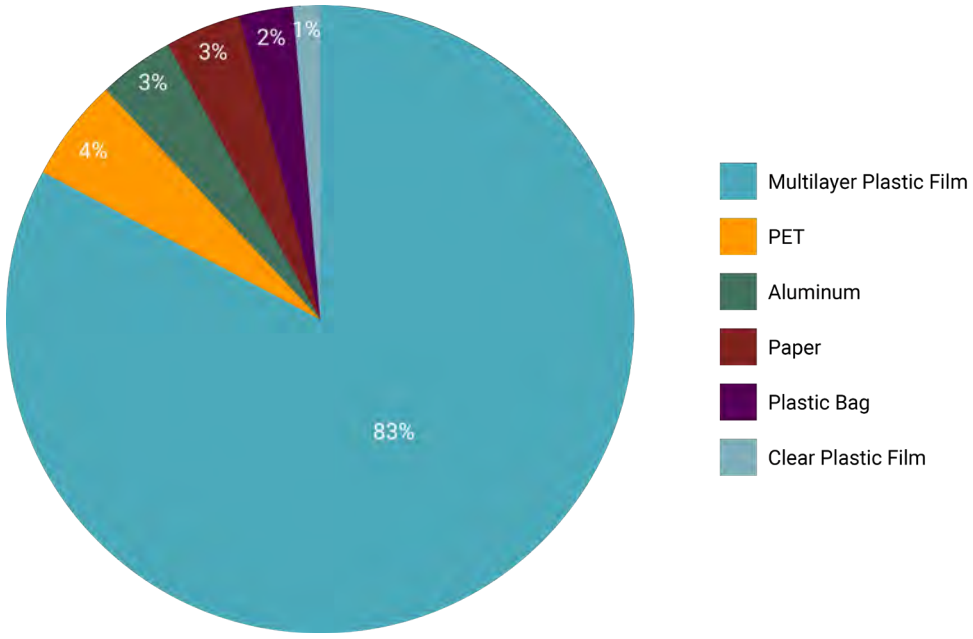
To characterize material types used in common consumer products, samples of common convenience and to-go items were obtained as described in the Input section. The LIP was not able to sample stores and vendors in each of the nine 1km^2 transect areas, as it can be difficult to find them in many of the less urban parts of the city. The average weight of both the packaging and the product itself were collected for all 76 samples (Table 3).

Table 3: Average weight of products and their plastic packaging for common convenience items

Product Type	Count of Product	Average Weight of Plastic Packaging (g)	Average Quantity of Product (g)
Beverages	12	17.23	258.94
Candy	13	1.13	11.37
Personal Care Products	7	1.76	13.1
Snacks	41	5.26	57.92
Tobacco	3	6.39	22.05

All (20 items) of the top candy and personal care products purchased from convenience stored in Can Tho were packaged in multilayer film plastic. In addition, 90% of snack products and 41% of beverage products were also packaged in multilayer film plastic. Of the remaining beverage items, 33% were in PET packaging and 33% were in aluminum cans (Figure 5).

Figure 7: Material Breakdown of Top Convenience Store Items



Beverage products on average had the highest packaging and product weight, though they had the smallest ratio of packaging weight to product weight (Figure 10). Tobacco products had the higher ratio of packaging weight to product weight. Candy, beverage, and personal care products had similar ratios of packaging weight to product weight.

Figure 8: Convenience Store product to plastic ratios, shown in grams

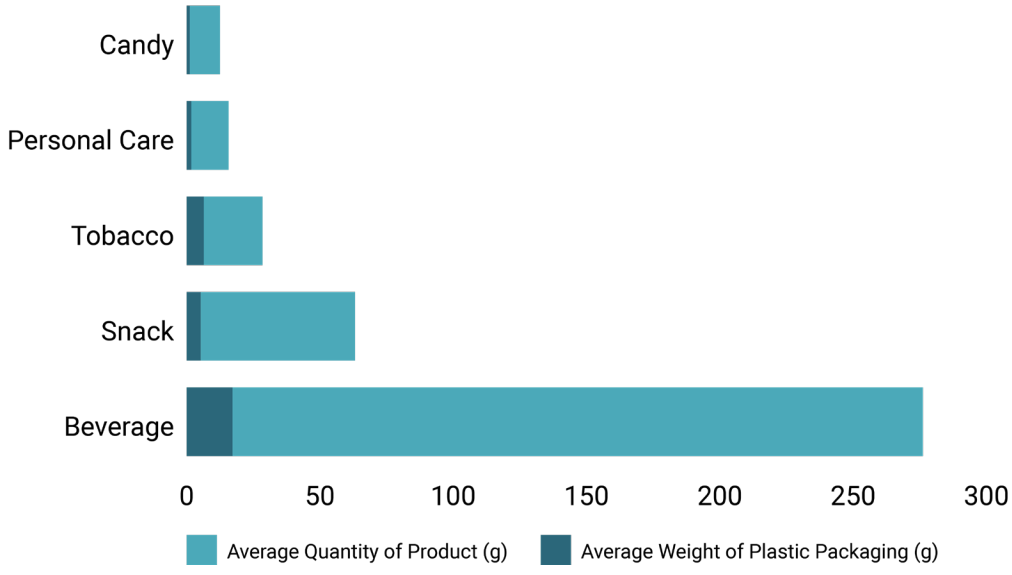


Figure 9: Example of Food Vendors in Can Tho

(Photo Credit: DRAGON Institute)

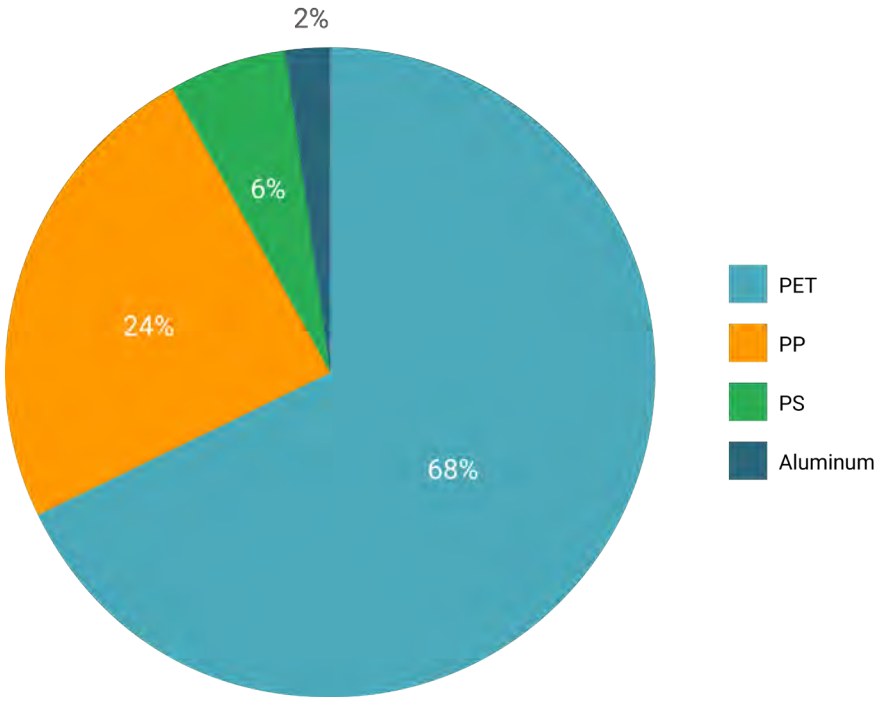
Within each of the selected nine 1km^2 transects in Can Tho, the LIP also visited up to 3 randomly selected food vendors or to-go restaurants to sample the food packaging and utensil types that were being distributed, totaling 22 vendors sampled. The LIP collected 48 to-go items from those vendors and documented their weight, material type, and brand, where possible (Table 4).

Table 4: Average weight of common plastic packaging and to-go items from food vendors

Material Type	Number of Samples	Average Weight of Plastic Packaging (g)
PET (to-go cups and plastic bags)	33	5.75
PP (straws and utensils)	11	1.08
PS (to-go cups and containers)	3	30.09
Aluminum (can)	1	14

In contrast to the products observed in convenience and grocery stores, the majority (68%) of products sampled from food vendors and restaurants were in PET packaging (Figure 10). It was also noted by the LIP that some higher-priced coffee shops will sell their coffee in to-go paper cups but will then wrap those paper cups in plastic film or a plastic bag so that they can be taken by the consumer and transported via motorbike, which is a common practice in the city.

Figure 10: Material breakdown of the to-go items sampled



No organic or biodegradable material items were provided from vendors for sampling and weighing, though it was noted that one small restaurant did offer rice straws as an alternative to plastic straws and some vendors did offer cardboard and paper to-go containers.

The LIP noted that there are no clear policies on the use of biodegradable products in stores and restaurants in Can Tho, so vendors typically prefer to purchase and use plastic items for convenience and because they are not familiar with other options. It was also noted that when alternatives are available, they often come at a much higher cost to vendors as compared to plastic products, which is another deterrent to transition.

Use

Among the 48 convenience stores and food vendors sampled in Can Tho, all of them offered plastic as their main type of bag. The average weight of the plastic bags sampled was 3.09 g and was on average around 30 x 15 cm in size. Plastic bags were often cited as an item that is both critical and difficult to replace for consumers but also often ends up in the environment due to its difficulty in the collection and lack of value in recycling. The LIP noted that many consumers and vendors during informal interviews mentioned that they use the “self-destructing bags" as an alternative. However, these are typically oxodegradable bags that do not actually biodegrade, but simply break down into smaller plastic fragments faster when left in the environment.

Habits and convenience seem to be strong inhibitors to change attitudes towards reuse and use of alternative items.

People tend to be in a routine of using plastic as the default option and are not aware of alternative options to single-use products. It was noted that, even if people are indeed aware of the negative impacts of plastic pollution and want that to change, they are often not able to make a change themselves because plastic is convenient and cheap and there are no incentives or policies to encourage alternatives. It was noted by several consumers though that if they purchase an item that is reusable, such as a durable plastic bag or a rigid PET plastic bottle, then they will try to wash and reuse it as much as possible.

In Can Tho, habits seem to be stronger than efforts made by education and government campaigns and are largely controlled by what is most convenient or most readily available. Plastic bags are irreplaceable in this way; the alternative must be as convenient as the plastic option.

> **"I think it's not so effective. [laughs] In terms of propaganda, it may be effective at that time but after the project has ended or the locality has stopped the propaganda, people will go back to their habit."**
>
> **— Alternatives business owner**

> **"Due to family culture, school culture … it will be superficial if the education is not thorough."**
>
> **— Freelance businesswoman**

> **"No one asked about it [alternatives to plastic bags] … Yes, they just took what are given to them."**
>
> **— Grocery store owner**

> **"[Policies are] Not that effective. We have to use plastic bags because nothing can replace it in the meantime. Take my business for example, I can't sell anything if I can't give the customers a bag to bring their purchase home."**
>
> **— Food vendor**

The current alternatives to plastic products are also more costly. Finances are a large barrier in switching from plastic to sustainable materials. Some consumers only switched to reusable products after they could fully and comfortably afford them, and it was noted that typically only the most affluent among the population able to purchase and use alternatives. In the business sector, owners can only give customers plastic alternatives then their profits allow.

> **"Then I switched to the stainless-steel straw. I can just afford it after its price has dropped. The price was very high previously."**
>
> **— Freelance businesswoman**

> **"The other thing from my side is that we are trying to work on the cost because as you know, the replacement products for disposable plastic are expensive."**
>
> **— Alternatives business owner**

> **"If those bags become widely available, then people will start using them. The price must be okay though."**
>
> **— Grocery store owner**

Despite the current barriers in implementing plastic alternatives, businesses are still finding ways to slowly change the sentiment. Completely switching to plastic alternatives is not yet possible, so cafes and shops are giving the customers options. Encouraging and inspiring customers is a popular strategy, and sometimes the only strategy. In some cases, these business owners are successful in gradually changing the consumers' behavior.

> **"My café is the only place that encourage customers to bring their own bottles when they buy drinks here because we don't use plastic cups and paper cups. They get a 20% discount when they bring their own bottles, so most people love it."**
>
> **— Business owner**

> **What I'm trying to say is, I try to avoid using plastics as much as possible. In general, we don't forbid the use of plastics. We only try to inspire people by giving them the option of not using them."**
>
> **— Business owner**

> **"Our customers usually feel uncomfortable in the beginning. They're uncomfortable because they think we're being difficult, but once they understand why we're doing it — It's like they care about their interest first."**
>
> **— Business owner**

It is promising to hear in the interviews that several initiatives have recently been started in Can Tho, particularly led by the younger generation, to develop and use alternatives. This could be an opportunity for local business and innovation in the city and could also lead to a tipping point for access to alternatives and social pressure for behavior change in the future. Some of those initiatives include:

1. Coffee shops using noodles, rice and bamboo straws instead of plastic
2. Food stores and coffee shops applying discount programs for customers using personal containers
3. Stores selling bags and personal containers made of cloth and bamboo instead of plastic with slogans encouraging users not to use plastic or to protect the environment together.
4. Initiative called "Building a model of people in Con Son to limit using plastic bags"

In 2019, the city of Can Tho announced its plan for implementing the National Strategy in Solid Waste Management to 2025. As part of this plan, the city committed to ensuring that 40% of plastic bags at trading centers and supermarkets will be made from "environmentally friendly" materials (VNS 2019).

Collection

As part of Can Tho's plan to carry out the National Strategy in Solid Waste Management for 2025, the city has a goal of collecting 100% of household waste by 2030. The city has also committed to upgrade its regulations and policies on solid waste management, modernize its waste treatment facilities, and study advanced technologies for solid waste treatment (VNS 2019). It is currently estimated that the collection and transport capacity for Can Tho is around 650 tons/day and that the city collects 55% of the total waste generation across sectors (World Bank 2011). URENCO Urban Environmental Company Limited undertakes daily household waste collection in Can Tho and services 78.4% of households. Around 6% of households are using local garbage collecting private services and 15.6% reportedly treat their waste themselves (Can Tho City People's Committee 2015).

While household collection rates in the urban areas seem relatively high and there appears to be a consensus that the majority of people in the urban centers have access to waste management services, it was noted in interviews that there can be confusion around the specific timing for collection, sorting policies, and what items will or will not be accepted. The LIP also noted that there has been a relatively new cost implemented for residents to pay for regular pickup, and while the information on the policy is available, it hasn't effectively been communicated to the general public. This may be leading to a system that isn't maximizing collection of household waste.

> **"The initiative of sorting garbage was launched early this year but it just lasted for a very short time and no one collected it. They just distributed flyers without anyone to actually collect garbage."**
>
> **— Freelance Businesswoman**

> **"I have to arrange it neatly, or they won't take it."**
>
> **— Food Vendor**

> **"If they come but the people in the house don't bring the garbage out at once, then they leave. [But they still have the access?] Yes."**
>
> **— Freelance Businesswoman**

Financial factors seemed to be another common barrier to waste collection access. Stakeholders in the interview process described that they were unsure about the extent and coverage of the collection fee, and how much would extra collection cost. It seems that the fee system is relatively new, and communication may not have reached every

household yet. This is also another instance in which rules of collection may not be optimally communicated or regulated.

> **"...if there's a lot of trash, if the garbage men see that there's a lot of trash, they will leave some uncollected until you give them extra money... They didn't collect the branches until I gave them money in person."**
>
> **— Business owner**

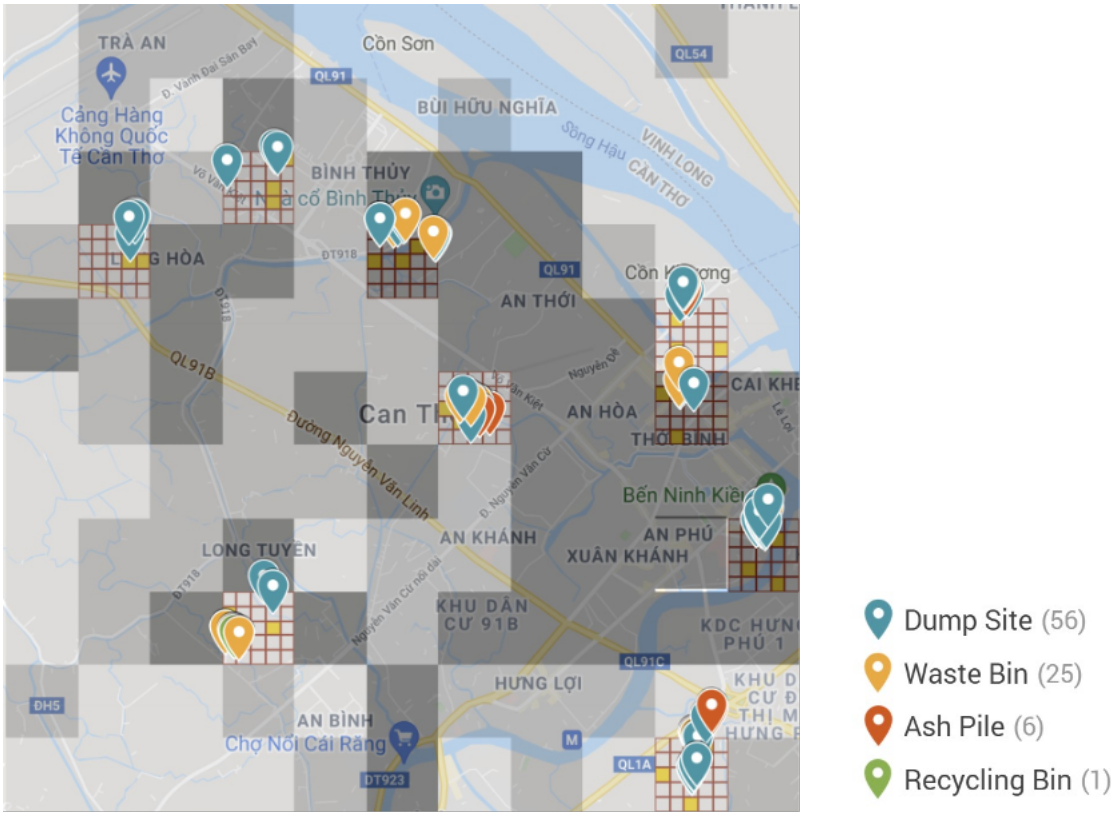
Furthermore, physical barriers block parts of the community from receiving waste collection services. Alleyways and bridges seem to be common barriers around Can Tho. The stakeholders expressed that the garbage collection trucks from public services are not able to travel through narrow alleys or narrow bridge passes.

> **"Usually, for smaller alleys, they [can't collect waste]."**
>
> **— Food vendor**

> **"Only 50% [can access services]. It's like the path to my house where the truck can't pass the bridge. The area over there is not included. There are two sides but only my side is included while the other side is not. The [waste collection] truck can't pass the bridge."**
>
> **— Informal scavenger**

As was noted in the Community section of the report above, there can also be some confusion around waste collection policies and regularity in the city, and infrastructure and transport for the informal sector is minimal.

Figure 11: Locations of public waste receptacles in Can Tho from LIP survey



From a visual survey conducted by the LIP during litter transects (a total of 2700 m^2), it was noted that there were 25 public waste bins and only one recycling bin, and two of the nine 1km^2 areas did not have any public waste receptacles available at all (Figure 14). Zoomed-in versions of the transect areas in Figure 14 are included in the Appendix. In addition, the 2700 m^2 area contained 56 informal dump sites and 6 ash piles from burnt waste. Those dump sites were either areas where a large amount of waste had been littered indiscriminately, or, more commonly, were areas where household waste had been collected together from multiple households and left on the street for collection. The latter tends to occur when people are unaware of their household waste collection pickup times, or if the timing is not convenient for them or they won't be home. This relatively high number of informal dumping in the city may be another indication that people are confused about collection of waste.

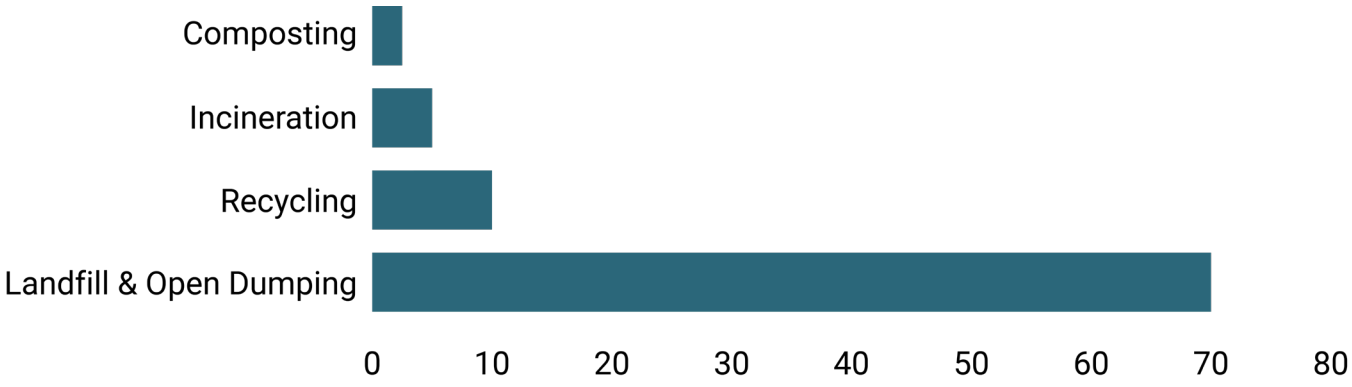
Figure 12: Informal/Illegal dump locations

(Photo Credit: DRAGON Institute)

End of Cycle

Previous studies have found that the majority of the solid waste in Vietnam ends up in landfill or open dump (MONRE 2011). The recycling sector in Can Tho is entirely informal and noted by the LIP as an important component of the waste collection and management in the city.

Figure 13: Solid Waste Management in Vietnam

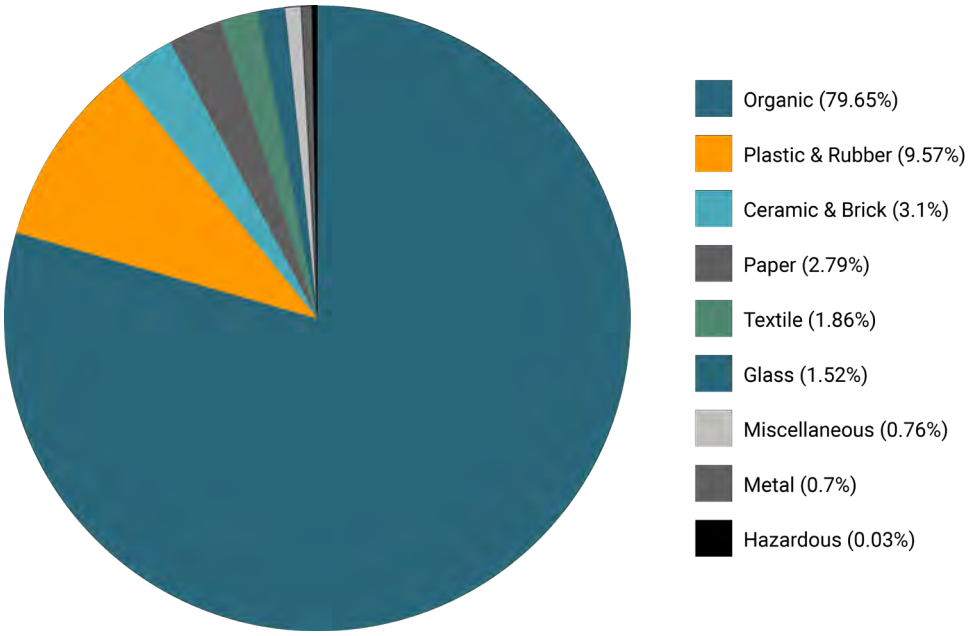


(MONRE 2011; Luong 2013)

About ten years ago, plastic reportedly constituted a relatively small percentage (estimates between 6-9%) of the full household solid waste stream in Can Tho (Nguyen et al. 2010; Nguyen et al. 2011), but this may have changed (and plastic is often in the 11-13% range globally). The vast majority of household waste (estimated between 75-85%) is organic, biodegradable food waste (Thanh et al. 2010), which is still likely the case today. Some rural areas do more household composting, but there is currently no market for selling compost in Can Tho. It was noted that farmers typically prefer to use chemical fertilizer. There could, however, be an opportunity to compost in the city, particularly

if waste segregation protocols were implemented and enforced, and create a market for rural areas to use that compost in their farming. Interviewees also mentioned that rural areas or somewhat isolated areas are difficult for waste collectors to reach and do not receive high rates of household waste collection.

Figure 14: Municipal Solid Waste in Can Tho



(Nguyen et al. 2011)

In 2018, Can Tho opened one of the largest incineration plants in Vietnam. The Thoi Lai district waste-to-energy plant mainly services Ninh Kieu district and Binh Thuy district, and can process around 400 tons of waste per day and generate 60 million kilowatt-hours of electricity per year. The plant projects to be able to process around 70% of the household waste from Can Tho (Kien et al. 2018; Huynh et al. 2018). According to some stakeholder interviews, the perception among the community is that, since all of the waste will soon be incinerated as long as it's a burnable material, it doesn't matter whether it gets separated or recycled. However, it has been found that at least 11% of the household waste stream in Can Tho is recyclable (Thanh et al. 2010).

A plastic upcycling social enterprise started in the Netherlands in 2017 was introduced in Vietnam in 2018, called Upp! Upcycling Plastic. The initiative works closely with local partners to collect and treat plastic waste from the environment and integrate it back into the plastic production stream to make upcycled products for sectors such as construction and furniture (Ho 2019). Funded by the Rockefeller Foundation, the enterprise scoped areas in Can Tho in 2018 and originally planned to install catchment devices in Cai Khe Canal, Bun Xang and Xang Thoi lakes, Rach Ngong, and Can Tho rivers. The project operation would cost 150,000 euros and was originally projected to be able to collect and treat a portion of the 650 tons of waste per day produced in the area (VietnamNet 2018). Some of this plastic would be used to create a "Recycled Park" in Can Tho, modeled after one in Rotterdam. However, it was found that there was not enough value in the waste that would be collected in Can Tho, so the operation has been on hold for the last two years. A Circular Plastics Factory is, however, being constructed in Phu Quoc, and there is currently one mobile catchment facility set up in Cai Khe Canal that is estimated to have cost around 400,000 euros.

The Can Tho Solid Waste Management Plan has outlined goals related to the expansion of infrastructure related to the management of waste in the coming decades, which has been summarized below (Hong et al. 2015):

- By 2020:
  - » Continue the implementation of phase 2 of the solid waste disposal complex in O Mon district (expanding by about 27 Ha) and phase 2 of the solid waste disposal complex in Thoi Lai district (to expand further). about 10 ha), meeting the needs of domestic and industrial solid waste treatment.
  - » Investing in phase 1 of the solid waste treatment area in Vinh Thanh district (about 15 ha).
  - » Implement a roadmap to close the scattered conventional and hazardous solid waste treatment sites that are no longer suitable to the planning in Can Tho city.

- Period 2021-2030:
  - » Continue to improve management capacity and community awareness.
  - » Investment in equipment for solid waste collection, transportation, and treatment.
  - » Perform synchronous solid waste classification at source and solid waste collection and transportation in the city area.
  - » Build and complete solid waste treatment zones in Thoi Lai and Vinh Thanh districts.

- After 2030 with a vision to 2050:
  - » Expand solid waste disposal complexes to meet the city's treatment needs in the future.
  - » Upgrade solid waste treatment technologies towards land saving, energy-saving and recovery, and environmental friendliness according to sustainability criteria.

Just last year, the Prime Minister issued Directive No. 33 / CT-TTg to strengthen the management, reuse, recycling, and treatment of plastic and to ultimately minimize plastic waste (Plastic Waste Plan 2020). It was then anecdotally reported by stakeholders that the sale of plastic bags in Can Tho actually increased as stores wanted to continue to use them, but this cannot be verified. However, there are activities and goals to be executed by state ministries, branches, and localities as part of the regulation that will be implemented in the coming years, which are summarized below (Plastic Waste Plan 2020; Nhandan 2020):

- State agencies and affiliated public non-business units need to be exemplary, active and take the lead in reducing plastic waste:
  - » Minimize the use of disposable plastic products (including persistent nylon bags, food plastic packaging, plastic bottles, straws, food containers, cups, and tableware)
  - » Do not use disposable banners, slogans, bottles, cups, straws, bowls, plastic chopsticks, etc. at work and during conferences, seminars, meetings and holidays, anniversaries, and other events
  - » Prioritize the selection of recycled and environmentally friendly products

- Educate the public:
  - » Promote the development of circular economic models
  - » Implement waste reduction and classification at source, collection, reuse, recycling, and treatment of waste (including plastic waste)
  - » Develop technical documents guiding waste classification at source

  - » Study and propose a production and consumption restriction mechanism and a roadmap to ban the production and consumption of a number of disposable plastic products

- Strictly comply with regulations on the import of plastic scrap in accordance with the law on environmental protection
  - » The Ministry of Natural Resources and Environment was assigned to:
  - » Complete the solid waste management institution in the draft revised Law on Environmental Protection in the direction of considering waste and plastic waste as natural resources
  - » Promote the development of circular economic models
  - » Research and build up technical environmental barriers against products and goods containing micro-plastic particles, plastic nano-bags, and plastic bags

Leakage

Figure 15: Examples of litter transects walked in Can Tho

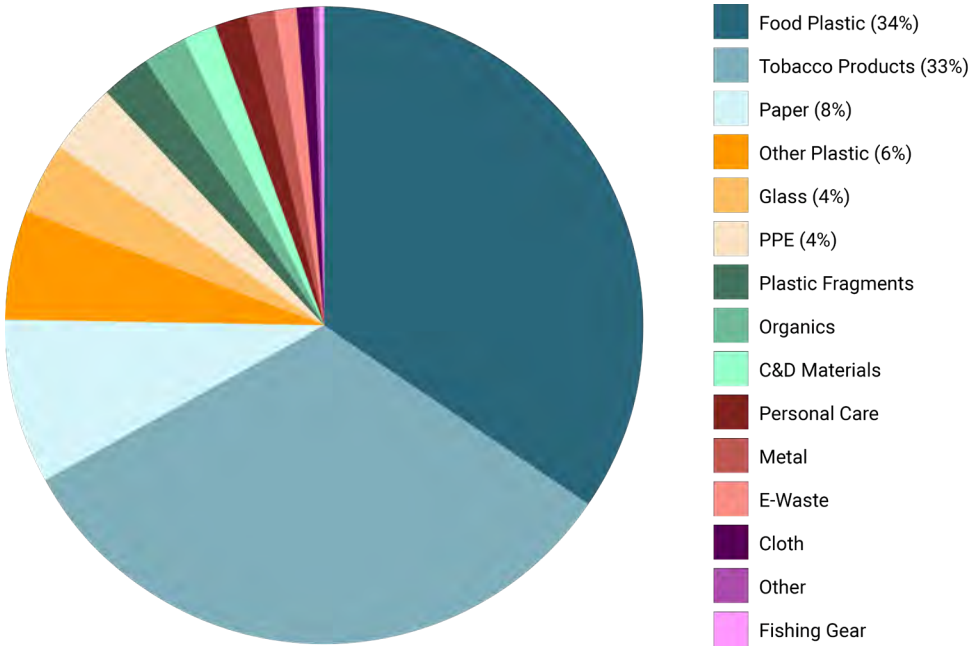
(Photo Credit: DRAGON Institute)

In total, 2,704 litter items were recorded across 27 100m^2 transects in nine different square kilometer areas sampled between October 2020 and January 2021. Litter transect locations were selected using a stratified random sampling method, in which transects were randomly selected in nine square kilometers which were distributed across three groups of population count (upper, middle, lower) based on LandScan ambient population data. Litter items were recorded using the open source Marine Debris Tracker app.

Across all 27 transects, the largest percentage by category of litter items was food plastic, followed very closely by tobacco products. Paper, other plastic, glass, and PPE comprised between 4% and 8%, while all other material cat-

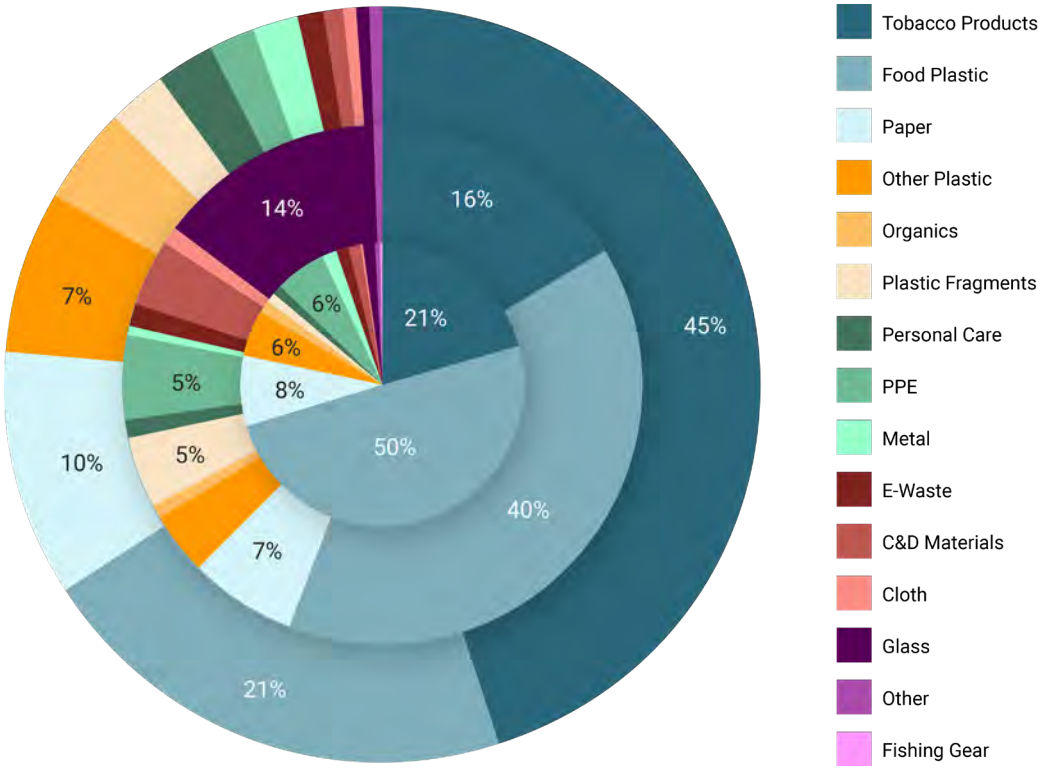
egories including plastic fragments, organics, C&D materials, personal care, metal, e-waste, cloth, fishing gear, and other waste formed 2% or less of the total litter count (Figure 16). The total percentage of common plastic items (the sum of food plastic, other plastic, PPE, plastic fragments, and personal care items) found was 47% of the total items.

Figure 16: Material types of litter collected in Can Tho across all transects



When examining the litter characterization based on the population count, we see some distinctions can be seen between the three groups (Figure 17). In the highest population count area, tobacco items are by far the majority of litter items found, whereas in the middle and lower population count areas food plastic represented the majority. In the middle population count area, we see a higher percentage of glass and plastic fragment waste than we see in either of the other population count areas. Fishing gear was also only identified in the lowest population count area. In each of the areas, PPE comprised around 5% of the litter items found, but it is worth noting that the number of PPE items littered would likely have been closer to zero before the COVID-19 pandemic and represents a new type of land-based litter that may be worth monitoring in the future.

Figure 17: Proportion of most common material types among litter in low (inner), mid (middle), and high (outer) population count areas in Can Tho.



It was noted in the interviews that there is a regulation on littering that currently exists for the city of Can Tho, but it's not readily enforced and most people are not aware of it or feel there are any consequences associated with littering ("not like in Singapore where you go to jail for littering"). Some interviewees noted that no one intentionally throws their litter in the environment anymore, but others noted that this has been an ongoing issue for many years and continues to be an issue in Can Tho today.

Table 5: Litter density and top litter items from all transects in Can Tho

Population Tertile	Top 5 Litter Items	Litter Density (count/m²)
Lower (5 – 916 persons/ sq km)	1) Cigarettes, 2) Plastic Grocery Bag, 3) Plastic Food Wrapper, 4) Straws, 5) Foam or Plastic Cups or Lids	1.29
Middle (916 – 2,225 persons/ sq km)	1) Plastic Food Wrapper, 2) Cigarettes, 3) Glass Bottle, 4) Plastic Grocery Bag, 5) Straws	0.75

Population Tertile	Top 5 Litter Items	Litter Density (count/m^2)
Upper (2,225 – 45,599 persons/sq km)	1) Cigarettes, 2) Straws, 3) Plastic String, Tape, or Packaging Straps, 4) Plastic Grocery Bag, 5) Plastic Food Wrapper	0.95

The litter density was calculated for each of the three population count tertiles (Table 5). The density of litter per square meter was highest in the lowest population count areas and lowest in the middle count areas. Plastic food wrappers, cigarettes, plastic grocery bags, and straws were among the top five items in all three population count areas, and some of the top litter items overall.

Litter densities across other developing countries in South Asia range from 0.5 items/m^2 to 15 items/m^2, with an average of around 4-5 items/m^2 (n = 40). The litter in Can Tho is significantly below the average values of those observed in South Asia, and also slightly lower than those found in a small island nation (1.8 items/m^2) (Youngblood et al., In Preparation).

Opportunities

Vietnam's National Solid Waste Strategy for 2030 and Can Tho's Solid Waste Management Plan for 2025 are on track with their visions and goals for the city in the coming decades. With population growth and waste generation projected to increase, it will be important for infrastructure, public awareness, and policy enforcement to continue to grow with any new initiatives that will be implemented.

We recommend exploring the following opportunities to expand and enhance circularity in Can Tho based on the findings of this report. These opportunities are categorized based on the seven spokes of the CAP model and are roughly listed based on level of potential impact to reduce plastic waste in Can Tho. The purpose of the forthcoming Opportunity Assessment Workshop in Can Tho as part of Urban Ocean is for the city to further prioritize these opportunities based on impact, feasibility, and cost. It is important to note that the opportunities listed below are individualized based on the findings, but solutions cannot happen in a vacuum and are most impactful when strategically combined within a holistic system framework.

INPUT

- There may be an opportunity to work with domestic manufacturers on the extensive amount of multilayer plastic film products that are sold in convenience stores in Can Tho, either to redesign product packaging, promote reused schemes or bulk sales, foster EPR for local re-collection, or increase the local market for capture and recycling of those items.

COMMUNITY

- There is a desire for enhanced local awareness campaigns and more effective communication to the public about existing and upcoming improvements and regulations around waste management. It was noted that information exists but is not reaching everyone in an impactful way. Partners in this program may be able to work together to develop and sustain targeted communication campaigns to reach certain demographics with clear messaging. There is particular interest to reach nursery and elementary school students to support the next generation.
- The younger generation in Can Tho seems enthusiastic about initiatives that reduce single-use plastic and increase the use of alternative and reusable items, which may lend itself to opportunities to invest in new businesses.
- Plastic bags were readily identified as a high convenience item that is difficult to replace, but that people typically want to try to reuse as it has no value in the recycling market and is often not taken by waste collec-

tors — there could be an opportunity to create a campaign around targeted single-use items and raise awareness for and availability of alternatives and reusable items. However, it became clear through the stakeholder interview process that such policies and campaigns would need to be coupled with economic incentives in order to sustain long-term behavior change among consumers and business owners.

PRODUCT DESIGN

- Food vendors and restaurants seem to largely offer PET packaging, which typically can be readily recycled — this recycling should be further explored and enhanced if needed and it may present an opportunity to more strongly connect local food venues and local informal recyclers to manage that waste stream.

USE

- The high cost of alternatives and lack of standard regulations around biodegradable items has caused local shops and vendors to not switch from single-use plastic, so there may be opportunities to develop and enforce new rules that would incentivize those behavior changes in individuals and businesses in Can Tho. Oxo-degradable plastic bags should not be sold as “self-destructing” or “degradable” bags — they simply make bags fragment into microplastic faster.

COLLECTION

- The littering component of leakage in Can Tho is relatively low. Average concentrations of litter are lower than other areas in the south and Southeast Asia, as well as a small island state. However, 56 recorded illegal dumpsites were found in the 9 km^2 area that was assessed for the CAP. It appears that dumping waste may be more of an issue than littering in Can Tho. Community members report confusion about waste collection and management, which could lead to localized dumping and waste mismanagement. There appears to be a large opportunity to 1) design the optimal collection system in collaboration with the city and both private and informal collectors and 2) to engage the community in this system through education and outreach to reduce illegal dumping.
- Improvement of collection facilities through procurement of better transport vehicles (more in number and also potentially additional vehicles that can access physically hard-to-reach homes) would also maximize and optimize the waste collection process in the city.
- The city has very limited waste separation categorization as Burnable / Unburnable / Hazardous waste. Can Tho City should further incorporate recyclable (Plastics/wood/glass/ paper, etc) categories in its separation strategy. This also provides an opportunity to upgrade the city’s Transfer Stations with recyclable waste sorting facilities.
- Recommend increasing the number of public waste bins in the city, coupled with increased efforts to communicate proper disposal of waste.
- The Department of Natural Resources and Environment lacks the mandate to collect waste flowing in water streams/rivers. Can Tho would benefit from additional tools/ways to collect littered waste from its water system.

END OF CYCLE

- There may be opportunities to provide additional resources (e.g., electric carts instead of bicycles) and standardize (e.g., collection times and locations) the informal recycling sector so that the informal workers can increase their collection and optimize the recycling system in Can Tho. Other working conditions for the informal sector could be explored to determine if other improvements are needed.
- Recommend exploring new technologies that can help increase waste collection and management for physically hard-to-reach areas, and also to support waste picker communities and cooperatives.
- Policy development (and enforcement) in coordination with national waste management and plastic pollution plans.
- As all recycling is currently done by the informal sector, support/capacity building for this group could improve collection service, increase the recycling rate and generate jobs.
- Can Tho City is categorizing construction waste as unburnable waste and dumping the waste in landfills; City has the opportunity to implement a material recovery facility to recover/recycle such materials, and there may be useful opportunities to partner with Industry to find Innovative treatment solution for dealing with Hazardous and Unburnable waste
- Explore the option of household composting, given the high percentage of household food waste and potential demand for compost in more rural areas.
- Further explore the possibility of effectively closing (cap) the old landfill sites that service Can Tho.
- Explore opportunities surrounding 'Waste Treatment Hub' project. The 47-acre hub will treat different forms of waste from the entire province. The pilot project of the Waste-to-Energy Plant is already operating on the first 5.2 hectares.
- As reported by stakeholders, the local incineration facility may be hampering motivation for source separation, recycling, and material recovery. Incineration should be the last component of an integrated and hierarchical waste management system with recycling maximized and only residuals being combusted for energy.
- There is a small but dedicated recycling/reuse community in Can Tho that could be further supported and developed.

LEAKAGE

- Solutions above, particularly around policy and outreach, can be targeted to the most problematic litter items that are found in the city, such as certain tobacco products and food products.
- Litter transects can be revisited and repeated over time in order to measure change following interventions that are implemented as a result of the Urban Ocean process.
- Targeted catchment devices, while typically a last resort for preventing waste from entering or perpetuating in the environment, could be explored in Can Tho. For example, The Ocean Cleanup announced a partnership with Coca-Cola in 2021 to place a river catchment device in Can Tho, as well as 14 other river systems worldwide (The Ocean Cleanup, 2021). Management of the resulting waste and associated infrastructure should be prioritized so that cleanup projects such as this are sustainable and do not have a negative effect on the local economy or environment.

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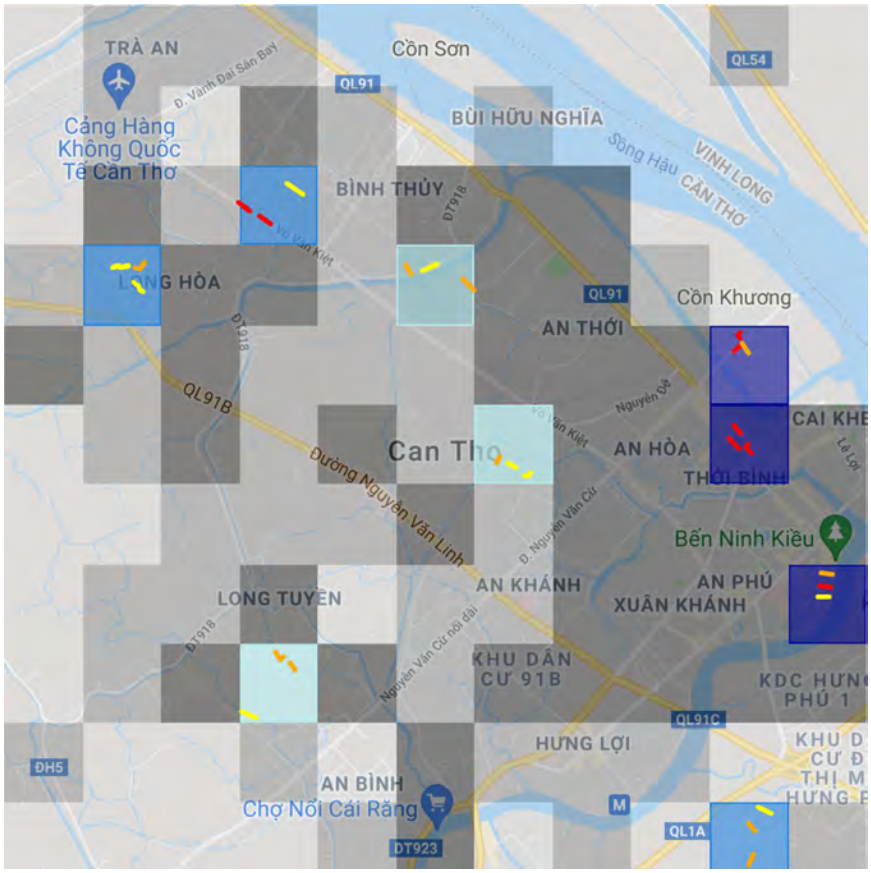
Appendix

Figure 18: Litter Densities Sampled in Can Tho



Transect Litter Denisty
Litter Count per 100m
- 18 – 61
- 62 – 106
- 107 – 318

Area Litter Density
Average Litter Count per 1km^2
- 54 – 57
- 58 – 109
- 110 – 212

Table 6: Full List of MDT Litter Items and Associated Material Categories

Material	Items
C&D Materials	Aggregate & Brick Bolts, Nails, and Screws Building Materials Lumber Other C&D
Cloth	Clothing Fabric Pieces Other Cloth
E-Waste	Batteries E-Waste Fragments Other E-Waste
Fishing Gear	Buoys and Floats Fishing Line Other Fishing Gear Plastic Net or Net Pieces Plastic Rope
Glass	Glass Bottle Glass or Ceramic Fragments Other Glass
Metal	Aluminum Foil Aluminum or Tin Cans Metal Bottle Caps or Tabs Metal Fragments Other Metal
Organic Waste	Food Waste Other Organic Waste
Other	Other Popsicle Stick
Other Plastic Products	Bulk Bags Flip Flops Other Plastic Plastic String, Tape, or Packing Straps Rubber Bands Tires

Material	Items
Paper	Coated Paperboard Corrugated Cardboard Multi-material Paper Box Noncoated Paper Food Wrapper Other Paper Paper Receipts
Personal Care Products	Blister Pack Cotton Buds Other Personal Care Product Personal Care Product Sachet Shampoo or Other HDPE Container Toothbrushes Toothpaste or Other Product Tube
Plastic Food Products	Foam or Plastic Cups or Lids Other Food-Related Plastic Other Plastic Bag Plastic Bottle Plastic Bottle Cap Plastic Food Wrapper Plastic Grocery Bag Plastic Utensils Straws Street Food Bowl Styrofoam Container
Plastic Fragments	Film Fragments Foam Fragments Hard Plastic Fragments Other Fragments
PPE	Associated PPE packaging Disinfectant Wipes Disposable Gloves Face mask packaging Face Masks Face Shield Hair nets Hospital shoe covers Other PPE

Material	Items
Tobacco Products	Cigarette Packaging Cigarettes Other Tobacco Product Tobacco Sachets

Table 7: Convenience Store Top Product Manufacturers and Parent Companies

Brand	Product	Material	Manufacturer	Manufacturing Location	Parent Company	Parent Company Location
P&N	Chocolate Candy	Multilayer Film	Phạm Nguyên confectionery company limited	Ho Chi Minh City, Viet Nam	Phạm Nguyên confectionery company limited	Ho Chi Minh, Viet Nam
Alpellipe	Candy	Multilayer Film	Perfetti Van Melle Viet Nam	Binh Duong Provine, Viet Nam	Perfetti Van Melle Group	Lainate, Italy Breda, The Netherlands
Bảo Tín	tea	Multilayer Film	Bao Tin company	Bao Loc city, Viet Nam	Bao Tin Company	Lam Dong provine, Viet Nam
Bento	Snack	Multilayer Film	Srinanaporn marketing PLC	Samut Sakhon 74130, Thailand	Srinanaporn marketing PLC	Samut Sakhon 74130, Thailand
Bopbi	Snacks	paper +plastic bag	Thuận Thiên Tuấn Limited Company	Cao Lanh City, Viet Nam	Thuận Thiên Tuấn limited company	Dong Thap Provine, Viet Nam
Chicky Stick	Bimbim	Multilayer Film	Variety Foods International	Samut Sakhon 74130, Thailand	Variety Foods International	Samut Sakhon 74130, Thailand
Clear	shampoo package	Multilayer Film	Unilever VietNam	Ho Chi Minh city, Viet Nam	Unilever	London, UK
Clear	shampoo package	Multilayer Film	Unilever VietNam	Binh Duong Provine, Viet Nam	Unilever	London, UK
Clear	shampoo package	Multilayer Film	Unilever VietNam	Binh Duong Provine, Viet Nam	Unilever	London, UK
comfort	fabric softener	Multilayer Film	Unilever VietNam	Binh Duong Provine, Viet Nam	Unilever	London, UK
comfort	fabric softener	Multilayer Film	Unilever VietNam	Binh Duong Provine, Viet Nam	Unilever	London, UK
comfort	fabric softener	Multilayer Film	Unilever VietNam	Binh Duong Provine, Viet Nam	Unilever	London, UK
comfort	fabric softener	Multilayer Film	Unilever VietNam	Binh Duong Provine, Viet Nam	Unilever	London, UK

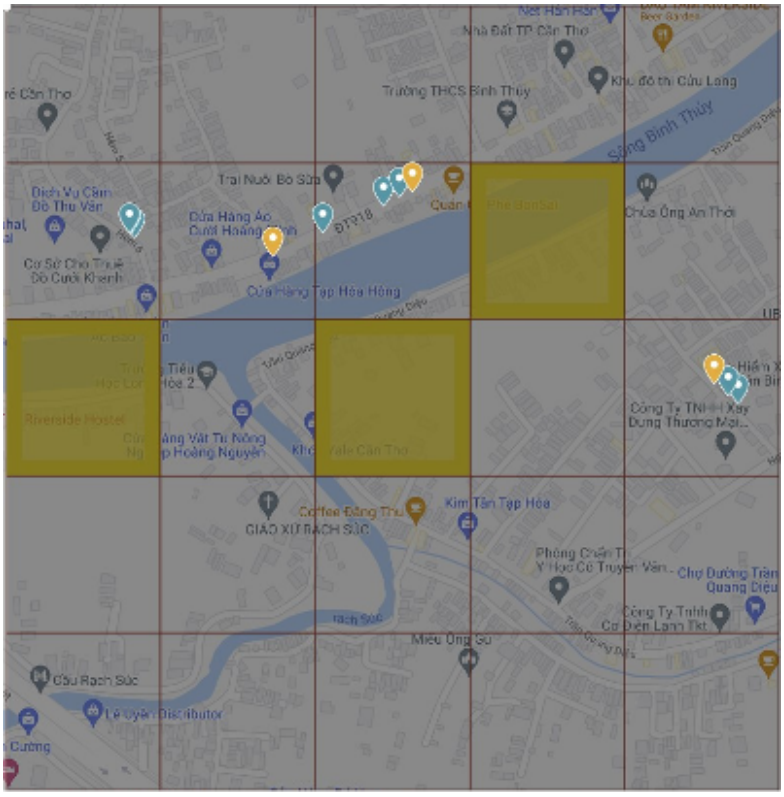
Brand	Product	Material	Manufacturer	Manufacturing Location	Parent Company	Parent Company Location
Cool Air	chewing gum	Multilayer Film	Mars Philippines Inc.	Antipolo city, Philippines	Mars, Incorporated	Virginia, US
Cool Air	chewing gum	Multilayer Film	Mars Philippines Inc.	Antipolo city, Philippines	Mars, Incorporated	Virginia, US
Cosy	Cookie	Multilayer Film	Mondelez KinhDo Viet Nam	Binh Duong Provine, Viet Nam	Kinh Do Corporation	Ho Chi Minh, Viet Nam
Cosy	Cookie	Multilayer Film	Mondelez KinhDo Viet Nam	Binh Duong Provine, Viet Nam	Mondelez Kinh Do Corporation	Chicago, US
Craven	tobaco	paper	Craven A tobaco company	Ho Chi Minh city, Viet Nam	British American Tobacco	London, UK
Craven	Tobaco	Paper	Craven A tobaco company	Ho Chi Minh city, Viet Nam	British American Tobacco	London, UK
DG	Tobaco	Multilayer Film	Dong Nai Food	Dong Nai Provine, Viet Nam	Dong Nai Food	Dong Nai Provine, Viet Nam
Doublemint	chewing gum	Multilayer Film	Phú Tường Company	Long An Province, Viet Nam	Wrigley Jr	Chicago, US
Doublemint	chewing gum	Multilayer Film	Phú Tường Company	Long An Province, Viet Nam	Wrigley Jr	Chicago, US
Golla	Candy	Multilayer Film	Perfetti Van Melle Viet Nam	Ho Chi Minh city, Viet Nam	Perfetti Van Melle Group	Lainate, Italy Breda, The Netherlands
Hảo Hảo	instant noodles	Multilayer Film	Acecook VietNam	Ho Chi Minh, Viet Nam	Acecook	Ho Chi Minh, Viet Nam
Hoàng Thắng	Vietnamese snacks	plastic bag	Hoàng Thắng	Can Tho city, Viet Nam	Hoàng Thắng	Can Tho city, Viet Nam
Hữu Hạnh	Dried Banana	plastic	Hải Dương	Dong Nai, Viet Nam	Hải Dương	Dong Nai, Viet Nam
Indo Chips	Chips	Multilayer Film	Vietnam Liwayway Joint Stock Company	Binh Duong Provine, Viet Nam	Liway Holding Company Limited	Philippines
Indo Chips	Chips	Multilayer Film	Vietnam Liwayway Joint Stock Company	Binh Duong, Viet Nam	Liway Holding Company Limited	Philippines
jelly bean	Candy	Multilayer Film	Pran Dairy Limited	Palash Narsing di, Bangladesh	Pran Dairy Limited	Dhaka, Bangladesh
Kara Mucho Strong	Snack	Multilayer Film	Koikeya Limited Viet Nam company	Dong Nai, Viet Nam	Koike-Ya Inc.	Tokyo Japan

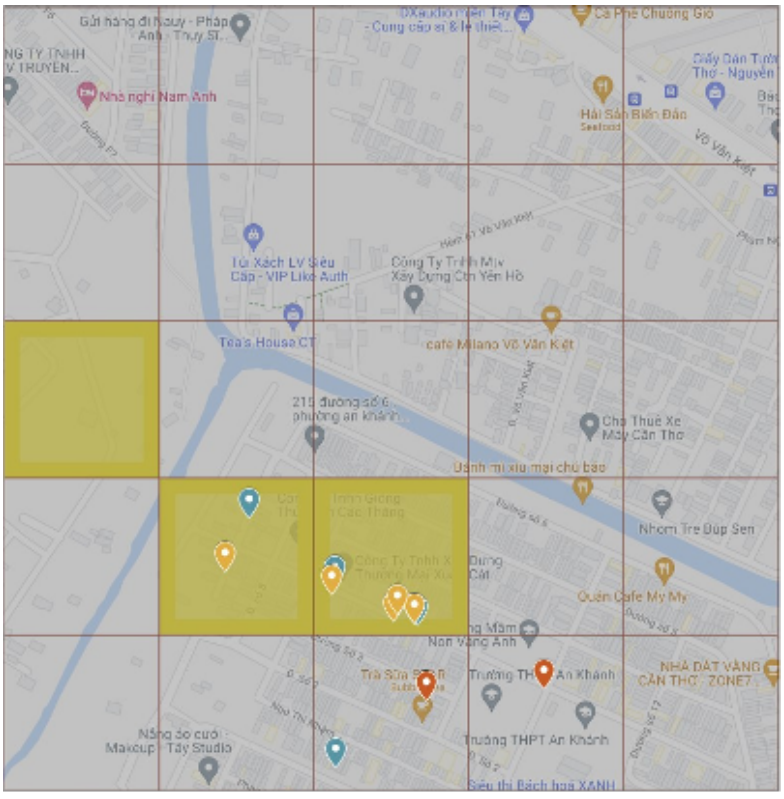
Brand	Product	Material	Manufacturer	Manufacturing Location	Parent Company	Parent Company Location
Kinh Do	sandwich packaged	Multilayer Film	Mondelez KinhDo Viet Nam	Binh Duong Provine, Viet Nam	Mondelez Kinh Do Corporation	Chicago, US
Kinh Do	bread packaged	Multilayer Film	Mondelez KinhDo Viet Nam	Binh Duong Provine, Viet Nam	Mondelez Kinh Do Corporation	Chicago, US
Lays	Chips	Multilayer Film	Pepsico VietNam	Binh Duong Provine, Viet Nam	PepsiCo Inc	New York, US
Lays	Chips	Multilayer Film	Pepsico VietNam	Binh Duong Provine, Viet Nam	PepsiCo Inc	New York, US
Lays	chips	Multilayer Film	Pepsico VietNam	Binh Duong Provine, Viet Nam	PepsiCo Inc	New York, US
Lays	Chips	Multilayer Film	Pepsico VietNam	Binh Duong Provine, Viet Nam	PepsiCo Inc	New York, US
Lays	Chips	Multilayer Film	Pepsico VietNam	Binh Duong Provine, Viet Nam	PepsiCo Inc	New York, US
Lays	chips	Multilayer Film	Pepsico VietNam	Binh Duong Provine, Viet Nam	PepsiCo Inc	New York, US
Lolipop	candy	Multilayer Film	Gia Linh Co Ltd	Ho Chi Minh city, Viet Nam	Gia Linh Co Ltd	Ho Chi Minh city, Viet Nam
M&M	Candy	Multilayer Film	Mars Food	Jiaxing, China	Mars Food Limited Company	Zhejiang, China
Mina	Agar agar	Multilayer Film	Mina Co Ltd	Ho Chi Minh city, Viet Nam	Mina Co Ltd	Ho Chi Minh city, Viet Nam
Mirinda	bottled water can	Aluminium can	Suntory Pepsico VietNam	Ho Chi Minh City, Viet Nam	Suntory Pepsico	Ho Chi Minh, Viet Nam
Mobters	Chips	Multilayer Film	Vietnam Liwayway Joint Stock Company	Binh Duong Provine, Viet Nam	Liway Holding Company Limited	Philippines
Mucho	Snack	Multilayer Film	Koikeya Limited Viet Nam company	Dong Nai, Viet Nam	Koike-Ya Inc.	Tokyo Japan
Nabiti	Cheese Wafer	Multilayer Film	Nabati Indonesia	Kabupaten Sumedanag, Indonesia	Nabati Food	Indonesia
Nabiti	Cheese Wafer	Multilayer Film	Nabati Indonesia	Kabupaten Sumedanag, Indonesia	Nabati Food	Indonesia
Nhật Hưng	dry beef	Multilayer Film	Nhật Hưng Food	Ho Chi Minh city, Viet Nam	Nhật Hưng Food	Ho Chi Minh city, Viet Nam

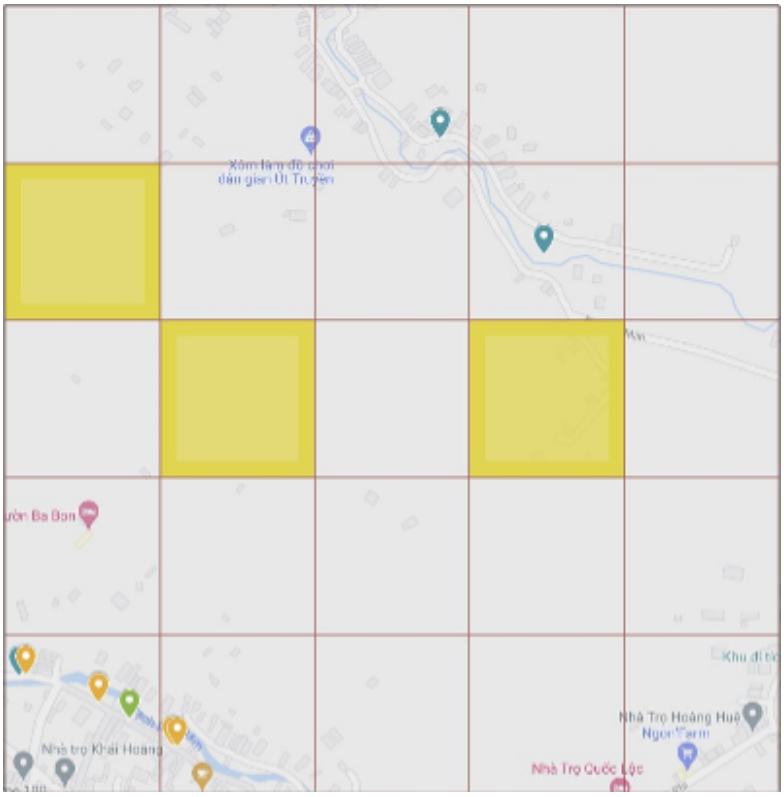
Brand	Product	Material	Manufacturer	Manufacturing Location	Parent Company	Parent Company Location
no brand	banana paper	Multilayer Film	Lộc Nương	Vinh Long Provine, Viet Nam	Lộc Nương	Vinh Long Provine, Viet Nam
Oishi	Snacks	Multilayer Film	Vietnam Liwayway Joint Stock Company	Binh Duong Provine, Viet Nam	Liway Holding Company Limited	Philippines
Oishi Indo	Chips	Multilayer Film	Vietnam Liwayway Joint Stock Company	Binh Duong Provine, Viet Nam	Liway Holding Company Limited	Philippines
Oishi Kipei	Chips	Multilayer Film	Vietnam Liwayway Joint Stock Company	Binh Duong, Viet Nam	Liway Holding Company Limited	Philippines
Oishi Pillow	Snack	Multilayer Film	Vietnam Liwayway Joint Stock Company	Binh Duong Provine, Viet Nam	Liway Holding Company Limited	Philippines
Oishi Pillow	snack	Multilayer Film	Vietnam Liwayway Joint Stock Company	Binh Duong, Viet Nam	Liway Holding Company Limited	Philippines
Oishi Tomato	Chips	Multilayer Film	Vietnam Liwayway Joint Stock Company	Binh Duong Provine, Viet Nam	Liway Holding Company Limited	Philippines
Oishi Tomato	Chips	Multilayer Film	Vietnam Liwayway Joint Stock Company	Binh Duong, Viet Nam	Liway Holding Company Limited	Philippines
Oishi Tomato	Chips	Multilayer Film	Vietnam Liwayway Joint Stock Company	Binh Duong, Viet Nam	Liway Holding Company Limited	Philippines
Olong	bottled water	plastic	Pepsico VietNam	Binh Duong Provine, Viet Nam	PepsiCo Inc	New York, US
OOlong	bottled water	Plastic	Pepsico VietNam	Binh Duong Provine, Viet Nam	PepsiCo Inc	New York, US
Ostar	Chips	Multilayer Film	Vietnam Liwayway Joint Stock Company	Binh Duong Provine, Viet Nam	Liway Holding Company Limited	Philippines
Ostar	Chips	Multilayer Film	Vietnam Liwayway Joint Stock Company	Binh Duong, Viet Nam	Liway Holding Company Limited	Philippines
P&N	Snack Cake	Multilayer Film	Phạm Nguyên confectionery company limited	Ho Chi Minh City, Viet Nam	Phạm Nguyên confectionery company limited	Ho Chi Minh, Viet Nam
Phố	instant coffee	Multilayer Film	FES Viet Nam	Binh Duong Provine, Viet Nam	Food Empire Holdings	Singapore
Phố	instant coffee	Multilayer Film	FES Viet Nam	Binh Duong Provine, Viet Nam	Food Empire Holdings	Singapore

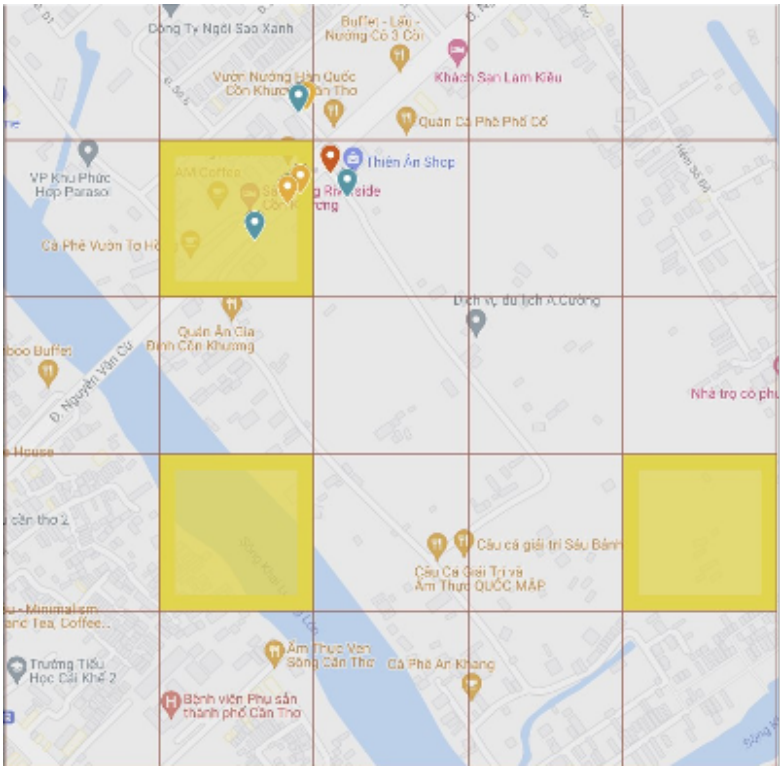
Brand	Product	Material	Manufacturer	Manufacturing Location	Parent Company	Parent Company Location
Potata Biscuit	biscuits	Multilayer Film	Pran Dairy Limited	Palash Narsingdi, Bangladesh	Pran Dairy Limited	Dhaka, Bangladesh
Redbull	bottled water can	Aluminium can	RedBull Viet Nam	Binh Duong, Viet Nam	RedBull GmbH	Fuschl, Austria
Revive	bottled water	Multilayer Film	Pepsico VietNam	Binh Duong Provine, Viet Nam	PepsiCo Inc	New York, US
Revive	bottled water	plastic	Pepsico VietNam	Binh Duong Provine, Viet Nam	PepsiCo Inc	New York, US
Sting	bottled water can	Aluminium can	Suntory Pepsico VietNam	Ho Chi Minh City, Viet Nam	Suntory Pepsico	Ho Chi Minh, Viet Nam
Tấn Hưng	Vietnamese snacks	Multilayer Film	Tấn Hưng	Can Tho City, Viet Nam	Tấn Hưng	Can Tho City, Viet Nam
Thành Đông	dried jackfruit	Multilayer Film	Mekong Fruit Limited Company	Can Tho City, Viet Nam	Thành Đông Company	Ho Chi Minh, Viet Nam
TingCo	Bottled water	plastic	Tiến Nga Food	Dong Nai, Viet Nam	Tiến Nga Food	Dong Nai, Viet Nam
Toppo	Stick Snacks	paper	Thai Lotte Co Ltd	Chonburi, Thailand	Lotte Holding Corporation	Seoul, Korea
Vị Hương	instant noodles	Multilayer Film	Thiên Hương Food	Ho Chi Minh, Viet Nam	Thiên Hương Food	Ho Chi Minh, Viet Nam
Vitamin C Glucose	Vitamin C Glucose	Multilayer Film	MeKophar Company	Ho Chi Minh city, Viet Nam	MeKophar Company	Ho Chi Minh city, Viet Nam
Xylitol	chewing gum	Multilayer Film	Lotte Viet Nam	Binh Duong Provine, Viet Nam	Lotte Holding Corporation	Seoul, Korea
Yomost	milk box + Straw	Multilayer Film	FrieslandCampina Viet Nam	Binh Duong Provine, Viet Nam	FrieslandCampina	Amersfoort, Netherlands

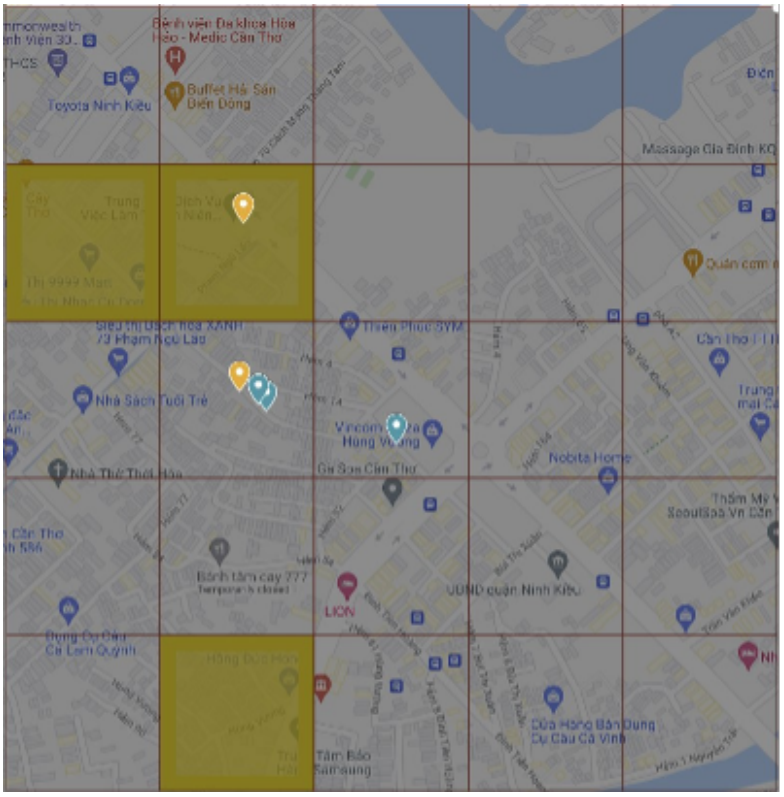
Figure 19: Waste Bin Locations from Litter Transect Areas

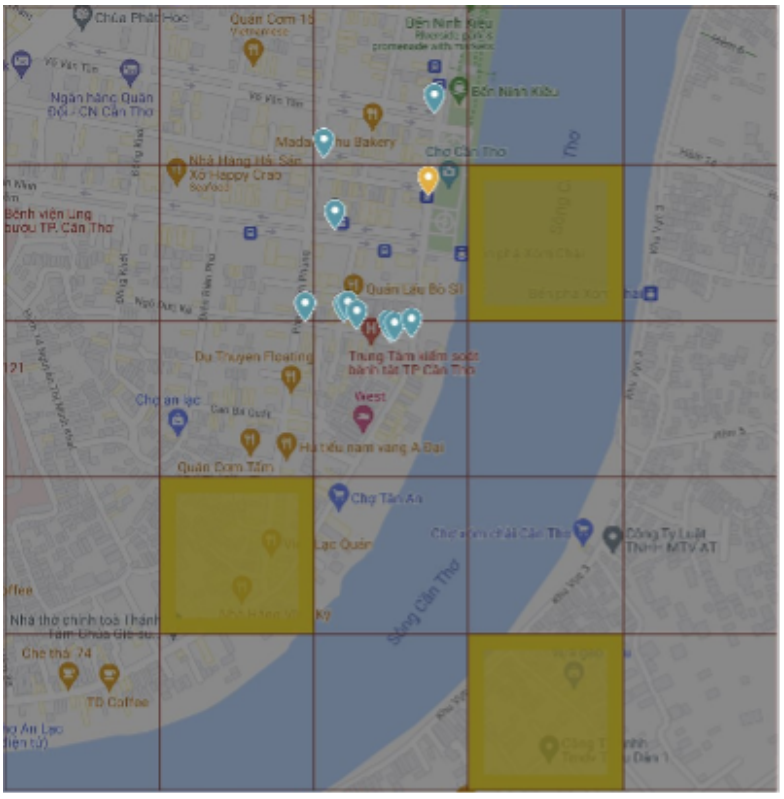

Dump Site (56)
Waste Bin (25)
Ash Pile (6)
Recycling Bin (1)


Dump Site (56)
Waste Bin (25)
Ash Pile (6)
Recycling Bin (1)


Dump Site (56)
Waste Bin (25)
Ash Pile (6)
Recycling Bin (1)


Dump Site (56)
Waste Bin (25)
Ash Pile (6)
Recycling Bin (1)


Dump Site (56)
Waste Bin (25)
Ash Pile (6)
Recycling Bin (1)


Dump Site (56)
Waste Bin (25)
Ash Pile (6)
Recycling Bin (1)

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