REPORT

ASSESSMENT OF SOLID WASTE MANAGEMENT CONTEXT AND MARKET IN THE EAST TONLE SAP LAKE COMMUNITY

NOVEMBER 2022

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This research was conducted and report produced by the iDE Innovation Lab and the iDE Cambodia Water, Sanitation & Hygiene Team as a component of the European Union-Funded Generating Resilient Environments and Promoting Socio-Economic Development of the East Tonle Sap Lake (GREEN) Project. Additional research support was provided by GREEN partners Save the Children, Volunteer Services Oversees (VSO), and Wetlands Work (WW).

Special thanks to the Cambodian Ministry of Environment, local officials from the provincial, district, and commune administrations from Kampong Chhnang, Kampong Thom, and Pursat Provinces, representatives of Fisheries Action Coalition Team (FACT), Japanese International Cooperation Agency (JICA), and the many local businesses and households who offered their time and advisory support.

EXECUTIVE SUMMARY

Solid waste management (SWM) is an ongoing problem worldwide. As part of the GREEN Project, funded by the European Union, the research team has focused on SWM solutions for areas bordering the East Tonle Sap Lake (ETSL) in three provinces in Cambodia: Pursat, Kampong Chhnang, and Kampong Thom. This research is a foundational step in developing relevant SWM solutions for these communities and focuses on understanding the current solid waste landscape in the ETSL area, identifying relevant stakeholders and actors, and identifying areas of opportunity for SWM solutions.

Solid wastes including plastics, glass, and food waste were observed in the ETSL community. Many of these include daily consumption waste (plastic bags, plastic bottles, plastic straws, plastic cups, plastic, beer cans, and cardboards) and durable waste (fishing nets, clothes, copper wires). The products generally come from the district or commune markets which are the main place selling/distributing products to households at the community level.

Residents of the ETSL area often differentiate between saleable and non-saleable waste in their SWM practices. The saleable wastes, mostly metals and some plastics, are generally kept and sold to local waste collectors. Aluminum cans can provide a household with around 4,000-6,500 riel per kilogram while PET plastic bottles can bring in around 200-500 riel per kilogram. Some waste sits on a blurred line between saleable and non-saleable, which means they are not always accepted by the et jay (waste buyer/seller). Some et jays reject buying plastic bottles due to low-profit margin and large waste volume. As a result, much plastic waste, including saleable plastics, is not recycled.

Current solutions for non-saleable waste at the household level are varied depending on the geographical location. In the ETSL area, some households are in villages that never flood from the lake's seasonal expansion, others are in villages that flood seasonally (up to six months per year) and some are in areas that are flooded year-round (houses are floating on water). People in dry areas year-round often burn their trash in all seasons and sometimes bury it near or on their property. Households with seasonal flooding are likely to burn or bury waste in the dry season but often litter openly into the environment in the rainy season. People living in year-round flooded areas mostly choose to throw waste into the water during all seasons.

Currently there are no SWM solutions in the area that have been proven effective and scalable. Some basic incinerators have been produced by the community, but face challenges regarding waste transportation, lack of human resources, and no financial support. More technologically advanced incinerators introduced by NGOs have had challenges regarding sustainability and maintenance. Waste collection bins have been provided by an NGO to a few villages, however market access to such bins, consistent household use of them, and means for safe waste disposal remain a challenge. Households in parts of several villages near market areas have limited access to fee-based waste collection through a trash truck service, but access to this type of service is not widespread. Additionally, there are no formal landfills available, only open dumpsites with irregular means of maintenance and access.

SWM has not yet been prioritized by local authorities. While authorities at the district-level have a mandate for facilitating SWM around market areas, there is no clear focus, capacity, mandate or funding for residential SWM. However, the private sector is active in this area. Informal collectors, garbage truck owners, local and regional waste aggregators, middlemen, and recycling companies, play important roles in the flow of saleable waste.

ABBREVIATIONS

Abbreviations	Full Name
ADB	Asian Development Bank
CSR	Corporate Social Responsibility
ETSL	East Tonle Sap Lake
EU	European Union
FACT	Fisheries Action Coalition Team
FMCG	Fast-moving Consumer Goods
GREEN	Generating Resilient Environments and Promoting Socio-Economic Development of the East Tonle Sap Lake
HCD	Human-centered Design
JICA	Japanese International Cooperation Agency
RoI	Return on Investment
SWM	Solid Waste Management
TOR	Terms of Reference
VSO	Volunteer Services Overseas
WASH	Water, Sanitation, and Hygiene

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1. INTRODUCTION

Between 2021 and 2025 a consortium including Save the Children, iDE, Volunteer Services Overseas (VSO), Wetlands Work, Super Tunsai (Hydrologic), Tap Effect. and The University of Battambang will collaborate on the European Union-funded *Generating Resilient Environments and Promoting Socio-Economic Development of the East Tonle Sap Lake* (GREEN) Project. The project aims to improve the socio-economic status of vulnerable East Tonle Sap Lake (ETSL) fishing communities and their resilience to climate change by increasing community access to water, sanitation, waste management services and products, green economy initiatives, and education.

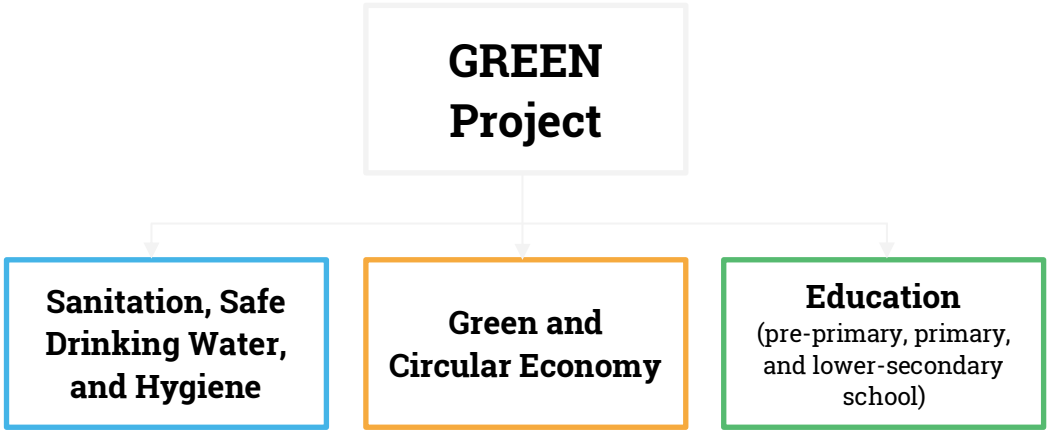

Figure 1: GREEN Project activities

Per the terms of reference (TOR), the project focuses on three specific actions:

- **Action 1 - Sanitation, Safe Drinking Water, and Hygiene** is led by iDE with Hydrologic Social Enterprise, Wetlands Work, and Tap Effect. This action will improve awareness and practices of key WASH behavior using evidence-based social behavior change practices, as well as increase access to market-based solutions for sanitation, safe drinking water, and SWM in households.
- **Action 2 - Green and Circular Economy** is led by VSO, University of Battambang and iDE. This action will focus on identifying, adapting, and promoting **green and circular economy initiatives** to support alternative livelihoods and stabilize household income, enabling the socio-economic development of target communities.
- **Action 3 - Education** is led by Save the Children and will improve access to **early childhood education (ECE)** in fishing communities by expanding and strengthening home-based ECE infrastructure, preschool facilities, and resources. This will strengthen the access and quality of **primary education** to ensure its inclusiveness and enable the successful transition of boys and girls to **lower secondary education.**

SWM is an important component of Actions 1 and 2 and overall project goals. However, contextual knowledge is currently limited and there is a need for deeper research. To meet this need for more information, iDE WASH has collaborated with the iDE Innovation lab on the Solid Waste Management Research Assessment. Details and findings from this initiative are addressed in this report.

2. RESEARCH OBJECTIVES

1. Describe the current SWM context in the ETSL area. Identify stakeholders involved in SWM market ecosystem.
2. Document the journey of solid waste from point of origin to eventual disposal, specifically with a focus on household waste.
3. Explore areas of opportunity for solutions to incentivize the management of solid waste in fishing communities.

3. METHODOLOGY

To achieve the goals and objectives described above, the team applied a human-centered design (HCD) approach. HCD is an innovation methodology that maximizes the likelihood of users adopting a solution(s) by utilizing a systematic process that deeply integrates the latent customer and stakeholder needs in the solutions while applying a discovery-based, iterative approach that follows the following: prototyping, testing, failing and iterating. This leads to desirable, feasible, viable, accessible, and sustainable results.

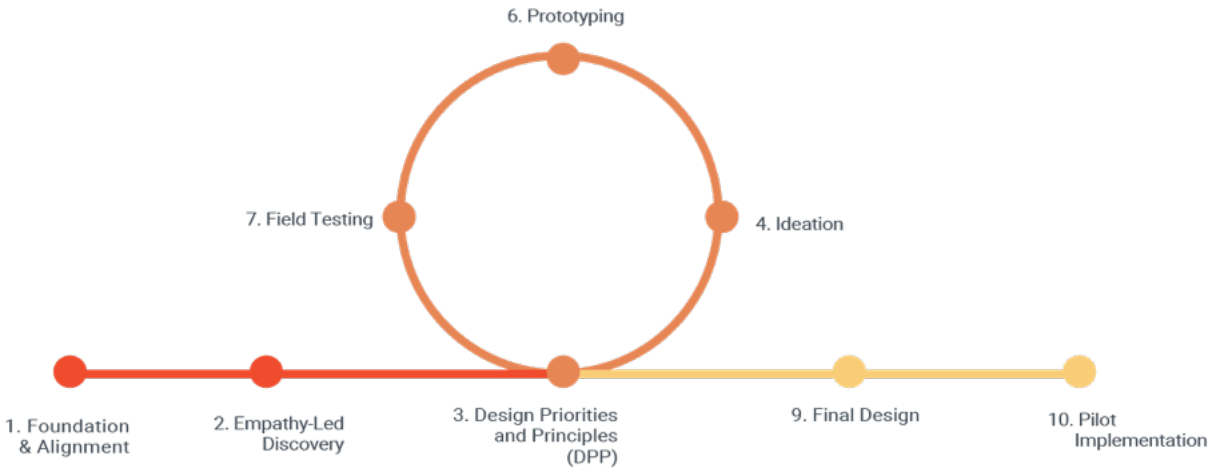

Figure 2: HCD: Innovation Led by People

This research focuses on the first four phases of the HCD methodology: foundation and alignment through ideation.

3.1 RESEARCH PHASES

PHASE 1: PROJECT INCEPTION

The team created an inception report outlining the plan for the research, including research objectives, key questions, locations, target audience, research methods, scope of work, and schedule.

PHASE 2: RESEARCH PLAN

Based on the kick-off meeting with the EU-GREEN team and desk research, locations and key informants were selected and semi-structured interview guides were developed.

PHASE 3: INTERVIEWS AND OBSERVATIONS

The research team conducted interviews with key informants and gathered observations, focusing on understanding the "whys" underlying the "whats".

PHASE 4: ANALYSIS

Rapid analysis and synthesis was conducted at the end of each field day in the form of rapid storytelling sessions, enabling the team to identify interesting insights and information gaps. After completing fieldwork, the team analyzed observations and findings.This analysis involves extracting novel observations, stories, quotes, and learnings from the field then identifying interesting insights, patterns, contradictions, and themes in the observations. The team used visual mind mapping techniques and analysis and synthesis methods including story-telling and affinity maps.

PHASE 5: REPORTING

Key findings were consolidated into a report to share insights and learnings with the EU-GREEN team.

3.2 RESEARCH METHODS

As part of the empathy-led discovery phase of the HCD methodology, the team conducted desk research, expert interviews, and field research. The desk research provided context and identified gaps to be focused on in field research. Expert interviews were conducted with FACT, iDE WASH Cambodia, Wetlands Work, Save the Children, Plastic Free Cambodia, the Ministry of the Environment, and the National University of Singapore–all key actors in the solid waste sector.

3.2.1 Interview methods and tools

This research was completed using several participatory methods and interview techniques:

- **In-depth interviews:** in-depth, extended conversations (1-1.5 hours) taking place in the natural environment of key informants, specifically focused on research objectives.
- **Rapid interviews:** short interviews (20 minutes maximum) focusing on specific topics related to research objects, used to get feedback/validation on an idea or insight. The rapid format allows for collecting information from a larger number of informants.
- **Artifacts/stimulus:** interactive, physical tools to gather information from informants (ex: card sort that allows respondents to sort priorities)

3.3 TARGET LOCATIONS

The target locations were selected within the target areas of the GREEN project. The research team selected locations within Kampong Chhnang, Kampong Thom, and Pursat based on the following criteria:

- Within selected provinces and districts of the GREEN project
- High population density (assumption is high concentration of waste)
- Variety of geographical characteristics including fully floating, seasonally floating, flooded, and non-flooded areas

- Presence of minorities (Vietnamese and Cham)
- Ability to interview variety of respondents

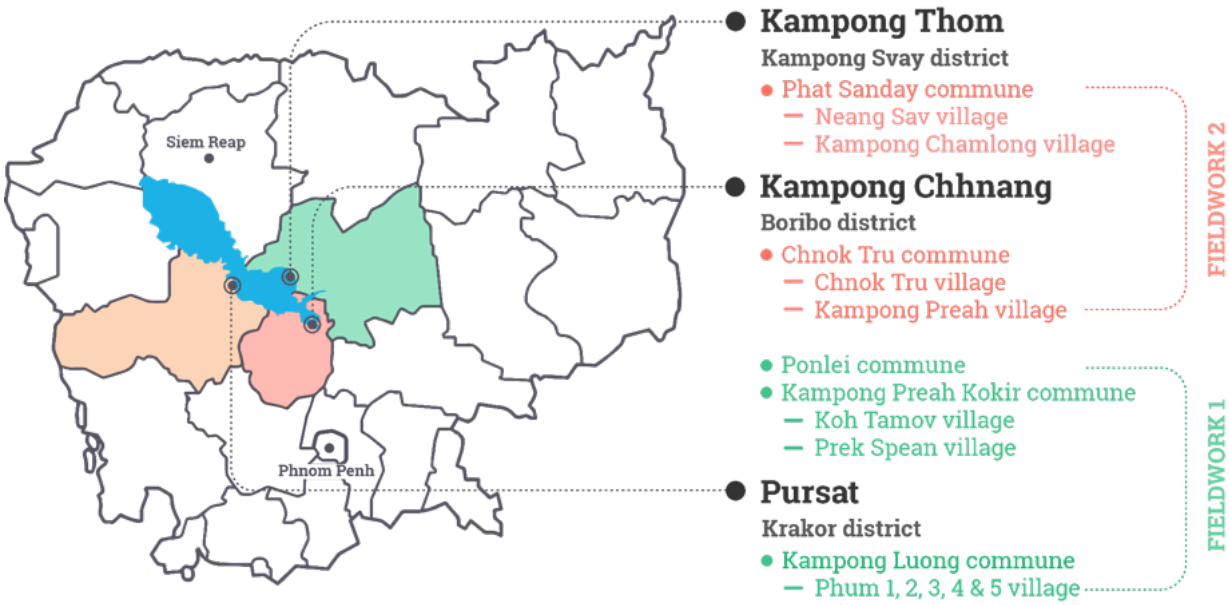

Figure 3: Selected ETSL communities

In the ETSL area, some households are in villages that never flood from the lake's seasonal expansion, others are in villages that flood seasonally (up to six months per year) and some are in areas that are flooded year-round (houses are floating on water). This results in varying practices, availability of services, and barriers to SWM access. The research focused on villages in each of these categories to better understand the complexity of the SWM situation in this context.

3.4 RESEARCH TARGET PROFILE

The research team engaged with a variety of actors in the ETSL area:

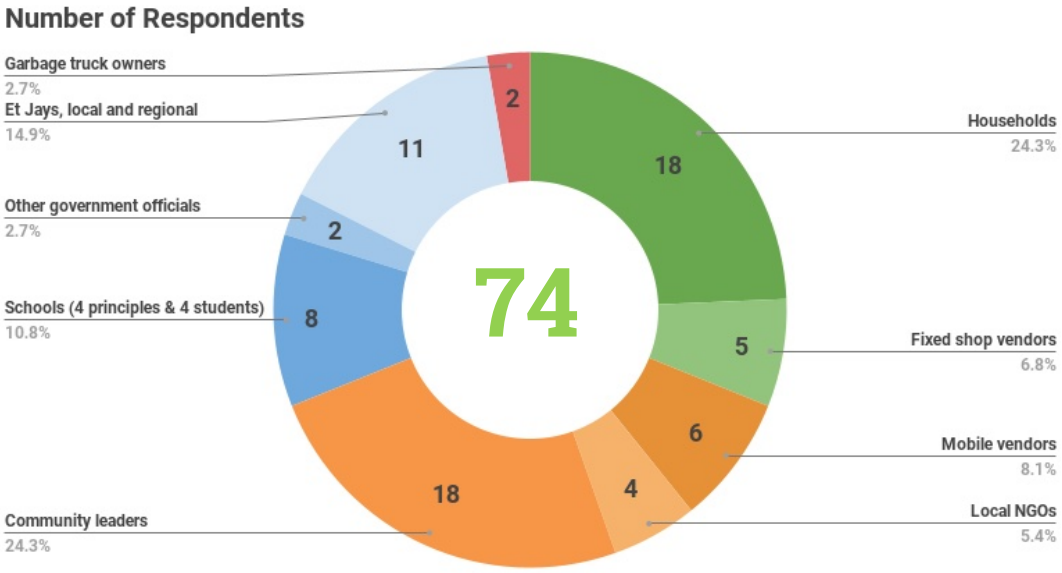

Figure 4: Number of respondents by category

3.5 RESEARCH TIMELINE

This research took place in 2022, beginning in March, with key findings presented in July.

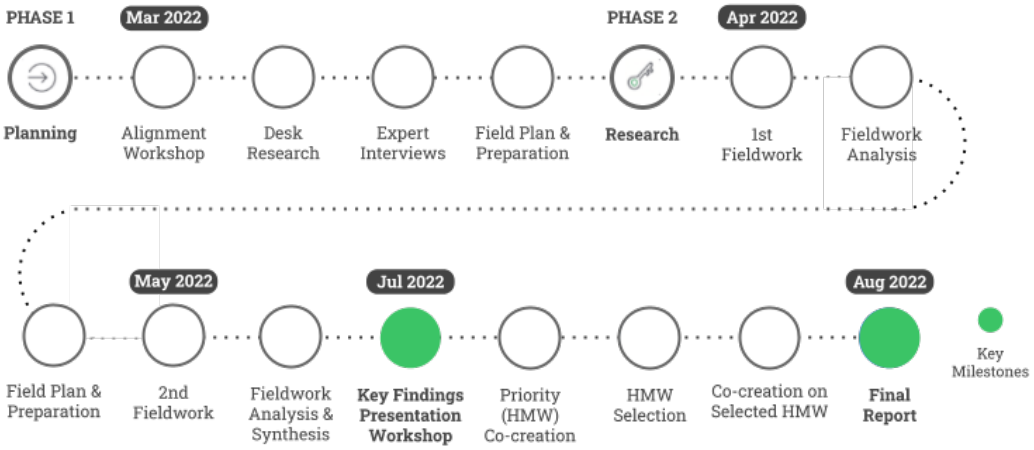

Figure 5: Research timeline

4. KEY FINDINGS

4.1 SOLID WASTE OBSERVED IN ETSL COMMUNITIES

According to the World Bank, Cambodia generates four million tons of solid waste annually (2015). This research focuses on commercial solid waste[1] with a special emphasis on plastic waste– the most pressing issue for the ETSL community. Other types of waste (glass, metals, etc.) are discussed in less depth.

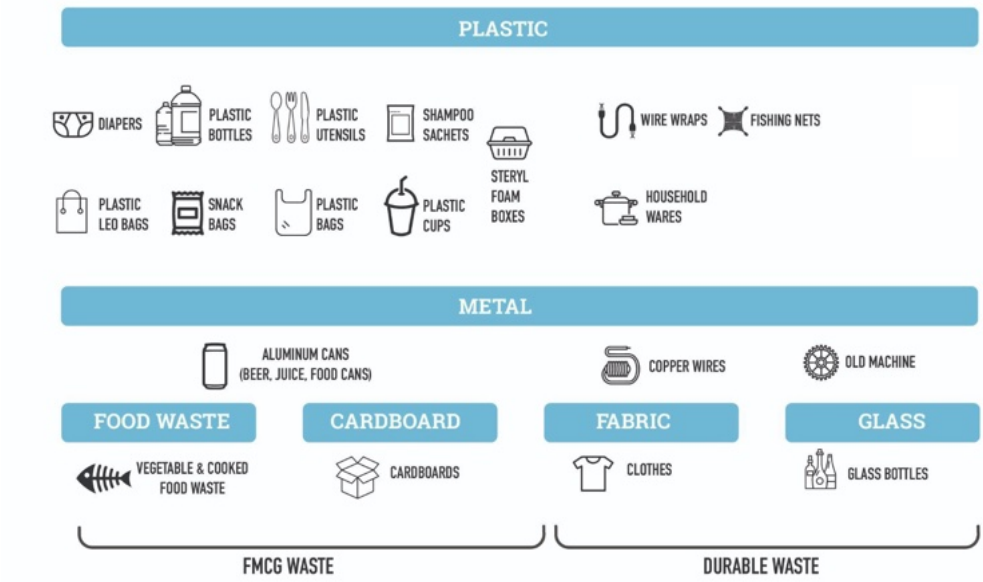

Figure 6: Observed solid waste in the ETSL community

[1] Commercial solid waste includes, cardboard, plastics, wood, food waste, and glass, metals, special waste, and hazardous waste

Residents generally perceive plastics as the most littered solid waste in the region. While the research team could not confirm whether this is the largest quantity of solid waste generated in the community, based on observations, it has the greatest presence in the environment.

There are different types of plastics with different densities and compositions including PET, HDPE, PVC, LDPE, PP, and PS. Types of plastic waste include plastic cups, plastic straws, plastic spoons, plastic bags, plastic drinking bottles, plastic sachets, plastic snack bags, styrofoam bowls/boxes, and diapers. Plastic waste was seen either floating in the river, sitting on the shore, scattered on land, and in foliage including bushes and water hyacinth.

Glass waste was also observed in many places including homes, on roadsides, and in the water. Food waste is another common waste that people dispose of in the water with or without packaging (sometimes wrapped in plastic bags floating in the river). This is less observed due to food waste decomposing. After the wet season, newly dry areas of the community are often littered with waste.

Image 1: Solid waste scattered at Chhnok Tru village, a key port to the Tonle Sap Lake in Kampong Chhnang province

4.2 SOLID WASTE GENERATION

4.2.1 Identified solid waste generating sources

Solid waste in the ETSL community comes from several sources: internal, external, and transients/mobile vendors.

- ***INTERNAL***. Internal waste is generated *within* the community from households, schools, restaurants, and other public institutions.
- ***EXTERNAL***. External waste is generated from communities upstream or up-current (including markets) and flows into the community.
- ***TRANSIENTS/MOBILE VENDORS***. Waste is littered by individuals and mobile vendors who do not live in the village, but pass through including mobile vendors and fishermen from other areas.

Image 2: Solid waste observed scattering at the river shore at Tonle Sap lake

Image 3: The plastic waste scattering at the roadside at the ETSL community

4.2.2 Flow of products and waste into communities

Figure 8 illustrates how goods flow into the ETSL community and eventually generate waste. In general, wholesale and retail vendors bring goods to the community. Households then receive their goods (foods and daily use materials) from these vendors. Households will also attend district markets to purchase foods or products that are not available at the community level.

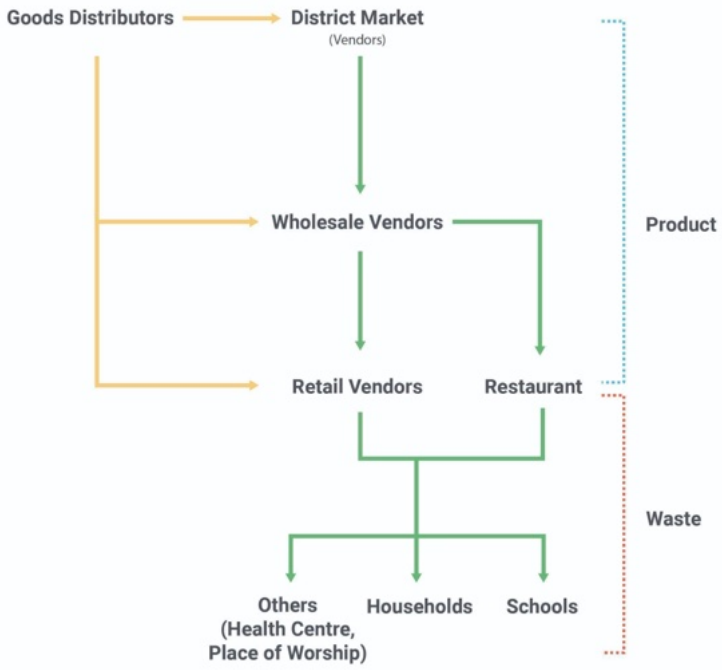

Figure 8: Flow of products and waste into ETSL communities

4.3 QUANTITY OF INTERNALLY GENERATED WASTE

The research team used surveys to roughly estimate the amount of waste generated by households, vendors, and restaurants. The team interviewed a small sample of 18 households, six mobile vendors, five stationary shop owners, and two restaurants within five communes. The survey asked the number of waste items disposed of each day and calculated the mass of the waste generated per day. This research focused on daily waste generation, namely from fast moving consumer goods. Some examples of this type of waste are plastic bottles, beer cans, diapers, and leftover cooked foods. This survey did not capture "durable waste," or items will last longer in terms of time such as fishing nets and kitchen tools. Food and other organic waste was also not assessed.

The communities surveyed were located in relatively rural areas, and as such they may have a smaller generation of waste compared to wealthier locations or villages closer to district markets. The markets that generate a significant amount of solid waste are not included in this analysis. A more rigorous study would be needed to understand the daily solid waste generation of the ETSL area in greater detail.

HOUSEHOLD

Household waste generation varies depending on the size of family and economic status. Based on 18 household interviews, one household may generate approximately 324 grams of waste (excluding food waste and durable waste) per day. Plastic waste mainly includes plastic bags, plastic straws, "leo" bags (used for holding cups), and plastic cups.

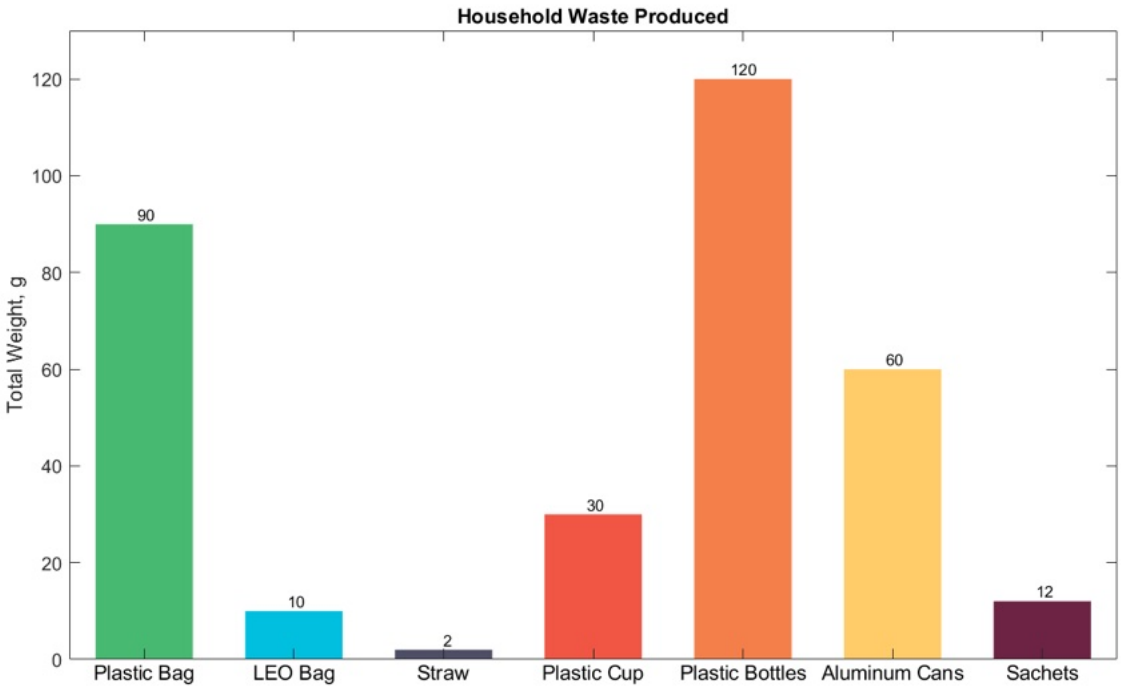

Figure 9: Reported solid waste that a household generates in a day

Image 4: Household interviewed at Kampong Loung commune, Pursat province

MOBILE VENDOR

Based on six interviews, one mobile vendor (snack and drink mobile vendor) produces approximately 818 grams of solid waste per day, mainly consisting of aluminum cans, plastic bags, plastic cups, plastic bottles, milk containers, and plastic straws.

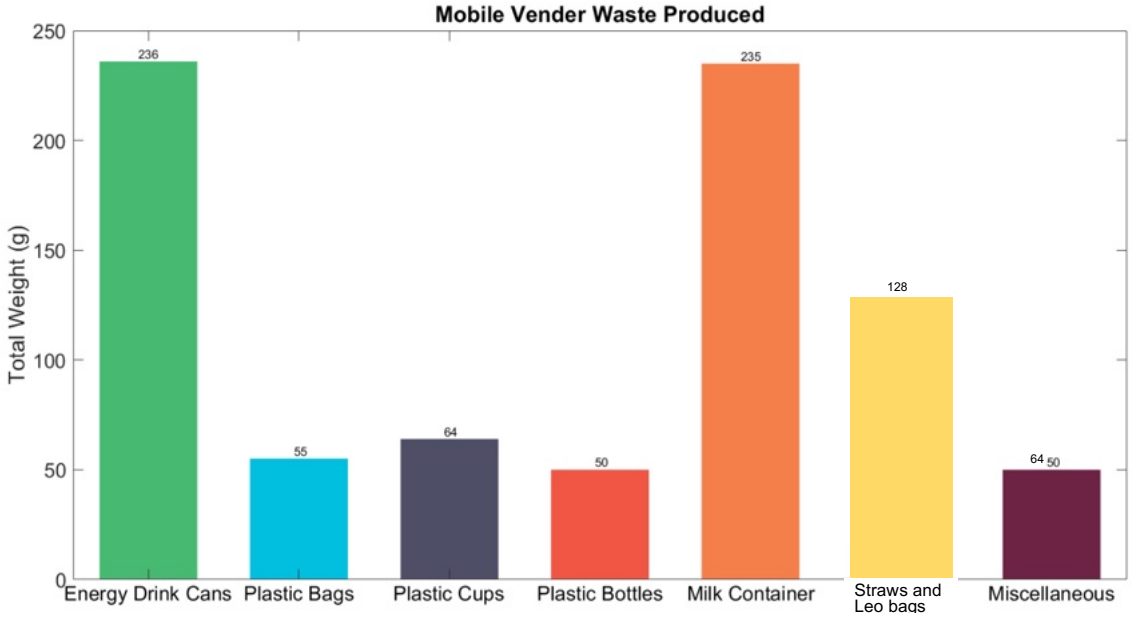

Figure 10: Reported non-food solid waste that a mobile vendor generates in a day

Image 5: Mobile vendor interviewed at Kampong Luong commune, Pursat province

FIXED (NON-MOBILE) SHOP VENDOR

Based on five interviews from a mixture of small, medium, and large shops, one fixed shop vendor (grocery store) produces approximately 1,011 grams of solid waste per day, mainly consisting of plastic water bottles, plastic snack bags, nylon rope, and aluminum cans.

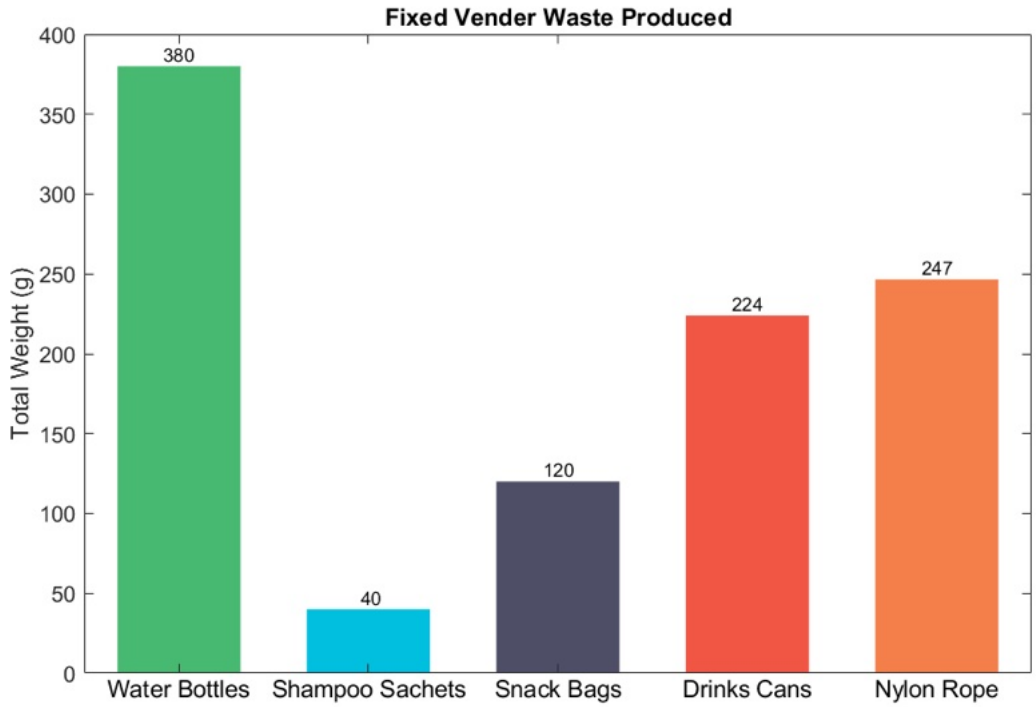

Figure 11: Reported non-food solid waste that a fixed shop vendor generates in a day

Image 6: Stable/fixed shop vendor interviewed at Kampong Preah Kokir commune, Kampong Chhnang province

RESTAURANT

Based on two interviews, a single *small* restaurant produces approximately 2,324 grams of solid waste per day, resulting in a ton of waste generated annually from one restaurant. This amount of waste increases in areas of high population. In the ETSL area, restaurants generate the largest amount of waste.

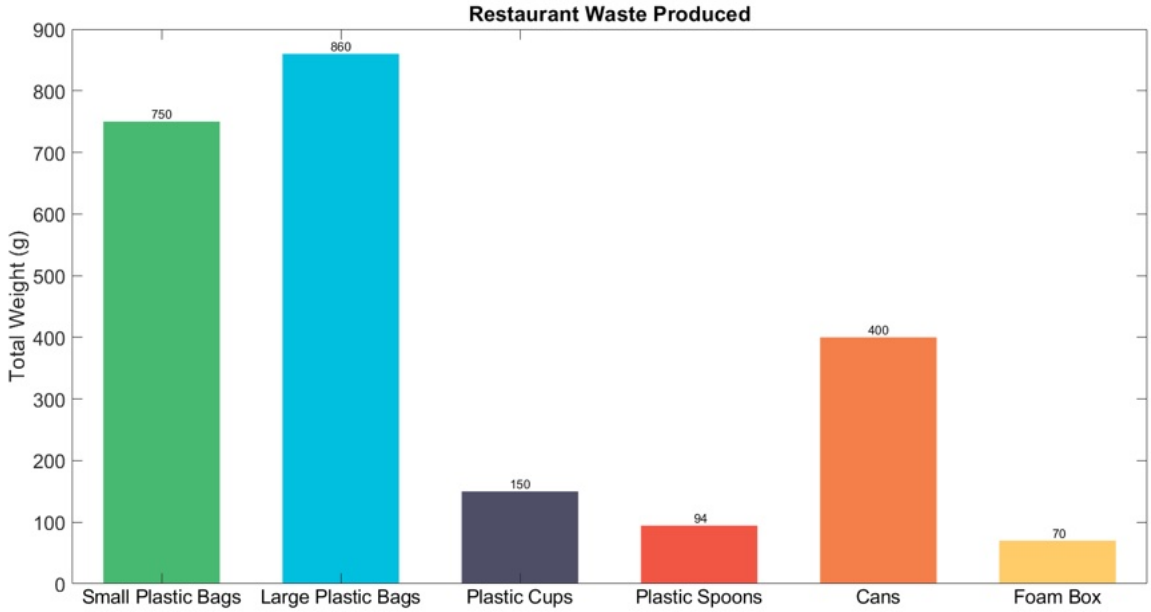

Figure 12: Reported non-food solid waste that a restaurant generates in a day

Image 7: Restaurant interviewed at Kampong Luong commune, Pursat province

4.4 FLOW OF SOLID WASTE

4.4.1 Current solid waste practices

In general, ETSL communities generate similar types and volumes of waste and therefore have similar perceptions and attitudes towards solid waste. However, current solutions for non-saleable waste at the household level vary depending on several factors.

- **Knowledge**. This refers to understanding the importance of keeping the environment and households clean, leading to healthier environments for families and communities.
- **Emotional**. This refers to the individual emotional response that triggers a response in managing solid waste.
- **Environmental**. This refers to the context in which households live, which as noted above varies due to proximity (and duration of that proximity) to water.

The most common practices in dealing with solid waste are burning and throwing away, either into the water or on land. In general, burning is the most common practice for those who live on land or have access to land. However, those with access to land may also bury or dump their waste near their home. This practice of dumping waste is much more common when waste is wet, often during the rainy season.

The practice of managing waste is more difficult for those who live on the water (fully floating and seasonally floating) or live in the seasonally flooded areas. Their common practice is to throw waste into the water, either consolidated in a plastic bag or as individual pieces. Those who live in seasonally flooded areas are inclined to throw waste into water during the rainy season as the water surrounds their house and hinders their ability to burn trash.

Seasonal variation is a key factor driving variation in SWM behavior. As illustrated in Fig 13 below, people in year-round dry areas often burn their trash in all seasons and sometimes bury it near or on their property. Households with seasonal flooding are likely to burn or bury waste

in the dry season but often litter openly into the environment in the rainy season. People living in year-round flooded areas tend to throw waste into the water during all seasons.
Some households living far from the water but close to a local market may have access to waste collection from private garbage trucks if they pay a service fee. This service is highly uncommon within the ETSL and not always reliably available where it exists.

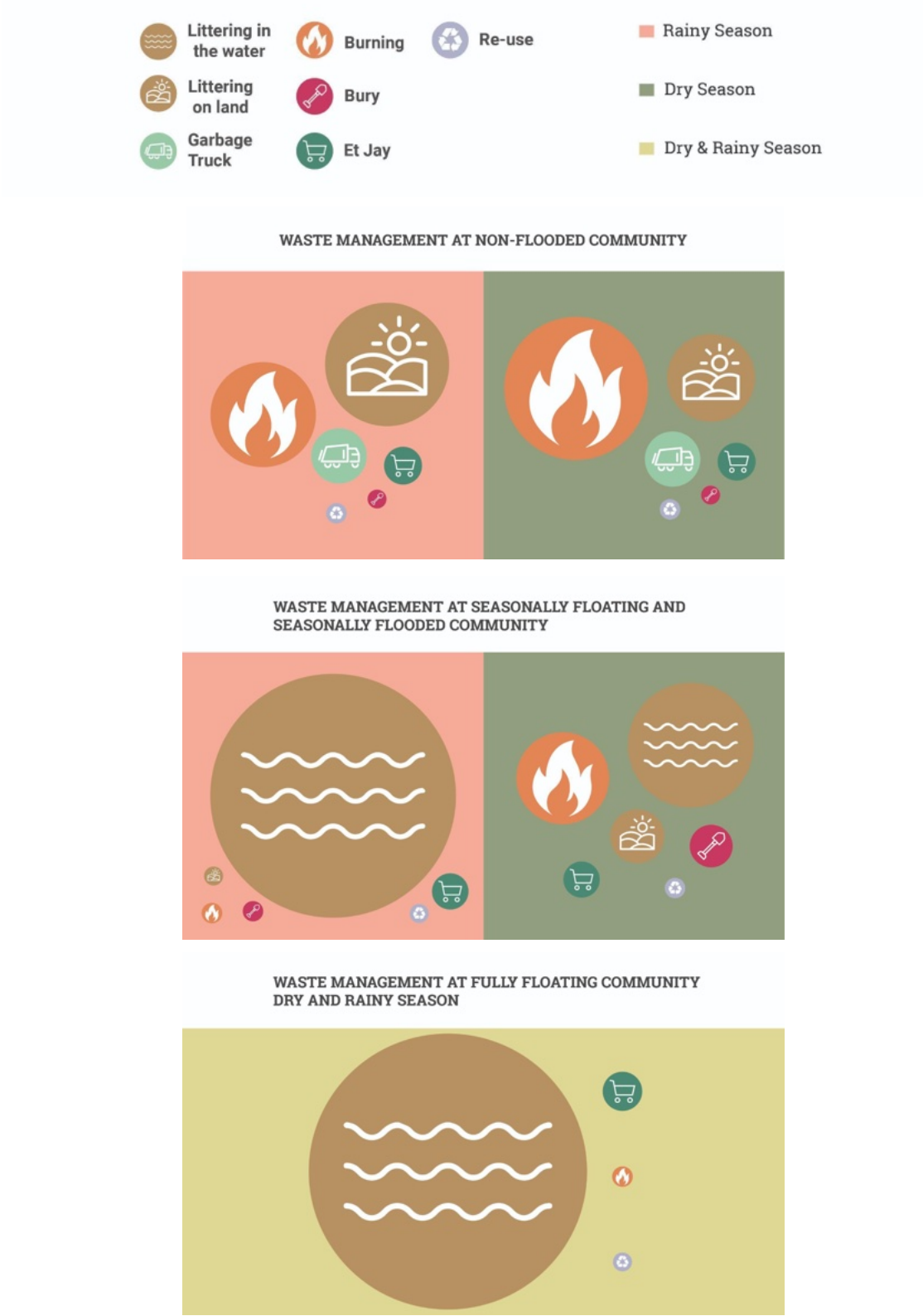

Fig 13. Current SWM practices in ETSL villages by village characteristic

Findings in this section refer mainly to households, vendors, shops, and restaurants. However, the research team found different SWM practices among government institutions, such as schools and health centers. For example, schools and health centers required waste to be placed in designated bins to be collected for burning. Some schools had waste pits for burning trash generated at the school.

Farmers often bury their agricultural plastic waste by burying it or plowing it underground rather than burning. However, during floods, this agricultural plastic waste can spread and float into water bodies.

All households, public institutions, vendors and restaurants collected and sorted at least some types of saleable waste for et jays. For plastic bottles, a small number are reused (e.g. storing gasoline or dish soap). On land, plastic bottles are often collected to sell to et jays. However, in areas near or on the water, et jays often won't buy plastic bottles due to relative challenges transporting high volumes of relatively low value waste. In these areas, plastic may also be considered low quality as it may be soiled after long periods of floating in the water. In the figure below, the seasonal practices of households

4.4.2 Solid waste flow mapping

Figure 14 describes the journey of solid waste, delineating saleable and non-saleable wastes. Saleable waste sorting is done in the interest of selling it. Sorting is done by households, vendors, scavengers, and garbage truck collectors. Only a small portion of salable waste ends up in dumpsites or littered on land/water.

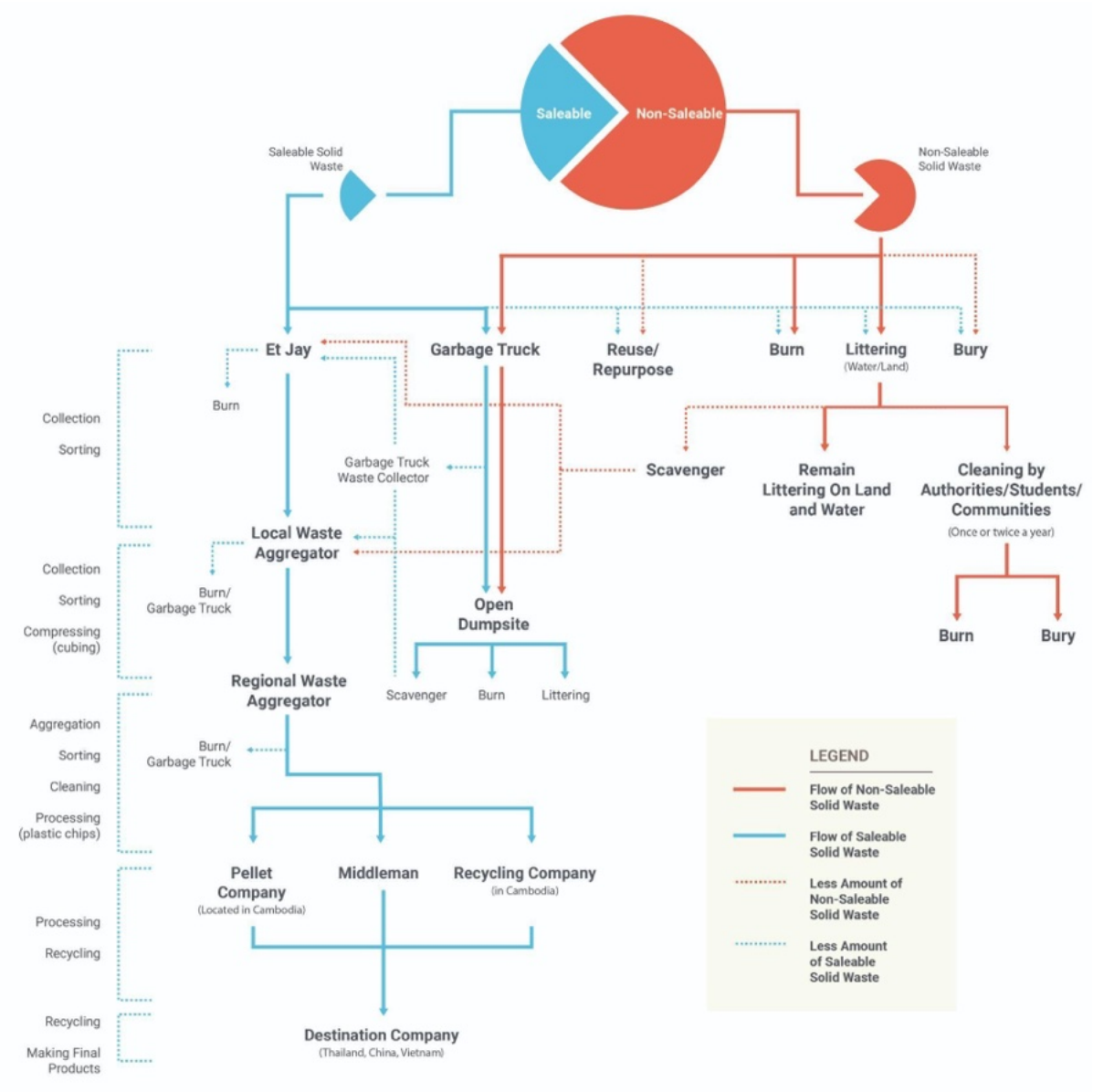

Figure 14: Waste journey at the ETSL community

4.4.3 Saleable and non-saleable solid waste

Households in the ETSL community often categorize solid waste as saleable (has monetary value) or non-saleable (no monetary value). Figure 15 shows some of the most common waste the research team found in the field and places them on a non-saleable and saleable scale. Items high on the scale –aluminum cans, copper wires, old machines, and cardboard– are kept by households to be sold to an et jay. Items in the middle of the scale may be saleable or non-saleable, depending on the particular et jay who is buying. Items at the bottom of the scale had no known buyers in the ETSL.

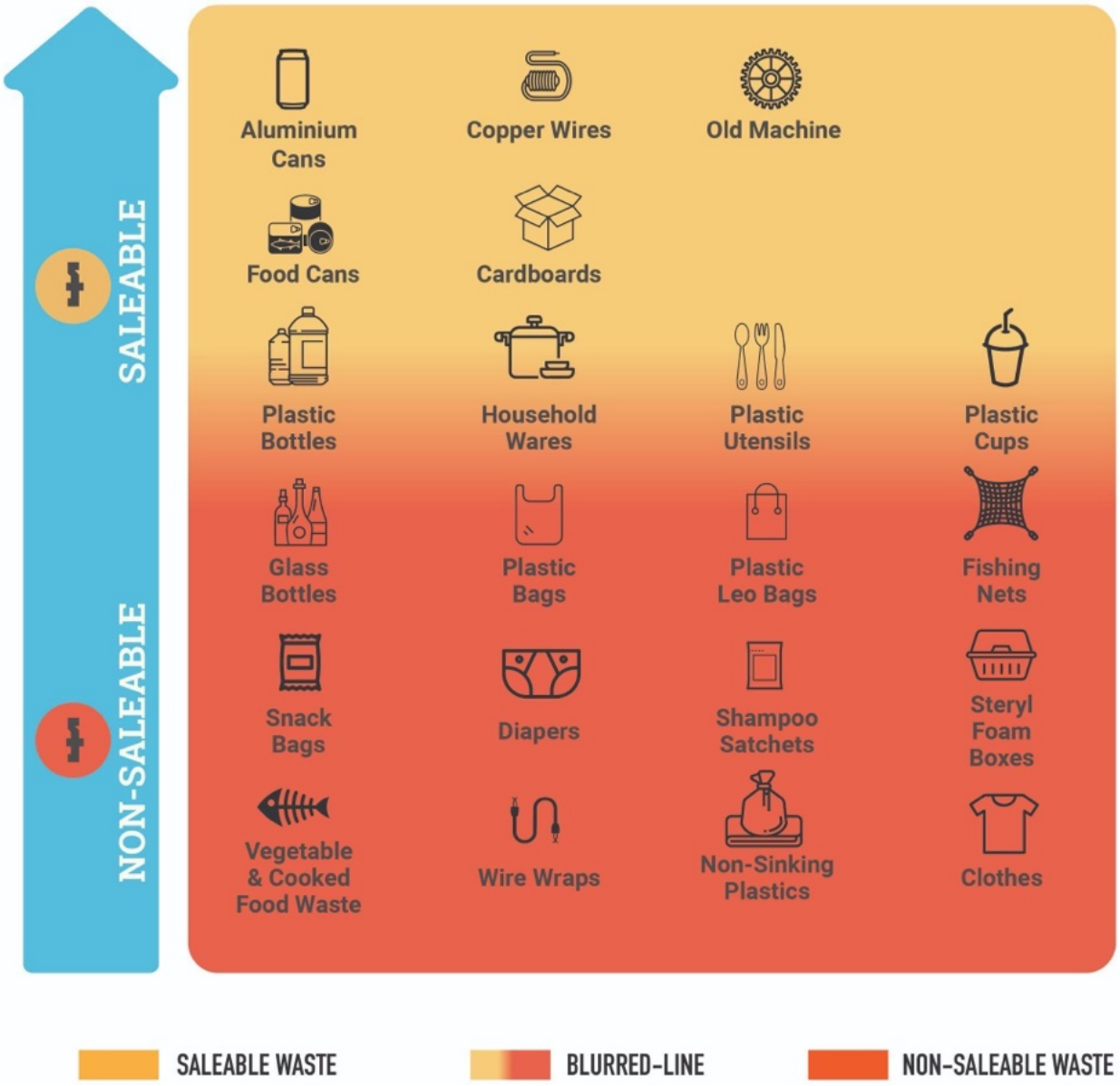

Figure 15: Observed solid waste at the ETSL on the saleable and non-saleable scale

SALEABLE SOLID WASTE

Based on the field interviews and observations, it is clear that households are aware of saleable versus non-saleable solid waste. Generally, they save their saleable waste to sell to et jays when they have enough (5,000 riel worth or more). The money earned from selling saleable waste is normally shared among the household members, especially kids. The motivation among households in the ETSL community is quite high to keep and sell saleable solid waste to et jays, but motivation varies based on waste type. For example, aluminum beverage cans are prioritized compared to cardboard.

Plastic bottles and food cans are on the blurred line between saleable and not-saleable solid waste. In some areas, et jays will buy these wastes at low prices (ex. 200 reil per kg of plastic bottles). In other areas, these wastes are not accepted by et jays. Main reasons for et jays not purchasing this waste include transportation costs and challenges (especially transporting high volume/low weight products by boat), low margins, storage constraints, and local aggregators asking that et jays not purchase them when there is no market to resell. Some

buyers also reported that the quality of plastic bottles from flooded communities is often lower because they have been soiled after long durations floating in the water. This can also reduce their perceived value.

Figure 15 below provides a high level understanding of the price point and range of the most common saleable wastes –aluminum beer cans and plastic bottles– based on interviews with households, et jays, and local and regional aggregators. The research team was not able to capture all the buying and selling prices of other waste types. The data was derived from 11 interviews (7 local et jays, 2 local aggregators, and 2 regional aggregators) and does not intend to generalize the price ranges and market price of the aluminum cans or plastic bottles, but to give insight to the price range and how it varies.

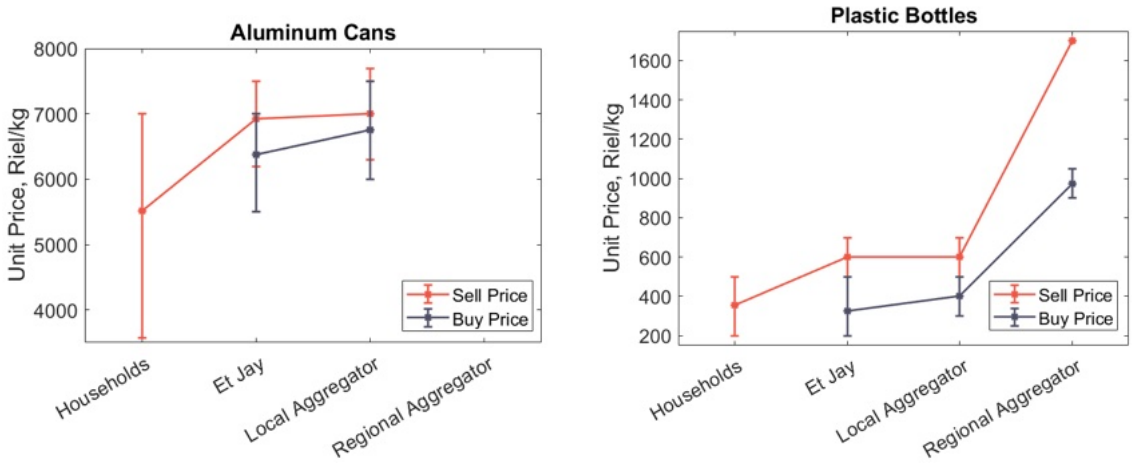

Figure 16: Aluminum can and plastic bottle price range

Aluminum cans (such as beer cans) are the most popular waste that households collect to sell to et jays. Households can earn 4000 to 7000 riel per kg for aluminum cans. Et jays who buy aluminum from households reported generally profiting 500-1000 riel per kilogram of aluminum. Profit margins for local aggregators were reported to be generally smaller; however, it is likely that they compensate for this by selling in large quantities.

Plastic wastes have much lower profit margins than aluminum cans. Households reported selling PET bottles for 200-500 riel per kg, and et jays reported selling bottles to local aggregators for 500-700r. Therefore, et jays reported profiting between 200-500 riel per kg. Value of plastic increases significantly after being processed, as regional aggregators report the highest selling value of their plastic. However, that does not necessarily equate to profit, considering the major capital investments necessary for advanced plastics processing.

In general, it was challenging to ascertain if interviewees provided accurate information on the price for which they sell products to their buyers. Particularly for the local aggregators, the reported selling price of their product was far lower than the reported buying price reported by the regional aggregator. It is reasonable that a business operator would not make her or his margins publicly known, as this could put pressure on them to increase their own buying price from local et jay collectors. Additionally, this discrepancy may be due to the fact that only two local aggregators were interviewed and may be anomalous.

Lastly, interviews indicated that prices for waste fluctuate frequently and significantly depending on season and buyer preferences. For example, in the rainy season when waste collection is more difficult, some buyers increase their buying prices to incentivize collection. Conversely, some buyers may stop buying certain types of waste like PET bottles entirely in

the rainy season as it is more challenging to accumulate enough volume to be profitable. During rains, it's also possible for waste to become more soiled with mud and dirt, which can decrease the value, especially for plastic bottles. Macro-level shifts in international buying prices can also quickly shift prices at the village level. One example of this is decreased value of PET plastic bottles during COVID-19 pandemic due to border closures to Vietnam and Thailand that prevented shipment of waste to processing facilities in those countries.

Image 8: Saleable solid waste collected to sell to et jay at a household in ESTL community

NON-SALEABLE SOLID WASTES

Many household wastes are non-saleable including glass bottles, diapers, snack bags, and shampoo sachets. LDPE plastic bags and polystyrene food containers were among the most common plastic waste observed littering the community and both households and businesses reported no known buyers of this type of plastic. These waste are not considered valuable or reusable at the community level and are likely to be burned, littered, or scattered at dumpsites

The research team found that in some cases, there is a market at the regional level for traditionally non-saleable waste. For example, there is a plastic buyer in Oudong, Kandal province that buys HDPE plastics without the waste needing to be cleaned or processed. There are also a limited number of buyers for LDPE bags in Cambodia. However, access to these buyers is limited due to high transportation costs, especially for remote households in the ETSL area.

Image 9: Non-saleable waste observed at ETSL community

Image 10: A couple working as et jay at Krakor district, Pursat province

Image 11: Local waste collector at Krakor district, Pursat province

Image 12: Cubed plastics at the regional waste aggregator at Oudong district, Kandal province

4.5 CURRENT SWM INITIATIVES

4.5.1 PRIVATE SECTOR

SMALL-SCALE/INFORMAL COLLECTORS (ET JAYS)

The private sector is the driving force for SWM in the ETSL area and is mostly composed of informal “et jay” waste collectors. Individuals and families operate these small enterprises with limited assets including hand carts, fishing boats, and motorbikes with trailers. Some have limited space at their homes or accessible land to store collected waste. As noted above, in fully flooded areas these collectors primarily collect aluminum cans and scrap metal. In mainland, non-flooded areas, plastics collection (primarily PET bottles) and cardboard is also common.

Et jays in the ETSL do not appear to have particular loyalty or firm connections with a specific local aggregator, but rather bring waste to the aggregator who they perceived to offer the best market rate. They reported getting this price information from other et jays or the regional aggregators themselves. As prices for materials in this area have fluctuated rapidly in the past years and more regional aggregators have begun operating in the area, et jays appear to have the ability to diversify their buyers to access better prices. However, price transparency and access to this information was revealed to be a challenge nonetheless. Seasonality has a major impact on et jays in this area. In the rainy season (July-Nov), waste is harder to collect due to bad road conditions and in many cases the need to use boats in addition to land transportation to reach households. Plastic waste can be also be considered lower quality if it is wet or dirty, which can yield lower prices when they sell to local aggregators. As such, income fluctuates widely for small-scale et jays during the year and many do not have access to significant capital reserves.

LOCAL AGGREGATORS

Local aggregators (also known as depots) are buyers of waste including plastics, metals, and cardboard from small-scale et jays. All have space for sorting and storing waste. Most have invested in some type of capital machinery including trucks, waste compactors (balers), and cranes to move compacted waste bales. Many have employees that support with waste sorting, packaging (including baling), and loading for transportation. Local aggregators often sell their waste to regional aggregators and ship waste to these buyers via owned or rented trucks.

As is the case for small-scale et jays, seasonality is a challenge for local aggregators in the ETSL. In the rainy season, the volume of waste they are able to buy can decrease significantly. One regional aggregator reported a difference of being able to buy and sell 10 metric tons of PET bottles per month in the dry season versus six tons in the rainy season. Other challenges include maintenance of machinery like balers, which may require specialized parts not locally available. Long delivery times for these parts can result in local aggregators not being able to process and transport waste. If these delays persist, eventually aggregators may be forced to stop purchasing waste from et jays due to limited materials purchasing capital or storage space. This also likely contributes to volatility in local markets as et jays lose some negotiation power by being required to sell to a narrower selection of local aggregators, if any.

Image 15: Local Aggregator Facility in Pursat Province

REGIONAL AGGREGATORS

Regional aggregators are located closer to urban spaces including Phnom Penh, Siem Reap and Battambang. These aggregators have large storage space for waste and have often invested in heavy machinery and transportation. Virtually all have invested in waste balers and some have invested in processing lines to shred and wash plastic. Regional aggregators purchase waste from large radii, often comprising multiple provinces. These businesses often have direct relationships with international or domestic materials buyers, who request waste with detailed specifications (including type, size, weight, quality and volume). Relationships may be directly with recycling companies or with middlemen who interface with recycling companies. In one reported instance, the buyer (a middleman) actively facilitates investment for the regional aggregator to purchase heavy machinery and expand processing capabilities.

Regional aggregators were extremely reticent to share buyer contact information with the research team. As a result, the team was not able to corroborate information about buyer preferences and support offered.

Image 16,17: Plastic Shredding Facilities at Regional Aggregator near Phnom Penh

WASTE COLLECTION SERVICES/GARBAGE TRUCK OPERATORS

Fee-based, residential waste collection services through waste trucks are uncommon, but sometimes available to those who live on land near district towns and markets. In the few instances in which these service providers were identified, they were also responsible for managing solid waste from the district market. These businesses operate under the authority of a permit granted by district officials. Permit holders may subcontract work to service providers and appear to have wide jurisdiction for dictating the terms of the subcontracting arrangement. Conversations with district level authorities indicated an unclear bidding process and limited support from local authorities to facilitate conditions that could incentivize broader residential SWM service provision. For example, district officials in Kampong Luong district, Pursat, described that while an operating permit is for 20 years, subcontracts offered from that permit-holder to direct service providers (i.e. truck operators)

in that area are for one year. This short contract period is a major barrier to incentivizing investment in durable machinery and professionalizing a workforce.

In Kampong Luong, service providers reported waste collection fees of 5,000-10,000 riel per household (depending on if the household also runs a business). Fee collection is done directly by the service provider and is not managed or facilitated by local authorities. Reticence from service providers to handle payment collection, risk of not receiving payments and reports that many households are unwilling to pay for this service are apparent barriers for service expansion. Cost of purchase and maintenance of heavy assets including waste trucks also appear to be barriers.

Image 18: Garbage truck service running at Kampong Loung commune, Pursat province

Additionally, there are no formal landfills available, only open dumpsites with irregular means of maintenance and access. Dumpsite land is sometimes allocated from local authorities at the commune or district level, however some sites are privately owned and operated. There does not appear to be regulation, oversight, or mandated maintenance of such sites from authorities.

Image 19: Municipally owned open dumpsite in Boribo District, Kampong Chhnang Province

4.5.2 COMMUNITY INITIATIVES

At the provincial level, the Department of Environment leads SWM work, contingent on the provincial administration's support. The district administration and commune councils are responsible for SWM work at the sub-provincial level. However, they expressed limitations in financial support, SWM knowledge, and resources (including human resources). As noted above, district authorities are responsible for administering the bidding process for solid waste management service provision around district markets. District officials expressed challenges with organizing this bidding process and ensuring quality of service provision after the contract was awarded.

In some communities, there is a once-per-year SWM initiative that is led by the district administration and commune offices. Students, teachers, local authorities and other relevant stakeholders (including the ETSL community households) are called and gathered to clean up the area, collecting waste that is scattered on the road or public spaces in the commune. This activity is generally conducted after the rainy season. In general, local authorities described SWM activities as reactive in nature, with most efforts (primarily clean-ups) being connected to events including visits from high-ranking government officials or celebratory events.

While there appears to be general community awareness of plastic contamination of the environment in the ETSL, especially in areas near or surrounded by water, there is little in the way of systematic action at the village level to address the issue. Some basic incinerators have been produced by the communities but households still face challenges regarding waste transportation, lack of human resources, and no financial support. More technologically advanced incinerators introduced by NGOs have had challenges regarding sustainability and maintenance. Novel ways of waste burning have been used in flooded areas. In Phat Sanday commune, community leaders described that on an irregular basis, local officials will facilitate trash burning on the open water over a mass of floating water hyacinth. The official reported that hyacinth is first grouped up, then non-organic waste (primarily plastic) is piled on top before a flammable agent like gasoline is poured over the pile in order to ignite it. The research team did not witness this practice, however it was corroborated by multiple officials within this commune. It is unclear how often this has taken place.

Waste collection bins have been provided by an NGO to several villages, however market access to such bins, consistent household use of them, and means for waste conveyance and safe disposal remain a challenge.

Image 13: Basic incinerator owned by a local school for burning waste at Kampong Luong commune, Pursat province

Image 14: Bins at households for waste storage

Schools and health care centers are in some cases implementing their own solutions. Health centers may have their basic incinerator or collect and transport waste to burn elsewhere. Some schools have their own waste pits for dumping and burning trash.

Implementers previously involved in SWM solutions in the ETSL area include FACT, JICA, and VSO. Ministry of Environment is also engaged and promoting community-based incinerators but with limited evidence of community uptake and investment.

7. LIMITATION & CHALLENGES

- The project focuses only on provinces located around the East Tonle Sap Lake, including Pursat, Kampong Chhnang, and Kampong Thom. Specifically, the research only included districts of these provinces that are adjacent to the Tonle Sap Lake and River.
- This research is qualitative in nature and any quantitative representations are rough estimates, not intended to withstand statistical scrutiny.
- Inconsistencies between reported buying and selling prices of waste from and between local and regional aggregators suggest that information on margins from service operators may not be fully credible. This was expected due to the sensitive nature of these questions and reasonable desires for private cost information to be confidential (despite the research team's assurance to interviewees that specific identifiable information would be kept confidential).
- A small amount of regional waste aggregators agreed to be involved in the research study, and none who were interviewed provided contact information for their buyers (including recycling companies and middlemen). Therefore information from these regional aggregators may be anomalous and was difficult to corroborate.
- The research was done in the dry season. Due to considerable fluctuation in circumstances between rainy and dry seasons within this area, in-person observations of the area during the rainy season would add strength and corroboration of insights. As it stands, insights around behavior and context during the rainy season were not verified by direct observation.

8. APPENDICES

Appendix I: SWM Stakeholders

Appendix II: Influence/Interest Matrix

Appendix I: SWM Stakeholders

This table lists the stakeholders, identified by the research team, who are involved in solid waste management at various levels. They have been classified as influencers, implementers, or supporters of SWM in the ETSL. These stakeholders are from three different sectors: Government, Private Sector and NGO.

INFLUENCER Those who have the ability to influence decisions of SWM	**IMPLEMENTER** Those who work directly to implement SWM	**SUPPORTER** Those who are only occasionally involved in SWM solutions and have limited influence

GOVERNMENT SECTOR	PRIVATE SECTOR	NGOs

	STAKEHOLDER	ROLES	ACTIVITIES
1	**DoEF - Department of Economic and Finance**	Financial controller of provincial SWM.	- Selects a solid waste collector through a bidding process - Issues license for the selected waste management service provider
2	**DoE - Department of Environment**	Leading institution on SWM at the provincial level.	- Work with provincial and district levels to conduct annual environmental day (cleaning up area around Tonle Sap) - Provide training on SWM
3	**Provincial Administration**	Priority setter of the provincial administration to all relevant departments and organizations.	N/A
4	**District Administration**	Priority setter of the district administration to all relevant units, offices, and organizations. Intermediary between provincial	- Involved in the process of bidding for new waste management service providers at the district level (centered around district market). - Work with relevant government officials to solve any rising environmental issues at the district level (ex: waste at the market is not collected on time) - Lead ad hoc SWM initiatives. Students, teachers, local authorities, and other relevant stakeholders (including the ETSL community households) are

STAKEHOLDER		ROLES	ACTIVITIES
		and commune level authorities. Financial controller of sub-provincial initiatives.	called and gathered to clean the waste scattered on the road or public space in the commune once a year. - Initiate to have an incinerator at the district or commune level (not yet successful)
5	**Commune Council**	Priority setter from the district administration to all relevant stakeholders who work at the commune and village level. Intermediary between district and village level officials	- Lead/join ad hoc SWM initiatives led by the district administration or commune office itself. - Offer permission and support to different stakeholders as required for the SWM project. - Mediate to deploy solid waste solutions such as given-away bins to the households in the community - Have a monthly meeting with village chiefs to get overall updates from each village to solve problems - Ensure the market is clean and resolve community complaints regarding waste
6	**Public Entity (ex: school principles)**	Source of SWM knowledge and continue to educate at schools	- Develop their own SWM solutions such as having waste pits or incinerators. - Commit to doing extra regarding SWM by imposing rules for students (ex: waste needs to be placed in the bin and brought to the dry land to burn) - Some schools allow students to collect saleable waste to sell to an et jay. - Collaborate with different partners (including the department of the environment) to run SWM projects at school.
7	**Village chief**	Intermediary between commune officials and households within a village.	- Lead house-to-house SWM education - Gather people for meetings with NGO staff. Collaborate with and support NGOs and other stakeholders in implementing SWM projects - Participate in the assigned SWM activities by the commune office - Report the actual situation (generally to the commune office) regarding waste in the village.

	STAKEHOLDER	ROLES	ACTIVITIES
8	**Pellet company / recycling company**	Producer of recycled goods or saleable plastics products including pellets	Buy plastic and shred, melt, pelletize, and/or produce recycled products.
9	**Garbage truck service owners**	Trash collector from the district town market and surrounding households	- Go through the bidding process to have access to communities located in the district town - Arrange for dumpsite use (including creating their own if needed)
10	**Middlemen**	Intermediary between aggregators and recycling companies	- Shipping waste between actors in the value chain - Connecting waste buyers to sellers
11	**Regional Waste Aggregator**	Waste buyer from local waste aggregators and et jays	Buys and sells waste from local aggregators or nearby et jays
12	**Local Waste Aggregator**	Waste buyer from et jays	Buys and sells waste from local collector et jays
13	**Et jays/ scavengers**	Collector/buyer of waste from households, restaurants, schools, public spaces	- Buys and sells types of cans, metals, cardboard, plastic bottles, and occasionally other types of plastic waste from households. Scavenges waste on roadsides or dumpsites for valuable materials.
14	**NGOs**	Initiator of development projects within communities	- Enter communities and communicate with district administration or commune office to initiate an SWM project - Raise awareness through door-to-door conversations or group conversations - Provide different SWM solutions, including raising awareness and trying different technical solutions (e.g.: incinerators)
15	**Community-based Tourism Lead**	Representative of tourism providers in the community	- Coordinate tourism service to tourists such as accommodation and travel - Advocate for clean environment and proper trash management among team members and households

	STAKEHOLDER	ROLES	ACTIVITIES
			- Connect with DoE to get permission and a license to operate community-based tourism - Occasionally, initiate cleaning activities on the river shores
16	**Fishery Administration**	Protect and manage fish in the river and lake	- Initiate efforts to protect fisheries and water resources within the community. - Warn and penalize people who dispose harmful waste in water (es: used oil, agricultural input waste)
17	**DoSAE - District official of Sanitation, Agriculture, Environment**	Coordinator of relevant stakeholders regarding agriculture, natural resources, and the environment	- Monitor and coordinate active activities in agriculture and other fields. Limited to no involvement in SWM
18	**Vietnamese Community Association**	Representative of ethnic Vietnamese community at the village level. Intermediary between commune official and ethnic Vietnamese households	- No current activities related to SWM. Ability to mobilize support from the ethnic Vietnamese community when needed.

Appendix II: Influence/Interest Matrix

The matrix below classifies SWM stakeholders based on their interest and influence in the SWM space. The ones plotted in the “High Interest and High Influence" are likely to be the biggest leverage points and are those with whom collaboration could potentially yield high impact. Those in the “High Interest and Low Influence” and “Low Interest and High Influence" quartiles may still be valuable to be involved in SWM initiatives. The stakeholders listed in the “Low Interest and Low Influence” may add less value but still merit consideration when planning SWM initiatives.

Figure 16: SWM Stakeholders placed on the Interest and Influence Matrix