

Capacity Mapping for Monitoring and Assessment of Plastic Pollution

in the Lower Mekong

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Foreword

Globally, plastics use has become dominant in the consumer marketplace. Plastic litter fluxes in water environments have been mainly attributed to mismanaged and leaked land-based plastics resulting from poor waste management systems. Lower Mekong countries— Cambodia, Laos PDR, Thailand and Viet Nam have been cited among the top countries with mismanaged plastic waste. Notably, the Mekong river has been ranked as one of the top 20 polluting rivers globally. Lower Mekong countries have channelled concerted efforts to reduce plastic pollution through the development of appropriate policies and infrastructure. Considering ASEAN region-wide effort towards improving plastic waste governance, Lower Mekong Countries are keen to embrace data driven policy making as key efforts to prevent plastic pollution and leakage into water environment. Plastic pollution monitoring and assessment are key to support the building of data and knowledge for evidence-based policy development and implementation. However, Lower Mekong countries are faced with significant capacity needs for conducting plastic pollution monitoring and assessment in the Basin and the Mekong River. These challenges may be addressed by systematic planning and support of capacity development at various levels of plastic waste governance, involving relevant inclusive multi-stakeholders.

Considering the complexities of planning and implementing plastic pollution monitoring and assessment programmes in transboundary rivers such as the Mekong, a clear understanding of available capacity assets-technical and functional capacity- and capacity needs is invaluable for appropriately guiding policy design and policy management. Capacity mapping for monitoring and assessment of plastic pollution provides the first step in a series of processes in conducting capacity needs assessment for plastic pollution monitoring and assessment. This process is critical in outlining the relevant available capacities, and where these capacity assets reside, as Lower Mekong countries may harness the available capacity assets to complement ongoing efforts to improve plastic pollution. Mapping of capacity assets provides an informative basis for designing strategic capacity building programmes for the Lower Mekong Countries' national governments to support plastic pollution monitoring and assessment.

This report focuses on mapping out the available functional and technical capacity assets for monitoring and assessment of plastic pollution in the four Lower Mekong countries, focusing on governmental entities with a mandate to formulate and implement policies related to plastic pollution on land and in the water environment. A review of the enabling environments and technical capacity assets available in the four Lower Mekong Countries for plastic pollution monitoring and assessment. The study explored the available capacity assets vis-à-vis the contextual factors and challenges prerequisites for developing best-fit local, national, and regional level solutions.

This report provides information on key capacity assets and gaps available to all actors— private and public sector, private investors, civil society, and development finance institutions to guide the development of capacity development programmes for plastic pollution and monitoring in the Lower Mekong Countries. A snapshot of capacity assets is provided to guide relevant stakeholders engaged in capacity development and mobilisation capacity assets to design and implement robust plastic pollution monitoring and assessment programmes in the Lower Mekong Basin.

Abbreviations

DoNRE	Department of Natural Resources and Environment
LMB	Lower Mekong Basin
LMC	Lower Mekong countries
MSW	municipal solid waste
MoNRE	Ministry of Natural Resources and Environment
OC	Ocean Conservancy
ODA	Official development assistance
ONEP	Office of Natural Resources and Environmental Policy and Planning
PAO	Provincial Administration Organization
PCD	Pollution Control Department
PPCs	Provincial People's Committees
PPP	Private partnership models
SDG	Sustainable Development Goals
SUN	Thailand's Sustainable University Network
SWM	Solid waste management
TAO	Tambon (Subdistrict) Administrative Organization
TBCSD	Thailand Business Council for Sustainable Development
TIPMSE	Thailand Institute of Packaging and Recycling Management for Sustainable Environment
UN	The United Nations
UNDP	The United Nations Development Programme
UNEA	The United Nations Environment Assembly
UNESCAP	The United Nations Economic and Social Commission for Asia and the Pacific
UNHabitat	The United Nations Human Settlements Programme
UNODC	The United Nations Office on Drugs and Crime
URENCO	Urban Environment Company
USAID	The United States Agency for International Development
VASI	Vietnam Administration of Sea and Islands
WEPA	Waste Management and Environment Promotion Agency
WIPO	World Intellectual Property Organization
WMAD	Waste Management Affair Department
WWF	The World Wide Fund

1 / INTRODUCTION

of the chain. Having a drainage basin spanning across multiple countries, the comparatively poor, ineffective waste management system within the LMB contributes to major plastic waste leakage into the Mekong.

Under the CounterMEASURE project, a region-based approach was developed for periodic monitoring and assessment of plastic pollution and plastic pollution leakage scenario and hotspotting (as a GIS platform for data visualization). To sustain these outputs, a better understanding of the LMB's potential to support the long-term operation and management of a plastic litter monitoring programme is very crucial. Complementary to these project outputs, the capacity mapping study was commissioned to first identify the needed capabilities for designing and maintaining (i) robust monitoring programmes and (ii) accurate, reliable data collection, management and dissemination in the Lower Mekong countries (LMC).

Essentially, this report provides information on the capacity assets required for the monitoring and assessment of plastic litter – or in other words, land-based plastic leakage and plastic waste in the environment. It also makes recommendations to support decision-making towards the development of appropriate countermeasures in reducing marine plastic litter in the Mekong. In addition, the report provides relevant information to support decision-making and policy input for relevant stakeholders, including policymakers, scientists and investors,

among others – in line with national, regional and global frameworks and conventions.

UN Environment Assembly Resolution UNEP/EA.4/L.7, Marine Plastic Litter and Microplastics (adopted on 15 March 2019), has called for immediate action to strengthen (i) scientific and technological knowledge on marine plastic litter, both macroplastics and microplastics, and (ii) the assessment of sources, pathways and hazards to understand this issue. Four specific target areas considered for strengthening scientific and technological knowledge are highlighted in this resolution, including (i) convening of science advisory initiatives; (ii) preparing an assessment of the sources, pathways and hazards of marine litter and microplastics, and their presence in rivers and oceans, and of the scientific knowledge about the adverse effects on ecosystems and the potential adverse effects on human health; (iii) technology innovations in environmentally sound clean-up and management; (iv) recommending indicators to harmonize monitoring and report and assess methodologies; and (v) gathering of information to inform policies and action on environmentally sound technological innovations, options and measures for reducing risks of discharge.

Efforts are under way among various countries in the region to tackle plastic pollution. Pursuant to relevant global and regional frameworks, this report provides relevant information for knowledge-building, decision-making and catalysing action

on plastic waste for LMCs and, ultimately, for delivering on the nationally adapted goals in addressing plastic litter. These frameworks include the Sustainable Development Goals (particularly SDGs 11, 12, 13 and 14), the ASEAN Socio-Cultural Community Blueprint 2025 (sections C.1., C.2. and C.4) and the ASEAN Framework of Action on Marine Debris 2017 (Framework II [B 2-3]).

A capacity map for monitoring and assessment can serve as the fundamental point for the development of a capacity building strategy and response for plastic pollution prevention and management. It may also stimulate the thrust to build political support for capacity need assessment and capacity building strategy. It may also provide a launchpad tailored dialogue among stakeholders in promoting the right alchemy of capacity needs necessary to implement plastic impact driven plastic pollution prevention programmes.

1.2 Study objectives

As part of the CounterMEASURE project, this capacity mapping study aimed to scope, analyse and map out available capacity assets available in four Lower Mekong countries – Cambodia, Lao PDR, Thailand and Viet Nam – with the aim of monitoring and assessing plastic waste and its leakage into the water environment, particularly the Mekong River and its tributaries. The study explored and mapped out the structures, systems and resources at the local (community), subregional (Mekong subregion), and national levels necessary for conducting plastic litter monitoring and assessment on land and in the Mekong River. It also explored the dimensions and the relevant capacity assets at various administrative levels of plastic waste management.

Essentially, this study is guided by the following key questions::

- What existing capacity assets are available in the LMCs to carry out monitoring and assessment of plastic leakage from land-based sources, including plastic litter in the Lower Mekong River?

- Where are these capacity assets necessary for carrying out monitoring and assessment?
- At what levels of societal, institutional or organizational stratification do these capacities reside?

1.3 Report scope and structure

Considering the parameters of the study, the scope of this report does not extend to capacity needs assessment but rather covers the following areas:

- The identification of capacities required to undertake the monitoring and assessment of plastic litter leakage on land and in the water environment in the four LMC countries – Cambodia, Lao PDR, Thailand and Viet Nam.
- The scoping and mapping out of existing and latent capacity assets necessary for undertaking plastic litter monitoring and assessment in these countries.
- Recommendations to support decision-making, capacity-building and the development of countermeasures to prevent plastic litter leakage into the Mekong River.

As such, the first section provides a brief overview of the capacity mapping study, introducing the larger project context from which this study was commissioned. In this section, the objective and scope of the capacity mapping study is elaborated upon as they relate to the overarching objectives of the CounterMEASURE project. A brief background of the study is provided, drawing out (i) the linkages of the study with the relevant prevention and management of plastic litter leakage and (ii) the interventions pursuant to regional and global frameworks, resolutions and conventions. Briefly introduced are also the concepts of plastic litter monitoring and assessment followed by discussion on the needed capacities, the conceptual framework for the capacity mapping study and the role of capacity mapping for the monitoring and assessment of plastic litter leakage in the LMB. The

section concludes with an overview of the study's methodological approach for data-collection and capacity-mapping strategies.

The *second section* gives an overview of capacity mapping for the monitoring and assessment of plastic pollution. This chapter provides the definition of capacity mapping as well as its components: functional and technical capacity. It provides key questions as a guidance to the study.

The *third section* describes the methodological approach of capacity-mapping and data-collection strategies, and it outlines the mapping of capacity assets for the monitoring and assessment of plastic litter leakage.

The *fourth section* briefly explores the socioeconomic situation of the LMB, providing an overview of the basin's shared resources and the Mekong River's relevance in sustaining the livelihoods of local populations. Solid and plastic waste management profiles of the LMCs are presented, providing a situational overview of plastic waste generation, waste collection, handling and disposal profiles and including the challenges and gaps of the respective countries.

The *fifth section* introduces the identified capacity assets necessary to conduct the monitoring and assessment of plastic litter leakage on land and in the water environment. A discussion of the dimensions of the two broad categories of capacity assets – namely, functional and technical capacities assets for such monitoring and assessment – are presented in this section with emphasis on capacities for (i) land-based plastic pollution assessment, including value chain hotspots and accumulation hotspots, and (ii) riverine plastic litter monitoring and assessment in the four target countries. In this context, this section also explores the various levels of government administration in which these capacities exist and presents key questions to identify and analyse these capacity assets. The discussion then focuses on country analyses of existing capacity assets, with visual illustrations of the findings presented in this section.

Finally, the report concludes, in the sixth and seventh sections, with a summary of the study and key recommendations that may inform decision-making and serve as input for conducting capacity needs assessment and capacity-building. .

2 / CONCEPTUAL OVERVIEW: CAPACITY MAPPING FOR THE MONITORING AND ASSESSMENT OF PLASTIC POLLUTION AND LEAKAGE

2.1 Monitoring and assessment of plastic litter

In the context of the environment, “monitoring” refers to the repeated measurement of a characteristic of the environment, or of a process, in order to detect a trend in space or time. In contrast, “assessment” is part of the process whereby the results of a monitoring programme are analysed and used for an informed decision-making process.

GESAMP (2019) defines “monitoring” in the context of the environment as the repeated measurement of a characteristic of the environment, or of a process, in order to detect a trend in space or time. In contrast, “assessment” is considered to be part of the process whereby the results of a monitoring programme are analysed and used to

inform the decision-making process — for example, to understand whether some reduction measure has been effective.

As such, the monitoring and assessment of plastic pollution and leakage is necessary to understand (i) the state, sources, use and fate of plastic pollution and (ii) leakages into various compartments of the environment be it land or water. Information obtained from the monitoring and assessment of plastic litter can support the collection of objective information necessary for mitigation design and adaptive measures. Monitoring of plastic flow, pollution, and leakage along the plastic value chain is valuable to understand the dynamics and distribution of flow, quantify the amounts of plastic properly managed and mismanaged,

and model and forecast, for instance, hotspot areas. The cost of developing and maintaining plastic pollution monitoring programmes is high because they often require dedicated resources and compliance with legal and institutional frameworks. As such, responsible administrative authorities may hardly allocate sufficient resources for conducting monitoring and assessment. Where monitoring information needs to inform policy, monitoring programmes may be designed, where applicable, for surveillance — that is, to monitor policy and project/ programme implementation and its effectiveness and to track ecological effects (Hutto and Belote 2013).

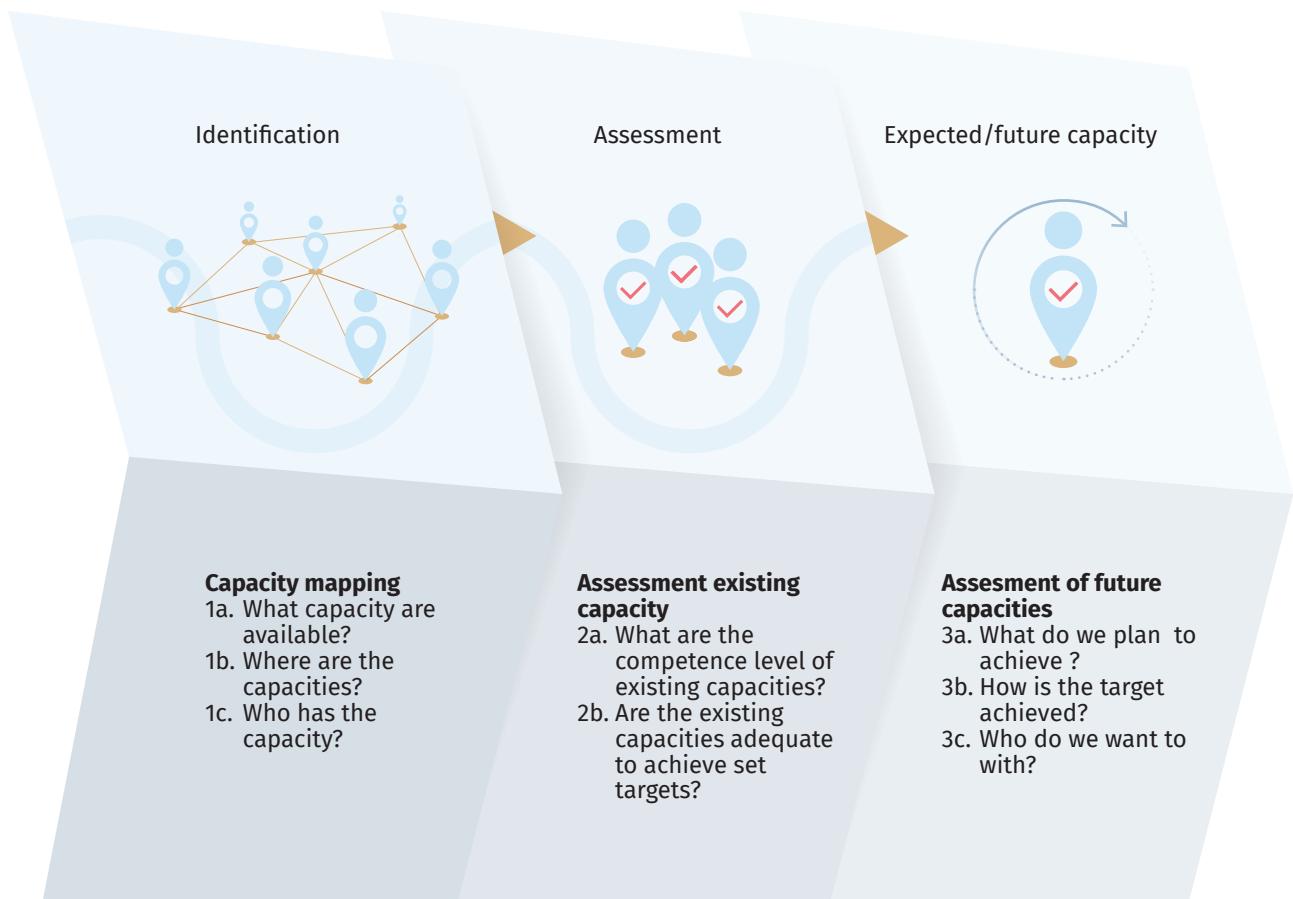
Recommendations by the UN advisory body GESAMP (2019) and observations of Hanke et al. (2013) note that, notwithstanding monitoring programme requirements, a robust monitoring strategy must reflect the following key characteristics:

- Defining spatial and temporal scales and areas for sampling.
- Using rigorous, repeatable sampling and analytical procedure protocols.
- Developing suitable mapping and dissemination tools to show the environmental status of the different indicators.
- Linking the sampling scales and indicators to management issues (e.g. mitigation measures) as well as to resource considerations.

2.2 Capacity mapping

“Capacity mapping” describes the strategy to find the available latent (or unrecognized) resources and capabilities necessary to conduct the monitoring

Figure 1 **Process for capacity mapping and capacity needs assessment**



and assessment of plastic pollution (Dato et al. 2002). Essentially, in the context of this study, capacity mapping scopes, identifies and maps out the structures, systems and resources — at the local (community), subregional (Mekong) and national governments — necessary for conducting plastic litter monitoring and assessment.

In other words, capacity mapping is the first step in a process designed to conduct capacity needs in an assessment study, as shown in Figure 1.

Capacity mapping studies have been widely applied in many fields of the development context as a decision support tool. These studies have been used as an essential strategy to find untapped, unrecognized or latent resources for the purpose of achieving a specified objective. This strategy refers to an analysis of a country's or an organization's structure and resources that is aimed at identifying its inherent abilities and potential. The availability of a supporting climate, including enabling legal, regulatory and policy frameworks, and technical tools, provide an enabling environment for monitoring and assessment. The specific challenges of data on plastic litter monitoring will vary from country to country and can include issues such as the lack of a clear mandate for data collection, insufficient human resources, limited technical knowledge or lack of funding. In some countries, these challenges may be overcome by simply adapting and expanding existing processes for collecting and managing waste management data.

Capacity mapping essential strategy to find untapped and unrecognized/latent resources for the purposes of achieving specified objective.

In other countries, a whole new set of protocols and procedures may be needed to collect data. Efforts are under way among LMCs to tackle plastic pollution. Several countries are doing this at the national and local levels by regulating single-use plastic products or packaging (or both) or by planning for the elimination of single-use plastic products.

Functional and technical capacities for the monitoring and assessment of land-based plastic pollution and for riverine plastic litter monitoring and assessment in the four Mekong countries includes;

- Functional capacity is necessary for creating and managing policies, legislation, strategies and programmes that provides support and the enabling environment for various actors — individuals, NGOs, community-based organizations, international development agencies, governmental and other relevant stakeholders — to be able to carry out monitoring and assessment of plastic litter in the water environment, including land-based leakage sources.
- Technical capacity explores the technical and technological capabilities necessary to conduct accurate, reliable assessment plastic litter on land and in water environments — that is, storm drains, streams, rivers and riverbanks, lakes and beaches. These capabilities include the availability of adequate infrastructure, tools and equipment for monitoring and assessment of plastic leakage along the value chain.

While LMCs have many challenges in waste management that need improvement, capacities for the monitoring and assessment of plastic litter is necessary to foster robust data gathering on the flow of plastic to understand the state and sources of plastic pollution and leakages into drains, inland waters and oceans. Further, the development of robust monitoring and assessment programmes are crucial to support the collection of objective information necessary for the design of mitigation and adaptive measures. The capacity mapping study on the monitoring and assessment of plastic litter in the Mekong River encompasses both (i) the functional and technical capacities assets and (ii) the operational and latent capacity that exist at the local, national and subregional levels in the four project target countries — Cambodia, Lao PDR, Thailand and Viet Nam.

Box 1 Semantics of the Global Conundrum – Plastic Pollution in Rivers and the Marine Environment

Terms such as “litter”, “debris” and “plastic” may have particular meanings to different groups of people, sometimes depending on the scientific or technical context or simply on cultural preference. The term “plastic” covers a broad range of synthetic polymers of varying size, shape and composition (similar in many ways to natural resins found in trees and other plants compositions and properties). Size, shape and composition all influence the distribution. Being low cost, strong but lightweight, and potentially transparent, this versatile material is suitable for a variety of applications in transport, telecommunications, clothing and packaging. Packaging accounts for the majority of plastic consumption and consists of products that have a very short life span. Several broad classes of plastics are used in packaging, including polyethylene (PE), polypropylene (PP), polystyrene (PS), polyethylene terephthalate (PET) and polyvinyl chloride (PVC).

Plastics use have become part of everyday consumer lifestyle. The increased use of plastic has given rise to increased plastic waste generation. Unfortunately challenges of inadequate infrastructure and poor waste management faced by many countries, plastic pollution of rivers and other water bodies, however, has become a global conundrum. Experts are focusing on identifying the quantity, sources, transport, accumulation and fate of plastics in the oceans. This involves (i) developing a harmonised approach to the design of plastic sampling programmes, the selection of appropriate indicators (i.e. type of sample), the collection of samples or observations and the characterisation of sampled material; (ii) dealing with uncertainties, data analysis and reporting the results; and (iii) informing the establishment of national and regional field monitoring programmes.

Definitions of “monitoring” and “assessment” are included (in section 2.2), and issues describing the size of items of litter are explored (section 2.3.1) because this has been a point of contention. These guidelines provide a set of recommended definitions, based largely on common usage, in a global context. In some cases, these may differ from those used in specialized technical fields, in which more precise definitions are required (e.g. ISO standards) (GESAMP 2018).

3 / METHODOLOGY FOR CAPACITY MAPPING AND DATA COLLECTION STRATEGIES

This section begins by presenting the methodology to mapping capacity assets and concludes with strategies for data collection analysis. The CounterMEASURE capacity mapping study began by identifying what the monitoring and assessment of marine plastic litter entails and delineating the necessary tools, equipment and infrastructure. Scenarios of likely monitoring programme types and their objectives were drawn up with probable objectives. Emphasis was placed on capacities for land-based plastic pollution, including (i) value chain hotspots and accumulation hotspots and (ii) riverine plastic litter monitoring and assessment in the four target countries of the Lower Mekong basin (LMB). Once the probable monitoring programmes and their objectives were established in the appropriate context of the project's terms of reference, relevant information and data requirements were subsequently mapped out and categorized. Further, an analysis of actor

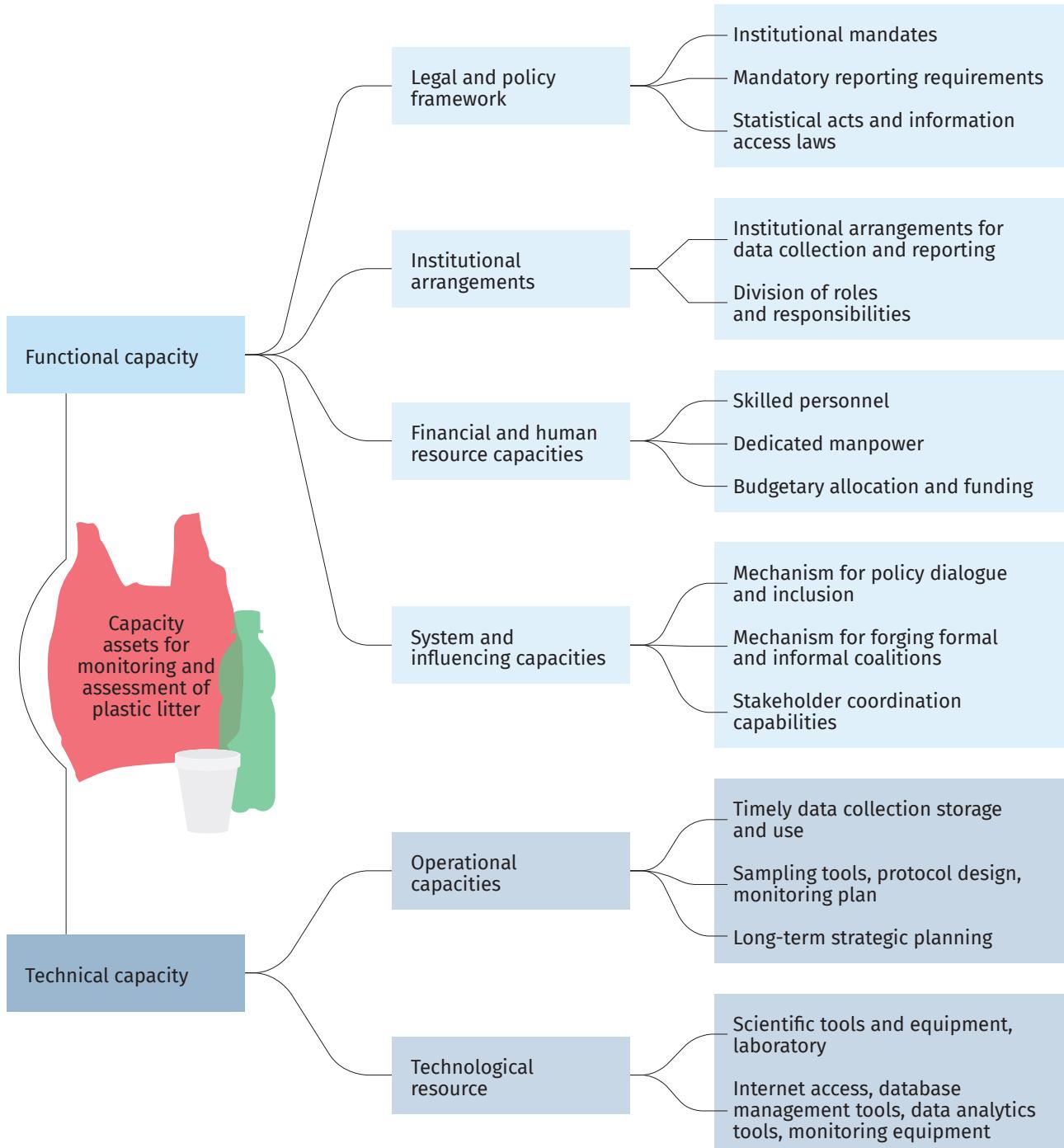
relationships of plastics- monitoring policy instruments and programmes were carried out to reveal distinct relevant stakeholders and levels of social administration possessing capacity assets, both active and latent, needed to monitor and assess plastic litter. Capacity resides at various levels of social administration and structures including communities and individuals. An attempt was made to identify and map out the various levels within the LMB where capacity assets reside. Capacity assets for monitoring and assessing plastic litter resides in individuals, communities, villages, cities, municipal authorities, provincial administration, national levels and subregional institutions.

3.1 Approach to mapping capacity assets for the monitoring and assessment of plastic pollution

Mapping of capacity assets is critical for the monitoring and assessment of plastic litter leakage, namely, functional and technical capacities assets

Capacity assets mapped for the monitoring and assessment of plastic litter in the Mekong River were classified into two broad categories, namely, functional and technical capacities assets (as shown in Figure 2). Referring to hard and soft capacities, the term “functional and technical capacities” is useful in distinguishing technical, tangible and visible capacities from social, relational, intangible and invisible capacities (Sambati et al. 2018). This

Figure 2 Mapping of capacity assets for monitoring and assessment of plastic litter leakage



distinction includes active and latent capacities existing at the local, national and subregional levels in the four project target countries — Cambodia, Lao PDR, Thailand and Viet Nam.

Functional capacities are necessary for creating and managing policies, legislation, strategies and programmes that provide support and the enabling environment for various actors. These include individuals, NGOs, community-based organizations,

international development agencies, governmental and other relevant stakeholders needed to be able to carry out the monitoring and assessment of plastic litter in water environment, including land-based leakage sources in a typical source-to-sink approach. Essentially, institution and policy maps were drawn out at different levels of waste governance as subactivities relating to a broader category of functional capacities.

Box 2 **Frameworks of capacities and definitions**

The term “functional and technical capacities” refers to hard and soft capacities and are useful in distinguishing technical, tangible and visible capacities from social, relational, intangible and invisibles capacities (Sambati et al. 2018). Functional capacities are necessary for creating and managing policies, legislation, and strategies and programmes that provides support and the enabling environment for various actors — individuals, international development agencies, governmental and other relevant stakeholders — to be able to carry out the monitoring and assessment of plastic litter in the water environment, including land-based leakage sources. This capacity mapping study aims to map out the existing capacities of Lower Mekong countries for the monitoring and assessment of plastic litter on land and in the Mekong River.

Data collection for plastic monitoring and assessment aims at answering specific questions and can be done at different locations and times, allowing for good comparison between rivers via the following methods or techniques:

- Active sampling methods are well suited for quantifying aquatic microplastic concentrations, but they are less suited for macroplastics since sample volumes are usually rather small and sampling is limited (e.g. net openings or pump outlet sizes). Additionally, these methods require special equipment (and even infrastructure) and are often labor-intensive.
- Passive sampling is performed using existing infrastructure, without the need for additional equipment. Passive sampling includes the analysis of plastic collected by municipal waste handlers (e.g. fish fyke) and waste collection booms. Using existing infrastructure without extra equipment makes passive sampling relatively cheap and less labor-intensive. However, samples often either are not tailored towards specific research questions or have a hotspot approach. Additionally, they are not flexible in terms of sampling location since they are dependent on existing infrastructure.
- Visual observations are (often) simple and straightforward. They include visual counting and plastic litter identification from bridges on riverbanks. These methods are easy to apply, and data collection can be done by either professionals or citizen scientists. Visual observation can be done at different locations and times, allowing for good comparison between rivers. A disadvantage, however, is the human bias that can occur when visually identifying plastics — for example, small or transparent particles are easily overlooked. Furthermore, infrastructure, such as bridges and the availability of skilled observers, are a prerequisite for applying this method.

To date, most rivers lack (long-term) measurement infrastructure to quantify plastic transport. Yet, there urgently exists the need to characterize riverine plastic transport in order to quantify (i) concentrations of plastic in rivers and (ii) their transport from the rivers to the oceans. Increased understanding of plastic transport processes can be used, in turn, to improve modeling approaches and to develop prevention and mitigation strategies.



Functional capacities are necessary for creating and managing policies, legislations, strategies and programmes that provides support and the enabling environment for various actors.

Technical capacities explore the infrastructural and technological capabilities necessary to conduct accurate and reliable assessment plastic litter on land and in water environments.

Technical capacities explore the infrastructural and technological capabilities necessary to conduct accurate, reliable assessment of plastic litter on land and in water environments. These include the availability of adequate infrastructure, tools and equipment for the sampling, monitoring and assessment of plastic leakage along the value chain.

The dimensions of each broad category of capacity asset were explored by decomposing what encompasses (i) an enabling environment to support the effectiveness of monitoring programmes and (ii) the know-how and technologies to carry out reliable monitoring objectives and to assess, maintain and disseminate monitoring data.

In this context, the study scopes, identifies and map out the structures, systems and resources at community or local, national and subregional (Mekong subregion) level necessary for conducting plastic litter monitoring and assessment.

3.2 Data collection analysis strategies

To source relevant data, the capacity mapping study applied a multimethodological approach, involving survey instruments, focus group discussions, key informant interviews and expert opinions. In addition to a thorough desk review of the literature, the data collection approach employed by the study involved technical workshops, surveys of technical experts and focal points of solid waste management at relevant government entities from all four LMCs — at the national, provincial and municipal levels. Project staff also consulted with experts, including their national focal points

from the Mekong River Commission — an intergovernmental organisation that works directly with the Cambodia, Laos, Thailand, and Vietnam governments to jointly manage the Mekong's shared water resources and sustainable development.

Desk review: was conducted by reviewing policy instruments, published reports, planning documents, organization websites and policy statements on the two broad capacity assets. In the process, attention was focused on texts or indications related to the monitoring and assessment of solid and plastic waste. (Since “plastic waste management” has been categorized under “solid waste” in most LMCs, as such, it is common to find a range of legislation not specific to plastic waste management.) Policy documents were examined for the clarity of objectives and institutional mandates and for the existence of guidelines for implementing legal provisions on plastic or solid waste (or both), among others. Then, using a snowballing technique, information and indications were inventoried and analysed, including mandates from these documents (i.e. legal and policy documents) linked with policy actors and stakeholders referenced in the context of the policy under investigation.

Survey questionnaires were designed based on the capacity mapping framework developed for this project. Key questions and possible indicators were developed to help scope, analyse and map the existence of each capacity asset at the various waste governance levels for each LMC. Questionnaires were sent via email to identify relevant stakeholders and focal technical staff of national government agencies and line ministries, subnational government administrations and the environmental units of city-level administrations. .

Technical workshop for the monitoring and assessment of plastic litter in the Mekong were organized —in conjunction with the Mekong River Commission in Vientiane — to interface with about 60 participants, including key experts of the LMC working on solid waste and plastic-related issues. The workshop



focused on introducing the CounterMEASURE project and sharing the progress achieved in developing a region-based approach for the monitoring and assessment of plastic waste leakage and pollution reduction, including ground data collection by project partners. Further, the workshop introduced the concept of the capacity mapping for the monitoring and assessment of plastic pollution in the Mekong and presented the findings of the desk review. Key technical experts and country focal experts were engaged to draw out data and information on various capacity assets – considering that active and latent capacities are available at the local, provincial, national and subregional levels of the LMCs as well as in the Mekong River.

Country group discussions were held during the technical workshop to review available information and data presented from the desk study. Guidance notes and flip charts were provided to guide the discussions and mapping exercise among experts of each country. The country group discussions were used to stimulate dialogue and knowledge-sharing on the dimensions of capacity assets at the various levels of waste governance in each LMC's. The country group discussion was employed to draw out the existing capacity assets necessary in each country to support plastic-litter monitoring and assessment.



Box 3 UN Environment regional technical workshop on plastic monitoring and assessment in the Mekong



Day I of the workshop focused on introducing the CounterMEASURE project and on sharing the progress achieved in developing a region-based model for the monitoring and assessment of plastic waste leakage and for pollution reduction, including ground data collection by project partners.

Day II focused on introducing the concept of capacity mapping for the monitoring and assessment of plastic pollution in the Mekong component of the project. This session engaged country participants to draw out data and information on various capacity assets; active and latent capacities are available at various levels of local, city, provincial, national and subregional levels to carry out the monitoring and assessment of plastic waste leakage in the Lower Mekong countries as well as in the Mekong River.

4 / PLASTIC POLLUTION IN THE LOWER MEKONG BASIN



This section sets the context for plastic pollution in the Lower Mekong basin before presenting country-specific profiles for basin-wide plastic pollution.

4.1 Setting the Context

The Mekong ranks tenth among the world's great rivers based on mean annual flow. As of 2015, an estimated 65 million people lived within the Lower Mekong Basin (LMB), with Thailand and Viet Nam each accounting for a little over one third of the population; the Kingdom of Cambodia (Cambodia), a fifth; and Lao PDR, the remainder. The population density of Cambodia is almost double that of Lao PDR — with that of Thailand a little higher and the Vietnamese portion of the basin having a relatively high population density (Mekong River Commission 2018).

From a geographical view, the lower Mekong basin spans almost two thirds of the entire landmass of Laos PDR and Cambodia, one third of Thailand (its north-eastern region and part of its northern region), and one fifth of Viet Nam (the Central Highlands and the Delta).

Map 1 provides a visual representation of the countries situated in the LMB, which is depicted in green (Mekong River Commission 2019).

The Mekong River contributes significantly to the socio-economy of the Lower Mekong countries (LMCs) — notwithstanding the fact that marked development and population growth has intensified environmental stress. With a combined GDP that could exceed US\$1 trillion, these LMC's now constitute a consumer and labour market of over

Map 1 Countries Flanking the Lower Mekong River Basin (Source: Mekong River Commission (2019))

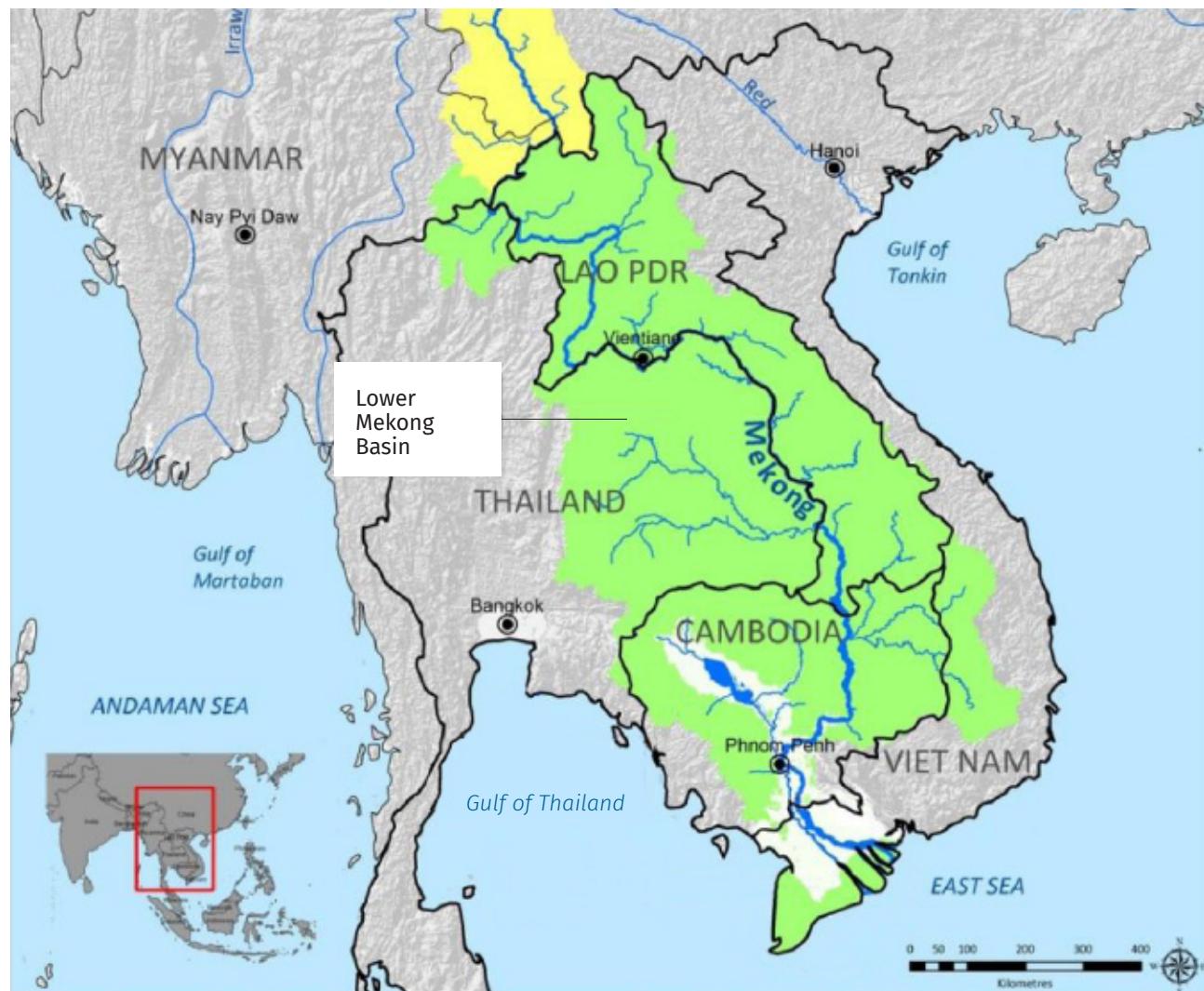
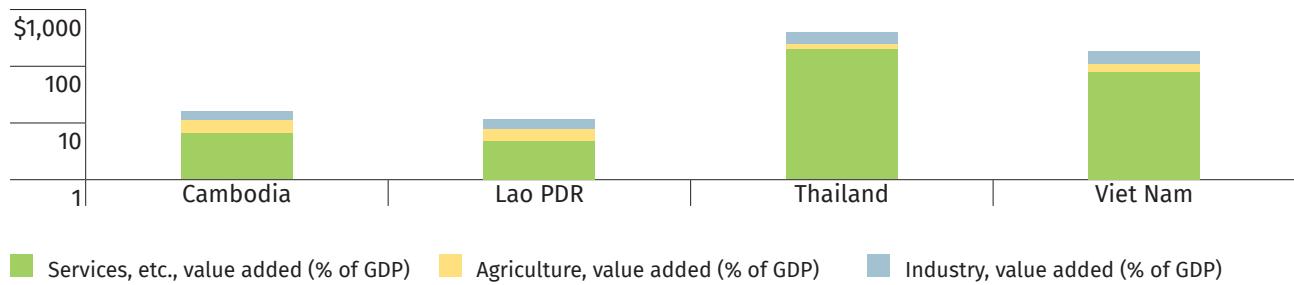


Figure 3 GDP at market prices indicating the differential economies of LMCs (Source: WWF-Greater Mekong (2016))¹



¹ Agriculture—farming, fishing, and forestry; Industry—mining, manufacturing, energy production, and construction; Services—government activities, communications, transportation, finance, and all other private economic activities that do not produce material goods

300 million people, the livelihood of which is sustained by the the Mekong. In fact, the river is the basin's major water source for irrigated agriculture and hydropower development, particularly in the north-eastern part of Thailand, which relies heavily

on the Mekong River for agricultural irrigation. In addition, the Mekong serves as the inland waterway for traditional cargo and passenger transport in the region's riverine communities.

Map 2 Economic value and country incomes from all sectors for lower Mekong basin countries (Source: Mekong River Commission, 2018)



Data Source: (Rice) Provincial statistical data from LMB countries for 2013. DAD 2018; FAOSTAT database, retrieved from <http://www.fao.org/faostat/#data>.
 Fishery: So Nam, Sovannay Phornmakhone, Ly Vuthy, Theerawat Sampawannana, Nguyen Hei Sen, Malaiwan Khumman, Ngol Peng Ban, Kong Sovannara,
 Peter Degen and Peter Stur (2015); LMB series estimation to be worth \$17 billion a year. Catch & culture volume 21, No. 3, December 2015.
 Hydropower: MRC, 2018; Hydropower Database 2018.

The Lower Mekong also supports other valuable sources of livelihood with economic activities including sectors such as construction, fisheries, forestry, tourism and food production. For instance, a booming construction industry is increasing the demand for sand winning and construction gravel drawn from the Mekong at the expense of the river's ecological sustenance (World Bank 2019). And an estimated 86 per cent of the population living in the shared basin depend on fishing and flood recession rice farming in the Lower Mekong Floodplain. With regard to Laos PDR, in 2015, LMB supported about 69 per cent of total rice production, 91 per cent of fisheries, and 10 per cent of hydropower development. Figure 3 shows the GDP at market prices in billions of USD w/ proportional breakdown by sector (WWF-Greater Mekong, 2016).

In Viet Nam, the Mekong Delta covers a relatively small portion of the entire country, encompassing about 11 provinces and about 3.9 million ha of land used predominantly for agriculture and forestry (Yoshida et al. 2020). With a land area of 39,712 km², the Mekong Delta accounts for 12.1 per cent of the whole country, about 3.9 million ha of land. Notably, this region (i) is the habitat of about one fifth of the total population (18 million) and (ii) contribute about 27 per cent of GDP, 50 per cent of national rice production (Berg et al. 2017), 70 per cent of national fruit production, over 40 per cent of aquaculture fish products and over 74.6 per cent of total national fishery production (Thang 2019).

Considering the Mekong Delta's contribution to the economy and livelihood of Viet Nam, this basin also affects national policies and regulations. Key policy and economic changes have led to livelihood changes in the delta: From rice intensification to livelihood diversification (many communities in the flood-prone area had constructed dike systems to prevent floods enabling them to produce three rice crops per year (Howie 2011; Triet et al. 2017).

Income levels are also higher in countries the Mekong Delta compared with those in other parts of these Mekong subregion, for instance, Cambodia and Laos. Map 2 shows the economic value derived from the Lower Mekong basin for various sectors (Mekong River Commission 2018).

↓ Increasing waste generation and plastic consumption patterns were observed within many urbanized areas in the basin as resulting in leakages of land-based mismanaged plastic into the Mekong.

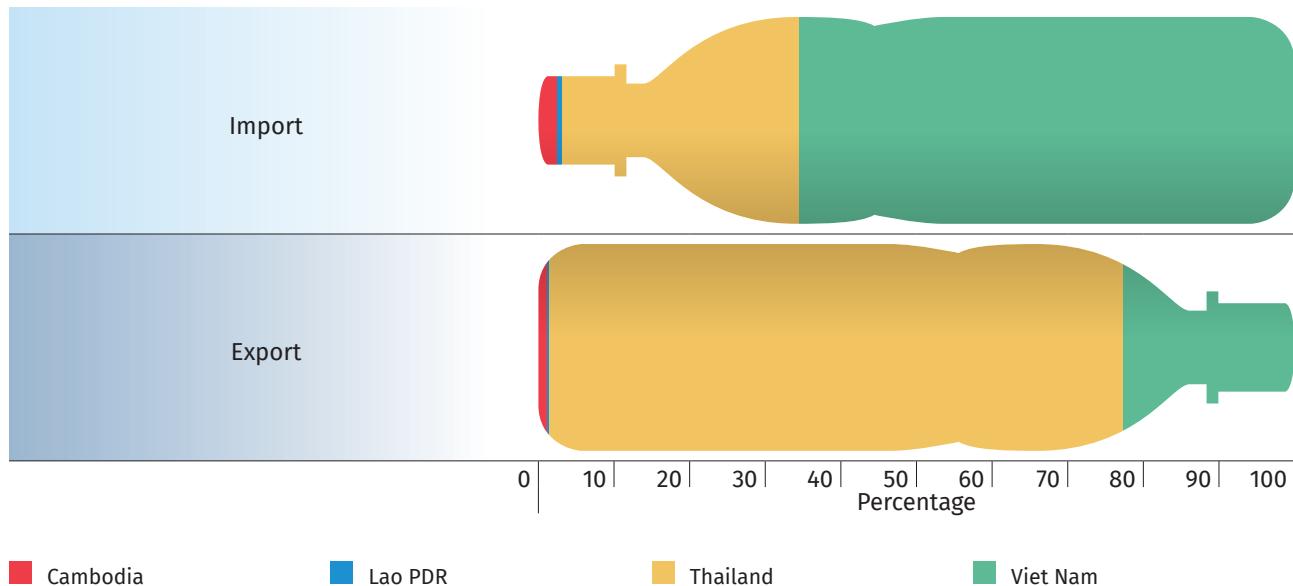
Generally, changes in livelihoods of people in Generally, changes in the livelihood of Mekong Delta inhabitants are linked with changes in agricultural systems, which are closely associated with the Delta's physical conditions (soil and water), the settlement process and canal excavation as well as with the socioeconomic situation and government policy (Can et al. 2006).

Considering the indispensable economic value of the Mekong as a shared resource within the LMCs, safeguarding the ecological health of the Mekong River is invaluable. Notwithstanding this fact, along with changing consumer patterns of over 60 million riverine inhabitants, burgeoning economic development and urbanization pose threats to the ecological sustainability of the river and its ecosystem. Increasing waste generation and plastic consumption patterns, observed in the many urbanized areas within the basin, result in leakages of land-based mismanaged plastic into the Mekong. Moreover, emissions of plastic litter from drains and tributaries, as well as those ensuing from touristic activities, are major threats to the ecological health of the Mekong.

In 2018, global plastics production almost reached 360 million tons. Of this total, about 51 per cent of distributed plastics were produced in Asia, with China itself generating about 30 per cent of the global total and with Japan and the rest of Asia generating 4 per cent and 17 per cent, respectively (PlasticsEurope 2019). Plastics types produced include thermoplastics, polyurethanes, thermosets, elastomers, adhesives, coatings, sealants and polypropylene fibres.

With regard to import-export trade, Viet Nam imports a high level of plastics and plastic articles, amounting to about \$15.3 billion, followed by Thailand with about \$7.3 billion. In contrast, Thailand has a high level of exportation, about \$14 billion compared to the other four Mekong countries examined in this study. Trends in the

Figure 4 **Share of Import-export of 39 plastics/plastic articles by Lower Mekong country, 2018 (%)**
 (Source: Extracted from ASEANstatsDataPortal, Trade in Goods Quarterly Dashboard, <https://data.aseanstats.org/trade-quarterly>)



import-export of 39 plastics and plastic articles in LMCs in 2018 are shown in Figure 4, extracted from the ASEANstatsDataPortal.

4.2 Country profiles: Basin-wide plastic pollution

Combined efforts to reduce plastic loading and consequentially reverse the Mekong's contribution to global marine plastic pollution requires tackling the fundamental causes at the local, national and transboundary level of countries within the shared basin of the Lower Mekong.

Though riverine plastic emission into the ocean is a global problem, the Mekong River has garnered significant global attention owing to its unique, transboundary and socioeconomic significance and to its characteristically high discharge volume. In fact, the Mekong River has been cited among the top 15 rivers contributing plastic waste into the ocean, emitting between 1.88×10^4 to 3.76×10^4 tons per year (Lebreton et al. 2017).

The vulnerability of the Mekong to plastic pollution is further underscored by the rudimentary, underdeveloped waste management systems of the LMB countries — particularly as regards the collection, transfer, temporary storage and treatment of municipal solid waste (MSW) and associated disposal systems. These countries feature proliferated disposal sites, improperly designed landfills and open dumpsites. Open burning at landfill sites is an illegal practice in these countries; however, it is sporadically done in some cities or provinces during the dry season to reduce the volume of waste and to increase the capacity of disposal sites.

As a result of ineffective waste management systems, low-income countries have been generally noted to contribute a high volume of land-based plastic leakage into water environments. Whereas about 80 per cent of plastic waste entering the ocean has been reported as originating as managed land-based plastic wastes with the remaining 20 per cent coming from sources including direct littering in waters— transport and other activities. Considering the large discharge volume of the Mekong River, plastic loadings from LMCs may result in a disproportionate increase in plastic loading and emission from the river into the oceans. Thus, tackling plastic waste management issues in LMCs

is imperative to reduce plastic waste loading into the Mekong.

In this light, transboundary rivers that receive plastic waste inputs from drainage basins spanning multiple countries can benefit from transnational collaborative actions — actions that leverage harmonised efforts and capacity assets at the community, national and sub-regional levels to monitor and assess plastic flux into the rivers and oceans. Combined efforts to reduce plastic loading and consequentially reverse the Mekong's contribution to global marine plastic pollution requires tackling the fundamental causes at the local, national and transboundary levels of countries within the shared basin of the Lower Mekong.

4.2.1 Cambodia

Plastic waste generation

Like many other developing countries, Cambodia is confronted with the challenges of increasing MSW generation and composition in the major urban cities (Phnom Penh, Siem Reap, Krong Ta Khmau, Battambang, Kampong Cham and Sihanoukville). In fact, these cities have been associated mainly with accelerated population growth, urbanization and economic growth —trends that have stimulated internal migration from rural to urban areas for job and business opportunities.

Being one of the fastest-growing consumer markets in South-East Asia, Cambodia has seen notable changes in per-capita consumption that is underscored by an expanding consumer-based economy with high daily plastic consumption. This trend is observed particularly among the growing urban middle class (Sethy 2017; Yoon 2017). In fact, whereas estimated per-capita MSW generation for rural areas is about 0.5 kg per day, for major cities, particularly Phnom Penh, per-capita generation is about 1.0 kg per day².

Owing to these demographic and lifestyle trends, plastic waste is the second highest fraction

(3%–20%) of the country's MSW after organic waste (Kokusai Kogyo 2005; Curea 2017). In urban Cambodia, particularly in the capital city of Phnom Penh, annual MSW generation amounts to about 4.09 million tons per year (Akenji et al. 2019). About 10 million plastic bags are used daily in Phnom Penh (UN Environment 2019). Estimates show an average of 12 plastic bags are consumed per household/per day. An upsurge of plastic waste generation has been noted with notable increase from 6 per cent in 1999 (Cambodia, MoE 2004) to 17.8 per cent in 2013 (Seng et al. 2013),

Solid waste management in Cambodia

Since 1999, Cambodia has pursued a decentralization agenda to devolve waste management operations to the local or subnational administrative levels. By this, the functional responsibilities regarding (i) MSW management under the mandate of the Ministry of the Environment and (ii) waste handling by the provincial and capital administration devolve to municipal or district administration. Thus, local government authorities are end implementers of waste management policies through the establishment of a technical working group who provide technical assistance and facilitation of waste management services. However, effective solid waste management remains a countrywide challenge because Cambodia still grapples with a low level of bins, collection frequency and cleaning services. Source segregation is estimated at less than 50 per cent, while the plastic recycling rate is reportedly about 50 per cent.

↳ Waste collection services from households and urban centers are woefully inadequate to match the rate of waste generation.

Waste collection, transportation and disposal in major cities and towns are provided by private companies under the supervision of local governmental authorities and technical line agencies. Nonetheless, some provincial towns and urban areas in Cambodia still do not have any solid waste collection services.

² For more information, refer to the presentation, posted on the UNCRD website, titled "Cambodia: Major Achievements and Initiatives on Implementation of Ha Noi 3R Declaration, at <https://www.uncrd.or.jp/content/documents/773Country%20presentation-Cambodia.pdf>.



The bulk of MSW generated in Phnom Penh is serviced by the Dangkor Dangkor Landfill Management Authority, under the Waste Management Division of Phnom Penh Capital Hall. Annually, about 1.5 million tons (41%) of total waste collected ends up in dumpsites; 400,000 tons (11%) is recycled; and 48 per cent is illegally dumped into water bodies or is open burned (UNCRD, 2019)

But in other areas, waste collection services from households and urban centres are woefully inadequate to match the rate of waste generation, and most waste collected in Cambodia ends up in landfill sites that are mainly open dumps. Moreover, most plastic waste generated in urban areas is either burned or discarded at public spaces, roadsides, markets and residential areas. Most often, such uncollected waste ends up in drains and surface water bodies and is eventually emitted into the sea.

The most sorted wastes are food waste followed by paper, aluminium and steel cans, and bottles made of glass or polyethylene terephthalate, or PET. Of recyclable waste, only 7 per cent of plastic waste is recycled locally, with a large share of recyclable materials, including plastic, paper, steel and aluminium, disposed as unsorted waste. This scenario shows that challenges in plastic waste management are exacerbated by the characteristically low investment by national governments in building the necessary infrastructure and creating awareness and technical know-how of plastic waste management.

4.2.2 Lao PDR

Plastic waste generation

During recent years, Lao PDR has experienced urbanization from a growing urban population accompanied by a changing lifestyle resulting in plastic packaging consumption. (In fact, the urban population makes up about 36.3 per cent of the total with an annual urbanization rate of 3.28 per cent (Central Intelligence Agency [CIA] 2019). Plastic waste is generally considered as part of MSW in Lao PDR. Plastic waste is generated mainly from residential and commercial areas (e.g. stores, hotels, restaurants, markets, office buildings, tourist areas), institutions (e.g. schools, government offices and

facilities, hospital buildings and monasteries) and other communal service activities. In some urban areas, solid waste generation has been observed to continually increase probably owing to the urban growth rate, as is the case in major cities such as Vientiane Capital, Luang Prabang, Kaisone/Savannakhet, Xayabury, Pakse and Thakek/Khammouan (as shown in Figure 5, which shows trends for waste generation in major cities in LAO PDR from 2000 to 2015, as extracted from Lao PDR, Ministry of the Environment [MoNRE] (2017). For example, in Vientiane Capital, waste generation was expected to grow from 166.7 ton/day in 2013 to about 564.1 ton/day in 2020 (Lao PDR, MoNRE 2017).

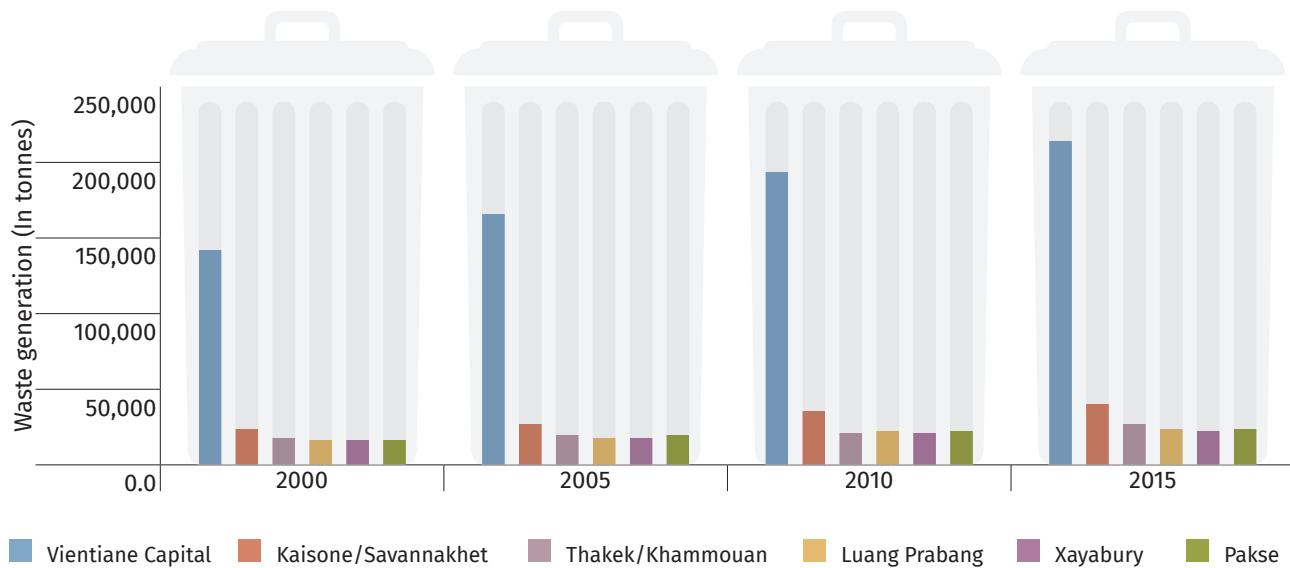
Data on solid waste composition shows inconsistencies; however, the Ministry of Natural Resources and Environment (MoNRE) noted MSW in Lao PDR is composed mainly of organic material (30%), plastic (30%), paper (15%) and glass, cans and other metals (25%) (Lao PDR, MoNRE 2017). Considering the high organic and plastic waste content of MSW, many projects have focused on the production of compost from collected wastes. Introducing composting of kitchen waste, grass and wood is effective as an intermediate treatment to reduce the discharge amount of waste and to mitigate environmental issues at the final disposal site in major cities of the country.

Nonetheless, dumping on abandoned land, city outskirts, river sites wilderness and burning in open areas is quite common place in the country. Solid waste collection and disposal services are only available in major cities. Therefore, most solid waste collected in small towns and villages is disposed illegally. About 40–70 per cent of waste generated (on average) is collected and transported to landfill sites. There are no engineered landfill sites in the



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Figure 5 **Waste generation in major cities in Lao PDR, 2000–2015** [Source: Data extracted from Lao PDR MoNRE (2017)]



major cities because of the lack of budget, technical knowledge and human resources. Waste collection increased after the 2016 Japanese Government grant aid project that allocated 47 waste collection vehicles to Vientiane, 8 to Luang Prabang and 4 to Xayabury (Sato et al. 2018).

In Vientiane, about 46 per cent (259.3 tons/day) of total waste generated is collected by the Vientiane Urban Development Administration Authority, while the remainder is collected by contracted, private waste collectors.

In Lao PDR, the informal sector collects high-value plastic recyclables like polyethylene terephthalate,

or PET, along the Mekong River in Luang Prabang. This sector plays a significant role in plastic recycling in relation with economic activities in Lao PDR.

4.2.3 Thailand

Plastic waste generation

↳ Plastic packaging consumption is one of the major sources of plastic waste in Thailand.

Thailand is a leading plastics producer and plastic pollution contributor in Asia. Plastic pellet and resin production capacity was at 6.094 million



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tons in 2015, while 2.127 million tons of plastic was consumed in the same year (Wichai-utcha and Chavalparit 2019). The domestic consumption of plastic in Thailand is approximately 40 kg year/person (Ibid.).

Plastic packaging consumption is one of the major sources of plastic waste in Thailand. The largest share of plastic waste in MSW is plastic bags, accounting for about 80 per cent of the total 2 million tons of plastic waste produced in 2018. Recyclable waste, comprising mainly of PET bottles, accounts for about one third (500,000 tons) of the total, while the rest of 1.5 million tons is plastic bags and other plastic/solid waste, including glass, boxes, trays, bottles and bottle lids (Thailand, MoNRE, Pollution Control Department [PCD] 2019). In fact, plastic waste has shown an annual increase of 2 million tons (12%) over the past decade, constituting about 20.9 per cent of total waste generated in Thailand in 2017 alone (Ibid.)

About 0.03 million tons of the total improperly disposed municipal solid waste (7.36 million tons) was unmanaged across the country (Ibid.). Low waste collection coverage, illegal dumping sites, open burning of waste, which leads to water, air and visual pollution are harmful to people and the environment (Srisatit et al. 2016). About 47 per

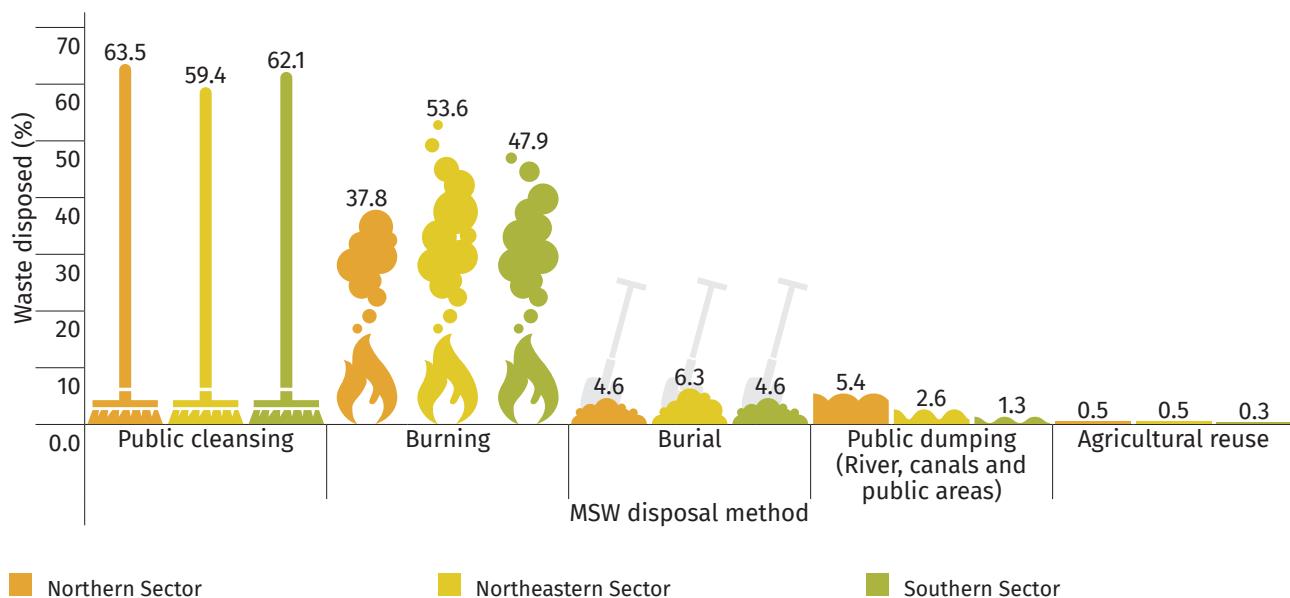
cent of MSW was managed, whereby 27 per cent was disposed of in sanitary landfills, 20 per cent was reused/recycled, and the rest was incinerated (Thailand, MoNRE, PCD 2019). Most of the waste, such as glass, paper, plastic, iron and aluminium, was being redirected into manufacturing processes. However, almost half of the total MSW was organic waste of which only a small portion is compostable. The remaining MSW was subdivided into plastic waste (20%), paper waste (10%) and other waste (20%).

Plastic waste handling, disposal and technology

↳ Most plastic waste is low-value, contaminated plastic waste, such as plastic bags, and composite plastic both presenting a low incentive for recycling.

At the national level, four ministries in Thailand – the Ministry of Natural Resources and Environment (MoNRE), the Ministry of Public Health, the Ministry of Industry and the Ministry of Interior – are involved in plastic waste handling, disposal and technology via entities under each ministry that oversee solid waste management. The ministries' main work is to set national environmental policy and to assign departments and agencies under the

Figure 6 **Method of disposing of MSW per 100 household survey samples across Thailand (%) in 2017**
(Source: Huno, et al. (2019); adapted from Thailand, Ministry of Digital Economy and Society, National Statistical Office (2018))



ministries the responsibility for implementing the law by issuing regulations and technical guidelines (Institute for Global Environmental Strategies [IGES] 2012).



The National Environmental Board was formed in 1975 to oversee the management of the country's natural resource and environment quality, and in 1992, it was replaced by three environmental departments under the purview of the

Public Health Act of 1992. This legislation provided that solid waste and sewage disposal would fall within purview of the local government. The administrative organisations, at the provincial and local levels, are classified into five classes of local self-government units: provincial administration organizations; Bangkok Metropolitan Administration; Pattaya City; municipalities (with three subclasses, city, town and subdistrict); and subdistrict administration organizations.

At the provincial and local levels, the provincial, municipal and subdistrict (tambon) administrative organizations are primarily responsible for waste collection, transport, treatment and disposal. In the past few years, the Thai Government has implemented the Decentralization Action Plan, which included natural resource and environmental protection, and transferred functions, budget and personnel from the central government to nearly 8,000 local governments (*Ibid.*).

In Thailand, about 7.15 million tons of solid waste was disposed inappropriately in open dumpsters, including open burning in waste disposal sites and illegal dumping in public areas and in water sources. Generally, plastic waste is disposed by landfilling, recycling and incinerating. An analysis of plastic flow shows that about 0.77 million tons of plastic waste were recycled by local government organizations or used as raw material for plastic production by independent merchandizers, while 0.22 million tons were incinerated for energy recovery, and 2.08 million tons were disposed in landfills. Notably, most plastic waste presents a low incentive for recycling because it is composed

of low-value or contaminated plastic (e.g. plastic bags and composite plastic).

4.2.4 Viet Nam

Viet Nam produced and consumed about 5 million tons of plastic of which about 80 per cent of imported materials were derived from scrap plastic. Plastic consumption per capita in Viet Nam increased rapidly from 3.8 kg/person/year in 1990 to 41 kg/person/year in 2015. Of this consumption, about 37.43 per cent and 29.26 per cent were product packaging and household appliances, respectively. Hanoi and Ho Chi Minh City releases into the environment about 80 tons of plastic products and plastic bags daily.

Most solid waste received at the landfills is not segregated at the source. Plastic waste is recycled at Vietnamese craft villages, where the environment is seriously polluted, especially surface water. These villages not only recycle waste plastic from domestic sources but also from imported sources (Nguyen 2020).

↳ Most solid waste received at the landfills is not segregated at source.

Currently, no details or statistics exist on the amount, type and composition of plastic discharged into the Viet Nam seas, with only a few studies on plastic waste in general conducted by local research groups.

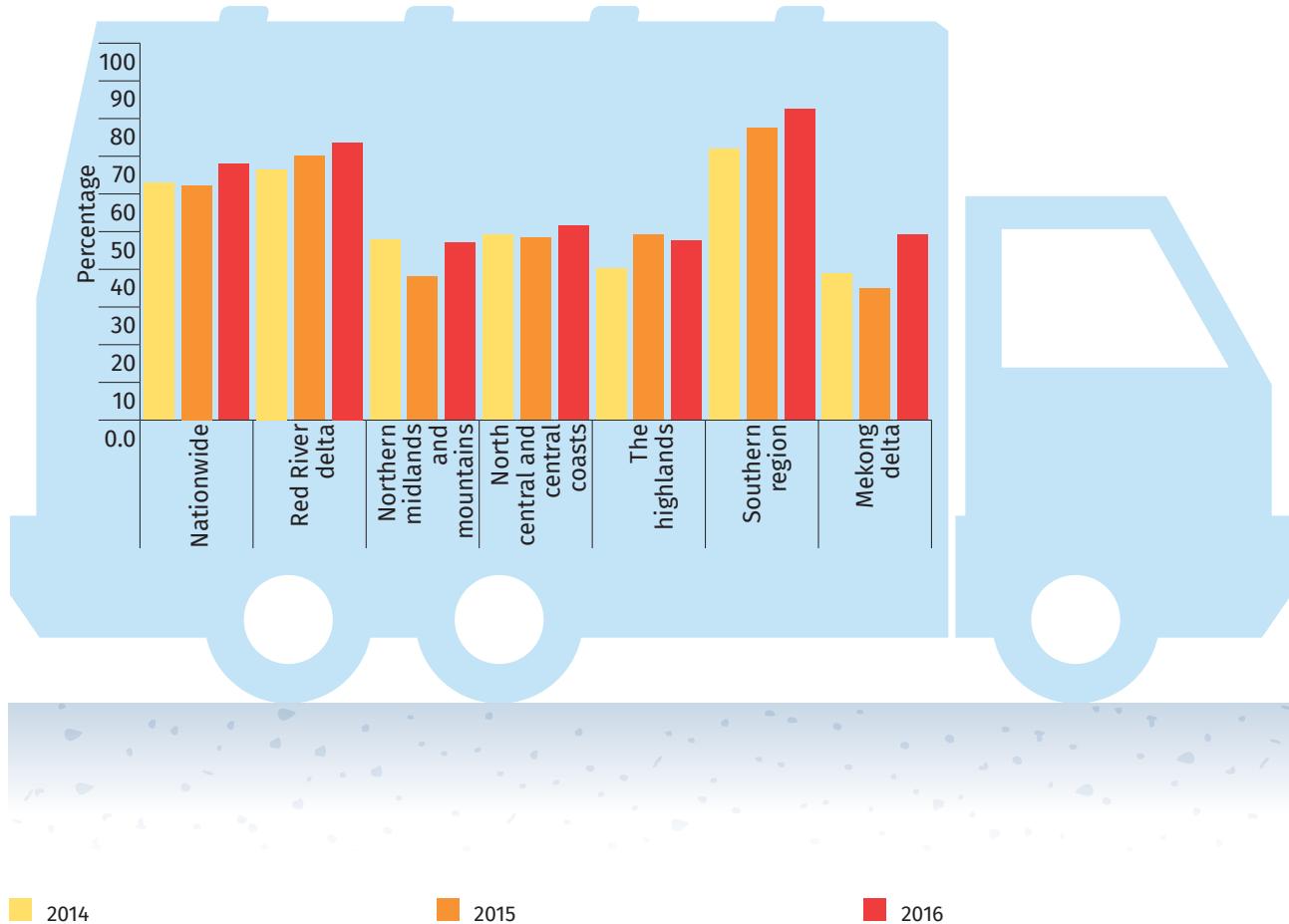
Figure 7 shows the share of solid waste treated in compliance with national standards and regulations in Thailand and selected regions (UN 2018).

Recognizing the serious risk of plastic waste to the environment, several decrees have been issued (the National Assembly, 2015; and the Prime Minister, 2009, 2013 and 2019). Many coastal provinces and cities also integrate marine plastic waste pollution and its disposal into local socioeconomic development plans (Thang, 2019).

In Viet Nam, solid waste management requires more effort and cooperation from all governmental levels and sectors. Resources, enforcement capacity and coordination mechanisms among stakeholders are still issues that still need to be more drastically



Figure 7 **Solid waste treated in compliance with national standards and technical regulations, Thailand and selected regions 2014–2016 (%)** (Source: Viet Nam, Ministry of Planning and Investment (2018))



directed from all levels of government. Public awareness of plastic waste recycling in the country is low with estimates of more than 50 per cent of households and small businesses lacking knowledge about the nature of plastic, the impact of leakage of plastic waste into the environment. Moreover, 63 per cent of households and small businesses do not have an understanding of any legal regulation on solid waste and environmental protection, and they are indifferent to the problem of plastic waste in their surroundings. Currently, about 5 to 9 per cent of households still discharge plastic waste directly into the environment, leading to an estimated 2019 discharge rate from 8 to 10 per cent, or an equivalent of 0.4 to 0.7 million tons. An estimated 25 per cent of plastic waste in Viet Nam is returned to the recycling market via the informal sector.

Sub regional efforts on curbing plastic waste

↳ All actors-private and public sector, private investors, civil society, and development finance institutions-have strong reasons to solve the plastic waste challenge.

Regional efforts in addressing marine plastic litter is highlighted in the ASEAN Framework of Action on Marine Debris, prioritises interventions in the area of (i) policy support and planning; (ii) research, innovation, and capacity-building; (iii) public awareness, education, and outreach; and (iv) private sector engagement (ASEAN, 2019). All actors have strong reasons to solve the plastic waste challenge the private or the public sector, civil society, private investors or development finance

institutions. However, this may be complex and challenging, requiring impactful solutions provided by the combined resources and the functional and technical/technological capacities of all actors – at all levels. Solving these challenges require analyses of contextual factors to develop best-fit local, national and regional solutions.

Notwithstanding the immense commitment by Mekong countries to deal with the challenge of plastic waste leakage, capacity needs are still required for the development of data and information to support policy and decision-making. A multi-stakeholder collaboration is needed to explore the potential development of monitoring

networks for acquiring, sharing and managing data and information on land-based plastic leakage in the Mekong Basin and the Mekong River. Monitoring for the presence of plastic litter is a necessary part of assessing the extent and possible impact of plastic pollution, devising possible mitigation methods to reduce inputs and evaluating the effectiveness of such interventions. However, LMCs with fast-growing markets and underdeveloped waste management systems are faced with enormous plastic waste management challenges. These persisting challenges have given rise to plastic waste leakage and common plastic waste hotspots.



5 / FUNCTIONAL AND TECHNICAL CAPACITY MAPPING IN LOWER MEKONG COUNTRIES

The section provides an overview of functional and technical capacity mapping for the four lower Mekong countries (LMCs) under analysis. It concludes by providing insights into the role of stakeholder and donor support in this regard.

5.1 Functional capacities for monitoring and assessment of plastic pollution

This section examines functional capacity in each of the four LMCs by discussing each country's legal, regulatory and policy frameworks and their ensuing institutional arrangements as well as their financial and human resource capacity, including skilled, dedicated human resources as well as system and influencing capacities.

Taken one step further, this suggests that social capital plays an important role in fostering the social networks and information exchange needed to achieve collective action – and sustaining a social and institutional learning environment which is ready to adapt and change.

Social capital can be thought of as the framework that supports the process of learning through interaction, and requires the formation of networking paths that are both horizontal (across agencies and sectors) and vertical (agencies to communities to individuals). The quality of the relationships within which learning interactions take place is especially influential on the quality of the learning outcomes in collaborative approaches.

5.1.1 Cambodia

Legal and regulatory framework

In Cambodia, although there are no specific legal provisions on the conduct of plastic pollution monitoring and assessment, solid waste management laws are mostly applied in plastic waste management

Environmental management laws and regulations are critical backbones for governments in supporting and reinforcing policy levers needed to shape decisions and behaviours to achieve environmental goals. Thus, legal and regulatory frameworks are often frequently developed by national governments with direct and indirect inputs from subnational governments.

In Cambodia, the broad definition of “solid waste” includes plastic waste, and as such, plastic waste management is practised within the legal remits of solid waste management laws (see Subdecree No. 36 ANRK.BK on solid waste management [1999]). There are no specific legal provisions on the conduct of plastic pollution monitoring and assessment. However, various laws enacted to govern the management of solid waste have been widely applied in plastic waste management. In sum, the legal framework for solid waste management in Cambodia provides the legal basis for the exertion of institutional mandates and responsibilities, including the issuance of technical guidelines and regulations on plastic waste management.

The Law on Environmental Protection and Natural Resource Management (1996) provides the overarching legal framework for environment and natural resources protection and management. This law promotes the preservation of environmental quality and public health by controlling, preventing and reducing point and non-point sources of pollution. The subsequent Subdecree No. 36 ANRK. BK (1999) on solid waste management issued in compliance with Article 13 of the aforementioned law, prescribes the issuance of regulations and

technical guidance on solid waste, rubbish and hazardous waste management nationwide. Article 4 of the Subdecree also mandates provincial and city authorities to establish waste management plans in their provinces and cities for short-, medium- and long-term management of waste. Moreover, Article 6 entrusts national-level administrations with responsibilities to monitor and ensure that subnational administrations implement waste management activities in compliance with issued guidelines and regulations.

Subsequently in 2003, the Joint Ministry of the Interior–Ministry of the Environment Inter-Ministerial Declaration (Prakas) No. 80 on solid waste management in provinces/municipalities was issued to promote and clarify the responsibilities of local and concerned authorities on solid waste management, that is, the collection, cleaning, temporary storage, transport and disposal or handling of waste in the provinces and municipalities of Cambodia (mainly in Phnom Penh, Preah Sihanouk, Kep and Pailin).

In this context, Subdecree No. 168 GNKR.BK (2017) on the management of plastic bags was also issued to enhance the effectiveness of reducing the importation, production, distribution and use of plastic. This subdecree prescribes the duties of citizens and relevant authorities, alluding to general measures in managing plastic bags as well as to associated penalties for the violation of laws. Nonetheless, this subdecree does not stipulate specific legal provisions on the monitoring and assessment of plastic waste.

The Prakas on Public Participation in Environmental Impact Assessment Process (2016) also provides guidelines for public participation in environmental impact assessments. Although these environmental impact assessments do not substitute for long-term monitoring and assessment programmes, they allow for some level of public participation in environmental management through stakeholder consultation arrangements (Article 4[4A]) and a project’s environmental management monitoring plan.



Policy framework

- ↳ **The National Environmental Strategy and Action Plan (2016–2023) provides an overarching strategic framework and action plan for the National Council for Sustainable Development and relevant stakeholders.**

Innovative policy interventions can help to plug gaps in information that prevent effective plastic litter management on land and in water environments. As such, Cambodia has in place policies and technical guidelines to control and manage solid waste. For instance, to integrate environmental considerations into policies, programmes and investments, the National Environmental Strategy and Action Plan (2016–2023) provides an overarching framework for the National Council for Sustainable Development (Cambodia) and for the following: all government ministries and institutions at the national and subnational levels, the private sector, civil society, development partners and local communities (Cambodia, National Council for Sustainable Development [NCSD] 2017). The Action Plan provides support for institutional policy development to improve the integration of environmental and natural resource sustainability into policies, strategies, action plans and programmes. The Plan also supports existing environmental sustainability-related policies implemented by related ministries and institutions, development partners, the private sector, civil society organizations, NGOs, education and research institutions, and local communities. For another example, the provisions of the National Strategic Plan on Green Growth (2013–2030) encourages the promotion of monitoring programmes on marine pollutants to protect marine ecosystems and ensure the improvement of environmental quality by adopting the 3Rs (reduce-reuse-recycle) (Cambodia, National Council on Green Growth [NCGG] 2013) (see also sections 3.2 and 4.8). However, there is no specific reference to setting up programmes for monitoring solid waste or for plastic pollution monitoring and assessment.

Other subnational policies relating to solid and plastic waste management include

- ▶ Draft Strategy and Methodology for Improving Waste Management and Cleansing, Collection

and Transport of Solid Waste in Phnom Penh Capital

- ▶ Sechkdey Chun Damnoeng (Notification) on Waste Storage, Cleansing, Waste Discharge and Penalties on Improper Waste Disposal in Phnom Penh Municipality, No. 13 (2013)
- ▶ Instruction Plan on the Application of Penalties to Promote Environmental Sanitation Raising in Phnom Penh Municipality, No. 09 (2010)
- ▶ Instruction Plan on Waste Separation Promotion in Phnom Penh Municipality, No. 08 (2010)
- ▶ Sechkdey Nainoam (Instruction) on Penalties on Waste Disposal in Public Area, No. 16 (2010)
- ▶ Declaration on Industrial Solid Waste Collection and Transport in Phnom Penh and Kandal, No. 148 (2002)
- ▶ Declaration on the Permission Sarom Trading to Collect and Transport Industrial Wastes from Phnom Penh and Kandal province, No. 156 (2001)

- ↳ **Cambodia has technical guidelines on solid waste management: discarding, storage, collection, transport, recycling, treatment, composting and disposal of solid waste.**

Technical guidelines for implementing Subdecree No. 168 GNKR.BK on the management of plastic bags (2017) are yet to be developed. However, in 2006, the Ministry of Environment of Cambodia and COMPED (Cambodian Education and Waste Management Organization) published “Environmental Guidelines on Solid Waste Management in Cambodia”, referencing related laws on solid waste management, including

- ▶ Law on the environmental protection and natural resources management (Article 13)
- ▶ Subdecree No. 36 on the solid waste management (Articles 1, 4 and 11)
- ▶ Declaration (Prakas) No. 80 of the Ministry of Interior and the Ministry of Environment on garbage solid waste management in provinces-

cities of the Kingdom of Cambodia (Articles 1 and 2)

These technical guidelines apply to all activities related to the storage, collection, transport, recycling, treatment, composting and disposal of all kinds of solid waste. The guidelines spell out mandates for authorities of provinces or cities to report and disclose waste flows to the Ministry of Environment and to the local authorities annually. However, the guidelines provide no clear indications for mandatory plastic waste monitoring activities by local or provincial authorities. Though not specific to plastic waste, they underscore the relevance of the collection and use of key information on waste collection, transport and disposal; the measure of waste avoidance or the 3Rs (reduce-reuse-recycle); and the set-up of a solid waste management plan for areas like communes. This information, however, is best obtainable from waste-monitoring activities.

Institutional arrangements

↳ Solid waste management is practiced within a decentralized framework. However, provincial authorities wield significant influence in decision-making and contracting issues at the municipal and district levels.

Monitoring of the various types of plastic from the value chain into water environments requires inter-agency, cross-sectoral cooperation to effectively monitor plastic on land and in the water environment. Various aspects of plastic waste governance are handled via the collaborative actions of multiple actors and stakeholders, including line ministries, subnational administrations, local authorities, private actors and civil society organizations.

An efficient, fully functional intra- or inter-agency coordination of actors provides a good launchpad for establishing plastic litter monitoring and assessment programmes. The Ministry of Environment has an overarching responsibility for coordinating and leading the preparation of guidelines on solid waste management, including collection, transportation, storage and recycling.

The National Council for Sustainable Development has legislative and executive decision-making

powers to formulate subnational policies, including those relevant to waste management — and the responsibility to ensure that the decisions have been implemented. Municipal technical departments of line ministries support waste management in many capacities through technical assistance by the Ministry of Environment; Ministry of Public Works and Transport; Ministry of Tourism; Ministry of Health; and Ministry of Industry, Science, Technology and Innovation.

The roles and responsibilities of the various actors in solid or plastic waste governance have been defined by the legal provisions on waste management, albeit not specific to collecting data via monitoring programmes (National League of Local Councils 2016), and are outlined in Table 1.

Though waste governance is decentralized, in practice, the municipal and district authorities do not wield the full breath of power in decision-making, thus undermining the effort to devolve power in waste governance. Instead, the provincial authorities wield significant decision-making influence in policymaking and contracting issues at the municipal and district levels. Such occurrences inhibit the development of localized context-specific solutions and local-level innovation.

Other shortfalls and constraints seem to persist in ensuring the full functional authority of subnational administrations. Limited institutional capacity of the public sector has contributed in many ways to the inefficient decentralization of municipal SWM policies in Cambodia (Spoann et al. 2019). For example, in Phnom Penh, Kum et al (2005) reported that regulatory government agencies have difficulties — politically and practically — in ensuring that other government units comply with regulations. For instance, the Ministry of Environment has difficulties in monitoring the management of disposal sites operated by Phnom Penh Waste Management Authority, and it may be difficult or impossible for the Ministry to collect fines from the Phnom Penh Waste Management Authority for any regulatory violation. Sethy et al (2014) cited the lack of law enforcement and cooperation in Cambodia as a common challenge in implementing waste management regulations (Sethy et al. 2014). In surveying waste management



Table 1 Roles and responsibilities of public actors, by subfunction for waste management

Sub-function	Municipalities and District Council	Municipalities and District Board of Governors	Ministry of Environment	Ministry of Economy and Finance	Private Sector
Planning				●	● ● ●
Dumpsite identification	●		●		
Budgeting	●			● ●	● ● ●
Contracting	●			● ●	● ● ●
Implementation	●		●	● ●	● ● ●
Fee tariff setting and collection	●			● ●	● ● ●
Support and coordination	● ●		● ●	● ● ●	
Monitoring and oversight	●			● ● ●	
Evaluation	●			● ● ●	
Education	● ●		● ●		

● Little involvement

●● Some involvement

●●● Heavy involvement

practices in municipalities and districts, Ming (2016) reiterated the same institutional challenges.

Beside overseeing associated coordination, supervisory and regulatory functions, the Ministry of Environment has full responsibility for establishing guidelines on waste management — that is, the disposal, collection, transport and storage, recycling and dumping of household waste — in the provinces and cities. The legal remits of the Ministry also extend to monitoring, checking and evaluating environmental work relating to the management of urban solid waste. However, direct monitoring and assessment of hazardous waste (including plastic waste from the production or use of plasticizers) by the Ministry is prescribed by law. This order makes mandatory the submission of quarterly reports by companies on the amount, type, source, transport and handling data by owners of the hazardous waste. The Ministry of Environment, together with the Ministry of Trade, also exerts monitoring and regulation mandates by issuing import-export trade permits and licences for hazardous waste. Within the waste management sector, the Joint Prakas 80 prescribes the roles and responsibilities of the provincial/municipal environmental departments and district (khan) environmental agents. They are required to work as subordinates to local

authorities in their preparation for management planning; participation in developing action plans on the collection, temporary storage, transport and disposal of solid waste; cooperation and monitoring of that implementation; and drafting of their action implementation report on the collection, temporary storage, transportation and disposal of solid waste every semester and the submittal of this report to the Ministry of Interior and the Ministry of Environment.

Institutional collaboration on waste monitoring is hindered by a general lack of waste management data- and information-sharing obligations among relevant institutions and stakeholders.

Monitoring of the appropriate implementation of waste management activities by the Ministry of Environment is hampered by the lack of adequate resources. Commitment to the proper monitoring of solid waste generation, collection, treatment and disposal can be resource-intensive and inconsistent and, as such, mostly performed by very few municipalities and districts on the request of administrative agencies at the provincial or higher levels. In fact, the lack of solid waste/plastic litter monitoring has been partly attributed to the lack of

technical and financial support from the provincial departments of economy and finance (National League of Local Councils 2016). There appears a general lack of waste management data- and information-sharing obligations among relevant institutions (Kum et al. 2005).

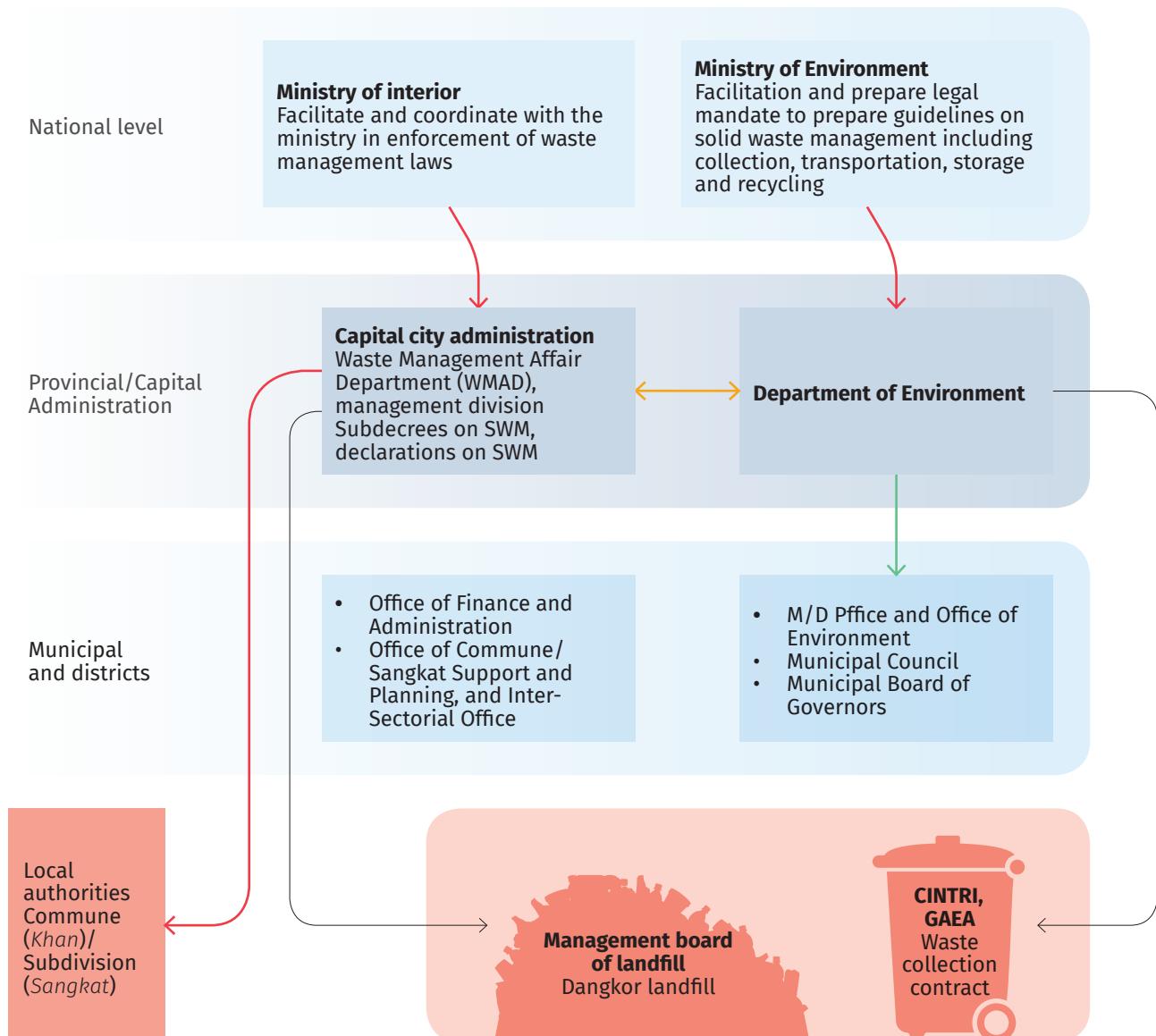
Generally, access to data and information in Cambodia is expected to improve considerably with the passing of the draft law on access to information. When adopted and fully implemented, access to government information on relevant data and information is expected to improve. This will enhance the legitimacy of data- and information-

sharing among institutions to improve governance and accountability. Figure 8 outlines the institutional hierarchy for solid waste management in Cambodia.

Financial and human resource capacity

Undoubtedly, public sector funding of waste management services, including research and data acquisition, is woefully inadequate in many developing countries. Waste management in Cambodia suffers similar challenges involving funding shortfalls – and the lack of adequate budgetary supports from the central government in some cases.

Figure 8 **Institutional arrangements for solid waste management in Cambodia**



Abbreviations: CINTRI; Cintri (Cambodia); GAEWA, GAEWA Waste Management Company

Accordingly, this section explores the availability of budgetary allocations for the sampling and assessment of plastic litter on land and in water environments within the institutional structuring of waste governance in Cambodia. Solid waste management financing and the functioning of regulatory agencies is severely affected by inadequate financial resources and facilities, resulting in weak enforcement and less attention to assigned tasks. Public finance mechanisms and personnel management systems with heavy dependence on international donor funding still involves high degree of centrally managed governance arrangements (Niazi 2011).

↳ Public sector funding; local and national sources of funding for solid waste management, including research and data acquisition is inadequate

Under the decentralized system, the Ministry of Environment still maintains responsibility for setting waste management regulations, monitoring and evaluating plastic waste and levying penalties for noncompliance. Other line ministry agencies support the nation's waste management efforts, as follows;

- the Ministry of Interior supports the Ministry of Environment through coordination with other relevant agencies in capacity-building and sharing of lessons learnt.
- the Ministry of Economy and Finance also coordinates with the Ministry of Environment and the Ministry of Interior in establishing tariff rates for urban solid waste management services.
- the Ministry of Planning and the Ministry of Economy and Finance coordinates with the Ministry of Environment the approval of sector investment plans, the establishment and approval of cost-recovery levels and appropriate service tariffs, the allocation of government funds for investment projects, and the solicitation and organization of grant.
- the Treasury and the provincial offices of the Ministry of Economy and Finance consolidate all budgets in the provinces and send them

to the Ministry; a consolidated budget is then submitted by the Minister of Economy and Finance to the National Assembly and the Senate for further approval.

Provisions of the Joint Prakas No. 073 (2015) stipulates that municipal and district administrations are to receive central government funding for waste management. However, in practice, these funding streams are hardly adequate. In addition, the Law on Administrative Management of the Capital, Provinces, Municipalities, Districts and Khans (2008, organic law) stipulates the responsibility of subnational institutions to secure the necessary financial sources to accomplish their administrative roles and responsibilities via three categories of revenue streams, namely, subnational revenues, revenues from national government and other revenues (as outlined in Box 1).

The management of waste, including plastic, is handled by provincial administrations or private waste management companies such as CENTRI, GAEA and other market fee collectors, which represents a transformation that allows district/municipal administrations to deliver local services through the private sector. Municipal administration also mobilizes additional support from private individuals in terms of tools and equipment from trash collection. However, a notably high level of non-compliance for waste collection service patronage has contributed to poor performance of these companies. Funding for waste management is very limited, and such locally responsible agencies find it difficult to allocate funds for other non-revenue-generating solid waste/plastic pollution initiatives. The revenue from disposal fees for disposal site maintenance allocated by private companies, and some small amounts from international donors could be inadequate for extra monitoring activities.

This has led to the inability of contracted companies to mobilize enough funds for investment in improving waste management services. The financial arrangements of the existing solid waste management system need improvement, and public participation is also important and should not be overlooked.

Box 4 Snapshot of subnational public finance in Cambodia

Subnational governments are almost entirely dependent on funding from national governments, whose limited budgetary scale often translates into limited public service delivery, as well as other sources of revenue, as outlined below.

National Government revenues

- Local allocation tax
- Revenues by intergovernmental transfer from national government
- Implementation fee for special services provided by subnational governments for national government agencies and entities

Sub-national Revenues

- Local tax
- User fee, compounding fee and non-tax revenues

Other Revenues

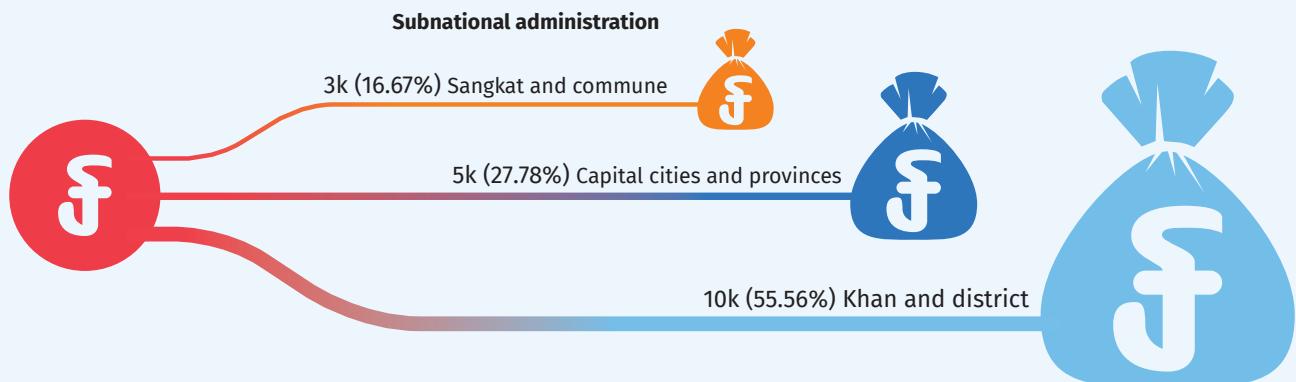
- Grants from international donors (e.g. JICA, ADB)
- Private companies and foundations (e.g. Unilever and Chevron)

Such limited budgetary outlays translates into limited public service delivery, including that for waste management. For instance, in Phnom Penh City, the total allocated budget for the subnational administration increased by 30.6 per cent in the 2019 budget, a mere increase of 5 per cent from the 2018 budget, of which the municipal and provincial administration budget experienced the largest increase – that is, 39.3 per cent. Moreover, the city and district administration budget increased by 24 per cent, while the commune (district of a province) and the sangkat (subdivision of a district, in Phnom Penh) administration budget expanded by 20.7 per cent.

Sub-national budget (in millions of riels)	2018	2019	% change
Total	1,684,674	2,199,636	30.6%
Municipal and provincial administration	1,060,233	1,476,946	39.3%
o/w transfer from the central administration	148,814	83,808	-43.7%
City and district administration	160,400	198,890	24.0%
o/w transfer from the central administration	155,015	192,060	23.9%
Commune and Sangkat administration	434,041	523,800	20.7%
o/w transfer from the central administration	434,041	523,800	20.7%

Sources: World Bank Group (2019) Cambodia Economic Update; Recent Economic Developments and Outlook

Flow of Intergovernmental transfer from National to Subnational Administrations, FY2013 (Source: Phnom Penh Waste Management Strategy and Action Plan 2018-2035)



Skilled, dedicated human resources

↳ **Cambodia lacks adequate financial and human resources to support local government authorities in management solid waste.**

The setting-up of monitoring and assessment programmes in a decentralized waste management setting could prove potentially effective provided there are dedicated, adequate and well-trained staff resourced to carry out specialized routine monitoring. Thus, government entities should identify human resource structuring, staffing and arrangements at the national, provincial, district and municipal level to this end.

However, there are human resource limitations in the various administrative agencies. At the national level, the Ministry of Environment has the legal mandate to set, monitor and evaluate regulations and to levy penalties for waste management non-compliance. However, satisfactory performance of these services is severely challenged. Subnational administrations have been reported to have an inadequate number of staff members, and limitations on the availability of appropriate office facilities is also a major concern.

Similar observations have been noted by earlier surveys conducted by Ming (2016) on the implementation of waste management at the municipal and district administration levels. The provincial Department of Environment works on behalf of the Ministry of Environment without further delegation of its work to offices at the municipal and district levels, owing to the limited capacity of provincial and national line offices. According to Ming (2016), the Office of Finance and Administration, Office of Commune/Sangkat Support and Planning, and InterSectoral Office, and those under the control of provincial departments, such as the Office of Environment, are often understaffed and -resourced. These challenges inhibit the effective execution of waste management functions, including the monitoring of plastic waste leakage.

In turn, the lack of adequate human resources limits local waste management authorities in handling newly assigned tasks. Consequently, the conduct of

technical functions is carried out with instructions issued by the provincial Department of Environment. The lack of skilled civil servants and contracted workers in the public sector has contributed to the privatization of waste collection services (Spoann et al. 2019). However, privately operated solid waste management services companies have had to grapple with uncertainty about the available levels of cleaning service workers and some, such as CINTRI, have depended on migrant workers.

System and influencing capacities

↳ **Technical working groups were established by joint ministries to provide the platform for involved parties to identify common ground and engage in discussion.**

Over past decades, Cambodia has been committed to improving the inclusiveness and wider stakeholder participation in waste management decision-making. A part of this commitment involves the adoption and implementation of decentralised waste management across the country to improve local-level engagement in waste management issues. Though technical, financial and human resource challenges are prevalent, in principle, institutional structures are possible avenues for promoting inclusion, policy feedback and dialogue mechanisms. In this context, technical working groups have been established by the Government of Cambodia to encourage dialogue: such as the following:

- The National Committee for Democratic Development of Subnational Administrations issues royal decrees requiring all ministries to establish working groups, led by the sector minister, to support the development of policy and to implement agreed upon reforms. The National Committee establishes subcommittees on functions and resources, financial and fiscal affairs, and personnel administration. The National Committee may establish further subcommittees (composed mainly of relevant secretaries of state along with a subnational administration representative from each level) that consult and make recommendations to the Committee. The subcommittees may appoint

working groups and invite development partners to observe and even speak at meetings.

- › The National Committee for Support to Communes Councils, together with the Interministerial Commission, and Cambodia supports the development of key policies, particularly those regarding ministries implementing decentralisation. Since municipal and district administrations may also issue legal instruments, in line with legislation at a higher jurisdictional level or national-level legislation, community-based approaches to waste management policymaking are invaluable. These could be achieved via dialogue and interaction with municipal and district services representatives through the involvement of councils at the municipalities and districts (in Phnom Penh referred to as “Khan”, with their subdivisions referred to as “Sangkat”) as well as the communes. Moreover at the provincial level, the Board of Governors have also been reported to engage in awareness-raising and education of communities as well as in monitoring performance of waste management companies.
- › Each district and the municipal authorities are expected to establish an effective mechanism to resolve constraints and obstacles by having regular technical working group meetings and discussions. Established by joint ministries, the technical working groups could provide a platform for involved parties to identify common ground and engage in discussion. In addition, that local government authorities should be working politically and flexibly based on their own approaches and strengths for the reallocation of resources and funds from national governments and multinational corporations.

Overall, strong system and influencing capacities may hinge on strong and effective functioning of institutional and social processes of interagency relationships and cooperation, shared understanding, norms and values, and trust.

5.1.2 Lao PDR

Legal framework

↳ **The existing legal framework on solid waste management is inadequate to support plastic pollution monitoring and assessment at the national and subnational levels.**

The Constitution of Lao PDR is the main overarching legislation of the country: it confers all organizations and citizens the obligation to protect the environment and natural resources, including those at the land surface and underground, including forests, animals and water resources as well as the atmosphere in general. Nevertheless, no legislation exists specific to plastic pollution monitoring in Lao PDR. The Law on Environmental Protection No. 29/ NA (2012) stipulates the principles, regulations and measures relating to the management, monitoring, protection, control, preservation and rehabilitation of both the natural environment and the social environment.

Plastic waste management in Laos PDR is governed by Article 21 of the Urban Planning Law No. 3-99/NA (1999) and Article 8 of the Industrial Waste Discharge Regulation No. 180/MOIC (1994). Regarding the impacts of projects and factories on the environment, Articles 13–15 of the Decree on Environment Impact Assessment No. 112/ PM (2010) provides for (i) the development of environmental management/monitoring plans, social management/monitoring plans and (ii) the examination of the report on the environmental impact assessment, the environmental management and monitoring plan, and the social management and monitoring plan.



Moreover, Article 8 of the aforementioned 1994 regulation provides standards for industrial waste discharge. Plastic waste management is also conducted within the framework of the following: Decree on Hygiene, Disease Prevention and Health Promotion No. 13/PO (2001); Law on Hygiene, Disease Prevention and Health Promotion(Amended) No. 08/NA (2011); Decree on Sanitation of Public Area (No 1705/MOH, 20/7/2004) and Decree on Disposal Site Management No. 520 /TCPC (2007). Apart from not being specific to plastic pollution monitoring and assessment, these provisions are concerned with industrial and project development but do not conductive for long-term monitoring programmes that inform policy.

↳ Lao PDR has yet to formulate waste management laws and technical regulations bordering on general solid waste management as well as on plastic waste monitoring and assessment

In Lao PDR, whereas the main government entity responsible for waste management is the Ministry of Public Works and Transport, the Ministry of Natural Resources and Environment (MoNRE) develops laws and regulations on environmental management. Local waste collection and disposal is handled by subnational entities. In the national capital, the Vientiane Cleansing Unit, under the Vientiane Urban Development Administration Authority, is responsible for waste management, while the provincial administration and the district offices of public works and transport handle waste in other cities. Provincial decrees are issued to provide descriptions of the roles and scope of work for responsible agencies and committees to collect waste from households, government offices and commercial enterprises. Nonetheless, gaps in legislation on solid waste management, particularly at local level, need to be addressed.

Policy framework

↳ The existing policy framework lacks provisions for plastic pollution monitoring and assessment at the national and subnational administration levels.

Agreement on the National Environmental Standards No. 2734/PMO.WREA (2009) defines standards as the

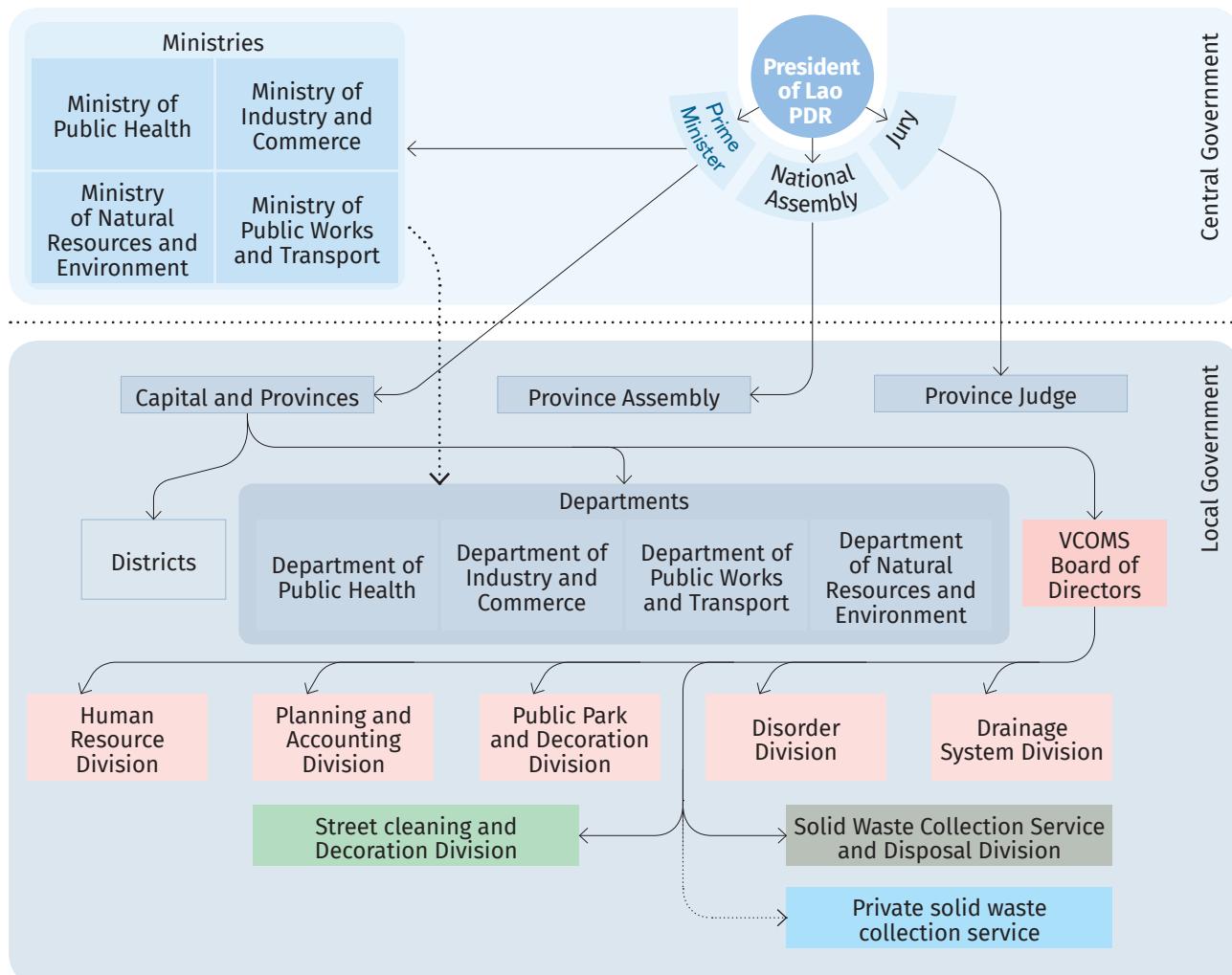
basis for environmental monitoring and pollution control of water, soil, air and noise, both in the sense of ambient environmental standards and emission standards. This Agreement applies to any relevant person, enterprise or organization to both protect the environment and control pollution in Lao PDR. It prescribes all the governing parameters that must be complied with both in the general context and the specific context for each specific activity or specific business sector.

MoNRE is the competent authority that will govern and monitor compliance with all the governing parameters defined. The development of the 10-year National Natural Resources and Environment Strategy 2016–2025 is based on government directives and policies, including the National Socio-Economic Development Plan 2011–2020, the National Strategies for Economic Development and Poverty Eradication and those pursuant to the Ninth National Congress of the Lao People's Revolutionary Party. This 10-year National Strategy was also based on regional and global orientations and policies, such as the Millennium Development Goals and multilateral environmental agreements. As such, in cooperation with line sectors and international organizations, the Strategy aims at ensuring and implementing an effective, efficient natural resources management and development system, one that would support national economic development towards green growth and sustainable development. In implementing this strategy, active coordination and cooperation with all key sectors and partners at the national, regional and subregional levels is thus crucial — as is the involvement of those at the local level.

Institutional arrangements

↳ Multiple institutional involvement in solid waste management at national levels however precludes obligations for monitoring and assessment and of plastic pollution

At the national level, MoNRE is the mandated authority that governs and monitors compliance with all governing parameters of environmental standard compliance law. The Ministry of Public Works and Transport and the Department of Housing and Urban Planning lead in the design

Figure 9 **Institutional structuring for central and local governments of Lao PDR**

Abbreviation: VCOMS, Vientiane City Office for Management and Services

of urban planning policies and in land-use allocation to facilitate urban waste management. The Ministry's other public works and transport responsibilities include urban planning and vehicle allocation for waste management purposes. The Provincial Department of Natural Resources and Environment promotes awareness of environmental education and addresses community-level' waste management, including drafting of city and community regulations on the environment and waste management and developing policy relevant to the 3Rs (reduce-reuse-recycle).

Figure 9 provides a comprehensive illustration of government structuring at both the central and local government levels. As shown in the figure, at the provincial level, the Vientiane City Office for Management and Services coordinates all major

waste management-related projects, and it plans and leads on implementing and monitoring project-related activities in the subdivisions villages (*baan*).

◆ **Local authorities promote communities, households, business sector engagement in waste management project activities by providing the basic and needed information to the project implementation committees**

At the district level, the vice governor has the responsibility (i) to advise the entities in the district and the authorities in target villages to participate in project implementation in the city and in the pilot (role model) project in their village and (ii) to assign a focal point for coordinating and monitoring of the aforementioned city-level project. Also at the district

level, the Vientiane City Office for Management and Services is responsible for coordinating and monitoring project implementation activities in each pilot (role model) village. A local office of the Ministry of Public Works and Transportation, however, is responsible for urban planning and land-use allocation to facilitate waste management within the pilot (role model) villages in this district. The MoNRE District Office undertakes awareness-raising campaigns and disseminates regulations for community engagement in environment protection and waste management, including segregation and composting.

At the village level, the local authorities engage with communities, households and the business sector in their jurisdiction promoting the need to cooperate and participate in waste management project activities; they do so by providing project implementation committees with basic, needed information. Moreover, their responsibilities extend to obtaining cooperation in project implementation and monitoring activities.

Financial & Human resource capacities

In Lao PDR, waste management is heavily underfunded by the central government. Thus, there exists a paucity of skilled personnel handling solid waste management at the various administrative authorities. As such, to augment their waste management budget, local administrations rely on revenue from waste-collection service fees and disposal fees from private waste collectors. Moreover, data collection and information-gathering on waste management are often obtained development projects from international donors.

System and Influencing Capacities

- ↳ **Winning community support on certain key areas of decision-making on solid waste management is challenging.**

Despite the challenges of inadequate legislative framework and unclear institutional mandates in managing solid and plastic waste, the government entities responsible for solid waste management has shown a strong commitment and efficient negotiations with key stakeholders in project co-development, management and coordination at

the national and subnational levels. These entities include the Ministry of Natural Resources and Environment, Ministry of Public Works and Transport, Department of Housing and Urban Planning and the Vientiane City Office for Management and Service, among others. Nonetheless, winning community support on certain key areas of decision-making on solid waste management has suffered setbacks: these include negotiating and setting collection fees as well as promoting awareness of the patronage of waste management services. As a result of these challenges, patronage for formal waste collection services is poor. Rather, open dumping and burning of waste is prevalent at many public areas across the major cities of the country.

5.1.3 Thailand

- ↳ **In Thailand, because the decentralization process began during the 1990s, waste management is handled within the decentralized system.**

In Thailand, no specific legal provisions specifically prescribe the monitoring and assessment of plastic litter leakage. However, the country has issued many laws that govern the conduct of business, projects or any activity that may likely release different types of contaminants to the various compartments of the environment, as discussed in this section.

The National Constitution, B.E. 2560 (2017), provides the overarching legal framework for setting up the various government agencies related to waste management. As part of this framework, the Enhancement and Conservation of National Environmental Quality Act, B.E. 2535 (1992) is the fundamental environmental law governing environmental standards, including planning and monitoring environmental quality and establishing a system for environmental impact assessments. The Public Health Act, B.E. 2535 (1992) provides a legal basis for the local administration and management of MSW through the issuance and establishment of regulations to control and protect environmental sanitation; the law covers waste collection, transportation and disposal. The National Health Act, B.E. 2550 (2007) stipulates that state agencies have the responsibility to reveal and provide data and information to the public;

the law obliges individuals to cooperate with state agencies in creating a good environment.

Other laws include the Enhancement and Conservation of National Environmental Quality Act (NEQA), B.E. 2535 (1992), of which Section 53 (9) states that the Pollution Control Committee has the duty to prepare and submit annually a report on the existing state of pollution to the National Environment Board. Sections 35 and 36 (7) this 1992 Act, relating to the development and implementation of an environmental quality management plan, prescribes, as necessary, the inclusion of schemes for the inspection, monitoring and assessment of environmental quality.

In Thailand, the decentralization process began during the 1990s, and as such, waste management is handled within the decentralized system. The Provincial Administrative Organization Act, B.E. 2542 (1992); the Administrative Organizations Act, B.E. 2537 (1994); the Sub-District Council and Local Administrative Organizations Act, B.E. 2537 (1994); and the Decentralization to LAO Act, B.E. 2542 (1999) are important legislative frameworks that transferred functional roles from the central government to the local government authorities.

Moreover, the Municipal Decentralization Act, B.E. 2542 (1999) stipulates the devolution of responsibility and authority to localities and municipalities for planning and managing within their jurisdiction. By this, waste management functions were transferred to the subnational administrative authorities. The governance of waste management in Thailand is carried out within the decentralized governance framework, in which environmental management has become a main responsibility of local authorities. The political and administrative structure of Thailand is represented by provincial administration organizations except for Bangkok and Pattaya, which are largest of the local government organizations. These provincial-level organizations manage and provide public services within their command area, facilitating the works of municipalities and subdistrict administrations effectively through collaboration with other administrations within the same province. Under the Ministry of Interior, the Department of Local Administration consults, supports and facilitates local government organizations to efficiently

manage and provide public services according to their roles and functions under the principle of good governance.

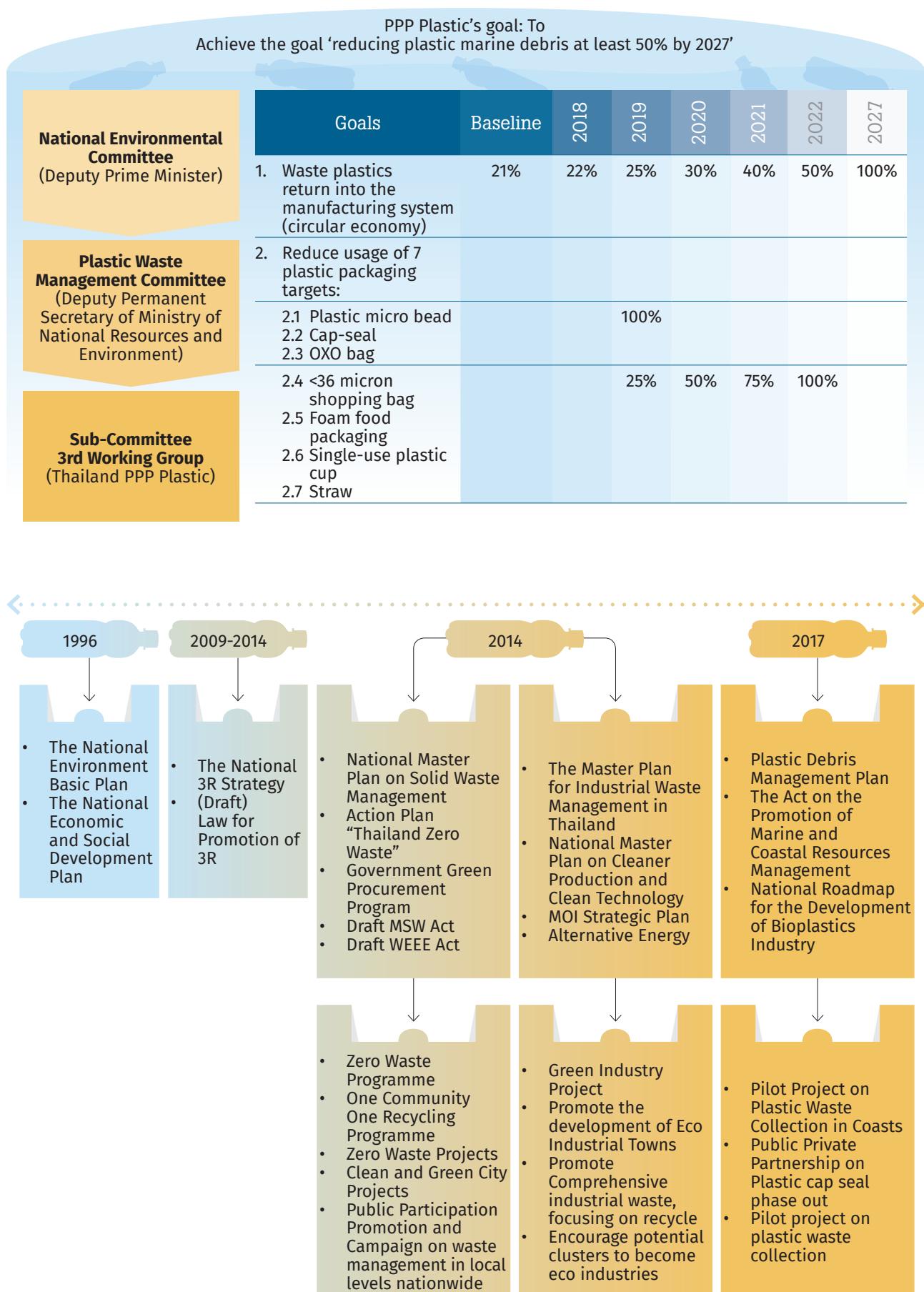
Administrative power has been devolved to the local level, with district and subdistrict administration organizations as the lowest administrative unit. The Pollution Control Department is responsible for the development of national policy recommendations on waste management and minimization. The Department also has responsibility to develop standards and technical guidelines, including the provision of technical support, monitoring, reporting and compliance investigation for issued laws. Local power is established under the purview of the state authorities; the local administrations are not independent bodies, but they are set up under the national laws for the benefit and well-being of members of the community. For instance, local ordinances for waste separation and collection, under the Act on Cleanliness and Orderliness of the Country, B.E. 2535, and amended Act (no. 12), B.E. 2560, are applicable for improving plastic waste management.

↳ Unclear law enforcement roles by local agencies contribute to institutional inefficiencies that could significantly hamper the execution of monitoring programmes.

At present, there are no technical guidelines for the monitoring and assessment of plastic waste in Thailand. At the national level, the Waste and Hazardous Substances Management Bureau of the Pollution Control Department handles aspects of pollution and environmental quality management planning and emergency response. The Bureau also recommends standards, measures, criteria and methods to monitor and manage waste and hazardous materials.

Nonetheless, the Public Health Act, B.E. 2535 (1992) stipulates that the Ministry provides for the management of environmental health sanitation for communities by initiating standards, guidelines, measures and management systems. Subnational government authorities, the main implementers of waste management policy, lack clear technical guidelines in many aspects of solid waste management. These deficiencies pose

Figure 10 Policy development for solid and plastic waste management in Thailand, 1996–2019



challenges to the design and implementation of monitoring programmes such as those for plastic waste monitoring. Solid waste management must be carried out in compliance with several national laws and regulations, including the Public Health Act, B.E. 2535 (1992); the Enhancement and Conservation of National Environmental Quality Act, B.E. 2535 (1992); and the Determining Plans and Process of Decentralization Act, B.E. 2542 (1999).

The interpretation and implementation of the mix of policies have posed challenges to local administrative organizations in enforcing local laws related to solid or plastic waste. These challenges have been cited by many studies that examined the implementation of waste management laws at the subregional level (Thailand, Ministry of Natural Resources and the Environment [MoNRE]/Ministry of Public Health [MoPH] 2017; Yukalang et al. 2018). Such unclear law enforcement roles

by local agencies may contribute to the lack of adequate administrative support and inefficient law enforcement, which could significantly hamper the execution of monitoring programmes. Section 53 (9) of the Enhancement and Conservation of the National Environmental Quality Act (NEQA), B.E. 2535 (1992), states that the Pollution Control Committee has the duty to prepare and submit the report on the state of pollution to the National Environment Board once a year to reflect the existing pollution situation.

In Thailand, the private sector is supporting the central government (through MoNRE) in reducing marine litter through the establishment of the Thailand Public-Private Partnership for Plastic and Waste Management, also known as PPP Plastic. Thailand PPP Plastic's activities are guided by its strategic vision statement, namely, to reduce landfilled plastic waste and leakage to the ocean

Figure 11 **Thailand PPP's programme strategy and key areas of focus** (Source: Chulajata (2019))



by engaging all stakeholders to embrace and implement the circular economy, as shown in Figure 10 (Chulajata 2019). This effort will also focus on behavioural change through public education, improve waste segregation and management systems, and provide a value added channel for all plastic waste to be reused or recycled efficiently.

Policy framework

Roadmap on Plastic Waste Management 2018–2030 includes the development of a national database incorporating data on the production, import, export, consumption and volume of each type of plastic waste.

Given the proliferation of diverse stakeholders and numerous actors, Thailand has developed many policies and tools to improve the country's management of plastic waste. For instance, Roadmap on Plastic Waste Management 2018–2030 includes the development of a national database, incorporating data on the production, import, export, consumption and volume of each type of plastic waste. The database is intended to serve as a vital information source throughout the country. However, it is not clear whether the data set would extend to plastic leakage in rivers and other water bodies. This database would be developed jointly with the private sector with inputs from Thailand PPP Plastic stakeholders. The 2018–2030 Roadmap also aims to accomplish the following: develop a fiscal and financial tool for plastic debris management, promote and encourage eco-packaging design and eco-friendly substitutes for plastic materials, develop a material flow for plastic containers and packaging inventory, implement the 3Rs (reduce-reuse-recycle) strategy for plastic debris management, and promote education for relevant stakeholders in the field of plastic material and its substitute.

The Pollution Management Strategy for 20 Years (2017–2036) is Thailand's long-term strategic policy that, among other things, has been developed to promote standardized pollution management, regulations, plans and implementation, in cooperation with all relevant agencies. Strategy IV of this policy (i) aims to develop the knowledge, laws and tools on pollution management and (ii)

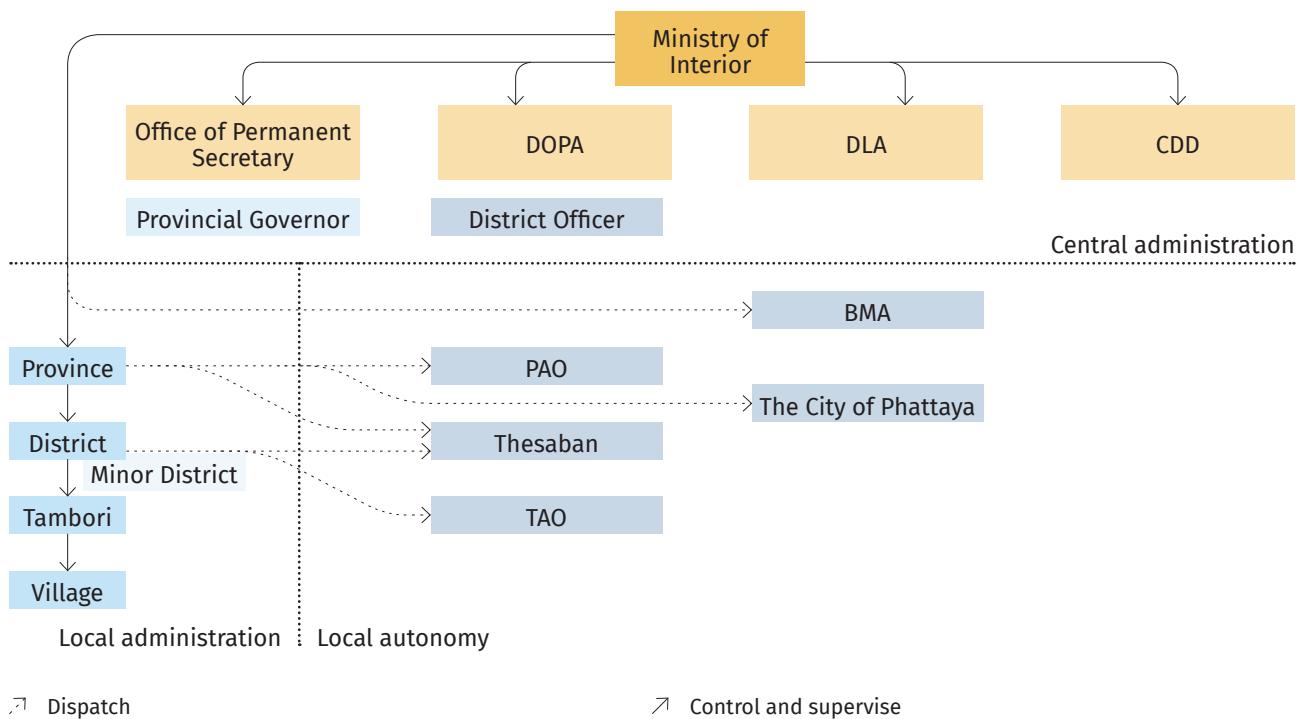
is expected to encourage public participation and stakeholder capacity-building to solve, investigate and monitor community pollution problems. The policy is expected to also support local administration organizations to apply pollution management concepts for implementation, while building human resource capacity for environmental and pollution management issues.

The National Solid Waste Management Master Plan (2016–2021), approved by the Cabinet on the 3 May 2016, supports integrated waste management. This Plan features several approaches to reduce plastic pollution by promoting and introducing eco-packaging design and eco-friendly plastic substitution, developing material flows for plastic containers and packaging inventory, implementing the 3Rs (reduce-reuse-recycle) strategy for plastic debris management and promoting education for relevant stakeholders in the field of plastics and its alternative materials.

Institutional arrangements

In Thailand, the provincial governments coordinate waste management-related activities between the central government and the local governments, which implement policy set by various entities under the purview of MoNRE, as shown in Figure 12 (Nagai et al. 2008). At the central government level, the Pollution Control Department provides recommendations on the technical preparation of MSW management policy. Moreover, the Department of Environmental Quality Promotion promotes and disseminates information on MSW management and develops technical guidelines and processes. The Office of Natural Resources and Environmental Policy and Planning prepares policies and prospective plans and administers the Thailand Environmental Fund. Moreover, under the Ministry of the Interior, the Department of Local Administration administers the finances of local government organizations and provides support for the preparation of local development plans, while the Ministry of Public Health issues ministerial regulations to stipulate service charges.

Through MoNRE, the central government engages in policy development and in regulatory and supervisory functions. In this context, the Ministry has overarching responsibility over all units and

Figure 12 **Diagram of control of local authorities in Thailand, (Since 2002)** (Source: Nagai et al. (2008))

Abbreviations: BMA, Bangkok Metropolitan Administration; PAO, Provincial Administrative Organizations; DLA, Department of Local Administration; MOI, Ministry of Interior; TAO, Tambon Administrative Organization.

departments in the country with responsibility for solid waste and plastic waste management. In other words, MoNRE is responsible for developing relevant policies, regulations, standards, guidelines, programmes, that are implemented through the Office of Natural Resources and Environment, Policy and Planning, Pollution Control Department; the Department of Environmental Quality Promotion; and the Department of Marine and Coastal Resources. To this end, MoNRE also engages in interministerial collaborations with other line ministries, such as the Ministry of Interior (local authority), the Ministry of Public Health, the Ministry of Energy and the Ministry of Industry (Department of Industrial Works).

Local government authorities, civil societies (network for monitoring of illegal dumping wastes) and private sector entities are engaged in collaborative the implementation and monitoring of waste management.

Through the Pollution Control Department, MoNRE has responsibility for key functions regarding the control, prevention and reduction of pollution at

the country level. As such, MoNRE manages the environment with the Department's Inspection and Enforcement Division overseeing inspection and enforcement within the framework of the Enhancement and Conservation of National Environmental Quality Act, B.E. 2535 (1992) and other related laws. The Division also manages public complaints about pollution, and it inspects and investigates legal disputes concerning pollution and seeks damages from the pollution sources. In addition to supporting and coordinating with local authorities in enforcing relevant environmental law, the Pollution Control Department engages with local government authorities, civil societies (network for monitoring the illegal dumping of wastes) and private sector entities in the collaborative implementation and monitoring of waste management regulations.

In Thailand, local governments handle waste management within governed areas through four categories of local administrative organizations: the municipality, sub-district administrative organizations, provincial administrative organizations and special administrative areas (Bangkok and Pattaya City). Various levels of

monitoring and control are exercised along the waste management chain, employing institutional and legal measures to control and guide the implementation of various waste management policies.

Following the ministerial reorganization in October 2002, the Department of Local Administration was divided into three entities: the Department of Local Administration, the Department of Disaster Prevention and Mitigation and the Department of Provincial Administration, which retained the authority to control and supervise provincial governors and district officers.

Financial & Human resource capacities

Local governments are responsible for implementing all waste management policies, including those for plastic waste, within their jurisdiction. Local government authorities and provincial authorities must brace up to the challenges and navigate the complex funding landscape to foster innovative public-private partnerships and donor support. These challenges include the lack of technical and financial leverage to be able to actualise central government directives.

↳ Subnational authorities lack adequate technical and financial leverage to be able to actualize central government directives even though fiscal decentralization is promoted

The situation is severe for local governments in rural areas. Apart that subventions from the central government are woefully inadequate, budgets are heavily constrained, and thus, environmental considerations are placed secondary to priority needs (e.g. the promotion of vocational employment or agriculture and infrastructure development) with the environment deemed as only an average priority area for investment. Also, systemic challenges inherent with local governance structures may be blighted by certain levels of administrative sectionalism (silos), which impact policy uptake and implementation.

Implementation of monitoring policies for land-based plastic waste management may be particularly affected by these challenges. While

certain policy tools may well apply to certain parts of the country, other parts, particularly the rural areas, may fall short in supporting the necessary revenue generation models for the local authority organizations. Waste generation and waste composition of the various provinces and these authority organizations are largely influenced by socioeconomic factors as well as by geographic location. Apart from disparities in the minimum wages set in the various provinces, the southern coastal parts of the country are major tourist destinations, thus potential hotspot areas for marine plastic litter.

System and Influencing Capacities

↳ The implementation of waste management policy is largely affected by the political setting – at the local government, local administrative, and central/national levels.

Various actors are involved in influencing the implementation of specific plastic waste management policies. A notable form of influence can be classified as being government actors – local authority organizations influenced by central government agencies that formulate policies for implementation. The top-down influence mostly inhibits successful policy implementation by these authority organizations, often laden with budgetary constraints and limited capacity to execute effectively.

A second form of influence involves government actors, including central and local entities on one side and private firms and non-governmental actors on the other. This influence seeks to court the support of the private sector in policy implementation. Examples of such actors include the Federation of Thai Industries. The third form of private sector influence is that exerted by market forces and dynamics requiring firms to remain competitive and be socially responsible to consumers.

Effectively, the implementation of waste management policy is largely affected by the political or administrative setting at the local and national government levels. Above all, political stability has implications for policy continuity as well as for sector resilience.

The inherent political structure of local-level governance, bureaucratic interference, corruption and political soft controls on waste management must be overcome to ensure little to no interference in policy implementation. Considering the huge investment shortfalls in the waste management sector of Thailand, private sector participation in various aspects of the plastic waste management value chain will boost the potential for improving the collection and recovery of recyclable wastes that otherwise may end up in landfills or marine environments. Private sector participation requires strong political will to pass favourable policies that promote win-win private-public partnerships with local governments or organizations. Tax rates, tariffs incentives, pricing regulations of recycled products as well as anti-trust laws related to plastic waste management must stimulate private sector participation in the sector. MoNRE and the Pollution Control Department have forged collaborations, for instance, with the private sector and academic institutions that wield strong influence and the capacity to impact the setting up of plastic litter monitoring programmes and policies. Some of these include the Thailand Public-Private Partnership for Plastic and Waste Management, under the Federation of Thai Industry, and Thailand's Sustainable University Network. In addition, the Government also promotes participation at all levels with local organizations, including local administrative organizations, the private sector and local business. particularly promoted at the local level are outreach programmes designed to encourage public opinion on government programme planning and implementation.

5.1.4 Viet Nam

Legal and regulatory frameworks

Although regulatory provisions in Viet Nam directly provide specific, legal obligations for plastic pollution monitoring and assessment, solid waste monitoring is achievable within the existing framework.

The legal and regulatory framework in Viet Nam forms the basis for policy aimed at both improving environment protection in general and controlling marine pollution caused by marine debris, plastics and microplastics, as outlined in this section.

In 2014, the National Assembly promulgated the Law of Environmental Protection (No. 55/2014/QH13), which provides for environmental protection activities, including (i) environmental protection policies, measures and resources and (ii) rights, obligations and responsibilities of agencies, organizations, households and individuals tasked in environmental protection, including solid waste management. Viet Nam has been improving its institutional frameworks and policies regarding environment protection by adopting legal decrees, including Decree No. 38/2015/NĐ-CP on the management of wastes and scraps.

Law No. 82/2015/QH13, Natural Resources and Environment of the Sea and Islands (effective 01 July 2016), provides a legal framework for the overall management of marine resources and the environment. The law extends to the prohibition of all acts deemed to be pose risk or degrade degradate environment and ecosystem of sea and islands.

In addition, Law No. 57/2010/QH12, Environmental Protection Tax, established taxable commodity groups of which plastic bags are included and taxed at about ₩30,000 to ₩50,000 (US\$1.5 to \$2.2) per kg. The law defines "taxable plastic bags" as thin, soft plastic bags and packings made from HDPE (high-density polyethylene), LDPE (low-density polyethylene) or LLDPE (linear low-density polyethylene resin), but it excepts ready-made packaging and plastic bags that meet the environmental friendly criteria set by MoNRE. Moreover, Decree No. 67/2011/NĐ-CP detailing and guiding a number of articles of the Law on Environmental Protection Tax (i.e. taxable plastic bags specified in Clause 4, Article 3 of the aforementioned).

Also, the following national technical regulations on infrastructure works, which include solid waste management, are in force in Viet Nam:

- National Technical Regulation (QCVN 07-9:2016/BXD), Technical Infrastructure Works on Solid Waste Treatment and Public Toilets, issued by MOC (via Circular 01/2016/TTBXD) on 1 February 2016
- National Technical Regulation (QCVN 25: 2009/BTNMT), Wastewater of the Solid Waste Landfill

Sites, issued by MoNRE (via Circular 25/2009/TT-BTNMT) on 16 November 2009

- Joint Circular (01/2001/TTLT-BKHCNMT-BXD), Guiding National Regulations on Environmental Protection for the Selection of Places, Construction and Operation of Solid Waste Burial Site, issued by the Ministry of Construction and the Ministry of Science, Technology and Environment on 18 January 2001.

Policy framework

↳ Viet Nam has in place key environmental policies to support the institutionalization of plastic pollution monitoring and assessment.

Viet Nam has shown strong commitment to reducing marine plastic considerably by implementing key policies such as the “National Strategy for Environmental Protection until 2010 and Vision toward 2020”. The objective of this policy was to ensure maximum environmental protection by halting pollution acceleration, remedy degraded areas, improve environmental quality and ensure sustainable development of the country. It also guaranteed that all citizens are entitled to live in the environment, landscapes and other environmental components with good quality of air, land and water that measure up to standards stipulated by the State.

In late 2019, Thailand approved Decision 1746/QD-TTg, Introduction of national action plan for management of marine plastic litter by 2030, resulting in the National Action Plan for Management of Marine Plastic Litter by 2030. The framework of this environmental action plan stipulates that Viet Nam is to act in the prevention, control and significant reduction of marine environment pollution; minimize the amount of ocean plastic waste in coastal provinces and cities; and target and collect 100 per cent of hazardous waste and domestic solid waste and then dispose the waste in accordance with environmental standards in coastal communities, among others.

Finalized in the second quarter of 2019, The National Action Plan, clarified the focus of Viet Nam on its coastal and marine ecosystems and currently on its

inland waterways. As such, Viet Nam is committed to promoting global cooperation for reducing plastic waste, which includes a focus on (i) data-sharing and human resource training and development and (ii) technology transfer and the sustainable use of marine and ocean resources. This cooperation is to be achieved by establishing an international centre for ocean plastic waste. Other initiatives include the development of a regional project under the Coordinating Body on the Seas of East Asia (also known as “COBSEA”). Mechanisms are being put in place to support the ministries, sectors, mass organizations, media, NGOs and localities in conducting necessary activities to prevent dumping of plastic waste into the ocean.

Accordingly, Viet Nam plans to reduce plastic litter by 50 per cent; collect abandoned, lost, or discarded fishing gear by 50 per cent; and prevent the use of single-use plastics and non-biodegradable plastic bags at coastal tourism sites by about 80 per cent. Moreover, Viet Nam plans to ensure that nationwide beach cleanup campaigns are launched at least twice a year and that 80 per cent of marine-protected areas are free of plastic litter (United Nations Development Program [UN Environment] 2020).

Further, according to the Action Plan, Viet Nam plans to control plastic litter at source by implementing key measures that will include investigating, enumerating and evaluating land-, ocean- and island-based plastic waste sources. The Country also plans to pursue the effective implementation of classification models for plastic waste at source and to develop and complete systems for the collection, classification, transfer and processing of plastic. The window of implementation of this action plan is between 2020 and 2030.

The Action Plan stipulates the annual monitoring of marine plastic litter and assessment every 5 years, including the estuaries in the 5 major drainage basins (i.e. in the North, South, North Central Coast, South Central Coast and the central region of Central Viet Nam) and in the islands with tourism potential in the 12 insular districts.

Other existing policy frameworks, in the form of approved decisions and circulars related to solid waste management, are as follows:

- Circular on strategic environmental assessment, environmental impact assessment and environmental protection plans" (Circular No. 27/2015/TT-BTNMT; MoNRE [2015]). This circular provides guidance for agencies, organizations and individuals engaged in the conduct of strategic environmental assessment, impact assessment and environmental protection planning.
- Decision approving the National Strategy of Integrated Solid Waste Management up to 2025, Vision towards 2050 (Prime Minister Decision No. 2149/QD-TTg [2009]). This policy aimed to reduce plastic bag use in supermarkets and shopping malls (i.e. 40 per cent in 2015 as compared to 2010; 65 per cent in 2020 as compared to 2010; and 85 per cent in 2025 as compared to 2010).
- Decision approving the project on improving the environmental pollution control for the use of non-biodegradable plastic bags by 2020 (Prime Minister Decision 582/QD-TTg [2013]). This policy aimed (i) to reduce plastic bag consumption by 40 per cent in supermarkets and shopping malls and by 20 per cent consumption in the markets and (ii) to collect and recycle domestic plastic bags by 25 per cent in 2015 as compared to 2010. By 2020, the corresponding rates were set at 65 per cent, 50 per cent and 50 per cent, respectively, as compared to 2010.
- Decision approving adjustments to national strategy for general management of solid waste to 2025 with a vision towards 2050 (Prime Minister Decision No. 491/QD-TTg [2018]). This decision targeted the use of 100 per cent environmentally friendly plastic bags in supermarkets and shopping malls by 2025.
- Decision on national strategy for integrated management of solid waste up to 2025, with a vision to 2050 (Prime Minister Decision No. 2149/QD-TTg [2009]). This policy aimed to reduce plastic bag use in supermarkets and shopping malls, that is, 40 per cent in 2015 as compared to 2010, 65 per cent in 2020 as compared to 2010 and 85 per cent in 2025 as compared to 2010.
- Decision approving the project on improving the environmental pollution control for the use of non-biodegradable plastic bags by 2020 (Prime Minister Decision 582/QD-TTg [2013]). This decision aimed (i) to reduce plastic bag consumption by 40 per cent in supermarkets and shopping malls and by 20 per cent in the markets and (ii) to collect and recycle domestic plastic bags by 25 per cent in 2015 as compared to 2010. By 2020, the corresponding rates were to be set at 65 per cent, 50 per cent and 50 per cent, respectively, as compared to 2010.
- Decision approving adjustments to national strategy for general management of solid waste to 2025 with a vision towards 2050" (Prime Minister Decision No. 491/QD-TTg [2018]). The decision aimed to require the use of 100 per cent environmentally friendly plastic bags in supermarkets and shopping malls until 2025.

Institutional arrangements

↳ Overlapping roles of multiple institutions in environmental pollution monitoring, including solid waste management

Many institutions are involved in reducing plastic pollution in Viet Nam, involving the public and private sectors, multinational development agencies, international NGOs and community-based/civil society organizations. Solid waste management falls under the jurisdiction of several governmental bodies at the national, provincial and municipal levels, although there is no unified or standardized system of waste collection. Institutional arrangements involve inter- and intra-agency coordination and the support of multiple government institutions at the central/national and local government levels (Rab et al. 2015).

MoNRE is the major state authority responsible for environmental affairs in Viet Nam. Regarding solid waste management, MoNRE's mandate includes (i) development and provision of regulations, technical guidelines, standards, policies and systems for solid waste management; (ii) support for research and technical development related to waste management; (iii) development of projects related to waste management; and (iv) approval of environmental impact assessment reports.



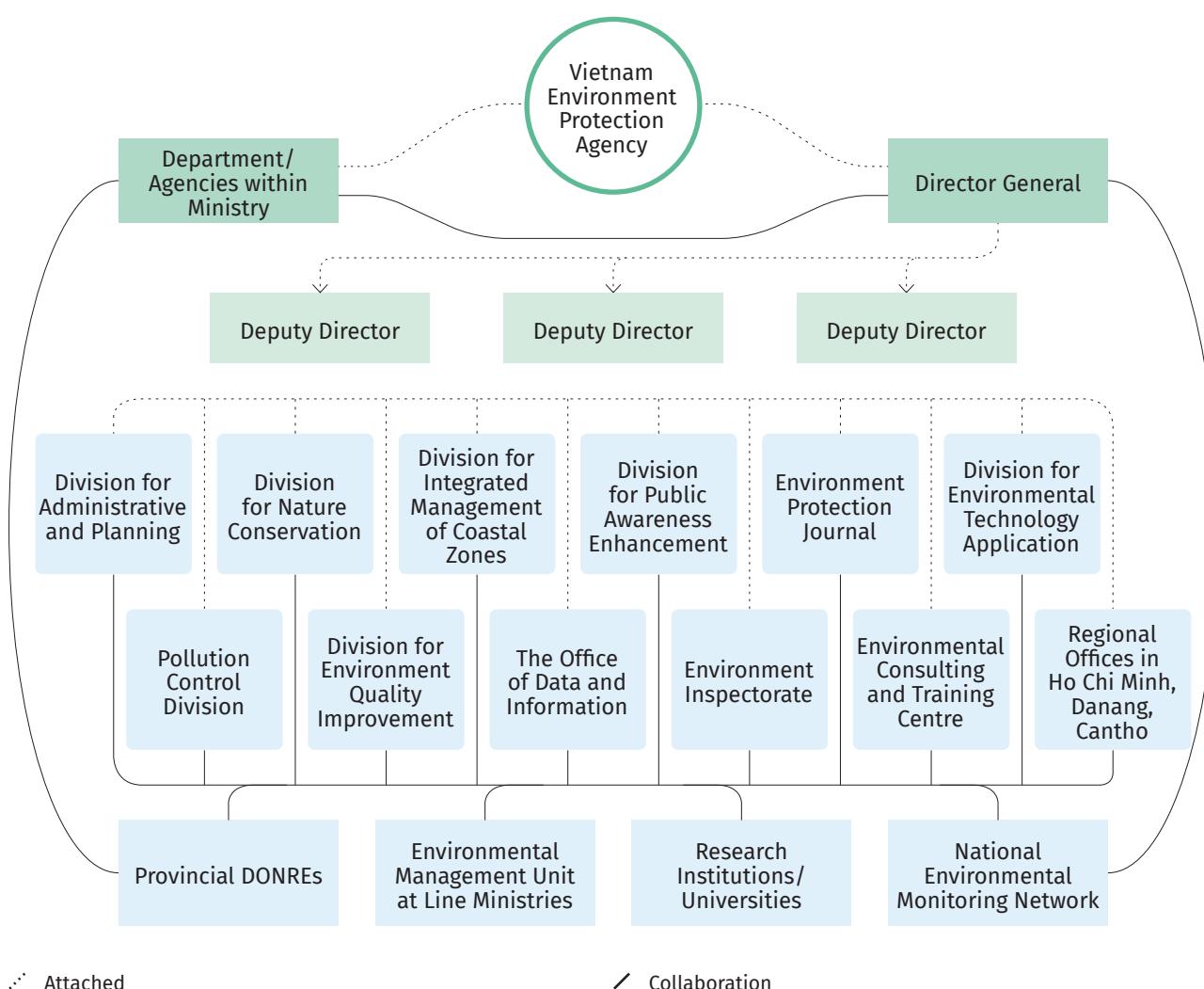
Under MoNRE, the Viet Nam Environment Protection Agency is responsible for state management of the environment sector, coordinating the process among all relevant departments and stakeholders as shown in Figure 13..

Moreover, waste management responsibilities are managed by the Waste Management and Environment Promotion Agency of the Viet Nam Environment Protection Agency. Considering that plastic waste generation and pollution issues, in particular, are cross-sectoral, the Ministry of Industry and Trade, the Ministry of Health and the Ministry of Agriculture and Rural Development coordinate to manage waste generated in their respective sectors. Solid waste management at

the regional and interprovincial levels and in cities and major economic zones is carried out by the Ministry of Construction, which collaborates with other ministries to manage non-hazardous domicile solid waste and industrial ordinary solid waste. The Ministry of Industry and Trade also plays a leading role in reviewing and implementing the laws and systems related to solid waste management in the industrial sector.

Clearly, multiple ministries are involved in solid waste management with often overlapping responsibilities that make policy management complex. Other state ministries involved include the Ministry of Education and Training; Ministry of Culture, Sports and Tourism; Ministry of Transport;

Figure 13 **Institutional structuring for environmental protection in Viet Nam** (Source: MoNRE; Viet Nam Environment Protection Agency (2019))



Abbreviation: DoNRE, Department of Natural Resources and Environment.

Ministry of Industry; and Ministry of Finance; No existing monitoring and assessment programmes for plastic pollution have been yet approved by MoNRE. However, the National Action Plan stipulates that MoNRE will lead and collaborate with other relevant ministries and communities to periodically develop and operate environmental monitoring networks and programmes.

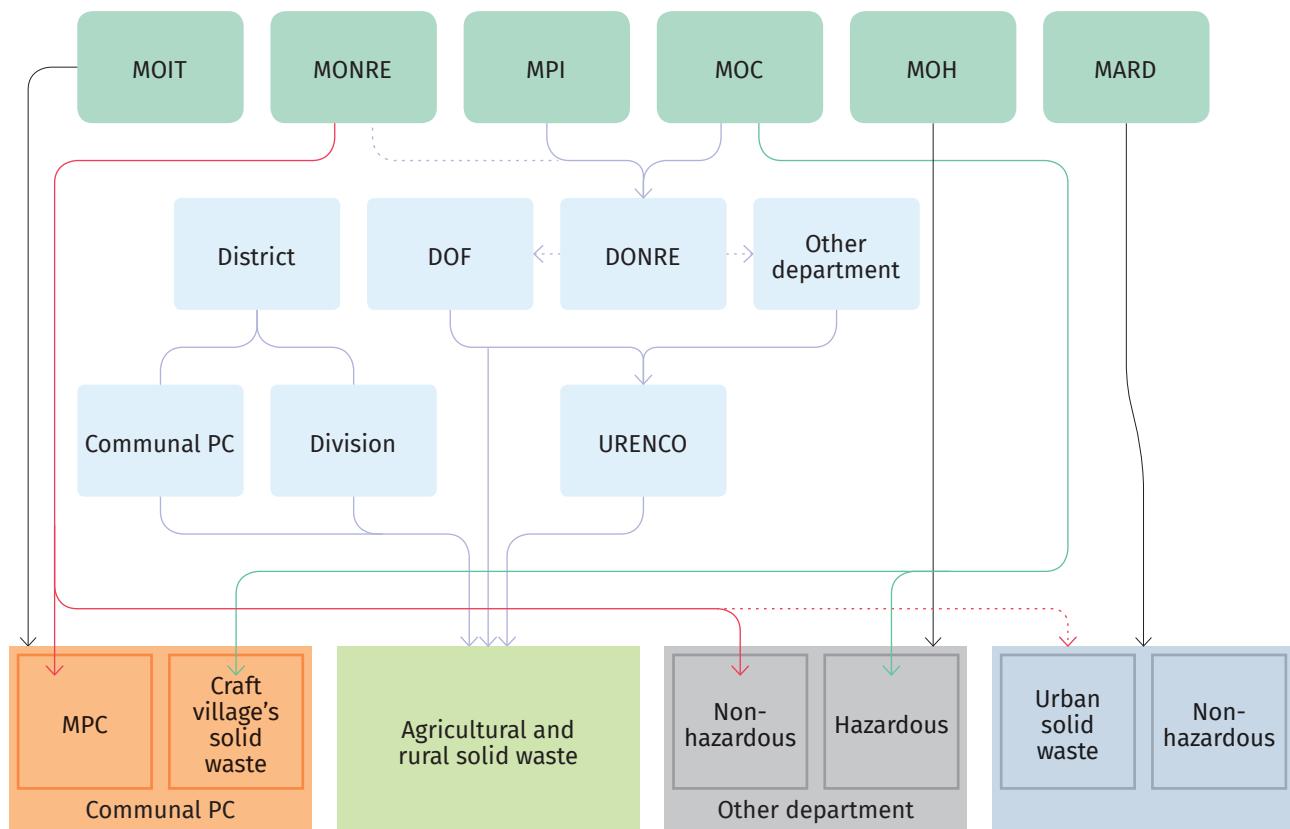
The Viet Nam Administration of Seas and Islands, established in March 2008 under the Ministry of Environment, has been appointed and mandated to conduct the function of integrated, unified state management for coasts, seas and islands in Viet Nam. The Administration's responsibility extends to the preparation of the National Action Plan for Plastic Waste Management, and it has created a task force that has initiated a participatory development process. In this arrangement, the formed advisory

team prepares the National Action Plan and participates in a series of consultation workshops.

At the local and provincial levels, departments and councils participate in waste management; these include the Provincial People's Councils and the Provincial People's Committees, established at the provincial-level administrative units; Department of Natural Resources and Environment (DoNRE), Department of Construction; and the Hanoi Urban Environment Company (referred to as "URENCO"), a public corporation specializing in waste treatment, The Viet Nam Provincial People's Committee is represented by its departments up to the national-level ministries. The Provincial People's Committee is responsible for overseeing local-level administration and partakes in implementing plans on annual and long-term environmental protection, directing their agencies in organizing and coordinating with the respective central

Figure 14 **Institutional arrangement of solid waste management in Viet Nam** (Source: Adapted by authors from

Government of Korea, Ministry of Planning and Investment (2016/17))



↗ Direct relationship

↖ Indirect relationship

▣ Financial relation

Abbreviations: MARD, Ministry of Agriculture and Rural Development; MoC, Ministry of Construction; MoH, Ministry of Health; MoIT, Ministry of Industry and Trade; MPI, Ministry of Planning and Investment

agencies and approving relevant projects based on the conditions of each locality

Figure 14 outlines the institutional structuring for solid waste management structure in Viet Nam.

Whereas the Provincial People's Council represents the provincial government, the Provincial People's Committee is an executive unit that oversees local administration that and is represented by its departments up to the national-level ministries. Among other responsibilities, the Provincial People's Committees (i) implement annual and long-term plans on annual and long-term environmental protection and (ii) lead their agencies in organizing and coordinating with the respective central agencies.

Moreover, DoNRE, which represents MoNRE at the local level (i) leads in the monitoring of environmental quality and (ii) manages and implements policies and regulations issued by MoNRE and the People's Committee. DoNRE collaborates with the Department of Construction to review and select waste disposal facilities and to obtain approval from the Committee. In cooperation with DoNRE, the Department of Construction is responsible for establishing and operating the landfill sites subject to approval by the central government via the Provincial People's Committee. DoNRE plays a key role in solid waste management and environmental monitoring based

on the policies and systems set by MoNRE and the Committee. Under contract with the local government, UNRENCO provides related public services from waste collection to transport and disposal.

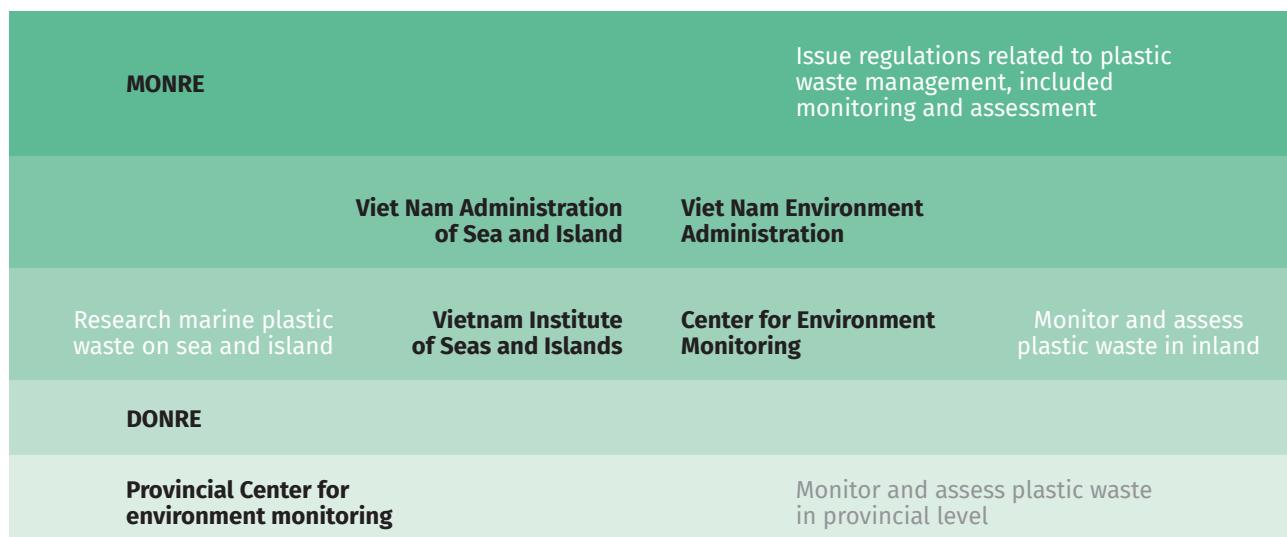
The institutional hierarchy between DoNRE and MoNRE is shown in Figure 15, which delineates their respective mandates to monitor and assess plastic waste.

Financial and human resources

↳ Human resource capacity unavailability issues relate to the lack of adequately trained staff and insufficient manpower to dedicated to plastic pollution monitoring and assessment

The implementation of comprehensive plastic pollution monitoring and assessment programmes requires, among other things, adequate financial resources and skilled human resources. In Viet Nam, funding models for waste management and other environment-related activities have been reported to be generally insufficient (UNESCAP, 2016). Moreover, there has been no budget specifically allocated for plastic pollution monitoring and assessment activities. Funding for solid waste management programmes is raised by the following: local-level initiatives (via the Provincial People's Committee agencies), central government funding for waste

Figure 15 **Institutional structure for plastic waste management in Viet Nam**



management, official development assistance and private sector projects, among others.

In this context, also under MoNRE is the Viet Nam Environmental Protection Fund is a state non-profit financial institution with the mandate to mobilize and manage funds to support environment-related initiatives. Funding sources include state budget international organizations and official development assistance, among others. The Fund operates by managing loan funds, allocating funding for loans and recovering debts from investors of environment protection projects through a contract between the Fund and entrusted organizations.

Notwithstanding the available institutional frameworks for raising and managing monetary resources for waste management monitoring at the national and local levels, the insufficiency of

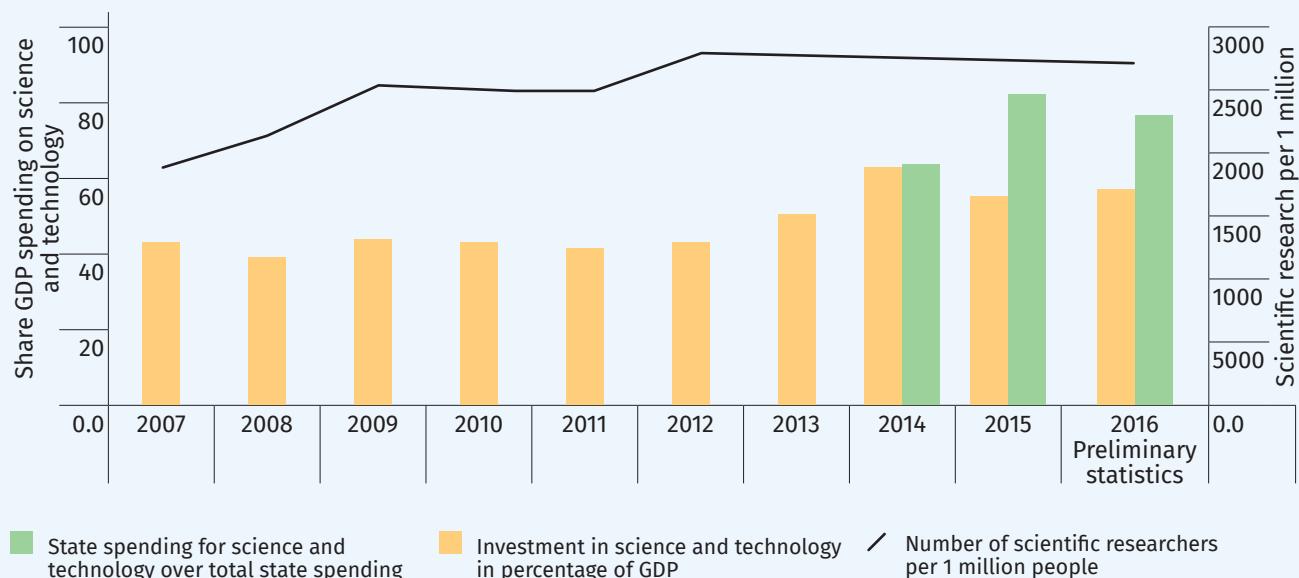
financial resources has been identified as one of the major challenges faced by local governments in effectively handling waste in their localities. To this end, plastic pollution issues at local level appear to have received considerable attention from government and other development partners. However, resources for plastic pollution monitoring and assessment activities have been championed by international development partners via grants, by far.

Outputs from focus group discussions corroborates findings that seem to assert the lack of adequate human resource capacity at the local levels (de Wit, 2007), needed to conduct the monitoring and assessment of plastic pollution on land and in the water environment. Essentially, the current issue of lack of human resource capacity relates to the lack of adequately trained staff and insufficient

Box 5 Improving trend of science and technology in Viet Nam

According to the World Intellectual Property Organization (WIPO), in 2017 the Global Innovation Index (GII) ranked Viet Nam 47th out of 127 countries, climbing 12 places compared to 2016. Viet Nam must continue to shift from quantity-based growth model (capital and labour) to a quality-based one (productivity is the key element). Viet Nam is now actively changing the way it manages its government. Viet Nam is committed to using modern information tools to create a favorable environment for the implementation of new ideas, to promote the creativity of enterprises and people. To successfully implement the SDGs the cooperation, experience sharing and technology transfers from the countries with more advanced science and technology are imperative for Viet Nam.

Figure 16 Share of GDP spending on science and technology (%) and number of scientific researchers/1 million people, 2007–2016 (Source: Viet Nam, Ministry of Planning and Investment (2018))



manpower dedicated to plastic pollution monitoring and assessment (Viet Nam, Ministry of Planning and Investment [MPI] 2018). As part of their development assistance, international development partners have initiated programmes to support the development of staff capacity in government agencies regarding marine debris prevention and management. Other non-governmental agencies and research units are involved in research into marine plastic litter monitoring and assessment.

System and Influencing Capacities

↳ There is continued effort to improve the institutional governance systems to respond to environmental quality management needs

Viet Nam has joined a global movement to combat plastic pollution by launching a nationwide initiative and actively participating in many regional and international forums and initiatives. At the same time, the Government of Viet Nam is continuing to implement drastic policies and measures to control environmental pollution caused by plastic waste, especially disposable plastic products and uncompostable plastic bags, by focusing on increasing recycling, reducing use, and promoting the reuse of plastic products as well as a circulating economy and green growth (Thang, 2019).

On the road to becoming a regional leader in minimizing ocean plastic waste, several decisions have been made³ on marine plastic litter, such as preventing, controlling and significantly reducing marine environment pollution. In turn, various agencies, local governments, businesses, the public at large, among others across the country, have been encouraged to join hands in combating solid waste and plastic litter pollution. To put this environmental commitment into action, in coastal provinces and cities, 100 per cent of hazardous waste and MSW are collected and treated up to environmental standards; moreover, 100 per cent of economic zones, industrial parks and coastal urban areas are planned and built smartly in the direction

of sustainable ecology, adapting to climate change and sea level rise.

Moreover, legal frameworks were put in place to facilitate and stimulate private sector investment projects through various public-private partnership models . For instance, on 9 June 2019, MoNRE collaborated with the Central Committee of the Ho Chi Minh Communist Youth Union and the Hanoi People's Committee, resulting in the launch of the national movement against plastic waste with the participation of the Prime Minister. After this event, most participating ministries, agencies and local governments and businesses have issued plans and implemented plastic waste prevention and management activities (Viet Nam, MoNRE 2016).

Moreover, existing relevant frameworks were reviewed in this context. For instance, in May 2018, the Government of Vietnam issued Decree 63/2018/ ND-CP to deal with shortcomings of the following previous legislation on public-private partnerships. The Decree provides the framework for public-private projects, especially the regulations on the intention to invest in these projects; financial resources for preparing projects and State participation in these projects; and the capacity of lead agencies and staff involved in project implementation of public-private partnerships.

An example of typical collaborotiosn involves clean up programmes and activities on marine debris were undertaken in 2016 to 2017, with the Body Shop, GreenHub, and Clean and Green Viet Nam joining these activities, which included the analysis of marine debris composition. Realizing the need for a coordinated action to implement most of its environmental commitments, the Government of Viet Nam has pushed towards forging partnerships with the private sector and many international organizations. For example, the Ha Long-Cat Ba Alliance Initiative was launched in 2014 to build a partnership between state agencies, businesses and communities to promote conservation activities and protect the Ha Long Bay and Cat Ba archipelago.

3 Resolution on the strategy for the sustainable development of Viet Nam's marine economy by 2030, with a vision to 2045 (Resolution No. 36-NQ/TW) was signed on 22 October 2018, on behalf of the Communist Party of Viet Nam Central Committee and adopted at the eight plenum of the 12th Party Central Committee. Subsequently, Decision No. 203/QD-TTg was signed by the Prime Minister on establishment of the national steering committee for implementation of the strategy

↳ Capacities to coordinate and collaborate with multi stakeholders and civil societal groups to implement projects on monitoring plastic pollution have been critical in Viet Nam's fight against plastic pollution

In June 2019, in the context of its MARPLASTICCs (Marine Plastics and Coastal Communities) Project, the International Union for Conservation of Nature, in collaboration with the MoNRE Department of Legislation organized the seminar “Plastic Pollution in Vietnam: Scientific Research to Support the Development of Policymaking”. Collaboration between UNDP and the Viet Nam Administration on Sea and Island yielded international workshops on the National Action Plan for managing marine plastic litter by 2030, also held in Hanoi, Viet Nam. The workshop focused on discussing, among other things, the support for the country to design a detailed implementation road map and implementation plan. The support is expected to help strengthen capacities for developing guidance for implementing the Quality Assurance Plan on the monitoring, inspection, and supervision of marine plastic waste management.

A project created by the Centre for Social Research and Development contributes to that vision by promoting the 3Rs (reduce-reuse-recycle) and introducing waste separation at selected local schools as well as through public involvement in the 5 per cent reduction target. The Centre conducted a range of activities, including the introduction of the 3R model in six local schools: they set up source separation systems at each of the schools, installed litter traps at bends in a waterway and conducted beach cleanups to remove plastic pollution from the coast.

5.2 Technical Capacity

Technical capacities explore the availability of technical resources and tools, including knowledge-sharing and capacity-building training programmes, that support the monitoring and assessment of plastic litter on land and in the rivers. This exploration includes examining the

scientific tools and the infrastructure available for sampling, processing and analysing the storage and transmission of data. Plastic pollution monitoring appears feasible in cities where the following have been secured: adequate financial resources; the development, adaptation, and dissemination of appropriate technologies; partnerships and capacity building with relevant stakeholders, as well as accountability frameworks and a sound system for data monitoring and accountability. In other words, these are all important to ensure the implementation and the service quality of the strategy and action plan.

This section discusses technical capacity in relation to each of the four LMCs, including operational capacities and technological resources.

5.2.1 Cambodia

Operational capacities

Setting up systems and structures for timely data collection, storage and use is a desideratum for setting up and operating effective monitoring and assessment programmes. To establish these, it is necessary to establish relevant data and information on plastic production, use and flow (within the country and across its borders); plastic waste disposal and leakage; and trade and import-export of pellets, recyclables and other plastic-related materials. To this end, general data monitoring and collection and collection in particular are coordinated by the National Institute of Statistics, a division of the Ministry of Planning, which has undergone trainings on statistical data handling under the National Strategy for Development of Statistics.

Among other technical responsibilities, the Ministry of Planning supports the line ministries and agencies. Plastic pollution monitoring data is of no exception to these arrangements. Nonetheless, sectoral data collection on plastic pollution is under the purview of the Ministry of Environment; it has insufficient technological tools to undertake data collection on plastic pollution on land and in water environments such as rivers, storm drains and the seas. Central government and line ministries have varied roles in acquiring the different aspects of monitoring data and the data



types that must be curated to complete monitoring data and assessment requirements. Land-based plastic pollution monitoring data is planned to be supplied by private companies in charge of waste collection services. Moreover, the Ministry of Environment, together with the Ministry of Trade, exerts monitoring and regulation mandates by issuing import-export trade permits and licences for hazardous waste, which by law require the submission of quarterly reports on the amount, type, source, transport and handling of data by company owners. Most of the available data sources are project-based data and collected during project implementation with funding from development partners such as JICA.

Resources for developing long-term plans, such as action plans, and solid/plastic waste monitoring programmes are often funded by project-based international development partners. This is mainly due to the limited resources available to fund the development and sustenance of such long-term programmes. During country focus discussions, it was noted that the ministries and local government authorities of the Ministry of Environment do not have the necessary sampling tools and any established protocols or monitoring plans for monitoring and assessing plastic pollution. Subregional organizations and international research networks, such as the Mekong River Commission, have considerable experience in conducting water quality and sediment monitoring in rivers.

Technological resource

Government agencies lack scientific tools and equipment for analysing and implementing plastic pollution monitoring and assessment. Although some plastic assessment analytical tools and equipment are available at universities and research institutes, monitoring equipment, such as drones and trap nets, are hardly available to collect relevant data. Local authorities may have to collaborate with private waste management service providers to collect land-based plastic pollution data at disposal sites..

5.2.2 Lao PDR

Operational capacities

In terms of the availability of technological resources for monitoring data on the collection, storage and use of plastic litter on a timely basis, MoNRE has minimal technical resources. Local-level authorities also lack the necessary technological tools and equipment to conduct the monitoring and assessment of plastic litter in water environments. Thus, data collection on land-based plastic pollution requires private sector collaboration to deliver data on waste collection services.

With specific regard to data management, the Department of Planning, in the Ministry of Planning and Investment, and the Lao Statistics Bureau are the national entities in charge of this function. However, at the sectoral level, reportedly, statistical capacities are weak and must be strengthened to harness new technologies for data management (Lao PDR, Government of 2018).

Technological resource

Analytical tools for analysing sampled plastic pollution data are available mostly in research institutions and universities. For the most part, government agencies lack the analytical tools for database management and for data use and transmittance. At both the national and local levels, agencies do not have the necessary instruments for monitoring, sampling, and analysing plastics pollution. To work around this issue, subnational administrations may collaborate with research institutions to conduct plastic pollution monitoring and assessment.

5.2.3 Thailand

Operational capacities

Though Thailand has made significant leaps in data collection on plastic pollution issues, challenges remain in terms of collecting data and monitoring across the country. At national level, the National Statistical Office of Thailand oversees the harnessing and mobilising of data across all ministries. Thailand uses an integrated management information system and a data and

statistical database across government agencies. Nonetheless, the collection and management of data and statistics are among key challenges because of many factors, such as the lack of statistical experts in many government agencies (Thailand, Ministry of Foreign Affairs 2018).

The Pollution Control Department, through MoNRE, needs to (i) develop more qualified statistical experts at the national and local levels and (ii) strengthen management tools for waste data collection, which can be applied to plastic pollution monitoring at local levels. As a step towards this goal, together with stakeholder collaboration from private and international development organizations, MoNRE is building material flow databases to monitor plastic pollution in the country.

In collaboration with communities, subnational administrations are working to monitor and collect data on plastic litter pollution in water environments and at designated monitoring stations. In recent years, for instance, plastic pollution monitoring efforts have been promoted in Thailand in collaboration with private sector organizations and research institutions and universities. Regarding plastic monitoring in the Mekong, focus group discussions revealed, however, that the country has not embarked such monitoring programmes yet. Monitoring systems and protocols are being developed for application in marine plastic monitoring.

Technological resource

Government agencies at the local and national levels lack the requisite scientific analytical tools and equipment to assess, monitor and analyse samples. Collaborative research efforts with national and foreign universities are being explored to undertake monitoring and assessment programmes on plastic pollution.

5.2.4 Viet Nam

Operational capacities

Scientific tools and equipment, laboratories, database management tools, data analytics and monitoring tools are vital resources to carry out

plastic pollution and assessment programmes. Setting up systems and structures for timely data collection, storage and use is a desideratum for effectively setting up and operating monitoring programmes. Relevant data and information – for instance, on plastic production, use and flow within the country and across the country's borders; trade and import-export of pellets, recyclables and other plastic-related materials; and plastic disposal and leakage – are very necessary to establish plastic flow and inventory.

Central governments and line ministries, as well as other partners, have varied roles in acquiring the different aspects of monitoring data and data types that need to be curated to meet data monitoring and assessment requirements. For instance, country-level statistical data –concept, content, method of calculation, disaggregation, income period and data source – have been widely reported as being essentially lacking. In this context, Viet Nam established a statistical working group composed of representatives from relevant ministries their agencies, led by the Ministry of Planning and Investment and the General Statistics Office. The primary purpose of this working group is to formulate and monitor indicators relative to the Sustainable Development Goals and to evaluate their performance. The skills developed by this working group may be a vital resource onwards and serve as skill transfer for other environmental monitoring systems, including plastic pollution monitoring and assessment.

At present, there are recommendations for Viet Nam to invest in improving the existing statistical system and the capacity of relevant staff. Presumably, statistical capacity strengths of the various environmental monitoring entities and statistics staff at the local level are low. There also have dedicated research units or departments for the monitoring and assessment of plastic litter on land and in water environment with modern laboratories and resource centres (universities) equipped with analytic instrument equipment for analyses, equipment, instruments, tools, technologies for plastic leakage monitoring at dumpsites and landfills, information technology, internet services and development of protocols for the monitoring and assessment of plastic litter.



Technological resources

To control marine plastic waste, MoNRE has assigned the Viet Nam Institute of Seas and Islands as the focal point to coordinate issue management regarding ocean plastic waste. The Research Institute of Sea and Islands implements projects via investigation and assessment of the current status of plastic waste in Viet Nam, and with this project, it will draw out control and management solutions. MoNRE is seeking to build an international centre for ocean plastic waste. Similarly, it deployed an open database, which may provide an opportunity for Viet Nam to expand international cooperation with many relevant international research and management agencies and organizations as well as to share knowledge and experience in the fight against plastic waste.

5.3 Stakeholder and Donor Support for Functional and Technical Capacity Mapping

Lower Mekong countries (LMCs) must foster multi-stakeholder collaboration various actors — the private sector, pro-environment civil society organizations, international development partners, and communities — in mobilizing resources for plastic pollution prevention of which the capacity mapping of functional and technical capacity is a key element. This section discusses the role of universities and research institutions, the private sector and other key stakeholders — namely, civil society, including NGOs, and subregional, regional and multilateral institutions.

Box 6 University and research institute initiatives on plastic pollution monitoring and assessment in the Lower Mekong Countries

<i>Project:</i>	River of Plastic Project: The Journey of Plastics along the Mekong and its Ultimate Fate in the World's Oceans
<i>Project funding:</i>	National Geographic
<i>Implementing institution:</i>	University of Hull, United Kingdom
<i>Project partners:</i>	Newcastle University United Kingdom Nouthern Institute of Water Resource Research (SIWRR), Viet Nam Panassastra University, Cambodia

The River of Plastic project aims to systematically study plastic flows in the Mekong by applying an integrated physical and social approach to understanding plastic waste transport through the river. Researchers hope to use the data to develop new models that predict the distribution of plastic waste in rivers and its entry into the ocean. During the project, the researchers, together with their in-country partners, will undertake a physical sampling of microplastic concentration throughout the Mekong River basin in Cambodia, Laos PDR and Viet Nam. Also, the study aims to identify population and development gradients in microplastic concentration. By sampling through the water column, the researchers will also be able to show how different types of plastic are transported at different depths, ultimately controlling their interaction with fish and other freshwater and marine species. Coupled with this, the study will document the perceptions of local communities throughout the Mekong Basin in a series of video workshops and documentaries. It will also focus on exploring how local communities use plastic in everyday life and on potentially developing low-cost interventions to reduce their plastic waste.



5.3.1 Support of research institutions and universities

Relevant capacities for the monitoring and assessment of plastic pollution are substantial in research institutions and universities that focus on environmental sustainability — as is research for knowledge-building. These capacities include the laboratories, equipment and tools needed to conduct plastic pollution research and assessment research and monitoring, including the capabilities to develop and manage databases on plastic pollution. These institutions have options to access financial and technical resources (in the form of research grants) from research collaborations. These critical resources could be harnessed through partnerships and collaborations to support the design and building of national plastic pollution

monitoring and assessment programmes and associated databases.

5.3.2 Support of the private sector

Private sector entities are key stakeholders in reducing plastic pollution in the Lower Mekong basin (LMB) by aiming for sustainable production and consumption . Initiatives and activities promoted by this sector are focused on sustainable practices and integrated monitoring and reporting on environmental, social and governance, or ESG, criteria. Through partnership mechanisms aiming at increased engagement of private sector entities, multinational corporations in the LMCs have become the key leverage points for governments in these countries to increase their technical and financial resources needed to tackle plastic pollution issues in the region. Increasingly, LMCs are gradually

Box 7 Private sector initiatives on plastic pollution monitoring and assessment in the Lower Mekong countries

The Thailand Public-Private Partnership for Plastic and Waste Management, or PPP Plastic, was established on 5 June 2018, by the Plastic Industry Club and the Federation of Thai Industries, in partnership with the Thailand Business Council for Sustainable Development, public and private sector organizations as well as private individuals.

PPP Plastic aims to reduce marine plastic debris by at least 50 per cent by 2027 — through solutions such as sustainable waste management, the circular economy, and the 3Rs concept (reduce-reuse-recycle). In addition to this ambitious goal, PPP Plastic also vowed for all plastic waste in Thailand to be fully recycled by 2027 (GC 2020).

To this end, six PPP Plastic working groups were established to assist the project in fulfilling its mandate, covering (i) waste separation and management, (ii) innovation development, (iii) policy development and legislative measures, (iv) communications, (v) plastics database management and (vi) identification of new sources of capital.

In Viet Nam, for example, to enhance sustainable development in the business community, the Corporate Sustainability Index (CSI) was formulated by Vietnam Chamber of Commerce and Industry as a basis to evaluate and select sustainable enterprises in Viet Nam. The Viet Nam Sustainability Index (VNSI) was introduced by the Ho Chi Minh City Stock Exchange in July 2017 to evaluate the sustainability performance of 20 companies listed on the exchange. These companies have target programmes for sustainable development and report regularly on their social and environmental solutions. However, most enterprises in Viet Nam are not fully aware of the benefits of sustainability reporting with just a limited share of enterprises preparing such reports.

PPP Plastic's activities are supported by many leading corporations, including Central Group, Dow Chemicals, Integrated Refinery Petrochemical Complex, Siam Cement Group, PTT Global Chemical and Siam Piwat.

Source: For more information, visit the Vietnam Cleaner Production Centre's webpage, "Sustainable Product Innovation in Vietnam, Laos and Cambodia(SPIN-VCL)", <https://vncpc.org/en/project/sustainable-product-innovation-in-vietnam-laos-and-cambodia-spin/>

improving the available public-private partnership mechanisms needed to attract the private sector in building sound platforms for environmental data and monitoring systems. For example, the Thailand Public-Private Partnership for Plastic and Waste Management, led by the Federation of Thai Industry and TBCSD (Thailand Business Council for Sustainable Development), provides key support for Thailand MoNRE in developing and implementing the National Strategy and Action Plan on Marine Debris.

5.3.3 Support of civil society and subregional and multilateral institutions

The vastly biodiverse Mekong River is of socioeconomic relevance to LMCs, contributing to various industries and sectors, including trade, transport, agriculture, fishing and energy. Established pursuant to the 1995 Mekong Agreement, the Mekong River Commission has a membership of four countries: Cambodia, Lao PDR, Thailand, and Viet Nam. The Commission serves as a platform for water diplomacy and regional cooperation designed to lead the development of basin-wide strategies and procedural frameworks for managing the Mekong. The Commission is also a knowledge hub for the Mekong. The Commission's six core functions include data acquisition and exchange monitoring, analysis and monitoring, basin planning, weather (flood and drought) forecasting, and Commission procedures. The Commission has developed various monitoring systems for data collection and transfer: water quality, WQN; aquatic ecology, hydrology, HYCOS; discharge and sediment, DSMP; and fisheries, FADM+ others. Currently, the Mekong River Commission and UN Environment have signed a memorandum of understanding highlighting (i) a joint effort towards work on water quality monitoring, including fresh water plastic pollution, and (ii) collaboration on activities of mutual interest and benefit in the following areas: knowledge-sharing and capacity development, consultancy services, networking and outreach, and data and information-sharing and management.

The Asia Foundation has a pilot project in Cambodia in cooperation with CINTRI (Cambodia) Limited and Phnom Penh Capital Hall to optimize waste collection operations through strategic use of GPS and GIS systems. Marine Conservation Cambodia carried out marine surveys to highlight the most biodiverse areas and those in need of protection; they have carried out daily clean-ups around the island of Koh Seh as well as organized large joint clean-ups on Kep Mainland beaches. In 2016, Fauna & Flora International established the country's first marine protected area, known in Cambodia as a "Marine Fisheries Management Area"⁴. FFI carries out baseline biological surveys and monitoring as well as capacity-building, training and awareness-raising in the management and protection of Cambodia's marine environment.

The Centre for Marine Conservation and Community Development was established as a Vietnamese NGO in 2003 under the Vietnam Association of Marine Science and Technology, based on lessons learned by the US-based NGO International Marine Life Alliance in Vietnam. The Centre's activities include reducing marine plastic pollution in the Red River delta, along the central coast of Vietnam, promoting local technology for collecting waterway trash and promoting social networks to reduce marine trash. Other activities include implementing floating trash bins in fishing ports, creating pilot localized automatic trash trappers adjacent to an oil refinery in the sea, replacing polystyrene foam buoys for aquaculture cages, engaging in organic composting and promoting plastic recycling and plastic waste separation. In response to growing concerns about the sources, quantities and effects of marine debris in Vietnam, a collaboration was formed by the Ocean Conservancy, Centre for Marine Life Conservation and Community Development, and the Vietnam Administration of Seas and Islands) is to begin baseline work to start to understand the sources, fate and effects of marine debris, including microplastics (plastic debris <5mm in size), in this region. Owing to its importance as a biodiversity hotspot, a national conservation area

⁴ For project Information, see Fauna & Flora International's webpage, "Protecting Cambodia's coastal and marine environments," at <https://www.fauna-flora.org/projects/protecting-cambodias-coastal-marine-environments> CGIAR (2018). Capacity needs assessment (CNA): CNA framework and tools for the partners of the CGIAR Research Program on Livestock CRP

and resources for local populations, the project , developed a protocol of microplastic sampling and

debris, which was conducted at Xuan Thuy National Park in the Red River delta.

Table 2 **International development project assistance by organization, key initiatives and Lower Mekong basin country**

Organization	Area of focus	Focus country
UNEP Regional Office for Asia and the Pacific (UNEP/ROAP)	CounterMEASURE Project on Plastic Pollution	Cambodia, Lao PDR, Thailand, Viet Nam
Mekong River Commission (MRC)	Capacity needs assessment for plastic pollution monitoring and assessment	Cambodia, Lao PDR, Thailand, Viet Nam
International Union for Conservation of Nature (IUCN)	Collecting and monitoring marine debris	Viet Nam
European Union (EU)	Reducing plastic bag waste in major cities of Cambodia Building capacity of waste management actors Collecting and monitoring marine debris	Cambodia Cambodia Lao PDR/Viet Nam
Japan International Cooperation Agency (JICA)	Strengthening Phnom Penh's waste management system (in terms of collection and final disposal) and building capacity and developing infrastructure Collecting and monitoring marine debris	Cambodia Lao PDR
United States Agency for International Development (USAID)	USAID Municipal Waste Recycling Program	Viet Nam
Korea International Cooperation Agency (KOICA)	Developing green cities and improving access to waste management and treatment services, including collection, waste-to-resource opportunities	Lao PDR
Association of Southeast Asian Nations (ASEAN)	Strengthening capacity for marine debris reduction in ASEAN Region by formulating National Action Plans and integrated land-to-sea policy approach	Thailand, Viet Nam
United Nations Development Programme (UNDP)	Combating plastic pollution in Cambodia Collecting and monitoring marine debris	Cambodia Lao PDR/Viet Nam
United Nations Environment Programme (UNEP)	State of Waste Management in Phnom Penh, Cambodia Collecting and monitoring marine debris Marine debris, plastic pollution, waste management systems	Cambodia Lao PDR/Viet Nam Thailand
Partnerships in Environmental Management for the Seas of East Asia (PEMSEA)	Marine Debris Initiative of the PEMSEA Network of Local Governments for Sustainable Coastal Development (PNLG)	Viet Nam
Asia Foundation	Optimizing waste collection operations via strategic use of GPS/GIS systems Collecting and monitoring marine debris	Cambodia Lao PDR, Viet Nam
Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)	Rethinking plastics – circular economy solutions to marine litter Collecting and monitoring marine debris	Cambodia Thailand, Viet Nam
World Bank Group	Collecting and monitoring marine debris Marine Litter, Development and Implementation of Policies and Regulations, Capacity Development and Financial Investments	Lao PDR/Viet Nam Thailand, Viet Nam
SWITCH-Asia	Building capacity of waste management actors Collecting and monitoring marine debris	Cambodia Lao PDR/Viet Nam
Fauna & Flora International (FFI)	Providing baseline biological surveys, monitoring, as well as capacity-building, training and awareness-raising in managing and protecting Cambodia's marine environment; establishing protected areas	Cambodia
Marine Conservation Cambodia (MCC)	Collaborating with communities to carry out marine resource conservation programmes	Cambodia

Organization	Area of focus	Focus country
Institute for Global Environmental Strategies (IGES)	State of Waste Management in Phnom Penh	Cambodia
Konrad-Adenauer-Stiftung (KAS) Cambodia	Capacity-building on decentralized waste management	Cambodia
Cambodian Education and Waste Management Organization (COMPED)	Dealing with the waste crisis in Cambodia	Cambodia
Norwegian Agency for Development Cooperation (NORAD)	<i>Clean Oceans through Clean Communities</i>	Cambodia
Asian Development Bank (ADB)	Collecting and monitoring marine debris	Lao PDR
World Wide Fund (WWF)	Collecting and monitoring marine debris <i>Better Waste Management & Recycling, Municipal Waste Recycling Programme/Building Plastic Pollution-Free Cities Program in Vietnam</i>	Viet Nam
UNHabitat	Collecting and monitoring marine debris	Viet Nam
United Nations Office on Drugs and Crime (UNODC)	Collecting and monitoring marine debris	Viet Nam
United Nations Food and Agricultural Organisation (FAO)	Collecting and monitoring marine debris	Viet Nam



6 / SUMMARY OF CAPACITY MAPPING FINDINGS

Generally, mapping of capacities may be considered controversial because of apparent subjective concepts of what could be considered as relevant capacity. Fundamentally, mapping the full breath of capacity assets available within an administrative boundary may be inexhaustive and resource-constrained. Notwithstanding, the careful mapping of these resources is critical for countries to maximise the use of often limited resources at the disposal of governments to meet unlimited needs.

For instance, Thailand and Viet Nam have existing master plans and road maps for plastic waste management at the national level. However, Cambodia and Lao PDR do not yet have such road maps. Thus, plastic pollution monitoring and assessment programmes and policies must be promoted at the national level. In turn, local administrations must incorporate and operationalize these programmes and policies into their waste management agenda. It is noteworthy that cities in

Cambodia, Thailand and Viet Nam have only partial influence and capacity to ensure compliance with waste management laws. Thus, plastic pollution monitoring and assessment frameworks must be developed and operationalized at local levels where adequate capacities are available.

Some Lower Mekong countries (LMC) have current legal and regulatory frameworks on plastic-specific strategies, taxes on single-use plastics and deposit-refund systems. These countries also adhere to international legal conventions such those of the London Convention (i.e. Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter 1972) and MARPOL73/78 (International Convention for the Prevention of Pollution from Ships), among others. Regulations on the ban of single-use plastics are being

implemented in Thailand and Viet Nam, while Cambodia and Lao PDR are in the process of developing these policies.

With regard to the informal plastic recycling sector, Cambodia and Thailand have no legal provisions in their existing legal framework for regulating the sector. LMCs like Lao PDR and Viet Nam have legal provisions, but they are not currently enforced. There are no binding mandatory data requirements for plastic pollution reporting at the local level. However, central government administrations have the legal mandate to monitor the compliance of waste management regulation and implementation at the subnational levels.

Multi-actor engagements in plastic waste management are widely promoted in the Lower Mekong. Within a decentralized framework, plastic waste management responsibilities are shared between national- and subnational-level administrations. Central government administrations are mainly engaged in drafting regulations, developing policies and strategies, and supervising subnational administrations, among other activities. Inter-and intra-sectoral collaborations within ministries and departments are promoted in these four countries. However, provincial and city authorities wield significant power in decision-making.

Multi-stakeholder collaborations, particularly with private sector and international development partners must be strengthened and harmonized for operationalizing plastic pollution monitoring and assessment programmes. However, these collaborations could be strengthened, particularly in the management of plastic pollution. Apparently, some subregional organizations and research institutions in the Lower Mekong possess considerable experience and demonstrated capacities in running long-term environmental monitoring programmes. These experiences may be tapped and adapted to support the knowledge on plastic pollution monitoring and assessment. These experiences could also be extended to guide site selection for monitoring programmes. Cambodia, Thailand and Viet Nam have existing artificial riverine barriers, in areas such as port controls and dams, which can serve as stationed monitoring units.

Most LMCs regularly publish annual reports on solid waste management at the local, provincial and national levels. Most of these countries are not regularly engaged in community-led cleanup and plastic waste management initiatives as part of their monitoring activities on plastic waste in water environments. Most Mekong countries have experience in community mobilization and rapid assessments for solid and plastic waste management.

In fact, the greater part of the Mekong countries have challenges in implementing relevant laws, regulations and policies on solid and plastic waste monitoring. These challenges include lack of adequate financial resources, human resource constraints, poor legislative frameworks and lack of technical capacity. In these countries, the technical and financial resources of government agencies are inadequate to pursue regular, long-term data collection and to build a mechanism or modality to use statistics produced by non-governmental domestic and international organizations. In this light, the current capacity of the statistical system also must be strengthened – particularly at the local levels.

The identified gaps and opportunities regarding policies and strategies on plastic waste management, monitoring and assessment in the four project target countries are the following:

- Low budgetary allocations by central governments and local governments for waste management research to build knowledge and raise awareness towards behavioural changes targeted at plastic waste reduction.
- Effective policies and measures to mitigate plastic waste in most of these countries should start by strengthening monitoring systems, with a view to better understand issues regarding the quantity, components, movement, distribution, major sources and impacts of waste.
- Technical capacity-related constraints as the main bottlenecks to effective waste management, underlining the need for further institutional reforms, new strategy development and improved collection and transport systems.

Table 3 Summary of availability of capacity assets for four Lower Mekong countries

	Cambodia	Lao PDR	Thailand	Viet Nam
Legal and policy framework Key question: <i>Do relevant environmental policies provide frameworks and clear actionable plans for solid waste/plastic waste monitoring and assessment?</i>	Policy provisions made are not specific to the conduct of plastic pollution assessment and monitoring. Solid waste management laws are mostly applied in plastic waste management		Policy provisions not specific to plastic pollution assessment and monitoring. Existing policy frameworks include roadmaps and action plans for plastic pollution management	
Institutional arrangement Key question: <i>Functional blueprint for intra- and or inter- government agency coordination, (solid waste/plastic waste) on monitoring and assessment of solid waste/plastic litter monitoring and assessment?</i>	No functional blueprint for inter-and intra-agency collaborations on plastic pollution assessment and monitoring. Institutional collaboration and overlapping roles on solid waste management engagements		There are no specific protocol or procedures for cross sectoral collaborations for plastic pollution assessment and monitoring. However, there is an active multi-stakeholder engagement on plastic waste management	
Financial and human resource Key question: <i>Resources; operational arrangement necessary to set up, sustain and maintain systematic monitoring and assessment of plastic litter</i>		Lack of budget and human resources, lack of skills. Dedicated financial resources for plastic pollution assessment and monitoring not available. Local and national sources of financing plastic pollution programmes are mostly supported by international development partners		
Systems and influencing capacity Key question: <i>Mobilization of knowledge, and expertise relevant to meet strategic objectives and the needs of plastic litter monitoring and assessment programmes?</i>	Need to strengthen mechanisms for policy dialogue and inclusive contribution to policy Forging formal and informal coalitions coordination and management		Policy dialogue and inclusive contribution to policy Strong private and public sector institutional coalitions on plastic waste management	
Operational capacity Key question: <i>Operational arrangements available to running monitoring and assessment programmes of plastic litter?</i>		Lack of adequate technological resources within public sector setting to conduct plastic pollution assessment and monitoring		
Technological resources Key question: <i>Technologies and instruments are available for implementing protocols for monitoring and assessment of plastic litter?</i>	Inadequate manpower and skilled labour to implement plastic monitoring and assessment. Long-term strategic plans, result based planning			

 Present

Partially present

Not present

- Data on the volume of plastic waste generation and recycling and on the number of recyclers and existing recycling operations in the country remains limited.
- District governments and municipal authorities remain unclear about their roles and responsibilities in enforcing laws and regulations on waste.
- Institutional fragmentation and unclear mandates and role-sharing must be addressed.
- Plastic waste separation at source must be expanded.
- Informal waste pickers must be supported with occupational health measures such as protective gear and regular health checks.
- Solid waste recycling technologies, including plastic waste, have not been fully documented and evaluated to provide guidance on the selection of recycling technologies in accordance with local waste characteristics.
- Low-quality plastics are increasingly not attractive for market-based material recovery activities.
- Community-led cleanup and plastic pollution monitoring initiatives in water environments are carried out by mandated government agencies.

The CounterMEASURE project mapped the available capacity assets of central and subnational government authorities to support plastic pollution monitoring and assessment based on the basis of capacity dimensions, as shown in Table 3.



7 / CONCLUSIONS AND RECOMMENDATIONS

The management of solid waste and plastic pollution in the Lower Mekong countries is practised primarily within a multilevel governance context. This context involves the adoption of complex, overlapping relationships between state and non-state actors in decision-making and governance at the national, regional and local levels. Thus, identifying the availability of an enabling environment to carry out plastic leakage monitoring and assessment functions must be oriented within a multilevel governance framework and context in the Lower Mekong — one that explores the availability of favourable legal and policy frameworks at various levels of environmental administration.

Plastic waste management has been traditionally managed as a fraction of solid waste in countries of this region. Until recently, most legislation and laws have not been specific to plastic waste management. However, the quite recent focus on plastic pollution challenges has stimulated a shift

to plastic waste management as a priority for legal and regulatory provisions. While some countries have legal provisions and mandates to promote plastic pollution monitoring and assessment, other countries barely have such provisions.

Waste management in the Lower Mekong is practised within a decentralized context, albeit with challenges. Laws and regulations provide limited powers to local administrative authorities — particularly at the city and community levels — to exercise the full autonomy needed to develop, plan and execute contextually relevant programmes and communications without the interference of provincial- and national-level authorities. Various legislative instruments have been issued on solid waste management across these four countries; however, in reality, plastic waste is not being

managed separately from municipal solid waste. As such, the management of plastic waste has been carried out under the legal provisions of municipal solid waste management. However, owing to recent concerns on marine plastic debris, these countries have taken steps to develop laws, regulations and policies to curb plastic waste generation, management and leakage.

Most existing legislative frameworks across these LMCs are focused on applying the 3R approach (reduce-reuse-recycle) to curbing increasing plastic waste; moreover, the aspects of monitoring and assessing plastic waste flow have received little attention. Extant laws place greater emphasis on institutional compliance monitoring or environmental monitoring programmes rather than on continuous monitoring and assessment programmes designed to generate data and knowledge for policy- and decision-making. Clearly, the decentralized nature of waste management provides a limited legal framework for establishing dedicated divisions or units within subnational administrations for plastic litter monitoring and assessment. As such, legal and regulatory frameworks are woefully inadequate to support monitoring and assessment programmes within national and subnational administrative levels.

Beside the absence of the enabling legal environment for carrying out monitoring and assessment, little to no capacity exists for carrying out plastic litter leakage monitoring within governmental institutional settings. Many unclear institutional mandates leading to overlapping responsibilities have been observed in all four Lower Mekong countries. Generally, there are no provisions under related legal frameworks specific to the monitoring of plastic pollution and leakage. Institutions authorized under certain laws are sometimes not established. In some cases, they are not given the proper mandate, budget and capacity in accordance with the law.

In fact, government administrations in the Mekong working on waste management face enormous technical and financial challenges. As a result, scarce monetary resources are expended on very essential environmental monitoring programmes or critical services, thus, solid/plastic waste

monitoring and assessment is often neglected from consideration. Instead, air pollution, water quality and chemical waste data typically make up the list of statistical indicators or data elements in environmental monitoring programmes.

Otherwise, when such programs are operational, data management is another issue. Where mandatory reporting requirements are necessary, most data on plastic waste are hardly sourced from monitoring programmes. Rather, they are sourced from statistical projections and estimations and, in some cases, from donor-funded projects.

In addition, woefully inadequate human resources funding has led to a lack of technical staff with the skills necessary to undertake the monitoring and assessment of plastic litter leakage on land and in the water environment. This situation is particularly true for subnational organizations. In sum, these challenges have the potential to inhibit obligations to undertake long-term monitoring, and data management initiatives. .

Recommendations and practice

The governments of Lower Mekong countries have minimal capacity assets at the central and subnational government levels to conduct the monitoring and assessment of plastic pollution on land and in the water environment. This scenario presents significant challenges to the acquisition of data and information required to support decision-making and investments. Thus, policies for plastic pollution monitoring and assessment vary widely between countries in the Lower Mekong.

Thus, essentially, capacity-building efforts for this activity in this subregion needs to be done in a comprehensive, systemic manner, focusing on creating an enabling environment with specific attention to the vital linkages between the community, organizational and individual levels. As such, considerations for legal agreements, reforms and amendments must be considered in setting up plastic monitoring and assessment programmes. The thrust for the development of

evidence-based policies for impact must stem from a strong commitment to stakeholder engagement, partnership and consensus-building.

Legislation for plastic pollution management must incorporate elements for the monitoring and assessment of plastic pollution with key functional and decentralized mandate to subnational waste management authorities. Similarly, technical guidelines, action plans and road maps for implementing legislation and policies at local levels must be developed to provide the enabling environment needed to support plastic pollution monitoring and assessment. While such an environment provides the needed support for establishing monitoring programmes, provisions must be made for mandatory reporting and information obligations based on set indicators and policy objectives. Moreover, institutional roles and responsibilities must be clearly stated to prevent the overlapping of mandates.

Setting up and maintaining plastic pollution monitoring and assessment programmes can be resource-intensive. Government subventions are mostly inadequate for providing institutional support for programmes such as those for plastic pollution monitoring and assessment. Thus, full fiscal decentralization must be promoted to support the implementation of environmental policies and programmes at the local level. Sustainable, viable funding options must be drawn up to support the establishment of programmes to monitor and assess plastic litter in the Lower Mekong basin. Governments in this subregion must focus on closing gaps between institutional and investment needs and opportunities by exploring innovative, transparent funding models, including public-private partnership models should there exist gaps between institutional and investment needs and opportunities. The capacities of those subnational organizations and research institutions with experience in pollution monitoring and assessment can be tapped to strengthen and improve the development of country-level capacities. The development and implementation of long-term

plastic pollution monitoring and assessment may require dedicated budgets and long-term funding. Institutional arrangements for such an intervention may adopt a cross-sectoral, interdisciplinary approach whereby networks of institutions may be pooled to implement different aspects of plastic pollution monitoring and assessment. By this, harmonized protocols must be developed to ensure consistency in applying monitoring standards and methods.

Lower Mekong countries must endeavour to foster multi-stakeholder collaborations with private sector, pro-environment civil society organizations, international development partners, and communities in mobilizing resources for plastic pollution prevention. To this end, these countries must promote the following:

- Inclusive communication and consensus-building on the prevention of leakage of the key plastic types identified at plastic application hotspots.
- Effective communication and dialogue on policies and policy objectives on plastic waste management at the local level.
- Cross-sectoral, interdisciplinary approaches between state institutions and actors in policy formulation and implementation.
- Inter- and intra-institutional dialogue in Lower Mekong countries to foster the ownership of, and participation in, plastic waste leakage assessment and management.

In addition, LMCs need to develop mechanisms to assess the capacities of various key stakeholders to prevent plastic pollution, including communities, the private sector, the informal sector, and religious and civil society groups. Finally, a thorough capacity needs assessment would be required to gauge capacity-building needs in the Lower Mekong in order to support plastic pollution monitoring and assessment on land and in the water environment.

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Appendices

Appendix 1. Thailand – Mapping of Legal and Policy Framework for Solid Waste and Marine Litter Management

Name of Laws/Regulations	Solid Waste Management	3R	Single Use Plastic ban	Marine Debris Collection	Marine litter Discharge*	Marine litter Monitoring
[Laws and Regulations]						
National Level						
Navigation in the Thai Waters Act B.E. 2456 (1913)					●	
State Irrigation Act B.E. 2485 (1942)					●	
Fisheries Act B.E. 2490 (1947)					●	
National Park Act B.E. 2504 (1961)						
National Reserved Forest Act B.E.2507 (1964)					●	
The Enhancement and Conservation of National Environmental Quality Act B.E.2535 (1992)	● (Clause 78)					
Public Health Act B.E.2535 (1992)	● Section 20(1)			●	●	
Public Cleanliness and Orderliness Act B.E.2535 (1992)					●	
Factory Act B.E. 2535 (1992)					●	
Office of the Prime Minister Regulation on National Waste Management Organisation B.E.2557 (2014)	●					
Ministerial regulation B.E.2545 (2002) on waste management fee including solid waste and night soil collection, transportation and treatment and other related fees	●					
Act on the promotion of Marine and Coastal Resources Management, B.E. 2558 (2015)				●	●	●
Municipal Level						
Pattaya City Administration Act B.E.2521 (1978)	●					
Bangkok Metropolitan Administration Act B.E.2528 (1985)	●					
Sub district Administrative Office Act B.E.2537 (1994)	●					
Provincial Administrative Organisation Act B.E.2540 (1997)	●					
BMA Act B.E.2541 (1998) on controlling waste-related business including solid waste and night soil collection, transportation or treatment	●					



Name of Laws/Regulations	Solid Waste Management	3R	Single Use Plastic ban	Marine Debris Collection	Marine litter Discharge*	Marine litter Monitoring
BMA Act B.E.2546 (2003) on solid waste and night soil collection and transportation fee according to Public Health Act B.E.2546 (2003)	●					
BMA Act B.E.2546 (2003) on solid waste and night soil collection and transportation fee according to Public Health Act (2nd revision) B.E.2548 (2005)	●					
BMA Act B.E.2546 (2003) on solid waste and night soil Collection related staff remuneration and private sector	●					
BMA Act B.E.2546 (2003) on process for solid waste and nightsoil from public health service provider building B.E.2545 (2002)	●					
[Action Plan & Strategy]						
Roadmap on Solid and Hazardous Waste Management endorsed by NCPO on 26 August 2014	●	●				
Action Plan "Thailand Minimal Wastes" (2015 – 2016)	●	●				
National Solid Waste and Hazardous Waste Management Master Plan (2016 - 2021)	●	●				
Action Plan "Thailand zero Waste" (2016 – 2017, Approved in 2016)	●	●		●	●	●
20-year Development Plan for Bangkok Metropolitan (2013-32) – 4 phases	●	●				
Solid Waste Management Plan for Bangkok Metropolitan (2015-19)	●	●				
Future Plan of 20-year Solid Waste Management for Bangkok Metropolitan	●	●				
National 3R Strategic Plan	●	●				
Government Green Procurement Programme	●	●				
National Environmental Basic Plan (2017 – 2021)	●	●				
National Solid Waste Management Master Plan (2017 – 2021)	●	●	●			
The Plastic Waste Management Road Map 2018-2030		●	●	●		
The Plastic Waste Management Road Map 2018-2037 (Draft)	●	●	●	●	●	●

Appendix 2. Cambodia – Existing Solid Waste Management Laws and Regulations: 3Rs, Single-use Plastics and Marine Plastic Litter Collection, Discharge and Monitoring

Laws/Regulations	Solid Waste Management	3R	Single Use Plastic ban	Marine Plastic Litter Collection	Marine Plastic Litter Discharge*	Marine Plastic Litter Monitoring
National Level						
Sub-decree on solid waste management No. 36 (1999) ⁷⁸	● ⁵ (Article 4/11)		● ⁵ (Article 8)			
Sub-decree on the management of garbage and solid waste in urban areas No.113 (2015) ⁷⁸	● ⁵ (Article 1)		● ⁵ (Article 3)			
Inter-Ministerial Declaration of Ministry of Interior-Ministry of Environment on Waste and Solid Waste Management in Province/Municipalities of Cambodia, No. 80 (2003) ⁷⁸	●					
Sub-Decree No. 168 GNKR.BK on the Management of Plastic Bags of October 2017 ⁷⁸	●		●	● ⁵ (Article 14)		
Municipality Level						
Declaration on the permission Sarom Trading to collect and transport industrial wastes from Phnom Penh and Kandal province, No. 156 (2001) ⁷⁸	● ⁵					
Declaration on Industrial Solid Waste Collection and Transport in Phnom Penh and Kandal, No. 148 (2002)	● (Article 2)					
[Action Plan & Strategy]						
National Environment Strategy and Action Plan 2016-2023 ⁷⁸	● ⁵		● ⁵ Objective 2.3			
Waste Management Strategy and Action Plan of Phnom Penh 2018-2035 ⁷⁸	● ⁵		● ⁵			● ⁵
The laws for London convention and MARPOL73/78 ⁷⁸					●	●

5 Government provided environmental sanitation budget to sub-national administration to support and fulfil the gaps temporarily (in 2015 amount 5,000 million riel (USD 1.25 million) and 2016 amount 8,000 million riel (USD. 2 million)) to support and promote the responsibility of sub-national administration on urban solid waste management. www.switch-asia.eu/fileadmin/user_upload/Events/Cambodia_16/PPTs/9_Introduction_to_field_visit_Waste_management_in_Cambodia_COMPED.pdf

Appendix 3. Cambodia – Solid Waste Management Technology

Country	Source Segregation	Technology Collection Rate (Urban)	Recycling Rate	Technology Gap				
				Treatment/Disposal				
				Composting	Incineration	Sanitary Landfill	Open Dump	Open Burning
Cambodia ⁶	<50% ⁷	92% ^{8,9,10,11}	15% ^{12,13}	C ^{14,15,16}	I ¹⁷	SL ^{18,19,20}	OD	OB
Total 3.65 million tons, - 10,000 tons per day. ²¹ - 2017 Phnom Penh 3,000 tonnes per day ²² Sihanoukville 600 to 650 tonnes per day Siem Reap city - 350 to 400 tonnes per day Battambang - 130 tonnes of waste/ day				Landfill Dangkor sanitation landfill, Phnom Penh - 808,530 tonnes per year ²³ Dumpsite ²⁴ Siam Reap Rubbish Dumpsite, Poipet Municipal Dumpsite, Preah Netr Preah district Dumpsite, Svay Chek District Dumpsite, Thma Puok District Dumpsite, Serei Saophan Municipality Dumpsite, Battambang Dumpsite, Banan District Dumpsite, Prey chhor dumpsite, Chbor Mon Dumpsite, Takhmao Dump - Kandal Province				

- 6 Government provided environmental sanitation budget to sub-national administration to support and fulfil the gaps temporarily (in 2015 amount 5,000 million riel (USD 1.25 million) and 2016 amount 8,000 million riel (USD. 2 million)) to support and promote the responsibility of sub-national administration on urban solid waste management. www.switch-asia.eu/fileadmin/user_upload/Events/Cambodia_16/PPTs/9_Introduction_to_field_visit_Waste_management_in_Cambodia_COMPED.pdf
- 7 Plastic waste (20.9%), paper (9.9%). https://www.ccet.jp/sites/default/files/2018-07/State%20of%20Waste%20Management%20in%20Phnom%20Penh%2C%20Cambodia%20_web.pdf
- 8 Collection rate for Phnom Penh. <http://documents.worldbank.org/curated/en/697271544470229584/pdf/132827-PUB-9781464813290.pdf>
- 9 Decentralized waste collection and disposal model is operated through concessions to private sector
- 10 Waste collection by private companies; 1. CINTRI (Phnom Penh, Kampong Cham, Sihanoukville, Battambang, etc.) 2. GAEA (Siem Reap, Kampot, Serey Sophorn, Kampong Thom. Vgreen company. Also, there are informal collectors. In Siem Reap has a landfill 28 km from the city. Waste collection to landfill 230 tons/day. Transfer station receives 230-250 tons/day. Phnom Penh relies mainly on Dangkor landfill (808,530 tons/year). In April 2019 – The United Nations Industrial Development Organization (UNIDO) and the Global Green Growth Institute (GGGI) signed a technical cooperation agreement to jointly improve waste recycling in Battambang - will cooperate on capacity building and community education as well as on the design and implementation of a large-scale trial for household waste segregation and transport. Existing recycling facilities will be upgraded and general recommendations to improve recycling in the city will be developed and subsequently implemented.
- 11 In Siem Reap, GAEA and Naga Earth are collaborating to recycle glass from businesses. The project has started as of July 2019 and GAEA is now collecting glass from local businesses
- 12 Recycling rate in 2015 is estimated 15% [(MSW reuse and recycling)/(Total amount of MSW generation)]. State of 3Rs in Asia and the Pacific, 2018.
- 13 Recyclable materials are mainly exported abroad for the recycling markets. Recovered products are first transported to small depots then bigger depots prior to the in-country recycling markets and export to Vietnam, Thailand.
- 14 Composting facility in Battambang city (7 tons / month); Biogas processing (3 biogas plants), influent 240 kg / day for cooking, lighting and generation. <http://www.uncrd.or.jp/content/documents/6581Country-G-3-Cambodia.pdf>
- 15 A 3-tonne-capacity IRRC was established in 2012 at Kampot through a partnership between ESCAP, the Community Sanitation and Recycling Organization (CSARO), Kampot Municipality and Kampot Province- <https://www.unescap.org/sites/default/files/3%20Kampot.pdf>
- 16 Recycling centers for compost include; COMPED-WM and IRRC and CSARO
- 17 Cambodia has 6 units for IW 3,525 t/year (5 units WtE in garment industry) of Small-Scale Incineration (without pollution control system)
- 18 In 2018, Global Action for Environment Awareness (GAEA) intends to start the development of the first sanitary landfill in Cambodia. The project design has been submitted to Ministry of Environment in 2017 and to kick-start Recycling and Composting activities which are for now at pilot stage
- 19 Forecasted country wide disposal at landfill estimated at 1.080-1.461 million tons/yr between 2014-2020. Ibid see footnote 3
- 20 There are about 76 landfills/dumpsites which are open pits and open burning sites; Kampong Cham, Preah Sihanouk ville; Phnom Penh; Battambang; Siem Reap; Kampot
- 21 Government statement in Khmer Times <https://www.khmertimeskh.com/539241/waste-production-continues-to-rise/>
- 22 ibid
- 23 State of Waste management in Phnom Penh https://iges.or.jp/en/publication_documents/pub/policyreport/en/6563/State+of+Waste+Management+in+Phnom+Penh%2C+Cambodia+_web.pdf
- 24 UNDP Report Status of Waste Management in Cambodia https://issuu.com/undpkh/docs/final_provincial_

Appendix 4. Four Lower Mekong Countries – Mapping of Solid Waste Management Technology

Technology				
Country	Source Segregation	Collection Rate (Urban)	Recycling Rate	
Cambodia ²⁵	<50% ²⁶	92% ^{27,28,29,30}	15% ^{31,32}	
Lao PDR	<50%	40% - 70% ⁴⁰	<50%	
Thailand	<50%	58% ⁴¹	25.79% ⁴² >90% (Metal) 50% - 60% (Paper, Construction) <50% (Others)	
Viet Nam	<50%	40-85% ⁴⁶	8-15% ⁴⁷ >90% (Metal) >70% (Plastic, E-waste) 50% (Paper) <50% (Others)	
C Composting	I Incineration	SL Sanitary Landfill	OD Open Dump	OB Open Burning

Source: Data updated 2019 from different sources and from Waste Management in ASEAN Countries, UNEP, 2017

- 25 Government provided environmental sanitation budget to sub-national administration to support and fulfil the gaps temporarily (in 2015 amount 5,000 million riel (USD 1.25 million) and 2016 amount 8,000 million riel (USD. 2 million)) to support and promote the responsibility of sub-national administration on urban solid waste management. www.switch-asia.eu/fileadmin/user_upload/Events/Cambodia_16/PPTs/9_Introduction_to_field_visit_Waste_management_in_Cambodia_COMPED.pdf
- 26 Plastic waste (20.9%), paper (9.9%). https://www.ccet.jp/sites/default/files/2018-07/State%20of%20Waste%20Management%20in%20Phnom%20Penh%2C%20Cambodia%20_web.pdf
- 27 Collection rate for Phnom Penh. <http://documents.worldbank.org/curated/en/697271544470229584/pdf/132827-PUB-9781464813290.pdf>
- 28 Decentralized waste collection and disposal model is operated through concessions to private sector
- 29 Waste collection by private companies; 1. CINTRI (Phnom Penh, Kampong Cham, Sihanoukville, Battambang, etc.) 2. GAEA (Siem Reap, Kampot, Serey Sophorn, Kampong Thom. Vgreen company. Also, there are informal collectors. In Siem Reap has a landfill 28 km from the city. Waste collection to landfill 230 tons/day. Transfer station receives 230-250 tons/day. Phnom Penh relies mainly on Dangkor landfill (808,530 tons/year). In April 2019 – The United Nations Industrial Development Organization (UNIDO) and the Global Green Growth Institute (GGGI) signed a technical cooperation agreement to jointly improve waste recycling in Battambang - will cooperate on capacity building and community education as well as on the design and implementation of a large-scale trial for household waste segregation and transport. Existing recycling facilities will be upgraded and general recommendations to improve recycling in the city will be developed and subsequently implemented.
- 30 In Siem Reap, GAEA and Naga Earth are collaborating to recycle glass from businesses. The project has started as of July 2019 and GAEA is now collecting glass from local businesses
- 31 Recycling rate in 2015 is estimated 15% [(MSW reuse and recycling)/(Total amount of MSW generation)]. State of 3Rs in Asia and the Pacific, 2018.
- 32 Recyclable materials are mainly exported abroad for the recycling markets. Recovered products are first transported to small depots then bigger depots prior to the in-country recycling markets and export to Vietnam, Thailand.
- 33 Composting facility in Battambang city (7 tons / month); Biogas processing (3 biogas plants), influent 240 kg / day for cooking, lighting and generation. <http://www.unep.org/content/documents/6581Country-G-3-Cambodia.pdf>
- 34 A 3-tonne-capacity IRRC was established in 2012 at Kampot through a partnership between ESCAP, the Community Sanitation and Recycling Organization (CSARO), Kampot Municipality and Kampot Province- <https://www.unep.org/sites/default/files/3.%20Kampot.pdf>

Technology Gap				
Treatment/Disposal				
Composting	Incineration	Sanitary Landfill	Open Dump	Open Burning
C ^{33,34,35}	I ³⁶	SL ^{37,38,39}	OD	OB
		SL	OD	OB
C	I ⁴³	SL ⁴⁴	OD ⁴⁵	OB
		SL ⁵⁰	OD	OB

- 35 Recycling centers for compost include; COMPED-WM and IRRC and CSARO
 36 Cambodia has 6 units for IW 3,525 t/year (5 units WtE in garment industry) of Small-Scale Incineration (without pollution control system)
 37 In 2018, Global Action for Environment Awareness (GAEA) intends to start the development of the first sanitary landfill in Cambodia. The project design has been submitted to Ministry of Environment in 2017 and to kick-start Recycling and Composting activities which are for now at pilot stage [<http://cityforall.net/wp-content/uploads/sites/3/2018/10/Improving-Waste-Management-in-Cambodia-Saruom-Ran-GAEA.pdf>]
 38 Forecasted country wide disposal at landfill estimated at 1.080-1.461 million tons/yr between 2014-2020. Ibid see footnote 3
 39 There are about 76 landfills/dumpsites which are open pits and open burning sites; Kampong Cham, Preah Sihanouk ville; Phnom Penh; Battambang; Siem Reap; Kampot
 40 UNEP, 2017. Asia Waste Management Outlook
 41 Pollution Control Department, 2017. Thailand State of Pollution Report 2016. <http://infofile.pcd.go.th/mgt/Pollution%20Report%202016%20.pdf?CFID=180470&CFTOKEN=98992030>
 42 Recycling rate in 2010 is estimated 25.79% (Annual total waste utilized amount)/(Annual total waste generation). State of the 3Rs in Asia and the Pacific, 2018.
 43 8 units of Small-Scale Incinerators (without pollution control system) and 2 units of incinerators (with pollution control system)
 44 73 units of Sanitary/Engineered Landfill without Gas Recovery and 367 units of controlled dumping
 45 Open Dumping -2,075 disposal sites (mostly in small size municipalities); MONRE Thailand, 2019 presented during the 9th Regional 3R Forum
 46 In Viet Nam, there are 44 units plus 25 units in intermediate treatment centres of Incineration (with pollution control system)
 47 Recycling rate in 2015 is estimated 8-15% (Collected recyclable waste for recycling from MSW)/(Total amount of collected MSW). State of the 3Rs in Asia and the Pacific, 2018.
 48 28/31 units Operational Not prevalent of composting
 49 In Viet Nam, there are 44 units plus 25 units in intermediate treatment centres of Incineration (with pollution control system)
 50 121/458 units of Sanitary/ Engineered Landfill without Gas Recovery

Appendix 5. Survey Respondents from 4 Mekong Countries

No	Respondents	Organization
CAMBODIA		
1	H.E Mr. Khov Meas	Department and National Coordinator for ED, CNMC
2	Mr. Sok Khom	Solid Waste Management Department, MOE
3	Mr. Dek Vimeanreaksmeay	for ED, CNMC
4	Mr. Thay Piset	Royal University of Phnom Penh, Cambodia
5	Mr. Meng Kru	Tonlé Sap Authority, TSA
LAO PDR		
6	Mr. Khamsone Philavong	LNMCS
7	Mr. Thilaphone Phoumما	LNMCS
8	Ms. Outhonelamany Toulamasing	Department of Environmental Quality Promotion (DEQP), MONRE
9	Mr. Khamsamay Silapheth	Pollution Control Department, MONRE
10	Mr. Somboun Chanliya	Living Aquatic Resource Research Center National Agriculture and Forestry Research Institute (LARREC)
11	Dr. Vatthanamixay Chansomphou	Faculty of Environmental Sciences, National University of Laos, Lao PDR
13	Ms. Souvanna Phengsiseomboun	National University of Laos, Lao PDR
THAILAND		
14	Dr. Panut Manoonvoravong	Thai National Mekong Commission
15	Miss Montharop Puruen	Inland Fisheries Research and Development Division
16	Miss Chittima Charudacha	Department of Environmental Quality Promotion, MONRE
17	Dr. Apisom Intralawan	Mae Fah Luang University, Thailand
18	Dr. Pawena Limpiteeprakan	College of Medicine and Public Health, Ubonratchathani University, Thailand
19	Ms. Pattayaporn Unroj	Mae Fah Luang University, Thailand
20	Ms. Viphawan Monyanont	Mae Fah Luang University
21	Ms. Benchawan Chokchaitrakolpho	Pollution Control Department, Thailand
VIET NAM		
22	Mr. Nguyen Dinh Dat	Vietnam National Mekong Commission
23	Mr. Pham Tuong	Vietnam National Mekong Commission
24	Mr. Nguyen Van Trong	MONRE, Viet Nam



