MOPA
MALDIVES OCEAN PLASTICS ALLIANCE

NIG CAPITAL

SOCIO-ECONOMIC IMPACT ASSESSMENT OF THE USE OF PET IN THE MALDIVES

February 2021

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FOREWORD

Without urgent policy and management action, single-use plastics could potentially become the defining environmental degradation risk for the pristine Maldivian oceans. In particular, the steady increase in importing, manufacturing, retailing and utilizing of PET bottles was the underlying cause for the formation of the Maldives Ocean Plastics Alliance (MOPA) in early 2020. The commitment of the Government of Maldives to strengthen legislation on reducing ocean plastics pollution has complemented and enhanced civil society and private sector initiatives on environmental protection and waste management.

The 'Socioeconomic Assessment of Single-use Plastics in Maldives' was commissioned by MOPA as an early initiative of the Organisation. We sincerely thank NIG Capital for undertaking this comprehensive study. Our objective is to share this pertinent research with all stakeholders, including presenting it to the Ministry of Environment. Furthermore, our corporate partners committed to safely repurposing plastics as well as those engaged in mass recycling initiatives will also find the underlying findings of tremendous value in charting their future course in reducing ocean plastics pollution in the Maldives. MOPA will publish the report on its official website for the benefit of researchers, academics and students.

We are, indeed, proud to have commissioned this report and hope to continue contributing towards academic and research endeavours in our chosen field of interest. It is pertinent that our report has coincided with the recent announcement by the Government of Maldives of an initial ban list of plastics imports into the country. With our strong support towards the initiatives of the Government in managing ocean plastics, including the pledge to phase out all single-use plastics by 2023, MOPA hopes to continue its engagement with the Ministry of Environment.

Thoriq Ibrahim
Founder and President
Maldives Ocean Plastics Alliance

As per the main findings, the total plastic footprint in the Maldives is about 12% of the total waste in the country, while PET bottles used in beverages industry is about 10% of the total plastic waste **(1% of the total waste)**

I. EXECUTIVE SUMMARY

Given the geographical nature and the remoteness of islands in the Maldives, single use plastic containers has become the most preferred, convenient and cheapest option for food and beverage products. Further, due to negative public perception towards tap water, most households in Male' and islands in outer atolls use bottled water for their daily use.

Polyethylene Terephthalate (PET) plastic is much lighter and easier to handle than glass, and other alternatives. The production of PET is also much more economical compared to glass, and these savings go directly to the consumers in the form of lower prices. This has made small sized PET water bottles very convenient, especially when people are on the go, and for outdoor activities. However, when poorly managed, PET bottles can become an environmental problem when it is thrown in the sea and the beautiful beaches in the Maldives. Unlike glass that immediately sinks, the PET bottles floats and are more visible.

As per the main findings, the **total plastic footprint** in the Maldives is about

12% of the total waste in the country,

while **PET bottles used** in beverages industry is about

10% of the total plastic waste.

(1% of the total waste)

This Report presents an assessment of the socio-economic impact of use of plastic bottles in the Maldives, conducted by NIG Capital in association with Maldives Ocean Plastics Alliance (MOPA).

Despite the low volume of PET in comparison to other wastes, the lack of biodegradability and the negative impacts to the marine environment make plastic pollution a highly visible, as well as pertinent environmental problem in the Maldives.

LOCAL PRODUCTION OF PET BOTTLES

The local production of PET bottles, including water and soft drinks is estimated at

143 million bottles per year, or **3300 tons.**

REVENUE

The government's estimated annual revenue directly from the industry is

MVR 148 million

including the revenue from Goods and Services Tax (GST).

CONTRIBUTION TO GDP

The bottling industry in the Maldives contribute to

2% of GDP

(Gross Domestic Product), is one of the few significant local industries.

As per the NIG Capital Household Survey conducted at national level, **57%** of the households use plastic water bottles for daily consumption. This high level of usage confirms with previous studies and surveys.

In addition to PET or plastic bottles, the country also imports a significant volume of other plastics including plastic bags, food packaging, wrappers, pipes, and products used in beauty and hygiene. T**he total plastic waste constitutes an estimated 43,134 tons per year.** However, due to lack of segregation of different types of waste, and with no systematic plastic waste collection system, the percentage of mismanaged waste in the country is significantly high at 66%.

With only a minimal collection of 1% of the total plastics by NGO's or other cleanups, part of these PET bottles and other plastics are being leaked into the marine environment. However, since PET packaging has economic value due to its recyclability, with a proper waste management system, it can be exported to recycling facilities, either baled or as flakes. At present, the country incurs a lost revenue of approximately MVR 10.8 million (equivalent to $700,000) per year, as more than 3,000 tons of PET bottles per year are either burnt or thrown away.

While there are several approaches to deal with plastic waste, waste management activities should be organized in a manner that is consistent with international best practices, including considerations given to minimizing impacts on human health, and the natural environment.

According to the Waste Management Regulation of 2015, the Strategic Action Plan of the Government from 2019-2023, as well as in the Single Use Plastic Phaseout Plan, the Government of Maldives has stated the importance of waste management activities including the provision for Extended Producer Responsibility (EPR), with guidelines for a trust fund that is operated through a separate account for the fund, the establishment of a re-use and recycling industry, and provision of incentives for those industries to develop as a business, as well as the implementation of Polluter Pays Principle (PPP).

Based on a holistic and a sustainable approach to waste management, and considering the socioeconomic impact of PET consumption in the Maldives, this Report recommends Maldives to set up a collection and recycling system where the PET containers are collected, baled or flaked, and exported.

II. PROLOGUE

The overall objective of this study is to conduct a socio-economic impact assessment of the use of plastic bottles in the Maldives, and to identify ways to minimize the environmental impact and the negative externalities of plastic usage. It is also part of the objective to seek the possibility of establishing a recycling facility in the Maldives, in order to better manage the plastic waste, and minimize the impact on the environment.

In the first part of this study, the amount of total plastic imported, and produced in the country was measured based on the available data, and the primary survey conducted by NIG Capital. The second part focuses on waste management practices, introduction of Regulations on Extended Producer Responsibility (EPR), and recycling prospects, so that the best option for recycling can be recommended for Maldives. This study has been limited to the socio-economic impact of plastic bottles used in the beverages industry.

III. RESEARCH METHODOLOGY

The research was primarily focused on quantitative survey of households in the country, Key Informant Interviews (KII) of restaurants and cafés, and direct interviews of key stake holders. Imports data from Maldives Customs, published reports, newspaper articles, Online sources, and data from producers and Government institutions were also obtained.

A. HOUSEHOLD SURVEY

In order to represent the country well, the geographic structure of the country is taken into consideration. The frame is divided into 5 development regions. The survey uses the area frame. The required frame for sampling was obtained from population census 2014. Major characteristics of the frame are given below.

NUMBER OF HOUSEHOLDS BY DEVELOPMENT REGION

Region	Number of Atolls	Number of Inhabited Islands	Number of Households
North Region	HA, HDh, Sh	41	8945
North Central Region	N, R, B, Lh	45	8841
Central Region	K.AA, ADh, V	32	7043
South Region	GA, GDh, Gn, Addu	25	9879
Male'		1	24961
Male' total		187	39471
Atoll total		1	24961
Country total		188	64432

The primary sampling units (PSU) are the islands. The survey used two-stage stratified sampling method.

B. TARGET POPULATION

Target population of this survey are households in the Male' & Atolls.

C. STRATIFICATION AND ALLOCATION

Stratification allows to divide the target group into relatively homogenous groups and thereby reducing the total variation by reducing the margin of inter-group variation. Stratification allows proper allocation of sample in different groups and makes it more representative.

As the consumer behavior in capital city Male' very much differ from the rest of the country it is important to treat Male' separately. Hence, study have two domains namely; Male' & Atolls.

Stratification in Male' is done by wards. In Atolls it is done by development regions and capital island & rest of the islands. The allocation households were made based on equal number of households for all strata. The number of Enumeration blocks as well as the number of households did not vary much, so the fixed number of samples over all strata resulted in sampling fraction ranging from 2% to 7% for enumeration blocks and 1.1% to 3.6% for households.
Allocation of sample by strata is given in Table 2. Allocation of sample in Male' strata is made on same principle. For each of the 6 strata equal number of households will included. That is 50 households per stratum, which gives total number of 300 households.

ALLOCATION OF SAMPLE IN DOMAINS

Domain	Population		Sample	
	Number of Households	In %	Number of Households	In %
Male'	24,961	38.74	300	33.33
Atolls	39,471	39.471	600	66.67
Total	**64,432**	**100.00**	**900**	**100.00**

ALLOCATION OF SAMPLE IN DOMAINS

Strata	Total Number of Households	Sample Number of Households	Sample Fraction in %
Region 1 - Capital	2264	60	2.65
Region 1 - Other islands	6681	60	0.89
Region 2 - Capital	1697	60	3.5
Region 2 - Other islands	7144	60	0.83
Region 3 - Capital	764	60	0.84
Region 3 - Other islands	3999	60	1.5
Region 4 - Capital	1016	60	5.9
Region 4 - Other islands	6027	60	1.0
Region 5 - Capital	4932	60	1.22
Region 5 - Other islands	4947	60	1.21
Total	**39,471**	**600**	

Region	Island	Total HH	Sample HH
Region 1 - Capital	HDh.Kulhudhuffushi	1,359	60
Region 1 - Other islands	N.Manadhoo	274	60
Region 2 - Capital	AA.Rasdhoo	240	60
Region 2 - Other islands	Th.Veymandoo	110	60
Region 3 - Capital	Gn.Fuvahmulah	184	60
Region 3 - Other islands	HA.Kelaa	123	60
Region 4 - Capital	B.Goidhoo	202	60
Region 4 - Other islands	K.Gulhi	171	60
Region 5 - Capital	F.Biledhdhoo	1,595	60
Region 5 - Other islands	S.Feydhoo	655	60

D. FIELD OPERATION

In Male' the data was collected via social media as per the HPA guidelines due to the COVID pandemic. The Online form was circulated in social media and data collection was done via Computer-assisted web interviewing (CAWI). The survey was done on a voluntary basis.
In the Atolls, focal points were assigned in the selected islands and the task of filling forms was assigned to the focal person. The data was collected using mobile phone.

E. NON-RESPONSE

As the survey adopted CAWI method, the response was lower than expected. In Male', the total sample was 300, however, the response was 180. With this result, major conclusions based on the results of Male' separately, we are accepting a 7% of margin of error in our estimates.

In the case of Atolls, the response rate was fairly good. The total sample size was 600, however, 508 responded to the survey. Initially the survey was designed to present the result at regional level. However, with the current response rate, the decision was to present the results for Male' and Atolls. In the case of Atolls, with the current response rate we report our estimates with a 3% margin of error.

CHAPTER 1

DIFFERENT TYPES OF PLASTICS AND THEIR RELATIVE USES

1.1 TYPES OF PLASTICS

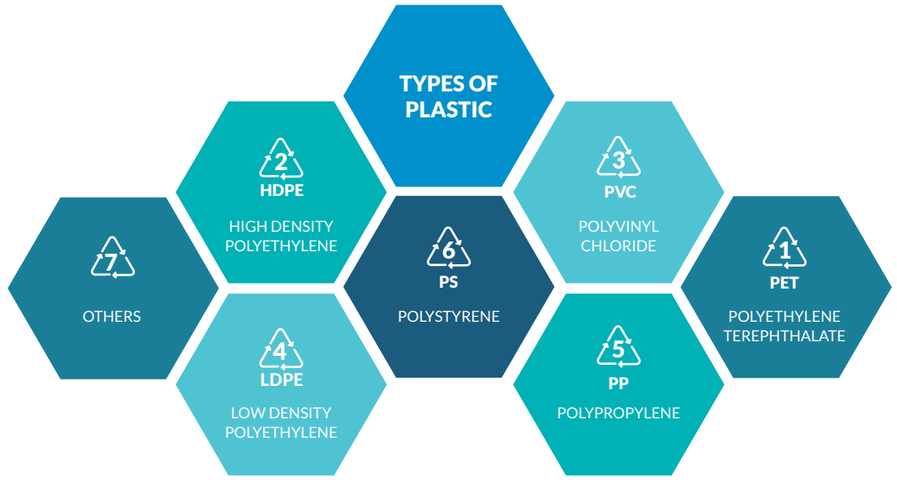
Our everyday life today is surrounded by different types of products that contain plastic. Plastics materials were designed as a solution for the substitution of scarce and non-sustainable natural resources such as tortoiseshell, ivory or animal bones (Plastics Europe, 2019).

The two main types of plastics are Thermoplastics and Thermosets.

Thermoplastics
Thermoplastics can be melted when heated and hardened when cooled, whereas

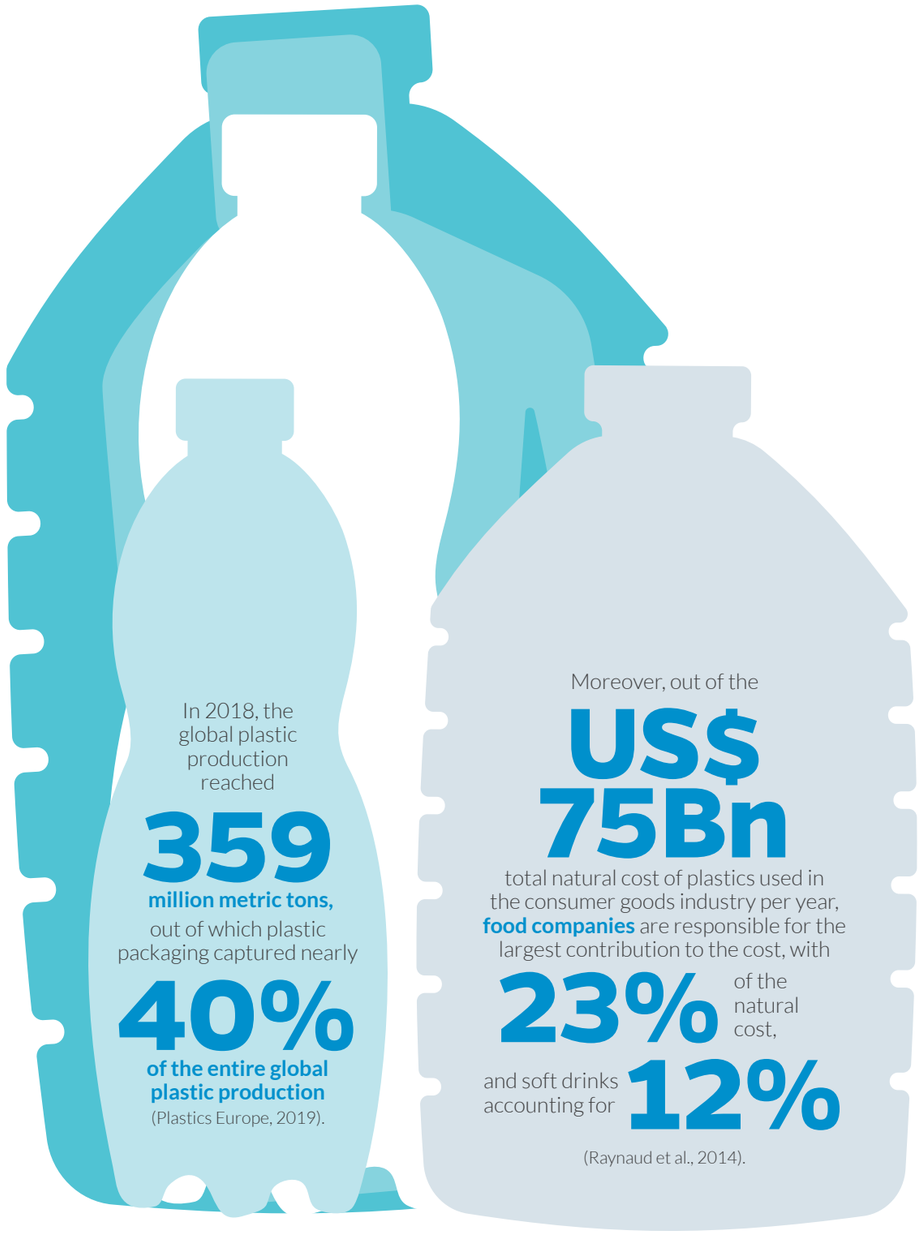
Thermosets
Thermosets are plastics that undergo chemical changes when heated, and creates a three dimensional network. They cannot be re-melted and reformed after they are initially heated and formed.

FIGURE 1.1 TYPES OF PLASTICS



Source: qualitylogoproducts.com

Since 1988, all plastics were designated a number (1 through 7) to their recyclability and resin type, as defined by ASTM International. The code number identifies what kind of resin each particular plastic product is made of. PET is identified by the Resin Identification Code 1.



Most soft and fizzy drinks, water, packaging for other food products and oils are packed in **polyethylene terephthalate (PET)**, while milk bottles, bleach, detergent and shampoo bottles are packed in **high-density polyethylene (HDPE).**

1.2 WHAT IS PET

Polyethylene terephthalate (PET) is a type of plastic or polymer made by reacting two monomers (ethylene glycol and purified terephthalic acid, PTA) via a process called condensation polymerization, in the presence of a small amount of a catalyst. The resulting polyester is used for making fibers and other applications. In order to make bottle grade PET resin, an additional step, solid state polymerization (SSP) is required. This step increases the molecular weight which in turn increases the intrinsic viscosity of the PET and make it suitable for making bottles for packaging applications.

Virgin PET (vPET) is one of the most important engineered polymers in the past decades, due to its rapid growth in use, as well as its versatility in various applications. It is also renowned for its excellent physical and chemical characteristics, such as tensile and impact strength, clarity, chemical resistance, processability and thermal resistance and stability (Caldicott, 1999).

PET used for food and beverage packaging provides many advantages.

- It provides **safety and hygiene**, and acts as a barrier against bacteria and **extends the shelf life** of products longer so that it **reduces food waste.**

- Water packed in PET bottles also allows **access to safe drinking water** for millions of people in the world that lack fresh drinking resources (Macaronne, 2018).

- PET production is also **less resource intensive** than alternative materials, and since they are lightweight and strong, incurs **less transportation costs**, **saving fuel and emissions during transportation.**

However, despite the many economic, and even environmental benefits of PET, there are numerous negative environmental, and health impacts from the extraction of fossil fuels used to make virgin PET, the manufacturing and processing, of plastics, as well as the use and disposal of plastics, especially plastic packaging. PET has an extremely slow rate of natural decomposition, and complicated and cost-intensive procedures are needed for PET to degrade biologically (Pacia, 2002).

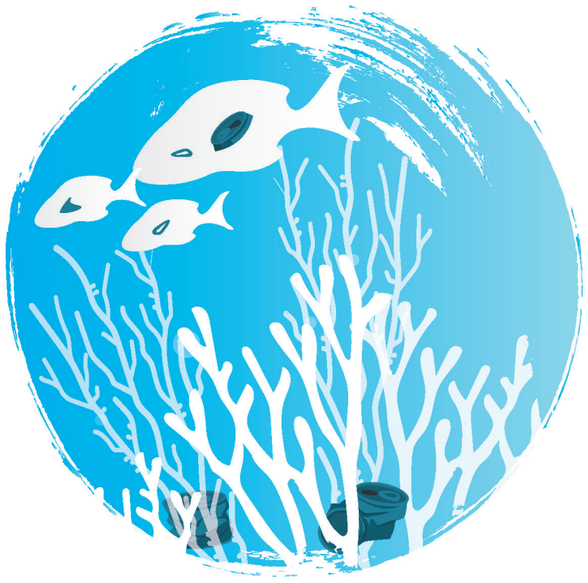
1.3 HOW DOES PLASTIC COMPARE WITH OTHER ALTERNATIVES?

1.3.1 USE OF ALUMINIUM

While people are understandably concerned about plastic pollution, the impact of aluminum and glass containers have not generated the same kind of headlines—but it needs to be carefully analyzed too. Aluminum creates more greenhouse gases:

A February 2016 study on gas emissions by the U.S. Environmental Protection Agency, using the widely accepted Waste Reduction Model (WARM), shows that aluminum cans, even when manufactured with recycled materials, **generate more tons of carbon dioxide (CO_2) per ton of metal than do PET bottles or containers** with recycled PET.

Too many packages become litter and end up in our waterways. Aluminum cans have been discarded into the world's oceans since their invention in 1959. But, unlike many plastics that float on or near the surface and remain visible to the naked eye, **aluminum cans sink.**



The concerns are:

- Cans accumulate on ocean floors, in delicate coral reefs, and in bays and riverbeds.
- There, they are more difficult to see, collect and recycle.
- Can tabs break off and are ingested by wildlife and fish.

All aluminium starts out as bauxite ore, which must be mined. Mining causes:

- Deforestation
- Land erosion
- Pollution of nearby waterways

Aluminium must also be refined before it's made into a can or container. The process uses caustic soda and other chemicals to extract aluminum from the ore. According to the EPA's recent Bauxite and Alumina Production Wastes report, this process leaves behind residual byproducts that can find their way into soil and water, including: Uranium, Thorium, Radium.

Food and beverage cans have a plastic liner, often a bisphenol-A (BPA)–based epoxy, which forms a barrier between the product and metal, protecting against food-borne diseases. On its website, the Aluminum Association states its position on BPA: "The Association understands that ongoing research and study is taking place on the safety and efficacy of BPA, and will continue to monitor these developments closely."

However, **compared to plastics, the benefit of aluminum is that it retains its properties indefinitely, no matter how many times it is recycled** (Aluminum Association, 2020). Plastics even though they are fully recyclable, can deteriorate over time from multiple rounds of heating and reheating, as the polymer bonds are broken. Thereby, **even thermoplastics like PET can be recycled a maximum no more than 10 times.** This will be detailed more in Chapter 6.

1.3.2 USE OF GLASS

Glass creates more greenhouse gases
Glass containers create more greenhouse gases than plastic containers. According to Springer.com, an academic publisher dedicated to the advancement of science, its 2008 Life Cycle Assessment (LCA) found that "glass jars produce between a quarter and a third more greenhouse gases than plastic jars."

Glass transportation costs are higher
Glass, by nature, is heavier than plastic, weighing up to 10 times more. This makes it more costly to transport and requires more fuel to be consumed and/or more trips to be made, according to PackagingoftheWorld.com. Increased emissions from either or both issues creates even more greenhouse gases.

Shattered glass is more dangerous
Glass shatters if it's dropped or damaged, which is a safety hazard for consumers. PET bottles and containers are flexible and will not shatter, whether in transit or when tossed into a recycling bin.

Glass fragments are a waste problem
Broken glass is as dangerous for waste haulers and recyclers to handle and sort as it is for consumers. In fact, according to Solutions.recyclecoach.com, many facilities are not equipped to remove tiny bits of broken glass from other recyclables. Broken glass can also contaminate other recyclables such as paper and cardboard. Today, more and more recycling companies do not accept broken container glass at all.

1.4 RECYCLABILITY OF PLASTIC

An important aspect of PET which has not gotten wide attention is its recyclability. Being a thermoplastic, it can be melted and reformed into a wide range of products, without significantly losing its properties. Even though many of the popularly used plastics are also thermoplastics, and hence are recyclable, **PET remains one of the most widely recycled plastic worldwide.**

Despite being in existence for over six to seven decades and with such an extensive use; many are not aware of the fact that **PET bottles can be 100% recycled** and are being widely recycled into a wide array of products.

The recycling rates of PET bottles vary across the world. Countries like Japan and Germany are far ahead in having achieved a very high rate of recycling PET products compared to the rest of the world. PET recycling is not uniformly high, even if one considers only the developed countries. For example, in the US, only a little over 30% of the PET bottles in circulation is collected for recycling, and more so, a quarter of that gets exported to other countries like China to get recycled. The situation is roughly same in Europe as well. Even though Europe has a higher collection rate of 59%, a very large portion of it is once again exported to China, Hong Kong and other countries.

There are various issues related to how PET bottles are used, discarded, what are the collection mechanisms in place, how they get recycled, what are the incentives, how the value chain is structured, are there enough incentives for each link in the value chain for the recycling to progress are all questions that determine the overall recycling rate of PET in any country.

TO SUMMARISE

a. Out of the **$75 billion natural cost of plastic** used in consumer goods, **food companies** are responsible for the largest contribution **(23%)** while **soft drinks** account for **(12%).**

b. **Aluminium creates more greenhouse gases**, even when manufactured with recycled materials than recycled PET bottles.

c. Unlike PET bottles and containers which often float in water, **aluminium sinks**, which can **damage our delicate coral reefs and ocean beds**.

d. **Aluminium retains its properties indefinitely,** regardless of how many times it is recycled, whereas plastics can deteriorate over time through the recycling process.

e. **Glass containers create more greenhouse gases** than plastic containers.

f. **Broken glass is dangerous to handle**, and many recycling facilities are unequipped to remove small pieces of glass, which could then contaminate other recyclables such as paper and cardboard.

g. Plastics were first used to substitute natural resources such as ivory and animal bones. However, due to the increased production of plastic, the mismanagement of its disposal, and how long it takes to biodegrade, **plastics are quickly becoming a large problem that threatens our environment.**

h. **We have to figure out how to solve our plastic problem** – be it through increased recycling, decreased production, education of the populace or a mix of all three. We should also research the impact of plastic as compared to other packaging – such as glass and aluminium.

i. Each comes with its pros and cons – aluminium keeps its shape longer but sinks to the bottom of the ocean if not disposed of properly which makes it increasingly **harder to clean.**

j. **Glass creates more greenhouse gases** to produce than plastic and is also **more difficult to recycle** especially if it is broken.

k. All in all, while plastic is not something that is very good for our environment, t**hrough proper disposal and recycling we can control how it affects the environment** and prevent further damages.

CHAPTER 2

PRODUCTION, IMPORT AND CONSUMPTION OF PLASTIC IN MALDIVES

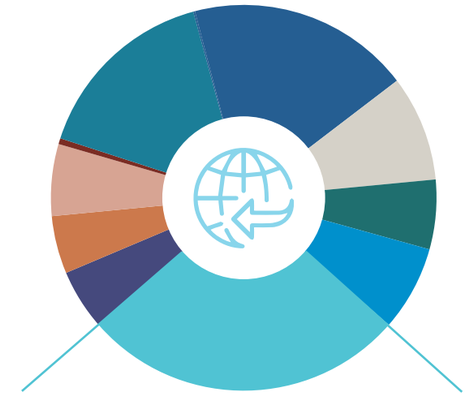
One of the important elements of management and reducing single use plastic is to measure the amount of plastic that is used and discarded. A baseline of material flow analysis, the scale of plastic and the types of plastic that are most problematic need to be identified to make evidence based and informed decisions by policy makers.

In Maldives, most of plastic we use come from two major ways – imported plastic and locally manufactured plastic. We will first look into the imports of plastics and its flows. The figure 2.1 shows the major imports of Maldives for 2018.

2.1 IMPORT AND CONSUMPTION OF PLASTIC IN MALDIVES

Like many other small island economies, Maldives is heavily dependent on imports for consumption, since the local production capacity is limited. The total value of imports in Maldives was US$ 2,960 million in 2018, followed by a slight reduction to US$ 2,888 million in 2019. The largest import by component in 2018 is machinery and electric category (19%) followed by fuel category (16%). When Plastic and Rubber is considered, it stands substantially small compared to the other imports and it only accounts for 4% of the total in 2018.

FIGURE 2.1: TOTAL IMPORTS BY MAJOR PRODUCTS IN 2018

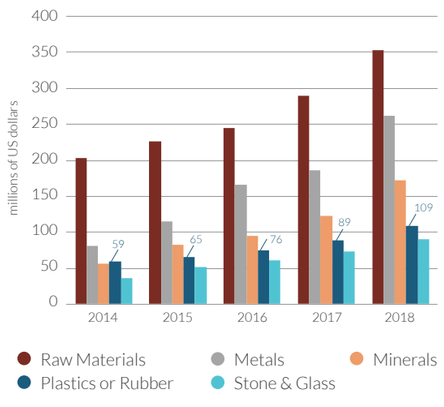


- Mach and Elec 19%
- Metals 9%
- Food Products 6%
- Miscellaneous 7%
- Hides & Skins 27%
- Animal 5%
- Chemicals 5%
- Minerals 6%
- Fuel 16%
- Footwear 0%
- Hides & Skins
- 4% Plastics or Rubber
- 3% Stone & Glass
- 2% Textiles & Clothing
- 6% Wood
- 6% Vegetable
- 6% Transportation

Source: World Integrated Trade Solution (WITS)

The figure 2.2 shows the relative size of the Plastic and Rubber category compared to other selected items which are used as inputs in the production of goods. It can be seen that Plastic and Rubber category averaged US$78 million in 2014-2018, and is relatively small compared to other items such as Raw materials (US263 million), Metals (US$162 million) and Minerals (US105 million).

FIGURE 2.2: IMPORTS OF SELECTED GROUPS



Source: World Integrated Trade Solution (WITS)

In terms of the total value of Plastic and Rubber, it stood at around US$109 million in 2018 and it has grown on average 17% during 2014-2018. The highest value of plastic imports consists of Pipes which are mostly used in the construction sector. It accounted for 25% of all plastic imports (US$30 million) followed by Plastic Lids (US$10.5 million), Plastic Building Materials (US$8.9 million) and Raw Plastic Sheeting (US$7.5 million) which are also largely used in the construction sector.

There are many different polymers that exhibit different characteristics and properties and are used for different purposes. For example, polyvinyl chloride (PVC) is commonly used in the building industry for use in double glazing frames. Polypropylene and Polyethethylene terephthalate (PET) are commonly used in the manufacture of bottles. In Maldives, the significant imports related to bottle manufacturing is Ethylene Polymers and it accounted to US$3.9 million. Other similar plastic inputs imported to Maldives includes Propylene Polymers (US$27 thousands), Amino-resins (US$3.9 million), Styrene Polymers (US$312 thousand), Vinyl Chloride Polymers (US$514 thousand), Acrylic Polymers (US$86 thousand), Polyacetals (US$6.9 million).

FIGURE 2.3: MAJOR SUB-COMPONENTS OF PLASTIC AND RUBBER IN VALUE IN 2018 (IN MILLIONS OF US DOLLARS)

Upto 5 mn	5-10 mn	10-15 mn
Amino-resins 4.63	Plastic Building Materials 8.86	Other Plastic Products 12.87
Other Rubber Products 4.37	Raw Plastic Sheeting 7.54	Plastic Lids 10.55
Other Plastic Sheetings 4.16	Plastic Floor Coverings 7.40	
Ethylene Polymers 3.93	Polyacetals 6.94	More than 15 mn
Rubber Tires 2.89	Others 5.59	Plastic Pipes 30.12
Rubber Pipes 2.40	Plastic Housewares 5.52	
Self-adhesive Plastics 2.00		
Plastic Wash Basins 1.30		

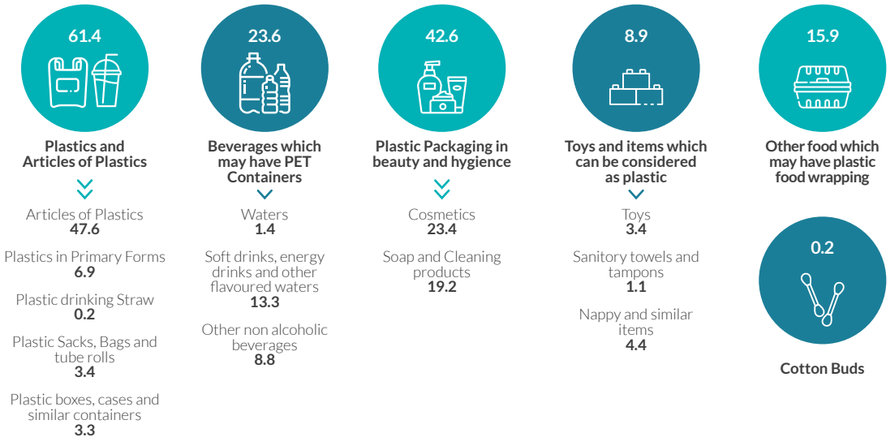
Source: Observatory of Economic Complexity (OEC)

2.2 MAJOR SUBCATEGORIES OF IMPORTS OF PLASTIC TO MALDIVES

For the purpose of this study, we have included other categories of related plastic imports and taken major six categories based on the document of Environment Ministry's policy paper including:

- Plastics and Articles of Plastics
- Beverages which may have PET Containers
- Other food which may have plastic food wrapping
- Plastic Packaging & products used in beauty & hygiene
- Cotton Buds
- Toys and items which can be considered as plastic decorations

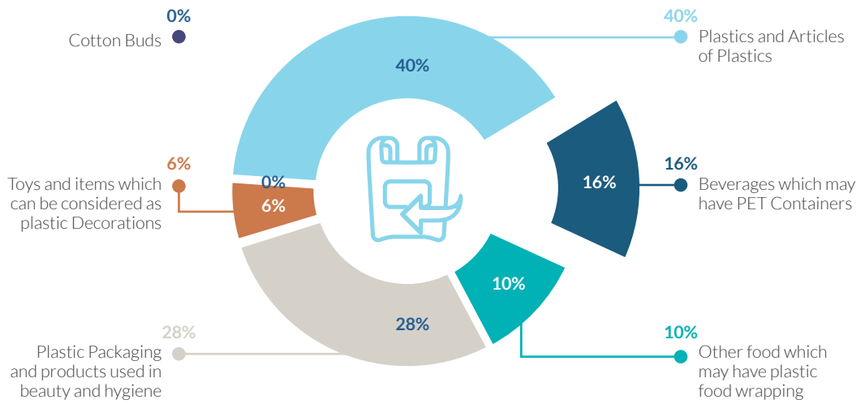
FIGURE 2.4: MAJOR PLASTIC IMPORTS IN VALUE IN 2019 (IN MILLIONS OF US DOLLARS)



Source: Maldives Customs Service

The total value of all these six categories totalled US$153 million (figure 2.4) in 2019 compared to US$144 in 2018, and as a percentage of the total imports in 2019 it was 5.3%. It can be seen that the number of total imports in 2018 at USD144 million is higher compared to Plastic and Rubber category (USD109 million) seen above. This is because more items that are not recorded in the Plastic and Rubber category are included here so as to see the full impact of total imported plastics in the Maldives.

FIGURE 2.5: MAJOR CATEGORIES OF PLASTIC IMPORTS IN 2019



Source: Maldives Customs Service

It is apparent that the majority of the related plastic imports consist of **Plastics and Articles of Plastics, which account for**

40% or **US$ 61Mn** in 2019

The second largest category is **Plastic Packaging products (which are largely used for beauty and hygiene products) and accounts for**

28% or **US$ 43Mn**

and if the **'Other food which may have plastic food wrapping' category is included** a total of **US$ 16Mn**

the total value of both categories accounts for close to **40%** of all imported plastic.

The other significant groups in the total value of imports are **Beverages** (which may have PET contents) and it amounts to

16% or **US$ 24Mn**

The share of other groups is **'Toys and items which can be considered as plastic Decorations'** at **6%**

& **'Cotton Buds'** with a mere **0.2%**

Since these imports are recorded in the customs data in different types of measurements (such as in liters and numbers), the quantities cannot be compared and as such, important subcategories are recorded separately which are in similar quantities. We will briefly analyse major components and its major trends over the year based on the data available from Maldives Custom Services.

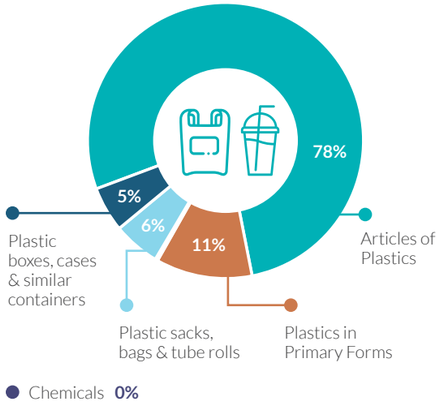
2.2.1 PLASTICS AND ARTICLES OF PLASTICS

This is by far the largest category and represents the sub-components of the Plastic and Rubber category. As per the World Customs Organization, under HS code, Chapter 39, Plastics And Articles Thereof (section 7) is the main category which record the import of plastic to country.

In this chapter, World Customs Organization defines plastic as "those materials of headings 39.01 to 39.14 which are or have been capable, either at the moment of polymerisation or at some subsequent stage, of being formed under external influence (usually heat and pressure, if necessary, with a solvent or plasticiser) by moulding, casting, extruding, rolling or other process into shapes which are retained on the removal of the external influence" .

When we look at figure 2.6, it can be seen that in the Plastics and Articles (Chapter 39), the largest component with 78% (US$47.6 million) is the Article of Plastic, followed by Plastic in the primary form with 11% (US$6.9 million), Plastic Sacks, Bags and tube rolls at 6% (US$3.4 million) and Plastic boxes, cases and similar containers at 5% (US$3.3 million).

FIGURE 2.6: PLASTICS AND ARTICLES OF PLASTICS

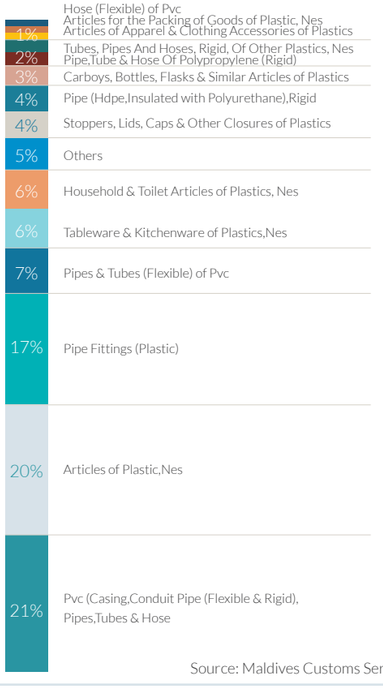


Source: Maldives Customs Service

One of the most common plastic among them which is used at very high level in daily consumption are plastic sacks and bags. Based on data availability in Maldives Customs, there were about 97 thousand or 97 metric tonnes of Polythene Tube Roll (for Packing) imported in 2019. Similarly, plastic bags are imported in large quantities and during 2019 almost 150 million Biodegradable Plastic Bags were imported, while about 16 million Plastic Bags were imported and additional 15 million Sacks and Bags (of Polymers of Ethylene) were almost imported during the same period.

The following are the major breakdown of Article of Plastic and it can be seen it has many different categories which are related to plastic. However, the largest category is the PVC (Casing, Conduit Pipe and Pipes, Tubes & Hose) and in 2019 a total of US$155 million or about 9 million meters (MTR) were imported. That adds up to 21% of all plastic of Article of Plastic and are mostly used in construction industry.

FIGURE 2.7: BREAKDOWN OF ARTICLES OF PLASTICS



Source: Maldives Customs Service

2.2.2 PLASTICS IN PRIMARY FORMS

Plastic in primary form accounts of 11% (US$7 million) of all Plastics and Articles of Plastics in 2019. During 2019, a total of 1100 tonnes of various form of plastic were imported that are largely plastics in primary forms such as polyethylene, fiber glass resin and epoxied resins.

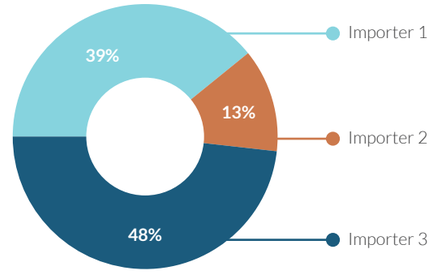
Among them, one of the significant inputs used to manufacture PET plastic bottles consumed substantially domestically is Polyethylene terephthalate. **Polyethylene terephthalate (PET or PETE) is a strong, stiff synthetic fibre and resin. It is a member of the polyester family of polymer and is spun into fibres for permanent-press fabrics and blow-moulded into disposable beverage bottles.** They are mainly imported from China, Oman and India. The PET Resin importation has greatly increased over the past three years and on average it amounted 2300 tonnes and this is about 30% of all such Plastic in primary forms. It is observed that producers of such PET bottles are 3 major manufacturers and since two of the producers have a market share of over 80%.

TABLE 2.1 PET RESIN (POLYETHYLENE TEREPHTHALATE) IMPORTS

Company	2017	2018	2019	2020 est
Weight (Metric Tons)	1,761	1,703	3,507	2,321
Value (in millions of MVR)	29.5	42.5	61.8	36.1

Source: Maldives Custom Service

FIGURE 2.8: MAJOR IMPORTERS OF PET RESIN IN 2019



Source: Maldives Custom Service

2.2.3 BEVERAGES

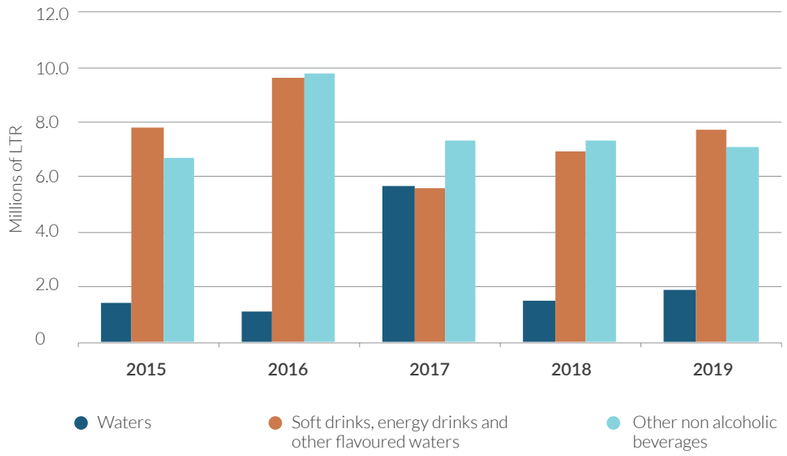
The figure 2.9 depicts the imported quantity of beverages which may have PET containers as the actual packaging is not clear from Maldives Customs data. Annual imports of water is at 2.3 million liters but if we exclude 2017 as an outlier the average consumption of imported water is about 1.5 million liters per year. The increase of mineral water bottles in 2017 could be attributed to the increase in demand during the dry season and a decrease in local production causing a shortage.

Soft drinks, energy drinks and other flavoured water beverages can come in cans, PET bottles and even in glass but data is not available of the breakdown by packaging.

The average of such drinks has been around 7.5 million liters and has had double digit growth except in 2017 when it decreased by over 40% on an annual basis. Lastly, other non-alcoholic beverages have almost same amount and on average 7.6 million liters.

They can also have different types of packaging. However, even if we assume all of them are various plastic bottles, a rough estimate (based on average weights of standard sizes of PET bottles) will be around **80,000 bottles imported** every year. This can roughly mean about 100 tonnes of plastic is imported as beverages.

FIGURE 2.9: IMPORT OF BEVERAGES WHICH MAY HAVE PET CONTAINERS (LTR)



Source: Maldives Custom Service

2.2.4 OTHER FOOD WHICH MAY HAVE PLASTIC WRAPPING

Other foods which may have plastic wrapping accounts for 10% of the value of major categories of plastic imports in 2019 as above. Since the imports of these are recorded in different units and plastic weights are also not recorded, an accurate estimate of plastic weights cannot be made. As such, based on available data of the weights of the products, about 4000 tonnes of such foods items were imported in 2019. However, these 4000 tonnes include the content weights of these products and subsequently its PET content would be much lower than this amount.
In addition, about 3.7 million liters of such products were imported in 2019.

2.2.5 PLASTIC PACKAGING AND PRODUCTS USED IN BEAUTY AND HYGIENE

The other category of significance is Plastic Packaging products (which are largely used in beauty and hygiene uses) and accounted for 28% of value of major categories of plastic imports in 2019 as above. This includes cosmetics, soap and cleaning products. As a share of the value of imports, the largest category is cosmetics with 55%. Since the weights of plastic and other details are not available in the data, we can look to the total quantities in different forms. As such, for cosmetics there were a total of1000 tonnes of such hair colouring, beauty & skin-care products which were packed in plastic.

Similarly, products such as shampoo, makeup and eye make-up remover had about 3 million liters of imports in 2019. For instance, in 2019 there were more than 570,000 liters of shampoo bottles imported. Likewise, there were many other items in numbers such as lip balm and products pertaining to pedicures and manicures with plastic content which have been imported, For instance, in 2019 there were about 170,000 such bottles imported.

2.2.6 COTTON BUDS

This is another item which the Government is planning to ban in 2021 since it is used in daily household consumption, and as a total value of imports in the selected plastic items it represents only 0.2% of the total value of imports. However, the number of cotton buds are quite high and in 2019, and there were more than 31 million cotton buds imported. If we assume that on average it has a weight of 0.25g per unit for plastic stemmed cotton buds , this means around 8 tonnes of plastic is consumed as cotton buds alone.

2.2.7 TOYS AND ITEMS WHICH CAN BE CONSIDERED AS PLASTIC DECORATIONS

This item includes things such as balloons, sanitary towels, tampons, nappies, toys and similar items. As a percentage of the total value of selected plastic items this has a value of 6%. The largest category among the above mentioned are nappies and as of 2019, the Maldives has imported about MVR4 million worth of items. Further analysis shows that there were more than 35 million such napkins (for both babies and adults) imported, and that they were mostly disposable and single use ones. If we assume that each nappy weigh around 100 grams, and if around 33% of it is plastic , a total of over 1000 tonnes of plastic nappies are consumed and dumped as waste. In addition, there were more than 24 million sanitary towels, tampons and over 7 million toys at different sizes imported in 2019.

2.3 DEMAND FOR PET BOTTLES IN MALDIVES

Due to the geographical nature of the Maldives, communities are mostly separated by sea. There are 188 inhabited islands, and 150 registered resorts operated on separate islands. Traditionally, islands relied on ground water, and rainwater collected during the rainy season. However, since the early 2000s, most islands are unable to rely on their ground water, and with growing populations in many islands collection of rain water has also become challenging.

The Government established the state water company, Male' Water and Sewerage Company (MWSC) in 1995, and residents of Male' have been provided connections to desalinated water. Following the December 2004 tsunami, some of the islands in the atolls have received installation of desalination water plants, and household connectivity through grant assistance from international donor agencies. Today, with only 40 inhabited islands with water connections, Government aims to provide water and sanitation services to all inhabited islands before November 2023.

As per the results of a study done by (Latheef, 2019) only

trusted public utility water as a source of drinking water,

and **86%**

trusted mineralized bottled water as a source of drinking water.

More than **78%**

of the respondents used bottled water for drinking at household level,

while around **14%**

used filtered tap water.

A similar behavior is seen even in office environments and educational spaces as well.

When we take into consideration all three settings, the choice of drinking water

60%

of the time is bottled water

13%

of the time is filtered tap water

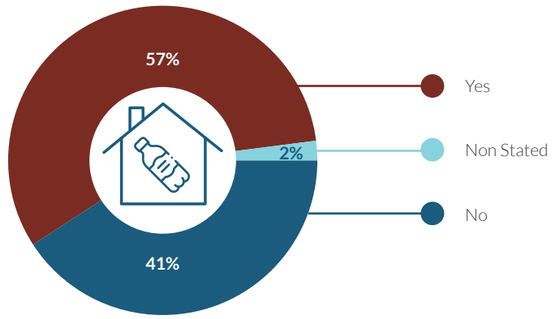
12%

of the time is water cooler with a barrel

Among the 29.5% of the respondents who had trust in the public utility water, 48% still used bottled water. When asked to give a score between 1 and 5, on the safety and hygiene of utility water, 10.9% gave a score of 1, while 21.4% gave 2, and 37% gave 3. However, 50% of respondents gave a score of 4, while 28% gave a score of 5 to bottled water.

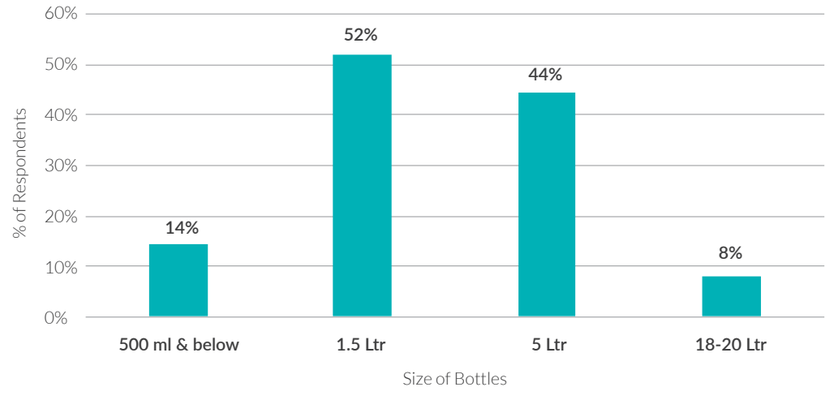
As per the survey conducted by NIG Capital, we found that more than 57% of the households in the Maldives are consuming mineral water in PET bottles, which is higher than the rate as per the last Census.

FIGURE 2.10: PERCENTAGE OF HOUSEHOLDS USING MINERAL/BOTTLED WATER FOR DRINKING



Source: NIG Capital Survey, 2020

FIGURE 2.11: USAGE OF MINERAL WATER BY SIZE OF BOTTLES BY HOUSEHOLDS

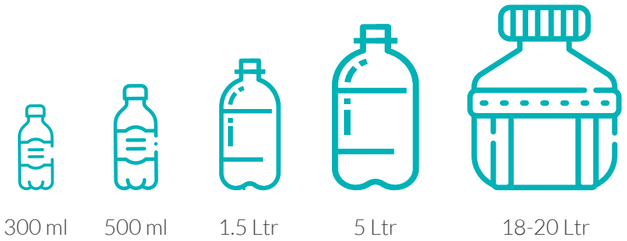


Source: NIG Capital Survey, 2020

2.3.1 PRODUCTION OF PET BOTTLES IN MALDIVES

There are three major producers of mineral water bottles in the Maldives: Male' Water and Sewerage Company (MWSC) producing the brand "TaZa", Happy Market Trading Company producing "Life" brand, and the Male' Aerated Water Company (MAWC), producing the brand 'Bonaqua'. In addition to mineral water, MAWC also produces soft drinks under the Coca Cola umbrella.

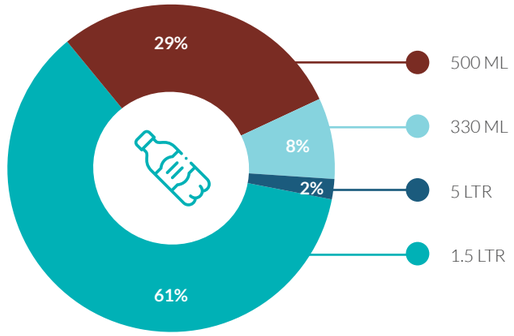
Mineral water is produced and distributed in five main bottle sizes in the Maldives:



An estimated **143,293,343** **bottles were produced in the year 2019**

which is equivalent to **3,300 TONNES**

FIGURE 2.12: BOTTLES PRODUCED BY SIZE



Source: NIG Capital Household Survey 2020

The chart above depicts that 61% of total production in the country accounts for 500 ml bottles, while 29% are of 1.5 Ltr. 5 Ltr bottles and above account for about 8% and 330 ml is about 2% of total production.

When the soft drinks are excluded, total number of water bottles produced is estimated at 128,552,540 (equivalent to 3 thousand tons) per year. The number has been derived through data collected from the producers and imports data of resin which is used in the bottle production.

As per the household survey conducted by NIG Capital, 57.5 million bottles are consumed per year by the households, corresponding to 45% of the total production. The data also reveals that 52% of the total production goes to the atolls, while 48% is consumed in Male'. Detailed discussion of household survey results and consumption patterns are discussed in the next chapter.

TO SUMMARISE

a. Plastic and Rubber constituted **4% of total imports** of Maldives in 2018.

b. **Importation of plastic** has grown on average **17%** between 2014 and 2018.

c. Some of the **most common plastic used** at a high level in daily consumption in the Maldives are **plastic sacks and bags**. (Around 150 million biodegradable plastic bags, 16 million plastic bags were imported in 2019).

d. **Annual imports of water is about 1.5 million litres per year**, if 2017 is considered an outlier. (Refer to figure 2.9)

e. Traditionally, islands relied on ground water and rainwater for drinking. However, **due to growing populations** this is quickly becoming **unfeasible.**

f. More than **78% of residents in Male' use bottled water for drinking** at a household level, and 14% use filtered tap water.

g. **57.5 million bottles** are consumed every year by households, which corresponds to **45% of the total production.**

CHAPTER 3

SOCIO-ECONOMIC IMPACT OF PET

POPULATION

As per the last Maldives Population and Housing Census Report 2014, Maldives resident population was about 402,071 in September 2014. This includes 338,434 Maldivians and 63,637 foreign residents. The latest estimates of National Bureau of Statistics projects total resident population of Maldives in 2020 at 557,426 with 379,270 Maldivians and 178,156 resident foreigners.

The population of the Maldives is dispersed into 188 inhabited islands separated by sea. The capital city of Male', consisting of Male', Villingili, and Hulhumale' has a total population of 227,486 divided into 24,961 households. The total resident population in the Atolls is at 248,017 divided into 39,471 household. Additionally, there are 166 registered resorts, with a total bed capacity of 37,602. The total resident population in the non-administrative islands is at 81,924.

ECONOMY

Maldives economy is dependent heavily on the tourism sector, with fisheries, construction, trade and service sector as other major economic activities in the country. The nominal GDP reached USD 5.6 billion in 2019, and is estimated to shrink to USD 3.8 billion following the global pandemic (MMA, 2020). Tourism, as the highest contributor to the economy accounts for more than 30% of GDP directly. Maldives has made significant progress in meeting the Millennium Development Goals (MDGs), as the country has been graduated to a middle income country. Maldives has also made substantial progress in eradicating extreme poverty, achieving universal primary education, reducing child mortality, improving maternal health, and demonstrating strong commitments to the social sectors.

In terms of climate change resilience, Government infrastructure projects have been implemented in recent years to develop safer, environmentally resilient islands with a greater commitment to renewable energy sources, integrated water resources management, and resilient sewerage systems. Given that Maldives economy and social well-being is very much linked to its natural environment, particularly its marine environment resources, the sustainable management of these resources have been a key priority of the Government.

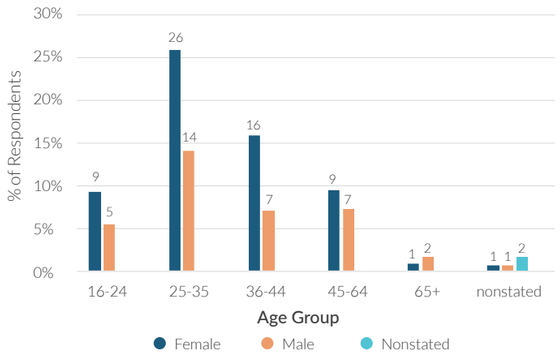
3.1 RESULTS OF THE HOUSEHOLD SURVEY ON PET USAGE

The results of the household survey conducted by NIG Capital will be summarized by looking into four main areas – demographic characteristics of the respondents, consumption of PET bottles and the perception and reaction of households to a plastic ban.

3.1.1 DEMOGRAPHIC CHARACTERISTICS OF RESPONDENTS

From the 688 responses that were garnered from across the Maldives, the results are analyzed at National level, Atolls level and for Male'. Of the total sample, 62% of the respondents were female and the majority were between the ages of 25-35.

FIGURE 3.1: DEMOGRAPHIC CHARACTERISTICS OF RESPONDENTS

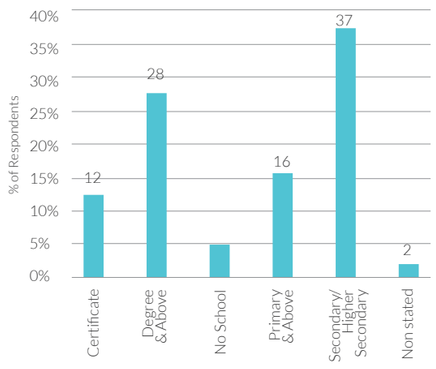


Source: NIG Capital Survey, 2020

With regards to the educational qualifications of the respondents, 40% had stated they had pursued a tertiary education (degree and above), followed by 37% that stated that they had attended secondary or higher secondary school and lastly 7% of the respondents had not attended school or did not state their level of education.

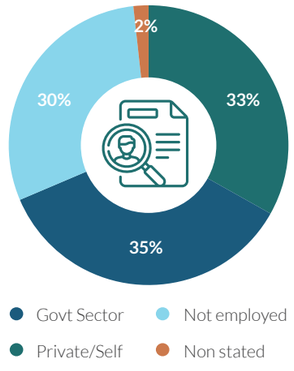
These results showcase that the sample represented a high number of well educated, young population. Similarly, more than 60% of the survey participants were employed – with 35% in the Government sector and 33% in the private sector.

FIGURE 3.2: EDUCATIONAL QUALIFICATION OF RESPONDENTS



Source: NIG Capital Survey, 2020

FIGURE 3.3: EMPLOYMENT STATUS OF RESPONDENTS



Source: NIG Capital Survey, 2020

3.1.2 CONSUMPTION OF PET BOTTLED WATER

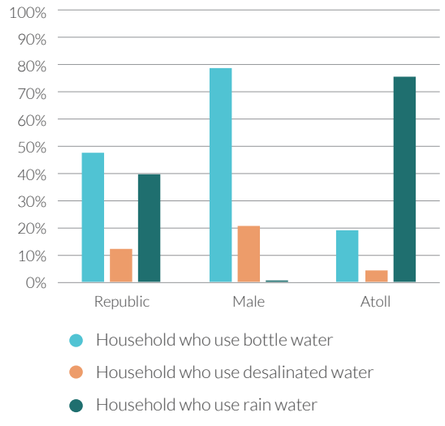
The survey results show that there is a large demand for PET bottles in the Maldives. As per the survey, on a national level 57% of respondents stated that they consume PET water bottles for drinking. Of this percentage 68% represents consumption in Male', and 53% represents consumption in atolls. Compared to HIES (Household Income and Expenditure Surveys) 2019, which showed a national average of 48% of households who use bottled water as their main source of drinking water, this percentage is higher as per the results of this survey.

However, HIES 2019 of the National Bureau of Statistics (NBS) showed a higher percentage of PET bottles used for drinking in Male' at 79%, and a lower percentage for atolls at 19%. Similar studies done by Latheef (2019) and Ibrahim (2019) have confirmed high amounts of consumption of PET water bottles in the Maldives. As per Latheef(2019) survey conducted in Male' with a sample of 384, over 60% of people used PET water bottles as their main source of drinking water while as per the study conducted by Ibrahim (2019), showed a much higher rate of consumption at 83% with PET water bottles as the main source of drinking water in the study.

Our survey also showed that 41% of the sample population does not consume mineral water (often packaged in PET bottles), and the number is high in the atolls, at 45%. This is consistent with HIES 2019 findings, which showed that consumers in atolls largely consume rainwater.

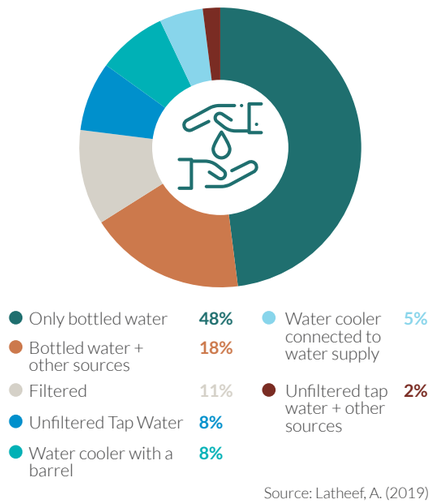
As per HIES 2019, 76% of residents in the atolls consume rainwater, and only 5% consume desalinated water mostly due to the lack of RO water connections. Latheef's (2019) survey also noted that unfiltered tap water was chosen 8% of the time, filtered tap water 11%, water cooler with barrels at 8% and water cooler connected to water supply was 5%.

FIGURE 3.4: TYPES OF WATER CONSUMED BY HOUSEHOLDS (HIES 2019)



Source: National Bureau of Statistics

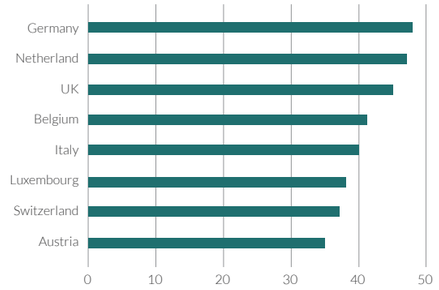
FIGURE 3.5: SOURCES OF DRINKING WATER AMONG RESPONDENTS THAT HAD TRUST IN PUBLIC UTILITY WATER AS A SOURCE OF SAFE DRINKING WATER



Source: Latheef, A. (2019)

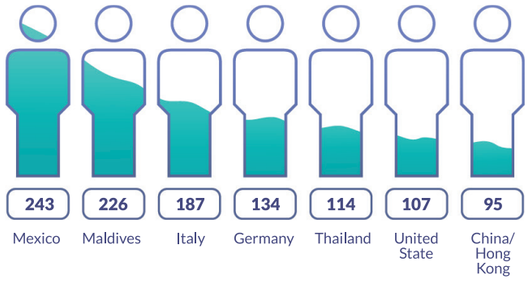
Using the survey results, it was estimated that a total of 57 million bottles or 125 million litres of bottled water is consumed in Maldives by households at home per year. If we do a per capita comparison, it can be seen from Figure 3.7 that Maldives per capita consumption of bottled water of 226 litres per year is much higher than some of the European countries such as Germany and Italy with 134 and 187 litres per capita respectively. However, even with high consumption levels, as it is shown in Figure 3.6 these European countries, the recycling rates are comparatively higher as well, which is above 40 percent.

FIGURE 3.6: PLASTIC PACKAGING RECYCLING RATE FOR SELECTED COUNTRIES IN EU



Source: Plasticseurope, association of plastic manufacturers

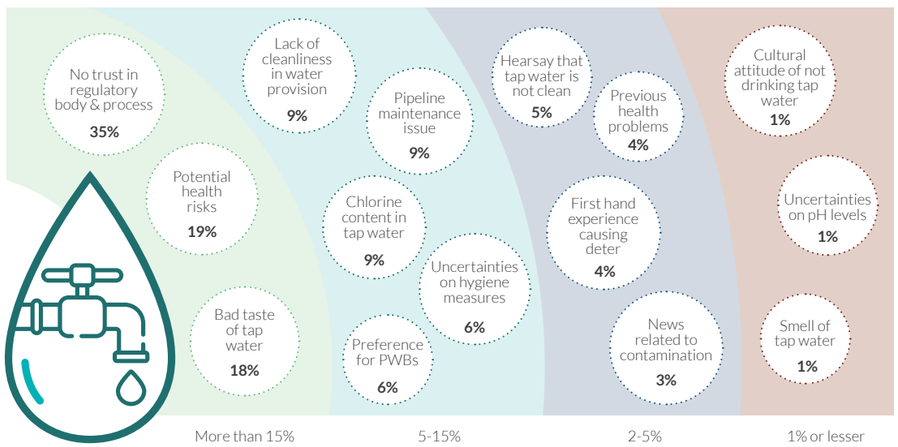
FIGURE 3.7: PER CAPITA BOTTLED WATER CONSUMPTION OF SELECTED TOP COUNTRIES (LITRES PER PERSON PER YEAR)



Source: Canadean Ltd

The amount of consumption of bottled water in Maldives is very high compared to similar developing countries especially in Male' where utility company is providing tap water and this could be that there is huge mistrust and negative perception with the water quality provided by utility companies.

FIGURE 3.8: EXPLANATIONS FOR UNWILLINGNESS TO USE TAP WATER AS MAIN SOURCE OF DRINKING WATER

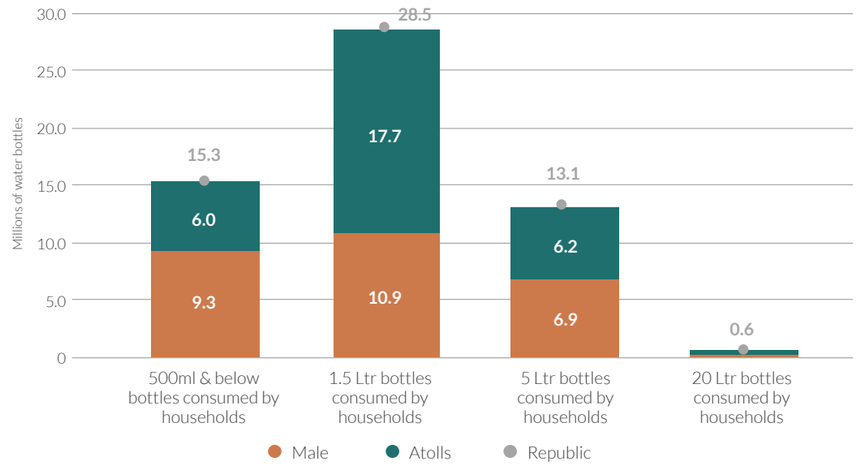


Source: Latheef, A. (2019)

This was confirmed by both studies of Latheef (2019) and Ibrahim (2019) as consumers have high preference to PET water bottles. As per Latheef (2019) taste of utility water was one of the main factors influencing the public's choice to opt for bottled water over tap water, as almost half (46.8%) of respondents gave the taste of utility water a score of 2 and below. Similar responses were found by Ibrahim (2019) and it showed when asked about the likelihood of opting for tap water as the principal source of drinking water, 78% of respondents declined and their major reason is seen in the figure 3.8. The major responses highlighted clear dissatisfaction in the treatment process, distribution process and regulatory authorities.

As per different sizes of water bottles, the survey by NIG Capital shows that most of the households prefer to use 1.5 litres (L) and 5 litres while 500 millilitres (ml) and 20 litres were not used much. As can be seen from the figure 3.9, over 73% of consumers are consuming those two categories and this amounted to over 41 million bottles or of water in this category.

FIGURE 3.9: BOTTLED WATER CONSUMED BY DIFFERENT SIZES BY HOUSHOLDS AT HOME

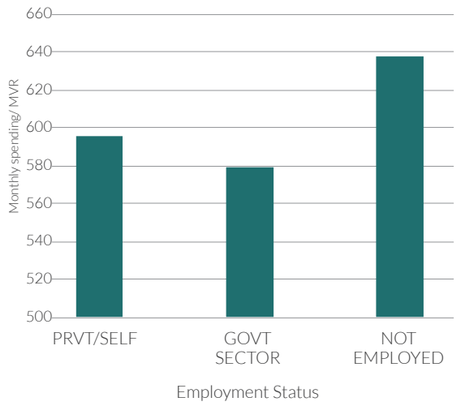


Source: NIG Capital Survey, 2020

3.1.3 EXPENDITURE ON THE CONSUMPTION OF PET WATER BOTTLES

With regard to expenditure on PET water bottles, on average households spent more than MVR600 per month across Maldives. The amount spent is high among private and self-employed individuals compared to those employed in the Government sector. This is a significant amount considering the average monthly income of households. Based on the average incomes reported in the HIES 2019 survey, this amount represents on average 2% for Male' and even high in the atolls at 3%. As per HIES 2016, the households spent on average 2.3% for non- alcoholic beverages and a large part would be on bottled water. In addition, the households spent on average 2% on water bills , and this percentage is higher in Male' at 4%. Hence, it can be concluded that consumers spent on average 4-5% of their income for total water consumption which is significantly high compared to other similar smaller island countries.

FIGURE 3.10: AVERAGE MONTHLY SPENDING ON WATER BY EMPLOYMENT STATUS OF HOUSEHOLDS

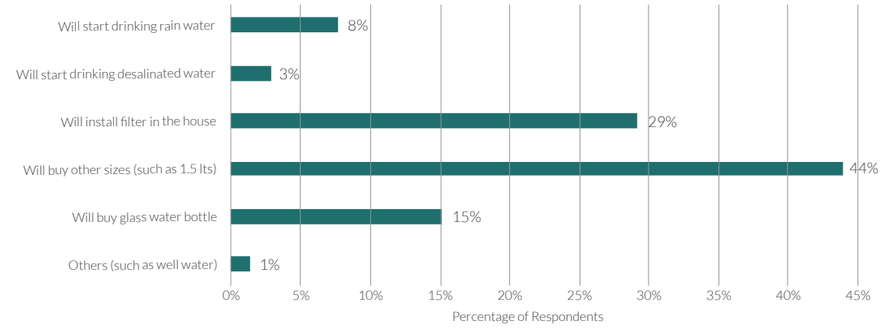


Source: NIG Capital Household Survey 2020

3.1.4 PERCEPTIONS ON THE POSSIBLE BAN

As per Government of Maldives's pledge in Strategic Action Plan (SAP), the President Ibrahim Mohamed Solih on 5th Nov 2019 approved the proposed plan by the Ministry of Environment to phase out single-use plastics in the Maldives by the year 2023. President Solih initially announced the Government's intention to phase out single-use-plastics from the Maldives by the year 2023, during his maiden trip to the United Nations General Assembly, to attend its 74th session, held in New York in 2019. In order to tackle the problem, the Government plans on using a 'drawdown' model for reducing plastic waste: implementing a series of 'smart policies' aimed at eradicating the most problematic plastics from the country, using policy interventions ranging from outright bans and taxes to new industry standards and guidelines. One of the policy key policy in the draft plan published by Ministry of Environment on 17th August 2020 was a complete ban of all imported and locally produced beverages in PET packaging below 300ml and below (includes water and soft drinks) by Jan 2021 and all imported and locally produced water that is below 1 litre and packed in PET packaging from December 2023 onwards.

FIGURE 3.11: ALTERNATIVE MEASURES RESPONDENTS ARE WILLING TO CHOOSE IF A BAN IS ON SMALL PET BOTTLES



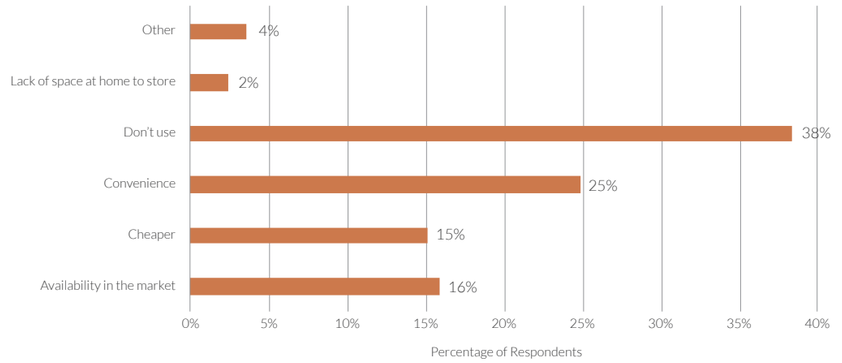
Source: NIG Capital Household Survey 2020

To gauge the impact of this possible ban, one of the main key question asked to households in the survey was their perception on the possible ban of bottled water . With regard to possible ban of smaller water bottles, households were largely unworried as they can easily swap and substitute to the larger size (44%) of PET bottled water and only 3% had responded that they would be switching back to desalinated water or rain water while over 29% of households (a high percentage of highly educated group) have expressed their willingness to install filter systems at their homes if such a ban took place.

Even though 38% of the households do not consume smaller PET water bottles at home, when asked about the reasons for the use of smaller sized bottles, more than 25% of households said it is convenient to use such sizes while other 15% buy it as it is relatively cheaper. In addition, 16% of respondent have said they buy such smaller sizes as it is available in market.

In addition, the survey also found that more than 15% of the responded said they may be willing switch to glass water bottles if there is a ban on PET water bottles. However, only 8% of the respondents said they are willing to pay a price higher than MVR10 to buy glass water bottles while over 58% are willing to pay a price of MVR6 and 35% are willing to pay a price of MVR10.

FIGURE 3.12: REASONS FOR SMALLER BOTTLE PREFERENCE



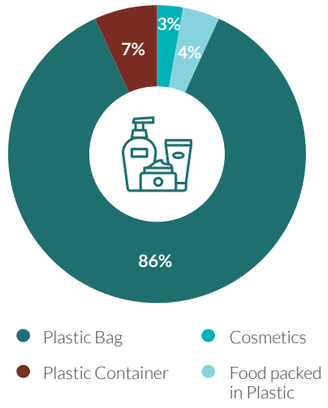
Source: NIG Capital Household Survey 2020

3.1.5 CONSUMER PERCEPTION PET RECYCLING AND ENVIRONMENT

The survey shows that consumers are aware and conscious of the negative impact on the environment, of disposing PET bottles and previous two studies conducted by Latheef (2019) and Ibrahim (2019) have already confirmed this behaviour. As such more than 70% of the households have responded favourably to pay more for alternatives such as glass bottles in order to avoid usage of plastic waste and to help to protect the environment.

Apart from PET bottles, 86% of the households identified use of plastic bags as their most commonly used plastic. In addition, there is also a high consumption of plastic containers (7%) followed by food packed in plastic (4%) and cosmetics (3%) which have plastic content and are used and thrown as waste.

FIGURE 3.13: PERCENTAGE OF COMMONLY USED PLASTICS IN MALDIVES APART FROM PET BOTTLES



Source: NIG Capital Household Survey 2020

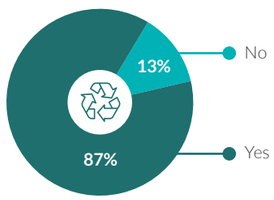
One of the main issues regarding plastics is how it is collected and managed. More than 59% of respondents are not happy with how the garbage and waste is collected and they believe waste collector does not give enough importance in sorting and management of waste. As such, since no clear system and mechanism is advised and provided by waste collectors, more than 28% has responded that they find it difficult to sort plastic and non-plastic every day.

FIGURE 3.14: CHALLENGES FACED IN DISPOSING GARBAGE BY HOUSHOLDS

Source: NIG Capital Household Survey 2020

In addition, the survey clearly shows that households are also aware that PET water bottles can be recycled. As per the Chart shown, more than 87% of households are aware that PET bottles can be recycled, which shows that people may be more willing to help the environment by recycling such plastic rather than disposing the plastic in a harmful way.

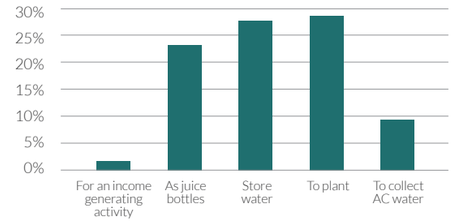
FIGURE 3.15: AWARENESS OF RECYCLABILITY OF PET BOTTLES



Source: NIG Capital Household Survey 2020

Lastly, many households make use of the empty PET bottles after consumption. As such more than 75% use empty water bottles for other purposes. The Chart shown indicates several different ways in which household reuse plastic bottles. More than 28% use it to store water, while 29% use it for planting and 23% use it to store homemade drinks.

FIGURE 3.16: HOW PLASTIC BOTTLES ARE RESUSED BY THE HOUSEHOLDS



Source: NIG Capital Household Survey 2020

3.2 CONSUMPTION OF PET WATER BOTTLES AT RESTAURANT AND CAFE' INDUSTRY

From the previous section, it was evident that about 45% of the total PET water bottles are consumed by the households, while 21% is estimated to be consumed in the resorts. This leaves 34% which is estimated to be consumed in restaurants and cafés.

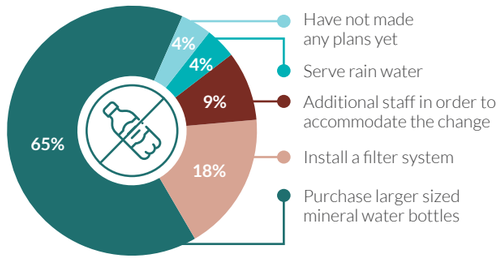
The restaurants in Male' and the atolls mostly sold 500 ml and 1.5 Ltr mineral water bottles to their customers. The restaurants and cafés in the atolls on average sold 3.7 cases (89 bottles) of 500 ml per day on average, while 1.3 cases (16 bottles) of 1.5Ltr bottles were consumed. The average for Male' is at 175 bottles of 500ml and 40 bottles of 1.5Ltr per day. Prices in Male' range from MVR5 to MVR 14 per bottle for a 500 ml bottle, while for 1.5Ltr it ranges between MVR 12-28 per bottle.

When asked about a possible ban of 500 ml bottles, 45% of the respondents stated that they will purchase larger sized mineral water bottles, and provide customers with reusable glass bottles. However, 18% of the respondents said they will opt to install a filter system so that filtered tap water can be served to customers in glass bottles.

About (9%) respondents said that it will be very difficult for them, and that they will require additional staff in order to accommodate the change. While 4% of the respondents said that they will serve rain water, and the remaining 4% of the respondents saying that they have no plans yet.

Based on the Key Informant Interviews, Restaurants in Male', on average is estimated to make MVR 42,724 as profit per month from the sale of 500 ml water bottles, while in the Atolls, the average is about MVR 6,675 per month.

FIGURE 3.17: RESPONSES OF KEY INFORMANTS OF RESTAURANTS/ CAFÉ IF A BAN OCCURS FOR SMALLER BOTTLE WATER



Source: NIG Capital Survey, 2020

3.3 CONSUMPTION OF PET BOTTLES AT RESORTS

Maldives has a total of 166 registered Resorts, with a total bed capacity of 37,602 as at December 2020.

166
Registered Resorts

The pre-covid total tourist arrivals in 2019 was at
1.7 MILLION

An estimated
27.2 MILLION PET BOTTLES
from the domestic production are consumed in the Resorts, which is about 21% of the total production.

The total estimated revenue per year, generated from the sales of water bottles in the resorts exceeds
MVR 700 MILLION

Out of the total PET bottles consumed in the resorts, about 15% are 330ml soft drinks bottles that are usually sold at the mini-bars in the guest rooms. These single-serve bottles are sold to guests at an average price of $4-5 per bottle. Additionally, the 330ml water bottles are also provided free of charge in most speedboat transfers between the resorts and the airport.

Resorts also serve an estimated 11.1 million 500ml bottles per year, and constitutes about 41% of the total consumption in the resorts segment. Guests are served at the restaurants and are also given free of charge during transfers in speedboats.

The 1.5 Ltr sized mineral water bottles are given complementary in guest rooms and also served at the restaurants in the resorts, and make up about 44% of the total consumption of plastic bottles in the resorts.

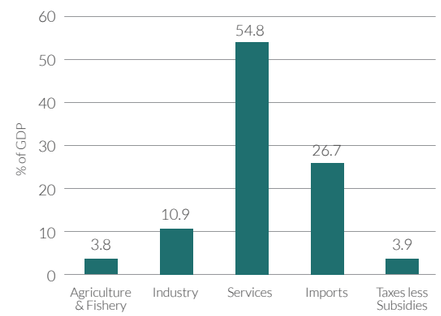
As per the Key Informant Interviews conducted with the Resorts, most five star and four star properties interviewed operate their own bottling plant, and use refillable glass bottles to serve drinking water. While 30% of the resorts interviewed, which are mostly three star properties, purchase and serve locally produced PET bottles in their minibars, restaurants, guest rooms and transfer speedboats. However, all of these resorts that are three star properties, have plans for own bottling plant, and switch to refillable glass bottles in the future.

All the resorts interviewed dispose their plastic waste by sending compacted bottles to Thilafushi.

3.4 BENEFITS TO PRODUCERS AND GOVERNMENT AND CONTRIBUTION TO GDP

The Maldives GDP is heavily dependent on the tourism industry, which is represented in the services sector as shown in the Figure 3.18. The imports sector represents 26.7%, while the industry has a 10.9% share. The bottling industry is among the very few industries in the country, and is estimated to be at 2% of GDP.

FIGURE 3.18: MALDIVES GDP COMPOSITION



Source: National Bureau of Statistic Maldives

The total employment in the beverages production sector is estimated at **930**
broken down into factory production at **540 & 390** in the delivery and distribution.

In addition to the director employment in the industry, as per interviews with key industry players, there are more than
2500
retail shops or distributors that benefit from this industry.

The total revenue for the producers from the sale of beverages in 2019 exceeds
MVR 933 MILLION
as per data from Maldives Inland Revenue Authority (MIRA).

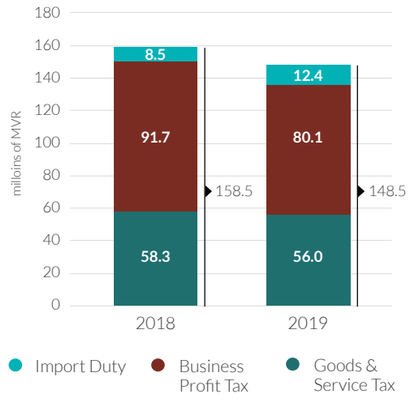
The producers' combined net profit for 2019 is estimated to exceed
MVR 530 MILLION
(MIRA, 2020).

The Male' area with an estimated population of 227,486 as at 2020, is highly crowded and is among the cities with highest population densities in the world. With a significant percentage of residents relying on cafés and restaurants for their daily meals, use of PET bottles in the restaurants is prevalent. As per the results of the NIG Household Survey, and

the Key Informant Interviews, about 60% of the 500ml water bottles produced are consumed in the restaurants and cafés. The total estimated revenue for the restaurants industry from the sale of water bottles exceeds MVR 240 million per year (NIG Capital own estimates).
Since an estimated 20% of the total production of 500 ml and 1.5 Ltr bottles are consumed in the tourist resorts, an estimated total revenue of MVR 700 million is generated from the sale of water bottles in the resorts per year.

As per data obtained from MIRA and Maldives Customs Service, Government received a total tax income of MVR 148 million from all the producers in 2019, and MVR 158 million in 2018.

FIGURE 3.19: GOVERNMENT REVENUES FROM PET BOTTLE INDUSTRY



Source: Maldives Custom Service & Maldives Inland Revenue Authority

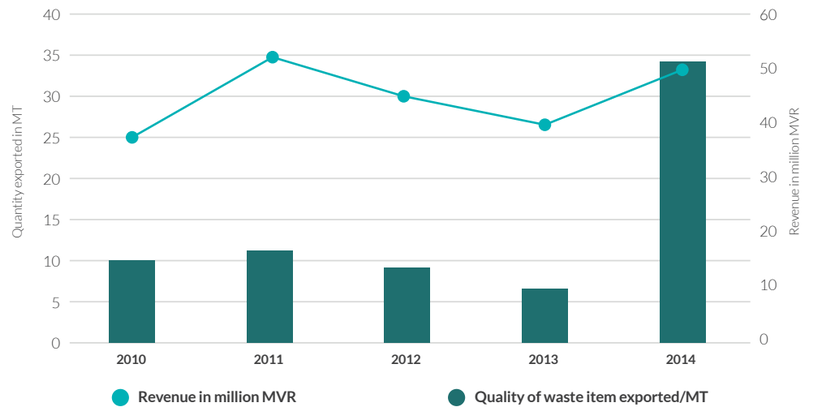
3.5 BENEFITS TO EXPORTERS OF PLASTIC

Statistics from Maldives Customs Service shows that approximately 7,277MT of waste material worth over MVR 50 million was exported in 2014 alone. The waste items exported in 2014 included but were not limited to waste oil, parings and scrap of plastics, waste paper, waste and scrap of steel, copper scraps, wastes and scraps of aluminum and battery waste. In 2018, a total of MVR47 millions of waste material was exported while in 2019 this amount increased to MVR56 million. The total value of Plastics and Rubber amounted MVR3.9 million in 2018 and 47% accounted for scrap plastic and plastic lids. As such, by exporting plastic (Articles of plastic and waste, parings and scrap of other plastics), a total of MVR 2.4 million was received as revenue in 2019 while in 2018 it was MVR1.8 million. On average only 488 tones of plastic was exported per year.

Parley Maldives is the local chapter of an International NGO and one of their key goals of them is creating the blueprint for global change with steps towards a new, blue economy in Maldives. Parley has been addressing global waste issues and they have been actively involved in reducing and recycling PET bottles in Maldives. Using their Parley AIR Strategy, they have been collaborating and working with public and private sector in intercepting and recycling plastic waste, and educating the public and schools. They are also involved in export and majority of the exports of plastic of 488 tonnes is exported by Parley but this represents only 13% of PET produced and consumed locally and only 1% of the total plastic waste estimated to be produced annually in the Maldives. As per ADB report in 2018 , in 16 months, they have exported 34 containers, 40 feet each and each container costs US$ 5000 for logistics and export charges and as ADB has recommended the establishment of the waste transfer facility would help to improve the collection of the recyclable materials. After exporting the recycled plastic, Parley Maldives has also been partnering with international brands such as Adidas in using the recycled material from PET bottles to produced t-shirts, shoes, and even sunglasses.

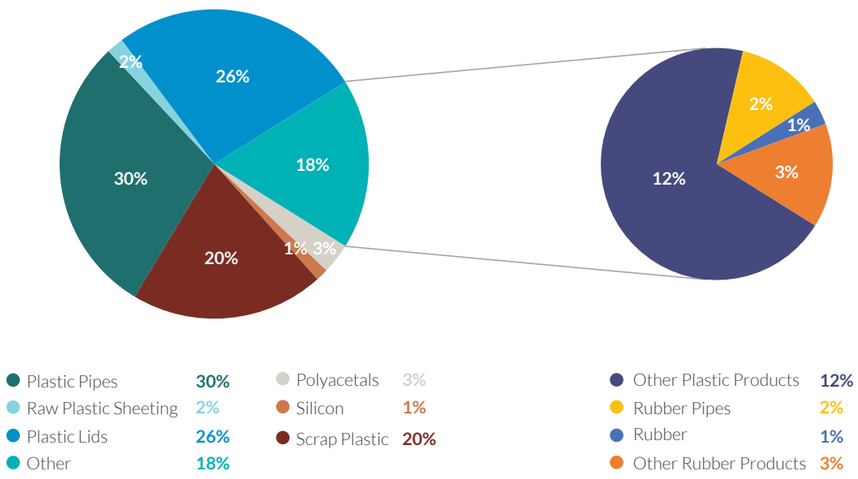
At the moment, since of Waste Management Corporation Limited (WAMCO) is burning the remaining plastic produced in Maldives of over 40,000 tone, there is a huge opportunity cost of over MVR160 million of potential revenues they could have earned if they are properly managed and exported.

FIGURE 3.20: QUANTITY AND VALUE OF RECYCLE MATERIALS ARE EXPORTED, 2010-2014



Source: Maldives Custom Service, (2015)

FIGURE 3.21: EXPORT OF PLASTIC AND RUBBER IN 2018



Source: Observatory of Economic Complexity (OEC) database

3.6 IMPACT OF PET ON THE ENVIRONMENT

Even though plastic packaging has several advantages, the production and consumption of plastics also negatively impact the environment, including human health and wildlife, which also has economic impacts. When plastic waste is littered, it ends up in landfills, which consumes land space, and poses socioeconomic and health impacts to communities. Moreover, plastic waste in marine and coastal ecosystems kills up to 1 million seabirds, and 100,000 mammals and sea turtles (Miller & Spoolman, 2012). Moreover, fragments of plastics, or micro-plastic in the oceans can become transferred in the food chain upon ingestion by marine organisms, and has a high impact of marine life (Miller & Spoolman, 2012).

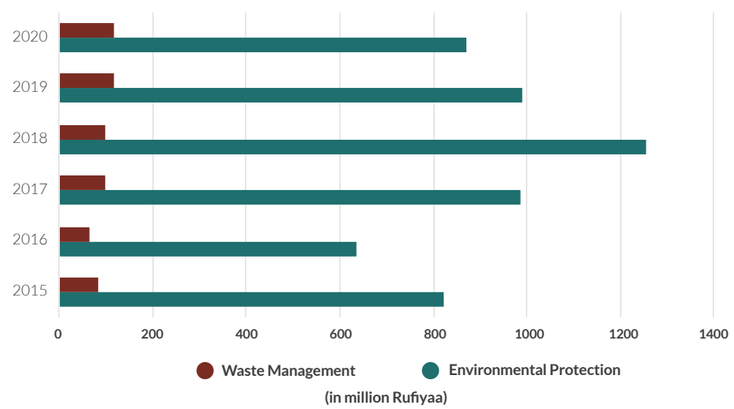
Plastic waste in the oceans also negatively impact fisheries and tourism sectors, or industries that are reliant on a healthy and vibrant marine and coastal ecosystem. The impact from plastic pollution causes a decline of 1-5 percent in benefit humans derive from fisheries, aquaculture, tourism and recreational activities (Hodal, 2019). Plastic pollution was found to lead to US 0.3 and 4.3 billion less revenue for fisheries and aquaculture sector, and a reduction in revenue of between US 0.2 and 2.4 billion for the tourism sector. In 2014, it was estimated that the economic impact of land-based plastic pollution to marine ecosystems was at US 13 billion per year (Raynaud et al, 2014) and this figure had increased to US 19 billion in 2019 (Deloitte, 2019).

3.7 COST OF WASTE MANAGEMENT

High rates of consumption of PET water bottles has become a major problem in Maldives since due to the lack of available infrastructure relating to disposal, and there being negligible policies to separate waste into various components. Over the recent years, government has been spending huge amounts of infrastructure investments and increasing expenditure on waste management effort and environment protection. As such, on the total environment protection expenditure stood over MVR900 million during last 5 years and during 2020 it was at MVR869 million. Of this over 10% of the expenditure is spent on waste management. During the years a number of waste collection centres have been developed by the government and efforts to manage waste have increased and over MVR90 million was spent per year on average during the last 5 years. During 2020, it reached MVR118 million. A large part of these expenditures have been funded by multinational institutions especially ADB and World Bank have been assisting government to fund and to establish a proper waste management system in Maldives. Greater Malé Environmental Improvement and Waste Management Project is one such project over USD150 million and it is co funded by many multinationals including ADB, Asian Infrastructure Investment Bank (AIIB) and Islamic Development Bank (IDB) and largely is targeted to solve the waste management issue in the greater Male region. Similarly, World Bank is also undertaking Maldives Clean Environment Project of over USD17 million to help improve solid waste management in outer atolls of Maldives.

In addition, with the establishment of Waste Management Corporation Limited (WAMCO) in 2015, waste management responsibility of the greater Male' region has been assigned to the company. This includes the daily transfer of waste from Malé to Thilafushi, the waste management of Villimalé, and the disposal of waste at Thilafushi landfill area. During the last 3 years, government has spent on average MVR50 million per year on the corporation.

FIGURE 3.22: ENVIRONMENTAL PROTECTION EXPENDIURE BY GOVERNMENT BUDGET



Source: Ministry of Finance, Budget 2015-2020

3.8 POSSIBLE IMPACT OF A BAN OF SMALLER PET WATER BOTTLES

When the overall impact is analyzed from a microeconomic point, the immediate and the biggest impact of the ban would be borne by the consumers that consume PET water bottles at restaurants and cafés. This is because the intermediaries who would be selling PET water bottles can easily pass on the effect of this ban to consumers since consumers would not have a choice other than to order a larger PET water bottle when are they are dining outside. As such, their bills would increase and with a large percentage of income already being spent on water consumption, consumers would have to bear the additional cost and this could contribute to higher prices and inflation. Already households spend over 4% of their income on water, out of which 2% of their income is spent on water bills (HIES, 2016).

This one-off increase will come into effect immediately after the ban, since expenditure on beverages has a very high weightage (about 2%) in the CPI index.

In addition, even with the ban of small bottles, the incentive for restaurants and cafés to install the filters to provide tap water is lower, since the cost at USD6.16 or MVR 95 per cubic meter is relatively high considering the worldwide cost of producing desalinated water in other countries. As per a technical paper by World Bank (The role of desalination in an increasingly water-scarce world, 2019) , the costs for desalinated water globally per cubic meter in 2016 ranged between USD 0.49 to USD2.86 and even with a 50% margin, the Utility companies could charge a price

in the range between USD0.74 to USD4.29. Hence, with high cost in using tap water (at USD 6.16 per cbm), it may be more profitable and convenient for the restaurants and cafés to provide larger water bottles to consumers and **ultimately consumers would bear the additional burden of this increase in price.**

One alternative for consumers following a ban of smaller PET water bottles, would be switching to glass bottles, if they are introduced in the market. However, consumers may have to pay a relatively higher price since the manufacturing and recycling costs of glass bottles may be much higher. Since the demand for water is very insensitive and fairly inelastic to change in prices, the consumers may be forced to take the full burden of the increase in prices. This was reflected by the responses of consumers in NIG Capital Household Survey (2020) as it showed that majority of consumers are willing to pay a price of MVR6 for a 500 ml water bottle and this also represents an increase in the price of over 100%.

As per the producers of PET water bottles, they may lose part of their revenue since the category of 500ml is one of their major sales. Total estimated sales from 500 ml water bottles is at MVR 155 million. The government could face a loss of MVR 13.4 million from GST revenue, following the ban of 500 ml bottles. Since 65% of the market is dominated by cafes and restaurants, those establishments are expected to lose an estimated MVR 241 million as well. However, the likely impact could be the increase in production of 1.5 L bottles, resulting in restaurants and cafes, as well as producers to compensate for part of that loss.

Although the proposed increase in import duty on inputs such as resin, bottled water and other fizzy drinks may increase Government revenue, it will also lead to increase local production costs, resulting in possible increase in domestic prices of bottled water. In addition, there may not be a short to medium term decrease in the plastic waste as the consumers may switch to larger water bottles and the amount of plastic waste of over 40,000 tones may further increase. This creates the need to set up a proper waste management and recycling facility and this could also increase the revenue of WAMCO through collecting and exporting baled or flaked plastics.

TO SUMMARISE

a. As per the NIG Capital Household Survey 2020, **57% of the households** at the national level consume **PET water bottles.**

b. **The per capita bottled water consumption** of Maldives is at **226 litres per head per year**, compared to about 134 litres per head in European countries like Germany.

c. As per a study done in 2019 by (Ibrahim,2019), the **taste of utility water** and the **mistrust on the tap water** has been given as the main factor influencing public's choice to opt for bottled water.

d. On average households in Maldives **spent over MVR 600 per month on bottled mineral water.** Together with the spending on water bills, households spend about 4-5% of their incomes on total water consumption per month.

TO SUMMARISE

e. Most respondents of the NIG Capital Household Survey stated that they will **switch to bigger bottles** if there is a ban on smaller PET bottles.

f. While **87%** of the respondents of the NIG Capital Household Survey are **aware of the recyclability of the PET bottles**, **59%** stated that l**ack of segregation of waste** by the waste collector as the **main challenge.**

g. About **45% of the total PET bottles** are consumed at **household level**, while 21% is estimated to be consumed in the resorts, and 34% in restaurants & cafés.

h. The **bottling industry** is among the very few industries in the country, and is estimated to be at **2% of GDP.**

i. The **total revenue** of the producers from the **sale of beverages** in 2019 exceeds **MVR 933 million.**

j. An estimated **65% of the small sized (500ml) bottles** are consumed in the r**estaurant industry**, and a total annual sales of about MVR 240 million is generated from the sale of mineral water at restaurants.

k. Since at estimated 20% of the total production of 1.5 Ltr and 500 ml water bottles are consumed at the resorts, an estimated **total revenue of over MVR 700 million is generated from the sale of water bottles** in the resorts per year.

l. The Government received about **MVR 148 million** from all the producers in 2019 as **total tax revenue.**

m. One **alternative** for consumers following a ban of smaller PET water bottles would be **switching to glass bottles,** which will be **higher in price.**

n. **Another option** for restaurant customers would be to order **bigger sized bottles** at a **higher price.**

o. Due to inelastic demand for water bottles in Maldives, c**onsumers may be forced to bear the full burden of possible increase in prices** of other alternatives.

CHAPTER 4

WASTE MANAGEMENT LANDSCAPE IN MALDIVES

The amount of waste generated in the Maldives that is not disposed of properly threatens our very existence. Marine life and coral reefs that remain paramount to our defense against tsunamis and rising sea levels are being threatened by mismanagement of waste. Additionally, the burning of waste is a risk to public health as it releases toxic gases into the atmosphere.

The share of plastics inadequately managed in the Maldives is at 66 as per table 4.1, and this percentage is relatively high for some of the developing countries like Fiji, Mauritius, and Sri Lanka. However, most developed countries like New Zealand, Singapore, Germany, and Japan, the percentage is at 0 as shown in the table, despite their high total plastic waste generated.

Another interesting statistic is the per capita plastic waste, which is at 0.322 kg per person per day for Maldives, compared to only 0.189 to Fiji or 0.171 for Japan. Maldives figure is closer to that of Sri Lanka (0.357), which is relatively a bigger country with a larger population.

There is an estimated

365,000 tons

of solid municipal waste that are generated per year in the Maldives (World Bank, 2017, Maldives Clean Environment Project Report).

Out of the total waste generated in the country, plastic waste constitutes an estimated

43,134 tons

or 12% of the total waste.

The quantity of PET bottles produced in the country is about **10% of total plastic waste**, and about

1% of total waste in the country.

TABLE 4.1: COMPARISON OF TOTAL PLASTIC WASTE GENERATION AND INADEQUATELY OF WASTE MANAGEMENT FOR SELECTED COUNTRIES

	Plastic waste generation (tonnes, total)	Per capita plastic waste (kg/ person/day)	Mismanaged waste (% global total)	Mismanaged waste in 2025 (% global total)	Share of plastic inadequately managed
Bangladesh	1,888,170	0.03	2.47	3.20	87
Fiji	59,324	0.19	0.15	0.10	78
Germany	14,476,561	0.49	0.10	0.05	0
Japan	7,993,489	0.17	0.45	0.26	0
Maldives	43,134	0.32	0.10	0.06	66
Mauritius	104,971	0.23	0.18	0.11	51
New Zealand	525,630	0.33	0.03	0.02	0
Samoa	7,000	0.10	0.02	0.02	80
Seychelles	11,730	0.36	0.01	0.01	37
Singapore	359,483	0.19	0.02	0.02	0
Solomon Islands	19,842	0.10	0.06	0.26	86
Sri Lanka	2,621,606	0.36	5.00	2.78	82
Vanuatu	25,443	0.30	0.07	0.06	81

Source: Adopted from Our World in Data, 2020

4.1 WASTE COLLECTION AND DISPOSAL IN GREATER MALE' REGION

The majority of the waste is collected by the state-owned Waste Management Corporation (WAMCO). Household segregation is not conducted, and mixed wastes are transported to Thilafushi island, a lagoon that was reclaimed in 1992 to deal with the increasing amount of waste in the Male' area. **The majority of the waste is transported by boat to Thilafushi, and it is not sorted properly, and the bulk of the mixed and untreated wastes are often burnt.**

As per information obtained from an official from WAMCO in 2020, there are about **22 collection trucks** in Male' for household operations, and **13 vehicles** for commercial operations. There are **3 vessel trips per day** from Male' to Thilafushi. As per the recent estimates by the Waster Management Division of the Ministry of Environment, there is about 700 tons of waste generated per day from the Male' area.

OUTER ISLANDS AND TOURIST RESORTS

The majority of the other inhabited islands of the Maldives also do not have systematic waste collection, treatment and recycling facilities. Household waste collection is often conducted by the island councils, or outsourced to other private individuals or companies, whereby the mixed waste is also either dumped, or burnt openly, as the island councils face the burden of enormous costs of transportation to Thilafushi. Moreover, composting and recycling activities are limited and unsystematic, and in the few islands that do have small initiatives, it is with the help of ad-hoc efforts from NGO's, or small grant projects.

The tourist resorts also send their waste to Thilafushi, and while they are obliged to have on-site incineration facilities, few resorts manage the waste on site, and do responsible recycling or composting activities.

4.2 GOVERNMENT POLICIES AND RESPONSES TO THE ISSUE OF WASTE

The Government of Maldives has been responding to the increasing challenges of waste management in the country using integrated waste management policies and programmes. Island councils, with the exception of designated cities such as Male' Addu and Fuvahmulah are empowered to take decisions regarding waste management on the island and atoll level, whereas WAMCO is in charge of operating the waste collection and management activities of all the cities, as well as the Regional Waste Management Centers (RWMC's). The Regional Waste Management Centers, are being established in designated regional "zones" in the country, which aims to divert the burden on Thilafushi, and manage the wastes of each region in the Maldives separately.

There is currently one established RWMC in the island of Vandhoo in Raa Atoll, which is in the central-north, that was established under the Maldives Clean Environmental Management Project with the assistance of the World Bank. Under this project, waste generated in the atolls of Noonu, Raa, Baa and Lhaviyani are required to be transported to Vandhoo. The plan was to manage the organic waste by individual islands and transport the rest to the waste management facility in Vandhoo. Recyclable waste is to be exported, and the rest to be incinerated. However, most islands experience mountains of waste, and Island Councils are unable to frequently transfer inorganic waste to the waste management facility. Some councils take more than seven to eight months to transfer waste to the waste management facility in Vandhoo. At present the Vandhoo facility is managed by WAMCO, and Abudhabi Fund has also provided a $3 million loan for the project. The Government has started a MVR 3.4 billion waste management project, which includes a MVR 2.9 billion ($191 mil) for the Greater Male' area including the central atolls, and MVR 447 ($29.6 mil) for the Southern Regional waste management. The main component of this project is establishing incinerators in Thilafushi and other regional waste management centers.

4.3 GOVERNMENT EFFORTS TO TACKLE PLASTIC WASTE

4.3.1 MALDIVES SINGLE-USE PLASTIC PHASEOUT PLAN

The Ministry of Environment has published its plastic phase out plan in August 2020, that sets out target dates for ban of selected plastic products imported and produced in the country, as well as imposition of taxes and EPR policies on selected single use plastic products. As per the published Draft Report, government's short term targets include; achieving 85% collection of SUP waste in the country by 2023; and setting national level reduction targets for SUP's by 2022; and passing a national single use plastic phase out regulation in 2020.

Long term targets include; providing variety of affordable, and accessible non single use plastic alternatives to consumers by 2030; establishing regulations to promote circular economy for different sectors in the country by 2030; and establishing by 2030 at least one recycling facility in Maldives that has pre-sorting, sorting and recycling technologies.

Under the plan, together with other selected plastic items, all imported and locally produced beverages in PET packaging 330 ml and below was initially proposed to be banned from January 2021. Further, all imported and locally produced water that is below 1 Liter and packed in PET was proposed to be banned from December 2023. However, as per the President's Decree issued on 30th December 2020, all imported beverages in PET bottles below 500 ml will be banned from 01st June 2021. Additionally, all imported water packed in PET bottles 1 Litre and below will be banned from 01st December 2023.

4.3.2 THE AMENDMENT OF EXPORT IMPORT ACT

The Law No 7/2020 – The 17th Amendment to Maldives Export Import Act, which became effective on 01st August 2020 states that the President has the discretion to define single use plastics that will be banned from import from 01st January 2021. In accordance with the Law, the President has issued a Decree on 30th December 2020 with a list of 12 items that will be banned from import from the respective date specified.

The Chapter 39 of Clause 7 of the referred Law specifies plastics and plastic products that will carry a 0% import duty. Among those with 0% import duties are biodegradable plastic bags, plastic pipes, polyutherane, fiber glass resin, table/kitchen ware, food wrappers, single use disposable film/sheets/rolls, and stationery items.

TO SUMMARISE

a. As per the published SUP Phaseout Draft Report, government's short-term targets include achieving **85% collection of SUP waste** in the country by 2023; and setting national level reduction targets for SUP's by 2022; and **passing a national single use plastic phase out regulation in 2020.**

b. Currently a local NGO, Parley collects empty PET bottles with the help of WAMCO and that constitutes only a small proportion **(1%) of total plastic waste.**

c. In the Maldives, a relatively **large portion of single-use plastics ends up in the Thilafushi landfill area,** and are mostly burnt.

d. Through proper collection and recycling of plastics, in the coming years plastic waste in the Maldives can be reduced significantly. However, **this can only be done if the government, waste management companies and consumers can work together.** The collection and management of single use plastics can be costly and time consuming, however through correct procedures and handling it is a goal that can be achieved.

CHAPTER 5

EXTENDED PRODUCER RESPONSIBILITY

As per the Government's SUP plastic phase out plan, one of the key policy interventions proposed is introduction of regulations and extended producer responsibility (EPR).

EPR was a concept first coined by Thomas Lindhqvist, who presented the policy strategy to the Swedish Ministry of Environment in 1990. EPR extends the producer's physical and financial responsibility for a product to the post-consumer stage of a product's life cycle. Lindhqvist designed a model where the responsibilities of waste collection, safe treatment and recycling of post consumer products are assigned to the producers, and where the physical, economic and informative responsibilities were clearly defined in the EPR scheme.

Lindhqvist defines **economic responsibility** as the full or partial responsibility of the producer for the collection, recycling and final disposal of the manufactured products, where the fees are either directly paid by the producer, or outsourced to another company. **Physical responsibility** is defined as the physical management of the products and their effects in the full value chain of the product, by the manufacturers. **Informative responsibility** refers to the responsibility of the producer to provide information on the environmental properties of the products they are manufacturing (Lindhqvist, 2000).

EPR is implemented as a comprehensive policy package, that combine various instruments, where the burden of the responsibility of end-of life (EOL) management of the products are shifted from the state to the producers.

5.1 THE GOALS OF EPR

5.1.1 ECO DESIGN

EPR incentivizes producers to incorporate ecological design principles, and to incorporate an efficient end-of-life (EOL) management strategy of their products that will not harm the environment. This could mean designing and manufacturing products that enables easier reuse and recycling of products, such as increasing recycled content, using raw materials that are sourced with less environmental impact, or using raw materials that are environmentally sustainable, or that will degrade into the environment with minimal environmental impact. **This would also ensure that the producers integrate environmental externalities into the full value chain of the product.**

5.1.2 ENHANCED WASTE MANAGEMENT AND RESOURCE RECOVERY

EPR obliges producers to establish efficient collection of waste products, and manage the safe environmental treatment and disposal, and recycling of products at the EOL stage. This also transfers the financial burden of waste management from the public sector to the manufacturers, and reduces the amount of wastes for final disposal such as to landfills, or to the marine environment.

5.2 EPR POLICY INSTRUMENTS

EPR has been successfully implemented in different countries and applied across a wide range of products, such for packaging, household hazardous waste, batteries, vehicles, waste electronic and electronic equipment (WEEE). Some of the most common policy and complementary administrative instruments used to implement EPR policies include:

5.2.1 PRODUCT TAKE BACK MECHANISMS

Producers assume the responsibility of taking back their products (in whole or part) at the post-consumer stage. Performance standards determine the extent to which producers are required to recycle their post-consumer products. Standards provide incentives for producers to choose production processes and/or products that are easier to reuse and recycle.

5.2.2 DEPOSIT REFUND SYSTEMS (DRS)

Involves the consumer paying a deposit when purchasing a product and then receiving a refund when returning the post-consumer product, the container, or the packaging. The aim is to change consumer behavior by placing the burden of waste collection on the consumer, but at the same time increase collection by incentivizing the consumer with a refund.

5.2.3 ADVANCE RECYCLING FEES ARF

Advanced recycling fees charge consumers a fee at the point of the sale, which is then used to finance the collection, recycling or recovery of the product. However, unlike deposit refund systems, ARF's do not incentivize consumers to return the empty bottles, as they do not get a refund.

5.3 EPR IMPLEMENTATION IN OTHER COUNTRIES

Over 35 countries have EPR legislations (that includes packaging) where producers or companies that place products on the market are held responsible for the proper end-of life management of their products.

While EPR is an individual obligation on each producer, in practice producers comply with the EPR regulations collectively, often forming Producer Responsibility Organizations (PRO's). The PRO acts as a separate non-profit or profit oriented entity, acting on behalf of all the obliged companies/obliged industry to organize and finance the collection and treatment of the product at the end of its life cycle. Producers can finance the organization of collection and recycling entirely, or do co-financing with another company, or with the Government.

PRO's are also responsible for establishing critical infrastructure to achieve the collection and sorting of packaging waste at the household or municipal level, and for financing the sorting and recycling of wastes at a larger scale. PRO's need to work together with the Government on providing the right information about the amount of packaging that have been collected or recycled, versus the amount of plastic that has been put on the market.

5.3.1 EPR MODELS FOR PACKAGING

Different countries have specific legislations for EPR, according to the type of product. EPR schemes for plastic packaging such as beverage containers have been implemented with great success in various countries, often garnering high collection and recycling of waste products. EPR schemes can be defined as any system or mechanism that is bound by legislation, and set up by one or several producers to implement the EPR principle. Individual compliance schemes are set up when individual producers organize the eco-design, collection, and recycling efforts individually, and a collective compliance scheme is when several producers collectively collaborate to implement the EPR obligations as required by an EPR legislation (Deloitte, 2014). Collective compliance often takes the shape of implementation by transferring the EPR responsibilities to a specific entity or organization, such as via the formation of a PRO, as mentioned above.

There are broadly two types of EPR schemes, financial EPR schemes and organizational EPR schemes (Deloitte, 2014).

Financial EPR schemes are when the physical responsibility of waste collection and recycling is left to the municipalities or local authorities, and the financial responsibility is borne by the producers. An **organizational EPR scheme** is where the physical responsibility of waste collection and recycling is conducted by the producers, and the financial responsibility is borne by the local authorities. In practice, the physical and financial responsibilities can also be dually shared by the producers and the authorities, with producers contributing more either financially or physically. The financial responsibilities and organizational responsibilities can manifest in any of the following ways:

a. In a simple financial responsibility scheme, producers have an obligation to finance the existing waste management mechanisms, where they have minimal incentive to improve the waste management system, and public waste collection authorities conduct the waste management system.

b. Producers establish contracts with local authorities to collect and manage waste. The producers' motivation to improve waste management depends on the type of contract and the conditions included in it, such as meeting standards for collection and recycling rates, and requirements on the types of collection and final treatment required.

c. Producers take full financial responsibility and partial organizational responsibility, some physical activities (. e.g. waste collection) are implemented under the supervision of public waste collection operators or contracted to private companies, while other activities such as sorting and recycling are conducted by the producers.

d. Producers take full financial responsibility and full organisational responsibility. In this scenario, the producers subcontract activities to professional waste collection and treatment operators, or they could also own part of the collection and treatment infrastructure.

Often times, the producers' responsibilities are handed over to the PRO, where there are two major kinds of PRO ecosystems:

Industry led common PRO's
Where obliged industry actors consisting of producers, importers, breweries and retailers form a common non-profit entity that is responsible for the physical and financial responsibility of collection and recycling of packaging waste in the most cost efficient and environmentally friendly manner. The financial and operational responsibility can be shared by the local authorities, or fully borne by the industry.

Competing PRO's
Profit oriented companies can compete and share the responsibilities for collecting, infrastructure, sorting and recycling in a system where there are competing PRO's.

5.3.2 KEY FEATURES IN AN EPR SYSTEM

Clear cut allocation of financial and physical responsibilities, including the range of responsibilities among the stakeholders
E.g. Will producers bear the full financial and physical responsibility, or share the responsibility with the local authorities?

Clear identification of products to be covered

Costs coverage:
E.g. Identification of costs to be covered, and their proportions, under EPR (collection and recycling infrastructure, producer fees, deposits, provision of incentives, awareness campaigns)
There is consensus from literature and existing EPR schemes in the world that EPR systems should cover the collection, sorting and treatment costs of separately collected waste management (e.g. plastic), minus the revenues from recovered material sales i.e. the full net cost (Deloitte, 2014).

Full costs refer to:
- Collection, transport and treatment costs for non-separately collected waste (waste that should be collected by EPR but is mixed with municipal solid waste), or the implementation of a full segregation collection system for PET
- Costs for public information and awareness raising, including the PRO's own communication initiatives
- Costs related to waste prevention, and litter prevention and management
- Costs related to the enforcement, monitoring and surveillance of the EPR system such as waste audits, fines, data management and sharing with the authorities

Development and management of a system to collect Producer Fees

Designated collection and recycling infrastructure

Transparency and control

E.g. What is the reporting mechanism for producers and who is the monitoring body? How to maintain transparency of funds and accountability?

- Documentation of collection, sorting, recycling and recovery of waste and submission of data to the national/local authorities
- Develop and manage data collection system

5.4 DEPOSIT REFUND SYSTEMS AND EPR

Deposit refund systems (DRS) is an environmental policy instrument that has been introduced in some countries as a complementary administrative tool with EPR.

DRS can either be voluntary, or mandatory schemes imposed by the Government (Opschoor & Turner, 1994). As opposed to direct fees or taxes that incentivize illegal dumping, DRS can achieve high collection rates of recyclables, and thereby reduce the amount of solid waste disposal, (Fullerton and Kinnaman, 1993; Sigman, 1995; Palmer and Walls, 1996).

This is because, DRS curbs the issue of illegal dumping by providing refunds to consumers once they return the product, and it is also more difficult to evade an upstream deposit on product sales (Walls, 2011; Fullerton and Kinnaman, 1995). DRS around the world has achieved higher collection rates for recyclable beverage packaging, as compared with curbside collection programs, or other recycling initiatives. Moreover, mandatory DRS for one-way beverage containers have also garnered 80% collection rates internationally, where in some countries with more mature and established collection infrastructure, as well as consumer awareness, the rate is above 95% (PricewaterhouseCoopers, Albrecht, Brodersen, Horst, & Scherf, 2011).

5.4.1 DRS IN SMALL ISLAND DEVELOPING STATES (SIDS)

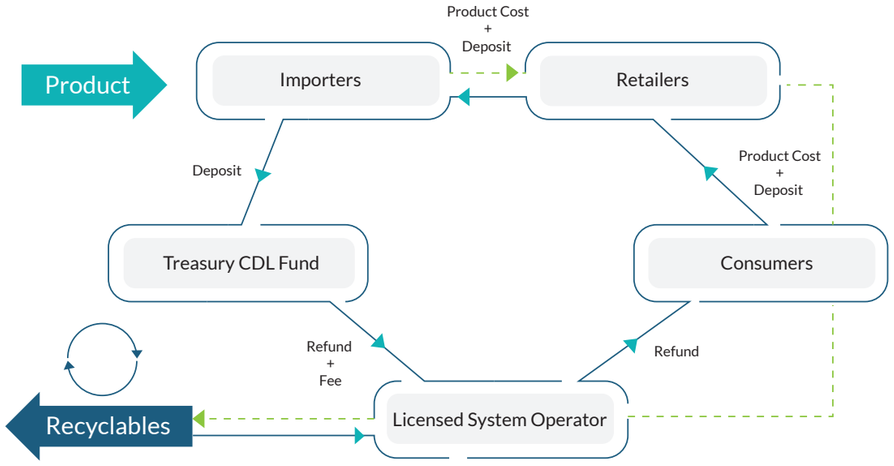
Palau is a small island nation in the Pacific that have successfully implemented DRS since 2006. Palau being a SIDS, share common geographic and socio-economic realities with that of the Maldives. Palau has approximately 250 islands, spread over 459 kilometers, and with only 21685 people (CIA, 2020), has considerably fewer people than the Maldives. Palau is also highly dependent on tourism, with 56% of the GDP relying on revenues from tourism in 2014 (United Nations Economic and Social Commission for Asia and the Pacific, 2014). In recent years, the revenue from tourism to GDP has slightly declined, to approximately 49% in 2017, and 43% in 2018 (World Data Info, 2020).

In 2006, Palau passed a Recycling Act, which stipulated the establishment of a deposit for beverage containers, the creation of a recycling fund, and the allocation of the responsibilities for the operation of the system. In 2009, a Beverage Container Recycling Regulations was passed, which further clarified the responsibliti1es for the state and the producers.

In accordance of the Act, the material and financial flows of the system were designed such that, for every PET bottle that is imported into the country, Palau Customs Service will collect $ 0.10 per container from importers. This money is then transferred into a designated Special Fund, which is managed, and monitored by the Ministry of Finance (MOF). Consumers in this system also pay $ 0.10 per container upon purchase. Once the consumer returns the bottle at the Koror State Redemption Center, which is operated by the Koror State Government (KSG), they receive a receipt from the Redemption Center. The consumer must then submit the receipt to the Ministry of Finance (MOF) in order to be refunded with $ 0.05. The refund money is withdrawn from the Recycling Fund, and $ 0.025 from every deposit fee paid by the importer is kept by the Ministry of Finance, as compensation, and another $ 0.025 is used to cover operation costs in the Redemption Center. According to interviews done in 2016 with the Solid Waste Management Officer Mr. Calvin Ikesiil, the products are collected and exported by the Palau Waste Collection Company, to Taiwan, and proceeds also go to the exporter as profit.

However, given the geography of Maldives, logistical and administrative challenges, a DRS system could be more costly to implement and may not be feasible in the Maldivian context.

FIGURE 5.1: BEVERAGE CONTAINER RECYCLING SYSTEM IN PLACE



Source adapted from: Richards et al, 2014

5.5 IMPLEMENTING EPR FOR PET BOTTLES IN THE MALDIVIAN CONTEXT

One of the most crucial steps is identifying the producers, importers and retailers by volume of products put on the market. Importers and retailers are also defined as producers and have to be bound by an EPR legislation. It is also advised to have a clearly defined cut-off amount for smaller retail stores and small corner shops, so that importers and retailers who import and sell PET products below a minimum amount do not have to be obliged by the EPR legislation.

Once the authorities have established the total quantity of PET bottles that are put on the market (local production and imported PET bottles combined), the Government must oblige producers and importers to fulfill the collection of a minimum percentage of the PET bottles put on the market, as well recycle a minimum percentage of the PET put on the market. Minimum collection and recycling targets have to be set by the Government after consideration of the total quantity of PET put on the market. This will allow the authorities to monitor the progress in collection and recycling, and the targets can be monitored and increased accordingly. For instance, to begin with, the Government can oblige producers and importers to collect and recycle no less than 50% or 60% of the PET that is put on the market.

5.5.1 UPSTREAM EPR

For upstream implementation of EPR, producers have to be directly involved in altering the upstream design, or production of the PET product so that it is more aligned with the EPR goals of minimizing environmental impact, enabling reuse and recovery of materials.
In the case where Maldives is challenged by technological and financial barriers to produce ecologically smart PET compromised of biomass, or with higher recycled content, the option for producers is to engage in the provision of packaging that is reusable, or in a non-PET alternative. This could mean finance into research and design of alternatives and conduct feasibility studies, or pilot projects on the provision of water in glass or non-plastic bottles, especially for island communities.

One more important strategy to reduce PET consumption, is the provision of financing mechanisms in conjunction with other finance or utility companies to install water filtration systems, in households or commercial buildings, or switch to the provision of 18L bottles that are reusable. Upstream EPR will require individual compliance by companies. Another key recommendation for Maldivian producers is to revise the pricing bands for household consumption, as it is currently very costly compared to other countries where desalinated water is provided (World Bank, 2019) This will also incentivize consumers to switch to tap water, along with a monthly payment mechanism for water filtration systems.

Another key action that companies can do to reduce PET consumption and encourage the use of tap water is to harmonise plumbing standards, in liaison with the relevant authorities, as part of EPR obligations. This will increase consumer confidence in the tap water system, and lead to more usage of public tap water facilities. This is also outlined as a recommendation in the SUP Phaseout Plan from 2020-2025 in the Maldives.

Furthermore, an important step in the upstream design process is shifting the production from coloured or tinted PET to colourless PET bottles, as this reduces costs in sorting, and also leads to higher quality recycled PET (rPET).

5.5.2 DOWNSTREAM EPR: COLLECTION AND RECYCLING

For the utilization of full EPR responsibilities in the downstream collection and recycling of waste products, producers, imports, and retailers can bear either the full or partial physical/organisational and financial responsibilities for the collection, sorting and treatment of plastic in the Maldives.

It is recommended for Maldivian producers to form a PRO to take the collective responsibility and enable the effective organization of PET collection and recycling in the country.

Producers can assume full financial and organisational responsibility, where they are fully responsible for the operational and financial costs involved in the collection and recycling, including infrastructure costs. Where the PRO assumes partial organisational responsibility, but full financial responsibility, the PRO can outsource the activities for collection and sorting to the public waste management authority WAMCO, or to another collection organization such as PARLEY or Secure Bag. However, they will be responsible for the provision of collection infrastructure such as collection centers, machines, RVM's, and recycling infrastructure.

The third option is where PRO assumes partial organizational and partial financial responsibility, where the responsibilities for PET waste management are dually shared by the Government and the PRO.

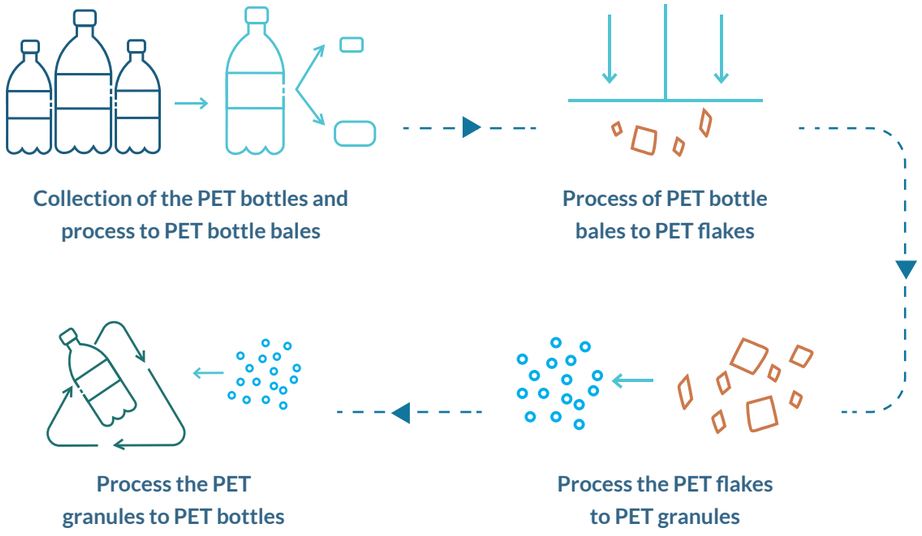
5.5.3 DESIGNATION OF A RECYCLING FUND AND ESTABLISHMENT OF PRODUCER FEES

The Maldives has to establish a special Recycling fund, where fees from the producers, importers and retailers are used to organize the collection and recycling activities of PET bottles in the Maldives. There are two ways that the Maldives can withdraw producer fees. One way is the obligation for producers to submit annual fees to the Recycling Fund, or the other option is obliging producers and importers to pay deposits per container at the time of import, to be paid to the Recycling Fund.

Another consideration is the allocation of the GST and import duties from the sale of PET beverage containers. The Government already makes USD 11,413,748 in total from combined GST and import duties from the producers. Additional income from GST and tariffs of wholesales and other importers of PET bottles, as well as retailers will further strengthen the case for implementing such as system, where these fees are extracted and used for the purpose of financing collection and recycling infrastructure and mechanism.

5.5.4 RECYCLING PET IN THE MALDIVIAN CONTEXT UNDER EPR

In an ideal EPR scheme, for PET bottle-to-bottle recycling to occur, producers would partially or fully finance and organize the following steps to achieve high recycling rates of products:



These steps above would ensure the closing of material loops, the reuse of valuable PET material back into the manufacturing cycle, and the recovery of waste materials that would otherwise end up in landfills or in the marine litter, further prompting the extraction and use of virgin raw materials.

However, for recycling to occur, there are several capital investment costs required for collection infrastructure and the recycling technology. Moreover, there need to be economies of scale for the recycling to be cost efficient.

In the Maldivian context, what is most possible without a full-scale recycling line at the moment, could be the separate collection of PET waste bottles, conversion of waste bottles to bales, or to PET flakes, and then exporting them to a recycling facility abroad where steps 3 and 4 are completed. It is however crucial to consider the economic and environmental costs of transportation, consumption of energy and water, carbon emissions, as well as the loss of PET quality after recycling, as they contribute directly or indirectly to climate change impacts. Nevertheless, concerns of emissions from transport, management of wastewater, and material loss due to downgrading of plastic during recycling, can be considered as secondary concerns to the Maldives, as compared with the primary concern of preventing marine litter. The most immediate aim for Maldives is to reduce marine litter, and the consequent harm to the vulnerable marine ecosystem.

TO SUMMARISE

a. EPR is a comprehensive policy package that **shifts the responsibility** of the end-of-life (EOL) management of the projects **from the state to the producers.**

b. **EPR obliges producer**s to establish efficient collection of waste products, and manage the safe environmental treatment and disposal, and recycling of products at the EOL stage.

c. **Deposit Refund System (DRS)** is an environmental policy instrument that can be used as a **complementary administrative tool** alongside EPR.

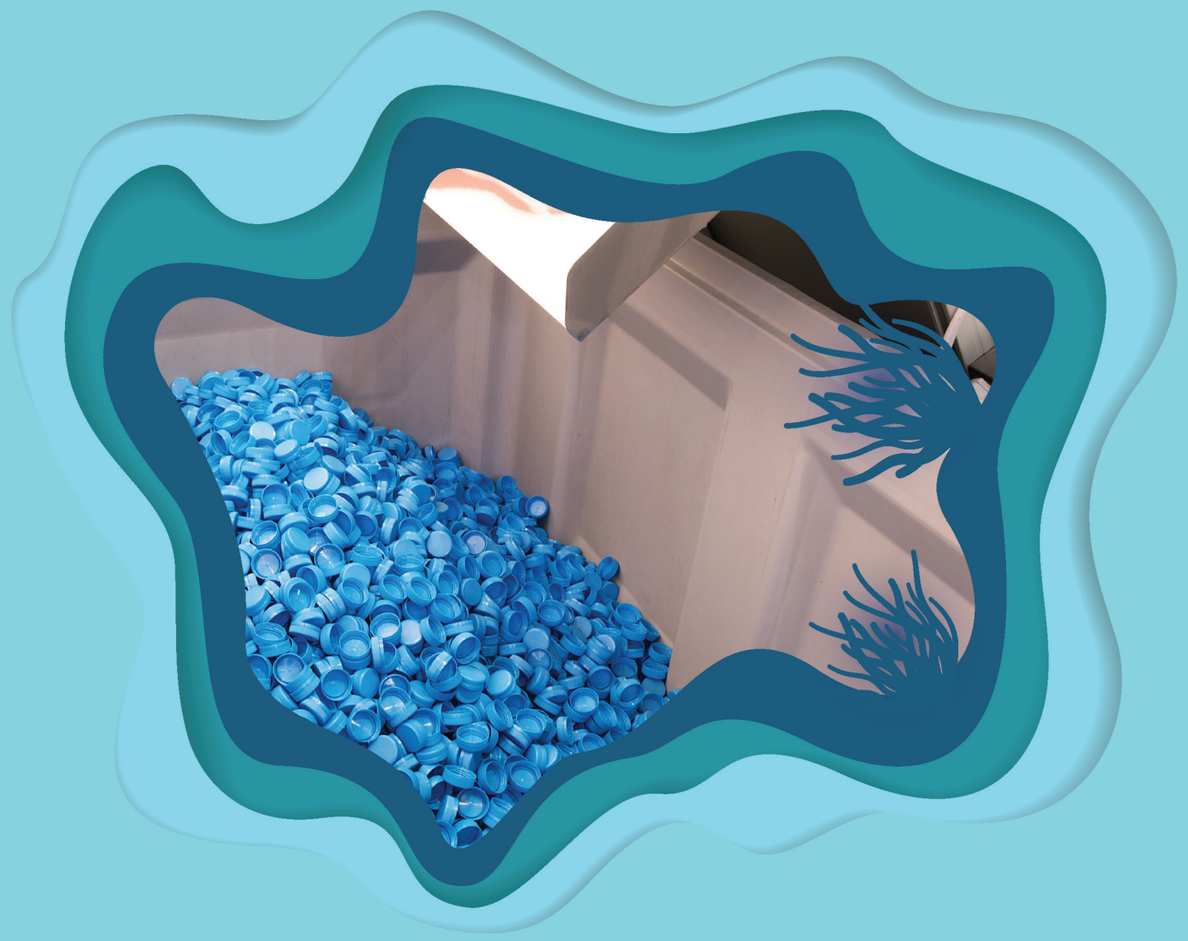
d. **DRS can achieve high collection and recycling rates of PET bottles,** often with 85-90 percent success rates.

e. Authorities can establish the quantity of PET bottles on the market and **oblige producers to fulfil the collection of a certain percentage of the PET bottles,** as well as a certain percentage of the PET to be recycled.

f. By shifting some of the responsibility of collection and recycling of PET bottles through EPR, the government can encourage **better practices** by producers such as requiring **more eco-friendly designs** into their products which make it easier to recycle and reuse. Even though EPR is the individual responsibility of each producer, producers often deal with it collectively, forming Producer Responsibility Organisations (PRO). PRO's act on behalf of the producers to organise and finance the collection of plastics.

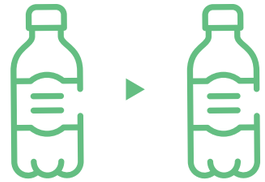
CHAPTER 6

PET RECYCLING POTENTIAL IN THE MALDIVES



As plastics are extremely durable and they persist in the environment for hundreds of years, they create significant impacts to the land and marine environment, as well as several health implications for humans and wildlife. Recycling plastics is one of the ways to mitigate the negative environmental and health effects of landfilling, or garbage dumping, and it is possible to chemically, mechanically, and thermally recycle plastics, or use it for the generation of energy (Hopewell et al, 2008).

In plastic packaging recycling, **primary recycling,** also known as close-loop recycling, produces new packaging of the same material e.g. PET bottle to PET bottle.



In **secondary recycling,** PET bottles can be turned into other materials made of PET in essentially the same form. Another example of secondary recycling is recycling car tires into other products made of rubber, but not new car tires. Secondary recycling or reprocessing occurs because of reduced polymer purity, and lack of collection infrastructure, and thereby is also called as “downgrading” (Hopewell et al, 2008).

In **tertiary recycling** or reprocessing, high heat or industrial chemicals are used to chemically de-polymerize the products into its chemical constituents i.e. completely break down the molecules into their chemical components, and make entirely new products (excluding energy recovery and incineration). For this reason, it is also described as chemical or feedstock recycling. For an example, chemically break down PET thread and use it to re-spun make polyester, or break down car tires used to produce computer mouse mats.

Quaternary recycling is described as energy recovery, energy from waste or valorization. When biodegradable plastics are composted, this is also described as an example of tertiary recycling, and is described as organic, or biological recycling (Song et al, 2009).

TABLE 6.1 TECHNOLOGIES FOR PLASTIC RECYCLING AND RECOVERY

ASTM D5033 DEFINITIONS	ISO 15270 :2008 DEFINITIONS	OTHER EQUIVALENT TERMS
Primary recycling	Mechanical recycling	Closed-loop recycling
Secondary recycling	Mechanical recycling	Downgrading
Tertiary recycling	Chemical recycling	Feedstock recycling
Quaternary recycling	Energy recovery	Valorization

Source adapted from Hopewell et al, 2008

6.1 CHALLENGES OF PRIMARY RECYCLING

Certain chemical properties in plastics make it problematic for primary recycling. **As plastic is highly sensitive to heat, it changes structurally when it is subjected to thermal and mechanical stress** (Ecology Center, 2020). Even PET that has a high melting point as a thermoplastic, and can be remoulded and recycled several times, becomes brittle and weak over several rounds of melting and extrusion, so that eventually the quality becomes degraded and compromised after every time that the long polymer chains are broken and reprocessed. This type of degradation is termed as **"heat history"** in the recycling industry, and the deterioration accumulates with each reprocessing and becomes irreversible (Ecology Center, 2020). Therefore, **PET is recyclable finitely, and virgin PET (vPET) needs to be added to upgrade or make the product robust.** Recyclers that make plastic containers out of other plastic containers typically blend virgin resin with the recycled resin to boost the product's performance, typically between 15 to 25%.

Another chemical property that makes primary recycling challenging is that **plastics are susceptible to contamination.** Often the plastic is mixed with various contaminants when it is collected, and it is not properly cleaned or removed during sorting. Thereby, when resins mix with contaminants when it is being melted, it can defect the molecular structure, which also leads to degraded properties. **Furthermore, the grade and quality of the resin and its colour can also affect the recycling process.** For instance, a common issue during recycling is the cross-contamination between PET and PVC, as the two polymers appear the same to the naked eye, and share the same specific density, and cannot be separated by conventional float-sink techniques. It is estimated that even one PVC bottle in a batch of 10,000 PET bottles can ruin an entire melt (ImpEE, 2005). Primary plastics recycling is therefore strongly limited by the chemical properties of the material.

6.1.1 PET RECYCLING STEPS

PET closed loop recycling is done in the following steps:

As mentioned in the previous chapter, the first step involved in waste management and treatment is the **collection.** Most countries that have implemented EPR schemes also have set up collection systems under EPR to cover recyclable items such as PET beverage containers. Secondly, the collected PET bottles must be **sorted** according to colour, or Resin Identification Codes (RIC). While sorting can be done manually, using specific equipment for sorting reduces collection costs, and makes the process more efficient.

Sorted PET bottles are then compacted into a **bundle, or baled.** The baled bottles are then sent to a recycling facility/Materials Recovery Facility (MRF) where PET bales are turned to PET flakes.

Before the bottles are turned to PET flakes, the bottles have to be firstly **de-baled,** and they undergo a second sorting process, in an air classifier, which removes materials that are lighter than PET such as plastic and paper labels. (In some facilities, de-baled PET is also shredded in a dry state, together with the labels and caps, before they are sorted in the air classifier).

Then it is **pre-washed** to remove any remaining labels with glue adhering to the PET, base cups, caps, and any other impurities or contaminants.

Then they are **shredded into PET flakes,** and they undergo a second washing, where the flakes are **washed** with a special detergent in a scrubber. This step removes any remaining food residues, or impurities that can remain on the surface of the PET containers, and it can also remove any further remnants of the glues used for sticking labels.

The washed PET flakes are then **passed through a float and sink classifier,** which makes the PET flakes sink to the bottom of the classifier, as they are heavier than water. Caps, and rings made from polypropylene PP, and base cups made from HDPE float to the top as they are lighter than water.

Then the PET flakes are passed through a **special dryer.** After drying, they are passed through an electrostatic separator, using a magnetic field, which separates PET flakes from any aluminum that might be present as a result of bottle caps, lids or ring. This stage is called the **clean flake.**

Once this stage is completed, clean flakes can be transformed to granules or pellets in a grinding reactor, which changes the viscosity of the recycled PET by **cutting it and fractioning it.**

Then, the recycled PET pellets or granules can be transported to a bottle manufacturing facility where they are mixed with virgin material, and they are melted, and **injection and blow molding** are conducted to make preform, and then produce PET bottles.

The pellets can also be further transformed into a commodity grade raw material such as plastic fibers or sheets.

6.1.2 COSTS FOR COLLECTION AND RECYCLING

The costs are calculated for the achievement of 50% collection rates of the estimated 143 million bottles, or 3300 tonnes of PET put on the market in the Maldives. However, this amount is likely to be above this, as this excludes all imports of soft drinks imported in PET packaging. **A 50% collection rate is 71.5 million bottles or 1650 tonnes.**

Investment costs for equipment brands and prices for compactors, industrial fans, weighing scale, forklift, and plastic shredder are obtained from documents published by the Koror State Government of Palau, (Bureau of Public Works-Solid Waste Management, Koror State Government-Solid Waste Management Office, and JICA, 2013). Investment costs are estimated at **USD 2 million or MVR 30 million.**

Additional investments like solar panels can increase up-front costs but in the longer term can decrease costs for energy inputs. Moreover, waste water treatment technologies that allow reuse of water for cleaning can also lower the costs for water. It is also important to note that wastewater treatment technologies need to be selected upon careful consideration, depending on the concentrations, legal parameters for wastewater treatment, as well as the wastewater volume. Thereby, it is important to conduct a more in-depth analysis on the chemical properties of wastewater from plastic recycling, from research or samples from neighbouring countries, or other similar contexts, as the specific data not only affects the costs of the treatment, but also the efficiency. Operational costs also include estimated costs for inputs such as energy, water, cost of water, transport from Male' to Thilafushi, export charges to nearest markets in India or Sri Lanka, wastewater treatment costs, and as well as labour costs. Total operational costs per annum for material and energy inputs is estimated at USD 170,000 or MVR 2 million, while transport, export and labour costs are approximately at **USD 295,000 or around MVR 4 million.**

The following table provides cost comparisons for conducting collection and recycling activities from collection to baling and exporting, versus collection to flaking, and exporting.

Sales revenue from baled PET is calculated at the rate of USD 0.34 per kg (equivalent to Indian Rupees 25). Assuming it is exported to the Indian market and a total of 1650 tons, the total Revenue will be about **MVR 8.6 million** (equivalent to USD 557,658). The price for washed, and dried flakes will fetch higher prices, assumed at 30 Rupees per kg. Hence, total revenue from collection to flaking will generate about **MVR 10.3 million** (equivalent to USD 669,190) per year.

The total costs for operating a collection system until the PET flaking process, and exporting it is estimated around USD 460,000 or MVR 7 million, while the total costs for operating a collection system until baling is estimated at USD 295,000 or around MVR 4.5 million.

TABLE 6.2 COST COMPARISON BETWEEN BALING AND FLAKING OPTIONS

	COLLECTION TO FLAKING	COLLECTION TO BALING
Export Income USD	669,190.00	557,658.00
OpEX USD	466, 141.00	295,477.00
Profit	**USD 203,049.00**	**USD 262,181.00**

6.2 PET RECYCLING AND IMPLICATIONS FOR MALDIVES

When producing a bottle from recycled PET, literature demonstrates reductions in greenhouse gas (GHG) emissions and fossil fuel consumption ranging from 13 to 56% on a cradle-to-grave basis , when compared to fossil-fuel derived PET bottles that are assumed to go to the landfill or to the ocean (Benavides et al, 2018). Furthermore, closing material loops also preserves the material value, and extends the life of the material. To achieve this, further investments for equipment and technology to convert PET clean flakes to pellets/granules are needed. Moreover, producer capacity and willingness also need to be carefully studied and taken into consideration before considering this as a third recycling option.

POTENTIAL COSTS

- Wastewater implications (chemicals and sludge) and environmental impact from wastewater to the marine environment

Plastic recycling machines generate wastewater during the treatment. Its main components are Total Dissolved Solids (TDS) with up to estimated concentrations of 5 to 8 g/L, and Chemical oxygen demand (COD) concentrations that can range from 200 to 900mg/L, that are similar to concentrations in sewage water. Plastic recycling also produces approximately 22 kg of insolubles per ton of processed plastic. For instance, processing 100 tons of plastics per day can produce 2.2 tons of insolubles, whereby sludge concentration can constitute from 10 to 60 g/L (Hydrotech, 2020).
The primary technologies used in wastewater treatment plants should comprise screening, sand catcher, flotation or sedimentation, and a technology to dewater and thicken the produced sludge. However, wastewater technologies that can allow the water to be reused back into the recycling process can lower costs.

- Energy intensive operations
- High capital investment (land, equipment, machinery)
- High running costs (energy, wastewater treatment, chemicals)
- Water consumption is lower in the conventional PET bottle manufacturing. Water demand consumption is high when making bottles with recycled PET (Benavides et al 2018), as recycled materials must meet mandatory hygienic and safety standards that are similar virgin PET (vPET). These costs can be reduced by reusing the treated wastewater, or by using sources such as rain water.

6.2.1 RECOMMENDATIONS FOR IMPLEMENTING PET RECYCLING IN THE MALDIVES WITH PRODUCER RESPONSIBILITY

Considering the financial costs required for capital expenditure, as well as high running costs, the financial obligation of waste collection and recycling can be shared among the producers, importers and large retailers, under EPR. As mentioned in Chapter 5.5.3, the costs for collection and recycling can also be dually shared by the Producers, or from funds that are diverted from GST and import duties from the import and sale of PET bottles. These requirements should first and foremost be stipulated in a Recycling Act, or an EPR Regulation, where producers under a PRO also be obliged to cover the costs of the capital expenditure, as well as maintenance of the infrastructure, and obliged to meet the collection and recycling targets. The funds can be transferred to WAMCO, where once the PET bottles are either baled or flaked, can be sold to the producers, also which is obliged by a Regulation.

The Producers or the PRO should bear the responsibility of organizing and financing the export of these end-products to a recycling market in India or another country.

In this way, the collection and recycling infrastructure and mechanism can be maintained. The first steps would then be to **Create a Producer Responsibility or Recycling Regulation, whereby the following clauses are included:**

Extraction of fees from producers, or extraction of GST and tariff revenues from the import and sale of PET to create a Recycling Fund to finance and organize the collection and recycling of PET in the Maldives	Setting minimum collection and recycling targets to be fulfilled by the Producers in the first year of implementation, and the rates to be increased to no less than 90% within 4 years of initiating the PRO/Recycling Regulation
Extraction of capital costs from Producers, high volume importers and retailers	Obligation of producers to buy the processed PET waste products and export it to a foreign market.

Since the costs of wastewater equipment and treatment are very high, it is recommended for the Maldives to first invest in plastic collection and baling infrastructure, and export it for profits. Considerable investments need to be made for awareness, as well as for setting up the physical infrastructure for collection and recycling, as well as the implementation. Thereby, the first phase can be investment in collection mechanism, and the second phase can be in the investment of a flaking unit, and further considerations and study of pelletizing and closing the material loops within the Maldives.

FIGURE 6.1: RECYCLING PROCESS

Producer intervenes to increase the reward for the collector & processor with a buying agreement at higher prices encouraging PET segregation and collection

Source adapted from: Richards et al, 2014

TO SUMMARISE

a. **Plastic recycling is made difficult due to lack of structure, knowledge and funding.** Even though it harms our environment, that alone is usually not enough incentive to bring about considerable changes. There are several different types of recycling, for example primary and secondary. Primary recycling involves producing packaging of the same material.

b. Plastic goes through structural changes when subjected to thermal and mechanical stress.

c. Some of the **main operational costs** of the PET recycling process can include **energy, water, transport and export costs**.

d. Considering the initial capital investment costs and the operational costs, the **financial obligation of waste collection and recycling can be shared** among the producers, importers and large retailers.

CHAPTER 7

CONCLUSIONS & RECOMMENDATIONS

1% of total waste in the country.

The total plastic footprint in the Maldives is about 12% of the total waste in the country, while PET bottles in the beverages industry is about 10% of the total plastic waste (1% of the total waste). In 2019, the local production of PET bottles, including water and soft drinks was estimated at 143 million bottles, or 3300 tons. Despite the low volume of PET in comparison to other wastes, the lack of biodegradability and the negative impacts to the marine environment make plastic pollution a highly visible, as well as pertinent environmental problem in the Maldives.

Glass bottles resulting in increase in prices

As per the assessment presented in this Report, alternatives to plastic such as glass bottles would result in increase in prices to consumers given the relatively higher production costs, and in the case of refillable glass, higher costs of washing and cleaning to a level acceptable on safety standards. The significant environmental impact in terms of energy and chemicals used also needs to be considered.

Lack of trust causing increased use of plastic water bottles

The lack of trust by households on tap water has also been one of the major reasons for the increased use of plastic water bottles in the Maldives. There are important factors to be considered and key policy decisions to be made by the utility companies and the relevant Government authorities on this front.

As there is no systematic plastic waste collection system, it can be estimated that most of the PET bottles that are produced and imported into the country are leaked to the marine environment, or collected with household and commercial waste and then burnt in Thilafushi. **In 2019, the export revenue from waste material shows that 488 tons of plastic waste was collected, generating an income of MVR 2.4 million**. This revenue can be increased significantly if there is a systematic and segregated waste collection effort imposed on the national level for plastic, and specifically for PET. This is because PET packaging has value, and it can be exported to recycling facilities that can buy the baled bottles, or cleaned PET flakes. **At present, WAMCO incurs a lost revenue of approximately $700,000 per year, as the country burns out or throws away more than 3,000 tons of PET bottles annually.**

While there are several approaches to deal with plastic waste, waste management activities should be organized in a manner that is consistent with international best practices, including considerations given to minimizing impacts on human health, and the natural environment. According to the Waste Management Regulation of 2015, the Strategic Action Plan of the Government from 2019-2023, as well as in the Single Use Plastic Phaseout Plan, the Government of Maldives has stated the importance of waste management activities including the provision for **Extended Producer Responsibility (EPR)**, with guidelines for a trust fund that is operated through a separate account for the fund, the **establishment of a re-use and recycling industry, and provision of incentives** for those industries to develop as a business, as well as the implementation of **Polluter Pays Principle PPP.**

The collection of plastic waste, the treatment and final disposal should be aligned according to the waste management principles and strategies of the Government. **Based on the best practice and principles of waste management, the socioeconomic impact of PET consumption in the Maldives, as well as the analysis of costs required for setting up collection and recycling infrastructure, this Report recommends the Maldives to set up a collection and recycling system where the PET beverage containers are collected, baled or flaked, and exported. Based on the costs, it is more feasible for the Maldives to invest first in a collection system, meeting the collection targets, and baling it for exports. In the next phase, the Maldives can invest in a flaking unit and process the waste to clean flakes and export it.**

However, there are studies that need to be conducted on the impacts of wastewater from PET recycling, as well as the potential feasibility of Maldivian producers to create a closed loop recycling facility.

KEY RECOMMENDATIONS OF THE REPORT ARE:

7.1 ESTABLISH PRODUCER RESPONSIBILITY FOR PET COLLECTION AND RECYCLING

In order to efficiently manage the PET waste in the country, the Government needs to introduce a an EPR Regulation which includes PET bottles. This is also stated in the SUP Phaseout Plan, and the SAP of the Government of Maldives. EPR Regulation should define and include:

Assignment of clear financial responsibility in waste collection and recycling of PET beverage containers to the producers, high volume importers and retailers of PET beverage containers. Financial responsibility includes investing in provision and maintenance of collection and recycling infrastructure, engaging in demonstrated efforts for eco-design or provision of non-PET packaged alternatives for drinking water (e.g. beverage packaging made from biomass, inclusion of recycled content, or provision of drinking water in reusable alternatives such as water filtration systems), and financing the awareness and communication about plastic recycling, and increasing public confidence about tap water in addition to the awareness efforts by the Government.

Assignment of financial and physical responsibilities in waste collection and processing of PET bottles to tourist resorts, whereby tourist resorts have to implement a mechanism to collect PET waste, and transfer it to a Regional Waste Management Facility or Thilafushi.

Obligation on producers and importers to disclose the number of PET bottles put on the market.

Announce minimum collection rates that can start at 20% to be increased to 90% over a 4 year time frame, starting from 2021.

Define a mechanism where producers are held liable for not meeting the collection targets e.g. by contributing more to the Recycling Fund. An EPR Tax for not meeting the minimum collection rates could be imposed for every ton, or per bottle.

Obligation of producers to buy-back the processed PET waste from WAMCO and export it for recycling, and commit a minimum percentage of profits to WAMCO.

Add guidance on the package label on how to collect and recycle.

Establishment of a Purchase Assistance Fee (PAF) by the Producer to increase the value of collected bottles artificially. This intervention artificially increases the price of a post-consumer PET bottle. The price offered for post-consumer bottles should be attractive enough so that it is a profitable venture for any island collector. The high post-consumer bottle will make it profitable for waste collectors on the island to bring PET bottle to the collection center.

Process PET waste in a way that can be sold as bales or clean flakes to the recycling market.

Obligatory coastal and marine litter cleanups under EPR.

Introduce recycling content back to PET beverage packaging, and reduce the packaging carbon footprint. Define minimum recycling content to be included in the packaging.

Introduce transparent/neutral colour for all PET water packaging.

Establish a Recycler Contract with an international recycler with an import license to buy the processed PET flake from the Maldives.

The Recycler is paid on the flakes processed. This payment becomes the financial injection into the value chain in the form of a PAF.

7.2 SETTING UP A RECYCLING FUND

The Government can establish a Recycling Fund, which shared financial contributions from the Producers, and from the Government. Producer profits from sale of beverage bottles, as well as the revenues from GST and tariffs that are accrued to the government, from the import and sales of PET packaging in the Maldives can also dually be used collectively used to maintain the collection and recycling system. According to the estimated costs calculated for this Report, a minimum of **USD 460,000 dollars (approximately MVR 7 million)** can facilitate the operational costs for collection and flaking and **USD 295,000 (approximately MVR 4.5million)** for collection and baling.

In addition to this, the Government could provide clauses in the EPR Regulation where Producers contribute to the Recycling Fund, such as by provision of capital expenditure and maintenance for the collection and recycling infrastructure, guaranteed buy-back of processed PET waste from WAMCO, and financial contribution to meet the obligated collection and recycling targets (or compensation to the Recycling Fund for failing to meet the collection and recycling targets).

7.3 IDENTIFICATION OF IMPORTED PRODUCTS BY PACKAGING

One of the most crucial steps in waste collection is the identification of the number of products that are put in the market, so as to identify how much waste is generated. As of now, the Maldives does not have proper data on the number of products imported into the country, by packaging. While the local production can be obtained, the Government also needs to identify the quantity of imports of PET and other types of plastic. This can be done by strengthening customs data collection, by requiring them to identify products by their type of packaging, in addition to the product name. This will also allow the Government to identify the most high-volume importers, and require the most high-volume importers to contribute to the Recycling Fund. This approach can also be applied holistically to other products as well, and can improve overall import and market data of the Maldives, as well as the waste management data.

7.4 INCREASING PUBLIC CONFIDENCE IN THE TAP WATER SYSTEM AND PROVISION OF INCENTIVES TO INCREASE TAP WATER CONSUMPTION

The Government can revise the household consumption band prices, as they are currently at USD 4.53 or MVR 70 per cubic meter, for the consumption from Band B in the Greater Male' Region, which is within the consumption range of most households. This is considerably costly as the costs of producing desalinated water per cubic meter in 2016 ranged between an average of USD 0.49 to 2.86 in the world, for 7 different methods of desalination (World Bank, 2019).

In addition, the Government should harmonise the plumbing standards in liaison with MWSC and other water utility companies, as there is a low confidence level in the public plumbing system, and poor quality and condition of the piping system have been cited as a reason for switching to PET bottled water as well.

Thereby, revising the band prices and harmonizing the plumbing system are ways for the Government to tackle the issue of plastic pollution, and provide solutions to prevent the consumption of PET bottled water.

7.5 USING BEST PRACTICE WASTE MANAGEMENT POLICIES AT THE NATIONAL AND REGIONAL LEVEL

Maldives needs a waste management strategy that includes solutions to the total waste of the country. Upon analysis of the current waste management policy landscape, it is apparent that there are some policies that can be in conflict with each other if used as the only waste management strategy. For instance, the Government has invested in incineration plants that may rely on the high calorific value of plastics for combustion, as the Maldives has between 60 to 70% organic waste. Thereby, eliminating plastic waste streams will increase the running costs of the incineration plant, as plastics constitute of one third of the carbon required for combustion (Tullo, 2018).

However, it should be noted that the waste-to-energy option from burning plastics is lower in the hierarchy of waste management principles, as incineration should ideally be limited only for non-recyclable items. Waste-to energy also contradicts circular economy goals, as the extraction of fossil fuels to make plastics, and then burning them again for energy instead of extending the life of the materials, or by recovering the material is a linear approach. In addition, waste-to energy contributes to air pollution and climate change impacts, and even with the installation of good end-of pipe technologies, incineration of plastic can release harmful dioxins and heavy metals in to the environment, as well as resulting ash, which need to be landfilled, and can pose additional environmental and socioeconomic impacts. In addition, while larger waste-to energy plants can generate electricity that is sufficient for tens of thousands of houses (Royte, 2019), studies have shown that recycling plastic saves more energy than incineration of plastics along with other wastes, by reducing the extraction of fossil fuels and processing it into new plastic (Morris, 2003).

Thereby, the most sustainable option is to segregate the plastics, and enable the safe collection for cradle-to cradle recycling, or downcycling it to be remade into other useful products.

While waste-to energy plants, or pyrolysis can be a supplementary waste management strategy in dealing with all the other residual plastic, and other types of waste, (while recovering energy and metals), the most sustainable option is to collect the high quality PET separately and export it to another country for recycling. However, as many countries are putting up green walls, exporting baled PET should only be a short-term strategy for the Maldives, and it is recommended that flaking operations are started in the country within a maximum period of 2-3 years.

TO SUMMARISE

a. Most PET bottles used in the beverages industry are collected along with other waste and mostly **burnt.** Some of the empty bottles also **leak into the marine environment.**

b. Increased use of plastic water bottles in Maldives is mostly due to the **mistrust in tap water.**

c. Maldives could set up a **collection and recycling system** where PET beverage containers are **collected, baled or flaked.**

d. Maldives could start **exporting high quality PET to other countries** in the short term until flaking operations can be set up.

e. Setting up recycling plants, and assignment of clear financial responsibility is a good **starting point**.

f. As Maldives gains most of its revenue from tourism, it is not untrue to say our beaches and seas are our livelihoods. In order to stop our oceans from being more polluted we should **put into place proper infrastructure that facilitates better waste management and disposal.**

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ABOUT MALDIVES OCEAN PLASTICS ALLIANCE (MOPA)

Registered in 2020, MOPA is a not-for-profit, non-governmental organization focused on forging alliances, and works in the jurisdiction of the Maldives.

MOPA is the first, and so far only, locally-registered non-government initiative dedicated to forging strong stakeholder alliances to reduce, recover, reuse, repurpose and recycle ocean plastics in the Maldives.

MOPA believes in working with manufacturers, importers, retailers, consumers, tapping into corporate social responsibility initiatives to safeguard our pristine environment. MOPA is committed to science, contribute to education and awareness and conform to policy initiatives, to formulate community-based programmes and ambitious projects aimed at ridding pollution from our oceans.

MOPA is inspired by the commitment of the government of Maldives to address ocean plastics through strong legislation. MOPA also supports the global movement towards banning single use plastics.

ABOUT NIG CAPITAL

NIG Capital Pvt Ltd. is a management consulting and an investment capital firm based in Maldives, catering big corporations, small and medium enterprises, public sector and private individuals.

In addition to financial advisory services, NIG Capital also provides expertise on economic and financial research, and advisory services of strengthening accountability and governance.

NIG Capital's approach to corporate responsibility focuses on having a positive impact on our society and the environment.

NIG Capital aims to act in the most responsible way possible towards society and the environment at all times. NIG Capital strongly believes in the well being of our people. As part of its social responsibility, NIG Capital continues to contribute towards developing careers, enhancing technical skills, and ensuring inclusiveness.

NIG Capital is committed to protecting the environment and focused on finding ways to work better with all stake holders to achieve their common objectives effectively.

LIST OF ABBREVIATIONS

ADB	Asian Development Bank
ARF	Advanced Recycling Fees
BPA	Bisphenol A
COD	Chemical Oxygen Demand
CO2	Carbon Dioxide
DRS	Deposit Refund Systems
EOL	End-of-Life
EPA	Environment Protection Agency
EPR	Extended Producer Responsibility
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GST	Goods and Services Tax
HDPE	High-density polyethylene
HIES	Household Income and Expenditure Survey
KII	Key Informant Interviews
KSG	Koror State Government
LCA	Life Cycle Assessment
MAWC	Male' Aerated Water Company
MOE	Ministry of Environment
MOF	Ministry of Finance
MRF	Materials Recovery Facility
MTR	Meters
MVR	Maldivian Rufiya
MWSC	Male' Water and Sewerage Company
NBS	National Bureau of Statistics
OECD	Organisation for Economic Co-operation and Development
PE	Polyethylene
PET	Polyethylene terephthalate
PP	Polypropylene
PRO	Producer Responsibility Organization
PTA	Purified Terephthalic Acid
PVC	Polyvinyl Chloride
PWB	Plastic Water Bottles
RIC	Resin Identification Codes
RVM	Reverse Vending Machine
SIDS	Small Island Developing State
SSP	Solid State Polymerization
TDS	Total Dissolved Solids
USD	United States Dollar
vPET	Virgin PET
WAMCO	Waste Management Corporation Limited
WARM	Waste Reduction Model
WEEE	Waste Electronic and Electronic Equipment

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