

Sustainable Plastic Waste Management in Sri Lanka

Effective policy approaches

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Supervisor

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Abstract

Waste management is one of the key environmental issues identified in Sri Lanka. Waste generation is linked with the increase of population and urbanization. Polyethylene and other plastics have become a significant consumable material in lifestyles of the public as well as all types of industries in the country. The plastic consumption is high with the sophistication of living standards of the lifestyle. Managing plastic waste is significant issue in Sri Lanka due to unavailability of validated technology along with the infrastructure for material recycling and recovery. Littering is the main issue of plastic and haphazard disposal, open dumping and burning of plastic cause negative externalities to the environment and human health. The main environmental impacts are air pollution, impact on human health, degradation of land and water, impact on biodiversity and aesthetic value. The government of Sri Lanka has taken many initiatives to improve waste management systems in the country where some of them are development of policies, strategies, guidelines, legislation and provision of infrastructure facilities for waste management. However, poor results have been achieved due to many reasons. This research aims to explore important policy approaches that could be applied in Sri Lanka as a long-term solution to manage plastic waste. The overarching goal of this research is to make recommendations based on policy tools that have been successfully applied in other countries and which can be adopted in Sri Lanka.

Keywords: Waste management, plastic waste, waste management policies, policy tools, implementation, Sri Lanka

Executive Summary

Municipal Solid Waste (MSW) is a global issue and the level of significance is higher in developing and emerging economies compared to developed countries since the capability of establishing sustainable waste management approaches are limited due to financial, technical and human resources. Although developing countries typically produce significantly less waste than developed countries, developing countries often have more challenging waste problems than developed countries.

Municipal Solid Waste (MSW) became an issue in late 1970s in Sri Lanka with the mass scale socio-economic transformation that happened in the country. As a result SW generation has increased rapidly causing negative externalities to the environment and human health. Littering is one of the major issues that provide habitat for vector-borne diseases and impact on aesthetic beauty of the country. In addition, land and water degradation, impact on biodiversity, blockage of drainage lines and air pollution due to open burning are also concerned issues due to indiscriminate disposal and open burning of plastics.

Sri Lankan Environmental Management Policy originates from the country's supreme law; the Constitution in 1970. In addition, there are a number of policy and policy tools that have been introduced by the government relevant to the waste management. The national government and Local Authorities (LAs) have the legal and regulatory powers relating to solid waste and hazardous waste disposal. The national government is responsible for developing the policies, strategies and developing the legal framework along with the provisions for waste management. Most of the Local Authorities are struggling with financial, technical and human resources for developing the collecting and disposal of the waste management system.

Although there are a number of policies and policy tools adopted by the government, poor results have been achieved due to gaps in resources and implementation. In this context, this research aims to explore important policy approaches that could be applied in Sri Lanka as a long-term solution to manage plastic waste. The overarching goal of this research is to make recommendations based on policy tools that have been successfully applied in other countries and which can be adopted in Sri Lanka. The study focuses on three main areas based on the theoretical framework. Firstly, it reviews the existing plastic waste management practices, policies adopted and main challenges in Sri Lanka. Secondly, it addresses how Sri Lanka has met those challenges. Thirdly, it studies the success policies that are applied in other countries in the region, including developing countries, for management of plastic in municipal solid waste.

As many other developing countries in the region and world, the predominant practice of waste management is open dumping and burning, owing to lack of resources and the sophistication of the infrastructure for waste management may not develop at an appropriate rate to comply with their increasing levels of plastic waste. Plastic waste is the second largest contributor to the municipal waste in Sri Lanka and it contributes 10%-11% share. Although the per capita consumption of plastic in Sri Lanka is 6 kg per year which accounts for a very low figure compared to developed countries, Sri Lanka is struggling with managing plastic waste owing to unavailability of scientifically and environmentally sound disposal mechanism. The issue is escalated with the negative attitudes of public on segregation and waste disposal methods.

Currently, around 500,000 metric tonnes of plastic/ polyethylene imports in Sri Lanka. About 30% is re-exported and balance of 70% is being used in Sri Lanka while used plastic waste ends in dump sites. However, out of this waste, 40% plastic is recycled currently. Sri Lanka has initiated a number of measures to control plastic waste: including formulation of Solid

waste management policy, National environment policy, National cleaner production policy, Technical guideline for solid waste management, a number of laws under the National Environment Act and Local Government Act etc. However, poor results were achieved so far with those policies and laws.

Therefore, in September 2017 the government of Sri Lanka passed important legislation pertinent to plastic waste, such as Prohibition of polyethylene in decorations, Prohibition of polyethylene food wrappers (lunch sheet), Prohibition of high density polyethylene bags (sili-sili bags), Prohibition of polyethylene products of twenty (20) microns or below and Prohibition of polystyrene products. These laws are too young to measure its effectiveness. However, those laws would be able to control plastic at least to some extent though implementation challenges are existing.

The plastic recycling industry is not much popular in Sri Lanka due to fluctuation of price in line with the fuel prices, unavailability of infrastructure for collection and separation, mix with plastic in MSW etc. There are a few leading companies, but the majority of them are small and medium-scale recyclers. Facilitation needs to be provided by the government to the small and medium-scale recyclers to convert the existing recycling process to an environmentally healthy process to avoid the re-bound effect.

There are number of policy tools that have been adopted by other countries in the region for managing plastic waste. For instance, Extended Producer Responsibility, Increase of thickness of plastic bags, Green purchasing act, Deposit-refund system. Taking into consideration the existing waste management practices, legislation, major challenges associated, a few recommendations have been made which may support in formulating future policies in order to manage plastic waste in Sri Lanka.

However, incorporation of good governance principles, in line with the environmental governance, into the policy formulation and implementation process plays a vital role for the success of the proposed policies, in order to reduce the pressure on natural resources by plastic.

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Abbreviations

AIT	Asian Institute of Technology
CEA	Central environmental Authority
CMC	Colombo Municipal Council
EDB	Export Development Board
GHG	Green House Gas
HDPL	High Density Polyethylene
ISWA	International Solid Waste Association
LAs	Local Authorities
LDPL	Low Density Polyethylene
MSD	Municipal Solid Waste
NEA	National Environment Act
NSWMP	National Solid Waste Management Policy
POPs	Persistent Organic Pollutants
UNEP	United Nations Environment Programme
WECF	Women in Europe for a Common Future
WEF	World Economic Forum

1 Introduction

Municipal Solid Waste (MSW) is a global issue and the level of significance is higher in developing and emerging economies compared to developed countries since the capability of establishing sustainable waste management approaches are limited due to various reasons. For instance, the major impediment in developing countries is the lack of capital, which jeopardizes improvements in waste quality and waste management. Developing countries may also lack access to advanced technologies. All the steps from waste generation to final end of the lifecycle incur with financial aspects for sustainable waste management systems. Developed countries have the capacity to invest considerable capital in waste management systems and achieve success, although they generate significant volumes of waste compared to developing countries. The World Bank has revealed that the global solid waste has increased to 0.68 billion tonnes per year as for 2002, while 1.3 billion tonnes per year in 2012. Further, it has been emphasized that in 2025 it would be 2.2 billion tonnes (Cogut, 2017).

Polyethylene and other plastic have become a significant consumable material in lifestyles of the global population, as well as, all types of industries in the world. Plastic is a highly useful material and its applications are expected to increase as more new products and plastics are developed to meet demands. According to the World Economic Forum, the plastic production industry has grown fast over the last fifty years. For instance plastic production in 1964 was 15 million tonnes and in 2014 it was 311 million tonnes as shown in Figure 1-1. It is expected to double over the next twenty years (WEF, 2016).

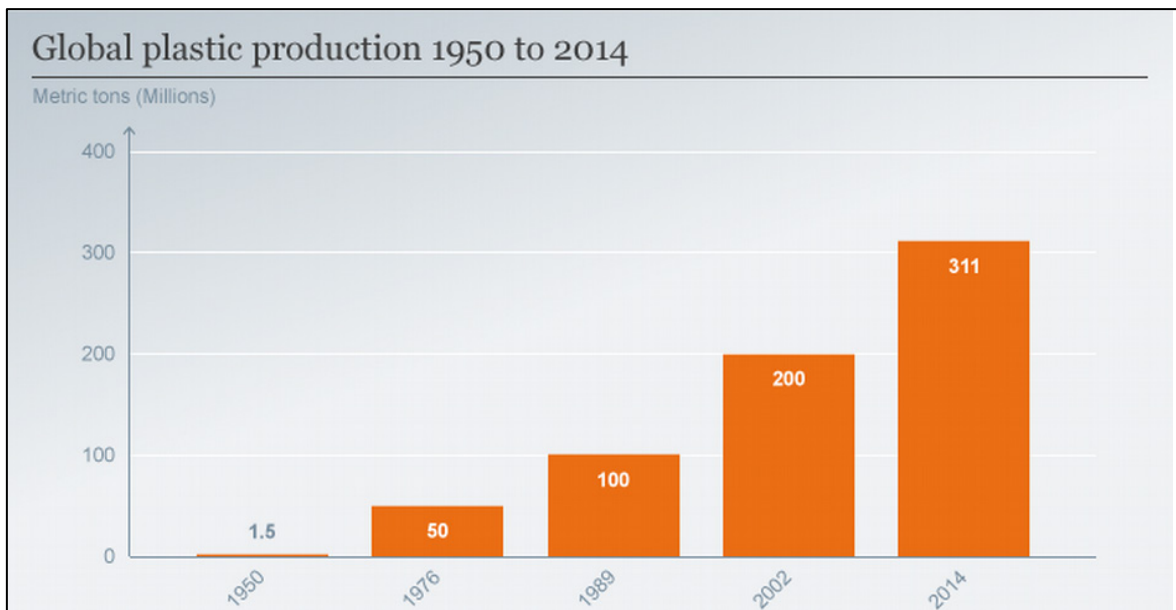


Figure 1-1 World plastic production

Extracted: <https://www.dw.com/en/six-data-visualizations-that-explain-the-plastic-problem/a-36861883>

According to United Nations Environment Programme UNEP et al. (2017), the consumption pattern of Asia has changed at an alarming rate with urbanization, rapidly developing economies and increasing the capacity of outlay, which are important factors for improving quality of life in Asia. It is obvious that waste generation in Sri Lanka has increased due to improved lifestyles. Even within the country the waste generation is high in urban areas compared to rural areas. As mentioned in the previous paragraph, polyethylene and other plastics have been used significantly in all sectors in Sri Lanka due to easy handling

and low price. As in many other countries, waste generation has increased in Sri Lanka and especially the consumption of polyethylene and other plastics. At present, waste has become a challenge for the government in many aspects in order to maintain the quality of the environment.

The highest per capita consumption of plastic in the world is in the United States and Europe which accounts for 68 and 50 kg per capita per year respectively. Japan and China accounts for 46 and 38 kg per year which is the highest amount of plastic consumption in the Asian region while India reaches 8 kg per year, Sri Lanka 6 kg per year and Bangladesh 3.7 kg per year (Mourshed et al., 2017). Although the amount of per capita consumption of plastic is low in Sri Lanka compared to the US and Europe, a substantial effort has to be made for managing plastic owing to lack of technological, financial and expertise knowledge compared to those countries.

The generation of plastic waste is also increasing rapidly in parallel to the plastic production. The major challenge is whether all the states in the world are capable of developing strategies to manage plastic waste successfully in line with the increased plastic generation. Developing countries have been struggling with the management of waste due to gradual increase of the rate of waste generation. It is obvious that, with respect to the developing and emerging economies the increased use and production of plastic is a decisive concern, since the sophistication of infrastructure for waste management may not develop at an appropriate rate to comply with these increasing levels of plastic waste. Sri Lanka is also experiencing such a situation, although a number of policy tools have been adopted during last two decades. According to Hikkaduwa et al. (2016), plastic is the second largest contributor to the MSW in Sri Lanka.

As in many other developing countries Municipal Solid Waste (MSW) is a crucial alarming issue in many urban areas in Sri Lanka. The main causes of waste generation are rapid urbanization, development, population growth, migration and changes in lifestyles especially changes in the consumption patterns and industrialization (Hikkaduwa et al., 2015). There are many issues associated with plastic waste in the country.

i. Air pollution

Open solid waste dumps are also a primary source of Green House Gas (GHG) emissions such as methane and carbon dioxide, leading to air pollution and to climate change (T Lalithasiri Gunaruwan, W Neluka Gunasekara, 2016; Pilapitiya, 2012). In addition, it was noticed that haphazard burning of solid waste generates high levels of odour, dust and toxic fumes in Sri Lanka (T Lalithasiri Gunaruwan, W Neluka Gunasekara, 2016; Asian Institute of Technology, 2004). Anaerobic digestion of waste releases hydrogen sulfide which causes highly unpleasant odour. However, the emissions release to the environment is subject to the characteristics of the plastic material and the way of combustion. For instance, polyethylene (PE), polypropylene (PP) and polystyrene (PS) materials that are subjected to incomplete combustion release carbon monoxide (CO) and noxious emissions (NOX) which contribute to the GHG emissions (Verma et al., 2016). In addition the dioxin emissions derived from the burning of organochlorinated substances are highly harmful and they persist in the environment.

ii. Health impacts

According to WECF (n.d.), burning of products which include polystyrene polymers for instance food packaging materials contribute to release of toxic gasses such as styrene. The harmful characteristic of styrene gas has a high capacity of absorption through the skin and

lungs which cause health disorders. The central nervous system can be affected due to long-term exposure by styrene along with headache, fatigue, weakness, and depression. Dioxine is one of the harmful POPs which has lethal effects and cause cancer and neurological damage. In addition, it has an impact on reproductive, hormone and respiratory systems (Verma, 2016). Because of the persistent characteristics of dioxine, it is a toxin which can be accumulated in the human and animal fatty tissues and its concentration increases in offspring. Furthermore, burning of plastic can increase the risk of heart disease, aggravate respiratory ailments such as asthma and emphysema, and cause rashes, nausea, or headache. Also organs such as the kidney, liver as well as the reproductive and nervous systems are damaged or disrupted due to burning of plastic (WEFC, n.d.).

In an article in “Daily mirror” Dr.Gunathilake stated that the death pattern of Sri Lanka has been changed from infectious and parasitic diseases to heart attacks, strokes and cancers which are dominating currently. He argued that plastic is responsible for this alteration (Ismail, 2017). A study has been conducted by the Colombo municipal council of Sri Lanka on the impact of MSW in Colombo. The results showed that 55% of the rag pickers, 20% of the staff, and 27% of the community were agonized with diseases pertinent to respiratory system (Abeyesuriya, 2007). The results are tabulated in Table 1-1.

Table 1-1 Health impact [percentage]

Selected group	Respiratory problems	Skin diseases	Water diseases	Malaria	Filariasis	Dengue fever
Community	27	35	15	12	-	-
Staff (Labors)	20	34	11	2	-	-
Rag pickers	55	45	23	9	5	5

Source: Abeyesuriya (2007)

According to the above results, rag pickers are the most vulnerable group owing to frequent exposure to waste. They collect waste without any precautionary measures and hence health impacts are accelerated since waste is not separated at the source of origin. The same type of unhygienic practice is applied by the municipal workers who collect waste in Colombo. Occupational health impacts are common with them due to frequent exposure to waste, Even though they have been instructed and provided precautionary measures like boots and gloves by the authorities, they are unwilling to use them (Abeyesuriya, 2007).

Besides, littering of plastic waste provides the ground for vector-borne diseases. For instance water is collected in plastic packaging materials during rains and floods and these are ideal habitats for mosquitoes, other insects and pathogens. Ministry of Health in collaboration with the Ministry of Defense launch campaigns to collect plastics in public places and home gardens to control the breeding grounds of mosquitoes in order to reduce the spreading of dengue fever during raining season.

iii. Impact on wildlife and physical environment

Sri Lanka has been identified as one of the bio diversity hotspots in the world. However, unscientific mode of discharge of MSW by the local authorities cause significant impact to the wildlife due to the utilization of marshy lands, forests and river reservations and wetlands as dumping sites (Karunaratne, 2015). According to Karunaratne (2015), since 250 open dumping sites are operated throughout the country, the impact on wildlife and environment is significant. The wild animals like elephants and birds, as well as domestic animals feed on

garbage, which consists of shopping bags, rotten food and other unhealthy and dangerous waste. There are incidence of ingestion of plastics and polyethylene into the wild animals. Yet scientific studies on this sector are limited in especially Sri Lanka.

Scattered or dumped garbage often ends up in drainage channels and other waterways, where it may cause pollution and can disrupt the water-flow. One of the reasons of flooding in Colombo and suburban areas is blocked drainage lines due to littering of plastic, which has been experienced over the years. Besides, Sri Lanka is an attractive country for tourists with its nature, geographical distribution, green environment, historical features and wildlife. Haphazard littering and dumping of solid waste reduce the aesthetic value and scenic beauty of the environment, thereby creating negative visible impacts to human beings and affects tourism.

1.1 Research problem, aim and research questions

Sri Lanka has been experiencing the above environmental negative externalities of improper plastic waste management for a long period of time. Still there is no pre-defined long-term proper plan or system for plastic waste management. The issue has been accelerated with the obvious lack/gap of policies as well as implementation issues of existing policies for plastic waste management. This research aims to explore important policy approaches that could be applied in Sri Lanka as a long-term solution to manage plastic waste. The overarching goal of this research is to make recommendations based on policy tools that have been successfully applied in other countries and which can be adopted in Sri Lanka. This is done in order to suggest strategies to overcome barriers for sustainable plastic waste management in the country.

The research questions for the study are as follows:

1. How is Sri Lanka managing plastic waste? What are the existing challenges for managing plastic waste in Sri Lanka?
2. How can Sri Lanka overcome those challenges?
3. What are the success policies that are applied in other countries in the region including developing countries for management of plastic in municipal solid waste?

1.2 Limitations and Scope

The geographical scope of the thesis is Sri Lanka and the focus is on plastic waste management. Since plastic waste is combined with municipal solid waste, the policies and policy tools adopted focus on both. Therefore, some parts of the thesis elaborate the municipal solid waste in addition to the plastic waste. Although the discharge of micro plastic is a severe issue and strong international attention is paid to manage it, there is no room for research on micro plastic in this thesis owing to limiting time constraints. The reasons for selecting plastic waste management in Sri Lanka are three. Firstly, limited studies have been carried out and published so far in this field in Sri Lanka as the focus of the research. Secondly, there is a significant impact on social, economic and environmental sectors from plastic waste. Thirdly, the inspiration from Swedish waste management system and practices made the study topical after spending more than a year in the country.

The main constraint of this research is limited access to the stakeholders as the author conducted the research from Sweden and there was poor response from a large number of stakeholders. Data collection studies on plastic waste has not been conducted all over the country and only a few studies are available in addition to the study that was done by JICA.

1.3 Ethical consideration

The research process creates tension between the aims of research to make generalizations for the good of others, and the rights of participants to maintain privacy (Orb et al, (2001). According to Orb et al. (2001), ethics are providing something good and helps to circumvent the harmful things for others during the research. There are number of application of apposite principles that have been identified in order to minimize or eliminate the harm of any party of the research. Thus, the author adheres to the principles of ethical considerations throughout the research.

1.4 Audience

Since the author expects to make recommendations based on the successful policy tools that have been adopted in other countries, the policy makers and regulators will benefit from the findings of this study. This study may provide the basement for academia to fill the data gaps available in the country through their research which can give guidance in support of developing necessary infrastructure for plastic waste management. The findings of the research may support the donors /NGOs to channel funds that are necessary for developing a system for managing plastic waste in the country.

1.5 Disposition

The author has already introduced the basic information on plastic in the world and its position in Sri Lanka. The detailed information is explained in the next sections. While the Contextual framework is deliberated in Chapter 2, Research Design and Methodology along with the Theoretical framework is explained in Chapter 3. The literature review section is focused to answer the designed research questions, the set up of which is found in Chapter 4. Chapter 5 focuses on the Discussion part of the research, while Conclusion & Recommendations are given in the last chapter.

2 Contextual Framework

Sri Lanka, an island country with a land area of about 65,610 sq.km located in the Indian Ocean, lies between 5.34N and 9.52N latitude and between 79.39E and 81.5E longitude. It is located at the global logistic hub by intercepting with the major air and sea routes between Europe and the Far East. The location map is shown in Figure 2-1. There is a significant temporal and spatial variation in the island's climate. The mean annual temperature in the coastal belt ranges from 26.0°C to 28.0°C, while in the central highlands it ranges from 15°C to 19°C. The population of Sri Lanka is 20.5 million with a population density of 331 per sq.km. There are four types of ethnic/religious groups in Sri Lanka namely 1) Singhalese, 2) Tamils, 3) Muslims and 4) Burgher. The per capita income of Sri Lanka has increased from US\$ 1062 in 2004 and US\$ 1,770 in 2008, while it was approximately US\$ 3,400 in 2014 and Sri Lanka has become a middle-income country. Sri Lanka has been classified as a middle-income country based on the increase of per capita income (Ministry of Environment, 2012 and JICA, 2016). A summarized country profile of Sri Lanka is presented in Box 1.



Figure 2-1 Location Map of Sri Lanka

Source: <https://kids.britannica.com/kids/assembly/view/66914>

Box 1 Sri Lanka Profile at a Glance	
GEOGRAPHIC PROFILE	HISTORIC & ADMINISTRATIVE PROFILE
<p>Location: Southern tip of Indian sub-continent - Strategic location near major Indian Ocean sea-lanes.</p> <p>Total Extent: 65,610 sq.km. Land: 64,630 sq.km. Water: 980 sq.km.</p> <p>Coastline: 1,585 km.</p> <p>Territorial sea: 12 nm.</p> <p>Contiguous zone: 24 nm.</p> <p>Continental shelf: 200 nm or to the edge of the continental margin.</p> <p>Exclusive economic zone: 200 nm.</p> <p>Climate: Tropical – Mean annual temperature: Low lying areas: 26 °C to 28 °C. Central highlands 15 °C to 19 °C. Mean Annual Rainfall: 1000mm to over 5000mm. Monsoon: Northeast monsoon (December to March), Southwest monsoon (June to October)</p>	<p>Ancient civilisation - "Serendip" / "Pearl of the Indian Ocean" to Arab geographers, the island fell under Portuguese and Dutch rule and finally came under British rule when it was called Ceylon.</p> <p>Administrative System: Unitary State with provincial bodies. Provinces -9, Districts -25, DS Divisions - 327, GN Divisions –14500.</p> <p>Capital: Legislative -Sri Jayewardenepura; Commercial – Colombo.</p> <p>Official Languages: Sinhala & Tamil; Link Language: English</p>
<p>DEMOGRAPHIC, HUMAN AND SOCIAL PROFILE:</p> <p>Population: 20.869 Mill. Population in urban areas 15.0%</p> <p>Annual population growth rate: 1.0%</p> <p>Rate of urbanisation: 1.1%.</p> <p>Age structure : 0-14 years: 24.9%, 15-64 years: 67.2%, 65 years and over: 7.9%.</p> <p>Literacy Rate : 91.9%. Overall adult literacy rate: 91.4% (Male 92.8%, Female 90.0%)</p> <p>Educational Enrolment Rate: 98%.</p> <p>Dropout Rate : Primary 1.6%. Secondary 14%.</p> <p>Ethnic Groups : Sinhala 74.5%, Tamil 16.8%, Muslim 8.9%, Others 0.7%.</p> <p>Religions: Buddhist 69.1%, Islam 7.6%, Hindu 7.1%, Christian 6.2%, others 10%.</p> <p>Poverty Head Counter Index: (2002): 22.7 (2006/2007): 15.2 (2009/2010): 8.9(b)</p> <p>Education and Health: Free for all citizens</p> <p>Economy: Open Market</p> <p>Contribution to the Economy: Agriculture Sector – 11.2%, Industrial Sector –30%, Service Sector –58.8%</p>	

Box 2-1 Sri Lanka Profile at a Glance

Source: Ministry of Environment (2012)

2.1 The role of Plastic in Sri Lanka

As mentioned in previous chapter plastic has become an unavoidable material in lifestyles of the public, as well as other sectors like industry, agriculture, health and building etc. with its characteristic features. The plastic consumption is rising with the sophistication of living

standards. The per capita consumption rate is high in developed countries as compared to developing countries. Figure 2-2 shows the per capita consumption of plastic of selected countries including Sri Lanka. According to the Figure 2-2, the plastic consumption rate is low¹ compared to the other countries with the exemption of Bangladesh, but the pressure of managing the plastic waste is high due to unavailability of infrastructure or methodology for managing plastic waste appropriately. According to Sirimane (2017), Sri Lanka annually imports 9,600 tonnes of raw plastic virgin (PET) to manufacture plastic products including bottles, packaging and for various uses. About 30% is re-exported and balance of 70% is being used in Sri Lanka while used plastic waste remains in dump sites. However, out of this waste, 40% plastic is recycled currently (Sirimane, 2017).

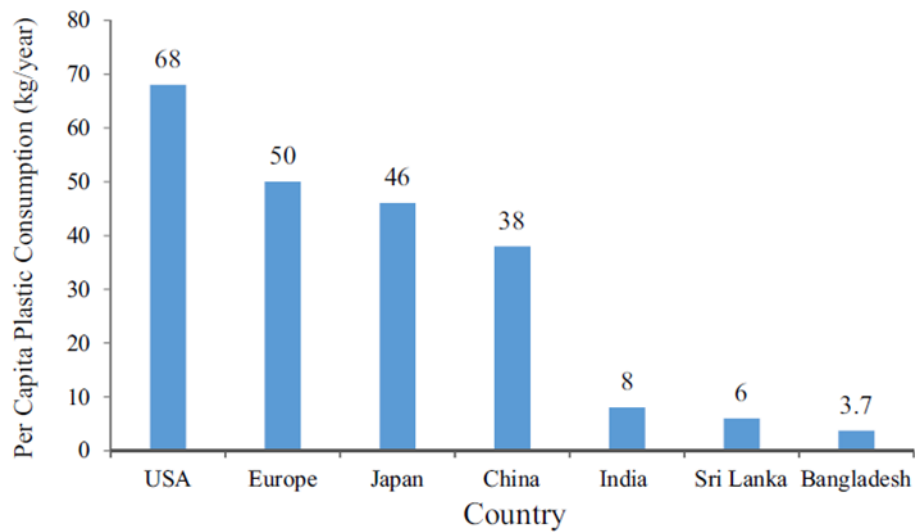


Figure 2-2 Per capita annual plastic consumption in selected countries
Source: Moursbed et al. (2017)

Although plastic waste causes severe impact on the environment, plastic plays a considerable role in the economy of the country and gives social benefits by providing employment opportunities for the society. The plastic industry in the country is nearly a decade old, and at present 232 companies are engaged in the sector producing for both local and international market (Gunaratna, 2012).

According to Fernando (2018), currently, around 500,000 metric tonnes of plastic/polyethylene imports in Sri Lanka and 70% of them are used locally. It has estimated that Sri Lanka earns USD 2 million² foreign exchange via imports and exports of plastics where imports make up around 160,000 metric tonnes of plastic raw materials (primary forms) and around 100,000 metric tonnes of finished goods along with intermediate products every year. In the meantime it exports around 280,000 metric tonnes, while the capacity of our local processing industry presently being nearly 120,000 metric tonnes per annum with an annual average growth rate of around 10% (Gunaratna, 2012). At present, the plastic industry is in primary stage compared to other export industries in the country. Figure 2-3 shows the

¹ During the literature review, author observed the different figures of plastic per capita consumption. Since this research was conducted by literature review, author was not in a position to review those figures.

² USD 1= LKR 140

percentage of plastic products contribution to total merchandise exports over ten years from 2008 to middle of 2018 (EDB, 2018).

It shows the plastic industry has not contributed significantly to exports over ten years. A study has been conducted, to analyze the future trends of plastic recycling in Sri Lanka and according to that around 220,000 tonnes (70.99%) would be wasted out of 310,000 tonnes of plastics consumed in year 2025 (Gunaratna, 2012). Since Sri Lanka is a small island such an amount of plastic waste would become a significant environmental impact due to non-biodegradable characteristic property of plastics. The dilemma of disposal of plastic waste affects significantly the environment and human health in the absence of validated technology for managing plastic waste.

According to Sri Lanka EDB (2018), over 400 companies are engaged currently, in plastic processing industry with the investment of USD 107 million³ while 66% of total investment focus on processing plastic products for the export market merely. United States, United Kingdom, Japan, India and Bangladesh are the buyers of plastic products of Sri Lanka while 40% is exported to United States (EDB, 2018). The sacks and bags, articles of apparel & clothing accessories and cellulose are manufactured through the plastics processing and exported directly and indirectly to the buyers.



Figure 2-3 Percentage of plastic product contribution to total merchandise
Source: Sri Lanka Export Development Board

2.2 Plastic waste management in Sri Lanka

The prominence of plastic pollution is interrelated with plastics being inexpensive and durable, which leads to high levels of plastics used by humans. As mentioned in the introductory part, plastic waste is the second largest contributor to the municipal waste in Sri Lanka and it contributes with 10-11% (Hikkaduwa et. al., 2015). Sri Lanka recognizes that it needs to find a solution to managing the plastic quantity due to limited treatment capacity and unavailability of technically sound landfill facilities. Thermoplastics are the main types of plastics used in Sri Lanka and they change their properties with the temperature. The thermal

³ USD 1 = LKR 140

sensitivity category makes them suitable for mechanical recycling. The most commonly used recycled materials are polyethylene (PE), polypropylene (PP), polystyrene (PS), polyethylene terephthalate (PET), and polycarbonate (PC). The polyvinyl chloride (PVC) is also being recycled to some level. However, there is no proper system adopted all over the country for plastic waste management and it has become a critical issue with haphazard disposal.

According to Gunaratne (2012), the most common plastic waste products are pen, straw, yoghurt cup, mega bottle, lunch sheet, milk packet, meal box and polyethylene bag. A few municipalities have adopted waste separation at the source for recycling purposes, for instance, Colombo Municipal Council (CMC), while in majority of the municipalities, waste separation is very low. The mixing of plastic waste with other waste causes many issues for the environment and the plastic recyclers, since extra resources incur with the separation and cleaning. According to recyclers, separation and cleaning is the high cost consuming stage of the recycling process. Besides, environmental issue is also associated with this stage due to land and water pollution. Waste generation and waste disposal reflect many complex economic and social factors. Taking into consideration social, economic and environmental aspects, plastic waste causes a significant impact to Sri Lanka. Littering is a main issue of plastic and haphazard disposal and provides habitats for vector-borne diseases. Most recently the widespread disease in urban settings all over the country is dengue virus epidemic, which transmits through a mosquito *Aedes aegypti*. Western province is highly affected and that may depend on especially the high rate of littering, non-bio degradable plastic and polyethylene, like plastic bags, food wrappers including yoghurt cups, plastic cans, plastic-lids of bottles etc. which provide breeding grounds for the mosquitoes. The children are highly vulnerable for the dengue and sometime it causes deaths as well (WHO, 2013).

The generation of plastic waste is significantly higher in urban settings compared to rural. However, government of Sri Lanka has taken many initiatives such as adopting policies and policy tools, awareness campaigns, establishment of institutions to overcome the issue. The policies that has been adopted by the government is discussed in the literature review chapter.

2.2.1 Plastic recycling in Sri Lanka

The reuse of plastic is the use of an item again after it has been used. This includes two ways such as conventional and new-life reuse. The conventional reuse is that an item is used again for the same function whereas in new-life reuse it is used for a different function. In contrast, recycling is the breaking down of the used item into raw materials which are used to make new items. By taking useful products and exchanging them, without reprocessing, reuse helps save time, money, energy, and resources. Energy and raw materials savings such as replacing many single use products with one reusable one reduces the number that need to be manufactured. Recycling is a process to change waste materials into new products to prevent waste of potentially useful materials.

Plastic recycling industry has been developing over the years and more than a hundred collectors, retailers and recyclers have registered at the CEA (Gunaratna, 2012). The Table 2-1 shows the plastic waste collectors and recyclers in nine provinces in Sri Lanka.

Table 2-1 Plastic waste collectors and recyclers in nine provinces in Sri Lanka

Province	2007		2008		2009		2010		2011	
	C	R	C	R	C	R	C	R	C	R
Western	18	20	20	24	20	28	30	36	43	37
North Western	-	-	04	02	05	02	05	02	06	02
Central	-	-	03	02	04	03	04	03	10	04
Northern	-	-	03	-	04	01	04	01	07	03
Eastern	-	-	-	-	-	-	02	-	01	01
Sabaragamuwa	-	-	01	01	02	01	03	01	03	01
Southern	-	-	01	01	06	02	07	03	05	03
Uva	-	-	-	-	-	-	01	-	-	-
North Central	-	-	-	-	-	-	01	-	-	-
Total	18	20	32	30	41	37	57	46	75	51

Source: National Post Consumer Plastic Waste Management Project Progress (Gunaratna, 2012)

However, unavailability of proper collection system all over the country is one of the major issues in plastic recycling. There are retailer shops in some urban centres and plastic collectors visit door to door to collect them, but not in regular intervals. A few local authorities are collecting plastic waste once a month or twice a month, based on the available logistical capabilities. In addition, informal sector; garbage pickers and waste collectors are also playing a role for material recovery processes including plastic in the country.

According to Gunarane (2012), the prominent plastic material which is used by the recyclers are polyethylene (PE), polypropylene (PP), polystyrene (PS), polyethylene terephthalate (PET), and polycarbonate (PC) based on import and export quantities from year 1995 to 2011. There are two or three leading companies established in the country for plastic recovery processes and they are expanding their investments for further development. The BPPL Holdings Limited (BPPL) will expect to invest USD 4.8 million⁴ for manufacturing recycled synthetic yarn in Horana for the fabric manufacturing industry using plastic waste in 2018. Currently, one third of plastic waste in the country is recycled by BPPL (Sirimane, 2017). Viridis Pvt. Limited is also one of the leading plastic recycling companies in Sri Lanka while other enterprises are in small and medium scale and are processing approximately 75-100 tonnes of plastic per month. The plastic recycling process consists of four major steps as illustrated in Figure 2-4.

⁴ USD 1= LKR 140

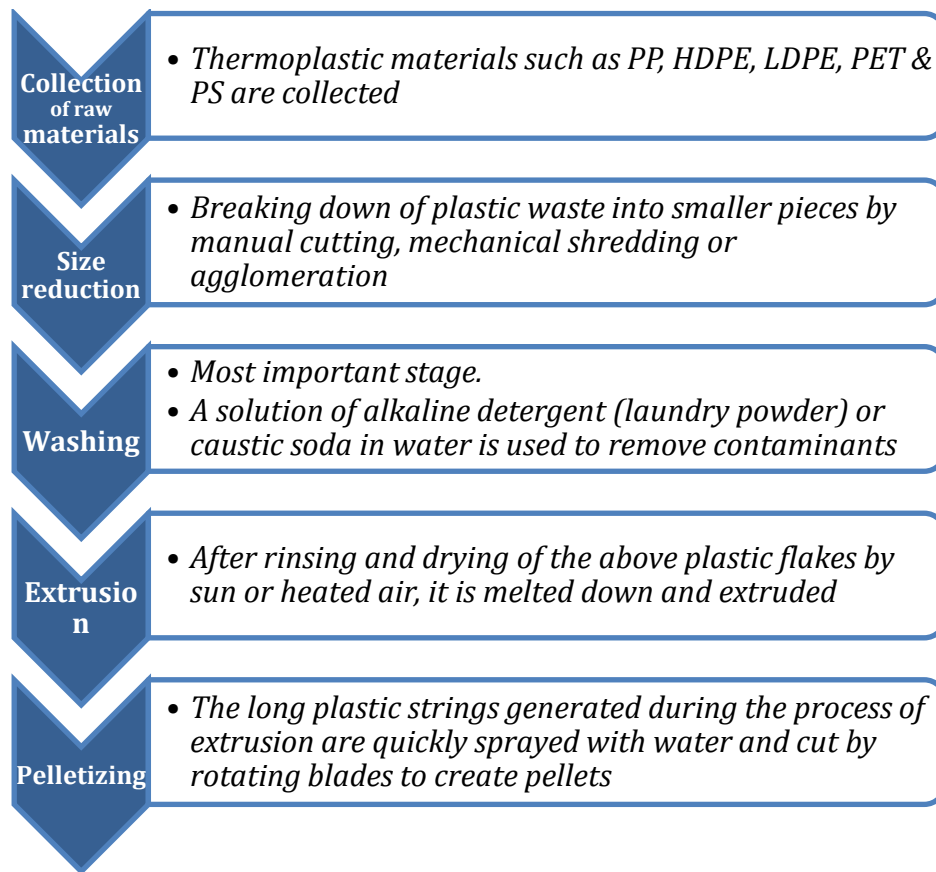


Figure 2-4 Plastic recycling process in Sri Lanka
Source: Gunaratna (2012) adapted by the author

The government has enacted important legislation relevant to plastic in 2007 and September 2017. Those regulations are discussed extensively in Chapter 3. In addition to this legislation, some initiatives have been taken by the government of Sri Lanka for plastic waste management, though they have not been effective over the period of time. The most common measures are as follows below.

2.2.2 Charge imposed for plastic bags

The government of Sri Lanka mobilized a charge for plastic bags at all shops with the intention of controlling the use of plastic bags and encourage reuse and alternatives. Unfortunately, it was revoked by the government due to a case filed under the consumer rights act. After the court decision, super markets again started to issue plastic bags without any charges (Fernando, 2018).

2.2.3 Establishment of Waste Management Authority for Western Province

Multiple authorities and agencies are involved in facilitation and implementation of SWM investments and services. According to the Local Government Act, the responsibility has been vested to provincial council. Since the garbage issue is critical in Western Province, Western province has established the Waste Management Authority (WMA) to manage the issue. The legal framework for SWM in the Western Province Strategy (2020) embraces two key principles of 3R (reduce, reuse recycle), and 'polluter pays'. The WMA has developed sectorial plans for SWM for local governments to follow to manage the plastic waste.

2.2.4 Development of waste collection mechanisms

The Ministry of Mahaweli Development and Environment is currently developing a system to collect plastic waste in the beaches in collaboration with the Marine Environmental Pollution Authority to clean the beaches. In addition, collection of plastic waste in the rural settings is also taking into account through the government officers' network which are established at the grass-root level. Because, the poor collection of plastic waste in the country-side compared to urban areas, since the recyclers reluctant to collect them in rural areas as it is not economically viable.

2.2.5 Deposit-refund system and Extended Producer Responsibility (EPR)

Although the deposit-refund system is applied for glass bottles in the country, it was not sustained all over the country for plastic bottles that government has tried to execute in past years due to impact on the economic development. The private sector claimed that since the logistical arrangements, including infrastructure, has not been developed properly all over the country, execution of the system is not viable for them. The expected logistical and infrastructure arrangements are collection of plastic and packaging, use hygienic and safe storage facilities, properly refund deposit and transportation. In this context, the major challenge is to engage all retailers, over 200,000 all over the country, and private sector stakeholders are reluctant to involve with the system (IUCN, www.iucn.org, 2018; Fernando, 2018).

Accordingly, IUCN is proposed to introduce Extended Producer Responsibility (EPR) based on the polluter pay principle where the plastic producers are highly responsible for recovering and developing disposal mechanism for the end of life of a product. The EPR system will be implemented with the financial support of USAID and the collaboration of Ceylon Chamber of Commerce through a Public-Private-Partnership model. This programme envisages an increase of the collection and recycling rate for polyethylene terephthalate (PET) plastics – the most common type of recyclable plastic – from 20% to 85% in three years. Initially it is planned a pilot programme to establish ten central collection and processing centres in the Western Province (IUCN, 2018).

2.2.6 Commonwealth Clean Oceans Alliance (CCOA)

Sri Lanka has recently joined to the CCOA. The aim of the CCOA is to eliminate avoidable single-use plastic in an ambitious bid to clean up the world's oceans. "The CCOA will work in partnership with businesses and NGOs, including the World Economic Forum, Sky, Fauna and Flora International, the Coca-Cola Company and WWF to share expertise and experience, and push for global change" (Editor, 2008). In order to comply with the agreement, a regulation has been adopted by the government of Sri Lanka recently to ban food wrappers of polyethylene and other plastics.

Sri Lanka has initiated some measures to control biodegradable waste by introducing composting at household level in some areas with providing composting bins by the CEA. It was identified that there is a need of a national level programme to manage the issue since more than 60% of waste consists of biodegradable waste. In this context, Pilisaru project has been launched by the Ministry of Environment and Natural Resources with collaboration of the Ministry of Local Government & Provincial Councils under the supervision of the CEA in 2008 with a view to resolve the solid waste problem in the country within the next five years. One of the main achievements of this project is the formulation and introduction of the national policy for solid waste management in 2007, which provides directions to

improve the solid waste management in the country. Expectations of the project was to manage the waste by reduction of waste generation by reuse, recycling and resource recovery to the maximum extent possible, followed by appropriate treatment and finally the disposal of residual wastes sustainably (Malwana, 2008).

2.3 Garbage mountain collapse

With the increase of population, urbanization, changing lifestyles and urban migration influence, the acceleration of waste generation has taken place. The sophistication of infrastructure has not been developed in parallel with the waste generation. The responsibility of managing waste comes under the purview of LAs by law and those LAs do not have resources to do the job. The open dumping is the most common method of disposal by all LAs, even Colombo municipal council. A dumping site called Meethotamulla, located close to the capital of Sri Lanka, started to dump waste by the Colombo municipal council and surrounding LAs in mid 1990s. Approximately 750 tonnes of waste are disposed per day only having a thin sand layer. The size of the area is about 20 acres and 1.2 million cubic meters of waste is dumped. Although there are residents surrounding the area, there is no environmental protection such as buffer zones, mechanism for collecting leachate, landfill gas extraction mechanism etc. The height of the dumping pile was about 43 meters and the waste mountain collapsed in 2017 which lost lives of 32 people, left 8 people missing, and destroyed 79 homes, affecting lives of 264 families (Ministry of Megapolis & Western Development, Ministry of Local Government, 2017). Figure 2-5 shows the collapse of the Garbage Mountain.



Figure 2-5 Garbage mountain collapse

Source: <https://www.google.com/search?q=images+of++meethotamulla+waste+mountain&tbm=isch&source=iu&ictx=1&fir=zVOJl5OgpGPqM%253A%252CvgKf8NTcKKnchM%252C>

3 Research Design & Methodology

The overarching goal of this research is to propose and make recommendations for sustainable plastic waste management in Sri Lanka based on the effective policy tools that have been practiced in other countries in the region. Therefore, this research is not focused to collect data and figures pertinent to plastic waste in Sri Lanka and concentrate on qualitative data and information. Theoretical studies focus on good governance and environmental governance and its essential principles were explored to broaden the knowledge of the author in the area of waste management policy.

Sources of data and information

1. The author used her own knowledge and fifteen years of experience of working in three ministries; Ministry of Agriculture, Ministry of Land and Ministry of Environment throughout this research.
2. Different type of data were collected for the research study. The main sources of data and information were gathered using published articles and documents by various authors, websites of government authorities, website informations of respective organizations, unpublished articles from the institutions and annual reports from the governments.
3. Personal communication with a policy maker in the Ministry of Mahaweli Development & Environment (Appendix 1), Sri Lanka and informal communications with the stakeholders during the author's career.

The literature review was conducted in following key areas:

- Current status of plastic production and plastic waste generation in the world as well as in the region along with special focus to Sri Lanka. This was done to get an overview of existing pattern of plastic consumption and its future trends to develop the introductory part.
- The environmental and human impacts associated with unsustainable plastic waste management in Sri Lanka were reviewed in figuring out the magnitude of the issue in order to structure the background information.
- Review of literature on existing waste management practices in Sri Lanka and the main challenges. Since the plastic waste is combined with the MSW, the literature review and information emphasizes the MSW with a key attention to plastic waste. The existing plastic waste management practices and existing legislation adopted were reviewed under the purview of research question one. During the literature review, recently adopted policy tools for plastic waste management in Sri Lanka were explored. However, those policy tools are fairly young and outcomes are premature to examine or analyze.
- The literature focuses on the major challenges of plastic waste and MSW management in Sri Lanka along with the suggestions for improvement. In developing this section, the author also used her experience gained during her past career in working with the Ministry of Environment.
- Besides, the research question two is focused to how Sri Lanka can overcome the barriers that have been indicated in the research question one. In view of this, the author used her own knowledge and experience as well as informal communications with a few stakeholders more than reviews of other literature. While developing this section, there is not any criticizing agenda on an

organization, institution or a person, rather than explaining how to avoid existing negative externalities within the system in order to managing plastic waste in Sri Lanka sustainably.

- A literature review was done to identify the success policies that are applied in other countries in the region including developing countries for management of plastic waste. The author studied the successful policy tools that have been implemented in other countries in the region with special focus to China, India, Japan and Taiwan. The focus was not on the most recent policies but rather on policies over the last two decades to secure better relevance for Sri Lanka and knowledge of outcomes of the policies.

Analysis of proposed policy tools

The selected policy tools are analyzed against some of the environmental governance principles such as transparency, and stakeholder engagement. In addition, how those policies are negatively or positively impact, in terms of environment and social aspects, are also analyzed based on the sustainable development perspective.

Evaluation of proposed policy tools:

Environmental policy evaluation came into effect in the late 1990s which was also the time when it arrived more generally in Finland (Mickwitz, 2006). There is a tendency of diminishing trust in and decreasing legitimacy of the states in many places in the world. Therefore, it is important aspect that ensures trust and legitimacy and policy evaluation is frequently justified through the task in order to ensure that implementing organizations are accountable within the system. The environmental problems are often characterized by the conflicting goals of different groups and by huge uncertainties even in the causal relationships, a comprehensive treatment of relevance is particularly important aspect in the system.

In order to make recommendations to increase the efficiency of plastic waste management policies in Sri Lanka, a few selected policy tools were evaluated using a few criteria. Four criteria were selected based on the environmental governance that states about how to reach environmental goals and how decisions are made. Accordingly, transparency, Effectiveness, Relevance and participatory rights (Mickwitz, 2006).

1. Transparency – To what extent are the outputs and outcomes of the environmental policies, as well as the processes used in the implementation, observable for outsiders?
2. Effectiveness – To what degree the outcomes will correspond to the intended goals of the policy?
3. Relevance – Do the goals of the instruments cover key problems of environmental policy?
4. Participatory rights – Who can participate in the processes through which the environmental policies are implemented?

3.1 Theoretical Framework

There are many concepts and theories embodied with the sustainable waste management systems. Since the research is more focused on environmental policies and policy tools, environmental governance concept is selected as the key concept for policy implementation. According to UN, “good governance promotes equity, participation, pluralism, transparency, accountability and the rule of law, in a manner that is effective, efficient and enduring”.

The governance is about making choices, decisions and trade-offs, and it deals with economic, political and administrative aspects. In general, governance is, how power and authority are exercised and distributed, how decisions are made, and to what extent citizens are able to participate in decision-making processes. Good governance aims to ensure inclusive participation, making governing institutions more effective, responsive and accountable, and reverential of rule of law, as well as, international norms and principles. Accordingly, good governance minimizes risks for corruption, or the abuse of entrusted powers for private gains (Wingqvist et al., 2012).

Fundamentally, environmental governance is about how to reach environmental goals and how decisions are made. It can be measured by the effectiveness of strategies and initiatives implemented to achieve environmental goals (Jeffrey, 2005). Participation of all stakeholders including minority groups, access to information, adequate funding, transparency and accountability, are crucial aspects of achieving good environmental governance. The governments who have effective institutions at national level, with strong capacities to implement national environmental legislation, can achieve the environmental goals while making attempts to incorporate business interests in the state of the environment through various market-based approaches.

Governmentality can help understand how environmental principles, techniques, stakeholders and institutions are actively constituted through the practice of governing. The key concepts and emerging directions in environmental governance were explained by Armitage et al. (2012) and they argue that the pertinent conventional philosophies are shifting. For instance, what governance implies (good governance), how governance takes place (through the state), and what governance processes seek to achieve (efficient resource use). Scholars concern on five concepts based on careful review of the mainstream environmental governance literature and are consistent with the concerns identified by other scholars: (1) recognition of the importance of fit and scale; (2) fostering adaptiveness, flexibility, and learning; (3) coproducing knowledge from diverse sources; (4) understanding the emergence of new actors and their roles in governance; and (5) changing expectations about accountability and legitimacy.

Lowe and Ward (1998), as well as Evans (2012), argue that the low politics, devolved fragmentation and disjointed incrementalism are the characteristic features in command-and-control approach in environmental governance.

Low politics: The priority for the environment was not in the political agenda and therefore it was not considered as a major concern for the central government. Environmental management and regulation have appeared as a special and technical area outside of the civil service. Environmental management reflects to structures of administration generally.

Devolved fragmentation: Environmental policy inclined to be decentralized to local authorities and semi-independent inspectorates, making it hard to act strategically or coordinate priorities between the many different branches.

Disjointed incrementalism: The regulations which cover each new environmental problem were simply added to those that already existed, without any attempt being made to identify common problems or address the wider causes of pollution. The long and largely unplanned history of environmental regulation led to a perplexing situation (Lindblom, 1979; Evans, 2012).

4 Literature Review

The literature review section is based on the three research questions:

1. How is Sri Lanka managing plastic waste and what are the main challenges?
2. How can Sri Lanka overcome those challenges?
3. What are the success policies that are applied in other countries in the region including developing countries for management of plastic in municipal solid waste?

4.1 How is Sri Lanka managing plastic waste and what are the major challenges ?

The author formulated this research question to get an overview of the existing waste management system and the challenges therein. In view of that, existing MSW management system, existing policies and legislations, especially for plastic waste, and main challenges for waste management are extensively discussed under the purview of the research question one.

Plastic was not an issue in Sri Lanka in early 1970s. The increase of plastic waste is linked with the introduction of the liberalization of trade and exchange controls and the introduction of an economic strategy dependent on private investment and market forces in 1977. The high volume of plastic waste generated from the households, industries, schools, offices, markets and trading centres, work sites, farmyards and hospitals in diverse volumes with the increase of population. The issue is accelerated with urbanization and urban migration. The plastic waste management issue is not significant in rural settings compared to urban areas. Sri Lanka has taken many initiatives to improve waste management systems in the country where some of them are development of policies, strategies, guidelines, legislation and provision of infrastructure facilities for waste management. Under the research question one, the author expects to explore the existing waste management system and existing policies and policy tools adopted in the country for plastic waste management in Sri Lanka while highlighting the challenges for plastic waste management.

4.1.1 Municipal Solid Waste in Sri Lanka

In 1999, the estimated average solid waste generation in Sri Lanka was 6,500 tonnes/day. With a 1.2 % population growth rate, total MSW generation in 2009 was approximately 7,250 tonnes/day⁵. In 1999, the average per capita MSW generation was 0.89 kg/cap/day and has been predicted to reach 1.0 kg/cap/day by 2025(Vihanarachchi, et.al., 2006).

Currently, only part of the waste stream is collected by local authorities, due to limited financial technical and human resources. After collection and transportation, approximately 85 % of the total MSW generated is being disposed of in open dumps (Visvanathan, et.al, 2004). The remaining fraction is being illegally dumped on road sides, forest areas, river banks and low lying marshes, thereby significantly reducing the aesthetic value of the environment in addition to the environmental and health impacts. For the collection process, house-to-house solid waste collection is being performed by most of the municipal councils. Even though some local authorities have shown interest in using small-scale composting and biogas production technologies, these treatment options have not been very successful. At

⁵ Author observed different figures for waste generation in various publications and this research is not focus to analyze or review those figures.

present, uncontrolled open dumping is the main disposal method in Sri Lanka, leading to many environmental and health problems. Sri Lanka is divided into nine provinces for the administrative perspective and waste management responsibility vested to the Local Authorities (LAs) through the Local Government Act. As at the middle of 2016 the population of the country was 21,203,000 and the average population density was 338 per square kilometer (Census & Statistics, 2017). The waste generation rate depends on various factors such as population density, economic status, level of commercial activity, culture and lifestyle of the people in the area. The average waste generation per day in Sri Lanka is 3242 metric tonnes while the largest population in the country live in western province (Hikkaduwa, 2015). According to Hikkaduwa et al. (2015), western provincial council collects 1783 metric tonnes of waste which is the largest contributor to the collected municipal solid waste (Hikkaduwa et al., 2015). The amount of waste generation may be much higher than the collection volume due to the activities of the informal sector and self-disposal systems. For instance, some people are using compost bins or pits in their home gardens when they have enough space to do so. The informal sector contributes to waste reduction and recycling. However, the fact that the volume of waste collected by the informal sector is not usually counted in official statistics for waste generation is often overlooked. As in many other countries, the local authorities are responsible of managing MSW in Sri Lanka. However, those local authorities are unable to provide the required level of service in order to manage the MSW.

The climatic condition in the country is vital to get the optimum reactivity of microbes in MSW. Generally, MSW is also characterized by high moisture content in the range of 60 to 80 % on a wet basis (Hikkaduwa et al., 2015). Since the biodegradable waste is the largest contributor in the MSW as shown in Figure 4-1, they are rapidly undergoing microbial degradation and forming leachate and odour causing number of environmental impacts when they are disposed haphazardly. According to JICA report (2016), in view of achieving public sanitation standards, the government has attempted to improve the main issues associated with MSW such as discharge, storage, collection and transportation in order to uphold the environmental considerations being a middle-income country. As many other developing countries in the world, the organic waste material contributes more than inorganic waste in MSW in Sri Lanka. Figure 4-1 shows the composition of municipal solid waste by their percentage and polyethylene and other plastic wastes are the second largest contributor to the municipal solid waste that represent 10.50%⁶.

⁶ Since the different figures for plastic waste generation were observed, it is important to use reliable figures when developing long-term waste management system.

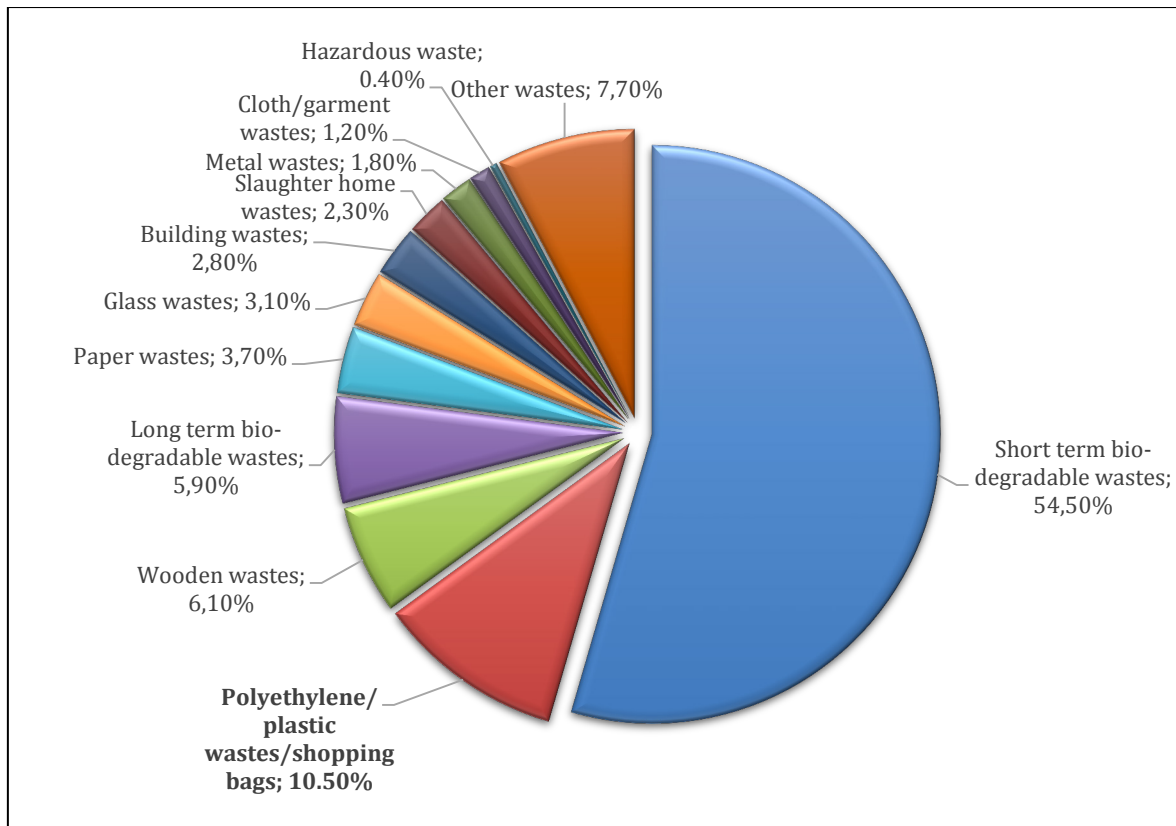


Figure 4-1 Composition of solid waste in Sri Lanka

Source: Database of Solid Waste in Sri Lanka, "Pilisaru" National Solid Waste Management Programme, CEA (2012) extracted from Hikkaduwa et al. (2015)

Plastic wastes are combined with the MSW in Sri Lanka. According to the technical guidelines on solid waste management in Sri Lanka issued by the Central Environmental Authority (nd), following waste categories are recognized as the MSW.

- Domestic waste (exclusive of sewage and hazardous waste)
- Commercial waste (Market waste)
- Institutional wastes (schools, hospitals (non-clinical), public offices, etc.)
- Street sweeping and beach cleansing waste
- Garden waste (Tree cuttings and grass cutting wastes)
- Wastes collected from drains and water courses in urban areas.

Figure 4-3 shows the average waste collected daily in different provincial councils. The issue of MSW is most acute in the municipality of Colombo, the capital city, and municipalities in the suburbs of Colombo. Due to lack of infrastructure for waste management, the currently adopted predominant method is open dumping and burning including illegal disposals on road sides, marshy lands, reservations etc. About 250 open dump sites are operated throughout the country and about 25 sites are located in Colombo (Ministry of Megapolis & Western Development, Ministry of Local Government, 2017).

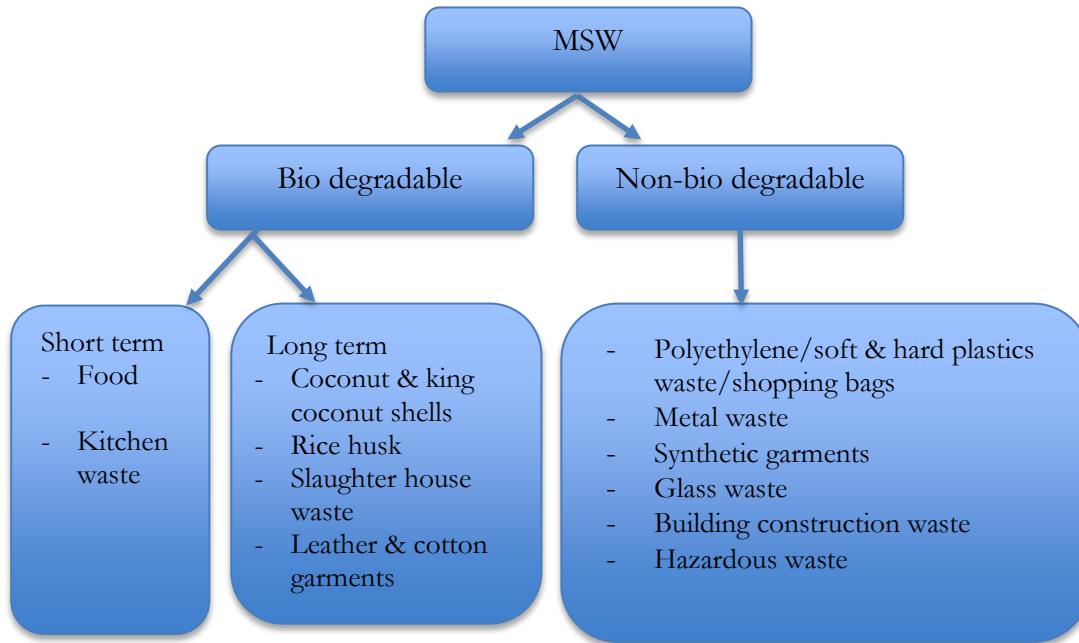


Figure 4-2 Categorization of MSW in Sri Lanka
Source: Hikkaduwa et al. (2015), adapted by the author.

As a whole, the waste collection rate is low in the country. There are more than 300 local authorities in the country and out of them, there are only 8 with a waste collection capability of more than 50 tonnes per day, 19 able to handle between 20-50 tonnes day, and 284 local authorities equipped to collect less than 20 tonnes of solid waste (Environment Foundation Ltd., 2007). However, Colombo Municipal Council (CMC) area the waste collection rate is relatively high and accounts for 75% (Ministry of Megapolis & Western Development, Ministry of Local Government, 2017). As indicated in the above paragraph the issue of MSW in CMC area is a crucial and adopted number of measures to manage waste for instance waste separation at the source and illegal waste dumping. The separation of waste has been strengthened with the recently adopted policy of avoiding collection of mixed waste by the CMC. With the purpose of sale of recyclable materials, a little amount of sorting is done by the CMC. The rest of the waste is dumped in Meethotamulla dumping land which is located in a residential area.

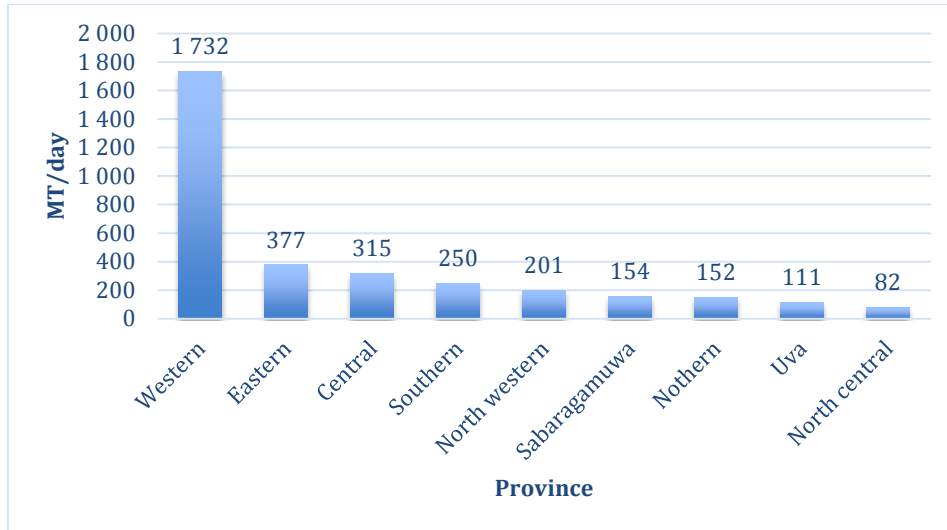


Figure 4-3 Average waste collection per day in metric tonnes in nine provinces

Source: Database of Solid Waste in Sri Lanka, "Pilisaru" National Solid Waste Management Programme, CEA (2012) extracted from Hikkaduma et al., (2015)

As mentioned, solid waste management involves the storage, collection, transport and disposal of waste which is generated in the home, commercial premises and institutions. Many of the south Asian countries do not have an infrastructure facility for formal house to house collection system; householders either deposit their waste in a communal container in short period, or leave it in small piles outside the house. The collection is done by municipal sweepers who take it to a larger waste transfer point or directly to disposal site depending on the available infrastructure. This scenario is applicable to Sri Lanka and the level of collection, disposal and treatment is determined by available infrastructure for waste management of the respective LAs. Table 2-1 shows the summary of waste generation and collection rates of each provincial council. According to the information in Table 4-1, collection rate is not at a satisfied level in all over the country. The highest collection rate is in Colombo at 51% while lowest collection rate in North-central province which accounts for 15% JICA (2016).

Table 4-1 Summary of status of MSW in Sri Lanka

Province	generation amount (tonnes/day)	% of collection amount	Collection amounts (tonne/day)	% of collection rate	Number of disposal sites
Nothern	566	5	178	31	16
Eastern	785	10	347	44	40
North- Central	616	3	91	15	35
North- Western	1,134	5	187	16	45
Central	1,585	9	304	19	47
Sabaragamuwa	835	5	178	21	30
Uva	587	3	116	20	24
Western	3,502	52	1793	51	52
Southern	1,158	8	264	23	32

Source: Moratuna University and NSWMSC, 2013, JICA (2016)

4.1.2 National Post-Consumer Plastic Waste Management Program

The objective of this programme is to address the necessary behavioral changes among consumers to ensure proper plastic waste disposal that avoids the negative externalities to the environment and make available necessary logistics to enable the collection and recycling. The national programme on post-consumer plastic waste management anticipates generation of foreign exchange savings to the country taking in to consideration the maximum amount of recycling of plastic waste. There have been large quantities of polyethylene were collected through the informal sector. The market is blooming with the escalation of crude oil prices based on the policies of national economy. Furthermore, the MOENR has launched a plant to produce fuel from waste, but with little success. Thus there is a reverse trend to produce primary products from plastic material.

4.2 Existing policies and legislation for plastic waste management in Sri Lanka

Sri Lanka has a long history and tradition for caring the nature and natural resources of the country. Sustainable consumption and production is an age-old tradition in Sri Lanka that has been practiced basically always. The principles of life cycle thinking and sustainable consumption and production are rooted deeply in the traditional lifestyles of citizens through the inspiration of Buddhism. However, those traditional values among the citizens have been diminishing with the modernization of the lifestyle.

Sri Lankan Environmental Management Policy originates from the country's supreme law; the Constitution of 1970. Article 27(14) of the Constitution of Democratic Socialist Republic of Sri Lanka recognized 1978 recognizes that "The State shall protect, preserve and improve the environment for the benefit of the community". Besides, the constitution shared this responsibility with the community by stipulating a corresponding article 28(f) stating that "It is the duty of every person in Sri Lanka to protect nature and conserve its riches". Such declarations indicate the state commitment and obligations of the citizens to safeguard the environment (Ministry of Megapolis & Western Development, Ministry of Local Government, 2017).

There are a number of policy and policy tools that have been introduced by the government relevant to the waste management. The national government and LAs have the legal and regulatory powers relating to solid waste and hazardous waste disposal. The national government is responsible for developing the policies, strategies and developing a legal framework along with the provisions for waste management. The main policies are as follows;

4.2.1 National Solid Waste Management Policy

Ministry of Environment and Natural Resources of Sri Lanka has formulated the NSWMP in 2007 by replacing the solid waste strategy adopted in 2000 with the overarching goal to ensure integrated, economically feasible and environmentally sound solid waste management practices at all level throughout the country (MMDE, 2013). The objectives of NSWMP are:

1. To ensure environmental accountability and social responsibility of all waste generators, waste managers and service providers
2. To actively involve individuals and all institutions in integrated and environmentally sound solid waste management practices
3. To maximize resource recovery with a view to minimizing the amount of waste disposal

4. To minimize adverse environmental impacts of waste disposal to ensure the health and well-being of the people and ecosystems

The National Solid Waste Management strategy was drafted to facilitate and guide the NSWMP with a view to translate the strategy into actions in order to implement suitable waste management programs for respective areas and obtain the fullest involvement and cooperation of the LAs to implement those action plans. Solid waste management strategy emphasizes and focuses on the waste management hierarchy where prioritization of waste avoidance, reduction, reuse, and recycling and final disposal in an environmentally sound manner while giving prominence for waste recycling over disposal. The separation of waste at the source is important factor that influence sustainable waste management practices more specifically recycling.

The focused areas of the strategy are:

1. Prioritize waste minimization using recycling and other forms of environmentally sound disposal
2. Reuse non-avoidable waste as far as possible
3. Maintain the content of hazardous substances in waste at the lowest possible level
4. Guarantee an environmentally sound residual waste treatment and disposal system as basic prerequisites for human existence (Walivita, 2014).

The NSWMP has broad focus on sustainable management of solid waste with sharing responsibility to all stakeholders in all levels including Municipal councils, urban councils and pradeshiya sabha in order to minimize environmental and health impacts caused by the municipal solid waste. In the context of translating above policy objectives into the plastic waste management is not a big exertion as they fully comply within the policy objectives. The waste minimization by recycling/reusing and sustainable treatment of plastic waste are important aspects that has been taken into account when formulating the national solid waste management strategy.

4.2.2 National Environment Policy

As mentioned above the responsibility “The duty of every person in Sri Lanka to protect nature and conserve its riches“ has given by the constitution of Sri Lanka. In order to comply with this commitment, the National Environmental Policy was formulated by the Ministry of Environment of Sri Lanka in 2003. Accordingly, it emphasizes that caring for the environment is the bounded duty of any institution, government or non-government, and of any individual that uses, or otherwise carries out an activity that has an impact on, the resources of the environment. This policy is an umbrella policy that covers many areas and provides the basement for many other policies and strategies. The aim of this policy is to ensure sound environmental management within a framework of sustainable development in Sri Lanka.

The main objectives are:

- To promote the sound management of Sri Lanka environment in its entirety without compromise, balancing the needs for social and economic development and environmental integrity, to the maximum extent possible while restricting inimical activities.

- To manage the environment by linking together the activities, interests and perspectives of all groups, including the people, non-government organizations and government at both the central and the local levels.
- To assure environmental accountability.

The key elements of plastic waste management such as reuse, recycle, polluter pay and pollution prevention are also emphasized in policy principles while highlighting lifecycle thinking in the policy statement. The National environment policy focuses on achieving the objectives in relation to the four basic natural resources of land, water, atmosphere and biological diversity (Ministry of Mahaweli Development & Environment, 2013). The plastic waste could make significant impact on both four natural resources if proper management practices have not been adopted.

4.2.3 National Environment Act

Among the number of legal frameworks, the overarching legal framework for the management of waste is the National Environmental Act (No. 47 of 1980) and its subsequent amendments. The act mainly covers environmental protection, environmental quality and environmental assessment. Two important legal instruments were created under the NEA in 1980; environmental impact assessment (EIA) and the environmental protection license (EPL) which covers both natural resources management and pollution control aspects respectively. Although EPL is a legal instrument, it provides guidance for pollution control and inspires the remediation measures for instance cleaner production, sustainable consumption and production and waste minimization. In compliance with the national standards for discharge of waste and emissions, the EPL procedure has been introduced in order to prevent or minimize the release of effluents and emissions into the environment from industrial activities. According to the regulations of NEA, the industries are classified into three categories such as A, B and C. High polluting industries are in list A comprising 80, while list B is consisting 33 medium polluting industries and list C is comprised of low polluting industrial activities. The powers have been vested to Central Environmental Authority by the NEA that includes power to grant or refuse permits and license to persons/agency who conduct prescribed activities that may have an impact on the environment. All development activities classified as “prescribed projects” are required to obtain EIA clearance from the appropriate authority. The EPL process for industrial units has been decentralized, and local authorities are empowered to issue licenses to specific industries (Central Environmental Authority, 2017).

In compliance with the amendment to the NEA in 1993 it is required an Environmental Impact Assessment (EIA) for the establishment of such facilities as intermediate treatment and final disposal site(s) with a capacity exceeding 100 tonnes/day (Ministry of Megapolis & Western Development, Ministry of Local Government, 2017). The agencies who are responsible for intermediate treatment or waste disposal need to obtain environmental clearance from the Central Environmental Authority before intervening with such an activity.

Besides, there are number of important legislations pertinent to plastics that have been passed by the government under the NEA to manage the plastic waste in order to diminish the environmental impacts.

i. Prohibition of polyethylene products of twenty (20) microns or below

Under the provisions of Section 23 W of the National Environmental Act, No. 47 of 1980, an extraordinary Gazette No. 2034/34 issued on Friday September 01, 2017 to prohibit the manufacture of polyethylene or any polyethylene product of twenty (20) microns or below in thickness for in country use; or the sale, offer for sale, offer free of charge, exhibition or use of polyethylene or any polyethylene product which is twenty (20) microns or below in thickness within the country. The polyethylene or any polyethylene product of twenty (20) microns or below in thickness may be permitted to be used with the prior written approval of the Authority for the purposes stipulated in the schedule of the legislation (Central Environmental Authority, 2017).

Moreover, there are five important legislations have been enacted by the government recently which are directly relevant with plastic in order to minimize impacts to the environment and human health.

ii. Prohibition of polyethylene food wrappers (lunch sheet)

This is one of the main sources of plastic waste generated. Most of the public including students in Sri Lanka take homemade lunch and breakfast wrapped in polyethylene (lunch) sheets. There are some industries/companies who are adopting sustainability approaches that restrict the lunch sheets. In addition, many schools are not allowed to bring their food wrapped in lunch sheets. However, it is estimated that 20 million of lunch sheets are consumed by the public per day in Sri Lanka (Fernando, 2018). It is obvious that immediate national wide action needs to be established in the country to control generation of such a large volume of polyethylene.

Accordingly, under the provisions of Section 23 W of the National Environmental Act, No. 47 of 1980, an extraordinary Gazette No. 2034/34 issued in Friday September 01, 2017 to prohibit the manufacture of food wrappers from polyethylene as a raw material for in country use. It is prohibited to sale, offer for sale, offer free of charge, exhibition or use of food wrappers manufactured from polyethylene (Central Environmental Authority, 2017).

iii. Prohibition of high density polyethylene bags (sili-sili bags)

High density polyethylene bags, which generally are referred to as sili-sili bags, are very commonly popular all over the country due to many reasons, such as less weight, minimum space required, low price, easily access and they issued to the customers without charge etc. In this context, the amount of polyethylene bags consumed by Sri Lanka is about 15 million per day (Fernando, 2018).

Considering the significancy of generating such a volume of plastic bags per day, the government recently issued a new legislation to control plastic waste.

Thus, under the provisions of Section 23 W of the National Environmental Act, No. 47 of 1980, an extraordinary Gazette No. 2034/35 issued on Friday September 01, 2017 to prohibit manufacture of any bag of high density polyethylene as a raw material for in country use. It is also prohibited to sell, offer for sale, offer free of charge, exhibit or use any bag manufactured from high density polyethylene as a raw material within the country (Central Environmental Authority, 2017).

iv. Prohibition of polystyrene products

Extraordinary Gazette No. 2034/38 issued on Friday September 01, 2017 under the provisions of Section 23 W of the National Environmental Act, No. 47 of 1980 to prohibit the manufacture of food containers, plates, cups and spoons from expanded polystyrene. In addition it is also prohibited the sale, offer for sale, offer free of charge, exhibition or use of food containers, plates, cups and spoons that are manufactured from expanded polystyrene within the country (Central Environmental Authority, 2017).

v. Prohibition of polyethylene in decorations

Polyethylene is widely used as decoration material for various type of events such as religious and cultural, other festivals, and political events. Polyethylene is popular among the public due to low price, durability, easy handling and resistance to water that leads to accelerate the consumption pattern of polyethylene by the public during the last decades. Although many attempts were employed by the government agencies, NGOs and civil organizations to control the use of polyethylene, unfortunately limited headway was achieved.

In this context, an extraordinary Gazette No. 2034/37 issued on Friday September 01, 2017 to prohibit the use of all forms of polyethylene, polypropylene, polyethylene products or polypropylene products as decoration in political, social, religious, national, cultural or any other event or occasion under the provisions of Section 23 W of the National Environmental Act, No. 47 of 1980 (Central Environmental Authority, 2017).

vi. Prohibition of open burning of products with plastics

As mentioned in previous chapters, open burning of waste is a global phenomenon where developing countries are most predominant owing to lack of proper infrastructure for disposal such as collection, treatment, technically developed landfill sites and incineration. This scenario is completely equivalent with the MSWM in Sri Lanka. The backyard open burning was common practice of the public who are living in rural and suburban areas even sometimes in urban dwellings. This practice is accelerated if the LAs are unable to collect waste in regular intervals due to many reasons. Then open burning is done by the public to lessen waste at their premises since lack or no short-term collection points nearby the dwellings as in developed countries. Most commonly burning materials are garden waste, plastics including food wrappers, rubber products and shopping bags, papers unwanted electronics. Besides, open burning can be seen in waste dumping sites to reduce the size of the mountains of waste.

According to a study conducted at one of the divisional secretariat divisions (Hikkaduwa) in southern part of Sri Lanka divulged that 70% of households used to do open burning of garden waste, papers and plastic waste. The frequency of burning at household level is based on the amount of waste generated. Thus, it happens once a week or several. The study has also revealed that there is burning of waste at dumping sites carried out with the aim of extending the life of dumping sites and reducing the volumes (Jayakody et al., 2008). Since the environmental impact due to uncontrolled open burning has been increasing with the increase of population, the government recognized the urgent need of a regulation of this matter.

In this context, an extraordinary Gazette No. 2034/38 issued on Friday September 01, 2017 under the provisions of Section 23 W of the National Environmental Act, No. 47 of 1980 to prohibit open burning or cause to, allow or permit the open burning of refuse or other combustible matters inclusive of plastics (Central Environmental Authority, 2017).

4.2.4 Solid waste management legislation

As in many other countries LAs are responsible for collection and disposal of waste generated by residents. In compliance with 13th amendment of the 1987 constitution, the powers of waste management were vested to the purview of PCs in the Provincial Council Act No. 42. There are three types of LAs established in the country namely, municipal councils, urban councils, pradeshiya sabha and all together currently 341 LAs. The mandate of collection and disposal of waste is stipulated in the Municipal Councils Ordinances No.16, Urban Council Ordinance No.61, and Pradeshiya Sabha Act No. 15. The powers have been vested to LAs to define the implementation rules necessary for the waste management and regulation and to impose penalties (Ministry of Megapolis & Western Development, Ministry of Local Government, 2017).

As mentioned in above, the NEA is the overarching legal framework for environmental protection, the Amendment to the NEA in 1993 requires an Environmental Impact Assessment (EIA) for the establishment of such facilities as intermediate treatment and final disposal site(s) with a capacity exceeding 100 tonnes per day.

Moreover, in compliance with the gazette notification number 595/16 in 1990 and its amendment in number 1534/18 gazette in 2008 provide the provisions for “General Standards for discharge effluents into inland surface waters”. In addition the following projects related to MSW have been specified to by the act to obtain EPL.

- Common wastewater (industrial or sewage) treatment plants
- Incinerators with a feeding capacity of five or more metric tonnes per day.
- Water treatment plants with a treatment capacity of 10,000 or more cubic meters per day.
- Municipal solid waste and other solid waste composting plants with a capacity of 10 or more metric tonnes per day.
- Solid waste recovery/recycling or processing plants with a capacity of 10 or more metric tonnes per day.
- Solid waste disposal facility with a disposal capacity of 10 or more metric tonnes per day.
- All toxic and hazardous waste treatment facilities or disposal facilities or recycling/recovering or storage facilities.
- The defined project for the Scheduled Waste Management License (SWML) is Industries /facilities that generate scheduled waste.

Three gazette notifications issued by the government for SWML which stipulated in the Gazette Extra Ordinary No. 924/13 of 1996, No. 1159/22 of 2000, and No. 1533/16 of 2008 under the provisions provided by the NEA.

4.2.5 Solid waste management guidelines

Although the specific technical guideline is not available for plastic waste management, the technical guidelines for solid waste management have been formulated by the CEA. This guideline is not a comprehensive technical guideline that addresses all imperative elements of waste management systems. But it provides the general directions along with some important aspects to be considered in waste management systems to the stakeholders such as investors, local authorities, and any other entities who initiate or operate any solid waste management activity to comply with an environmentally sound manner. The guideline is the basement for

complying with legal obligations. The guideline focuses on municipal waste, construction waste and industrial waste except hazardous waste. The municipal solid waste includes the following type of waste (Central Environmental Authority of Sri Lanka, n.d.).

- Domestic waste (exclusive of sewage and hazardous waste)
- Commercial waste (market waste)
- Institutional wastes (schools, hospitals (non-clinical), public offices, etc.)
- Street sweeping and beach cleansing waste
- Garden waste (tree cuttings and grass cutting wastes)
- Wastes collected from drains and water courses in urban areas

However, this guideline provides the guidance only for municipal solid waste and other waste categories like sewage, hazardous waste including medical wastes and hazardous industrial waste have not been taken into consideration. The technical guidance have been provided by the guideline for main aspects of solid waste management from generation to end of lifecycle such as waste collection, waste transfer, recovery of useful components of solid wastes, waste incineration, composting, bio gas generation and land filling in order to reduce the pressure on the natural environment.

The general guideline component consists of general requirements, legal requirements and operational requirements as common aspects of solid waste management systems. Among the general requirements of the guideline, highly applicable guideline for plastic waste management is the “waste recycling and resource recovery and to reduce the amount of final disposal must be prioritized when developing waste management plans”. Furthermore, promotion of prioritizing the separation of waste at the source is also considered as a requirement. All these main aspects have been explained extensively in previous chapters of the guideline (Central Environmental Authority of Sri Lanka, n.d.). In addition there are number of guidelines that have been issued by other ministries and agencies which are linked to MSW. Please see Table 4-2 for a summary of those guidelines.

Table 4-2 Summary of available solid waste management guidelines

Year	Guideline	Authority	Description
2001	Healthcare Waste Management Guideline	Ministry of Health and Indigenous medicine	To provide evidence based recommendation to clinicians to manage hospital generated waste with minimum harm to the environment.
2003	Solid Waste Management Guideline for Local Authorities	Ministry of Home Affairs, Provincial Councils and Local Government	To support the SWM practice for LAs
2005 & 2007	Technical Guidelines on Municipal Solid Waste Management in Sri Lanka	Central Environmental Authority	To support the SWM and siting of engineered landfills
2009	Guidelines for the Management of Scheduled Waste in Sri Lanka	Central Environmental Authority	To manage the scheduled waste management

Source: JICA (2016)

4.2.6 Multilateral agreements signed by Sri Lanka

UN declarations

The environmentally friendly solid waste management has been recognized as a main important aspect over the past few years. In 2002 the Johannesburg Declaration on Sustainable Development signed and adopted at the World Summit on Sustainable Development where solid waste was one of the focus points. The discussed priorities were prevention, minimization, reuse and recycling areas. In 2012, the conference on Rio+ 20, the importance of sound waste management was further recognized. According to the outcome document of Rio+ 20 called “Future we want” adequately indicated the importance of waste management within the Sustainable development goals. Being a member of United nations, Sri Lanka is committed to work on conditions stipulated in those agreements.

Paris agreement

Sri Lanka has signed the Paris Agreement (2016) on climate change. The concept of ‘Zero Waste’ identified as a top priority with a view to increase recycling, composting and to minimize waste. The real solutions now lie in the hands of national governments to “establish national goals for waste reduction and resource recovery” (Lombardi, 2017).

Convention on POPs, Basel and Stockholm

Sri Lanka has ratified the three convention with the overarching objective of protection of human health and the environment from pollution by specific chemicals and hazardous substances by controlling trade of selected dangerous chemicals through prior informed consent (Rotterdam Convention), phasing out, restricting and reducing the production and use of certain chemicals (The Stockholm Convention), and reducing production of hazardous wastes and their trans-boundary movements (Basel Convention).

4.2.7 Other policies and guidelines that support plastic waste management in Sri Lanka

There are a number of policies and guidelines formulated and issued by different government institutions in Sri Lanka, that directly or indirectly provide provisions for managing waste. Some of these are Climate Change Policy, Wetland Policy, National Cleaner Production Policy along with sectoral policies (Health, Industry, Fishery, Agriculture), Sustainable Consumption and Production Policy (draft), Framework for Conservation of Biodiversity, Water related Policies etc.

In addition, the government has introduced an innovative initiation to promote alternatives for plastics by providing incentives / tax concessions for importers of bio-degradable products (Fernando, 2018).

4.2.8 Major challenges for waste management in Sri Lanka

As many other countries in the world, the main challenge is the lack of proper implementation plan to achieve the objectives. Being a lower middle income country, Sri Lanka is also experiencing implementation barriers as many other developing countries.

Plastics have opened the way for new inventions and have replaced other materials in existing products due to characteristic properties like light weight, durability, versatility, resistance to moisture, chemicals and decay, along with its low price. Those characteristic properties cause negative externalities to the environment and human health. As many other developing countries, Sri Lanka is also having difficulties to adopt appropriate methods from

waste generation to disposal due to financial, human and technical resources. There is a lack of training of workers and staff of SWM sector and the availability of qualified waste management experts is limited. LAs have to manage the MSW with an insufficient budget allocation for waste collection, storage, treatment and disposal. The lack of strategic MSW plans, waste collection/segregation and a government policy on financial allocation and disbursement are major barriers to achieving effective SWM in Sri Lanka. The other most important factor that affect sustainable waste management is lack of accountability in current SWM systems and public attitude and commitment. Accordingly, the author categorized those challenges into three; organizational & technical, policy and social barriers which are discussed in more detail below.

4.2.9 Organizational & Technical barriers

1. Lack of resources and capacity of LAs

The institutions, who are dealing with the waste management sector do not have sufficient resources such as financial, human and technical capacity for functioning smoothly and effectively. However, the decision makers and policy makers are not well aware of the magnitude and severity of the direct and indirect impacts of open dumping and burning with regards to environmental degradation, economic losses and social burdens, or the benefits of improving existing poor MSW management with appropriate technologies. In addition, local authorities do not have enough number of vehicles to collect waste as well as sufficient staff to collect waste. The most of LAs do not have technically sound vehicles to collect waste and a tractor is the most commonly used vehicle for collecting waste. Once the vehicle breaks down, no collection is happened during the period of the repairing of the vehicle since there are no alternative vehicles for collection of waste. The financial allocation of LAs for the waste management system is approximately 10-30% of total allocation (JICA, 2016). The most expensive component of waste management system is waste collection of which most LAs allocate approximately 80% of expenditure of their municipal waste management expenditure on waste collection and transport (Walivita, 2014).

Most of the LAs do not have short-term collection centers, littering is prominent, if the collection has not done in regular intervals. The waste collection and disposal are undertaken by LAs themselves while some LAs are hiring private companies. Further, unavailability of technically sound landfill sites is a major issue to LAs for final disposal. Lack of human resources is another barrier in implementing a proper waste management system. For instance, a limited number of collectors are employed for collecting MSW with minimum wages. It is proved that the lack of facilities, infrastructure development and insufficient budget stops the management of plastic waste in Sri Lanka. With this scenario, LAs cannot cope with the rate of waste production with the increase of population since the resource allocation does not increase in line with waste generation.

Suggestions:

- Strengthen the capacity of LAs by providing sufficient resources such as human, technical and financial.
- Establish short-term collection centres in convenient places for the residents to keep their waste until the collectors transport them to the disposal site.
- Design periodical capacity-building programmes for all levels of staff in the sector
- Design and implement long-term action plan to manage waste including plastic waste

2. Lack of coordination among the institutions

There are number of ministries such as Ministry of Health, Ministry of Mahaweli Development and Environment, Ministry of Local Government and Provincial Councils and Ministry of Megapolis and Western Province Development that are involved in waste management activities in the country. Overlapping of programmes and activities are happening due to lack of coordination in waste management agenda. Further, the SWM policy which is applicable for plastic waste management was prepared by the Ministry of Environment in 2007 in collaboration with the Ministry of Local Government. The policy is implemented by the Ministry of Local Government through the Local Government Authority. The financial allocation or human resources have not been provided by the Environment Ministry to LAs unless special projects and programmes are conducted. According to the Local Government Authority Act, LAs are responsible for waste management including plastic waste. Therefore, Local Government Authority needs to develop suitable action plans to manage waste in consultation with the respective local authority. There are not any powers to monitor or review progress by the Ministry of Environment although it has been prepared. The involvement of all stakeholders in the decision-making process is lacking and applied methodology is top-to bottom approach which cause poor implementation.

Suggestions:

- Establishment of Inter agency coordination mechanism among the key institution for instance National Steering Committee for waste management co-chaired by the Secretaries of Ministry of Mahaweli Development and Environment and Ministry of Local Government.
- Technical Committee to be established with the experts in the sector to identify the issues pertinent with operational and technical aspects in order to suggest sustainable waste management strategies.

3. Lack of Quality Data

As many other countries in the region, solid waste management in Sri Lanka is fraught to handle the MSW produced in local jurisdictions and lack of integrated & updated datasets (Hikkaduwa et. al., 2015). The main important issue associated with plastic waste in Sri Lanka is unavailability of quality data. The local authorities are not in a position to collect such data due to lack of resources. There are a few research studies that have been done in some parts of the country. The actual waste generation volume is high compared to collected data, as different types of waste management systems are adopted by the public all over the country. Therefore, it is difficult to develop sound integrated MSW management strategies without quality data. Developing sound waste management system often necessitates to have knowledge of volume of waste generated, sources of generation, composition of waste, background information on available infrastructure, cost of alternatives, as well as environmental safety and impacts etc. Data gathering involves with cost, time and resource consuming factors, which need sound decision making. It is important to plan for an active data collection step or programmes before making critical strategy choices. While this approach may appear to result in slower progress in the short term, it will result in true long-term progress characterized by cost-effective and environmentally sound strategies.

Suggestions:

- Identification of data gaps in the waste management sector
- In close collaboration with the universities, develop strategies to fill the data gap

- Establish a well defined system to estimate waste generation by dwellings in island-wide in collaboration with the the Department of Census and Statistics who counts census of population regularly.

4. Priorities for other matters

The waste management is not considered as a priority sector in the political agenda and priorities have been given to increase the productivity in agriculture and industrial sector. Therefore, priority has been given to other sectors than waste management, when financial allocations are made by national budget annually. With this scenario, LAs receive insufficient financial support to cope with waste management activities with the increased waste generation. Since the infrastructure for plastic waste management is in its primary stage, considerable investment has to be done to upgrade the system to encourage plastic recyclers. According to Gunaratne (2012), plastic is mixed with MSW and cleaning processes consume a considerable amount of money during recycling. Therefore, development of infrastructure and public awareness on waste separation plays a major role in plastic waste management.

Suggestion:

- Develop mechanism to increase the annual budget allocation along with the increased population. This can be done if the per capita cost for waste management is calculated by the authorities.

4.2.10 Policy barriers

1. Policy formulation process and implementation issues

Policies are formulated by the respective Ministry in collaboration with the stakeholders is an apparent practice in Sri Lanka. In waste management cases, the Local Government Authority is representing all LAs. The capacities and resources of those LAs are not in equal condition and it depends on many reasons. Therefore, the actual picture at ground level and challenges they have in implementing the policies are not raised adequately in the forums of policy formulation. With this scenario, LAs are not in a position to implement those policies as expected by the policy makers and the government. On the other hand, poor attention for developing strategies and action plans with the respective LAs is a major issue in the country due to lack of resources and commitments of all stakeholders. A single strategy and action plan for the whole country does not make sense due to number of variables involved in different levels in all local LAs for effective implementation. Further, policies formulated in Sri Lanka have partially focused on short-term local environmental issues, with hardly any attention being paid to long-term socio-economic aspects, as well as, regional and global-scale environmental issues. Accordingly Lowe and Ward (1998), as well as Evans (2012), argue that the low politics, devolved fragmentation and disjointed incrementalism are the characteristic features in command-and-control approach in environmental governance. However, good governance aims to ensure inclusive participation, making governing institutions more effective, responsive and accountable, and reverential of rule of law, as well as international norms and principles.

Suggestions:

- Strengthen the policy formulation process with good governance principles
- Develop system to prepare action plans for waste management in each LA in compliance with the SWM policy and guidelines along with monitoring and evaluation mechanism

- Issues need to be prioritized and strategies and action plans need to be developed in order to minimize the impacts.

2. Unavailability of separate policy or guideline for plastic waste management

Although there are many issues associated with plastic waste, there is no separate policy or guideline for plastic waste management in Sri Lanka or any specifications where it is emphasized in the Solid waste management policy of 2007. A technical guideline has also been developed by the CEA for Solid Waste Management with limited emphasis on plastic waste. According to Lowe and Ward (1998) and Evans (2012), those practices indicate the command-and-control approaches in environmental governance rather than good governance principles. They explained it as disjointed incrementalism which emphasised that regulations which cover each new environmental problem were simply added to those that already existed, without any attempt being made to identify common problems or address the wider causes of pollution. The special attention on plastic is not paid in this policy and guideline. As shown in Figure 4-4, the key elements can be integrated, if a separate policy or guideline is adopted for plastic waste.

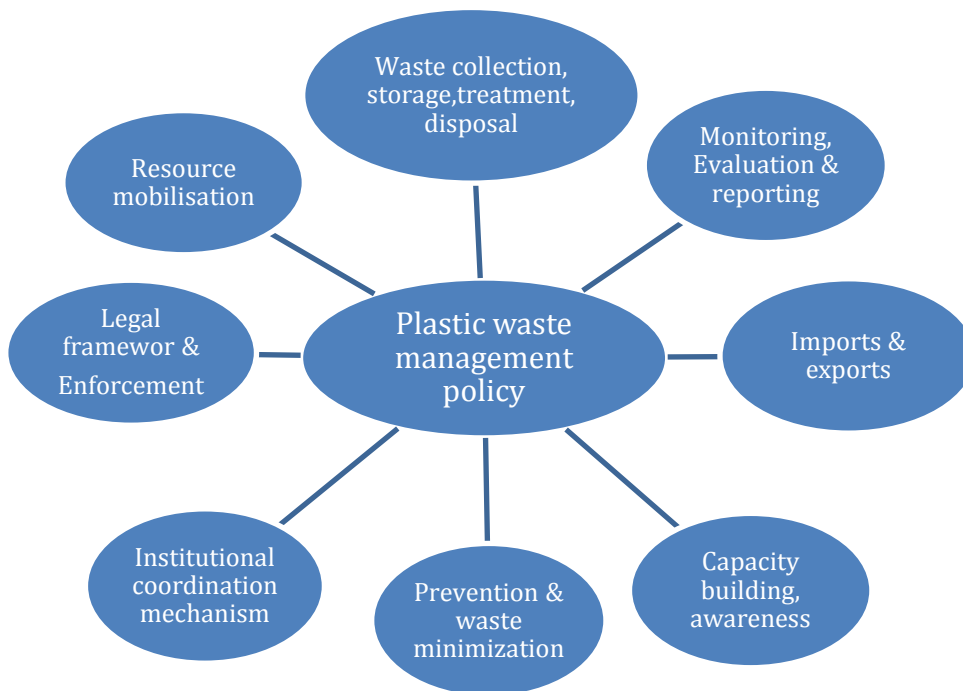


Figure 4-4 Key elements to be integrated in plastic waste management policy or guideline

Suggestions:

- Formulate a separate policy or guideline for plastic waste management
- Introduce EPR and PPP systems in the waste management strategies

3. Poor monitoring/ auditing, evaluation & enforcement

Monitoring and evaluation is a cornerstone of a policy. There is important legislation that has been enacted by the government under the provisions of NEA, also for plastic waste management recently. Due to many reasons, including human, financial and technical resources, policy implementation is being done all over the country with very little attention. Regular monitoring/auditing and evaluation mechanism along with a reporting system is needed for strengthening the system, in addition to policy makers to take decision to upgrade

the system. However, the lack of enforcement and a small amount of fine for non-compliances have not led to a fruitful result.

Suggestions:

- Regular monitoring and auditing mechanism need to be established by the central government.
- Develop a system to evaluate and update the policy
- Increase the penalties for the defilements.

4.2.11 Social barriers

1. Cost of alternatives

As stated in other chapters, plastic and polyethylene is the second largest contributor to the MSW in Sri Lanka. According to Prof. Ajith de Alwis, most of the garbage that is being thrown away is plastics and polyethylene bags. He stated that during the last three four years, photodegradable and biodegradable plastics have been introduced in Sri Lanka as an alternative for plastic bags. Since the alternatives are more expensive than existing bags, it was not successful in the country. “Cost factor became a major problem when people had to purchase them. They always look at the short-term usage and not the long-term environmental pollution. Also people don’t look at the lifecycle issues” (Times, 2014).

Suggestion:

- Introduce low cost and sustainable alternatives

2. Lack of public commitment

The local communities, as well as decision makers, are not well aware of the magnitude and severity of the direct and indirect impacts of existing waste management practices with regards to environmental degradation, economic losses and social burdens, or the benefits of improving existing poor MSW management with appropriate technologies. As in many developing countries, a lack of commitment for sustainable waste management practices from the general public can also be observed in Sri Lanka. Most of Sri Lankans are paying negative interest on proper disposal of waste. Waste segregation at household level is also practiced at a minimum level. Even though they are segregated, collectors dump all wastes into one collection chamber installed on the garbage collecting vehicles. In view of public, LAs are the only partner that committed for waste management and there is no responsibility for waste generators. As a result, a higher quantity of mixed waste is given to local authority waste collection services. Due to the low level of waste separation practices by households, LAs are only offered a mixed waste collection service. There are very few or no recyclable waste collection centres in many areas. Although illegal dumping and open burning are banned, this is the commonly adopted method by the public in order to minimize the waste quantity due to lack of monitoring and auditing.

Suggestions:

- Awareness and education programmes for public on
 - environmental and health impact due to indiscriminate dumping and open burning
 - waste prevention and 3R principles
 - existing legislation on waste management and practices

4.3 How can Sri Lanka overcome the challenges

Waste management is a significantly sensitive subject that is influenced by political, social and environmental factors in Sri Lanka. The public-policy issues arose due to discrepancy between the actual level of environmental quality and choice of public interests. The blaming game is on the top level among stakeholders while neglecting their responsibility and accountability. Therefore, Sri Lanka needs to adopt good governance principles in the waste management sector to ensure inclusive participation, making governing institutions more effective, responsive and accountable, and reverential of rule of law as well as international norms and principles. However, key ministries for waste management have taken a number of initiatives to manage the plastic waste. Besides, following suggestions are emphasized to overcome the issues.

4.3.1 Overcome the organizational and technical barriers

- Strengthen the capacity of LAs by providing sufficient resources such as man power, technical and financial.

As mentioned in Section 4.1, the decision makers and policy makers are not well aware of the magnitude and severity of the direct and indirect impacts of unsustainable waste management practices with regards to environmental degradation, economic losses and social burdens, or the benefits of improving existing poor MSW management with appropriate technologies. This may influence by appointing officers who do not have enough knowledge and experience in the relevant field. The short-term benefits are focused rather than long-term benefits that are influenced by the political agenda. Therefore, increase of capacity of the policy-makers on waste management practices is in need in all provinces. In addition, all levels of employees in the chain should be made aware of the general overview of the sustainable waste management along with the specified training need to be provided based on their responsibilities in the waste management system. Further, the most important aspect to be considered by the government is the transferring system of the officers in the government sector. The institutions, as well as, some of the all island services, transfer the officers on regular basis. The transferring of the officers who are handling the technical subjects may affect the system adversely because they have gained knowledge and experience in a particular sector. On the other hand, he or she needs to work with completely different subjects in the new place and these issues do not only impact the officers but also the system by deteriorating resources and time.

- Allocating financial resources

The government of Sri Lanka needs to adopt a system to allocate financial resources for waste management, as it has impact on social, economic and environmental issues of the country. A comprehensive study needs to be done to identify the existing pattern of waste management in all local authorities and their issues. The priority should be given to the critical issues and long-term holistic approach has to be developed in channeling funds for each local authority with the increase of population in mind. The allocation of funds for waste management systems should not be changed with the political agenda or the interest of the decision makers. Provincial councils may provide legal provisions in this regard in allocating funds smoothly.

- Establishment of proper landfill sites
Establishment of short-term collection centres with good standard in convenient places for the residents to keep their waste until the collectors transport them to the disposal site is a key factor in the system. This may support LAs to manage the waste transport with the limited number of vehicles since most of the LAs are struggling with the vehicle issue. Since there is a lack of collection facilities to provide daily waste collection by the LAs, establishment of collection centres close to residents which are convenient for them, avoid the keeping of waste bins or bags along the road-sides or in front of the dwellings. Then LAs have to have a proper collection mechanism with limited transport facilities.

Sri Lanka has experienced public protest for the last decades while establishing a pilot landfill site. Those protests may be influenced by political opposition parties, some NGOs with focus on short-term negative impacts to the environment or other purposes. Those protests caused impacts to the government in many ways. Therefore, government needs to establish a proper mechanism through the principles of transparency, access to information and inclusive participation in the decision-making process. Although landfilling is not the best option for waste management due to leachate, Sri Lanka needs to move to that option as an alternative for open dumping and burning. Since around 80% of the country's land is owned by the state, while only about 20% is privately owned, sanitary landfills may be one of the options to be established by the government by inclusively addressing good governance principles in order to avoid the public protests.

- Overcome the lack of coordination among the institutions
Since the subject of waste is cross-cutting, a number of agencies are engaging with this subject. Therefore, the inter-agency coordination mechanism is important to avoid overlapping that impact on resources and time. A high-level coordination committee is supposed to be co-chaired by the Secretaries of Ministry of Mahaweli Development & Environment and Ministry of Local Government & Provincial Councils. The technical expert committee is also in need to be established to make proposals and recommendations to the Inter-agency coordination committee. A working group to be formed to identify the issues of LAs in implementing the waste management strategies. When formulating suitable policies, strategies and action plans, the participation of the working group and respective LAs are the key essentials to avoid the command-and-control strategy of environmental governance.
- Quality data
Sri Lanka has many issue with the quality of data. For instance, during the literature review on the thesis, the author found two different data from different organizations. For instance, one organization revealed that the waste collection in CMC is 75% and the other source argued that it is 51%. Therefore, the government needs to focus on availability of quality data in waste management sector to develop proper waste management system for the country. Further, the developing system for waste management based on the unreliable data is a risk of failure of the system and also wasting resources as well. In addition, it is recognized that the data sources generated from the government sector are more accurate than other sectors, government shall coordinate with the local authorities to generate accurate data in the waste management system.

4.3.2 Overcome the challenges in policy formulation and implementation

1. Policy-formulation is a multi-actor and a multilevel phenomenon, which partly explains the sometimes substantial differences between policy on paper and policy in practice. Policy implementation challenges are one of the issues associated with the sector all over the world, and developing and emerging economies are struggling more than developed countries. Policy implementation is mobilizing and setting aside the required resources (human resources and financial resources), specifying procedures and rules, and determining the division of tasks and the coordination between the various organizations entrusted with implementation. Though there are a number of policies and policy tools that have been adopted by the country, significant progress have not been achieved. The policy formulation that is done by the central government in many developing countries may be based on fulfilment of the requirement of international organizations or a treaty. Sometimes, they provide funding for the formulation of a policy. The policy implementation process is, however, consuming more resources than policy formulation. Since the respective ministry does not have the capacity to implement the policy, it is available only in the book racks. With regard to the Solid Waste Management Policy, Ministry of Mahaweli Development & Environment formulated the policy with the stakeholders based on the order issued by the Supreme Courts of Sri Lanka. The policy implementation is done by the LAs which does not fall under the purview of the Ministry of Mahaweli Development and Environment. However, the Ministry is implementing many initiatives that support for the plastic waste management in collaboration with the CEA. Therefore, Ministry of Mahaweli Development & Environment needs to work in close collaboration with the Ministry of Local Government and Provincial Councils to develop suitable mechanism to implement the policy. In addition, there is a need to update the SWM Policy since it was formulated in 2007. It is important to update the policy as an overarching policy that covers all the waste streams including gaseous, liquid and other waste. The responsibility should be vested to the respective agencies to develop sectoral policy or guidelines along with the strategies and action plans to manage waste in the relevant sector. In view of that, a detailed study on the actual picture of the LAs needs to be done, in collaboration with the Local Government Authority, in order to identify the critical issues and the implementation barriers. These critical points are to be incorporated, in developing strategies and action plans in compliance with the updated SWM policy.

2. Changing the subjects of government bodies

The other issue that Sri Lanka faces today is inconsistency of central government bodies. According to the Constitution, the general election takes place in every six years to select the Parliament members to govern the country. All the central government bodies such as ministries and their subjects have been changing over the time accordingly. The policies and plans, as well as, officers are changed based on the political agenda. This unhealthy system is considerably impacting the system in many ways. Therefore, the central governing bodies like ministries and their subjects should be indicated in the constitution to smooth implementation of the system while avoiding impact on changing the governing party of politics.

3. Policy or guideline for plastic waste

Although the plastic waste causes a significant impact to the human health and the environment, a guideline or policy has not been formulated for plastic waste in Sri Lanka. A little indication is in the SWM policy and guideline. Therefore, it is important to introduce a separate guideline for plastic waste management, indicating the specific guidance for producers, consumers, collectors and recyclers with the legal provisions. The existing technical guideline does not have legal provisions. The policies for encouraging plastic collectors and recyclers can be adopted by the government. This may include development of infrastructure, awareness campaigns among the public market based instruments like tax concessions for recyclers etc.

4. Comprehensive study

Introduction of policy tools in the country should be done taking account of existing practices and laws, issues associated, implementation and monitoring mechanism along with the technical facilities available for monitoring. The introduction of new laws for the plastic waste management by the CEA is a vital attempt to manage the plastic waste in Sri Lanka. However, the legal powers have not been vested to CEA to raid the illegal producers or retailers without the Police officers. On the other hand, unavailability of technical tools to measure the thickness is another challenge that have been experienced at present. Therefore, government should study the whole system before introducing policies for plastic waste management. Another issue is the banning of HDPE. There is a tendency of rebound-effect. Since the poor strength of bags that are produced from LDPE, super markets provide two bags instead of a single bag to the customers to ensure the protection of the goods. Therefore, a policy needs to be adopted to ban the plastic bags without a charge.

5. Support small and medium-scale recycling industries

As mentioned in the contextual framework in chapter two, plastic recycling industry is in primary stage and not high profit making industry due to fluctuation of the price of plastic in the market as well as the fuel prices. Only a few leading companies are established in the Western province and majority of recyclers are small and medium-scale. Main concern of the plastic waste is mixing with the MSW which leads to costs for cleaning, where small and medium-scale recyclers are largely concerned with the costs, as well as, developing systems for water treatment. In addition, small and medium-scale recyclers apply unhealthy methodology for cleaning and recycling activities that cause impact on air, water and terrestrial ecosystem. In this context, government needs to support the small and medium-scale recyclers to develop environmentally friendly technologies by providing technical, financial and other logistical support to encourage them. If not, recycling industry may cause the rebound effect.

4.3.3 Overcome Social Challenges

1. Awareness

Waste is a sensitive subject, and charging for waste is not a practical way of handling the issue in Sri Lanka. The awareness of the public on the existing policies and laws is poor in the country and government authorities needs to pay attention to make aware the public through all media available. The special focus on health impacts and environmental impacts, waste separation, prevention may increase the results. The awareness through the school education is also an important source of waste reduction, where the Ministry of Health used this strategy to reduce the smoking

among the public, which achieved high results within a short period. Therefore, inclusion of waste management concepts into the school curriculum is one of the strategies that could be used. Production of alternatives among the rural settings like making bags using renewable resources such as coconut and leaves of palm, as well as, other cane products. The government should provide financial incentives or interest free loan schemes to upgrade and encourage them to develop alternatives.

2. Changing attitudes

The littering and haphazard disposal of waste is the major challenge in Sri Lanka. The awareness through all media and an awareness through the village level social committees will be more effective, though the method consumes more effort. Since unavailability of buying centres in the rural settings, as well as, sub urban areas is a challenge of the public to get rid of their waste. Since the price per kilogram of plastic is low, public are not interested in collecting them or sell. There are a few recyclers who have the capacity to collect plastics by visiting door-to-door that has happened in some urban and municipal areas. Therefore, the establishment of proper collection system all over the country is needed and government has to play a vital role in facilitating the system equally throughout the country.

4.4 What are the success policies that are applied in other countries in the region which can be adopted by Sri Lanka for managing plastic waste?

The objective of this research question is to get an overview of how other countries in the region manage the issue with the adoption of policies and policy tools in order to ensure successful plastic waste management in a long-term perspective. The policy tools that are adopted in the countries depends on the social, economic as well as environmental factors of the country. Therefore, a policy tool that has adopted in one country may fail in any other country. Some policy tools give supports for a paradigm shift. With this scenario, to adopt an effective policy in a country, a comprehensive analysis has to be done before to introduce a new policy tool in any country. The author wishes in this section to discuss the policy tools that have been successful in a few countries in the region that can be applied in Sri Lanka. The key point here is the necessity of grasping the concept on each policy and then the concept can be adopted with a local context.

There were evidence on waste management system and practices that has been adopted and evolved by the civilians of Asia over the years. Asia is one of the most important regions that has significant features of economic, social and environmental development of the world today. Asia provides shelter for more than 4.4 billion people in 2016 and full of natural resources (UNEP, 2017). At the sametime, it is recognized as the highest continent of waste generation. While some countries in the region such as Japan and Korea are able to manage the waste over past two decades, other countries responsible for contributing considerable volume of waste. In this context, there is a pressure for the governments of Asia to develop sustainable measures to manage the waste. Accordingly, there are different types of policies and policy tools that have been adopted over the past decades by the states of Asia for management of waste as well as plastic waste. This include the prohibition of waste disposal indiscriminately. However, considerable progress has not been achieved due to poor compliance including unavailability of regular auditing, and monitoring as well as low penalties.

The effective plastic waste management policies have been adopted by many countries in the world. These include principles, policies and policy tools including legislations and market based instruments. Some of these are discussed extensively herein after.

4.4.1 Principles of waste management

Prevention principle

According to the United States Environment Protection Agency (1998), “definition for Prevention is a multi-media environmental management approach which emphasizes the elimination and/or reduction of waste at the source of generation. The concept came about upon the realization of the need to look at all types of waste in order to comprehensively and adequately protect the environment and conserve natural resources”. Prevention is not something that can be simply added on to existing practices and systems. It involves identifying the root causes of waste and figuring out ways to minimize its creation with special attention to efficient use of energy and materials. Accordingly, pollution prevention is a challenge for all stakeholders of the society. It is indeed the awareness and education since pollution prevention requires skills, creativity, attitude to holistically identify the options for improvement and innovation (Environment Protection Agency, 1998). Since end-of-pipe treatment is transferring pollution from one medium to another, prevention is the most suitable option for developing and emerging economies in Asia. The end-of-pipe treatment system involves with regulatory tools which add other sets of costs associated with enforcing compliance.

The well known slogan “prevention is better than cure” is the most useful, practical and preferred option for waste management for preventing the generation of waste at the source. This is applied many stages including product design, production, packaging, use stages of a product. Prevention is the cheapest cost method of waste management because prevention helps to reduce handling, treatment, and disposal costs and reduces various environmental impacts. With this scenario, recent decades, there has been a paradigm shift from pollution control to pollution prevention.

The waste or material recycling by segregation, collection and re-processing to create new products is also another approach that comply with the prevention principle. The 3R approach (Reduce, Reuse, and Recycle) is also aimed at optimizing the management of municipal solid waste from all the waste-generators (households, commercial and institutional establishments, parks and gardens, construction and demolition activities, agriculture, safety and healthcare facilities) and involving all the stakeholders (waste generators, service providers, informal sector, regulators, government, and community/neighbourhoods). The adoption of the 3R concept helps to minimize the amount of waste to be handled by the municipal authority minimizing the public health and environmental risks associated with it.

Polluter Pays Principle (PPP)

PPP as an overarching principle of environmental responsibility, which suggests the one who pollutes should pay for the consequences. At the UN Conference on Environment and Development in Stockholm in 1972, the PPP was first adopted by the Organization for Economic Cooperation and Development (OECD). The OECD document elaborate the PPP as follows:

“the polluter should bear the expenses of carrying out the above mentioned measures decided by the public authorities to ensure that the environment is in an acceptable state.

In other words, the cost of these measures should be reflected in the cost of goods and services that cause pollution in production and/or consumption. Such measures should not be accompanied by subsidies that would create significant distortions in international trade and investment” (Khan, 2015).

According to the principle 16 of Rio Declaration, national authorities need “to promote internalization of environmental costs taking into account the approach that the polluter should, in principle, bear the cost of pollution, with due regard to the public interest and without distorting international trade and investment”.

In compliance with this, many member countries have taken initiatives to incorporate PPP in their waste management plans and systems through economic instruments such as taxes and charges, deposit-refund schemes, liability and insurance etc., Some of the countries in Asia such as Japan, Singapore, Korea have also applied the principle in order to manage the waste. Sri Lanka has also applied PPP to some extent by introducing taxes for plastic imports, license scheme for industries etc.

Extended producer responsibility (EPR) principle

EPR underpins the allocation of responsibility of environmental impacts related to products to manufacturers of products due to their capacity to make changes at source. EPR can be established not only for the plastic and packaging but also for wastes like electronics, batteries and consumer durables by state and national governments. States can take initiatives in this regard and regulations are usually legislated at state and national levels.

EPR concept has introduced by Thomas Lindhqvist in 1990 in Sweden and considered as one of the key founders of the EPR. According to him “EPR is an environmental protection strategy to reach an environmental objective of a decreased total environmental impact of a product, by making the manufacturer of the product responsible for the entire life-cycle of the product and especially for the take-back, recycling and final disposal” (International Reference Centre for the Life Cycle of Products, 2015). Then in 2000, OECD has defined EPR as “an environmental policy approach in which a producer's responsibility for a product is extended to the post-consumer stage of a product's life cycle. There are two related features of EPR policy: (1) the shifting of responsibility (physically and/or economically; fully or partially) upstream toward the producer and away from municipalities, and (2) to provide incentives to producers to incorporate environmental considerations in the design of their products” (International Reference Centre for the Life Cycle of Products, 2015; OECD, 2015).

4.5 Policies adopted by the Region for plastic waste management

4.5.1 China

In view of managing the generation of polystyrene food containers an important policy is established in Beijing China already in the end 1990s (Fung, 1999).

1. Restriction on sale and use of plastic bags and PS plastic containers

A sector specific regulation enacted by Beijing government in March 1999, to manage the plastic bags and single use polysterene. Accordingly, the sales and use of plastic bags and single-use PS food containers have been restricted. The plastic bags with thickness less than 0.025 mm are banned in trade and use in any business. Furthermore, the regulation stated that all enterprises are required to print the name of their companies or the shopping mall

where they are located on the plastic bags, which they give out to customers in order to facilitate the monitoring mechanism. While management of shopping centres is obliged to establish shops or counters that sell standard bags which fulfil the requirements, it is the duty of them to establish strengthening and monitoring mechanism to ensure the effective implementation of the regulation. Moreover, important and effective decision of the government is the restriction of sale and use of polystyrene food containers in train stations, long distance bus stations, the capital airport, major tourist spots in Beijing and hotel restaurants (Fung, 1999).

2. Economic incentives

A successful approach has been deployed by the Chinese government by introducing incentives for collectors of polystyrene containers. The incentives are provided to workers of CSB, offices, restaurants and canteens for collection of PS containers. Since it helps them to obtain an extra income, active participation of those categories, a significant level of collection has been achieved (Fung, 1999).

3. Policies for enhancing research and development of substitutes

The responsibility has been vested to the ministry of science and technology in India to support institutions or entrepreneurs to develop ecofriendly food packagings as an alternatives to the polysterene food packages. In view of this, the ministry of science and technology increase their funding in the field of technological investment (Fung, 1999) .

4.5.2 Japan

1. Act on the Promotion of Effective Utilization of Resources

The government of Japan recognized the scarcity of natural resources in the country and identified the necessity of effective utilization of resources. In view of this the act on the Promotion of Effective Utilization of Resources (Effective Resource Utilization Promotion Act) was passed in April 1991, in order to ensure the effective utilization of natural resources in all sectors of the country. Act focuses on four areas as follows:

1. Recycling of reusable materials
2. Development of easy to recycle of structures and materials
3. Labelling for sorted waste collection
4. Promotion of the effective use of by-products

According to the act, ten industries and 69 products are recognized as mandatory to undergo 3R initiatives which has been designated by the government ordinance. Accordingly, to comply with the ministerial ordinance, specific programs need to be implemented independently. The regulations have also been stipulated by the act to encourage and promote 3R in different stages of a product lifecycle such as design, manufacturing, waste collection and recycling by the entrepreneurs (Environment Ministry, 2014). The waste generation of Japan in 2000 was 54.8 million tonnes and it has become 44.9 million tonnes in 2013 due to recycling (22%), incineration (75%) and landfilling (10%) (Isher Judge Ahluwalia, Utkarsh Patel, 2018). For instance under the end-of-life vehicle recycling law, Japanese automobile manufacturers used the 3Rs and a life cycle approach to improve vehicle design for better recyclability and overall environmental performance. The Adidas sports brand together with an environmental initiative called “Parley for the Oceans,” launched a special programme to produce shoes using plastic debris collected from the oceans (UNEP, 2017). The overall legal framework for material recycling in Japan is shown in Box 2.

2. Extended Producer Responsibility

According to the Containers and Packaging Recycling Act, 1995, producers and operators of the businesses need to reduce the volume of waste generation. With this scenario, reduction of thickness and weight of packaging and containers, charging fee for the shopping bags and use of returnable containers have been deployed to reduce the waste generation (Environmentministry, 2014). For instance Manufacturers of PET bottles reduced the amount of resin and, as a result, produced thinner bottles which cause easy handling to waste collectors due to reduce weight (UNEP, 2017).

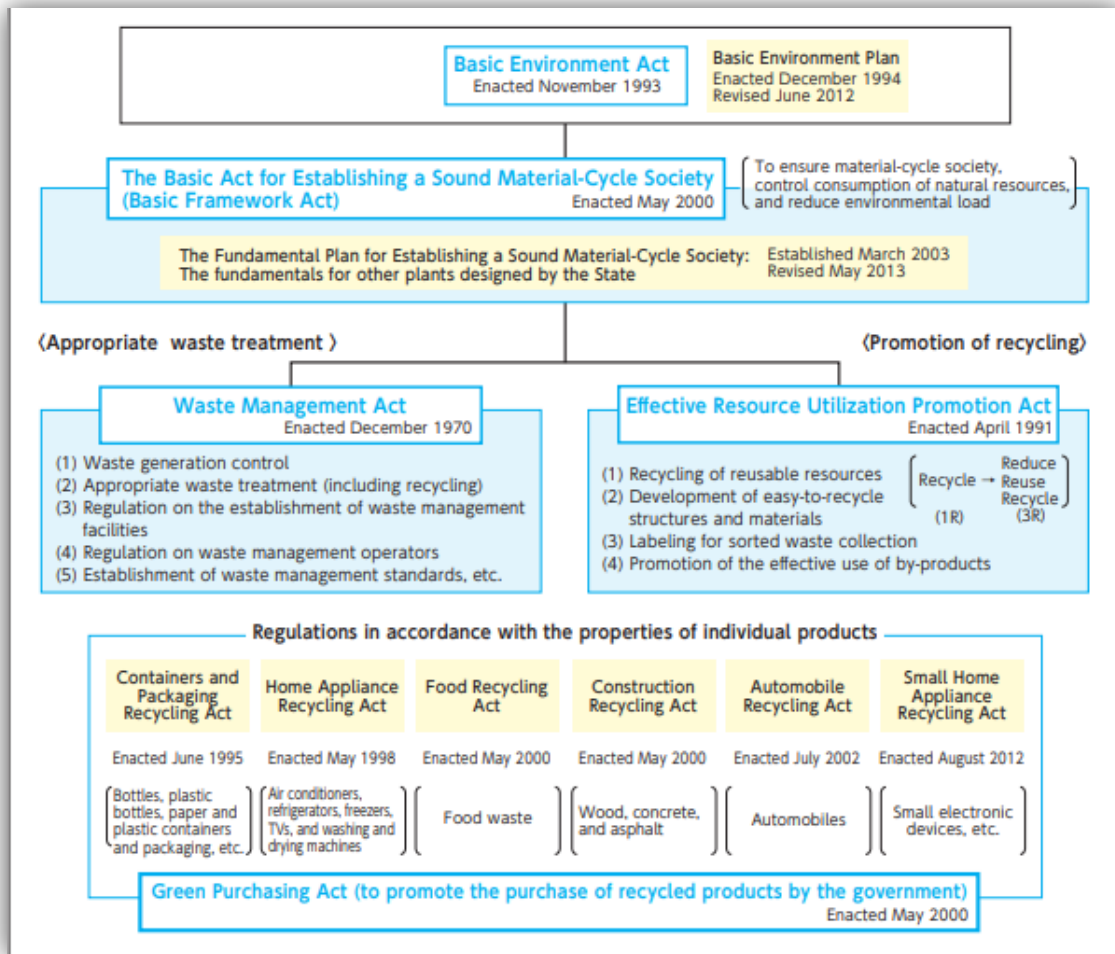


Figure 4-5 Legal system for establishing a “Sound Material Cycle Society”
Source: Environment Ministry (2014)

Green Purchasing Act

Green Purchasing Act was enacted by the government of Japan in May 2000. The overarching objective of the act is to promote and increase the purchase of recycled products by the government in order to create a sound material-cycle society. It is the requirement when purchasing goods and services by the organizations, priority should be given to the products that minimize environmental impacts by careful evaluation through out the lifecycle of a product. The establishment of a green market in the system is a challenge and national and local governments play a leading role in developing green markets in order to promote and finally establishment of a sound material-cycle society.

4.5.3 India

There are important policy decisions that have been taken by the government of India in 2016. The Ministry of Environment, Forestry and Climate Change has issued the plastic waste (Management & handling) rules in 2011 and with some amendments issued plastic waste management regulations in 2016. Some of the important policies that can be useful and potentially adopted by Sri Lanka with some modifications are as follows.

Increase of thickness of plastic bags

A thickness regulation of plastic bags was amended in 2016 under the Plastic Waste Management Rules 2016 with the objective of addressing the issue effectively. The minimum thickness of plastic carry bags was increased from 40 micron to 50 micron. Moreover, a comprehensive regulation extended its jurisdictions and applicability to rural areas and the supply chain of the plastic importers. The main objectives of this revision are to increase the manufacturing cost and escalation of recycling. Since the manufacturing cost is increased, the issuing of plastic bags free of charge by the retailers will be immobilized. According to the regulation, it is mandated to producers and brand owners to develop a plan to introduce take-back system of products after they are consumed by the consumers in consultation with the local bodies (Bhattacharya et. al., 2018). This is the initiation of Extended Producer Responsibility (EPR) in India that share the cost and responsibility of managing plastic waste among producers, importers and retailers to support the local authorities to manage plastic waste sustainably.

Responsibility of retailers and street vendors

In order to facilitate the monitoring and auditing mechanism, important decision has been taken by the government and following regulation has declared for effective plastic waste management in India. “Retailers or street vendors shall not sell, or provide commodities to consumers in carry bags, or plastic sheet, or multilayered packaging, which are not manufactured and labelled or marked, as prescribed under these rules. Every retailer, or street vendor, selling or providing commodities in, plastic carry bags or multilayered packaging or plastic sheets, or like, or covers, made of plastic sheets which are not manufactured, or labelled, or marked, in accordance with these rules shall be liable to pay such fines, as specified under the bye-laws of the local bodies” (Bureau, 2016).

Pre-registration fee

According to the policy, shopkeepers and street vendors should register with the local authority, if they are willing to provide plastic carry bags for dispensing any commodity. “The local body shall, within a period of six months from the date of final publication of these rules in the Official Gazette of India notification of these rules, by notification, or an order under their appropriate state statute or bylaws shall make provisions for such registration on payment of plastic waste management fee of minimum Rs. 48, 000/- @ Rs. 4,000/- per month”. Based on the production or capacity of sale, plastic waste management fee is prescribed by the local authority. In addition, the shopkeepers who have registered shall display at prominent place that they issue plastic carry bags with a charge. Only the registered shopkeepers, or street vendors shall be eligible to provide plastic carry bags for dispensing the commodities. Besides, the responsibility has been vested to the local authorities to utilize the amount paid by the customers for the carry bags exclusively for the sustainability of the waste management system within their jurisdictions (Bureau, 2016).

Recycling and recovery of plastic waste

In order to enhance the plastic recycling, disposed plastic material are utilized in the road construction, waste to oil or waste energy systems in the country (Bureau, 2016).

4.5.4 Taiwan

Deposit-refund system

Under the purview of waste management Act, Taiwan has adopted a deposit-refund system since 1988 which is one of the successful approaches in the waste management system. In compliance Disposal Act, the recycling requirements for PET came into force first in 1989. The act is administered by the Environmental Protection Administration (EPA). The objectives of deposit-refund system for PET bottles are; increase collection of PET bottles separated from municipal solid waste, increase the recycling rate of PET bottles, improve waste management of PET bottles and promote better product design for recycling. The deposit rate in Taiwan has been set at a level yielding strong incentives for recycling. In order to ensure the successful collection system, number of collection points has established and a sizable salvaging company has contributed to the success of the scheme. During the fourth year of operation, the recycling rate of PET bottles has reached to 80% at the rate of consumption was 260 million bottles per year (Environment Protection Administration,nd ;Narayan, 2001). In order to fulfill their obligations for PET recycling under the Waste Disposal Act, members of the PET industry created a modified deposit-refund system.

It is a mandatory requirement for manufacturers or importers to register at the EPA under the EPR scheme and report to EPA the amount of items sold or imported, and pay recycling fees for such items. In addition, the sellers are required to display collection-point marks at their stores and accept items returned by the consumers. Institutional framework has been established by the EPA for functioning EPR system smoothly and effectively.

5 Discussion

Waste is an issue that impacts people from all socio-economic groups, all regions and all cultures. The high-income countries characteristically have collection efficiency rates in between 90-100 percent where low income countries typically have less than 50 percent efficiency. There are some countries with collection rates around 40 percent (Cogut, 2017). There are many reasons for poor collection rates and most common issues are financial factor for waste collection, engaging sufficient staff for collection, unavailability of modern technology and infrastructure, irregular collection pattern etc. All these factors are in line with the situation in the waste management sector in Sri Lanka. According to the theoretical framework, good governance aims to ensure inclusive participation, making governing institutions more effective, responsive and accountable, and reverential of rule of law as well as international norms and principles. Therefore, discussion of the thesis focuses on good governance principles while analyzing the qualitative data and information gathered during the literature review.

5.1 Waste management and existing legislations

Solid waste became an issue in the late 1970s in Sri Lanka with the mass-scale socio-economic transformation that happened in the country. As a result, SW generation has increased rapidly causing negative externalities to the environment and human health. The government adopted institutional and legislative initiatives to manage this situation over time and currently new strategies are being implemented in order to cope with the existing state of the SW problem. Large volumes of waste is generated in urban settings rather than rural areas. For instance, the largest volume of waste is generated in the Western province. The waste collection, which is the most important stage, is done by the public sector in Sri Lanka with a few exceptions of private sector service provisions. Public sector collection service is characterized by irregular service provisions due to unavailability of resources. Most of the LAs generally have a low collection service coverage. Community-based source separation, re-use, composting, recycling schemes, initiated by a variety of stakeholders such as, NGOs, LAs, and community groups have been implemented amongst low, middle and high income households in certain urban areas. Besides, several recycling centres are also established in the country, especially Colombo, Kurunagala, Kandy and Maharagama. Moreover recycling material collecting centres are established in the main cities of the country. The common methods of disposal system adopted is open dumping due to unavailability of infrastructure and scientifically sound disposal system for waste management in the country. There are three sanitary landfills that are operated currently as pilot projects and these are presented in Table 6-1. These sanitary landfills are not sufficient to cope with the increased waste.

Table 5-1 Sanitary landfills in operation

	Funding agency	Capacity	Status
Dompe (Western province)	KOICA	90 MT/d	Operational
Baticalo (Eastern province)	ADB	99 m ³ /d	Operational
Ampara (Eastern province)	EU/UNOPS	100 m ³ /d	Operational

Source: Mabesba Thalagedera, Mallika Pinnawala (2017); Muthukuda Arachchi, K.H. (2016), *Environmental Regulations, Guest Speech, South Asian Symposium for Environmental Sciences, March 17th – 18th 2016, University of Peradeniya.*

However, sanitary landfill is not the best option for MSW as the leachate of the landfill contaminates the ground water table even though the basin is laminated. According to Pilapitiya (2012), the incineration technology is not a viable option for Sri Lanka due to the waste composition, moisture content and calorific value of the waste (Pilapitiya, 2012; (Ihalagedera et al., 2017). Therefore, it is important to introduce and establish sustainable methodology to prevent waste and reduce waste by adopting 3R principles.

The legislative efforts and effective implementation are playing a vital role for waste management and disposal in an environmentally sound manner, which protects human health and the environment. Sustainable development depends on the policy, institutional and legal framework related to environment, as well as, on the implementation capacity.

According to the literature review on question one, there are a number of policies and laws that have been passed by the government and Parliament for managing waste. The important legislation pertinent to plastic waste have also been passed recently. The basic legal and policy framework are often in place in developing and transitional countries with a scope of improvement. However the major challenges are related to effective implementation of the existing framework. The implementation gap is particularly evident at the sub-national levels (OECD, 2007). The implementation gap in developing countries has mainly been explained by a lack of technical and financial capacities among young environmental agencies in combination with the low political priority given to environmental aspects (OECD 1999). The legislative framework for waste management has been adopted at three levels; government, provincial council and local authority in Sri Lanka. This is characterized as command-and-control by Lowe and Ward (1998), as well as Evans (2012), under the low politics. Accordingly, environmental management and regulation have appeared as a special and technical area outside of the civil service. Environmental management reflects to structures of administration generally. Therefore, it is important to raise the issue that environment is the part of society and protection conservation of environment is the prime responsibility of the society to comply with the Constitution of Sri Lanka.

The implementation gap is basically hindered by the lack of resources and commitments of stakeholders. This is again linked with the low politics. The resources for the LAs are passed by the Parliament annually through the Ministry of Local Government and Provincial Council. Therefore, a comprehensive study needs to be done to fill the waste management implementation gap of the LAs and priorities have to be paid for the significant areas. The level of interest of the decision makers of the LAs is a key to underpin the successful implementation of waste management systems while paying significant level of politics to comply with the environmental governance.

According to Gunaratne (2012), the future plastic consumption trend will be increased by three times as compared to the situation in 1995 as shown in Figure 6-1. Therefore, the government of Sri Lanka should pay more attention with the demanding plastic waste management system with the increase of plastic consumption. Integrated MSW management (ISWM) is a systemic and comprehensive framework which covers all types of waste for managing it in environmentally friendly manner. The overall goal of ISWM are; 1. Improve the performance of the solid waste management system with a clear, sustainable policy, 2. Effectively balance costs and benefits with short-term strategies and long-term vision 3. Protect public health and the environment. ISWM covers all sources and stakeholders, and all aspects.

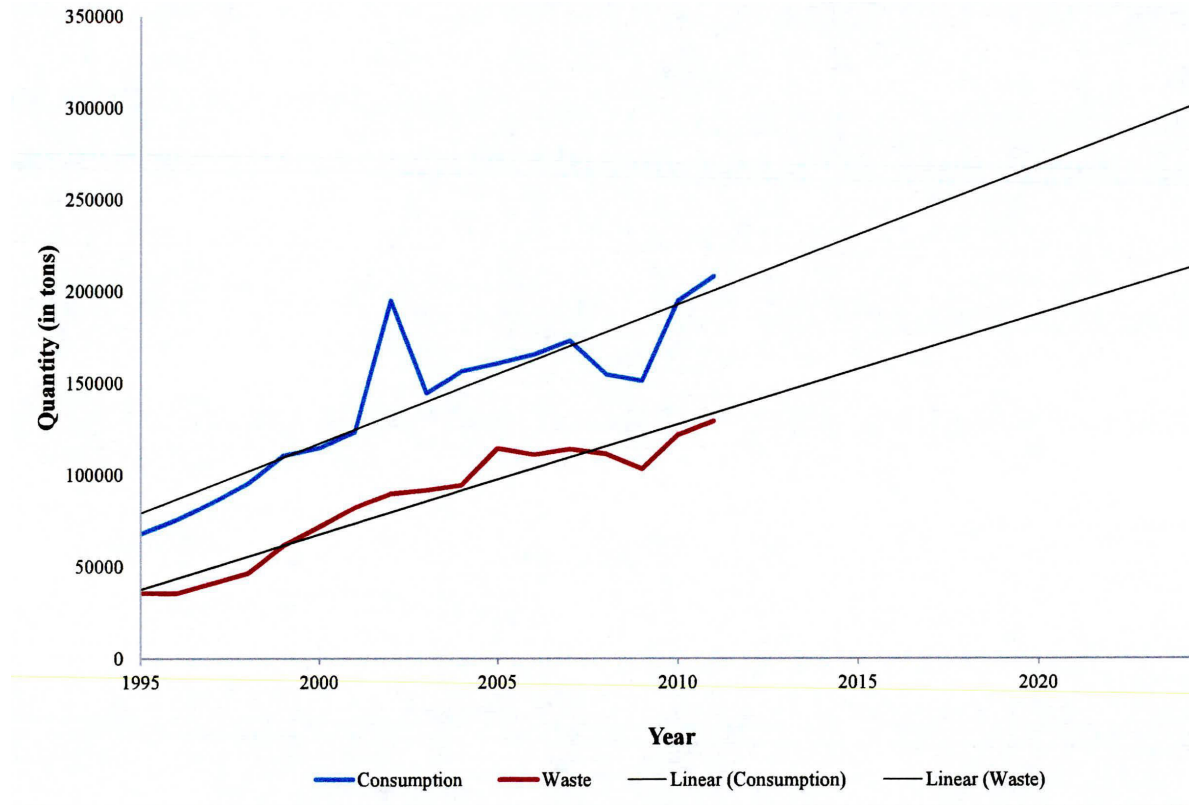


Figure 5-1 Future trend of consumption and waste generation of plastic
Source: Gunaratna (2012)

While the public sector has a key role in formulation and implementation of governance measures, such as strategies and regulations, the civil society and private sector also have important roles and responsibilities for environmental governance. One can argue that the consumption rates and waste generation will be reduced in compliance with the regulations adopted by the government recently such as Prohibition of polyethylene in decorations, Prohibition of polyethylene food wrappers (lunch sheet), Prohibition of high density polyethylene bags (sili-sili bags), Prohibition of polyethylene products of twenty (20) microns or below. Those important pieces of legislation play an indispensable role in managing plastic waste when the effective monitoring and auditing mechanism will be adopted by the central government, while strong commitment of stakeholders will be part of the implementation. However, laws are not the perfect solution for managing waste unless there are changes in the attitudes, lifestyles, along with the commitments and accountability of all stakeholders.

5.2 Analysis of Successful policy tools

The selected policy tools are analyzed against some of the environmental governance principles such as transparency, effectiveness and stakeholder engagement in addition to the environmental and social aspects of triple bottom line of sustainable development.

1. Deposit-Refund System

Although a number of policy tools have been passed recently, a suitable policy has not been introduced or adopted for managing PET bottles, which is one of the main issues in plastic waste management in Sri Lanka. These bottles are littering the beaches, sea and nature in a country where tourism is an important source of revenues. The governmental attention

needs to be paid for this in collaboration with all stakeholders. Many countries in the region have adopted successful policy tools to manage the PET bottle issue. For instance, Taiwan is a small country with high population and the issue of waste is managed by introducing deposit-refund system. Deposit-refund for PET bottles is mandated by the government. The mandatory deposit-refund system regulates involvement of all relevant producers (manufacturers and importers who sell drinks contained in PET bottles) in 'end' PET bottles management. Under this system, a new financial responsibility is allocated to producers. Deposit fees that are collected from producers are used to pay end-users as a financial incentive to bring back used PET bottles to a designated collection point. The mandatory deposit-refund system contributes to the separate collection of PET bottles from the general municipal waste stream. The main advantage of a mandatory deposit-refund system is to increase the collection rate of certain waste products like PET bottles separately from the mixed waste stream. This decreases the volume of MSW and provides provision for easy handling and final treatment. The responsibility of disposal is shared with the stakeholders and producers are accountable for collecting the waste. Taking into account loopholes of deposit-refund systems that were experienced in other countries, a modified system can be adopted in Sri Lanka to achieve the objectives. The establishment of transparent institutional framework for handling money of the system will be important to streamline and create trust with the stakeholders. In compliance with the theoretical framework, transparency and involvement of all stakeholders in the decision-making process and stakeholder accountability are some of the characteristics of good governance that underpin with the deposit-refund system. The deposit-refund remains an attractive instrument in this settings.

Deposit-refund system also generates relatively high recycling rates that leads to reduction of the extraction of virgin material in all sectors. For instance recycling rate in Canadian programme shows 77-91% in all type of recycling material with the deposit-refund system (Walls, 2011). The material recycling rate of PET and aluminium cans with the deposit-refund system in Sweden is more than 85% during 2006-2008 (Tojo, 2011). Those results proved the importance of material recycling in the waste management system that support the conservation of natural resources. According to the Swedish system the government has the role of setting up the basic rules and approving the system for smooth function, while keeping the system to private sector to manage it. The material and financial circulation of one-way PET bottles and aluminium cans and actors who are involved in the Swedish system is an important features that is highlighted in Figure 6-2. Returpack is a company established to set up the system for the collection and recycling of the aluminum cans. Sri Lanka may use important features and concepts within the local context to adopt such policy tool to manage the PET bottles.

In terms of social and environmental perspectives, deposit-refund system is reducing littering and other related issues like impact on aesthetic values, blocking the drainage lines, restrict habitat for vector-borne diseases etc. Since the health service is free of charge in Sri Lanka, it reduces the pressure on national budget. Increase of aesthetic values encourages the tourism industry. In addition, it reduces the volumes of MSW that reduces the burden on LAs. In this system stakeholder accountability and active participation are the key factors in compliance with the good governance principles.

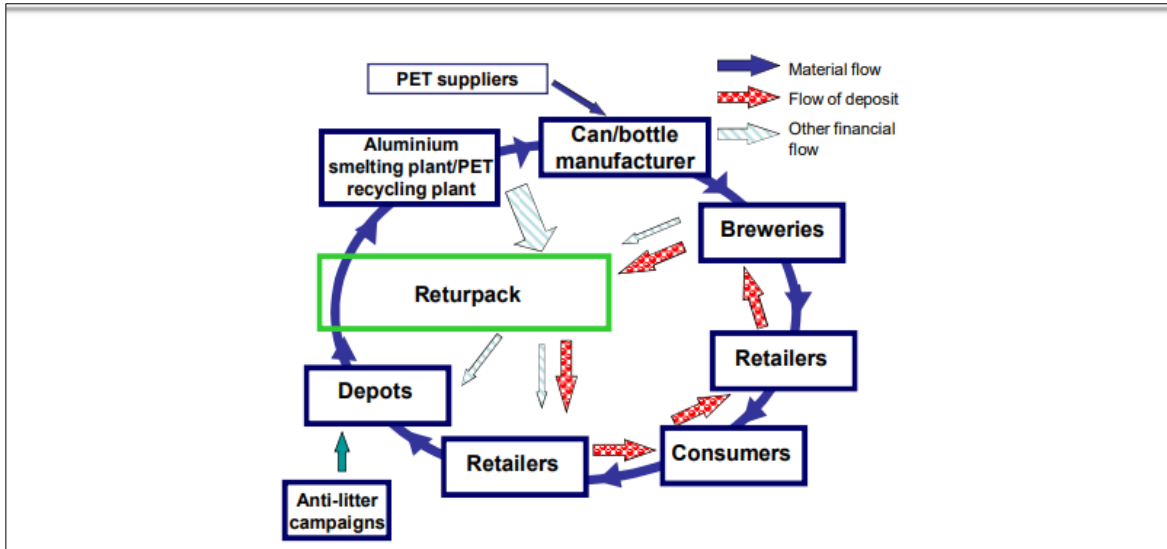


Figure 5-2 Deposit refund system for one-way aluminium cans and PET bottles in Sweden
 Source: (Tojo, 2011; Lindbqvist, 2009)

2. Legal system for Establishing a "Sound Material-Cycle Society"

According to the Basic Environment Act of Japan, it was established a legal system for a sound material-cycle society. The basic framework act was passed to ensure the material-cycle society in order to control the consumption of natural resources and minimize the waste. The other two important legislations are Waste disposal act and Effective resource utilization act along with the regulations in accordance with the characteristic properties of products. It is obvious that all these regulations will not be adopted in Sri Lanka. However, there are important features that could be adopted in Sri Lanka as a legislation to ensure the material-cycle society to strengthen the waste management system. This type of legislation is the key guide for relevant policy tools like deposit-refund system and 3R principles etc. When the waste management principles and practices are backborned with the legal instruments, significant level of results could be achieved in Sri Lanka. However, the legislation should not be incorporated into the existing laws to avoid disjointed incrementalism. With respect to the environmental and social aspects, it is obvious that due to increase of recycling, other social and environmental issues are decreased. Owing to the decrease of volumes of MSW, life cycle of dumping sites or landfill sites is increased and leads to utilization of valuable lands for other purposes. Because land is a valuable limited resource for Sri Lanka with the increase of population. In addition, with the increase of recycling industries, employment opportunities are generated for the society. Besides, it preserves the natural resources for the future generations of Sri Lanka with the increase of material recycling. Within this system all stakeholders are responsible and accountable for implementation. Public participation is a key factor in many stages of the system.

One of the key issues in Sri Lanka is changing the plans and activities with the changes in governing bodies of the country or head of the institution based on their interests. This situation causes inconvenience for the stakeholders who are engaging with the activities planned in addition to failures in resource utilization. In this context, establishment of a legal framework for the designed action plans for the waste management system in Sri Lanka may play a vital role for managing waste with a better resource utilization.

The stakeholder consultations and public hearing could be most important steps to get high involvement of public participation in decision making process, when preparing those action plans. The transparency, access to information and involvement of public in decision- making processes are some of the key factors of good governance to comply with the proposed theoretical framework.

3. Increase the thickness of plastic bags

In India, the minimum thickness of plastic carry bags was increased from 40 micron to 50 micron with the objective of increasing manufacturing cost and escalation of recycling. On the other hand, since the manufacturing cost is increased, the issuing of plastic bags free of charge by the retailers will not be practiced. Sri Lanka has also regulated the thickness value to reduce the consumption of plastic bags. Under the provisions of Section 23 W of the National Environmental Act, No. 47 of 1980, an extraordinary Gazette No. 2034/34 issued on Friday September 01, 2017 to prohibit the manufacture of polyethelene or any polyethylene product of twenty (20) microns or below in thickness for in country use; or the sale, offer for sale, offer free of charge, exhibition or use of polyethelene or any polyethylene product which is twenty (20) microns or below in thickness within the country. Although this thickness regulation is also regulated since 2007 in Sri Lanka, a significant reduction of consumption has not been achieved. The government needs to introduce respective policy tools after a comprehensive study of all aspects. The increase of the thickness of polyethylene may achieve fruitful results. The government of India recently adopted a regulation to increase the thickness of polyethylene bags from 40 to 50 microns in order to encourage recycling and reuse practices among the public. Sri Lanka may adopt such a policy to increase the recycling or reuse rates among the public. The effectiveness of the policy will be increased with the increase of thickness of polyethylene bags. However, it affects the production price as well as market price of polyethylene bags which leads to eliminate issue of polyethylene bags with free of charge by the super markets and groceries. In terms of social aspects, the policy tool is affected for the economy of general public. However, with the increase of recycling and reuse rates, the pressure on virgin material as well as natural resources is diminished.

Besides, sharing responsibility is highlighted in waste management principles in India. Accordingly, regulation has been adapted to vested responsibility to retailers and street vendors for their plastic bags. In view of this, retailers or street vendors shall not sell, or provide commodities to consumers in carry bags, or plastic sheet, or multilayered packaging, which are not manufactured and labelled or marked, as prescribed under these rules. In compliance with the theoretical framework on environmental governance, accountability and responsibility are important principles in addition to stakeholder engagement in every stage of waste management system and are valued points to streamline the process. In view of monitoring the policy tool, indicating the producer name is indeed for the effective implementation.

With a comprehensive study, incorporation of suitable tools into the existing legislation leads to increase the effectiveness of policy tools in compliance with the good governance principles that support plastic waste management in Sri Lanka.

6 Conclusion and Recommendations

Plastic is a key material and its applications are expected to increase as more new products and plastics are developed to meet demands. The increased use and production of plastic in developing and emerging countries is a particular concern, since the sophistication of infrastructure for waste management may not be developing at an appropriate rate to comply with the increasing levels of plastic waste. Legislative efforts and their effective implementation play a vital role in an environmentally sound waste management and disposal, which protect human health and the environment.

The principles of life cycle thinking and sustainable consumption and production are rooted deeply in the traditional lifestyles of citizens through the inspiration of Buddhism. However, those traditional values among the citizens have been diminishing with the modernization of the lifestyles. Solid waste became an issue in the late 1970s in Sri Lanka due to the large-scale socio-economic transformations in the country.

Sri Lanka has initiated a number of measures to control plastic waste: including formulation of Solid waste management policy, National environment policy, National cleaner production policy, Technical guideline for solid waste management, a number of laws under the National Environment Act and Local Government Act etc. However, as many other countries in the world, challenges for policy implementation are one of the issues for waste management in the country. With this scenario, littering, air pollution, water pollution, blockage of drainage lines, degradation of wildlife and land, and impact on aesthetic value are causes for concern in Sri Lanka.

Therefore, the government of Sri Lanka in September 2017 passed important legislation such as Prohibition of polyethylene in decorations, Prohibition of polyethylene food wrappers (lunch sheet), Prohibition of high density polyethylene bags (sili-sili bags), Prohibition of polyethylene products of twenty (20) microns or below and Prohibition of polystyrene products. Although legislation play a vital role in waste management, stakeholder commitment is another aspect to be considered. Awareness, education and capacity building programmes need to be established at the local level in order to streamline and make implementation of the system smooth. Attitudinal and behavioural changes among the public on waste prevention and 3R concept, in addition to, sophistication of infrastructure may achieve fruitful results. Since the literacy rate (91.9%) and education enrolment (99%) of the public in Sri Lanka is high, all type of media campaigns and awareness through school education would be important channels to changing attitudes of the public. Further, it is important to enhance public awareness of 3R issues by coordinated action through environmental education and dissemination of information on successful inter-stakeholder partnerships. These attempts raise the awareness of people on waste separation, prevention of waste generation, and reorganization of the waste management system in order to keep pace with the changing consumption patterns.

6.1 Recommendations

According to the literature review for the three research questions and the experience of policy-making process of the author, following recommendations have been made to incorporate those elements, when developing policies and strategies for sustainable plastic waste management.

Formulate a guideline/manual for plastic waste management

The plastic waste causes a significant impact to the environment and human health, government needs to develop a guideline or manual for plastic waste management that guides all stakeholders in managing plastic waste. The guideline may be more effective, if it is stipulated with legal provisions.

Formulate/introduce a policy tool for PET bottle management

There is no existing policy tool adopted for handling PET bottles, a comprehensive study needs to be conducted to adopt suitable and sustainable approach to tackle the issue while considering the experiences of other countries in the region. The EPR and deposit-refund system are useful policy tools that have been adopted by other countries in the region. These policy tools would be important for other materials as well, for instance, aluminium and glass. The deposit-refund system adopted by the Environmental Protection Administration of Taiwan is one of the successful approaches that can be adopted in Sri Lanka with some modifications. There are some loopholes in the Taiwanese system and Sri Lanka needs more attention to avoid those when formulating the system. Further, a deposit-refund system is exercised for some type of glass bottles in Sri Lanka. Therefore, a comprehensive study needs to be conducted to combine all those adhoc systems into one consortium in order to establish strong, effective and efficient management, as well as, implementation system. Since there are limited producers and more traders and consumers in the system in Sri Lanka, attention should be given to these aspects when designing the the policy tool. Further, appropriate method of registration of producers and traders is an important feature of success of a policy in order to avoid free riders in the system. The system can be strengthened by introducing labels on the PET bottles with electronically sensitive barcode.

Monitoring and evaluation of regulations

In view of managing plastic waste sustainably, Sri Lanka has recently passed important legislations pertinent to plastic waste. In order to achieve the objectives, a monitoring/auditing and evaluation team needs to be established with the members of key government agencies. The task of the team and responsibilities are defined with legal powers by the government. Since this task would be traumatic, members of the team may be changed once in six months. The review of the progress periodically is indeed essential for success of the implementation. The penalty for the violations are a key factor of managing the issue, in case the penalty fee is large enough. Therefore, the government needs to increase the penalty fee to decrease the violations with the effective monitoring system.

Promote no packaging policy among business society

In view of promoting voluntary initiations, there are several actions that can be adopted. For instance Godrej in India has adopted “no packaging policy” for refrigerators. According to the policy, the company ensures that the packaging, in which the appliance is delivered, is taken back by the supplier and reused. Sri Lanka may apply such analogous with necessary modification to encourage business groups to reduce volumes of packaging, while maintaining the requisite strength. Government may encourage business groups more, by providing incentives to such manufacturers.

Initiate sector-specific policies

Establishment of sectoral legislation is another way to address the issue. For instance some parts of Beijing City and public railway and bus stands prohibited to bring plastic bags. This type of regulation is applied in Sri Lanka in the national parks and some special areas. The expansion of those sector-specific regulations may support to manage plastic waste.

Policy for research and development

Policies for enhancing research and development of substitutes is important for the public to reach the alternatives. In India the responsibility has been vested to the Ministry of Science and Technology to support institutions or entrepreneurs to develop ecofriendly food packagings as an alternatives to the polystyrene food packages. In view of this, the Ministry of Science and Technology increased their funding in the field of technological investment. Sri Lank may need to adopt such a policy and identify a specific research and development institution. The adequate funds needs to channeled for conducting research on alternatives as early as possible as to obtain fruitful results from the regulations passed pertinent to the plastic waste reacently by the government.

Data gap filling

Compared to other developing countries in the region, Sri Lanka has poor collection of data in the sector. One of the major issues in waste management in Sri Lanka is the lack of data. The amount of waste generation by the sectors such as industrial, agriculture and construction sites, office premises, schools, hospitals and public places are limited. Further, the type of waste generation such as PET bottles, food packaging materials, other packaging materials are another important data that need to be collected in order to design suitable waste management system. The existing waste management system has several bottlenecks all over the system and increased financial resources are needed to overcome those challenges. Furthermore, scientific studies have to be conducted to adopt energy recovery technologies using different types of waste.

Reformulation of waste management system

Reformulation of waste management system with incorporation of new concepts and technology is indeed in the country that taking into account critics on the inefficiency of waste management system. For instance, there are two main areas to be more focused on the sustainable waste management system such as proper and effective monitoring mechanism of waste management and adequate financial support for upgrading the operation and infrastructure.

Implementation of Multinational Environmental Agreements

Effective implementation of commitments made under International Conventions such as Stockholm Convention on POPs and Basel Conventions at local level and continuous progress monitoring can ensure a higher commitment level of the country in beating plastic pollution.

Accountability of organization as well as stakeholders is the key of success of any sector in the system that leads long-term sustainability of a policy.

As indicated in chapter three, there is a tendency of diminishing trust in and decreasing legitimacy of the states in many places in the world. Therefore, it is important aspect that ensures trust and legitimacy and policy evaluation is frequently justified through the task in order to ensure that implementing organizations are accountable within the system. Accordingly, Table 6-1 illustrates the summary of a few proposed and selected policy tools evaluated based on the selected four criteria of environmental governance.

Table 6-1 Evaluation of selected policy tools

Policy tool	Criteria	Tranparency To what extent are the outputs and outcomes of the environmental policies, as well as the processes use in the implementation, observable for outsiders?	Effectiveness To what degree the outcomes will correspond to the intended goals of the policy?	Relevancy Do the goals of the instruments cover key problems of environmental policy	Participatory rights Who can participate in the processes through which the environmental policies are implemented?
Guideline /Manual for PWM		Publish the relevant materials using all media	Reduce PW by Preiodical progress reviewing	Yes	Increase the public participation in all stages of the policy
Policy tool for PET bottle management		Among the stakeholders	Progress reviwing / reduce littering /increase recycling	Yes	Stakeholders including government/public
No packaging policy		Producers and customers	Reduce waste, increase reuse	Yes	Stakeholders
Reseach and development policy for alternatives		All stakeholders	Altternatives and re-modification	Yes	Scientists, policy makers, implementators

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Appendix 1

Interview guide / Questionnaire for Policy Makers and Regulators

First of all I would like to briefly explain the purpose of this interview/questionnaire. Currently, I am following the Master of Science in Environmental Management and Policy programme at the International Institute for Industrial Environmental Economics (IIIEE) in Lund University, Sweden. The aim of this interview/questionnaire is to collect data and opinions of plastic waste management in Sri Lanka for my thesis in order to accomplish the requirements of the programme. I highly appreciate your valuable inputs.

Name: Sujewa T K K Fernando. Designation: Assistant Director/MMD&E

1. What is your impression on plastic waste in Sri Lanka? **Sri Lanka needs to strengthen plastic management and discourage n misuse of plastics.**
2. How do you define “plastic waste” in Sri Lanka? **Sri Lanka defines plastic and polythene as two categories though all are comes under plastic. Any unwanted plastic/ polythene item at a given times at a given place, which could be used as a resource or which cannot be used as a resource and requires sanitary disposal.**
3. What is the position of plastic industry in Sri Lanka? (import and export quantities, types of industries, employment opportunities within the sector etc.)
Imports – 500,000 Mt of plastic/ polythene – 70% used locally
Plastic Production Industries
Plastic Utencil Importation Industries.
Plastic Recycling Industries
4. What are the common methods of plastic waste disposal in the country?
 1. **Collected for recycling**
 2. **Dispose along with general waste**
 3. **Haphazard disposal in to the environment**
5. Do you know how much of plastic waste generated per day or per month by their sources?
 - a. Domestic
 - b. Industrial
 - c. Schools
 - d. Offices
 - e. Hospitals
 - f. Any other (please specify).....

All categories – per day 400 MT

6. Do you know the different types of plastic generated per day or per month

Type	Amount/day or month/weight or volume
Shopping bags	15 million per day
PET bottles	
Food wrapping (lunch sheets)	20 million per day
Yoghurt cups	
Other food packaging materials	
Industrial plastic waste	
Agro chemical packaging	
Other	

7. Do you think that enough studies on plastic waste have been conducted by academia and /or other agencies? If not what type of studies need to be done in the future?

1. Island wide survey on categories of plastic waste generated

I) Sector wise – Industries/ Hospitals etc.

II) Research on Micro plastics

III) Deficiencies in the plastic recycling industry

8. In terms of stakeholders of plastic waste management, on a scale of 1 to 10, 1 being highly responsible and 10 being less responsible, how would you rate their responsibility in managing plastic waste as per your experience?

Most of them are equally important therefore I have given an equal weightage

Policy makers	1
Regulators	2
Municipality/Local authority	2
Consumers	2
Collectors	3
Producers	2
Recyclers	3
Importers	3
Academia	3
NGOs	4

9. What are the Policies and Policy tools that have being adopted in Sri Lanka for plastic waste management?

- Plastic waste is covered under the National Policy on Waste Management and will be covered in sectoral policies that are being developed.
- Regulations : High Density Poly Ethylene (HDPE) shopping bags, carry bags and lunch sheets are banned.
- Extended Polystyrene lunch boxes and utensils are banned.
- Use of Polythene for decorations in festivals banned
- Burning of plastics & polythene in public places are banned.
- Bio degradable polythene introduced and available.
- Incentives / Tax concessions are provided for importers of bio degradable products.

10. Based on your experience among the policy tools, what is/are the effective tools for plastic waste management?

Policies to regulate plastic importation.

11. If not, what are the reasons for failures of some policy tools? **Changes in government policies**

12. Other than the policy tools, what are the other factors that make limitations for plastic waste management?

Attitudes of people

13. How do you feel on the existing infrastructure for plastic collection and recycling across the country?

Collection mechanism needs strengthening.

14. Rank the following factors that most influence for plastic waste management in the country (1 being the most important and 7 being the least important)

(Most of them are equally important)

Regulations for import	3
Regulations for manufacture	3
Regulations for use	3
Regulations for disposal	3
Consumer behavior	1
Public awareness	2

Infrastructure facilities for collection and disposal	1
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If you feel any other factors that are influenced, please specify.....

15. The market based instrument; EPR and PPP are success tools that are applied in many countries in South and East Asia. Why such tools are not applied in Sri Lanka? What are the barriers?

EPR – For several years a great effort is being carried out to implement EPR, but private sector is reluctant to get in to EPR.

Therefore at present Cabinet approval has been obtained for EPR , included in the Environment Act, regulations are being formulated to implement EPR.

What is your opinion on deposit refund system for PET bottles in Sri Lanka?

Private Sector is very much reluctant, the leading manufacturers who are practicing this in other countries are reluctant to practice this in Sri Lanka. (Government has tried very hard)

16. Many countries control the use of plastic bags by charging them at the supermarkets and any other shops which leads to reuse and avoid unnecessary packaging. Are there any possibility of introducing such a charging system for plastic bags or do you have any other opinion to control plastic bags?

We had a system, but now due to a court case on consumer rights, there is a court decision to give bags free of charge. We are trying to rivert that now.

17. Under the National Environment Act no. 47 of 1980, a gazette notification has been issued to ban manufacture, sale or use of polythene or any polythene product of twenty (20) microns or below in thickness in the country on 10th October 2006. Is this regulation caused any impact to control polythene bags or products in the country? **yes**

If not, what are the reasons for that?

18. Based on your experience and understanding, what are the main barriers for plastic waste management in Sri Lanka?

Weakness in collection mechanism

Haphazard disposal of plastic waste

19. What type of policy measures that you recommend for plastic waste management in Sri Lanka?

Policies to reduce imports of plastics and encouraging manufacturing environmental friendly packaging material instead of plastics.

20. Is there something you want to add? Something that I missed in asking about the things that you would value in plastic waste management in Sri Lanka?

Micro plastics in soil, animals, food and water

Thank you very much for the valuable inputs that you have shared with me.