

Circularity Assessment Protocol

NAM DINH, VIETNAM



Foreword

Plastic pollution is one of the greatest challenges facing our ocean today and requires action at all levels — international, national, urban, and individual. Vietnam has emerged as an early leader on the issue, setting ambitious goals to tackle marine debris in one of the world's first comprehensive country-level strategies, its National Action Plan on Marine Plastic Debris. Admirably, when developing its plan, the Vietnamese government showed not only political commitment, but also a determination to use the best available science to inform its actions.

Ocean Conservancy was honored to be included in the consultative process, and as longtime advocates for and investors in the science around ocean plastics, we also saw an opportunity to support the Government of Vietnam in its efforts to generate Vietnam-specific research around the issue. With the generous support of the U.S. Department of State, we teamed up with longtime partners at the University of Georgia's New Materials Institute and the Centre for Marinelife Conservation and Community Development (MCD) in Hanoi to bring Dr. Jenna Jambeck's Circularity Assessment Protocol (CAP) to Vietnam.

The ultimate goal of the CAP is to empower communities to understand their circularity challenges and opportunities. Armed with data, they can make informed decisions on how best to address plastic, litter, waste management, and circular economy challenges in their local context.

In addition to the science itself, the CAP process afforded us an opportunity to further deepen our relationship with MCD, a true leader in the marine debris space in Vietnam. This partnership became even more important when the global pandemic prevented the U.S.-based science team from the New Materials Institute from traveling to Vietnam to participate in the fieldwork. Everyone stepped up to develop an alternate strategy: the U.S. scientists developed the necessary materials to train their Vietnamese counterparts remotely on the CAP methodology, with MCD navigating around the current public health crisis and multiple mandatory lockdowns to conduct all of the fieldwork safely and effectively.

This is the true power of partnerships — the ability to move forward even under adverse circumstances. Ocean Conservancy hopes that the CAP reports for Hanoi and Nam Dinh will spark conversations and innovative collaboration in those cities and elsewhere in Vietnam around the implementation of the country's National Action Plan; and serve as a blueprint for other governments ready to do the same. After all, the ocean — and plastic pollution — know no boundaries, and it's going to take all of us to solve this problem.

— Chever Voltmer, Director Plastics Initiative, Ocean Conservancy

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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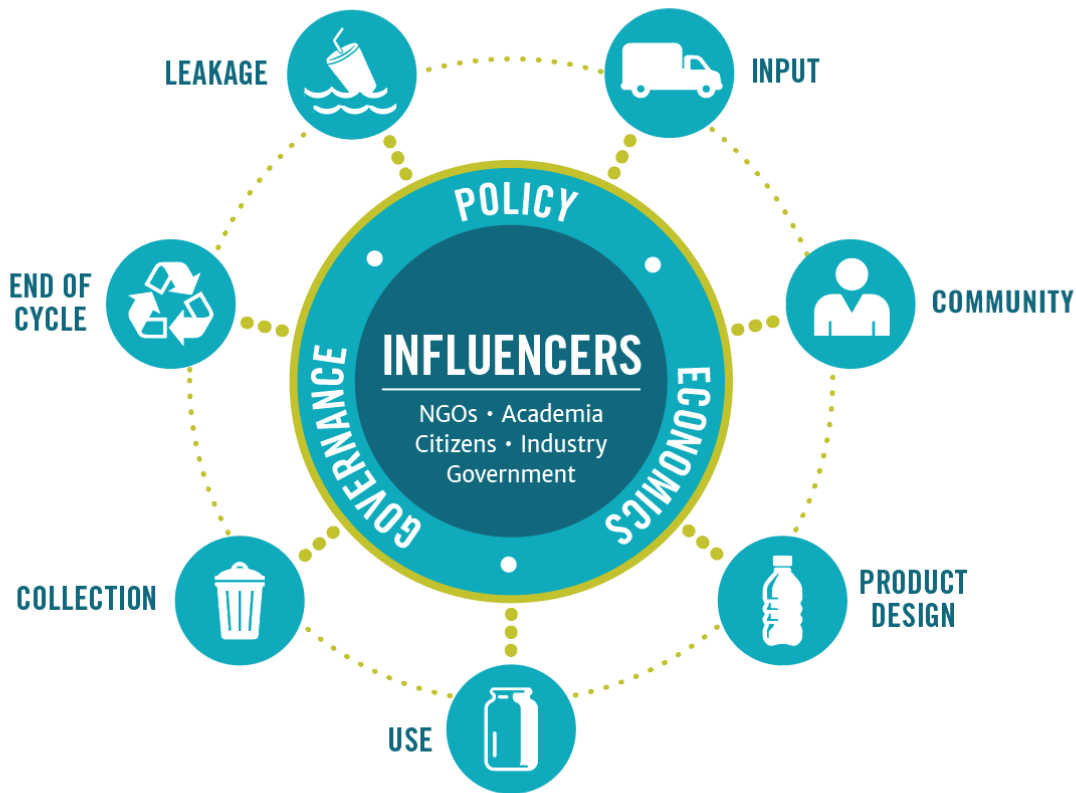
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Executive Summary

Developed by the [Circularity Informatics Lab](#) at the University of Georgia, the Circularity Assessment Protocol (CAP) is a standardized assessment protocol to inform decision-makers through collecting community-level data on plastic usage. 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, is comprised 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 February 2021 and March 2021, a team The Centre for Marinelifelife Conservation and Community Development (MCD), with guidance and support from the Circularity Informatics Lab, conducted fieldwork in the city of Nam Dinh, Vietnam. The CAP was conducted with support from the city's local government and Ocean Conservancy. Field work included product 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 following table.

Key Findings and Opportunities

INPUT



Findings: All top convenience store items are in plastic packaging, largely multilayer plastic film which is not readily recyclable. All of the tobacco, beverage, and 94% of the chip products sampled had manufacturers domestic to Vietnam, which may be an opportunity to increase circularity locally.

Opportunities

- Work with domestic manufacturers on the extensive amount of multilayer plastic film products that are commonly sold in convenience stores in Nam Dinh to either 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 is making efforts to improve waste management and public awareness. Awareness was one of the most frequently mentioned challenges to improving waste management, along with a lack of technology, funding, and manpower. The public seems receptive to interventions from local government to communicate and enforce policies and increase awareness. COVID-19 has undoubtedly impacted the livelihoods of informal recycler aggregators, as it has caused unpredictable price fluctuations as well as even more difficult working conditions for those in the informal sector. According to some plastic companies interviewed, alternatives made of natural materials still do not meet market demand because it is a new technology, it is weather-dependent, and it is three times more expensive to produce.

Opportunities

- 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.
- Partners in this program may be able to work together to develop and sustain targeted communication campaigns to reach certain demographics with clear messaging.
- Engagement could occur near well-known dumping sites to reach various community members and groups.
- Create an educational campaign around targeted single-use items, such as the most commonly found litter items, and raise awareness for and availability of alternatives and reusable items.

PRODUCT DESIGN



Findings: 100% of the top brand of chips and 64% of all top products from convenience stores are packaged in multilayer plastic film. 97% of to-go container products from vendors and restaurants were packaged in PP or PS, which is considered to be low-value plastic and not readily recyclable.

Opportunities

- Further examination of environmentally friendly alternative materials or usage of PET materials, which is often readily recyclable, could be explored and/or enhanced.
- Facilitate the connection between the local food vendors and informal recyclers to manage the recyclable waste stream.

USE

Findings: Habits and convenience seem to be strong inhibitors to change in the manners of reuse and use of alternative items; the alternative must be as convenient as the plastic option. It was documented that there are no incentives or policies to encourage people to seek out alternatives even though many are aware of the environmental damages caused by plastic pollution and would prefer to use environmentally friendly alternative materials. Lack of available biodegradable options, higher costs for plastic alternatives, and the convenience of plastic items left vendors and stores with no choice other than to use plastic packaging.

Opportunities

- There may be opportunities for new reuse and alternative product businesses as well as information dissemination on alternative product availability used elsewhere in the country.
- Develop and enforce new rules that would incentivize behavior changes in individuals and businesses in Nam Dinh.

COLLECTION



Findings: There are opportunities in the improvement of both formal and informal waste collection. With established goals to achieve higher rates of collection, the city of Nam Dinh can address topics such as set collection times and locations and community outreach. Because the general view of informal collectors seems to be positive, greater collaboration is possible between the community and informal sector. This could increase the pickers' efficiency and overall income.

Opportunities

- Design an optimal collection scheme in collaboration with the city and both private and informal collectors (including collection for cigarettes and tobacco products).
- Engage the community in the system through education and outreach providing people guidance and policy information.
- There is an opportunity to design and pilot a hyper-local waste collection model. Sub-communities or neighborhoods could coordinate with the informal waste sector about scheduling collection times or having collection information available, so they know when to place trash outside for collection.
- Alternatively, or in addition, there could be community receptacles (e.g., dumpsters) for people to dispose of waste.
- There may be opportunities to provide additional resources (e.g., electric carts instead of bicycles and communal waste receptacles) and standardize the informal recycling sector (e.g., collection times, transfer locations, or informal cooperatives) so that the informal workers can increase their collection and optimize the recycling system in Nam Dinh; which can lead to an increased monthly income and safer working conditions.
- Other working conditions for the informal sector could be explored to determine if other improvements are needed.

END OF CYCLE



Findings: A fifth of the city’s waste is left uncollected while rural waste collection rates are reported to be slightly higher at 88% efficiency. Over half of rural waste is either incinerated or self-treated by residents, with no formal recycling or composting. Within Nam Dinh city, there is only one formal recycling facility and one composting facility. Much of the recoverable material is separated and recycled in informal recycling villages. Residents of the city have pointed out that these along with informal garbage dumps are an environmental and public health issue and are open to systematic improvement.

Opportunities

- Recycling and reuse can be further supported and developed to optimize collection efforts and to prevent environmental or public health risks.
- 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, at an average of 2.03 items/m², were slightly higher in Nam Dinh compared to other Southeast Asian cities (Indonesia, Malaysia, and Vietnam averaged 1.83 items/m²), but slightly lower than litter densities in Hanoi with 3.11 items/m². Four dumpsites were documented, and only one public waste bin was documented within the 2700 m². Food plastic, tobacco products, and plastic fragments together constituted about 63% of the material found in litter items. Plastic food wrappers, cigarettes, and film fragments were among the top five items in for the low, medium, and high population count areas, which were largely made of non-recyclable plastic.

Opportunities

- Enforcement to reduce dumping, burning and litter are opportunities to reduce plastic pollution in Nam Dinh.
- Solutions above, particularly around policy and outreach, should be targeted to the most problematic litter items found in Nam Dinh.
- Regular assessments could be conducted to measure impact from interventions targeting opportunities to reduce plastic leakage.

Partners on this project included Ocean Conservancy through funding from the US State Department, and a local collaboration with The Centre for Marinelife Conservation and Community Development (MCD). The CAP in Nam Dinh, which is located along Vietnam's second-longest river and home to critical wetland habitats, the Red River, provides a data-driven comprehensive overview of Nam Dinh's circularity of materials, with a focus on plastic packaging. This baseline assessment will help to identify community-driven actions to meet local needs and fuel efforts to reduce plastic pollution on land.

Meet the Partners

Ocean Conservancy

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 1987, 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 their Trash Free Seas® program visit oceanconservancy.org/trashfreeseas, and follow Ocean Conservancy on Facebook, Twitter, and Instagram.

MCD

MCD is one of Vietnam's leading NGOs fighting against marine debris and ocean plastic, having pioneered environmental protection and community development across the country. As the primary in-country partner, MCD brings to the project unique and essential expertise on local waste conditions and cultural context. MCD has spent over 15 years establishing relationships with political leaders at all levels of government and was critical in obtaining formal approval from Vietnamese authorities to conduct in-country work on the current project. In 2019, MCD collaborated with Dr. Chelsea Rochman and her team from the University of Toronto (another sub-recipient on the current project) in performing a baseline assessment of marine debris conditions on the banks and in the Red River. MCD is the local collaborator with Dr. Jambeck and her team on the CAP, which not only provides data essential to the city and Vietnam's NAP goals, but also builds the capacity of local researchers to be able to conduct baseline assessment protocols and monitoring techniques.

Glossary of Acronyms and Abbreviations

CAP – Circularity Assessment Protocol

C&D – Construction and Demolition

CE – Circular Economy

CIL – Circularity Informatics Lab

HDPE – High Density Polyethylene

LIP – Local Implementing Partner

MCD – The Centre for Marinelifelife Conservation and Community Development

NDE.JSC – Nam Dinh Environment Joint Stock Company

NMI – New Materials Institute

PE – Polyethylene

PP – Polypropylene

PVC – Polyvinyl Chloride

PPE – Personal Protective Equipment

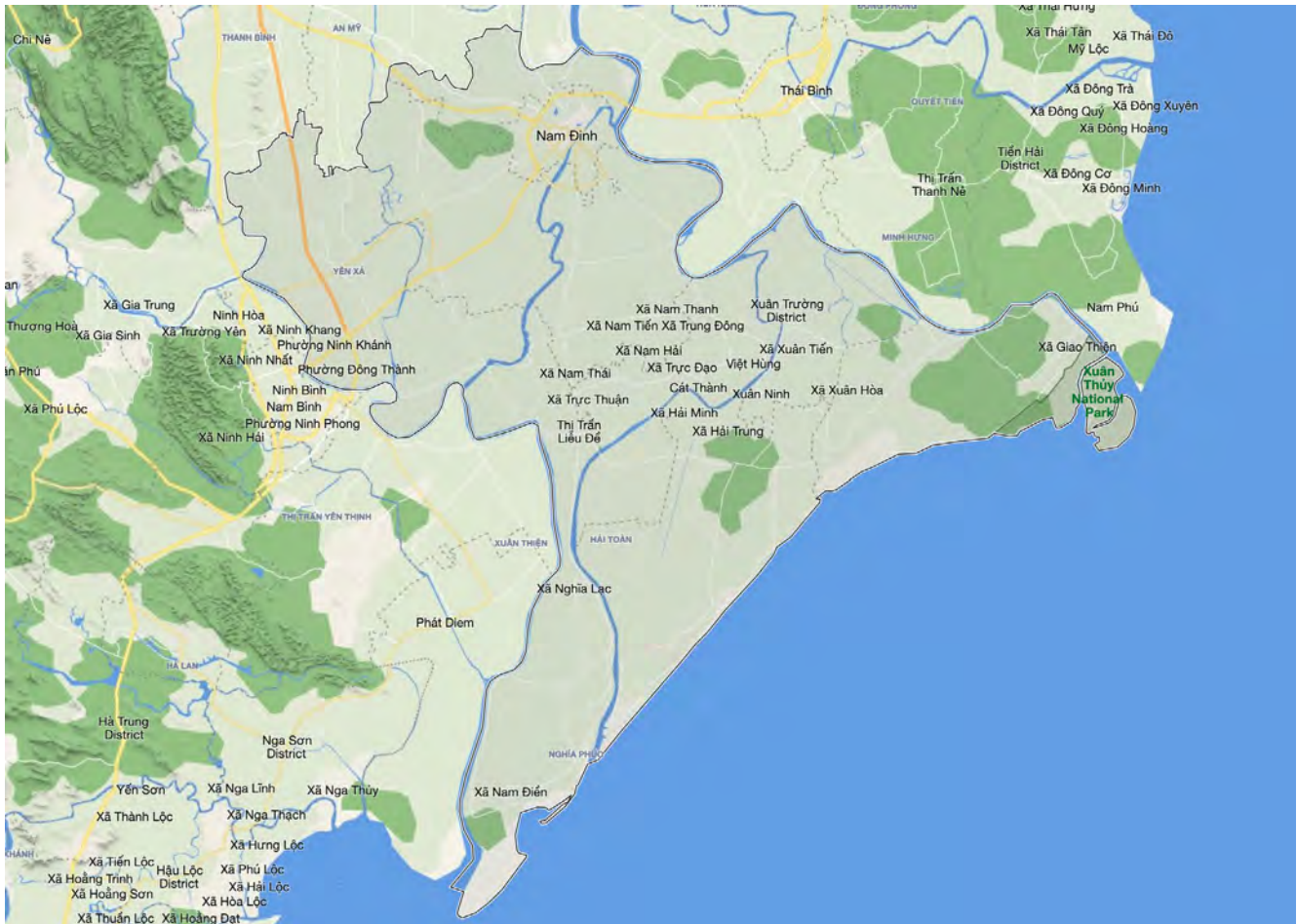
PS – Polystyrene

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 27 million ton annually (World Bank, 2018). 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). As for the municipal solid waste collection rate, it has increased from 78% in 2008 to 85.5% in 2017 (MONRE, 2017). In suburban rural areas, towns, and townships the waste collection rate is anywhere from 60-80% (MONRE, 2017), and only 40% in rural areas (World Bank, 2018). Collection services are practically non-existent in most villages and mountainous regions due to distance and financial limitation (Trinh et al., 2021). Where waste collection services do not exist or when community members choose not to participate, community members may get rid of their waste via open burning, burying waste underground, or dumping their waste on vacant land that gradually becomes an unofficial dumpsite for the community. In 2020, it was estimated that about 75% of collected waste is landfilled (Trinh et al., 2021), and only 20% of the 904 estimated landfills in Vietnam are considered to be hygienic. Countrywide, solid waste recycling activities are informal and spontaneous, and the estimated country-wide recycling rate is low at about 10% (World Bank, 2018). Furthermore, plastic processing facilities are poorly monitored and use outdated infrastructure that could be a public health hazard for the employees and nearby community members.

The province of Nam Dinh has a total population of over 1.8 million people, with a population density of 1,109 people / km². Nam Dinh is located in the south of the Red River Delta. It is bordered by Thai Binh province in the North, Ninh Binh province in the South, Ha Nam province in the Northwest, and by the Tonkin Gulf to the East. The primary industries in Nam Dinh are agriculture, forestry, fishing, and minerals, and the textile industry is becoming increasingly prevalent. To date, there is little data on waste characterization in Nam Dinh. Rural areas of Nam Dinh have a collection rate of 88% and a collection/processing rate of 580 tons/day (Loan 2019). Nam Dinh city has a domestic solid waste collection rate of 78% (NAMA 2016).



Nam Dinh, Vietnam

In partnership with Ocean Conservancy and MCD, Nam Dinh 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 process, UGA and MCD are collaborating to conduct a CAP in the city.

The Circularity Informatics Lab at the University of Georgia (UGA) developed the 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, and academia. While the hub and spoke model illustrates the CAP, it is a complex system with components inherently interconnected to each other and to 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, the CAP has been conducted in 26 cities in ten countries.

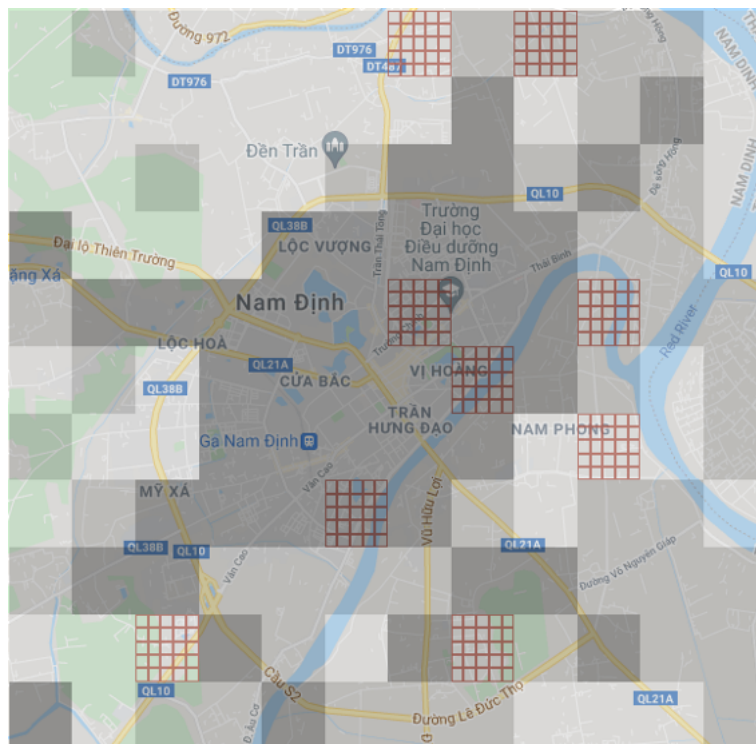
This report documents work conducted by the Circularity Informatics Lab at the University of Georgia (UGA) and MCD as part of Ocean Conservancy's Trash Free Seas Initiative. Background information. A literature review was conducted in September 2020. Field work was conducted in February 2021 - April 2021. The report is split into the following sections of the CAP, which include results and discussion of each: Input, Community, Product Design, Use, Collection, End of Cycle and Leakage, followed by Opportunities.

CAP Results

Input

To get a snapshot of the characterization, scope, and source of common plastic packaged items that are entering Nam Dinh, samples of common convenience items were sampled within nine 1km² transects in Nam Dinh—three within each tertile of the population count. The LIP selected three convenience or grocery shops to sample within each 1km² transect area.

Figure 1: Map of the 10x10 km sample area within Nam Dinh.



Locations of 1 km squares areas where LIP conducted convenience store surveys in high (dark grey), medium (medium grey), and low (light grey) ambient population distribution.

To get a snapshot of the characterization, scope, and source of common plastic packaged items that are entering Nam Dinh, samples of common convenience items were sampled within nine 1km² transects in Nam Dinh - three within each tertiles of the population count. The purpose of characterizing the packaging is related to what does or

does not end up as litter in the Leakage component of the CAP, and to explore alternatives through Product Design and Use. Where possible, the Local Implementing Partner, or LIP, selected 3 convenience or grocery shops to sample within each 1km² transect area, except for where the 1km² areas had less than three shops available (what was available was sampled), totaling 21 samples. For each shop, the LIP collected the most popular brands of candy, snacks, beverages, and 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 210 product samples total, 63 of which were candy, 63 chips, 63 beverages, and 20 tobacco products. The weight of both the plastic packaging and the product itself were measured for each item using a kitchen scale.

For each of the products sampled, 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, average, and median distance to both the manufacturing facilities and parent companies, Figures 2-4 show maps of both manufacturer and parent company locations as well as the top contributing convenience products by parent company of common brands found in local retail and convenience stores.

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

	Distance Store to Manufacturer (km)				Distance Store to Parent Company (km)			
	Minimum	Maximum	Average	Median	Minimum	Maximum	Average	Median
Beverages	25	2,687	598	134	25	13,885	2,854	623
Candy	71	3,280	1,706	1,975	71	13,404	3,595	2,107
Chips	71	1,078	519	463	71	13,220	3,987	2,235
Tobacco Products	74	9,306	2,111	1,021	74	13,220	6,013	6,200

*Note: Distances were projected using an Azimuthal Equidistant projection. Values have been rounded to the 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 Nam Dinh

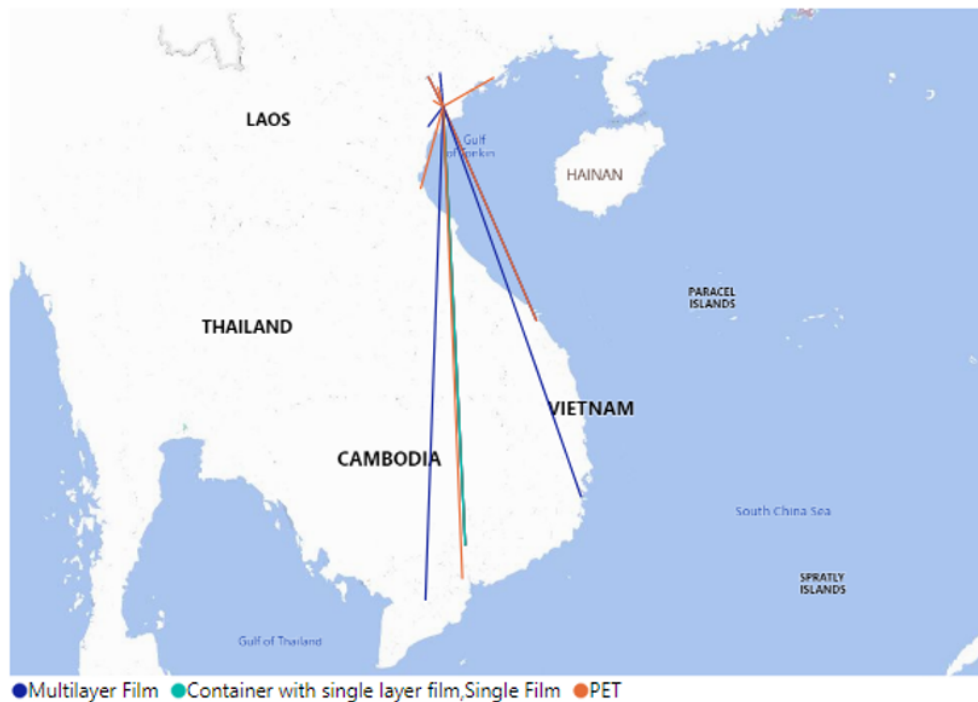


As is often the case, parent company locations are further away on average than the manufacturing sites; 26 out of 42 of the parent companies were located outside of Vietnam. The top three most common brands of convenience products (PepsiCo. Inc., Perfetti Van Melle, and Universal Robina Corp.) in Nam Dinh have parent companies located outside of Vietnam on average approximately 4,112 km away. The parent companies for the beverage products were the closest on average (2,854 km), followed by candy (3,595 km), chips (3,987 km), and tobacco products at an average of 6,013 km away. The farthest parent companies were located in Europe (Italy, The Netherlands, and the UK) and the USA.

Figure 3: Location of manufacturing facilities of common brands of convenience products in Nam Dinh



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



For manufacturing, sites were much closer and 63% of manufacturers were domestic to Vietnam (Figure 3, 4). The domestic locations for manufacturing beverages, candy, chips, and tobacco products were on average less than 350km away and were on average less than 630km away internationally. Manufacturing sites for the chips and beverage products were the closest on average (500–600 km) with some being just 25km away. The average distance for tobacco product manufacturing was the furthest away at just over 9,306 km, and all manufacturers were still located in East and Southeast Asia. Of all of the products sampled, all were sold in either single-layer film, PET, PP, or multilayer plastic packaging.

Community

To understand current attitudes and perceptions of plastic waste, semi-structured interviews were conducted by the LIP with 23 key stakeholders (Table 2). Among those interviewed, six were informal recycling aggregators, three were NGOs, three were government officials, three were plastic manufacturing companies, three were convenience store owners, two were waste management companies, two were food vendors, and one was an academic.

Table 2: Summary of stakeholder interview list

Stakeholder Group	Number of Interviews
Informal Recycling Aggregators	6
NGOs	3
Government Officials	3
Plastic Manufacturing Company	3
Convenience Store Owners	3
Waste Management Company	2
Food Vendors	2
Academics	1

In Nam Dinh, perceptions of community awareness were mixed. One convenience store owner noted that some consumers do not use plastic bags even when it would be more convenient to do so, while other consumers explicitly ask for plastic bags:

“Some people buy lots of things, but they don't need a bag. They put everything in their vehicle's trunk instead. They say that they don't like plastic bags, or that their children will complain. There are many people with such high awareness, while many others ask for plastic bags even though it is not worth it.”

— Convenience Store Owner

One interviewee felt that awareness in the community was satisfactory:

“As for encouraging people, I think people have done a good job when they are asked to sort waste at the source. Because we have got some sorting trash cans recently, they know it.”

— NGO Representative

Other interviewees felt that community awareness of plastic waste is not optimal or could have room for improvement. These sentiments are shared below.

“We don't have a big population here. Many people and youngsters like to enjoy their snacks by the lake. When they're finished, they can throw the trash in here. But many of them still leave plastic bags full of trash by the lake.”

— Food Vendor

“We do propaganda, but people's awareness has not been raised much.”

— Government Official

Awareness was one of the most frequently mentioned challenges to improving waste management, along with a lack of technology, a lack of sanctions, and a lack of funding. Examples of these sentiments can be found below:

“In my opinion, knowledge is the most important. People's awareness is one thing, but their knowledge on the harmful effects of littering in the environment is very important because if we can do propaganda widely, then they will know about the harmful effects.”

— NGO Representative

“To me, the first [barrier] is people's awareness. Regarding people's awareness, everyone knows that we must spread the word to them first. The second [barrier], I think, is a trash collection tool.”

— NGO Representative

“First, regarding trash collection, environmental companies haven't arranged

enough trash collecting vehicles to gather all the trash yet. The biggest part goes to environmental companies. It's due to limited human resources and vehicles. The second biggest challenge in gathering trash is the awareness of people. Too often, people dump trash at undesignated areas, affecting the trash collection process."

— I-8 Government Official

"The biggest challenge in waste management is the awareness and compliance of the people. The second is methods of sanction. We still don't have enough people to effectively enforce sanctions. Third, there's no place, no private landfill for gathering waste."

— I-8 Government Official

"One of the challenges would be awareness and a sense of responsibility... The second challenge would be expense."

— I-9 Government Official

"The most difficult, according to me, is the cost. Second, it is people's consciousness." - NGO Representative

To improve waste management in Nam Dinh, our interviewees suggested expanding public awareness, and increasing monitoring of illegal dumping and burning.

"First, we must raise people's awareness because people usually litter on the streets... People only want their own house to be clean. They do not care what it is like outside. Meanwhile, environmental workers only work during their specified time. That is why we must be more active in spreading the word."

— NGO Representative

"I'd like propaganda against using plastic bags because I hate them. If I don't give them, some people may say that I am stingy with the plastic bags. It is difficult for me as a seller as well... There must be a way to do propaganda."

— Convenience Store Owner

"There is no sanction mechanism, so people are getting more indifferent to that, right? What we're missing here is a community supervisor, someone to manage and supervise... Second [we are missing] a sanction mechanism."

— Government Official

“On implementation, authority of every level must get involved, especially the government. The party committee and the government must get involved. Wherever the authorities are involved, it works. The facilities really need the involvement of the government. Wherever we build a model with the involvement of the government, the model turns out to be very successful. And if the authorities are superficial, the model is almost impossible to succeed.”

– NGO Representative

“Actually, I think recycling plastic waste is one activity that is not encouraged by the state. However, I think this field should also be encouraged, just need to be stricter in management.”

– Waste Management Company Representative

From speaking to informal recycling aggregators, a few themes stood out. Three of the aggregators interviewed have been in the informal recycling industry for over 15 years, while the other three aggregators have been in the industry for over five years. COVID-19 has undoubtedly impacted their livelihoods, as it has caused unpredictable price fluctuations as well as even more difficult working conditions for those in the informal sector. Generally, there is little access to plastic alternatives, and although one plastic company is trying out a plastic alternative made of natural materials, this product does not meet market demand because it is a new technology, it is weather-dependent, and it is three times more expensive to produce. Regardless of these setbacks, there are clear ideas from the community on ways to improve going forward, and the general trends of awareness and waste management seem to be increasing at this time.

Product Design

Figure 5: Example of Convenience Stores in Nam Dinh (Photo Credit: MCD)



To characterize material types used in common consumer plastics, 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 1km² transect areas, as it can be difficult to find them in many of the less urban parts of the city but sampled 21 stores and 11 vendors in total (Figure 5). The average weight of both the packaging and the product itself were collected for all 209 samples (Table 3 & Figure 7).

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

Product Type	Count of Material	Average Weight of Plastic (g)	Average Quantity of Product (g)
Beverages	63	21.43	375.33
Candy	63	7.16	122.95
Chips	63	4.94	45.25
Tobacco Products	20	6.05	21.40

A majority (126 items) of the chip and candy products purchased from convenience stores in Nam Dinh were packaged in multilayer film plastic (Figure 6) with only 13 candy products noted being packaged in single layer film plastic. In addition, all single-use beverage products were packaged in PET which is also approximately 3 times heavier than multilayer film plastic, the second heaviest product material by grams (Table 3). All tobacco products were noted to be packed in a paper box with single layer film plastic.

Figure 6: Material Breakdown of Top Convenience Store Items

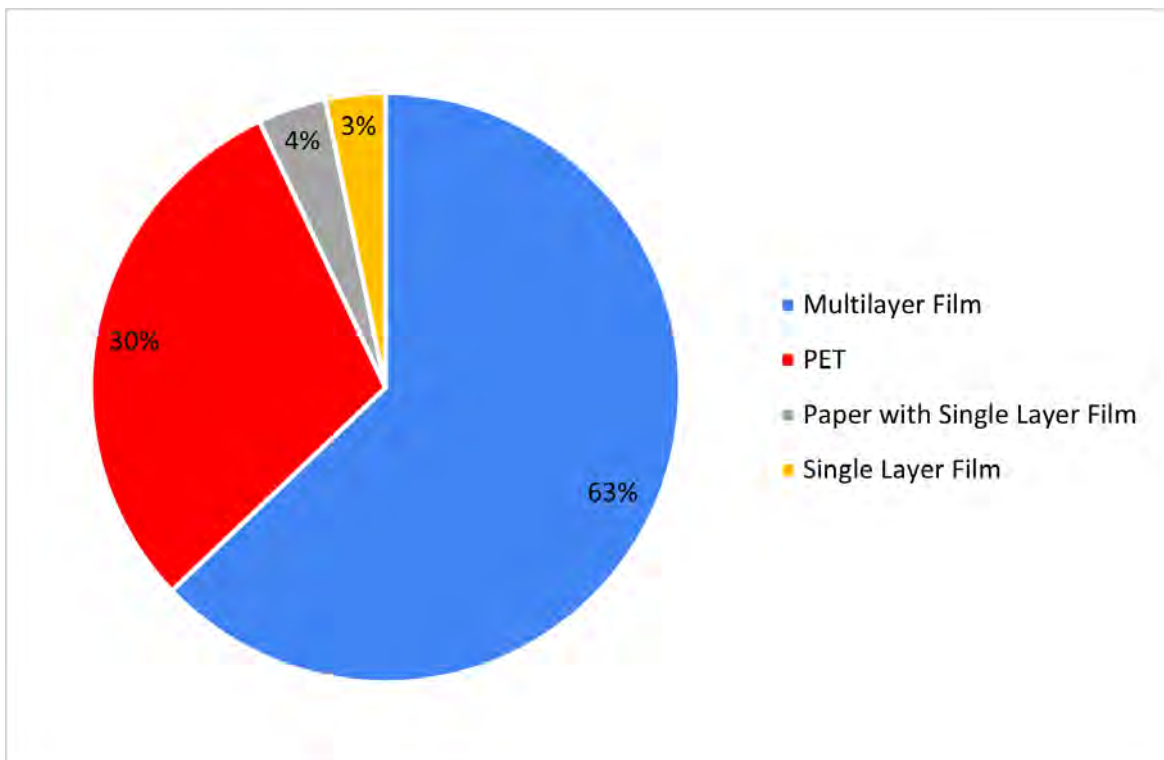


Figure 7: Convenience Store product to plastic ratios, shown in grams.

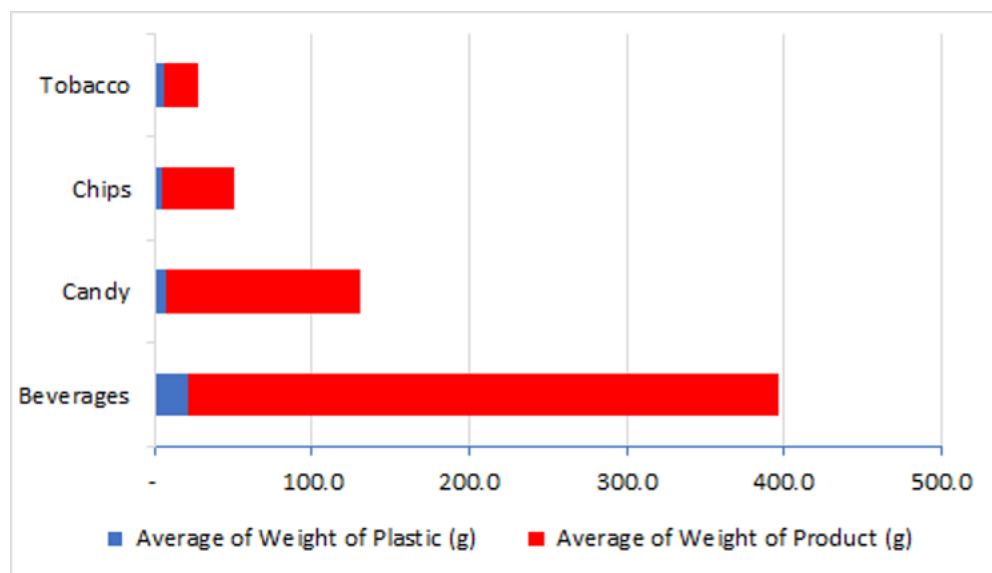


Figure 8: Example of Food Vendors in Nam Dinh



(Photo Credit: MCD)

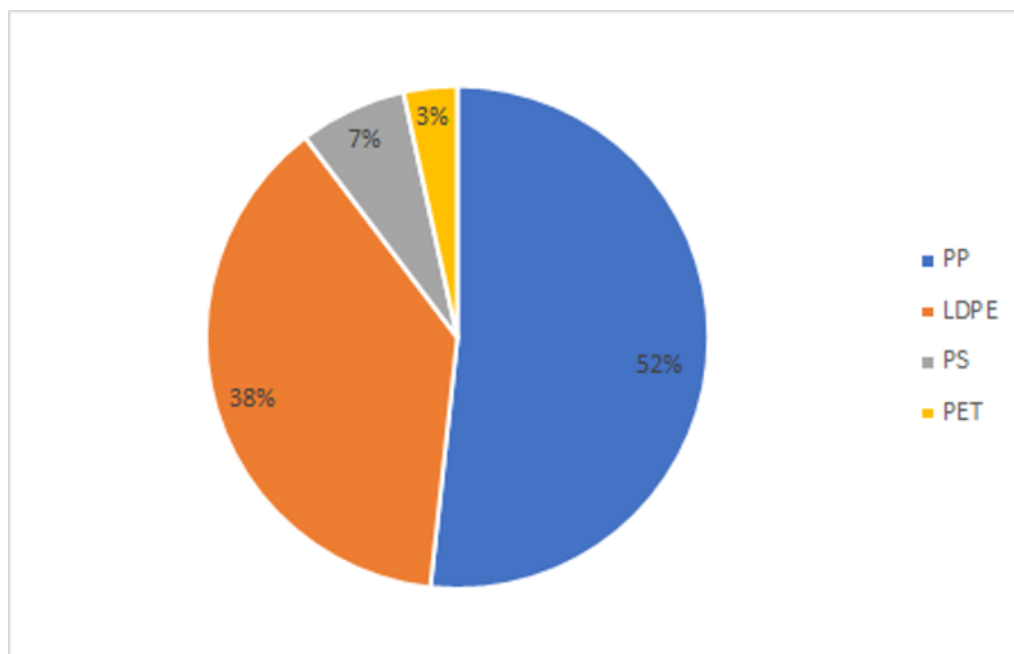
Within each of the selected nine 1km² transects in Nam Dinh, the LIP also visited up to three randomly selected food vendors or to-go restaurants where possible to sample the food packaging and utensil types that were being distributed, totaling 11 vendors sampled (Figure 8). The LIP collected 29 to-go 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 Packaging (g)
PP (to-go cups and utensils)	15	5.44
LDPE (bags)	11	2.64
PS (to-go cups and containers)	2	16.00
PET (plastic bottles)	1	18.00

In contrast to the products observed in convenience and grocery stores, the majority (52%) of products sampled from food vendors and restaurants were wrapped in PP packaging (Figure 9). It was also noted by the LIP that all food vendors used plastic bags as either a primary packaging material or as a reinforcement packaging material to carry plastic to-go items.

Figure 9: Material breakdown of the to-go items sampled



No aluminum, organic, or biodegradable material items were provided from vendors for sampling and weighing, and there was no record of any restaurant offering an alternative material to plastic.

Use

Among the 21 convenience stores and food vendors sampled in Nam Dinh, all of them offered plastic as their main type of bag. The average weight of the plastic bags sampled was 5.95 g. 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 collection and lack of value in recycling. On the other hand, there are a few efforts to capture some materials such as organic waste and faulty plastic items for food for livestock or product production.

“Most residential households will sort out recyclable waste. They can gather it and sell the scraps. That is the first. Next, one characteristic in our area is related to how we treat leftover food. We have buckets to store leftover food that can be used to feed cattle. And we also have plastic waste. For other wastes, like plastic bags, almost all of them are dumped together with – for example, non-recyclable waste. I have already mentioned that recyclable waste is sorted. For those plastic bags which are non-recyclable, they mix them together with other wastes like straw and stuff. On the other hand, organic waste.”

— NGO Representative

“Sometimes there are also items that they recycle to cut down on their cost. They send it back to us and we use it to produce. For faulty products, we put them in the crusher for recycling.”

— Plastic Company Representative 3

In Nam Dinh, habits and convenience seem to be strong inhibitors to change in the manners of reuse and use of alternative items 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. People tend to be in a routine of using plastic as the default option and are reluctant to turn down plastic bags or bring reusable ones. 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 also cited that some vendors would prefer to not use plastic bags as a take-away container, and are sometimes pressured by customers to use them, which is another deterrent to transition.

“Some people refuse to take them [plastic bags]. I also want people to limit their usage of plastic bags because I really hate it. I don’t like to use plastic bags when going to the market. However, some people keep asking for plastic bags even though they don't really need one. How can I refuse them? If I don't give them, they will get annoyed and won't shop here again.”

— Convenience Store Owner

In addition, the LIP noted that even plastic company producers are aware and concerned about the negative impacts of plastic pollution on the environment and public health and would like to or actively seek out alternative options to single-use plastic items.

“Actually, I’m afraid to talk about environmental issues because my industry is hated. It is accused of destroying the environment, because it relates to plastic. But in fact, I have a strong desire in my mind. When I produce this bag, I myself am aware that I have to do it the best way. Because the environmental problem is a long-term one, not only in my life but in my children's life, my grandchildren's life, my great-grandchild's life, etc. The next generations will enjoy my work. That's it. If I destroy the environment, my next generation will have to suffer for it. That's just to say in a family, a small family. If we discharge into the water, our next generations will drink that water in the future, right? If people grow vegetables using that source of water, our children will eat those vegetables. If people take fish from that lake, our children will also eat that fish. So, I’m well aware that it is extremely important to protect the environment. I work here so I know, in the surrounding area, I give special preference to the planting of trees and to the campus for it to become clean and tidy. If my workers go out and see garbage, they will put it in a bag and throw it in the trash can. And on this campus, they do a lot for me. Every few meters set a trash can to keep the trash.”

— Plastic Company Representative 1

Despite finances as a large barrier in switching from plastic to sustainable materials and the fact that current alternatives to plastic products are also more costly, other challenges may need to be addressed when seeking out other viable alternative materials. As a nation among the most affected by global climate change, the current alternatives to plastic products pose other challenges such as dependence on climate and annual rainfall.

“Currently I have very few left because firstly, it cannot meet market demand. First, it's new. Second, the technology is new. Third, it depends on—since it's from sugar cane, it's weather dependent. That is, good seasons or bad seasons will cause supply to fail to meet demand. That is why the material is very expensive, it is three times more expensive than normal materials. Their [biodegradables] quality is the same. They have the same durability, same toughness, same stability and same production technology but the price is extremely high.”

— Plastic Company Representative 2

Despite the current barriers in implementing plastic alternatives or promoting reusable items, businesses are seeking ways to slowly change their approach to material usage. Completely switching to plastic alternatives is not yet possible, but it seems the plastics industry is making efforts to move towards a more cyclical framework and are researching alternative sustainable options.

“Currently, I'm trying out an eco-friendly plastic product. In Japan, they have a lot of products which are friendly with the environment that originate from, for example, corn, tapioca, or the long and hairy potato...From lesser yam, from corn, and from sugarcane, from bagasse ...”

— Plastic Company Representative 3

When asked about any special policies related to the environment that apply to the company in the locality, one plastic industry representative cited:

“Actually, the company is also trying hard to seek for — research, develop or apply, but maybe in the near future, in order to improve the environmental problem, related to the materials used, and specifically plastic which the company is using, as well as trying to use some materials that can reduce things that — plastic for example, can reduce pollution or improve the environment. We are trying to research which products to apply. Yes. Have it [policies related to alternative materials] and are studying.”

— Plastic Company Representative 4

The sentiments from those working in the plastics industry are encouraging, and with community support, these industries may create innovative economically viable plastic alternatives or move towards more cyclical solutions. It is promising to hear in the interviews that the business sector in Nam Dinh would indeed like to develop and use alternatives to save the environment and create a better future for their children. 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.

Collection

In the urban center of Nam Dinh, the Nam Dinh Environment Joint Stock Company (NDE. JSC) is mainly responsible for solid waste collection and disposal. Their system operates with pushcarts, tipper trucks, and hooklift trucks (Klingel, 2001). While their service costs each household several thousand Vietnamese dong (Final Environmental, 2003), the collection efficiency of domestic waste hovers around 78% (NAMA, 2016). Rural waste collection is managed mainly by private companies. Rural regions have a slightly better collection efficiency at 88% (Loan, 2019). About 7% of households do not have any waste collection, so they take care of it themselves whether by burning waste or throwing it into ponds or lakes near their homes. Some households will combine their waste in a private zone until the volume is large enough and then it can be transported to a landfill (Huong & Linh, 2019).

In recent years, the city has discussed ways to improve collection efficiency, both in urban and rural regions. In 2017, the Nam Dinh provincial People’s Committee responded to the global and annual Campaign to Make the World Cleaner. Their resolution was to “strive to achieve the rate of hazardous medical wastes treated at over 92% in 2017; the rate of collected municipal solid waste reaches over 93%; the rate of rural solid waste collected is over 87%” (The Campaign, 2017). While Nam Dinh has met the goal in rural communities, the collection rate for urban areas is still lagging. As mentioned in the Community section above, many of the interviewees weighed in on the waste management system’s drawbacks. One problem that residents believed that they had was a lack of manpower to perform daily operations:

“The second problem is the lack of human resources in the management agencies of the state. There is only one department to manage all issues regarding urban, construction and environment in each commune and ward, not mentioning

farming and irrigation issues at the commune level: and all kinds of thing. At district level, every district only has one environmental officer. That officer has to manage everything in the district, not only solid waste but also other things."

— (I-7 Government Official)

Interviewees' quotes in the community section above noted that there was not sufficient equipment to collect the waste. Additionally, they mentioned that infrastructure and system management was less than ideal:

"The reason why we have not reached 100% is partly due to bad equipment infrastructure and difficulties in human resources as this environmental company used to belong to the state but now it has been equitized ... Another reason which is more important is the awareness of people. We only collect once a day. Then each area has different collection times. But people cannot arrange their time to dump waste following that time." Figure 10: Locations of public waste receptacles in Nam Dinh from LIP survey

— (I-7 Government Official)

Apart from private and municipal collection systems, the informal recycling sector helps to collect waste that is of value to them for recycling. The general attitude towards informal pickers seems to be appreciative, yet the current market for recycled materials is making business difficult for many of them:

"[They are] Doing good deeds while keeping the environment clean."

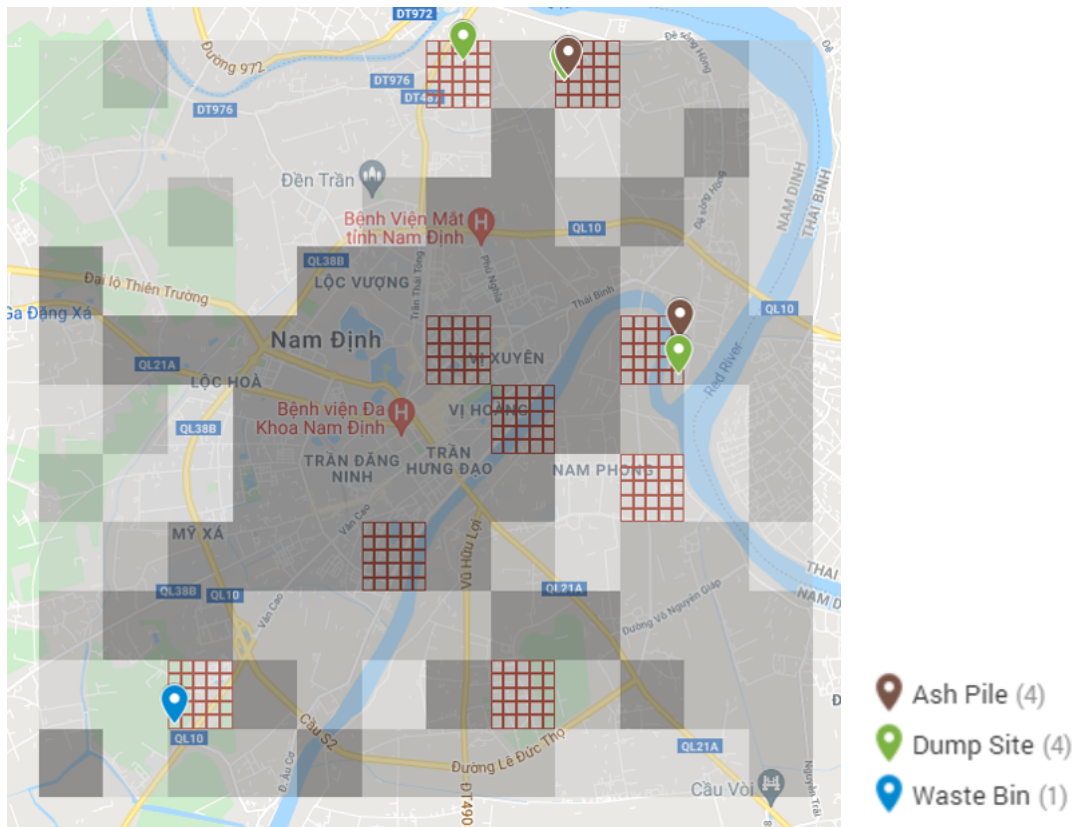
— (I-3 Convenience Store Owner)

"Scraps collection was a pretty good job 20 years ago. You could make some money occasionally, but now — The earning isn't enough to buy vegetables ... Some days I can get more than a thousand, and some days I return empty handed. I have to work from the morning until 3:00 PM but only getting dozens of beer cans. That's like getting nothing. I only make a few cents from them."

— (I-10 Informal Recycling Worker)

From a visual survey conducted by the LIP during litter transects (a total of 2700 m²), it was noted that there were 25 public waste bins, only 1 recycling bin, two of the nine 1km² areas did not have any public waste receptacles available at all (Figure 10). In addition, the 2700 m² area contained 56 informal dump sites and 6 ash piles from burnt waste. This relatively high number of informal dumping sites in the city may be another indication that people are confused about how to manage their waste or are limited in their choices for management by economics or logistics.

Figure 10: Locations of public waste receptacles in Nam Dinh from LIP survey



End of Cycle

In Nam Dinh, waste is processed at the end of its life in a variety of ways. This includes landfilling, incinerating, recycling, and composting. While NDE. JSC leaves 22% of domestic waste uncollected in Nam Dinh city, there are private garbage collectors in the surrounding rural areas that leave only 13% of their waste uncollected. However, of the rural collected waste, 47% is landfilled, while 43% is incinerated at a local incineration facility, and 10% is managed by residents and potentially dumped (Tran et al., 2020). Some rural districts have had more success in waste collection than others. A survey collected from households in the Giao Thuy and Xuan Truong Districts; it was reported that 29.4% of their domestic waste is thrown into fields or brushwood (Report on, 2010).

As expressed in the community section of this report, many interviewees do not have access to a sanitary landfill in order to dispose of waste properly. Around Nam Dinh there are several garbage complexes and treatment plants. However, it is unknown how effective these facilities are at reaching out to residents which could be a good starting point for instigating education campaigns on proper waste disposal methods available by locality. The garbage complex in the Loc Hoa commune is the most well-known of the facilities, landfilling about 260 tons of waste per day and incinerating about 18 tons per day. The facility previously composted organic matter; however, this operation was reportedly halted due to its low quality. The plant uses French technology such as automated treatment lines, but

Mr. Trieu Duc Kiem, chairman of the Board of Directors of Nam Dinh's previous waste management company Urban Environment Company, warns that this automated system is not suitable for the tropical climate in Vietnam (Nhà máy, 2011). Lesser-known facilities include the Nam Giang Waste Disposal, Truc Tuan Direct Waste Treatment Plant, and the ETC Hazardous Waste Treatment Plant (Thuy, 2019; Overview of Nam Dinh, 2016).

There are also several incineration plants around Nam Dinh. The Loc Hoa complex includes an incinerator in addition to landfilling. The My Thanh Commune houses an incinerator with an energy recovery system. Finally, the Tan Thanh Commune contains their own incinerator (BNews, 2019).

Beyond landfilling and incineration is material recovery, such as recycling and composting. There seems to be one formal recycling facility at the Nam Giang Waste Disposal site. It reports that it processes about 11,000 tons of plastic per year (Thuy, 2019). Other recycling services are found in informal recycling villages. The village of Vo Hoan specializes in recycling plastic, and the village of Binh Yen recycles aluminum. Recycling operations in Binh Yen are extensive, with 304 households involved in the work. Here, about 1,500 tons of aluminum scrap are recycled each month (Circulating economic, 2019). There is one official composting facility in the Hoang village of Loc Hoa. This site can process about 59 tons of compost per day (State of the 3 Rs, 2017).

While collected waste is mainly transported to the above facilities, uncollected waste can form informal dumping grounds. These waste dumps can burn in an uncontrolled manner, causing smoke and illness, as described by the interviewees in the Community section. Several stakeholders say that the dumping of waste has become a habit for citizens. Residents seem to dump their waste periodically for reasons such lack of knowledge about collection:

“... they're dumping garbage even in the morning. Since that's a regular gathering spot for trash. Their dumping garbage like that has become a very bad habit. That's why I said it was all about the sense of responsibility of each individual. Such action is not punishable yet.”

— (I-9 Government Official)

“Obviously, nobody wants to keep garbage in their house, so they will throw it out on the street... People do not know where to dump [construction/ demolition waste], so they throw it out on the street. Third, people only want their own house to be clean. They do not care what it is like outside.”

— (I-21 NGO)

One well known dumping ground is in the Yen Tri commune of the Y Yen district. It has been reported that the only treatment for waste at this site has been a continuous open burning (Linh & Vu, 2019). More similar sites are in the Yen Nghia commune, also in the Y Yen district. Here, there are multiple open-air dumps that have caused pollution and health problems (Press information, 2020; Pollution from domestic, 2020). On Le Duc Tho Street between the Loc An Overpass and the Nam Dinh Bridge is a one kilometer stretch of litter and garbage. Refuse is thrown out here by market workers, construction companies, and people emptying septic tanks (There are Spontaneous Landfills, 2019).

There have been several local initiatives to mitigate the negative effects of mismanaged waste in Nam Dinh. The Centre for Marine life Conservation and Community Development (MCD) is an active group in the city, and partnered with USAID from 2018 to 2020 to improve recycling operations and intercept riverine plastic pollution (MWRP, 2019). In March of 2018, the Department of Natural Resources and Environment signed a communication cooperation program in which dumping of waste was restricted and movements such as “Green Saturday” were encouraged (Signed communication, 2018). In 2019, representatives from Nam Dinh responded to the annual World Environment Day, World Oceans Day, and Vietnam Sea and Island Week. The city urged the community to raise awareness in “reducing, recycling, reusing, collecting, storing and treating wastes, especially plastic waste, plastic bags, hazardous wastes, pesticide packaging” (Thanh, 2019).

Leakage

In total, 3,986 litter items were recorded across 27 100m² transects in nine different square kilometer areas sampled between October 2020 and January 2021 (Figure 11). 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.

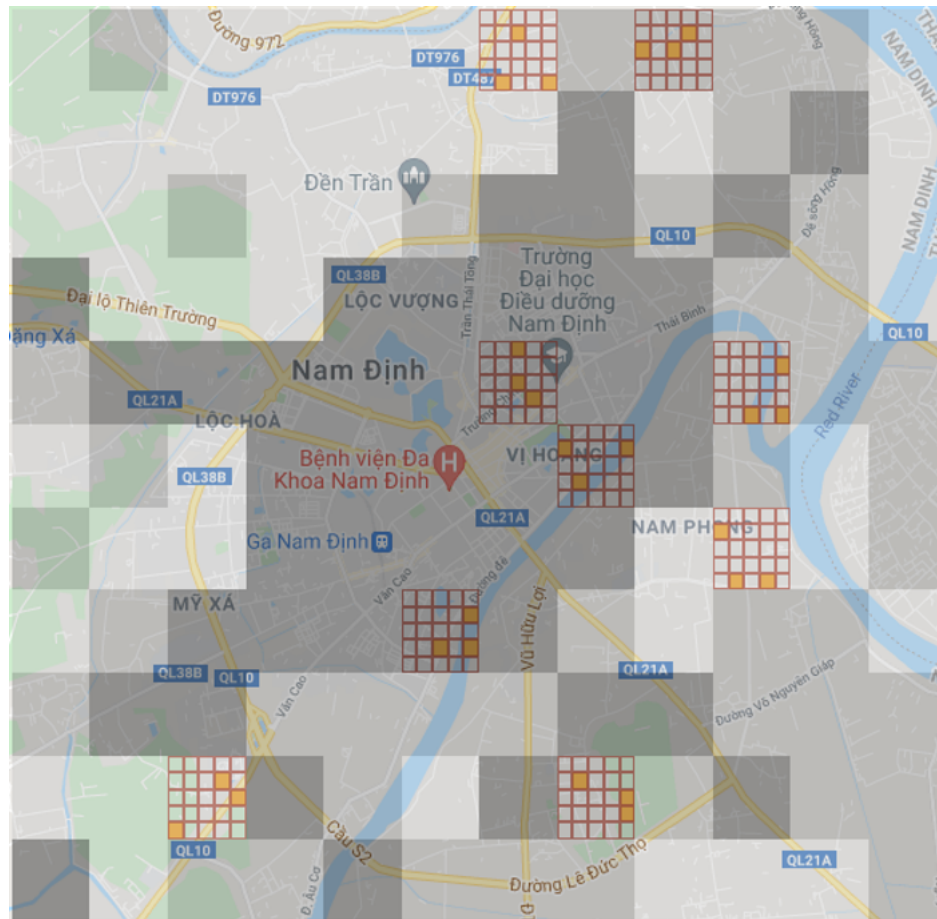
Figure 11: Examples of litter transects walked in Nam Dinh



(Photo Credit: MCD)

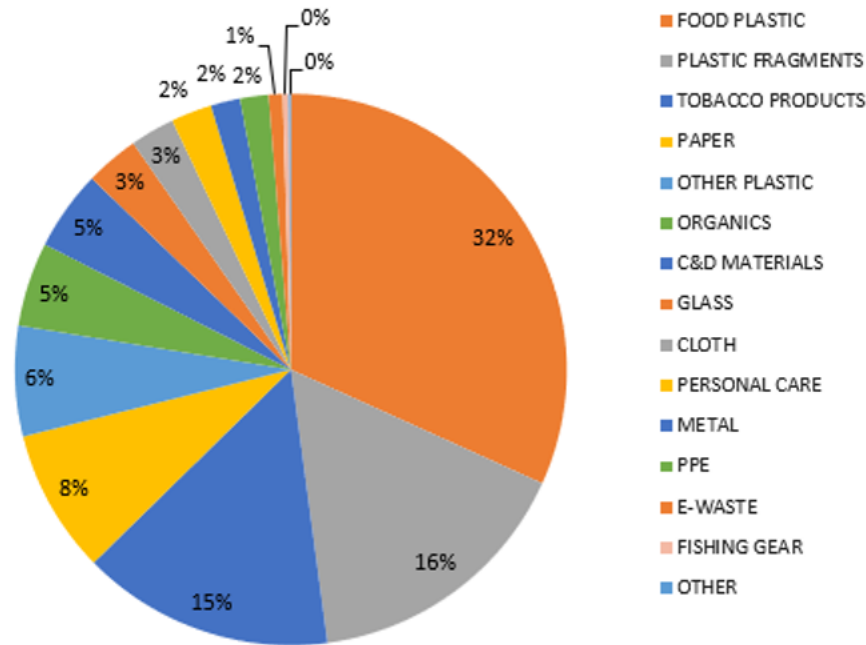
Across all 27 transects, the largest percentage by category of litter items was food plastic which comprised 32% of all the litter counted. Plastic fragments and tobacco products comprised similar proportions at 15% and 16%. Paper, other plastic, organics, and Construction & Demolition (C&D) materials comprised between 4% and 8%, while all other material categories including glass, cloth, personal care, metal, PPE, e-waste, fishing gear, and other waste formed 3% or less of the total litter count (Figure 12). The total percentage of common plastic items (the sum of food plastic, other plastic, PPE, plastic fragments, personal care items, and tobacco products) found was 74% of the total items (Figure 13).

Figure 12: 100-meter litter transect sample areas in high (dark grey), medium (medium grey), and low (light grey) ambient population distribution 1 km squares



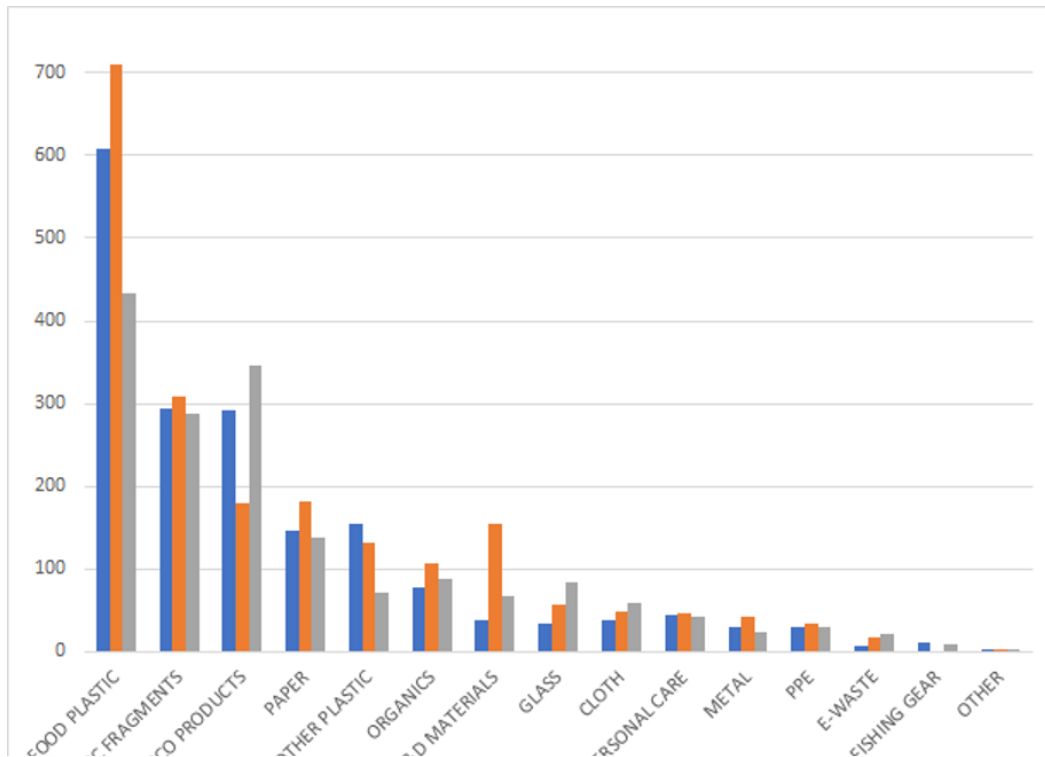
 Litter Transect (27)  1 km squares (225)

Figure 13: Material types of litter collected in Nam Dinh 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 14). In the high, middle, and low population count areas, food plastic items are by far the majority of litter items found with the middle population count reporting the highest litter count at 710 items found followed by the low population count areas (609) and high population count areas at 434 items found. In the middle population count area, we also see the highest percentage of plastic fragments, paper, and metals, as well as a stark divide from the other population tertiles for C&D material and a marginally higher percentage of PPE, comparatively and plastic fragment waste (plastic item that has broken down into smaller pieces or is no longer a distinguishable item) than we see in either of the other population count areas. The high population count areas seemed to have the largest percentage of tobacco products littered.

Figure 14: Proportion of most common plastic items in low (inner), mid (middle), and high (outer) population count areas.



Note: C&D Materials in construction and demolition material, PPE is personal protective equipment, and E-waste is electronic waste

Table 5: Litter density and top litter items from all transects in Nam Dinh

Population Tertiles	Top 5 Litter Items	Litter Density (count/m ²)
Lower (8 - 325 persons/ sq km)	1) Food Plastic, 2) Plastic Fragments, 3) Tobacco Products, 4) Other Plastic, 5) Paper	2.00
Middle (326 - 1,370 persons/ sq km)	1) Plastic Food Wrapper, 2) Plastic Fragments, 3) Paper, 4) Tobacco Products, 5) Construction and Demolition (C&D) Materials	2.24
High (1,371 - 30,877 persons/sq km)	1) Plastic Food Wrappers, 2) Tobacco Products, 3) Plastic Fragments, 4) Paper, 5) Organics	1.86

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 middle population count areas and lowest in the high-count areas. Plastic food wrappers, plastic film, and cigarette butts were among the top five items in all three population count areas, and

some of the top litter items overall. It is also worth noting that the density of cigarettes and food plastic was the highest in transect 5 which also had the highest density of restaurants and stores, and the only marked green space or park in the study area.

Litter densities across other countries in South Asia (e.g., India and Bangladesh) range from 0.5 items/m² to 15 items/m², with an average of around 4-5 items/m² (n = 40) (Youngblood et al., In Review). Litter densities across Southeast Asia (Indonesia, Malaysia, and Vietnam) range from 0.75 to 3.39 items/m² with an average of 1.83 items/m² (n = 27). The litter densities in Nam Dinh are just above the SE Asia average. All of three population count averages in Nam Dinh are greater than a city in South Vietnam where litter densities range from 0.75 to 1.2 items/m² however the medium and low population count areas in Hanoi (3.28 and 4.49 items/m², completed in tandem with Nam Dinh) are greater than all the averages found in Nam Dinh, while the high-count area in Hanoi is lower (1.58 items/m²).

It was also noted in the interviews that burning of residual waste or litter is an issue and community members are frustrated with the way some people are illegally disposing of their waste.

“Here. At night, lots of waste is brought here to be burned. Sometimes our family cannot sleep because of the unbearable thick smoke and burning smell. They keep doing it stealthily. We do not know how to deal with it. We are miserable in this polluted environment. You can suggest installing surveillance cameras, but we can only install two of them. We have specific areas to install them. The ward asks us to report them, but we cannot even see them, let alone report them. Because they do it in the dark. We only see it when it has been burnt already. So, we cannot report it. The ward police keep asking us to report them, but we can see nothing to report. They have already run away when they are done with dumping and burning waste so we cannot report them. We have had enough of it!”

— Convenience Store Owner

“Too often, people dump trash at undesignated areas, affecting the trash collection process.”

— Government Official

“Second, regarding trash collection tools. People sometimes just throw their trash out regardless of the trash collection timeframe. If it's not the collection time, people would still throw out trash in a hidden, unseen spot. Therefore, trash collection isn't perfect. See.”

— NGO Representative 1

“First, we must raise people's awareness because people usually litter on the streets. Take workers for example, if they come back home after the time of collection, waste collectors will have finished their work and gone home, right? Obviously, nobody wants to keep garbage in their house, so they will throw it out on the street. That is the first thing. The second is about solid waste collection like construction materials and construction waste from demolished houses. People do not know where to dump it, so

they throw it out on the street. Third, people only want their own house to be clean. They do not care what it is like outside. Meanwhile, environmental workers only work during their specified time. That is why we must be more active in spreading the word!"

— NGO Representative 2

"Another problem is consciousness. If you have good consciousness, you will take your waste out in time for collectors to collect it. Then it is no problem. Right? That's it. That is my point of view."

— NGO Representative 3

"People's awareness is one thing, but their knowledge on the harmful effects of littering in the environment is very important because if everyone knows about the harmful effects, if we can do propaganda widely, then will know about the harmful effects!"

— NGO Representative 4

Opportunities

Vietnam's National Solid Waste Strategy Solid Waste Management Plan provides visions and goals for managing waste into the future. With population growth and waste generation projected to increase, it will be important for infrastructure, business cooperation and responsibility, public awareness, policy enforcement, and behavior change to continue to evolve and grow along with any new initiatives that are implemented. A multifaceted approach including top-down and bottom-up support inclusive of all stakeholders can work well to address plastic pollution. Even small individual actions can add up or start movements toward larger changes within a community. So, whether change comes from the government or from a small street side vendor, every action can have an impact.

Based upon the findings in this CAP, the following opportunities may be able to expand and enhance circularity while overcoming some of the identified challenges (challenges in italics):

- It appears that both *littering and dumping of waste is a challenge to address in Nam Dinh*. The littering component of leakage in Nam Dinh is moderate. Average concentrations of litter (1.86 - 2.24 items/m²) are lower than other areas in south Asia and mostly lower than the leakage found in Hanoi during this same time period, but higher than another city in South Vietnam where litter densities range from 0.75 to 1.2 items/m². However, 4 dumpsites and 4 ash piles were found in the 9 km² CAP data collection area. Interviewees also reported illegal burning of waste during the night hours. Enforcement to reduce dumping, burning and litter are opportunities to reduce plastic pollution in Nam Dinh.
- *Community members report confusion about waste collection time and management localities*, which could lead to localized dumping, burning and waste mismanagement. So there appears to be an opportunity to 1) design the optimal collection system in collaboration with the city and both private and informal collectors (including collection for cigarettes and tobacco products) and 2) to engage the community in the system through education and outreach providing people guidance and policy information.
- There is an opportunity to design and pilot a hyperlocal waste collection model. Sub-communities or neighborhoods could coordinate with the informal waste sector about *scheduling collection times or having collection information available*, so they know when to place trash outside for collection. Alternatively, or in addition, there could be community receptacles (e.g., dumpsters) for people to dispose of waste.
- There are often *poor working conditions for the informal sector*. There may be opportunities to provide *additional resources* (e.g., electric carts instead of bicycles and communal waste receptacles) and standardize the informal recycling sector (e.g., collection times, transfer locations, or informal cooperatives) so that the informal workers can increase their collection and optimize the recycling system in Nam Dinh, which can lead to an increased monthly income and safer working conditions. Other working conditions for the informal sector could be explored to determine if other improvements are needed.
- The percentage of plastic in the waste stream is under 10% (relatively low) but *will likely increase over time with the global average at 12%* (Kaza et al., 2018). 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 Nam Dinh, either to redesign product packaging, promote reuse schemes or bulk sales, foster EPR for local re-collection, or increase the local market for capture and recycling of those items.

- 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 targeted communication campaigns to reach certain demographics with clear messaging. Engagement could occur near well-known dumping sites to reach various community members and groups.
- There is an overall *lack of alternatives to plastic available* (none of the products offered by food vendors included alternatives). Some of the plastic producers in the region seem concerned and willing to research and initiate “environmentally minded” alternatives to reduce single-use plastic, 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 continue to use even though it has no value in the recycling market and is often not taken by waste collectors. 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.
- *The high cost of alternatives, convenience of single-use plastic items, and lack of standard regulations on biodegradable or recycling materials management 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 Nam Dinh.
- *Food vendors and restaurants seem to largely offer plastic bags and PET packaging*. PET typically can be readily recycled which 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.

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Appendix

Table 6: Convenience Store Top Product Manufacturers and Parent Companies

Brand	Product	Material	Manufacturer	Manufacturing Location	Parent Company	Parent Company Location
Orion	Chips	Multilayer Film	Công ty TNHH thực phẩm orion VINA	Bắc Ninh Province, Vietnam	Orion Confectionery	Seoul, South Korea
O'star	Chips	Multilayer Film	Công ty TNHH thực phẩm orion VINA	Bắc Ninh Province, Vietnam	Orion Confectionery	Seoul, South Korea
Lay's	Chips	Multilayer Film	Suntory Pepsico Việt Nam	Bình Dương Province, Vietnam	PepsiCo, Inc	New York, USA
Chupa Chups	Candy	Multilayer Film	TNHH Perfetti Van Melle Việt Nam	Bình Dương Province, Vietnam	Perfetti Van MELLE	Lainate, Italy, and Breda, Netherlands
Cinnamon	Candy	Multilayer Film	Cheonnyeonae Food	Jincheon, Korea	Cheonnyeonae Food	Korea
Dynamite	Candy	Multilayer Film	Công ty TNHH URC Hà Nội	Bình Dương Province, Vietnam	Universal Robina corporation	Quezon, Philippines
Number 1	Beverages	PET	Công ty TNHH Number One Hà Nam	Hà Nam, Việt Nam	Công ty TNHH Number One Hà Nam	Hà Nam, Việt Nam
Latte	Beverages	PET	Công ty TNHH Nước giải khát Kirin Việt Nam	Bình Dương Province, Vietnam	Công ty Cổ phần Thực phẩm Quốc tế	Biên Hòa, Đồng Nai, Việt Nam
C2	Beverages	PET	Công ty TNHH URC Hà Nội	Hanoi, Vietnam	Universal Robina corporation	Quezon, Philippines
Thăng Long	Tobacco	Multilayer Film	Công ty Thuốc Lá Thăng long	Hanoi, Vietnam	Công ty Thuốc Lá Thăng long	Hanoi, Vietnam

Brand	Product	Material	Manufacturer	Manufacturing Location	Parent Company	Parent Company Location
Puff Corn	Chips	Multilayer Film	Công ty TNHH URC Hà Nội	Bình Dương Province, Vietnam	Universal Robina corporation	Quezon, Philippines
Poca	Chips	Multilayer Film	Suntory Pepsico Việt Nam	HCMC, Vietnam	PepsiCo, Inc	New York, USA
Oishi	Chips	Multilayer Film	Vietnam Liwayway Joint Stock Company	Bình Dương Province, Vietnam	Vietnam Liwayway Joint Stock Company	Bình Dương Province, Vietnam
Trident	Candy	Single Film	Mondelez Kinh Do Vietnam JS co.	Bình Dương Province, Vietnam	Mondelez Global LLC,	East Hanover, NJ, USA
Lot100	Candy	Multilayer Film	Cocoaland Industry Sdn. Bhd.	Rawang Integrated Industrial Park , Rawang, Selangor, Malaysia	Cocoaland Industry Sdn. Bhd.	Rawang Integrated Industrial Park, Rawang, Selangor, Malaysia
Almond Milk Crisp	Candy	Multilayer Film	Fujian Fupaiyuan Food Co., LTD	Jinjiang, China	Hongkong Shangke Food Co.,	Hong Kong
Tea+plus	Beverages	PET	Suntory Pepsico Việt Nam	HCMC, Vietnam	PepsiCo, Inc	New York, USA
Dasani	Beverages	PET	Coca - Cola Việt Nam	HCMC, Vietnam	Coca-Cola Company	Atlanta, Georgia, USA
Coca Cola	Beverages	PET	Coca - Cola Việt Nam	HCMC, Vietnam	Coca-Cola Company	Atlanta, Georgia, USA
Ribbon Line Sweat	Candy	Single Film	Fujian Fupaiyuan Food Co., LTD	Jinjiang, China	Hongkong Shangke Food Co.,	Hong Kong
Mentos	Candy	Multilayer Film	TNHH Perfetti Van Melle Việt Nam	Bình Dương Province, Vietnam	Perfetti Van MELLE	Lainate, Italy, and Breda, Netherlands
Kẹo sữa	Candy	Multilayer Film	PT. Internusa food	Jakarta, Indonesia	PT. Internusa food	Jakarta 14470, Indonesia
Joco	Beverages	PET	Chi nhánh công ty cổ phần Uniben tại Bình Dương	Bình Dương Province, Vietnam	Công ty cổ phần Uniben	Bình Dương Province, Vietnam

Brand	Product	Material	Manufacturer	Manufacturing Location	Parent Company	Parent Company Location
Poca	Chips	Multilayer Film	Suntory Pepsico Việt Nam	Bình Dương Province, Vietnam	PepsiCo, Inc	New York, USA
Alpenliebe	Candy	Multilayer Film	TNHH Perfetti Van Melle Việt Nam	Bình Dương Province, Vietnam	Perfetti Van MELLE	Lainate, Italy, and Breda, Netherlands
Xylitol Mint Candy	Candy	Multilayer Film	Công ty TNHH Lotte Việt Nam	Bình Dương Province, Vietnam	Lotte Confectionery Co.	Seoul, South Korea
Toonies	Chips	Multilayer Film	Công ty TNHH thực phẩm orion VINA	Bắc Ninh Province, Vietnam	Orion Confectionery	Seoul, South Korea
Yupi	Candy	Multilayer Film	PT. Yupi Indo Jelly Gum	Barat, Indonesia	PT. Yupi Indo Jelly Gum	Barat, Indonesia
Xylitol	Candy	Container with single layer film	Công ty TNHH Lotte Việt Nam	Bình Dương Province, Vietnam	Lotte Confectionery Co.	Seoul, South Korea
Ice+	Beverages	PET	Công ty TNHH Nước giải khát Kirin Việt Nam	Bình Dương Province, Vietnam	Công ty Cổ phần Thực phẩm Quốc tế	Biên Hòa, Đồng Nai, Việt Nam
Pepsi	Beverages	PET	Suntory Pepsico Việt Nam	HCMC, Vietnam	PepsiCo, Inc	New York, USA
Vinataba	Tobacco	Multilayer Film	Công ty TNHH Vinataba - philip morris	Cần Thơ, Vietnam	Philip Morris International	New York, USA
Fudge	Candy	Multilayer Film	Fujian Fupaiyuan Food Co., LTD	Jinjiang, China	Hongkong Shangke Food Co.,	Hong Kong
Kupu	Candy	Multilayer Film	Kupu Company	Osaka, Japan	Kupu Company	Osaka, Japan
Kẹo chanh muối nhật bản	Candy	Multilayer Film	YLF Food Industries (M) Sdn. Bhd - Malaysia	Johor, Malaysia	YLF Food Industries (M) Sdn. Bhd - Malaysia	Johor, Malaysia
Trà thái	Beverages	PET	Công ty Cổ phần Sữa Phù Đổng	Hanoi, Vietnam	Công ty Cổ phần Sữa Phù Đổng	Hanoi, Vietnam

Brand	Product	Material	Manufacturer	Manufacturing Location	Parent Company	Parent Company Location
TH	Beverages	PET	Công ty TNHH Nước tinh khiết Núi Tiên	Nghệ An Province, Vietnam	Công ty TNHH Nước tinh khiết Núi Tiên	Nghệ An Province, Vietnam
Nước gạo buổi sáng (morning rice)	Beverages	PET	Woongjin	Chungnam, South Korea	Woongjin Foods Co., Ltd	Seoul, South Korea
Camel	Tobacco	Multilayer Film	Thanh Hoa tobacco Co., Ltd	Hà Trung, Thanh Hóa, Vietnam	JT International	Geneva, Switzerland
Kẹo Oishi	Candy	Multilayer Film	Vietnam Liwayway Joint Stock Company	Bình Dương Province, Vietnam	Vietnam Liwayway Joint Stock Company	Bình Dương Province, Vietnam
Lavie	Beverages	PET	Công ty TNHH La Vie	Tân An, Long An, Vietnam	Công ty TNHH La Vie	Tân An, Long An, Vietnam
Sting	Beverages	PET	Suntory Pepsico Việt Nam	HCMC, Vietnam	PepsiCo, Inc	New York, USA
Gingerbon	Candy	Multilayer Film	PT agel langgeng	Agel Langgeng, Indonesia	PT agel langgeng	Agel Langgeng, Indonesia
Kẹo mềm Sugus	Candy	Multilayer Film	RUBIA INDUSTRIES LTD.	Bangyapraek, Thailand	RUBIA INDUSTRIES LTD.	Bangyapraek, Thailand
Nutriboost	Beverages	PET	Coca - Cola Việt Nam	HCMC, Vietnam	Coca-Cola Company	Atlanta, Georgia, USA
Craven	Tobacco	Multilayer Film	Công ty Công nghiệp Sài Gòn	HCMC, Vietnam	Carreras Limited	London, UK
Play more	Candy	Multilayer Film	Guangdong xinle foods Co., Ltd	Guangdong, China	Evermore Co., Ltd	Bangkok, Thailand
Aquaroma	Beverages	PET	CSSX Nhựa Thuận Phát	Hanoi, Vietnam	CSSX Nhựa Thuận Phát	Hanoi, Vietnam
Marlboro	Tobacco	Multilayer Film	Công ty TNHH Vinataba - philip morris	Cần Thơ, Vietnam	Philip Morris International	New York, USA
Calbee	Chips	Multilayer Film	Calbee four seas co. LTD	Hong Kong	Calbee four seas co. LTD	Hong Kong
Skittles	Candy	Multilayer Film	Mars China, INC.	Guangzhou, China	Mars Wrigley	Mclean, Virginia, USA

Brand	Product	Material	Manufacturer	Manufacturing Location	Parent Company	Parent Company Location
Kẹo Socola M&M's Minis	Candy	Container with single layer film	Mars China, INC.	Beijing, China	Mars Wrigley	Mclean, Virginia, USA
Kẹo gum Cool-air	Candy	Container with single layer film	Mars Philippines, INC.	Antipolo city, Philippines	Mars Wrigley	Mclean, Virginia, USA
Lipton	Beverages	PET	Suntory Pepsico Việt Nam	HCMC, Vietnam	PepsiCo, Inc	New York, USA
Aquafina	Beverages	PET	Suntory Pepsico Việt Nam	HCMC, Vietnam	PepsiCo, Inc	New York, USA
Hero	Tobacco	Multilayer Film	Hudson tobacco	unknown	Hudson tobacco	London, UK
TH Juice	Beverages	PET	Công ty TNHH Nước tinh khiết Núi Tiên	Nghệ An Province, Vietnam	Công ty TNHH Nước tinh khiết Núi Tiên	Nghệ An Province, Vietnam
Trà sữa 0 độ	Beverages	PET	Công ty TNHH TM DV Tân Hiệp Phát	Bình Dương Province, Vietnam	Công ty TNHH TM DV Tân Hiệp Phát	Bình Dương Province, Vietnam
Chanh muối	Beverages	PET	Phân xưởng sản xuất - Cơ sở Quang Hanh	Cẩm Phả, Quảng Ninh, Viet Nam	Phân xưởng sản xuất - Cơ sở Quang Hanh	Cẩm Phả, Quảng Ninh, Viet Nam
Kẹo Hạng	Candy	Multilayer Film	Công ty TNHH thực phẩm ORION VINA	Bắc Ninh Province, Vietnam	Orion Confectionery	Seoul, South Korea
Wake up 24/7	Beverages	PET	Công ty TNHH MTV Masan MB	Nghệ An Province, Vietnam	Công ty TNHH MTV Masan MB	Nghệ An Province, Vietnam
Chanh muối	Beverages	PET	Công ty cổ phần Nước khoáng Quang Hanh	Cẩm Phả, Quảng Ninh, Viet Nam	Công ty cổ phần Nước khoáng Quang Hanh	Cẩm Phả, Quảng Ninh, Viet Nam
Trà xanh 0 độ	Beverages	PET	Công ty TNHH Number One Hà Nam	Hà Nam, Việt Nam	Công ty TNHH Number One Hà Nam	Hà Nam, Việt Nam
Saigon Silver	Tobacco	Multilayer Film	Công ty thuốc lá Sài Gòn	HCMC, Vietnam	Công ty thuốc lá Sài Gòn	HCMC, Vietnam

Brand	Product	Material	Manufacturer	Manufacturing Location	Parent Company	Parent Company Location
Kẹo gum	Candy	Multilayer Film	Công ty TNHH Lotte Việt Nam	Bình Dương Province, Vietnam	Lotte Confectionery Co.	Seoul, South Korea
Dr. Thanh	Beverages	PET	Công ty TNHH Number One Hà Nam	Hà Nam, Việt Nam	Công ty TNHH Number One Hà Nam	Hà Nam, Việt Nam
Điện Biên	Tobacco	Multilayer Film	Công ty Thuốc Lá Thăng long	Hanoi, Vietnam	Công ty Thuốc Lá Thăng long	Hanoi, Vietnam
Xyliton	Candy	Container with single layer film	Hamada shokuhin kogio co.ltd	Osaka, Japan	Hamada shokuhin kogio co.ltd	Osaka, Japan
Tăng lực Muay Thai	Beverages	PET	THAICOM Group	Hưng Yên Province, Vietnam	THAICOM Group	Hưng Yên Province, Vietnam
Canyon	Tobacco	Multilayer Film	Khataco tobacco factory	Nha Trang, Vietnam	AK international Co., Ltd	Osaka, Japan
Keo Oishi	Candy	Multilayer Film	Vietnam Liwayway Joint Stock Company	Bình Dương Province, Vietnam	Vietnam Liwayway Joint Stock Company	Bình Dương Province, Vietnam
Kẹo sữa	Candy	Multilayer Film	Nhà máy bánh kẹo Hải Hà	Bắc Ninh Province, Vietnam	Công ty cổ phần bánh kẹo Hải Hà	Hanoi, Vietnam
TH True water	Beverages	PET	Công ty TNHH Nước tinh khiết Núi Tiên	Nghệ An Province, Vietnam	Công ty TNHH Nước tinh khiết Núi Tiên	Nghệ An Province, Vietnam
Trà 0 độ	Beverages	PET	Công ty TNHH TM DV Tân Hiệp Phát	Bình Dương Province, Vietnam	Công ty TNHH TM DV Tân Hiệp Phát	Bình Dương Province, Vietnam
Alpenliebe	Candy	Single Film	TNHH Perfetti Van Melle Việt Nam	Bình Dương Province, Vietnam	Perfetti Van MELLE	Lainate, Italy, and Breda, Netherlands
Apenliebe 2chew	Candy	Multilayer Film	TNHH Perfetti Van Melle Việt Nam	Bình Dương Province, Vietnam	Perfetti Van MELLE	Lainate, Italy, and Breda, Netherlands