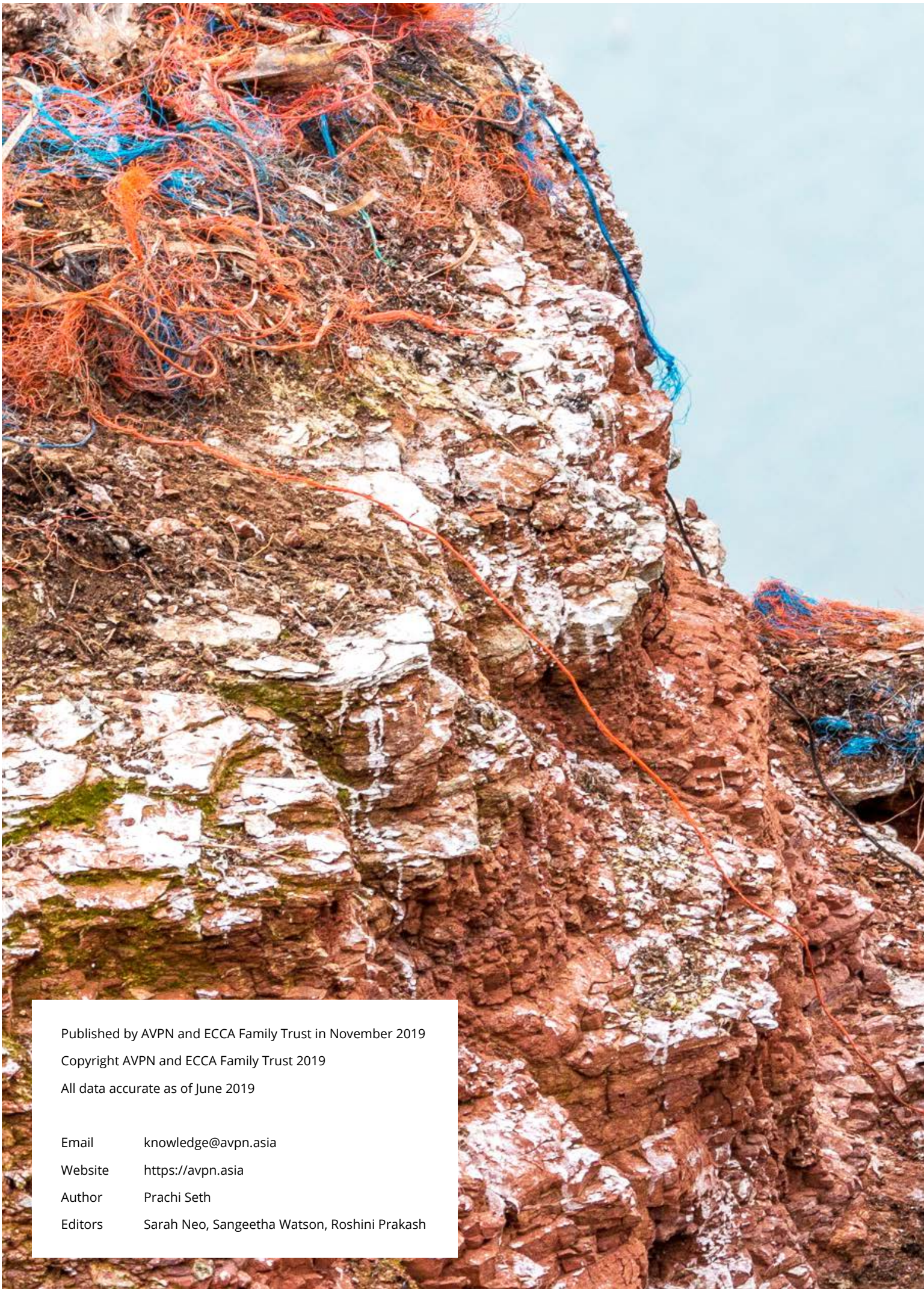
SURFACING INNOVATIVE SOLUTIONS

FOR REDUCING MARINE PLASTIC POLLUTION

A landscape analysis of Indonesia, the Philippines, Thailand and Vietnam

ECCA FAMILY TRUST

avpn



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ABOUT THIS REPORT

This study, undertaken by AVPN for ECCA Family Trust, focuses on Indonesia, the Philippines, Thailand and Vietnam, as four of the largest marine polluters in Southeast Asia and the world. The insights cited in this report are based on desk-based reviews and semi-structured interviews conducted with AVPN members, social purpose organisations (SPOs) and some local non-government organisations (NGOs) in these countries. The objective of this study is to examine, at a high-level, the overall waste management ecosystem and access the challenges to reduce marine plastic pollution for these four countries.

The report presents a landscape of organisations and actions targeting the problem of marine plastic pollution through two dimensions (i) themes and (ii) applications. It also provides a list of funding opportunities for further consideration and exploration in Indonesia, the Philippines, Thailand and Vietnam.

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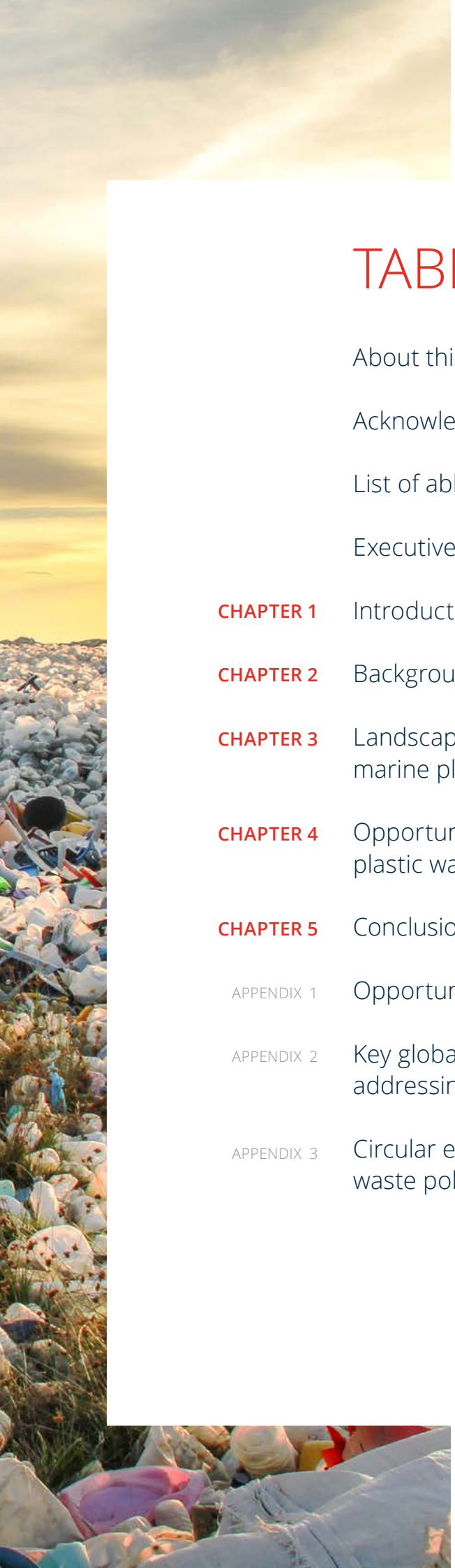
RAP VILLAVICENCIO	Mother Earth Foundation
ROSALINDA 'ROSALIE" LOPEZ-FUENTES	Ecobricks
YING STATON	Plastic Energy

LIST OF ABBREVIATIONS

3R	REDUCE, REUSE AND RECYCLE
3D	THREE-DIMENSIONAL
CAGR	COMPOUNDED ANNUAL GROWTH RATE
FCF	FULL CIRCLE FILAMENT
GDP	GROSS DOMESTIC PRODUCT
ha	HECTARES
kg	KILOGRAMME
km	KILOMETRE
MSW	MUNICIPAL SOLID WASTE
MMT[1]	MILLION METRIC TONNES
MT	MILLION TONNES
mt	MILLION TONS
MW	MEGA WATTS
NGO	NON-GOVERNMENT ORGANISATION
PE	POLYETHYLENE
PVC	POLYVINYL CHLORIDE
PET	POLYETHYLENE TEREPHTHALATE
POP	PLASTIC OFFSET PROGRAM
PPP	PUBLIC-PRIVATE PARTNERSHIP
SDGs	SUSTAINABLE DEVELOPMENT GOALS
SPO	SOCIAL PURPOSE ORGANISATION
SWOT	STRENGTH, WEAKNESSES, OPPORTUNITIES AND THREATS
sq. km	SQUARE KILOMETRE
TDRI	THAILAND DEVELOPMENT RESEARCH INSTITUTE
TNC	THE NATURE CONSERVANCY
USD	US DOLLAR
WTE	WASTE-TO-ENERGY

1. In the United States, a ton is 2,000 pounds. Outside the United States, a ton is 1,000 kilograms, or 2,204.6 pounds. To address this discrepancy in value the paper has used both units of measurements and has used Tons and Tonnes as cited in the reviewed literature.



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EXECUTIVE SUMMARY

Over 8 million metric tonnes (MMT) of plastic leaks into the oceans every year. Approximately 80 percent of this comes from land-based sources such as beach litter and sewage effluent, including waste entering through rivers. About 60 percent of land-based plastic waste leakage originates in five countries, all of which are in Asia: China, Indonesia, the Philippines, Thailand and Vietnam. In a business-as-usual scenario, these countries are likely to more than double their plastic waste by 2025.[2]

Currently the plastic industry is based on an extractive industrial linear model of 'take, make, use and dispose'. About 40 percent of plastic waste that is ineffectively managed (i.e. openly dumped, littered, channeled to uncontrolled landfills etc.) leaks into the oceans from within the region.[3] This can largely be attributed to a lack of infrastructure and financing, poor public awareness, lack of or poor execution of recycling policies, illegal dumping as well as unplanned industrial development, tourism and aquaculture. Only 9 percent of the 6300 MMT of plastic produced globally from 1968 to 2015 was recycled.[4] However, in recent years some organisations have started transitioning to alternative models, including creating a circular economy.

This study evaluates solutions available to reduce marine plastic pollution in Indonesia, the Philippines, Thailand and Vietnam. The insights cited in this report are based on desk-based reviews and semi-structured interviews conducted with AVPN members and a range of social purpose organisations (SPOs), including nonprofits and social enterprises. While the scope is not exhaustive, it will:

- Provide desk-based landscape analysis of the current situation in these countries;
- Highlight the interventions applied so far;
- Identify challenges and opportunities for future social investment.

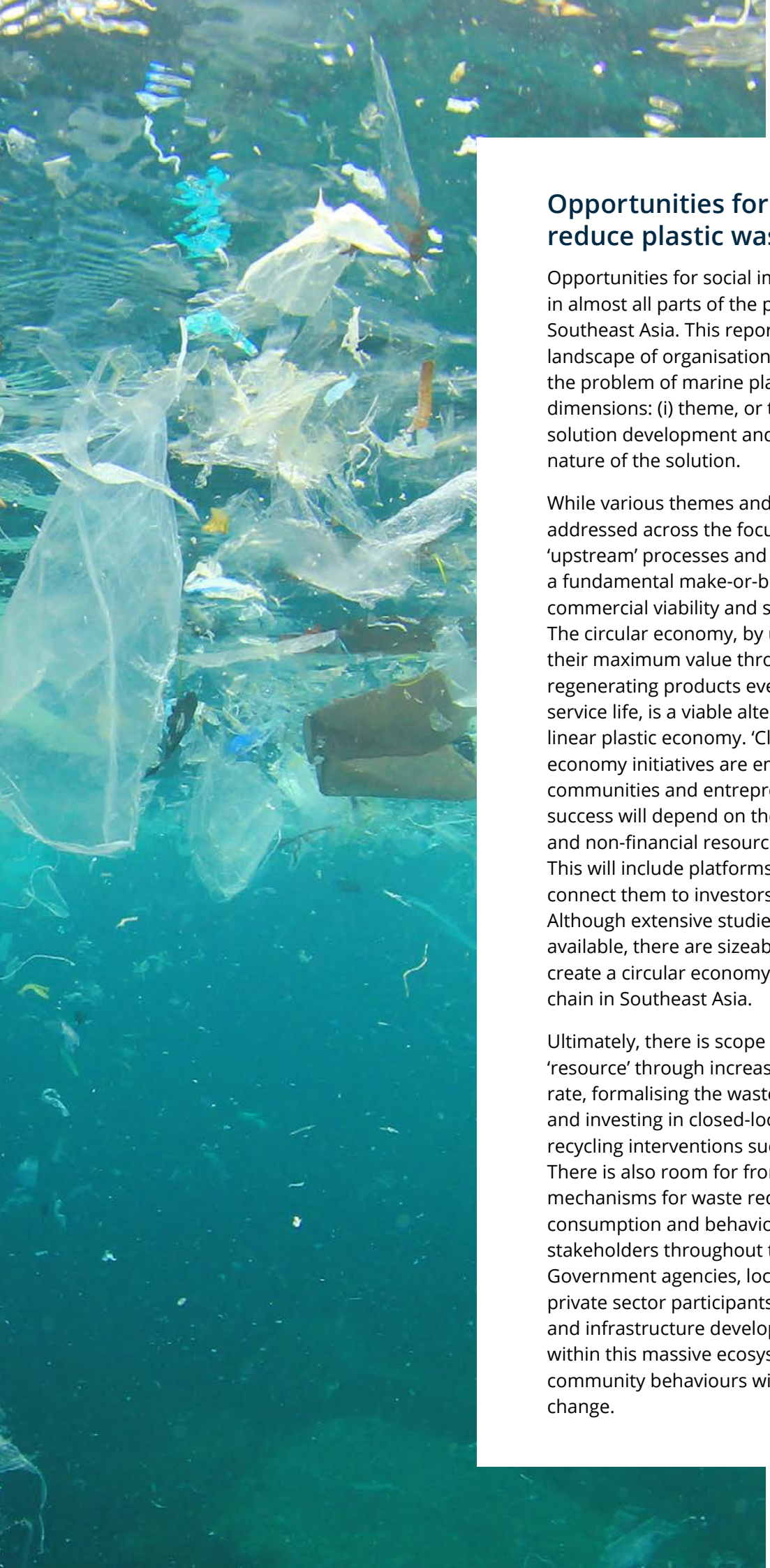
Landscape of Indonesia, the Philippines, Thailand and Vietnam

Indonesia, the Philippines, Thailand and Vietnam are fast growing emerging markets in Southeast Asia, with production and consumption of plastics increasing in lockstep. However, waste management ecosystems are largely nascent and waste collection is a logistically heavy and often poorly managed operation.

Although national policies, strategies, as well as downstream programmes and projects are in place in most of our focus countries, the execution and enforcement of these policies are largely inadequate across the board. Some challenges faced include the lack of execution coordination, knowledge of policies and overlapping responsibilities within the stakeholders and institutions downstream. In most cases, source segregation tends to be poorly implemented, with the exception of the Philippines and some parts of Thailand, meaning that industrial and household waste is mostly collected by the same agencies and stored or dumped in the same landfill. Lack of sorting and a largely informal supply chain, mainly managed by waste-pickers, means that industries setting up recycling facilities struggle to establish a constant supply stream.

Most of these countries have limited data and information on waste inventory, particularly for industrial and hazardous waste. There are some resources, such as the Pollution Control Department's annual report in Thailand, which provides local disaggregated data on the waste situation. However, such data are not comparable across countries or across urban-rural contexts. To our knowledge, cross-country data is not yet publicly available for analysis.

2. Jambeck et al. 2015. Plastic waste inputs from land into the ocean
3. Ibid
4. Geyer, R., Jambeck, J. R., and Lavender Law, Kara.2017. Production, use, and fate of all plastics ever made



Opportunities for investment to reduce plastic waste

Opportunities for social impact investment exist in almost all parts of the plastics value chain in Southeast Asia. This report organises the broad landscape of organisations and actions targeting the problem of marine plastic pollution into two dimensions: (i) theme, or the primary point of solution development and (ii) application, or the nature of the solution.

While various themes and applications are being addressed across the focus countries, addressing 'upstream' processes and infrastructure will be a fundamental make-or-break element in the commercial viability and scaling of any venture. The circular economy, by using plastics to their maximum value through recovering and regenerating products even after the end of their service life, is a viable alternative to the current linear plastic economy. 'Closed-loop' circular economy initiatives are emerging amongst local communities and entrepreneurs, and their success will depend on the availability of financial and non-financial resources to scale effectively. This will include platforms and mechanisms that connect them to investors and practitioners. Although extensive studies and data are not yet available, there are sizeable opportunities to create a circular economy within the plastics value chain in Southeast Asia.

Ultimately, there is scope to change 'waste' to 'resource' through increasing the waste recycling rate, formalising the waste management sector and investing in closed-loop technological recycling interventions such as waste-to-fuel. There is also room for front-end solutions i.e. mechanisms for waste reduction, sustainable consumption and behavioural change of stakeholders throughout the value chain. Government agencies, local communities and private sector participants need to be engaged and infrastructure developed to track data within this massive ecosystem. Finally, a shift in community behaviours will be required for lasting change.

INTRODUCTION

Over 8 million metric tonnes (MMT) of plastic leaks into the oceans every year, and approximately 80 percent of that comes from land-based sources such as beach litter and sewage effluent including waste entering through rivers.[5] At least 60 percent of litter collected from the coastlines and oceans is plastic waste.[6]

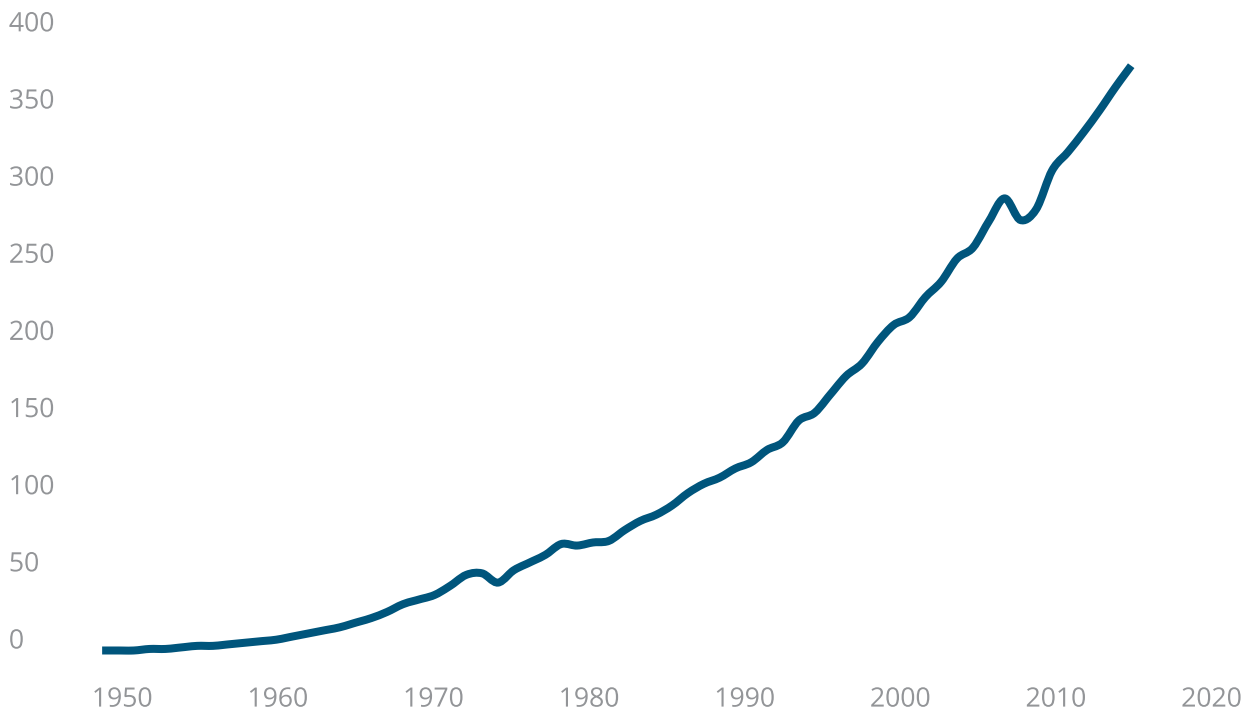
Since the 1980s, there has been a sharp increase in global plastic production due to its application in modern technology, medicine, construction, automotive industry and agriculture, alongside cheap production cost and other factors (See Figure 1 below). In 2015, the global production of plastic was as high as 388 MMT.[7] If this trajectory continues, it is estimated that there will be more plastic (by weight) than fish in the ocean by 2050.[8]

The gravity of plastic waste is multifarious. Ecologically, it goes far beyond what we see floating on the ocean surface. In fact, 94 percent of the plastic that enters the oceans ends up

FIGURE 1

GLOBAL PLASTIC PRODUCTION

MILLION METRIC TONNES (MMT)



Source: Jambeck et al. 2015. Plastic waste inputs from land into the sea

5. McKinsey Center for Business and Environment & Ocean Conservancy. 2015. Stemming the tide: Land-based strategies for a plastic - free ocean
6. Ibid
7. UN Environment. 2018. Mapping of global plastics value chain and plastics losses to the environment: With a particular focus on marine environment
8. Ellen MacArthur Foundation. 2016. The new plastics economy — rethinking the future of plastics

on the seabed, with an average of about 70 kilogrammes (kg) of plastic on the sea bed for every square kilometre (sq. km).[9]

Environmental impact

Marine life is directly affected through the ingestion of or entanglement in debris. Ingesting marine plastic can lead to internal injury and intestinal blockage, loss of nutrition, starvation, and even death. In addition, marine creatures are increasingly getting caught or trapped in plastic waste, sometimes being smothered by it. Marine plastic pollution can also scour, mutilate, smother, and cause damage to the marine habitat, for instance, coral reefs.

Social and health impact

More than 80 percent of drinking tap water samples collected globally tested positive for plastic content.[10] Each year, more humans and animals ingest macro, micro and nano-plastics through drinking water. While drinking water is treated in most countries, the sludge collected from this process (which contains nanoplastics) is often deposited back into the environment as fertiliser, thereby re-entering the food chain. A study conducted by Rochman et. al (2015), noted traces of anthropogenic debris in 28 percent of evaluated fish as well as 33 percent of evaluated shellfish sold for human consumption in Indonesia.[11] Toxic gases also emanate from the open dumping grounds, polluting the air quality and contaminating water bodies. This, in turn, leads to health issues such as nervous system damage and respiratory problems.

Economic impact

The natural capital cost of plastics on the consumer goods industry is estimated to be around USD 4.7 billion per annum.[12] The economic implications of marine plastic pollution include costs linked to beach and ocean clean-up, litter removal operations, loss in tourism, repair and replacement of damaged vessels as well as the reduction in fishing catches. Often, marine debris is quite large and difficult to see. If below water, these debris can damage vessels, tangle propellers or clog the intake. The tourism industry on the other hand is largely affected by the potential reduction or loss in the recreational and aesthetic values of the marine environment due to plastic pollution.

The Asian face of plastic waste pollution

About 60 percent of land-based plastic-waste leakage globally originates in five countries in Asia: China, Indonesia, the Philippines, Thailand and Vietnam.[13] Research by Jambeck and colleagues showed that eight[14] of the ten river systems responsible for more than 90 percent of the global output of plastics that ends up in the ocean are located in heavily populated regions in Asia.[15] Most of these fast-moving emerging markets have poor waste management systems which accounts for almost 40 percent of plastic waste being ineffectively managed. In a business-as-usual scenario, the global mismanaged plastic waste to marine debris rate would increase by up to 40 percent by 2025.[16]

9. McKinsey Center for Business and Environment & Ocean Conservancy. 2015. Stemming the tide: Land-based strategies for a plastic - free ocean
10. Kosuth, M., Mason, S. A., Wattenberg, E.V. 2017. Anthropogenic contamination of tap water, beer, and sea salt
11. Rochman, C. M. et al. 2015. Anthropogenic debris in seafood: Plastic debris and fibers from textiles in fish and bivalves sold for human consumption
12. World Business Council for Sustainable Development. 2017. The business case for reducing ocean waste
13. Based on the methodology adopted by McKinsey Centre for Business and Environment & Ocean Conservancy, 2015, Stemming the Tide: Land-based Strategies for a Plastic - free Ocean
14. Ganges, Indus, Yellow, Yangtze, Haihe, Pearl, Mekong and Amur rivers
15. Jambeck et al. 2015. Plastic waste inputs from land into the ocean
16. Ibid

TABLE 1

IMPACT OF MARINE PLASTIC POLLUTION AT A GLANCE

ENVIRONMENTAL IMPACT	Entanglement	270 different animal and marine species are being impacted by plastic pollution. Approximately, 1000 turtles are known to get entangled by plastics in the oceans every year.
	Ingestion	At least 240 different animal species have ingested plastics - leading to impaired immune systems and breeding, digestive blockages, and untimely death.
	Habitat damage	Plastic waste causes damage to soil conditions, loss of flora and fauna, and accelerates coral degradation.
SOCIAL AND HEALTH IMPACT	Poor health and wellness	Globally, 37 percent of plastic waste is mismanaged and in Asia, this figure is likely even higher. Such high percentages can cause several chronic health and well-being issues.
	Human plastics ingestion	Humans ingest approximately 5 grams of plastic every week, which is equivalent to the weight of a credit card.
	Soil and water contamination	Micro and nano plastics are collecting in the water bodies. While the water is treated in many countries, the sludge collected from the water treatment is often deposited back into the environment as fertilisers.
ECONOMIC IMPACT	Fisheries	The fishery industry is making a loss of approximately USD 69.25 million annually due to marine pollution.
	Maritime trade	Commercial shipping vessels make annual losses of approximately USD 297 million as a result of vessel damage, downtime, management of harbours, and emergency operations due to vessels affected by marine litter.
	Tourism	Plastic pollution has reduced profits and increased costs for the tourism industry due to either loss of aesthetic value or regular clean ups required.

Sources: Data adopted from the WWF Report on Solving Plastic Pollution Through Accountability[17], World Business Council for Sustainable Development's Roadmap for Reducing Ocean Waste[18] and Dalberg and The University of Newcastle's No Plastic In Nature: Assessing Plastic Ingestion from Nature to People for WWF

17. WWF. 2019. Solving plastic pollution through accountability

18. World Business Council for Sustainable Development. 2017. The business case for reducing ocean waste

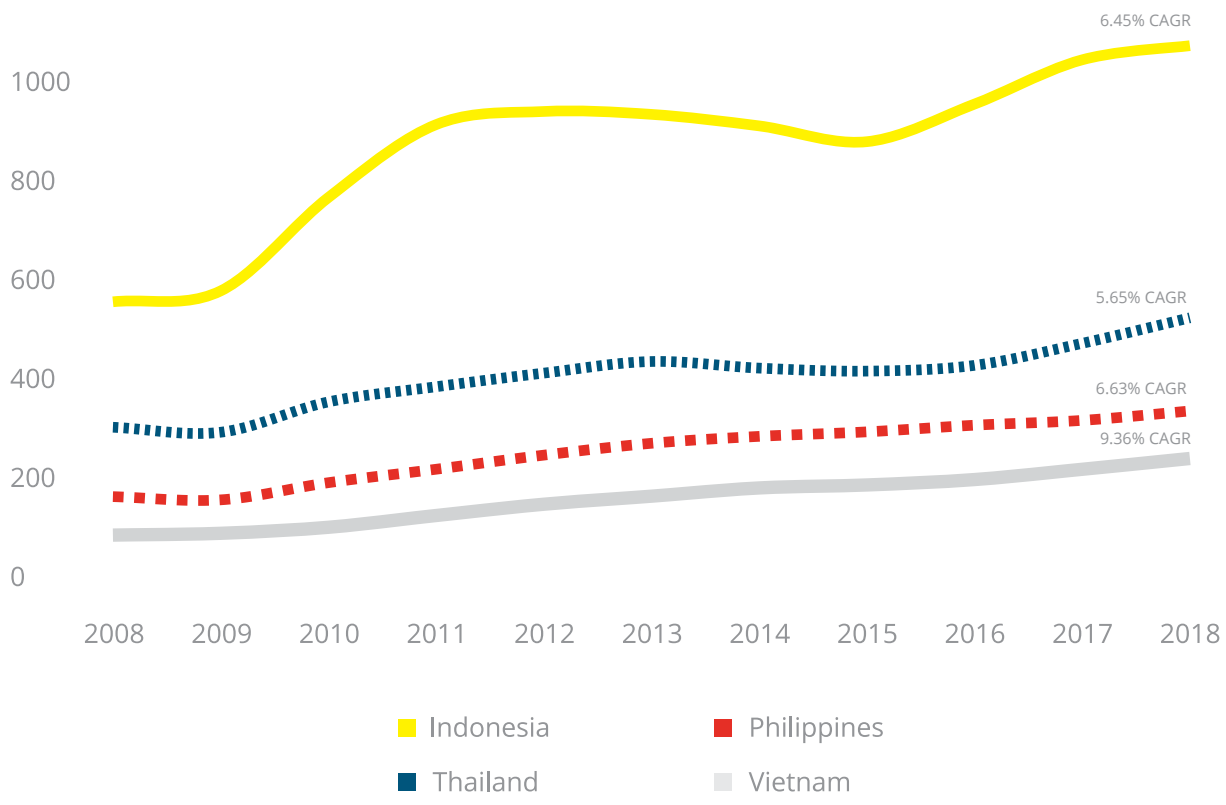
Southeast Asian context

Indonesia, the Philippines, Thailand and Vietnam are among the fastest growing economies in the world today (Figure 2), with an average compounded annual growth rate of Gross Domestic Product (GDP) of 6.45 percent, 6.63 percent, 5.65 percent, and 9.36 percent respectively (Figure 2). These economies have presented a low-cost base for industries and have seen tremendous growth in their manufacturing, construction, agriculture and fishing services sectors, among others. Consumer demand for disposable products and general use of plastic goods have also seen steady growth, particularly in lower- and middle-income households, as average incomes have increased. As these countries continue to develop, the use of plastic will also steadily increase.[19] Without sufficient infrastructure to manage and mitigate waste, these trends will undoubtedly lead to even higher levels of plastic waste pollution in these countries.

FIGURE 2

NOMINAL GDP FROM 2008-2018

(USD bn)



Sources: Indonesia: Badan Pusat Statistik; the Philippines: IMF, International Financial Statistics; Vietnam: from Vietcombank and IMF, International Financial Statistics; Thailand: National Economic and Social Development Board; IMF, International Financial Statistic

19. Plastics News. 2016. Worldwide plastics industry: ASEAN countries rediscover their strengths

BACKGROUND, POLICIES AND CHALLENGES

In this chapter, the situational context, policy framework and bottlenecks in addressing marine plastic pollution in each of the focus countries will be reviewed in alphabetical order.

Indonesia

Situational context

Indonesia is a marine-rich and diverse country, spanning three biogeographic regions with vast mangrove forests and seagrass meadows. The country is also one of the six countries that make up the coral triangle, which is home to 76 percent of reef-building coral species. The country is, however, grappling with severe coastal degradation, water pollution and over-exploitation of its marine species. Four of Indonesia's rivers (Brantas, Soo, Serayu and Progo) rank among the 20 most polluted rivers (in MMT) in the world, which makes it the second largest marine plastic polluter globally, after China.[20]

Approximately 85,000 tons of plastic waste is generated in Indonesia every day.[21] These startling numbers can largely be attributed to poor infrastructure, economic and population boom, lack of education and knowledge about recycling, and poor execution of policies. If left unchecked, these numbers are expected to increase to 150,000 tons per day by 2025.[22] The consequences of mismanagement will only continue to snowball, resulting in dramatic and longstanding damage to the country's ecosystem and human health. Therefore, Indonesia needs to prepare for this considerable increase in plastic production by developing preemptive solutions that can simultaneously manage current waste management needs and mitigate future burdens on both existing infrastructure and ecology.

Policy framework

In June 2017, Indonesia launched the 'National Action Plan on Marine Debris', which outlined strategies and plans aimed at reducing marine plastic debris on land, in coastal areas and in seas. The plan aims to streamline efforts to collect and dispose of solid waste properly and highlight how improving municipal solid waste (MSW) in coastal areas could reduce plastics leakage to the ocean by almost 80 percent.

The Indonesian government also pledged to reduce marine debris by 70 percent by 2025, made in conjunction with 100 percent urban collection targets on land.[23,24] In line with this, the government proposed to contribute to the development of bio-plastic industries by levying a tax on plastic bags, conducting public awareness campaigns and developing roads with waste scraps.[25] The government also began engaging with manufacturing industries with fast-moving consumer goods and retailers to reduce plastic waste from their products and services by redesigning their product packaging and encouraging the use of recyclable materials.[26]

Included within the action plan was a National Solid Waste Management programme, financed by national resources and complemented by

20. Lebreton et al. 2017. River plastic emissions to the world's oceans, Nature Communications
21. Shuker, I. G., Cadman, C. A. 2018. Indonesia marine debris hotspot, rapid assessment synthesis report
22. Ibid
23. Ibid
24. Villarrubia-Gomez, P. Cornell S. and Fabres, J. 2018. Marine plastic pollution as a planetary boundary threat – The drifting piece in the sustainability puzzle
25. Shuker, I. G., Cadman, C. A. 2018. Indonesia Marine Debris hotspot, Rapid Assessment Synthesis Report
26. The Borgen Project. 2018. The new road material reducing plastic pollution in Indonesia

World Bank funding, developed around four main pillars:

- Reduce land-based waste leakage
- Reduce sea-based leakage of solid waste and other pollutants
- Reduce accumulated coastal and marine pollution
- Reduce plastics production and use

USD 1 billion was committed by the government from 2017 – 2022 towards building proper waste management facilities.[27] Private companies were engaged to develop advanced waste treatment plants with the latest technologies to divert waste from landfills in selected regions across the archipelago to ensure that (i) organic waste is treated to reduce greenhouse gas emissions and (ii) recyclable waste is reintegrated into the production cycle. The government took a USD 100 million loan[28] from the World Bank towards supporting the national programme to reform waste management practices for around 70 participating cities, impacting around 50 million of its 264 million-strong people.[29]

Bottlenecks

Despite the initiatives undertaken, one year on, numerous leakages persist.[30] Drainage channels from residential areas are still connected to the flow of the rivers or canals and plastic continues to leak through the riverbanks. There is also lack of industrial and hazardous waste handling and dearth of treatment facilities. While the country has set up treatment and disposal facilities, almost all of its hazardous waste (generated by industrial sector) is disposed untreated.[31]

The prevalence of informal waste management collection and recycling systems is another challenge. As this system has worked for centuries and has provided waste pickers a parallel livelihood stream, efforts to educate or formalise the collection channels are often met with opposition from communities that are unwilling to jeopardise their source of livelihood. In 2016, the government attempted to introduce a minimal USD 4 cents tax on single-use plastic bags but even this was disputed by retailers' associations and was further reduced to a negligible USD 2 cents.[32]

The Philippines

Situational context

The Philippines is a biodiverse archipelago comprising 599 cities spread across 7,641 islands.[33] In 2015, its population was more than 100 million people. Its annual waste generation was projected to increase to 16.63 mt by 2020 from 13.48 mt in 2010.[34] The Pasig River alone dumps about 63,700 tons of plastic into the Pacific Ocean every year.[35]

The country has a promising waste management collection system in place. 85 percent of waste is collected through proper channels, with urban waste collection in Manila as high as 90 percent. Even rural areas have a waste collection of 40 percent.[36] Despite these efforts, it is still the third largest marine polluter in the world after China and Indonesia. 74 percent of plastic that leaks into the oceans is from waste that has already been collected and is sitting in collection areas (See Figure 3 on page 16).[37]

The reasons highlighted for the mismanagement of waste include corruption at the lowest levels

27. Ibid
28. Shuker, I. G., Cadman, C. A. 2018. Indonesia Marine Debris hotspot, Rapid Assessment Synthesis Report
29. The World Bank. 2019. Brief: Solid Waste Management
30. Shuker, I. G., Cadman, C. A. 2018. Indonesia Marine Debris hotspot, Rapid Assessment Synthesis Report
31. UNEP. 2017. Waste Management in ASEAN Countries
32. Jakarta Post. 2016. Minimum plastic bag tax set at negligible Rp 200
33. Sapuay, G.P. 2018. Sustainable Solid Waste Management and Sustainable Development in the Philippines. Proceedings of the International Conference in Urban and Regional Planning
34. Ibid
35. Garcia, A. 2018. Plastics Are Everywhere, and Hurt Marine Life. Save The Water
36. McKinsey Center for Business and Environment & Ocean Conservancy. 2015. Stemming the tide: Land-based strategies for a plastic - free ocean
37. Ranada, P. 2015. Why PH is world's 3rd biggest dumper of plastics in the ocean

FIGURE 3

PLASTIC COLLECTION, LEAKAGE AND DISPOSAL IN THE PHILIPPINES

Source: Expert interviews; field visits; Roland Geyer et al., "Plastic waste inputs from land into the ocean." Science. February 13, 2015,sciencemag.org; National solid waste management commission (Philippines); World Bank Group;

and lack of enforcement, illegal dumping of garbage and poor management by collection companies, open dumping sites which are sometimes near rivers or coastlines, and lack of funding for sanitary landfills.

Policy framework

A number of environmental laws such as the Republic Act 6969 or the Toxic Substances and Hazardous and Nuclear Waste Control Act of 1990 are in place to address the issue of solid waste management across the Philippines. The Republic Act 9003, also known as RA 9003 or the Ecological Solid Waste Management Act, requires local governments to form their own local ten year plan for waste management (i.e. minimising source reduction, reuse, recycle, resource recovery at barangay[38] level, effective collection, transportation and disposal and tackling the environmental challenges).[39] It also mandates that all open dumpsites must be converted into sanitary landfills by 2004. The Philippine Clean Air Act and Ecological Solid Waste Management Act also ban waste incineration.[40]

The Philippines National Action Plan of 2017-2019 has a unique feature of including subnational commitments by local governments. Since its implementation, many local governments in the Philippines have gradually moved towards banning the use of plastic bags. The first local government to ban plastic bags was Muntinlupa City in Metro Manila in 2011. The city has been plastic-free since and has kept in place stringent rules and fines to maintain this status. Since 2011, around 1,400 establishments have been issued tickets and seven have faced closure of their businesses on the basis of having committed violations at least four times in Muntinlupa City.

Even though many other cities have put a ban on single-use plastics, there is a need for more ambitious policies that could positively drive community and local political behaviours.[41]

Bottlenecks

Challenges to implementing the national law on ecological solid waste management stem from the lack of proper technology, under-developed financial markets and legal systems, insufficient budget and the lack of expertise and awareness. Recycling infrastructure is dated and requires upgrading as well as linkage to upstream waste supplies. The country also lacks space for treatment and disposal of garbage as most of the land is titled to private entities.[42] There is also an absence of sanitary landfills and infrastructure stemming from an overall lack of advanced technological waste management systems.

After over a decade since the RA 9003 law came into existence, the level of compliance by local government units continues to vary significantly. In some cases, local governments have been able to set up exemplary waste management systems, while in others, there is an abject lack thereof. It is estimated that only 24 percent of Materials Recovery Facilities that are mandated by the barangays are functional. While it is illegal to have open dumping sites in the Philippines under the Ecological Solid Waste Management Act of 2000, there are still only 70 sanitary landfills vis-a-vis 600 open dumping grounds.[43] There is also a lack of MSW segregation at the primary level (household) and the secondary level (transfer station). Mixed discarding of recyclable materials along with non-recyclable waste products pose challenges in collection and properly utilising recyclable materials.[44]

38. A barangay is the smallest administrative division in the Philippines and is the native Filipino term for a village, district or ward. This unit of administration usually consists of a cluster of families under a headman.
39. The Philippine Congress. 2001. Implementing Rules and Regulations of Republic Act 9003
40. UNEP. 2017. Waste Management in ASEAN Countries
41. Calleja, N. 2012. Muntinlupa mulls stiffer penalties for plastic ban violators, tax breaks for followers
42. UNEP. 2017. Waste Management in ASEAN Countries
43. McKinsey Center for Business and Environment & Ocean Conservancy. 2015. Stemming the tide: Land-based strategies for a plastic - free ocean
44. UNEP. 2017. Waste Management in ASEAN Countries

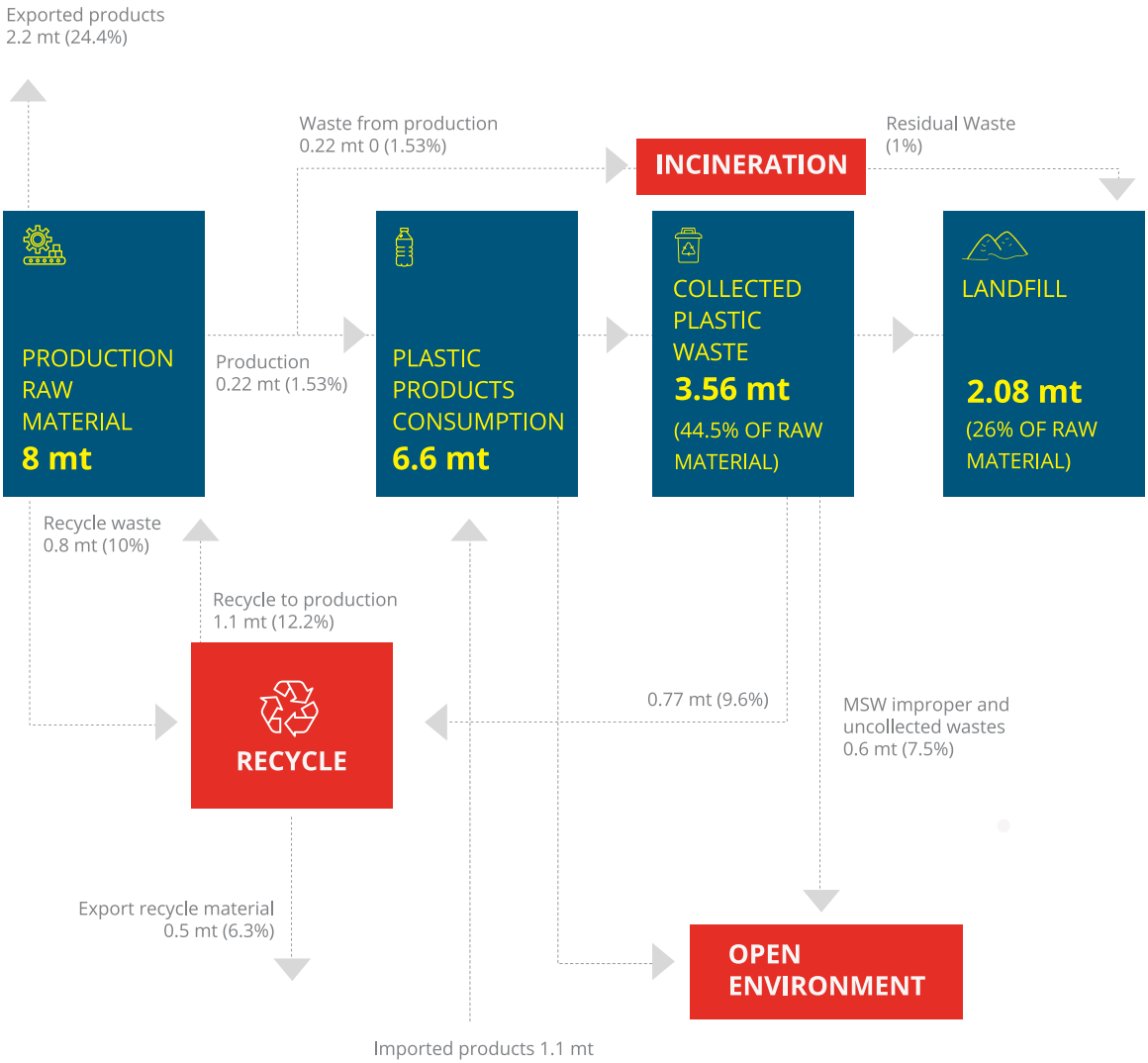
Thailand

Situational context

Thailand is spread across 510,890 sq. km of land and 2,230 sq. km of water, with a population density of 131 people per kilometre.[45] It is the fifth largest contributor worldwide for dumping plastic into the seas,[46] most of which is single-use plastic. Its overall waste sector accounted for 11.43 million tonnes of carbon dioxide equivalent (tC02eq) or 3.74 percent of its carbon emissions in 2011.[47] It is also the largest plastic manufacturer and contributor, with a plastic pellet and resin production capacity of 6.094 MT in 2015.[48] Of the country's total waste, plastic accounts for 12 percent (~2 mt) annually.[49]

FIGURE 4

MATERIAL FLOW ANALYSIS OF PLASTIC WASTE IN THAILAND IN 2013



Source: Wichai-utcha and Chavalparit. 2019. 3Rs Policy and plastic waste management in Thailand

45. CIA World Factbook. 2019. East Asia/Southeast Asia: Thailand
46. McKinsey Center for Business and Environment & Ocean Conservancy. 2015. Stemming the tide: Land-based strategies for a plastic - free ocean
47. Wichai-utcha, N., Chavalparit, O. 2019. 3Rs Policy and plastic waste management in Thailand
48. Ibid.
49. Ibid.

According to the Department of Environmental Quality Promotion, on average, each Thai uses about eight plastic bags per day, equivalent to approximately 500 million plastic bags in a year for the whole nation.[50] Figure 4 on page 18 explains the material flow analysis of plastic in Thailand in 2013.[51] That year, Thailand generated approximately 6.6 million tons (mt) of plastic waste, of which around 3.56 mt was collected and transferred to disposal sites by the local government. Only 0.77 mt of the total was recycled by local government and independent merchandisers, accounting for merely 11.5 percent of total plastic waste generated. The remainder was sent to landfills.[52]

Several factors account for low collection coverage such as the lack of waste collection infrastructure, inadequate knowledge of local government staff and communities on waste management, lack of funds, inadequate collection services, illegal waste dumping, open burning and lack of effective treatment. These ultimately lead to not only water pollution, but also land, air and visual pollution.

Policy framework

Thailand introduced the National 3R Strategy and the National Master Plan for Waste Management (2016–2021) to ensure proper solid waste management. It also established the Plastic Debris Management Plan 2017–2021,[53] that includes options such as eco-friendly packaging and alternatives, development of the material flow for plastic products, implementation strategy for 3Rs for plastic debris management and building awareness among the stakeholders in the field of plastics and alternatives. Recently, it launched the Roadmap on Plastic Waste Management 2018-2030, which will be used as a policy framework to deal with the plastic waste challenge in Thailand. The objective of this roadmap is to reduce, and ultimately stop the use of plastic (such as bottle caps, oxo-degradable plastics, and plastic microbeads) and replace it with environmentally friendly materials. The goal is to make plastic waste 100 percent reusable by 2027, therefore encouraging a circular economy.[54]

Several other interventions are taking place as part of Thailand's endeavour to fight plastic pollution. As part of an agreement between traders and the government, one day in a month (on the 4th or 15th of every month), shoppers are not given any plastic bags at supermarkets, convenience stores or large malls to encourage them to bring their own reusable bags. The Tourism Authority of Thailand introduced the 'Travel Thailand in Style, Reduce Plastic Waste' strategy in 2018 in collaboration with various stakeholders to address tourism-related waste and reduce it by up to 50 percent by 2020.[55]

The Thai government has also established subsidies and tax incentives for various waste-to-energy (WTE) plants. The current installed capacity stands at 203 megawatts (MW), and is likely go up to 500 MW in the next Power Development Plan for 2018-37.[56]

Bottlenecks

In Thailand, plastic pollution is a relatively new challenge as the existing waste management infrastructure is struggling to keep up with the growing amount of plastic waste. One of the many reasons is rapid economic growth. This, coupled with changing consumer preferences and lack of awareness, leads to increased use of

50. Maierbrugger, A. 2019. Finally, Thailand starts to manage is plastic junk problem
51. A more updated material flow analysis is being published by Pollution Control Department, however at the time of writing this report, this resource was not yet available to the public
52. Wichai-utcha, N., Chavalparit, O. 2019. 3Rs Policy and plastic waste management in Thailand
53. Ibid.
54. Ibid.
55. TAT News. 2018. TAT works with Stock Exchange of Thailand to promote sustainable tourism
56. Weatherby, C. 2019. Waste-to-energy: A renewable opportunity for Southeast Asia? Eco-business, China dialogue

plastic-intensive goods, including plastic bags, straws, packaging and other such applications. Most consumers are not aware of the ill impacts of plastic or how to recycle. At-source separation of waste is minimal and while this is changing in some parts of the country, the scale and level of success are still unknown.

Overall, financial and technical support in plastic waste management are insufficient. Investment in modern recycling facilities will require private sector participation. However, many challenges exist in coordinating multi-stakeholder cooperation. For instance, public-private partnership projects that exceed more than THB 5,000 million (USD 164 million) must comply with the Public-Private Partnership Act, which is procedural and cumbersome to follow.[57] Waste management[58] is also heavily dependent on informal waste pickers. These channels can be useful however, with appropriate policy frameworks to formalise waste management services and encourage private sector participation.

Vietnam

Situational context

Vietnam has a coast of over 3,260 km with an exclusive economic zone exceeding 1 million sq.km across 3,000 islands. It is also the fourth largest marine plastic polluter in the world.[59] More than 100 rivers leak into approximately 80 cubic kms of water depositing large amounts of pollutants into the oceans.[60] The volume of plastic waste from Vietnam to the East Sea ranges from 0.28-0.73 MT per year, equivalent to 6 percent of the total plastic waste going into the oceans globally.[61]

Vietnam generates more than 27.8 MT of waste annually 80 percent of which is still being buried in landfills and the remaining either composted or burnt. In 2017, only 120 of more than 450 landfills in the country were following proper sanitary regulations.[62]

Marine pollution will likely culminate in the rapid degradation of marine biodiversity. At particular risk are the coral reefs which cover about 1,122 sq. km of seabed off Vietnam's coast.[63] It is estimated that more than 50 tonnes of coral disappear every year and that, at this rate, one will not be able to see any coral in Vietnam's offshore waters in the next 20 years.[64]

The main reasons identified for the excessive marine pollution in Vietnam are unplanned industrial development, tourism and aquaculture, lack of recycling policies, population growth and poor public awareness.

Policy framework

Waste management is one of seven priority programmes within the National Strategy for Environmental Protection in Vietnam. The strategy has set ambitious targets to tackle solid waste mismanagement by 2025. According to a report by Duane Morris LLP, The Ministry of Natural Resources and Environment has established targets for the collection, reduction, reusing and recycling of waste across the country.[65] For example, by 2020, the country aims to collect and treat 90 percent of urban domestic solid waste, with 85 percent being recycled and reused.[66] The plan also focuses on levying sanitary fees from waste generators and those causing pollution.

57. UNEP. 2017. Waste Management in ASEAN Countries
58. Yukalang, N., Clarke, B. and Ross, K. 2018. Solid Waste Management Solutions for a Rapidly Urbanizing Area in Thailand: Recommendations Based on Stakeholder Input
59. Vietnamnet. 2016. Marine pollution at alarming rate off Vietnam's coast
60. Ibid.
61. Jambeck et al. 2015. Plastic waste inputs from land into the ocean
62. U.S. Embassies Abroad, 2017. Vietnam - Environmental and Pollution Control Equipment and Services
63. Vietnamnet. 2016. Marine pollution at alarming rate off Vietnam's coast
64. Ibid.
65. Cooper, G. 2017. Vietnam's waste-to-energy projects should be low hanging fruit. Blog Vietnam
66. Ibid.

Vietnam's (amended) constitution of 1992 recognises the role of the private sector in the economy and therefore encourages private sector and foreign investment into the country for waste management. Financial support for environmental protection activities (including reducing, reusing and recycling activities) are so far planned through the Vietnam Environment Protection Fund.

By 2025, the government aims to develop solid waste recycling plants in all cities for household-based waste. In addition, all solid waste generated in urban areas, including toxic and non-toxic industrial solid waste, will be collected and treated. There are also plans for 90 percent of construction solid waste and rural residential solid waste to be collected and treated.[67]

In the past, many WTE companies showed concern over the lack of favourable investment conditions and government incentives for foreign investors. This issue was addressed with the 2015 Public-Private Partnership Decree, which regulates PPP transactions and displays strong political will and credibility to give investors and financiers confidence.[68] Subsequently, in 2017, Hanoi set up its first industrial WTE plant, supplying electricity to the national grid. With a capacity to treat 75 tonnes of waste per day and generate 1.93 MW of electricity, the facility is a pioneering project in Vietnam's industrial waste treatment industry. In addition, many Japanese, Australian and Finnish companies have invested in WTE projects in the country. The Asian Development Bank has also signed a USD 100 million loan facility agreement with China Everbright International Limited to construct a series of municipal WTE plants in the Mekong Delta region.[69]

Bottlenecks

Despite the national legal framework for solid waste management, there is a lack of clarity on responsibilities among various authorities and implementing agencies. This has led to overlapping authority, lack of accountability and poor implementation of national strategies.

Unplanned industry development has been highlighted as the biggest challenge in waste management and implementation in the country. Almost 70-80 percent of waste leakage into the oceans originates from the mainland, which is the hub for many factories and residential areas that release untreated water and solid waste into the sea directly.[70] Irresponsible tourism and aquaculture releases thousands of tonnes of waste into the sea every day. For instance, as of 2017, Vietnam has over 670,000 hectares (ha) of shrimp farms that are responsible for dumping more than 3 MT of solid waste every year.[71]

The lack of advanced recycling technologies and infrastructure in the country is another challenge. For example, Ho Chi Minh City lacks advanced recycling technologies and depends mostly on sanitary landfills and composting. The high organic fraction of MSW creates problems for large-scale mechanical separation and mixed waste composting. Since most recycling facilities are small businesses, investment in recycling technology may not be affordable and this may lead to a low volume of recycled products.[72]

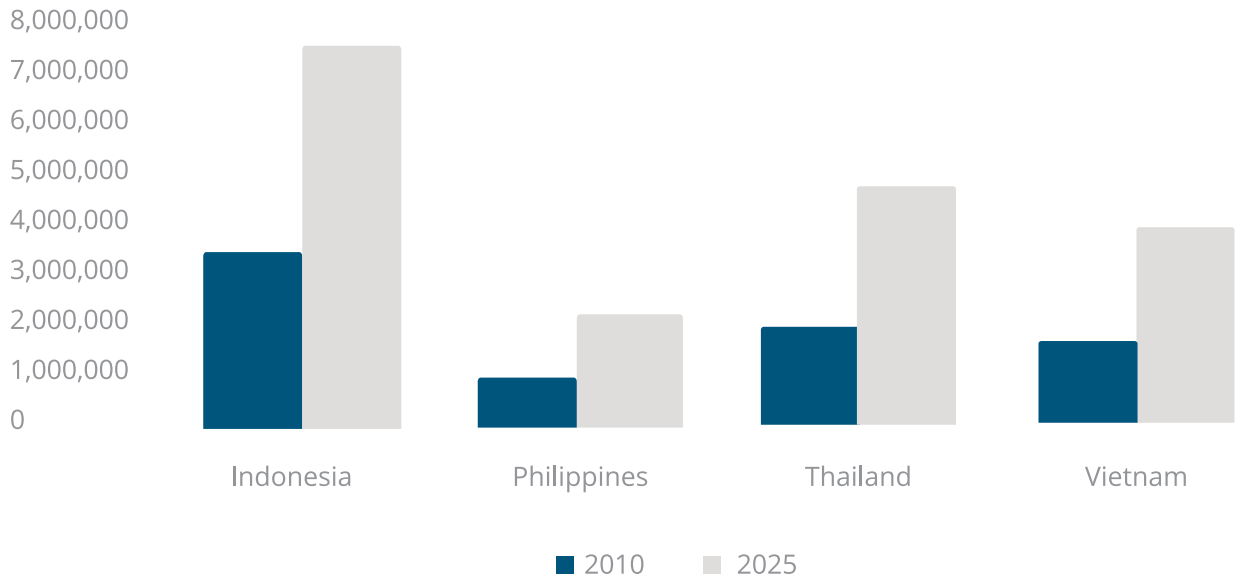
67. Ibid.
68. U.S. Embassies Abroad. 2017. Vietnam - Environmental and Pollution Control Equipment and Services
69. Vietnamnet. 2018. ADB supports waste-to-energy plants in Vietnam
70. California Environmental Associates. 2018. Shrimp Acquaculture in Vietnam
71. World Bank Group. 2017. An Overview of Agricultural Pollution in Vietnam: The Aquaculture Sector
72. Verma, R.L., Borongan, G. and Memon, M. 2016. Municipal solid waste management in Ho Chi Minh City, Vietnam, current practices and future recommendation

LANDSCAPE ANALYSIS IN THE CONTEXT OF MARINE PLASTIC POLLUTION

FIGURE 5

PROJECTED MISMANAGED PLASTIC WASTE

(KILOTONNES)



Data Source: Jambeck et al. 2015. Plastic waste inputs from land into the ocean

The estimated quantum of mismanaged plastic waste in our four focus countries is projected to more than double from 2010 levels by 2025 (see Figure 5). From the data collected by Jambeck and colleagues, we assessed that the amount of mismanaged waste will grow at a compounded rate of 5 percent in Thailand, 6 percent in Indonesia and Vietnam, and 7 percent in the Philippines if no timely action is taken.[73]

These four countries are within the bottom quartile in every aspect of overall waste management, such as waste generation, plastic waste generation, inadequately managed plastic waste and mismanaged plastic waste overall (see Table 2 on the next page). The main focus in most of these countries is on improving solid waste collection and management. However, improving waste management infrastructure requires substantial investments, which, in the case of low- and middle-income countries, is a challenge.

McKinsey Centre for Business and Environment and Ocean Conservancy estimates that in order to reduce plastic waste leakage by about 23

73. Jambeck et al. 2015. Plastic waste inputs from land into the ocean

percent, the collection rates need to increase to about 80 percent within these countries, as well as in China. If achieved, this could save these countries approximately USD 5 billion annually (based on a ten-year average).[74]

TABLE 2

MISMANAGED PLASTIC ANALYSIS FOR INDONESIA, THE PHILIPPINES, THAILAND AND VIETNAM[75]

	 INDONESIA	 THE PHILIPPINES	 THAILAND	 VIETNAM
Mismanaged plastic waste in 2010 (tonnes)	3,216,856	1,883,659	1,027,739	1,833,819
Mismanaged plastic waste in 2025 (tonnes)	7,415,202	5,088,394	2,179,508	4,172,828
Simple growth rate of mismanaged plastic waste 2015-2025 (%)	231%	270%	212%	228%
Compounded growth rate of mismanaged plastic waste 2015-2025 (tonnes)	6%	7%	5%	6%
Waste generation [kg/day]	Quartile 4	Quartile 4	Quartile 4	Quartile 4
Plastic waste generation [kg/day]	Quartile 4	Quartile 4	Quartile 4	Quartile 4
Inadequately managed plastic waste [kg/day]	Quartile 4	Quartile 4	Quartile 4	Quartile 4
Plastic waste littered [kg/day]	Quartile 4	Quartile 4	Quartile 4	Quartile 4
Mismanaged plastic waste [kg/person/day]	Quartile 3	Quartile 3	Quartile 4	Quartile 4
Mismanaged plastic waste in 2010 (tonnes)	Quartile 4	Quartile 4	Quartile 4	Quartile 4
Coastal population	Quartile 4	Quartile 4	Quartile 4	Quartile 4

Source: Data adopted from Jambeck et al. 2015. Plastic waste inputs from land into the ocean and AVPN analysis

74. McKinsey Center for Business and Environment & Ocean Conservancy. 2015. Stemming the tide: Land-based strategies for a plastic - free ocean

75. 4th Quartile reflects that these four countries are among the worst (bottom quartile) in every aspect of overall waste management such as waste generation, plastic waste generation, inadequately managed plastic waste and mismanaged plastic waste

Common challenges of addressing waste management and marine plastic pollution

As highlighted earlier, all four countries face a number of challenges in dealing with marine plastics. While the manifestations and countervailing actions may be numerous, we do also see commonalities in these challenges. Some of these are described below.

Policy execution

While national policies, strategies, programmes and projects are in place, execution and enforcement are inadequate at all government levels. Waste management policies tend to be developed at the national level; however, there is a lack of coordination among various institutions and stakeholders downstream. There is either overlapping of responsibilities and/or a lack of knowledge on policies at local, provincial, and municipal level that result in mismanagement. It is rare to see large waste management companies investing in the region and even when they do, services are not coordinated, leading to staggered and inconsistent outcomes.

Lack of segregation and awareness

The challenge of marine litter is part of a more systemic waste management issue which has become an environmental and public health hazard across Southeast Asia. Open dumping and burning of waste are prevalent in majority of these countries. There has been a lack of environmental education and awareness to adopt sustainable consumption and at source segregation practices in the region. Along with the increased volume and poor awareness, these countries have had to grapple with complex waste composition due to emerging waste streams, such as technology and e-waste. In most cases, segregation between industrial waste and household waste is absent since the waste collection and processing agencies are the same. Contamination occurs as all waste is collected and dumped in the same landfill.

Informal economy

Composting of organic waste and recovery of valuable recyclables such as plastic, metals and paper are mostly managed through the informal sector i.e. (i) waste pickers who collect recyclable plastics and other materials, and (ii) waste collectors who buy recyclable waste. While these practices have worked for many decades in providing livelihoods for waste pickers, they have also been a deterrent for big recycling businesses to venture into the region. Many businesses have been making efforts to find synergies between waste management methods (such as mechanical recycling and WTE) and marine plastic pollution, but navigation through the informal waste management system can be challenging. Efforts to integrate and educate consumers about commercial-scale waste management system are often met with opposition. The most effective solution for most of these countries therefore may be to formalise the already existing informal waste management systems through training and social empowerment programmes.[76]

Availability of waste feedstock

A key challenge in developing a strong recycling business in Southeast Asia is the availability of waste feedstock. Governments (e.g. in Indonesia and Thailand) offer subsidies and tax incentives for various WTE plants, but a lack of waste sorting means the industry struggles to establish a constant supply of recyclable waste. The organic content in the recyclable waste also means that incineration plants are unable to reach the high temperatures necessary

76. UNEP. 2017. Waste Management in ASEAN Countries

to produce electricity while avoiding toxic emissions and ash by-products. This has led to backlash from communities over pollution and health concerns. Additionally, while Europe levies gate fees, recyclers in Asia often have to pay a high price for waste feedstock. This is a barrier that will prevent recycling businesses from establishing a viable commercial model and will need to be addressed through policy change.[77]

Limited data and Information

Most of these countries have limited data and information on waste inventory, particularly for industrial and hazardous waste. There is also no publicly accessible regional comparative data to access the urban-rural outreach of waste management and collection services in these countries. Capacity monitoring agencies are largely absent in the region. Most hazardous waste is collected and transported together with non-hazardous waste to the landfill, instead of being separated at source. Rigorous longitudinal data on plastic waste pollution is sparse globally, and the few data sources available draw on figures from 2013-2015. It is critical to have up-to-date data to access the severity of the challenge in hand, develop appropriate policies and adopt proper interventions (for example technological or infrastructural development). In recognition of this issue, the World Business Council for Sustainable Development has initiated an open source, science-based global information project which aims to provide reliable data, metrics, standards, and methodologies on waste management to assist governments, private investors and organisations to accelerate interventions to stop plastic waste from entering the environment. However, at the time of writing, this resource was not yet available to the public.

Reflection on these challenges suggests that these are often the symptoms more than the problem. Challenges around execution and segregation often indicate either underlying process failure and/or behavioural limitations. Similarly, economic and availability challenges speak to, among others, questions of technology i.e. which technology can either improve economics of recycling, enable a circular economy for plastic waste or improve availability (feedstock) for any such action. Finally, the information challenge talks to the limits around data. The links between the challenges highlighted above and the underlying issues (e.g. process, behaviour, technology and data) are important to note because they help us discern where most of the effort is being directed through the initiatives we review later in Chapter 4.

77. Ibid.

The imported waste challenge

For decades, China has imported nearly half (45.1 percent cumulatively between 1988-2016) of the world's plastic waste and scraps.[78] However, in early 2018, it issued a National Sword Policy[79] regulating its import polices which mandates a complete ban on 24 types of waste material and a contamination limit of 0.5 percent on all imports.[80]

In the lead up to this announcement, many exporter countries were already exploring alternative destinations within Asia for their waste, such as India, Thailand and Vietnam. Between 2016 and 2017, Vietnam and Thailand saw a 105 and 400 percent increase respectively in plastic scrap from US exports alone. By 2018, Thailand was importing 2000 percent more polyethylene (PE) than it was in 2016 (91,505 metric tonnes vs 1,041 metric tonnes).[81] Vietnam showed a growth of 137 percent in its polyvinyl chloride (PVC) and polyethylene terephthalate (PET) imports in 2017 from 2016.[82] In the Philippines, the imports quadrupled to more than 1,000 tonnes in 2018, and then rose steeply to around 5,500 tonnes in the quarter after that.[83]

Policies on waste import bans

From the policy perspective, the four focus countries have responded to the shift in the global plastic waste trade by re-regulating their import policies. In April 2019, the Indonesian government issued a policy of 100 percent inspection at the materials' point of origin for recovered fiber exports.[84] The Philippines recently announced plans to return waste from Western countries that had improper labelling and has already returned waste to South Korea.[85] Vietnam has prohibited the issuance of new licenses for waste imports so as to address the number of new containers of plastic, paper, and metal scrap crowding its ports. It has also placed new regulations on plastic imports to allow only plastic scrap with less than two percent impurity or 'clean' plastic. Thailand, on the other hand, has introduced a temporary prohibition on plastic and e-waste imports in response to China's solid waste import ban.

While political commitments are being made, challenges around the lack of clarity, guidelines and poor implementation within the countries remain. In Vietnam, for example the definition of 'clean' plastic or impurities is unclear, making imports difficult.[86] Despite the government's plans, only 10 percent of incoming scrap loads are inspected before shipment to Indonesia.[87] Due to some recently-granted import licenses valid until 2021, Thailand's plans to ban plastic waste completely will be executed in 2021.[88]

78. Alliance of Zero Waste Indonesia. 2019. Export and import of plastic waste situation in Indonesia: Implications of National Sword China Policy
79. Zsombor, P. 2019. ASEAN Urged to adopt full ban on plastic waste imports
80. Dickinson, K. 2018. Thailand halts plastic and e-waste imports
81. Zein, Z. 2018. Thailand to ban plastic waste imports by 2021
82. Boteler, C. 2018. ISRI: Overall scrap exports up in 2017, despite China disrupting paper, plastic
83. Zsombor, P. 2019. ASEAN Urged to adopt full ban on plastic waste imports
84. Pyzyk, K. 2019. Indonesian government delays tight fiber inspection policies
85. Marks, D. 2019. Southeast Asia's plastic problem - East Asia forum
86. Das, K. 2018. Vietnam to Restrict Surging Scrap Imports
87. Recycling Today. 2019. Updated: Indonesia postpones tightening of scrap paper inspections
88. Financial Times. 2018. Thailand to ban foreign plastic waste from 2021

Illegal waste

Another challenge is that a lot of waste enters these countries illegally. For example, an environmental audit in Indonesia found that almost one-third of waste imported into East Java labeled as paper scraps was illegal scrap plastic.[89] Exports and imports are generally agreed between businesses; however, there are some companies with irresponsible and illegal practices selling their imported plastic waste and scrap to collectors outside of their factories.[90] With the existing poor recycling rates and waste management practices, the four focus countries are already struggling to deal with the burgeoning volumes of domestic plastic waste, let alone the plastic waste that is being dumped through imports.

89. Marks, D. 2019. Southeast Asia's plastic problem - East Asia forum
90. Alliance of Zero Waste Indonesia. 2019. Export and import of plastic waste situation in Indonesia: Implications of National Sword China Policy

Table 3 provides a SWOT analysis of the overall waste management systems based on the preceding review of policy frameworks and implementation challenges of the waste management systems in the four focus countries, bearing in mind the commonalities related to marine plastics. As can be seen, the challenges in this space are very much tactical and about plugging the right gaps in execution. Significant opportunities exist to structurally alter the landscape in this space.

TABLE 3

SWOT ANALYSIS OF WASTE MANAGEMENT SYSTEMS ACROSS FOCUS MARKETS

INTERNAL FACTORS	EXTERNAL FACTORS
STRENGTHS	**THREATS**
• Willingness of government, donors and the private sector to invest in this issue and overall waste management • Availability of strong and economical human capital • Existence of detailed policy frameworks	• Escalating economic growth and increased consumption patterns within the region • Increased industrial growth and therefore increased production of plastic goods and consumption • Unstable plastic waste and scrap import policies
WEAKNESSES	**OPPORTUNITIES**
• Poor execution of policies and legal frameworks • Lack of public sector financial funds to support implementation • Dominance of informal waste pickers who collect and sell recyclable waste • Inadequate training of local government staff and poor knowledge of proper waste management operations • Lack of access to leading technology solutions for processing, disposal and/or recycling final stage plastic	• Appetite of private investors • Informal waste management systems can be formalised • Government willingness to implement proper waste management systems • Better engagement of private sectors by changing economic structures and policies. • High fraction of organic waste and increasing plastic waste suggests opportunities for converting waste to energy or waste to compost

Source: AVPN analysis

CHAPTER 4

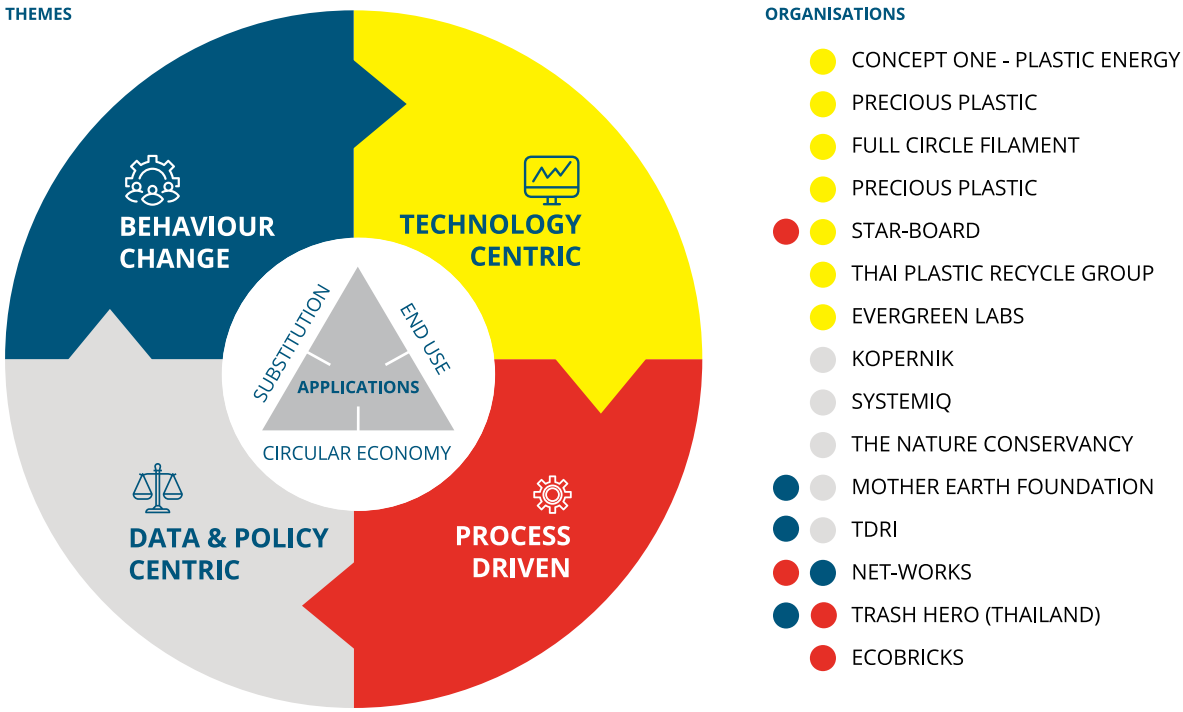
OPPORTUNITIES FOR INVESTMENT TO REDUCE PLASTIC WASTE

Various collection and end-use efforts are being made across Indonesia, the Philippines, Thailand and Vietnam to reduce plastic waste pollution. Based on an initial scoping exercise leveraging AVPN's network, there are several initiatives in place throughout the value chain.

As seen in Figure 6, the landscape of organisations and actions can be broadly categorized into two dimensions: (i) theme, or the primary point of solution development i.e. technology, process, data and policy, and behaviour; and (ii) application, or the nature of solution i.e. where in the plastics value chain the solution is being directed. Figure 7 on page 32 presents a schematic of the plastics value chain.

FIGURE 6

MARINE PLASTICS REDUCTION SOLUTION CANVAS



Source: AVPN Analysis

Theme

On the first dimension, we see organisations typically pick one or two of the following themes:

technology centric: development and deployment of a specialist technology;

process driven: changing an existing part of the process (e.g. source sorting);

data or policy centric: policy actions and research; or

behaviour centric: stakeholder behaviour change, and then construct other elements around it. To highlight the differences between themes and how they shape the investment opportunities, below is a non-exhaustive list of illustrations for each theme.

Technology centric

Technological advancement is an important lever which will help address the issue of growing marine plastics pollution globally. Finding effective and innovative ways to recycle and reuse plastic has been a challenge due to long testing periods and the accompanying cost implications. Full Circle Filament is working to help close the plastic waste loop by blending recycled PET from water bottles with polycarbonate to create a 3D printing filament to produce prosthetics, orthotics and replacement parts. Precious Plastics, a Netherlands-based global network, on the other hand, provides the tools and knowledge solutions to combat plastic pollution for people in all parts of the world through their website. In Vietnam, Evergreen Labs prototypes recycling machines which they use to produce plastic sheets and design and install furniture from recycled materials. Bigger players such as 'Plastic Energy' can convert 60 – 90 tonnes of plastic to fuel per day and up to 20,000 tonnes per year with a possibility of creating thousands of jobs and generating substantial economic output.

Process driven

A number of process-driven networks have emerged to address how waste is collected and managed. Ecobricks, a Philippines based social enterprise, converts plastic waste into reusable cradle-to-cradle building blocks for modular furniture, garden spaces, and walls. Ecobricks is a plastic bottle densely packed with non-biological waste to create a reusable building block, whilst keeping plastic from entering the ecosystem and empowering communities to adopt zero-cost solid waste solutions with many practical applications. Initiatives, like Plastics Bank and Eco Bali, are making contributions towards educating communities in the Philippines and Indonesia on source segregation of waste by providing collection centers.

Data and policy centric

A number of consultancies and research institutes are concentrating on policy and data collection and assessment. The Nature Conservancy's Indonesia Oceans Program is involved with a pilot project of waste characterisation study of Wakatobi National Park in East Java. This program will collect shoreline and household waste data in places like Kulati Village, Southeast Sulawesi, to develop a solid dataset of types of plastics from both marine and domestic waste collection. Such direct studies will help determine and influence natural and anthropogenic impact on the type and abundance of waste in Indonesia. Kopernik offers professional advisory services to corporations, foundations, the government and multilateral organisations through its consulting arm.

Behaviour change

While technology, process and policy actions are important, any holistic solution will also need to target behavioural change in these countries. Doing so is fundamental to ensuring long-term impact irrespective of what part of the value chain is being targeted, and glimpses of it can be seen in most interventions. For instance, Mother Earth Foundation is a zero-waste advocate which works with schools on waste reduction. This model for decentralised waste management is labelled as one of the best zero-waste models in Asia-Pacific. Another good example is that of Trash Hero (Thailand) which, with the support of local businesses and volunteers, comes together once a week to pick up trash from beaches, streets and schools. Their primary focus is on building a movement to create long term change in consumer behaviour.

Initiatives that will be impactful and successful in the long term will typically require actions on more than one of these themes. However, not all organisations have the capacity to simultaneously invest in more than one priority e.g. technology and behaviour change. Therefore, for an investor, there is a clear proposition in supporting organisations that can do many of these already or combine forces with an organisation that needs to invest in building one or more of these capabilities and enable it as a way of creating significant impact.

Application

As outlined earlier, there is an alternative dimension in analysing these initiatives which is related to where they are targeted along the value chain. There are three possible categories here:

substitution: upstream in the value chain where there is an attempt to avoid the use of plastics;

end-use: downstream where, through technology, plastics are disposed or transformed into another form (e.g. energy);

closed-loop use: where plastics are reused and recycled.

The first two categories fall into the traditional plastics industry's extractive industrial linear model of 'take, make, use and dispose'.

Substitution

Many alternative solutions to plastics are being tested globally. Bioplastics for example, have gained popularity in recent years. Due to their often complex design, bioplastics can create additional challenges to the present waste management systems. This alternative source is likely to utilise a large volume of land for feedstock (estimated to reach 1.4 million ha by 2019), and further strain water levels to produce such agriculture-based alternatives. The production will also result in land degradation and a loss of natural habitats, reduced water quality, increased levels of pollution and land conflicts. While there may be some scope for circularity within this application, the studies are at a nascent stage and it is still unclear how this will manifest.[91]

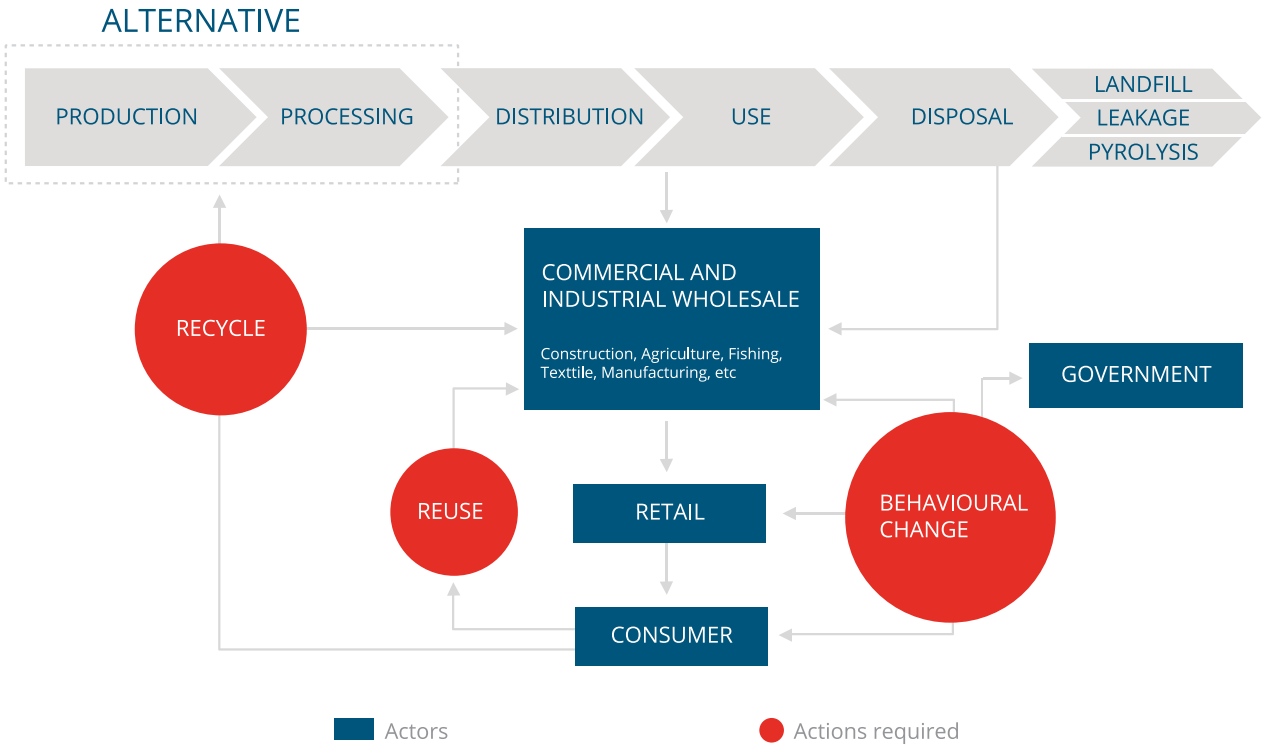
End-use

End-use technologies like incineration (an exothermic process) are being used in many parts of the world including Sweden, Denmark and Japan to generate electricity, heat water or produce steam. This can address the immediate issue of pollution by controlling production of methane gas and trapping pollutants, amongst others. While this technology can reduce large masses of plastic waste (in some cases, by close to 95 percent), it is capital intensive, produces harmful chemicals and does not focus on recycling and reusing components.

91. Trending Packaging. 2015. The most common eco-friendly alternatives for plastic packaging

FIGURE 7

VALUE CHAIN ANALYSIS AND POSSIBLE INTERVENTIONS



Source: AVPN Analysis

Closed-loop 'circular economy'

The third application brings forth the important concept of "circular economy". While there are a number of definitions and interpretations, a report on the circular economy by the Ellen MacArthur Foundation[92] describes it as a shift away from a linear model of consumption that follows the 'take-make-dispose' pattern to an economy that is intentionally restorative. This entails moving towards renewable energy, eliminating the use of toxic chemicals and eliminating waste through innovative design of materials, products, systems and, in turn, business models.[93] The circular economy operates in a continuous closed-loop where waste is recycled and returned into production through the reuse and recycling of materials. It does this without depleting resources and can be perpetuated indefinitely without any accumulation of waste in the environment. More details on the circular economy and its role in plastics waste pollution are provided in Appendix 3 on page 47.

Selected Funding Opportunities

Table 4 on the next page shows a list of selected funding opportunities for further consideration and exploration in Indonesia, the Philippines, Thailand and Vietnam through AVPN's network. Opportunities for social impact investment exist across themes and applications, and new initiatives are emerging from local communities and entrepreneurs. Their success, however, depends on the availability of financial and non-financial resources to scale effectively, including platforms and mechanisms that connect them to ecosystems of investors and practitioners.

92. Ellen MacArthur Foundation. 2013. Towards a circular economy

93. Ibid.

The scope of investment ranges from USD 20,000 to USD 10 million, but the details of each opportunity would need to be discussed directly with the organisation concerned.

TABLE 4

SELECTED FUNDING OPPORTUNITIES[94]

	 INDONESIA	THEME
Kopernik	Kopernik connects simple technology with last mile communities to reduce poverty. They source the best technology designed for the developing world and distribute it by partnering with local organisations and micro-entrepreneurs. They balance philanthropic and business approaches by mobilising donor funds to cover the upfront cost of sending technology to the last mile. When technologies are sold, the revenue is reinvested in sending more technology. Kopernik also offers professional advisory services to corporations, foundations, government and multilateral organisations through its consulting arm, Last Mile Consulting.	Data and policy centric
Plastic Energy - Concept One	Plastic Energy will retrofit an end-of-life fishing vessel into a state-of-the-art plastic collection and research vessel. Concept One will be the first plastic waste-to-fuel powered vessel, and will provide a unique service offering to Indonesia – education, awareness-raising and research on the impact of plastic while running a medical clinic in remote regions and recovering plastics from the oceans.	Technology centric
SYSTEMIQ	SYSTEMIQ advises organisations and new entrants on identifying and financing investable business opportunities that use natural and human resources in line with emerging policies. Their activities currently focus on - but are not limited to - business-driven solutions to the degradation of tropical forests and wasteful flows of industrial materials, such as plastics and carbon.	Data and policy centric
The Nature Conservancy	The Nature Conservancy (TNC) is a global environmental nonprofit organisation working on conservation of land and waters. TNC's Indonesia Oceans Program, is carrying out a pilot project of waste characterisation study in Wakatobi National Park, simultaneously enabling awareness and empowerment on waste management and environmental issues, through composting and environmental enrichment programmes for women and students respectively.	Data and policy centric

94. Range of funding opportunities varies from USD 20,000 to 10 Million and can be discussed directly with each organisation

 THE PHILIPPINES		THEME
Mother Earth Foundation	Mother Earth Foundation is a Philippines based NGO and a zero-waste advocate that seeks to raise the level of public awareness on environmental issues and mobilise communities in a positive manner. It engages the government, communities, waste pickers and youth through its zero-waste academy and zero-waste community programmes to find and implement better waste management solutions.	Data and policy centric; Behaviour change
Net-Works	Net-Works is a partnership between the Zoological Society of London, a conservation charity, Interface, a flooring manufacturer and Aquafil, a fiber manufacturer, as well as other local players, working toward plastic net removal efforts in parts of the Philippines and Indonesia. Net-Works redesigns global supply chains to create sustainable and scalable solutions that reduce marine plastic, increase fish stocks and improve the lives of marginalised coastal communities living in biodiversity hotspots of developing countries. To manage local supply chains, Net-Works has set up community banks, bringing communities together in informal cooperatives and providing much needed access to financial services. They are also developing ecological and inclusive seaweed supply chains, including carrageenan (seaweed extract) sourcing, in Southeast Asia.	Process driven, Behaviour change
Ecobricks	Ecobricks creates reusable building blocks, or ecobricks, created by packing clean and dry used plastic into a plastic bottle to a set density. The project has directly empowered 10,000 community members in a year by building awareness and direct participation in capacity development workshops. This concrete result is the completion of at least 10,000 ecobricks, which is approximately 1,750 kg of used plastics stuffed in plastic bottles. Most of these completed ecobricks were made into modular furniture, walls and building structures.	Technology centric
 THAILAND[95]		THEME
Full Circle Filament	Full Circle Filament (FCF) uses PET and polycarbonate to make 3D printing available for bottom of pyramid workers. FCF will increase the incomes of informal waste pickers as it directly sources waste plastics for their filaments. By processing their own materials, FCF will avoid commodity market costs, thereby enhancing profitability. This will increase recycling levels by offering above market rates for plastics with low recycling rates.	Technology centric

95. Please see Appendix 1 for details on investment opportunities in Thailand.

Thailand Development Research Institute	Thailand Development Research Institute (TDRI) is a nonprofit public policy research institute. It provides technical analysis to various public agencies to help formulate policies to support long-term economic and social development in Thailand. Its main tasks are to conduct policy research, network extensively with other institutions and individuals engaged in policy research, both in Thailand and abroad, and disseminate the research results to ensure maximum impact on policy-making. The research at TDRI emphasizes the use of behavioral insights to nudge the public or consumers to segregate waste at source and reduce the use of single-use plastic.	Data and policy centric; Behaviour change
Precious Plastic	Precious Plastic is a global network that tries to boost plastic recycling worldwide by providing people with tools and knowledge solutions to fight plastic pollution. Precious Plastic builds and tests open-source machines that can process plastic waste into flakes, pellets, filament, and new products. It has impacted local communities and has given additional revenue streams to these families. Precious Plastic is also active in Indonesia.	Technology centric
Star-board	Star-board is a nonprofit watersport technology company with a presence in 50 countries that aims to redefine the boardsport industry as sustainable and socially responsible. It manufactures sustainable boards with recycled and bio-based alternatives. Star-board's Thailand operation also helps to create awareness within schools, and promotes the concept of plastic footprint and plastic offset programmes, while enabling alternate income streams for people without work.	Process driven; Technology centric
Trash Hero (Thailand)	Trash Hero World creates and supports sustainable community projects worldwide to provide education on the environmental impact of waste. Their focus is on single-use plastic and promoting practical solutions to mitigate, prevent and/or avoid it. The three core programmes they run are the Action & Awareness Programme, the Bottles & Bags Programme and the Kids & Education Programme.	Behaviour change; Process driven
Thai Plastic Recycle Group	Thai Plastic Recycle Group is a social enterprise. It helps educate children and people in communities to recognise the importance of recycling. Their main product is hot washed PET recycled flakes from PET bottles, with an aim to reduce PET bottle waste in the environment by incorporating them in the recycling system. Their current project aims to expand the production line to a capacity of 2,400 MT by the end of 2019.	Technology centric
	 VIETNAM	THEME
Evergreen Labs	Evergreen Labs builds, consults, advises and implements environmentally conscious and socially-inclusive business solutions in frontier markets. They have worked extensively on waste management solutions (e.g. prototyping recycling machines and training waste workers), as well as designed, produced and installed furniture from recycled materials.	Technology centric

CHAPTER 5

CONCLUSION

Marine plastic pollution is a defining issue of our day. Asia is concurrently at the frontlines of both the problem and its solution, given that the top five marine plastic polluting countries in the world are in the region. Engendering a long-term solution for this looming concern will require a transition towards more sustainable ways of production and consumption, and in particular, the establishment of a closed-loop circular economy.

While stringent waste management policies form the backbone of any sustainable change, alongside proper implementation and execution, access to finance has been a regional challenge. This has resulted in a number of otherwise robust actions and ideas being confined to being subscale and/or fragmented. Accelerating opportunities to address marine plastics pollution will require catalysing private investments, creating opportunities for financial and technological innovations, and establishing networks targeted at sector-specific local conditions.To successfully address the issue of marine plastic pollution, countries must be able to find the resources to conduct research and develop and scale solutions effectively.

A social investment opportunity exists in almost every part of the value chain – from production (and finding alternatives) to alternative recycling uses. Improving 'upstream' processes and infrastructure, the single largest cause of increasing pollution, will require significant investment and partnerships across regions and organisations - from supply chain leaders and innovators to big brand companies. There is immense scope for partnerships between companies, investors and key players that operate in these markets and work alongside intergovernmental bodies and local communities that have country specific local knowledge.

There is a need to understand the supply chain dynamics through systems thinking to engage in investments that will help unlock bottlenecks and develop better recycling systems in this region. A clear opportunity is to go beyond direct financing to create platforms and mechanisms that integrate these organisations into ecosystems of investors and other practitioners.

Finally, even further upstream of capital, is technology and infrastructure. A key part of this change is going to be raising awareness of this issue to affect a shift in community behaviours. **Creating the infrastructure to track progress in end-user behaviour effectively will require multi-stakeholder partnership and engagement of representatives from government agencies, local communities and the private sector.**

OPPORTUNITIES IN THAILAND

FULL CIRCLE FILAMENT

Project overview

Full Circle Filament (FCF) is an inclusive social enterprise that's working to help close the plastic waste loop via 3D printing. FCF blends recycled PET from water bottles with polycarbonate to create a 3D printing filament that makes sturdy and attractive prints.

Phase 1: Produce filament via an inclusive business approach. Include waste collectors in the upstream value chain by sourcing clean waste PET.

Phase 2: Expand the inclusive element to include the downstream value chain with the production of 3D printed products that are made by and/or for low-income communities.

Partners

- Material science lab at Thammasat University's Sirindhorn International Institute of Technology (SIIT) to help with material testing and filament extrusion for product testing.
- Endeva and Covestro to facilitate strategy and operations development.
- Link up with Global Studies and Social Enterprise program at TU to offer paid internship.

Problem

- Low recycling within the region.
- Lack of solutions that integrate these resources into ecosystems.

Solution

- Goal is to reduce the volume of plastics entering our waterways and landfills while cutting the production of virgin plastic by the corresponding amount.
- Combine post-industrial plastics with recycled PET bottles in our products.

Financial ask

- Seed Funding: USD 350,000
- 18-month runway to achieve profitability, 4-6 months to finalise product and develop initial customer base

Uses of funds

- Product testing, including lab work and conducting product evaluation with customers.
- Market research branding, and sales channel development.
- Operations – labour, extrusion equipment, rent, utilities, transport, and raw materials.

Non-financial support needed

- Connecting with the target market, and developing and communicating a brand.
- Identifying and connecting with a variety of potential partners.
- Connecting to the right networks will help facilitate FCF's long-term strategy of creating useful products (prosthetics, orthotics, replacement parts, etc.) to turn recycled filament into socially valuable products.

THAILAND DEVELOPMENT RESEARCH INSTITUTE (TDRI)

Project overview

The TDRI, founded in 1984, is a private no-profit foundation specialising in public policy research. TDRI aims to provide technical analysis to various public agencies in the formulation of polices to support economic and social development in Thailand. TDRI's experience on waste management and marine debris currently includes conducting research which focuses on investigating the potential sources of marine debris in Thailand and identifying measures to address the marine debris problem. This research was completed in July 2019.

Problem

- Lack of large-scale research which seeks to identify the main sources of marine debris in the context of Thailand, for instance, sources that contribute the most release of waste into the ocean.
- Absence of a comprehensive study that suggests the measures – both economic and non-economic – to prevent and address the marine debris problem.
- Lack of collaboration between those that use material flow study to study the life cycle of plastic and those that conduct policy research on the measures to prevent plastic pollution in the context of Thailand.

Solution

- To work on issues by applying our knowledge and experience on behavioural economics on the development of *nudges* that trigger behavioural changes.

Financial ask

- Research Grant: USD 50,000 – 70,000

Uses of funds

- How to trigger behavioural changes amongst consumers/households, organisation (such as school, university, etc.) and retailers.
- Conduct small-scale research by selecting 1 or 2 communities/organisations to do field experiment first before scaling this up later.

Non-financial support needed

- Access to network of researchers working in the field of waste management in ASEAN countries or in other regions.

STAR-BOARD (THAILAND)

Project overview

- Roll out 200-page *Ambassadors for the planet* cutting-edge kids environment curriculum in Thailand, both in book form and online (extendable to serve as an adult program).
- Scale up the Plastic Offset Program (POP) program to collect 100 tons of plastic from beaches to promote the concept of plastic footprint, plastic offset programs and how this enables people without work to have a reasonable income.
- Finalise impact analyses and fee structures for plastic versus aluminum versus glass to help move production away from single-use plastic.
- Conduct research on technology solutions on how to recycle plastic material that currently does not exhibit efficient end of first life solutions. E.g. upcycling styrofoam to high end walk ways as an example.

Problem

- Lack of solutions to address marine plastic pollution.
- Lack of awareness and action.

Solution

- Connect with the UN, the Foreign Joint Chamber of Commerce and the Thai government's finance team to fast track and broaden regulations.
- Build awareness through engaging with schools, companies and people to share awareness, with the help of Trash Hero (Thailand).
- With our POP program we have created a return collection fee for any type of plastic found at beaches.

Financial ask

- Grant: USD 150,000

Uses of funds

- Expand current portfolio in Thailand to promote the concept of plastic footprint and plastic offset programs.
- The funds for the return fee and organisation come from taxing Star-board own company's plastic use.
- Broaden local outreach through Trash Hero (Thailand) and others by employing more staff.

Non-financial support needed

- Engage with other similar networks of researchers across Southeast Asia and globally.

TRASH HERO (THAILAND)

Project overview

Trash Hero (Thailand) currently runs the following three programmes.

- Action & Awareness Programme, which consists of simple, low resource actions designed to bring attention to the problem of plastic pollution and motivate behavioural change with regard to the consumption and disposal of plastic products.
- Bottles & Bags Programme, which targets both end-consumers and the local business community. It is run by chapter volunteers, who seek out businesses to participate, either through advertising on social media, or by direct visits. Local "refill stations" are published on a central map, which allows new customers to find them easily and gives each refill point free.
- Kids & Education Programme, which capitalizes on kids and education to create a new generation of environmental stewards in the community - community waste management support.

Problem

- Lack of community awareness and participation
- Poor environmental protection regulations
- Lack of practical solutions to marine plastic pollution

Solution

All programmes:

- Have the potential to create long term behavioural change with minimal financial resources
- Are open to and actively encourage participation from all sectors of the community
- Focus on practical action and solutions, rather than campaigning and blaming

Financial ask

- Grant or stable multi-year funding: USD 20,000 – 60,000 (towards any/all of the three themes)

Uses of funds

- With USD 20,000: Trash Hero (Thailand) can conduct 494 cleanup events, where approximately 16,800 Trash Heroes collect 84 tonnes of waste (based on average figures to date).
- With USD 20,000: Trash Hero (Thailand) can avoid the use of more than 2.1 million plastic bottles and 1.15 million plastic bags, replacing them with reusable stainless-steel bottles and Trash Hero bags; and expand the free water refill network to 24 new points in 4 new communities.
- With USD 20,000: 5,800 children will have the chance to become a Trash Hero and learn at a cleanup event why waste should not be openly burned, and what effects plastic has on our environment.

Non-financial support needed

- Access to network of researchers working in the field of trash collection in ASEAN countries
- Access to local businesses for programme outreach.

THAI PLASTIC RECYCLE GROUP

Project overview

- Thai Plastic Recycle Group is a social enterprise. It helps educate children and people in communities on the importance of recycling. Its main product is hot washed PET recycle flakes from PET bottle, with an aim to reduce PET bottle waste in the environment by bringing them to the recycle system. Its current project aims to expand production line to increase capacity to 2,400 MT by the end of 2019.

Problem

- Lack of knowledge and funding for research and development of recycling technologies.
- Currently, Thai laws do not allow recycled content in food packaging. However, if in the future the law changes to allow recycled PET (RPET) to be used in food packaging, the demand of RPET will increase significantly.
- The quality of RPET produced currently is low and there is a need to develop a product which would meet the standards of industries across many sectors.

Solution

- Development of good quality RPET will help expand the demand in different industries, create a circular economy for plastic waste, and reduce waste leaking to environment. In terms of social impact, it will help create more financial opportunities for waste pickers.

Financial ask

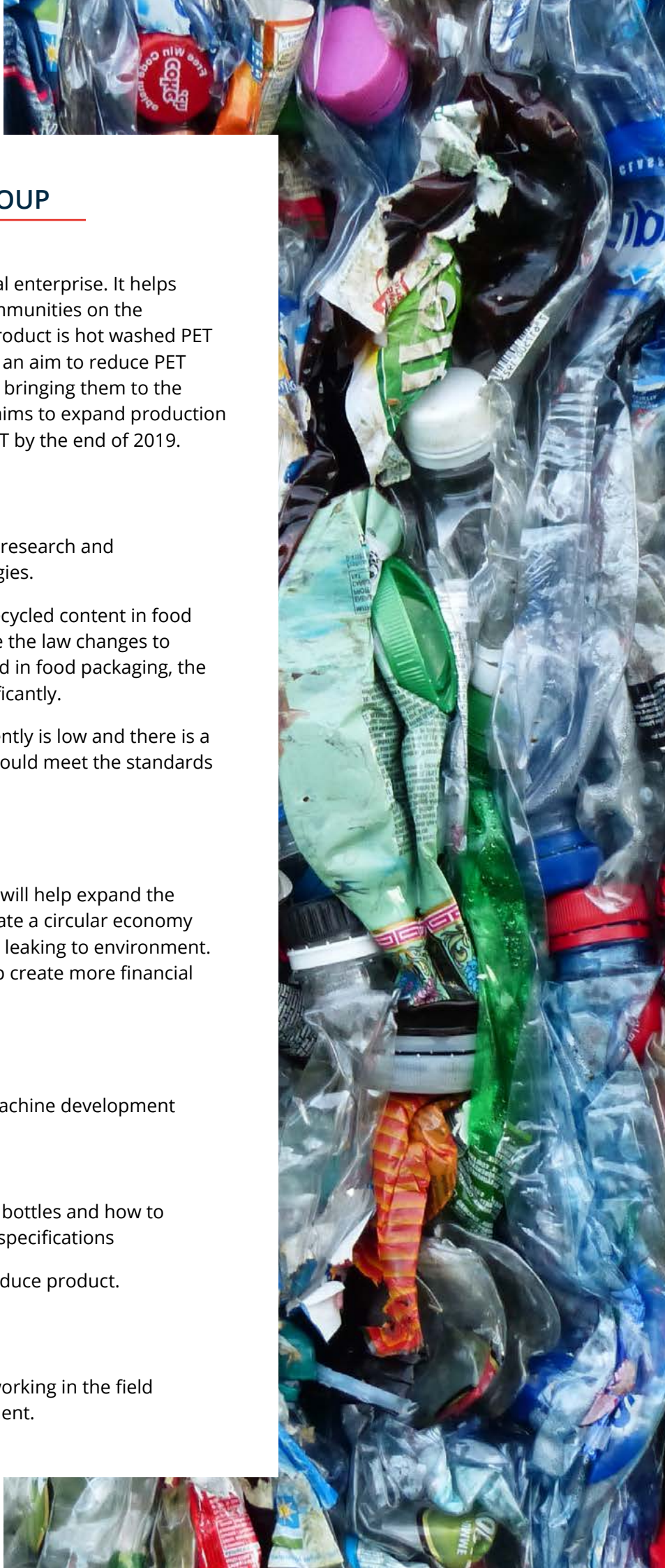
- USD 1.5 million for research and machine development

Uses of funds

- Research the social impact of RPET bottles and how to improve their quality to meet user specifications
- Develop and build machines to produce product.

Non-Financial Support

- Access to network of researchers working in the field recycling and technology development.



KEY GLOBAL FRAMEWORKS AND INITIATIVES ADDRESSING MARINE POLLUTION

The issue of ocean plastic pollution is rising on the global policy agenda, with several efforts being made to prevent and reduce marine litter and mitigate its impacts. The first global agreement *The International Convention for the Prevention of Pollution from Ships* (MARPOL) was signed in 1988. It addressed marine pollution from ships. Plastics were again on the agenda when the UN adopted Sustainable Development Goal (SDG) 14 in 2015, which calls for action to address marine pollution. SDG 6 (Clean Water and Sanitation), SDG 12 (Responsible Consumption and Production), SDG 15 (Life on Land) are also impacted by marine pollution. Below are some of the key global frameworks for marine plastic pollution:

TABLE 1

KEY GLOBAL FRAMEWORKS AND INITIATIVES FOR MARINE PLASTIC POLLUTION

FRAMEWORKS	GOALS
MARPOL	Aims to minimise marine pollution of the oceans, including dumping, oil and air pollution.
Sustainable Development Goal (SDG) 14: Conserve and sustainably use the oceans, seas and marine resources for sustainable development	Addresses the conservation and sustainable use of the oceans, seas and marine resources for sustainable development. 2025 targets include: to prevent and significantly reduce marine pollution of all kinds, sustainably manage, minimise impact of land-based activities, including marine debris and nutrient pollution.
London Convention for the Prevention of Marine Pollution from the Dumping of Wastes	An agreement to control pollution of the sea by dumping and to encourage regional agreements supplementary to the Convention.
Port Waste Reception Facilities Regulations 2003 (to deliver EU DIRECTIVE)	Consolidates plans for responsible ship-generated waste and cargo residues management and ensures that adequate port reception facilities are available to meet the needs of the users.
European Union Regulation on Shipment of Waste	Applies to shipments of waste, both within and into or out of the European Community.As part of this regulation, member states have to have a system of prior authorisation in place for the shipment of waste for disposal or recovery.

APPENDIX 2

FRAMEWORKS	GOALS
Global Partnership on Marine Litter	A voluntary multi-stakeholder coordination mechanism brings together policymakers, civil society actors, the scientific community and the private sector to discuss solutions and initiate actions.
The Honolulu Strategy	A planning framework to prevent and manage marine pollution and to reduce the ecological, human health, and economic impacts of marine pollution globally. It has a set of three specific goals to reduce amount and impact: (i) of land-based litter and solid waste to avoid leakage into the marine environment; (ii): of sea-based sources of marine debris such as solid waste, lost cargo, discarded fishing gears (ALDFG), and abandoned vessels introduced into the sea; and (iii) of accumulated marine debris on shorelines, in benthic habitats, and in pelagic waters.
EXEMPLARY INITIATIVES	GOALS
The EU Action Plan for the Circular Economy (COM/2015/614)	The EU Action Plan offers the potential to help reduce the scale and impacts of marine litter, while increasing the value of materials in the EU economy.
Rio+20 - Voluntary commitment	In 2012, a voluntary commitment of a significant reduction of marine debris was introduced at Rio+20 with a deadline of 2025.
UNEP Clean Seas Campaign	UNEP (February 2017) announced the Clean Seas campaign, asking for individuals, industries, and member states to voluntarily commit to an action of their choice to reduce plastic pollution.
Plastics Economy Global Commitment	Launched by Ellen MacArthur Foundation, it is a commitment by signatories to eliminate problematic or unnecessary plastic packaging by moving from single-use to reuse packaging models. This is done through innovation to ensure 100 percent of plastic packaging is easy and safe to reuse, recycle, or compost by 2024, and circulation of the plastic produced by significantly increasing the amounts of plastics reused or recycled and made into new packaging or products.

Source: Data adopted from Bricks et.al. 2016. Plastics Marine Litter and the Circular Economy and Borrelle et. al. 2017. Why We Need an International Agreement on Marine Plastic Pollution

In addition to the above frameworks, many other regional groupings such as the European Union, G7 and the Basel Convention, a treaty that controls the movement of hazardous waste from one country to another, have also established legislation and campaigns to address this issue.[96] Marine environment and protection was high on the agenda of the 2015

96. Brink, P., Schweitzer, J., Watkins, E. and Howe, M. 2016. Plastics Marine Litter and the Circular Economy

G7 Summit, where it was acknowledged that marine litter, in particular plastic litter, poses a global threat.

In addition, as of 2018, more than 60 countries have taken steps to ban or reduce the use of plastic and many more are joining the bandwagon.[97] For example, single-use plastic bags are now banned in Australia. In India, a ban on single-use plastic has been introduced which includes a fine of up to USD 367 for those caught selling plastic.[98] Most recently, in 2019, 187 countries took a major step forward in curbing the plastic waste crisis by adding plastic to the Basel Convention. Some innovative solutions to marine plastic pollutions across the globe are tabulated below (see Table 2).

TABLE 2

SOME SOLUTIONS TO MARINE PLASTIC POLLUTION ACROSS THE GLOBE

INITIATIVE	COUNTRY	DESCRIPTION
InnoAid, Waste sustainable handling project	India	A Danish engineer is using solar energy to convert plastic waste into bricks in Joygopalpur, India. The project involves educating people on waste segregation at source, creating waste collection points for plastic water and then creating bricks from solar cookers and other equipment.
K.K. Plastic Waste Management	India	K. K. Plastic waste management coverts plastic bags and other packaging material into other products. To do so, they engage garbage collectors by paying increased rates of 8-10 rupees (17 cents) per kilogramme. This creates an alternative economy and use for plastics. They mix plastic with asphalt to create a compound called polymerised bitumen. This compound is used in roads, which makes them sturdier and able to withstand monsoons and everyday wear and tear better than traditional pavement. Of the estimated 35 tonnes of plastic waste generated within Bangalore per day, K.K. Plastic utilises three to five tonnes of plastic daily in the roads industry.[99]
Plastic made from wood	Finland	The VTT Technical Research Centre of Finland has created a compostable multi-layer material from agricultural and forestry by-products, which could be used for stand-up food pouches for products such as muesli, nuts, dried fruit and rice. These wood by-products contain cellulose, the most abundant renewable polymer on the planet, making this new material an environmentally benign alternative to fossil fuel-based, multi-layered plastic packaging.

97. CBS News. 2018. Over 60 countries have introduced bans, fees to cut single-use plastic waste
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99. Khullar, M. 2009. Plastic Roads Offer Greener Way to Travel in India

APPENDIX 2

INITIATIVE	COUNTRY	DESCRIPTION
Compostable coatings	Germany	The Fraunhofer Institute for Silicate Research ISC has developed a high barrier coating which is fully compostable and extends the performance of existing bio-based and biodegradable packaging, which alone cannot guarantee the required minimum shelf life of many food products.[100]
ProtoCycler	Canada	A device which grinds all kinds of waste plastic such as plastic bottles, 3D-printing cut-offs and takeaway food containers into clean spools of plastic filament that can be used in a 3D printer.
Norway's Bottle Return System	Norway	Norway introduced a buy-back plastic bottle return system over 40 years ago which has been highly successful. These bottle return systems give money to people for simply returning bottles and cans. The bottles that do not get returned directly by the consumers are picked up by homeless people and kids who profit from returning them.
TerraCycle	USA	TerraCycle is a recycling company that recycles hard-to-recycle waste from post-consumer waste streams that usually end up in the trash. Examples are cigarette butts, pens, water filters, used toothbrushes and toothbrush tubes, packaging waste, industrial adhesive containers and even dirty diapers, which TerraCycle now processes into materials that are used to manufacture new products.
Bioplastech	Dublin	Bioplastech's new technology takes various bacterial species, screened from more than 400 microorganisms, and converts non-degradable plastic into a polyester called polyhydroxyalkanoate (PHA) that is biodegradable. The company is now working on developing a biodegradable adhesive from natural materials.[101]

100. New plastics economy. 2017. Combining materials that nature can handle

101. Nanalyze. 2019

CIRCULAR ECONOMY AND ITS ROLE IN PLASTIC WASTE POLLUTION

Of the 6,300 MMT of plastic produced globally from 1968 to 2015, only 9 percent was recycled.[102] Valued at between USD 100 and USD 150 billion annually, 95 percent of the material value of plastic packaging is lost to the global economy after only a single use.[103] The circular economy, which aims to use plastics to their maximum value by recovering and regenerating products even after their service life, is therefore gaining momentum vis-à-vis the current linear plastic economy. It is a financially responsible model which is both environmentally and socially sustainable.

Our expert interviews highlight that 'thinking in systems' is integral to the transition to the circular economy. A system is characterised by a group of parts that interact to form a coherent whole. The systems approach aims to organise material and product flows in a closed-loop cycle so that no resources are spoiled, and the volume of waste is strongly reduced. Systems thinking, through its design-based approach, can facilitate behavioural change over time, create policy structure, structure behaviour relationships and develop systems prototypes.

The World Economic Forum estimates that implementation of circular economy can accomplish a cost saving of USD 1 trillion annually by 2025.[104] There is about USD 4.5 trillion on business opportunities to be tapped on within this space which, along with environmental and social benefits, can have significant cost savings.[105] Collaborative work through a global commitment called the New Plastics Economy, includes a diverse group of members, consisting of the city of Austin, H&M, Unilever, PepsiCo, L'Oréal, Nestle, and Coca-Cola, along with other participants, such as World Wide Fund for Nature, the World Economic Forum, the Consumer Goods Forum, and 40 academic institutions.[106] This initiative collaborates with United Nations and is led by the Ellen MacArthur Foundation to promote a circular economy for plastic. Five venture capital firms have pledged USD 200 million towards the initiative. These corporations have jointly committed to phase out single-use plastic packaging and ensure it can either be reused, recycled, or composted by 2025. There are several other notable initiatives.

- Circulate Capital launched the incubator network to 'Accelerate Ocean Plastic Solutions' at the Ocean Partnership Summit alongside the G7 Environment Ministerial Meeting.[107] It will facilitate fast-tracking interventions to reduce ocean plastic waste by partnering with incubators and develop an ecosystem of waste management and recycling innovators.

102. Geyer, R., Jambeck, J.R. and Lavender Law, K. 2017. Production, use, and fate of all plastics ever made
103. Ellen MacArthur Foundation. 2016. The new plastics economy — rethinking the future of plastics
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- Coca-Cola's "Plastic Reborn: Give your Plastic Bottle a Second Life" programme in Jakarta targets millennials and shows that recycling can be cool. Plastic Reborn is increasing public awareness about responsible waste management and the importance of a circular economy, and has already collected 1.8 tonnes of post-consumer PET bottles channeling proper waste collection. These bottles are then shredded into PET flakes and then the process of upcycling turns the flakes into fashionable multi-functional bags.
- Unilever has developed new technology to recycle sachet waste. This technology, called CreaSolv Process, has been developed with the Fraunhofer Institute for Process Engineering and Packaging IVV in Germany and is inspired by an innovation used to recycle TV sets. Currently, billions of plastic sachets are thrown away globally every year. With this development, the sachets will be turned into plastic and channelled back into the supply chain.[108]
- Companies such as REFLEX, FIACE and MRFF are collaborating on solutions for the after-use of the value chain.[109] One such solution is the transition to circular economy. If five European countries (Finland, France, Netherlands, Spain and Sweden) make this transition they can reduce carbon emissions by two-thirds and create approximately 1.2 million jobs within these countries.[110] In Thailand, a number of plastic manufacturers, such as Siam Cement Group, PTT Global Chemical, Dow Chemical, etc. are transitioning towards circular economy model.

While similar studies and data in developing countries are not available, there is a large economic, social and technological scope that can be tapped into with plastics circular economy. The circular economy approach could not only help contribute to the SDG Goal 14 but can also help accelerate Goal 12 (ensure sustainable consumption and production to achieve efficient use of natural resources, reduction, recycling and reuse) and Goal 8 (inclusive and sustainable economic goals). For instance, through introduction of alternative recycle and reuse markets within the plastics value chains, this approach can increase the level of financial benefits for low-income families and formalise the waste picking industry in these countries.

Challenges linked to steady increase in consumption, waste management and end-of-life of plastics can be turned into an opportunity through the implementation of the circular economy. However, there is a need for detailed research to develop a more comprehensive list of initiatives to properly tap into investment opportunities, particularly those at the incubation and pilot stage.

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110. Scientific and Technical Advisory Panel. 2018. Plastics and the circular economy

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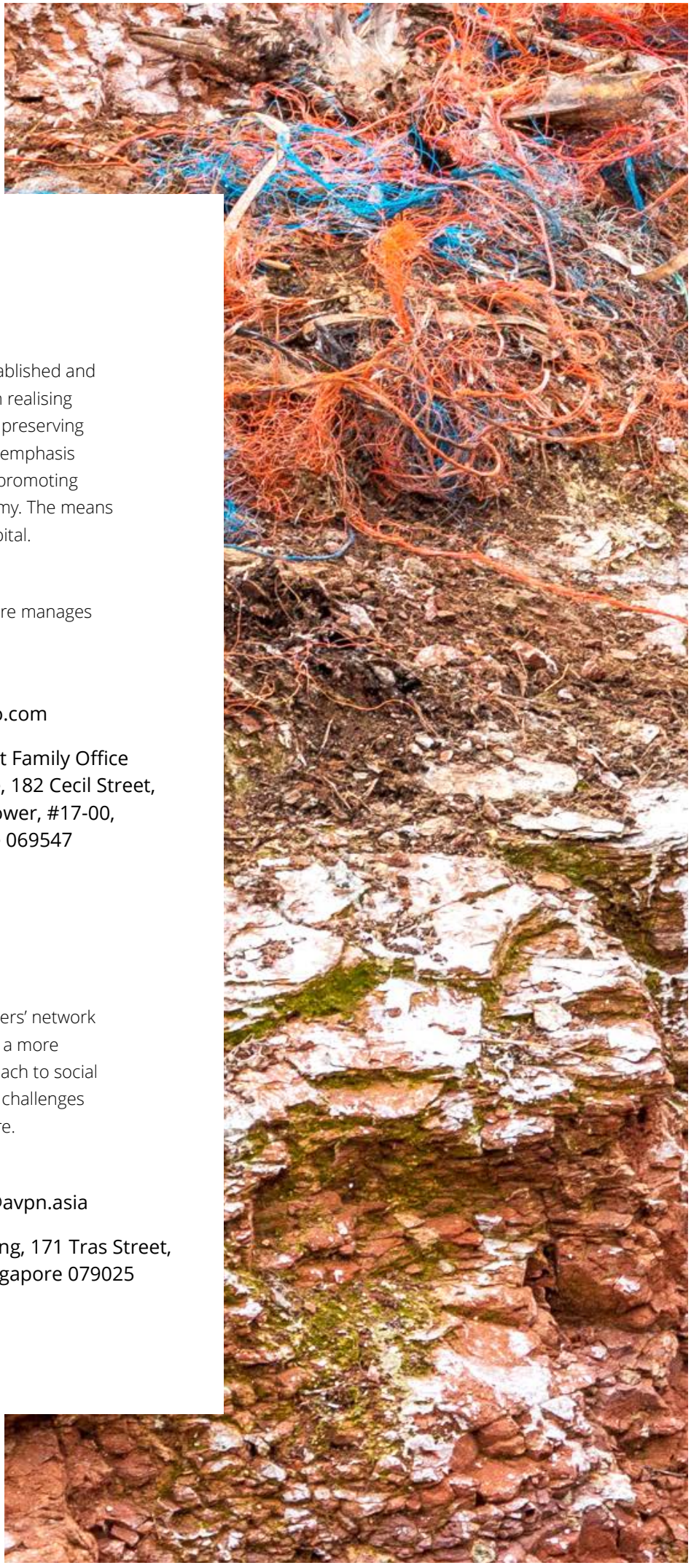

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