# Thesis

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# Problems of Plastic Waste Management in Laos

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# 1. INTRODUCTION

The environment is essential to our daily life as it provides the natural resources and services necessary for our survival and well-being. Our environment provides us with clean air, water, and food, which are essential for our health and survival. It also provides us with materials such as wood, minerals, and fossil fuels, which are used in the production of goods and services that we use daily.

Environmental degradation, including water, air, and land pollution has resulted from increased industrial activities over the years but was not taken into account. Most economic activity has a value proposition that disregards the degradation because it was not considered alongside the planned industrial growth. Businesses that cause environmental harm rarely face consequences for their actions. They put the burden of these expenses on the rest of society. Natural disasters, such as global warming, flooding, and extreme weather conditions, have damaged many ecosystems to the point where they can no longer withstand or recover from them.

One of the environmental problems that we are facing now is plastic waste pollution. Because of economic and population growth, it has been increased demand for plastic usage. Plastic waste can harm marine animals, which can mistake plastic for food or become entangled in plastic debris. In addition, plastic waste can release toxic chemicals into the environment, which can cause harm to both humans and wildlife.

Laos is now facing a high volume of waste. Plastics are a large and increasing component in waste streams, particularly those used in packaging. Many plastic items are single-use, products such as bottles, food packaging, and carrier bags, which are designed for a short life span. Currently, Laos does not have comprehensive policies around sustainable production and waste management, has limited public awareness over issues with inappropriate use and waste disposal, and lacks the services and infrastructure to collect, sort, and safely process post-consumer wastes. Consequently, a large amount of waste plastic is inappropriately disposed of, mismanaged, or leaked out of supply chains, resulting in environmental, social, and economic impacts.

The reasons that are mentioned above motivate this thesis study by focusing on the challenges of waste plastic management that Lao governments confronted. This study is beneficial to the Lao environment, society as well as the world environment. Moreover, this

thesis also investigates good policy and the possible way to solve the problem that we're facing to reach sociality to succeed in a sustainable development plan.

## 1.2 Research Questions

The following research questions guided this paper:

- What is the main problem of plastic management in Laos?
- How Laos's government administered the waste of plastic?
- What is the possible way to eliminate waste plastic in Laos effectively?

## 1.3 Research objective

- To study the government policies of waste management at the national level to find the real problem of administration.
- To study and find effective policies from another country.

## 1.4 framework objective

- This thesis focuses on the general problem of waste plastic management at the national level.

## 1.5 Expect outcomes

- Acknowledging the real factors of the problem of waste management at the national level in Laos.
- The Laos government is able to consider creating policies.

## 1.6 Research Hypothesis

- The main problem of waste management in Laos is the lack of funds and knowledge for effective management.
- The Laos government has to add a budget for waste management and cooperate with countries that have previous management experience.

# 2. LITERATURE REVIEW

## 2.1. Overview of Some major environmental problems

Environmental problems refer to issues that arise from the interaction between human activities and the natural world, which result in adverse effects on the environment. These problems can range from local issues such as air pollution to global issues such as climate change. Environmental problems have become a major concern for society, as they can have significant impacts on human health, biodiversity, and ecosystems (Riley & Rik 1991). In this response, I will provide an overview of five major environmental problems that are currently affecting the planet.

One major environmental problem is climate change, which is caused by the buildup of greenhouse gases in the atmosphere, primarily carbon dioxide from burning fossil fuels. Climate change is causing sea levels to rise, temperatures to increase, and weather patterns to become more extreme, which can lead to food and water shortages, displacement of populations, and economic instability. According to the Intergovernmental Panel on Climate Change (IPCC), human activities are estimated to have caused approximately 1.1°C of global warming above pre-industrial levels, and further warming is expected to continue if emissions are not reduced (IPCC 2021).

Another significant environmental problem is deforestation, which is the clearing of forests for agriculture, logging, and other uses. Deforestation can result in soil erosion, loss of biodiversity, and increased greenhouse gas emissions, as trees store carbon dioxide. According to the World Wildlife Fund (WWF), an estimated 17% of the Amazon rainforest has been lost in the past 50 years (WWF 2021).

Water pollution is another major environmental problem, which is caused by the discharge of pollutants into waterways from sources such as industrial activity and agriculture. Water pollution can lead to health problems in humans and wildlife, as well as ecosystem degradation. According to the United Nations (UN), around 80% of wastewater is discharged untreated into waterways, which can lead to serious health and environmental impacts (UN 2021).

Air pollution is also a significant environmental problem, which is caused by the release of pollutants into the atmosphere from sources such as transportation and industry. Air pollution can lead to respiratory problems in humans and wildlife, as well as ecosystem degradation. According to the World Health Organization (WHO), outdoor air pollution is responsible for an estimated 4.2 million premature deaths each year (WHO 2021).

Finally, plastic pollution is a growing environmental problem, which is caused by the accumulation of plastic waste in the environment, particularly in oceans and waterways. Plastic pollution can lead to harm to wildlife and marine ecosystems, as well as human health impacts. According to a report by the United Nations Environment Programme (UNEP), approximately 8 million tons of plastic waste enter the oceans each year (UNEP 2021).

## 2.2. Waste problem in general

Waste management is an essential aspect of modern society, as the amount of waste generated continues to increase with population growth and urbanization. The issue of waste management is multifaceted, encompassing environmental, economic, and social concerns. The improper disposal of waste can have significant negative impacts on the environment, including pollution of land, air, and water resources, as well as negative impacts on human health and well-being.

The global waste problem is substantial and growing, with approximately 2.01 billion metric tons of municipal solid waste generated annually worldwide (Hoornweg & Bhada-Tata, 2012). This is projected to increase by over 70% by 2050, with the majority of this increase occurring in low- and middle-income countries (The World Bank, 2018). Improper waste management practices in many developing countries, including open dumping and burning of waste, are a significant contributor to environmental degradation and pollution, as well as health problems such as respiratory disease and cancer (Kaza et al. 2018).

In addition to environmental and health impacts, the waste problem also has significant economic consequences. The cost of managing waste, including collection, transport, treatment, and disposal, is substantial, with estimates suggesting that the global cost of solid waste management could reach $375 billion by 2025 (The World Bank, 2018). However, the

economic impacts of waste are not limited to the costs of waste management. Waste can also represent a significant loss of resources, particularly in the form of materials that could be recycled or recovered. The value of these lost resources is estimated to be around $55 billion per year (The World Bank 2018).

Addressing the waste problem requires a comprehensive and integrated approach that incorporates both waste reduction and management strategies. This approach includes a range of actions, such as improving waste collection and disposal systems, promoting recycling and waste reduction behaviors, and implementing policies and regulations to incentivize sustainable waste management practices (Cointreau 2006).

## 2.3. Global growth in the use of plastic

Plastics are one of the most universally used materials across the world, with applications in a wide range of sectors from packaging, transportation, construction, electronics, textiles, consumer products, and healthcare. The functionality, versatility, and cost-effectiveness of plastics have helped inspire innovations and the development of products and solutions that could not exist without them. As shown in Figure 1, following initial mass production in the mid-twentieth century, global plastics use has increased twenty-fold in the past fifty years and their use is expected to double again in the next twenty years (EMF 2016). The average annual growth rate is 5%, with 335 million tonnes of plastics being produced globally in 2016 (Plastics Europe 2017).

The main primary producers of plastics are China and North America, as shown in Figure 2, with production dominated by a small number of multinational corporations. In 2017, the global market had a value of USD 318 billion and is predicted to grow to USD 400 billion by 2022. The largest market is packaging, representing approximately 25% of the total volume, at 87 million tonnes(Plastics Europe 2017).

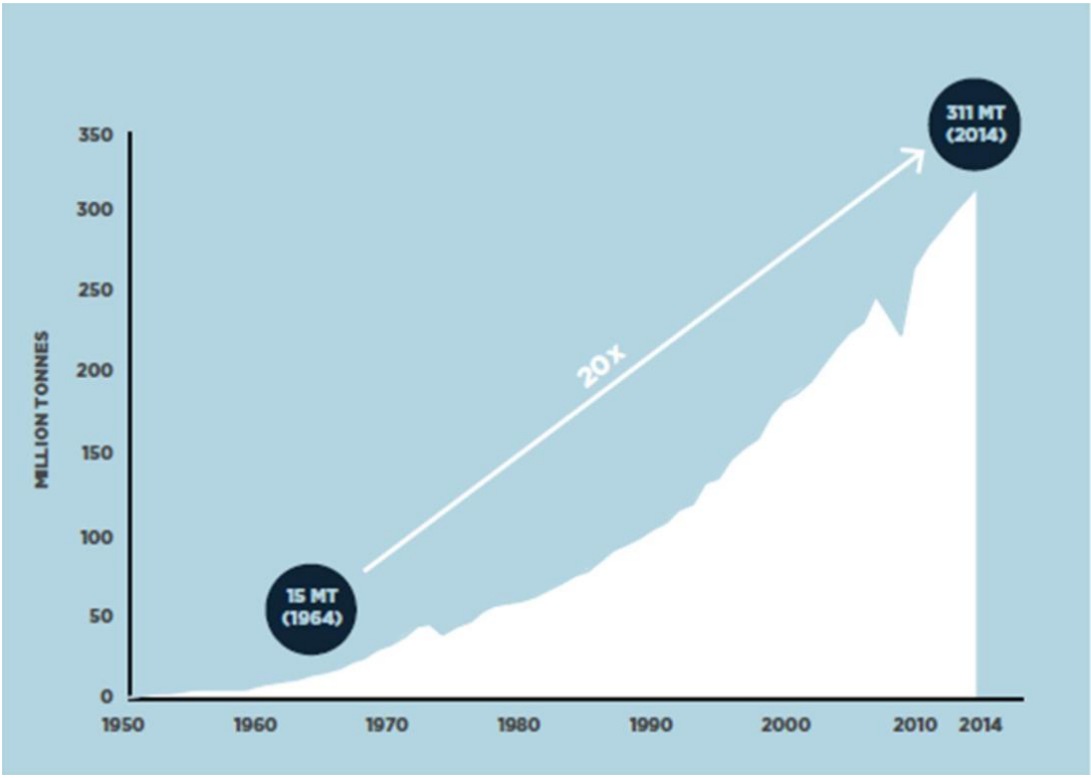


Figure 1. Global plastic growth [Source: EMF 2016]

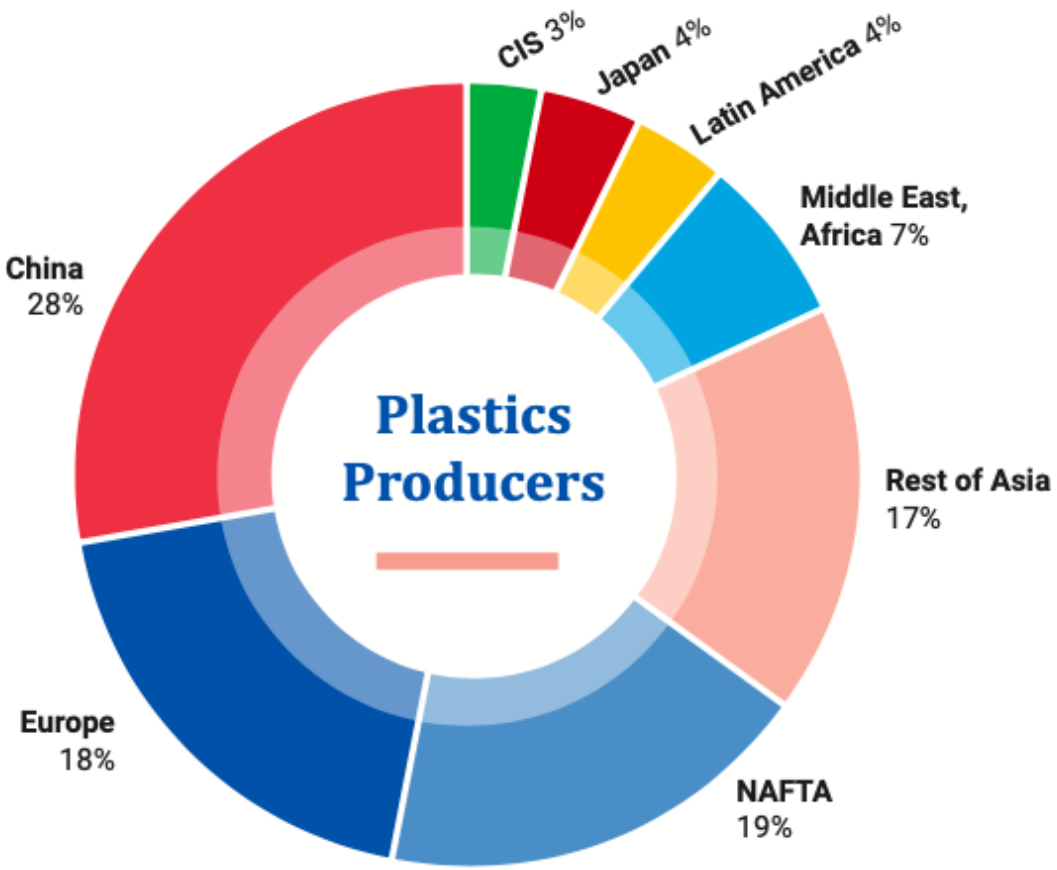


Figure 2. Plastics producers [Source: EMF 2016]

This growth in plastics has been due to their properties and because they are typically easy to manufacture and have low production costs. In terms of physical properties, plastics are valued for their high strength to weight ratio, versatility, and resistance to chemical, biological, and physical degradation. These properties and the wide functionality of polymers have led to plastics being increasingly used as a substitute for materials such as concrete, glass, metals, wood, and paper (Plastics Europe 2017).

## 2.4. Types of plastic

Most plastics are polymers of small organic molecules, synthesized from crude oil and natural gas. The main category of plastics is thermoplastics, which melt when heated and solidify when they cool. This means that thermoplastics can be re-melted and recycled. (Plastics Europe 2017). There are thousands of types of different plastics, each with its own composition and unique properties, although they are typically broken down into seven broad categories, as displayed in Table 1.

Table 1. Broad categories of plastics [Source: Long 2018]

| Name & Recycling Number | Uses | Packaging Properties |
|---|---|---|
| **Polyethylene terephthalate (PET)** 1 | Soft drink & water bottles; food packaging; clothing | Lightweight, hard & strong; transparent and can be coloured; good gas barrier; widely recycled plastic |
| **High-density polyethylene (HDPE)** 2 | Short shelf-life products (milk bottles); bottle caps; grocery bags; shampoo bottles; pipes | Very versatile, can be rigid & semi-flexible; highly permeable to gas; widely recycled plastic |
| **Polyvinyl chloride (PVC)** 3 | Non-food bottles; drainage pipe; doors; window frames; roofing; food wrap; clothing | Can be rigid & flexible; good clarity; durable; inherent fire retardant; waterproof properties; limited recycling due to additives |
| **Low-density polyethylene (LDPE)** 4 | Shopping & food bags; sauce bottles; food wrap; personal product bottles; toys | Can be rigid & highly squeezable; flexible & tough; highly permeable to gas; challenges with handling & contamination limit recycling |
| **Polypropylene (PP)** 5 | Food containers; bottle tops; shopping bags; furniture; plant pots; thermal clothing | Can be rigid or flexible; translucent; high resistance to fatiguel good on moving parts; permeable to gas; limited systems for recycling |
| **Polystyrene (PS)** 6 | Fast food trays; disposable cutlery; vending cups; drinking straws; foam; insulation | Can be rigid or foamed; flexible; very lightweight; high clarity; brittle; poor barrier to gases / moisture; limited recycling |
| **Other (O)** 7 | Range of uses, including Nylon, Acrylonitrile & Butadiene Styrene | Various properties; limited recycling as hard to identify |

### *2.4.1. Single used plastic*

Many plastic items are only used once before being disposed of, and often only after a very short period of use by the end consumer. The single-use nature of such plastics can be by design or simply through their actual use. Some products, such as those used in the medical industry (syringes, bandages, wraps, and some face masks), are designed to be disposable after a one-time use in order to prevent the spread of infection. Other single-use products, such as those

used in some packaging and food and beverage service ware, prioritize convenience over durability and represent a throwaway culture (Long 2018).

Food and beverage service ware includes items such as drinking straws and stirrers; disposable cups, plates, and cutlery; and meat and vegetable trays and containers. These products facilitate food and beverage consumption, as well as help extend the lifespan of foods and reduce the risk of contamination (Long 2018).

Plastic packaging is used in a wide range of food, beverage, and non-food products. Packaging may be in the form of a rigid-plastic container or a soft-plastic bag or wrap, which holds, protects, preserves, and facilitates the transport, handling, and use of a product. Packaging is often an integral part of the way a product is served, offering brands a way of presenting and marketing a product and influencing purchasing decisions. Global plastic packaging volumes have experienced strong growth in recent decades, representing approximately 25% of the total share of all packaging volumes (EMF 2016).

The widespread use of plastics has undoubtedly provided many benefits to society, Plastic packaging is used to protect food products from contamination, moisture, and other external factors that can compromise their quality and safety. It can help prolong food's shelf life and reduce food waste. Plastic packaging is popular for on-the-go food items such as snacks, beverages, and ready-to-eat meals because it is lightweight, durable, and simple to manipulate. Plastic packaging is often less expensive than other packaging materials such as glass or metal, which can help to save money on food products. However, the poor management of plastics, particularly with regard to end-of-life disposal and processing, has led to many economic, social, and environmental externalities and leakage of material out of systems. Since the 1950s, 8.3 billion tonnes of plastic have been produced globally and the majority (79%) has gone to landfill or been discarded into the environment (Geyer et al. 2017). The entire plastics industry currently utilizes 6% of the world's crude oil, and this is expected to increase to 20% by 2050. In 2012, plastics production alone resulted in a greenhouse gas footprint of 390 million tonnes of carbon dioxide equivalents (EMF 2016).

### *2.4.2. Post-Consumer plastic*

After consumer use, plastics are either discarded along with other wastes, or they are separated for recycling. Waste plastics will generally be either sent to a landfill, dumped, or

incinerated (waste to energy). Of the 8,300 million metric tonnes of plastic made throughout the world since 1950, 6,400 million tonnes have become waste: 79% is sitting in landfills or the environment, 12% has been incinerated and 9% has been recycled (Geyer et al. 2017). It is estimated that 95% of the world's plastic packaging-material value is lost every year after a short first use, representing a loss to global economies of USD 80 – 120 billion (EMF 2016).

## 2.5. Waste management method

- *Landfills*

Many plastics end up in landfills or uncontrolled dumping sites. Globally, the proportion of plastics in landfills has grown from 1% in 1960 to over 10% in 2005 (Jambeck et al. 2015). If current trends continue there will be 12 billion tonnes of plastic in landfills by 2050. Plastics being disposed of in this way represent leakage of material out of the economy and lost opportunities since many plastics are recyclable. Landfills require significant resources and costs for construction and management. Consequently, it is essential for societies to minimize the disposal of material that could still be utilized. Plastics are sometimes indiscriminately dumped and littered, often ending up in natural environments, including waterbodies and oceans (Parker 2017).

Plastics show minimal biological degradation. Some polymers may take periods of tens or hundreds of years to degrade, but their actual longevity in the natural environment remains only an educated guess (Moore 2008). However, it is clear that due to their persistent nature, this means that they can accumulate and impact ecosystems, wildlife, and human health (Barnes 2009).

- *Incineration*

Plastic is also incinerated in waste-to-energy plants, or through the combustion of refuse-derived fuel in industrial processes such as cement kilns, pyrolysis, or gasification. This approach reduces the need to separate wastes, eliminates the costs associated with landfill, and allows for the recovery of energy. However, the process still leads to a loss of material out of economies and accrues further losses in the embedded effort, resources, and labor that went into creating the material. Waste to energy releases carbon emits greenhouse gases and may

result in localized air pollution if appropriate controls are not in place. There are also concerns that due to the high investment costs of waste-to-energy infrastructure, such facilities can create a 'lock-in' effect, pushing higher-value options such as recycling out of the market (EMF 2016).

- *Recycling*

The main category of plastics is thermoplastics. These polymers melt when heated and solidify when cool, which means that plastics can be re-melted and recycled. Global recycling rates have grown since 1980 when there was negligible recycling (Geyer et al. 2017). Overall recycling rates are believed to have increased in recent years. However, there is a significant disparity across countries and regions, since the ability to recycle will depend on the types of plastics, the presence of local collection services, and access to markets for post-consumer material for recyclers (Geyer 2017).

## 2.6. About Laos - the situation of the economy and plastic pollution

Laos is a landlocked country in Southeast Asia with a population of approximately 7.5 million people. The economy of Laos is primarily based on agriculture, rice is the most significant crop, other agricultural products include corn, sugarcane, and coffee. In recent years, the manufacturing and production sectors have been growing, especially in the clothing and textile industries. The country is also full of natural resources, such as copper, gold, and tin, which are minerals (The Laotian Times 2021).

Laos's primary trading partners are its regional neighbors. It exports primarily copper, gold, and other minerals, as well as coffee, wood products, and clothing. The country's primary imports include machinery, fuel, and vehicles. In terms of consumption, Laos has experienced growth in its middle class and consumerism, particularly in urban areas. This has led to an increase in demand for goods and services, including plastic products (The Laotian Times 2021).

Laos, like many other nations, has a significant plastic waste problem. The rise in consumption and demand for plastic products has resulted in an increase in plastic waste,

especially in urban areas. Laos also lacks proper waste management methods and infrastructure, leading to the plastic waste problem (The Laotian Times 2021).

### *2.6.1. Manufacturing in Lao*

A total of 77 companies that are involved in the manufacturing or recycling of plastic goods are registered with the Ministry of Commerce and Industry. It is not clear exactly what type of goods are manufactured by these companies. In a World Bank project conducted in parallel with the current study, some of these companies were interviewed, identifying that 17 out of the 77 companies are manufacturers of drinking bottles, carrier bags, other bags and sacks, furniture, baskets, rope, and cups. These 17 companies have an annual production capacity of approximately 51,000 tonnes(World Bank 2020a).

### *2.6.2. Imports and Exports*

As a landlocked country with limited processed food production and manufacturing, Laos is dependent on imports to satisfy many of its needs. Laos also exports a range of goods, with agricultural products and natural resources accounting for the bulk of the country's exports. Laos' main exports are wood, clothing, coffee, electricity (from hydropower), metals, corn, and rubber. Over recent years, Laos has improved its balance of trade, with a trade deficit of 0.11 billion dollars in 2019. Laos' main trading partners are Thailand and China, as shown in Table 2. A large volume of goods from other parts of the world also enters Laos via Thailand. Laos is a member of the Asia-Pacific Trade Agreement (APTA), the Association of Southeast Asian Nations (ASEAN), and the World Trade Organization (WTO) (Plecher 2020).

Table 2. Laos Top Trading Partners [Source: Trend Economy 2019].

| Imports | | | Exports | | |
|---|---|---|---|---|---|
| **Country** | **Value (USD)** | **Share** | **Country** | **Value (USD)** | **Share** |
| Thailand | 2.91 billion | 50% | Thailand | 2.4 billion | 41% |
| China | 1.68 billion | 28% | China | 1.67 billion | 28% |
| Vietnam | 451 million | 8% | Vietnam | 1.05 billion | 18% |
| Japan | 118 million | 2% | Japan | 93 million | 1.6% |

### *2.6.3. Plastic pollution*

In 2020, the World Bank undertook a study in six cities in Laos as shown in Figure 3. The study found the most commonly found plastic items that are littered, by surveying hotspots across six cities in Lao. This study identified that 95% percent of plastic pollution is caused by only 10 items — all single-use plastics. Single-use food and drink packaging is the top plastic product category, accounting for nearly half of this pollution — the hospitality and tourism sectors have been identified as key contributors.
(World Bank 2020a):


Figure 3. Cities of assessment [World Bank 2020].

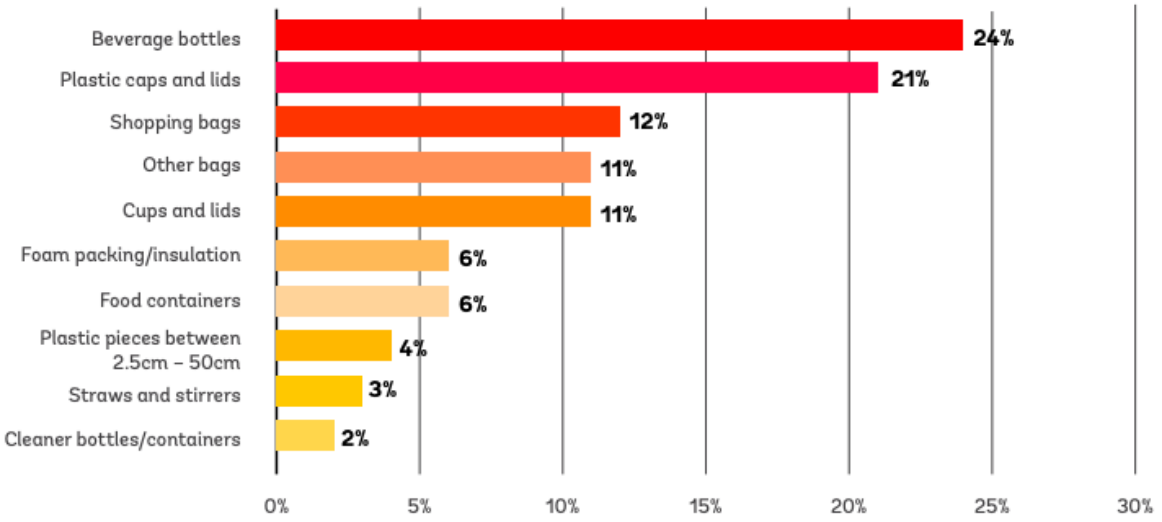


Figure 4. Top plastic item found in Laos [World Bank 2020].

The Top 10 items are all single-use plastics and were responsible for 95% of plastic pollution in the surveyed locations. Plastic bottles and their caps and lids accounted for the most plastic leakage in the Lao (45 percent of plastic waste). Plastic bags were the next most common type of waste (23 percent), and cups and lids followed next (11 percent).

The study also shows that the main contributors to plastic are:

1. Restaurants, bars, and cafés—Over 50 percent of hotspots were near these outlets. (see in table 3)
2. Tourists—Vang Vieng and Luang Prabang had much higher numbers of hotspots per 100,000 inhabitants than the other cities. This may be due to the higher numbers of tourists who visit these cities.

Table 3. Numbers and types of plastic [World Bank 2020].

| Area type of plastic pollution hotspot | Nr of hotspots (informal dumpsites) |
|---|---|
| Restaurants, bars, and cafés | 304 |
| Hostels, hotels, and similar | 143 |
| Markets, shops, and offices | 19 |
| Religious and tourist venues such as temple and monuments | 73 |
| Nature, parks, caves, and other recreation sites | 34 |
| Hospital, schools, universities, and bus stations | 16 |
| Industry such as factories and fish farms | 8 |
| **Total** | **597** |

As Laos does not yet have a specific regulatory framework on waste management, or clearly defined responsibilities, much of this rubbish is not disposed of properly. Waste management is largely limited to urban centers, and even there only 40-60% of waste is collected — and then taken to landfill sites that are mostly poorly managed. Uncollected waste is burned or openly dumped, often into waterways (World Bank 2021). In Vientiane, the waste generated per capita in 2019 has been estimated at 0.842 kilograms per person per day (kg/capita/day), having increased at a rate of 2.5% per year since 2011 (GGGI 2020).

- *Landfill Disposal*

Waste collection services are limited throughout Lao. This is due to the lack of existing collection services and the limitations of people being able to afford to pay for these services, which are not subsidized by the government. Collection services are predominantly only found in some urban areas, although urbanization is rapidly increasing and whilst the coverage of these services in these areas is currently limited it is increasing. Rates charged to householders for waste collection are typically in the region of 30,000 Laos Kip per month (just under USD 4) (GGGI 2020).

The Urban Development and Administrative Agency (UDAA) of each city is responsible for the collection and disposal of waste, although they may contract the services to designated private waste companies. Every province has at least one waste collection company, but the area of coverage varies considerably. The vehicle fleet for most collection services is old with limited functionality, such as the ability to collect different types of wastes and

recyclables. Insufficient vehicles and equipment are often an issue when short-term contracts are given to private companies since there is little incentive for investment (GGGI 2020).

The Vientiane City Office for Management and Service (VCOMS) is the relevant agency for overseeing waste management in the capital city, with collection services provided by ten private companies and two public agencies (including VCOMS). These services cover approximately 78% of the capital area, with an estimated 37% of households in these service areas using the service, which amounts to only a quarter of all the city's households (GGGI 2020). However, neighbors will often share one contract to reduce costs, so the actual number of households reached is likely to be higher than 37%(GGGI 2020).
There are a limited number of controlled landfills within Lao PDR, with only the capital Vientiane and the four secondary towns of Luang Prabang, Thakhek, Savannakhet, and Pakse using them for solid waste disposal. These sites may also have incinerators for disposing of medical and other hazardous wastes (GGGI 2020).

Other towns and rural areas have unmanaged dumps, which are often poorly sited and in the vicinity of watercourses and sensitive adjacent land uses. On the whole, landfills and dumpsites in Laos have limited environmental designs, controls, and management. Costs for dumping at landfills are either non-existent or low, particularly if management responsibilities are outsourced to private companies without enforcement capacity. At Vientiane's landfill, 32 kilometers from the city, the cost of dumping is just 40,000 kip per ton (just over USD 4). The low fees at Laos' landfills make the sustainability of operations unworkable, due to insufficient revenue to cover costs (Lao PDR Government 2018).

Figure 5. Waste being Dumped at Vientiane Landfill [Bengtsson 2020, photo by Magnus Bengtsson].

- *Collection for Recycling*

There are extremely limited collection services available for recyclable plastic materials in Lao. There are no formal, government-organized sorting and recycling systems. Some private companies have become established, such as Wongpanit, but these companies typically provide a limited number of drop-off points rather than formal collection services from homes and businesses (Lao PDR Government 2018). The majority of collections are made by the informal sector, through the following categories of workers:

- Street Material Pickers: People who pick up recyclable material from the open environment or sort through bins/bags that have been put out for waste collection.
- Waste Collectors: People who work on municipal waste collections or at transfer stations and are paid by private sector companies or public agencies. Whilst the collection of recyclable materials is not formally their job, these people may opportunistically sift through the mixed waste and pull- out recyclables in order to earn some additional personal income. In this capacity, these people are considered informal workers.

- Recyclable collectors: Self-employed people who use pushcarts or other small motorized vehicles to buy recyclables from households and businesses.
- Landfill Pickers: People who scavenge through waste piles at landfills, pulling out recyclable material, which is usually extremely contaminated.

The main recyclable materials that are collected in Lao are clear PET plastic bottles, aluminium cans, food ferrous (steel) cans, glass, paper, cardboard, and some plastic bags. Material that is collected will either be sold directly to recyclers in Laos or to buying centers/ junk shops/ resource recovery centers. These informal collectors are subject to a daily rate, set by market prices for recyclable material. Therefore, they are exposed to sharp fluctuations in prices, and depending on wider market conditions and demand from recyclers, at times certain materials will not be purchased at all. This makes it an extremely vulnerable livelihood (Lao PDR Government 2018).

The companies that purchase materials may perform some initial processing of the recyclable materials, such as the removal of labels and tops on drinking-water bottles, the washing of materials, color sorting, shredding, compacting, and baling, as shown in Figure 9. Despite some activity, it is observed that there is limited value-added creation by Laos-based processors along the recyclables value chain. Recovered materials are ultimately sold and processed in recycling facilities located in neighboring countries, such as Vietnam and Thailand, although domestic recyclers have increased in recent years (Lao PDR Government 2018).

- *Other disposal routes*

Plastic that is not sent to landfill or recycled will typically either be burnt outside people's homes and businesses, buried, or dumped into surrounding urban and rural environments. A World Bank study surveyed over 1,900 Lao citizens to learn about the habits and beliefs surrounding open waste burning. As it is how in Figure 7, One in three people did not have a waste collection service. While 53 percent of those that do not have this service report burning compared to 22 percent that have it. When they were asked why they did not have the service, the top reason was lack of availability. 1 in 4 respondents mention lack of awareness, high costs,


Figure 6. The percentage of people who burn and do not burn waste [World Bank 2020].

In addition, 70 percent of those who burn, do it in their backyard, highlighting the private modality of this behavior. When asked for their reasons to burn waste: 32 percent of those who burn responded that they did it to keep a clean house; 22 percent did not know other alternatives; 14 percent did it because people around them do it; and 13 percent did it because of a lack of access to collection service. The rest (18 percent) chose other reasons.

### *2.6.4. Environmental impacts*

Open burning of waste contributes to localized and regional air pollution problems (Kjellen, 2001). The burning of plastics present in municipal solid waste can lead to the release of toxic substances including Dioxins, Furans, Mercury, and Polychlorinated Biphenyls (Verma 2015).

When rain falls on landfills and dumpsites the water that passes through the waste can become contaminated with metals, oils, and organic compounds. This leachate can lead to the pollution of groundwater, and surface-water contamination of rivers, wetlands, and agricultural areas, particularly during the rainy season. Conversely, in the dry season dumped waste has the potential to cause fires, leading to habitat loss and danger to surrounding towns and villages (McFarlane 1983).

The accumulation of macro and microplastics in terrestrial and aquatic environments is of concern because of their persistence and threat to ecosystems and wildlife. Plastics can lead to

the entanglement, ingestion, choking, and starving of wildlife (Barnes, 2009). Microplastics have become a particular emerging environmental and health issue, due to their ability to bioaccumulate through the food chain, potentially resulting in detrimental ecotoxicological implications for the health of aquatic organisms and humans (Wang 2019).

## 2.7. Current Policies and Approaches in Laos

### *2.7.1. Responsibilities*

The Ministry of Public Works and Transport (MPWT) and the Ministry of Natural Resources and Environment (MoNRE) have the main responsibility for policy around municipal solid waste management. The Department of Housing and Urban Planning (DHUP) of the MPWT, has overall responsibility for urban planning and development. MoNRE's responsibilities for environmental issues associated with solid waste management include pollution control. MoNRE is responsible for coordinating and conducting research, formulation of plans on management and use of natural resources, and to perform a coordination role in the protection of the environment in collaboration with sector agencies and local administrations. The legislative basis for waste management in each city and area is by provincial decree, which allocates the scope of work and sets any fees. The Urban Development and Administrative Agency (UDAA) of each city is responsible for the collection and disposal of waste. Other Government agencies and departments that have some responsibility for guidance on waste legislation include the Ministry of Public Health (Department of Hygiene and Diseases Prevention); the Ministry of Industry and Commerce (Department of Industry); the Ministry of Agriculture and Forestry (Department of Agriculture); and the Ministry of Energy and Mines (Department of Mines) (Lao PDR Government 2018).

### *2.7.2. National green growth of Laos*

The National Green Growth Strategy 2030 of Laos is a comprehensive plan that aims to promote sustainable development in the country while mitigating the impacts of climate change and reducing plastic pollution. The strategy has identified several key areas of focus, including the reduction of plastic waste and pollution. To achieve its goals, the strategy proposes several initiatives, including the implementation of a plastic bag tax, the promotion of alternative packaging materials, and the development of a waste management infrastructure. The

government is also working to raise awareness among businesses and the public about the importance of reducing plastic waste and adopting sustainable practices (NGGS 2019).

The strategy also emphasizes the need to improve the collection and recycling of plastic waste. The government has established a target of increasing the collection and recycling of plastic waste to 70% by 2030, up from the current rate of around 10%. This will involve the development of new recycling facilities and the promotion of community-based recycling programs (NGGS 2019).

### *2.7.3. Relevant legislation*

Table 4 shows the current legislation relevant to the sustainable consumption and production of single-use plastics.

Table 4. Legislation Related to Waste Management and Recycling in Laos [Lao PDR Government 2018].

| Legislation | Key Relevant Details |
|---|---|
| *National Constitution, 1991* | Article 17 states that all Lao citizens must protect the environment and natural resources. |
| *Environmental Protection Law, 2012* | Specifies necessary principles, regulations and measures for managing, monitoring, restoring and protecting the environment in order to protect human health, including the protection of natural resources and the richness of nature, and to ensure the sustainable socio-economic development of the nation.<br><br>Relevant Articles include:<br><br>• Article 4: "Waste means objects, chemical substances or anything that persons or legal entities do not want and cannot recycle such as used oil, rubbish, wastewater and others, which are toxic or non-toxic."<br><br>• Article 38 Waste Disposal: "Disposal of general wastes, particularly rubbish, shall be separated for different purposes such as recycle, reuse, reprocess as new products and elimination with methods and techniques within identified areas based on regulations."<br>• Article 47 Environmental Information Services: "The natural resources and environmental sector shall develop the systems for environmental information management and services to ensure the public information provision based on regulations. Persons, legal entities and organizations shall be able to access environmental information."<br>• Article 52 Obligations of Natural Resource Users: "A natural resource user shall fulfil these obligations: 1. Using natural resources with economical, rational, effective and sustainable manners."<br>• Article 68 General Prohibitions: 4. "Burn, bury, dispose and demolish wastes, release and discharge wastewater into canals, rivers, natural water sources or any sites without treatment based on the technical standards." |

| | |
|---|---|
| *Law on Hygiene, Disease Prevention and Health Promotion, 2001* | The Law on Hygiene, Disease Prevention and Health Promotion "has the function to determine the principles, regulations and measures relating to the organisation of activities on hygiene, disease prevention and health promotion to maintain the good health, quality of life and longevity of the people thus contributing to national preservation and development."<br><br>Relevant Articles include:<br><br>• Article 11. Community Hygiene: "All persons in a community have the obligation to dispose of solid and liquid waste, and to preserve the cleanliness of water sources, water for drinking or use, roads, drains and public places, in order to avoid the occurrence of disease and ensure orderliness and beauty for their own health and the health of the whole society."<br>• Article 14. Hygiene of Buildings: "... Solid and liquid waste shall be regularly disposed of."<br>• Article 19. Hygiene in Production: "Hygiene in production refers to ensuring conditions and standards in the production of consumption goods to avoid the spread of germs and toxic chemicals which could be hazardous to consumer health, especially in relation to goods for daily consumption, children's toys and cosmetics. Individuals and organisations producing the above-mentioned consumption goods shall comply with technical standards for production, waste disposal management techniques and principles of hygiene in order to avoid hazards to human health and the environment. It is forbidden to release waste, chemicals or wastewater from factories, including other production sites, into water bodies or elsewhere without undergoing treatment."<br>• Article 22. Hygiene of Markets: "....a system for wastewater disposal, a system for waste storage and disposal."<br>• Article 47. Fines: "Persons or organisations will be fined in the following cases: ... 2. Persons disposing or releasing waste, animal carcasses, or chemicals into streams or rivers, in public parks or roads, or in other places;" |

## 2.8. Case study

In this chapter, we will talk about how national governments in selected countries are taking action on single-use plastics. Cases of other ASEAN member countries are considered most relevant to the situation in Laos, due to the same culture, and development status. Actions from the other world regions are only presented briefly, to serve mainly as examples of different policies and approaches.

**Other ASEAN member countries**

**Cambodia**

The Cambodian government controls the use of plastic bags under Sub-Decree No. 168 on Plastic Bag Management, issued in 2017. The import, manufacture, distribution, and use of plastic bags thinner than 0.03 mm is prohibited under the Decree. Furthermore, the import or fabrication of commercial plastic bags in quantities greater than 100 kg requires a license from

the Ministry of the Environment. The Decree also mandates that supermarkets and business centers charge customers 0.10 USD for each bag, with penalties for noncompliance. Supermarkets are permitted to keep the revenue generated by the collection of these charges. The regulation does not apply to smaller shops or fresh-food markets (Akenji et al. 2019).

A limited field study conducted in 2019 (UNDP) discovered that, despite the government's limited enforcement activities, more than half of the supermarkets investigated had complied with the Decree. According to compliant stores, demand for single-use plastic bags has declined by around half. Some supermarkets created reusable bags with their logos and provided them for free to frequent customers or sold them for USD 0.8-1, which is a somewhat expensive price for low-income households. Smaller supermarkets reported difficulty with implementation, owing primarily to staff shortages. The overall view was that communication surrounding the Decree had been poor, and that most consumers were still uninformed that bag costs were required by law (UNDP 2019).

The government is also encouraging the usage of biodegradable and biomaterial bags. Preferential taxation is used to support the import and production of such bags. However, it is unclear what criteria are utilized to categorize bags as biodegradable and whether such bags have a lesser environmental impact (UNDP 2019).

**Malaysia**

Malaysia's government started a statewide "No Plastic Bag Day Campaign" in 2011. Customers must pay a price for single-use plastic bags on designated plastic-free days. This regulation did not apply to wet markets, restaurants, or night markets. A review two years after the campaign's start discovered that around half of the customers polled were using reusable bags or no bags at all. Building on this early success, certain states in the country expanded the 'No Plastic Bags' campaign to include all seven days of the week (Asmuni et al. 2015).

**Thailand**

In recent years, the government of Thailand has undertaken several initiatives related to single-use plastics, including the following (GIZ 2018).

- Collaboration with industry associations and a major university to develop a database on the flow of plastic materials in Thailand.
- Campaigns to eliminate plastic cap seals of drinking water bottles.
- Ban on plastic bags and Styrofoam containers in national parks.
- Phase-out of plastic bags in 30 hospitals.
- Agreement with 16 business groups (operators of supermarkets, convenience stores, and department stores) to introduce two plastic-bag-free days per month.
- Promotion of bioplastics production under a separate National Roadmap since 2008.
- Efforts to increase plastic recycling under the Plastic Debris Management Plan (2017-2021).

Thailand PPP Plastic (Public-Private Partnership for Plastic and Waste Management) was established in 2018. Initially, 15 organizations joined the program, and by 2019, the membership had grown to 33 organizations, including government agencies, business associations, private corporations, and non-governmental organizations (NGOs). PPP Plastic has formed six working groups: waste separation and management, innovation development, policy development and legislation, communication, a national plastics database, and new funding sources. It is also carrying out trial initiatives with several of the collaborating companies (GIZ 2018).

The government adopted a Roadmap on Plastic Waste Management (2018-2030) in 2019, with the goal of reducing and eliminating the usage of plastics and replacing them with more ecologically friendly alternatives. Plastic water bottle cap seals, oxo-degradable plastics, and plastic microbeads will be prohibited beginning in 2019. Plastic bags less than 36 microns thick, Styrofoam food boxes, plastic straws, and single-use plastic cups will be phased out by 2022. The government, on the other hand, has accelerated the phase-out of plastic bags by instructing 43 large retailers, plastic producers, and department shops to stop handing out single-use plastic bags by the beginning of 2020 (GIZ 2018).

**Vietnam**

Since 2011, Vietnam charges a tax on the production and import of plastic bags. This tax is relatively low (around USD 2 /kg) and has reportedly had only a limited effect on consumption (Hanoi Times 2020).

In 2012, Vietnam introduced a standard for eco-friendly plastic bags and a system for certification. Such bags are exempt from the tax charged on regular plastic bags and manufacturers can receive other kinds of government support. These incentives, combined with awareness campaigns, appear to have been effective. A 2017 study found that the market share of conventional plastic bags had fallen to around 50%. The government aims to completely phase out conventional plastic bags by 2026 (Akenji et al. 2019).

In 2019, the government of Vietnam launched the National Action Plan for Management of Marine Plastic Litter by 2030, with targets for 2025 and 2030. The overarching objective of the plan is to reduce the amount of ocean plastic by 50% by 2025 and by 75% by 2030. The plan indicates four complementary solutions areas:

1. Education and behavior change (to be achieved through campaigns, training, awards for good practices, and improved enforcement of bans on plastic-waste dumping).
2. Collection and processing of plastic waste from coastal and ocean-based activities (through clean-up campaigns, provision of infrastructure for collection and treatment, and improved data collection).
3. Control of plastic litter at source (through source separation, improved data on waste sources, and strengthened enforcement of regulations).
4. International cooperation (including knowledge exchange, international technical assistance and investment, joint research projects on impacts, and joint monitoring systems).

**EU Member States**

In 2018, the European Union (EU) adopted its first-ever European strategy for plastics in a circular economy. The strategy intends to transform the way plastic products are designed, used,

produced, and recycled. It presents a vision for a new plastics economy by 2030, including the following objectives :

- All plastic packaging placed on the EU market is either reusable or can be recycled cost-effectively.
- More than half of the plastic waste generated in Europe is recycled.
- Sorting and recycling capacity has increased fourfold compared to 2015.
- Export of poorly sorted plastics waste has been phased out.
- Substances hampering recycling processes have been replaced or phased out.
- Demand for recycled plastics in Europe has grown four-fold.
- Innovative materials and alternative feedstocks for plastic production are developed and used where evidence shows that they are more sustainable.
- New companies emerge that provide circular solutions, such as reusable packaging or other alternatives to single-use plastics.

As part of this plastics strategy, the European Commission has proposed a Single-use plastics directive. The proposed rules are based on how each of the 10 items is produced, distributed, and used by businesses and consumers, how it is disposed of, and how it may end up in nature. The proposal includes the following measures, adapted to the characteristics of each product (EU 2018):

- Bans of problematic and non-essential products: Where alternatives are readily available and affordable, single-use plastic products will be banned from the market. This will apply to plastic cotton buds, cutlery, plates, straws, drink stirrers, balloon sticks, food containers made of expanded polystyrene, and products made from oxo-degradable plastic. From July 2021, these products will have to be made exclusively from more sustainable materials.
- Consumption reduction targets: Plastic food containers and drinks cups will continue to be allowed but EU member states will have to reduce their use. Each country should collect data to be able to monitor consumption volumes and trends and consider setting national reduction targets. They should also make alternative products available for consumers or require mandatory charges for single-use plastic items.
- Obligations for producers: Producers will help cover the costs of waste management and clean-up, as well as awareness-raising for food containers, packets, and wrappers,

drinks containers and cups, tobacco products with filters (such as cigarette butts), wet wipes, balloons, and lightweight plastic bags. These "polluter-pays" measures should be introduced by the end of 2024. The industry will also be given incentives to develop less-polluting alternatives for these products.

- Collection targets: Member states should ensure that 90% of single-use plastic drinks bottles are collected by 2025, for example through deposit refund schemes.
- Labeling requirements: Certain products will require clear and standardized labeling, which indicates how waste should be disposed of, the negative environmental impacts, and the presence of plastics in the products - applies to sanitary towels, wet wipes, and balloons.
- Awareness-raising: Member states will be obliged to raise consumers' awareness about the negative impact of littering of single-use plastics and fishing gear as well as about the available re-use systems and waste management options for all these products.

Ireland was the first country to charge a tax on plastic bags in 2002. Customers must pay EUR 0.15 for each single-use plastic bag. The fee reduced the usage of plastic bags by 90% and raised USD 9.6 million for a green fund that supports environmental projects. However, while the usage of plastic bags decreased, there was a significant increase in single-use paper bags, which is likely to have resulted in increased greenhouse gas emissions from landfills (Irish Environment 2015)

Many European countries have deposit refund schemes (DRS) for beverage containers, generally achieving collection rates well above 90%. For example, Lithuania, which has one of the smallest populations in the EU (2.8 million people), put in place a DRS in 2016 and now has the highest recycling rate for plastic packaging in Europe. All beverage bottles will have to have a deposit on them, and there are about 1,000 reverse vending machines and 1,700 manual collection spots all over the country (Magnus 2007).

# 3. RESEARCH METHODOLOGY

This thesis is a descriptive qualitative study. The author has arranged and analyzed the collected information in conjunction with the theories specified in the literary review by the author's expertise as the basis for the analysis, to achieve the objective of the study of this thesis, the study is based on secondary data, collected from reliable published resources: articles, news, books, websites, etc.

We chose a descriptive qualitative research for this study to gain an in-depth understanding of the current state of waste management practices in Laos and the challenges faced in implementing sustainable waste management systems. We analyzed the data thematically and identified several key themes related to waste management in Laos based on reports from the UN, WHO, etc. These themes included the challenges of waste collection and disposal in rural areas and the need for effective policy to support sustainable waste management practices.

The findings of this study suggest that there are significant challenges to implementing sustainable waste management practices in Laos. These challenges include a lack of resources and infrastructure in rural areas, limited community participation in waste management, and a lack of awareness about the importance of proper waste management practices. Our study also highlights the need for stronger policy to support sustainable waste management practices as well as shows some case studies from many counties which can be implemented for the country.

In conclusion, this study provides valuable insight into the perceptions and experiences of key stakeholders involved in waste management in Laos. The findings of this study can inform the development of effective policies and strategies to support sustainable waste management practices in the country.

# 4. RESULTS AND EVALUATION OF RESULTS

## 4.1. Results

Laos is a landlocked country located in Southeast Asia. Laos's economy heavily relies on agriculture, with rice being the primary crop. Additionally, the country exports coffee, timber, and other agricultural goods. Despite the government's efforts to promote private sector growth and attract foreign investment, poverty remains widespread, especially in rural areas. Laos remains one of the poorest countries in Southeast Asia, with a significant portion of the population living below the poverty line despite recent economic growth. The country is heavily dependent on foreign aid and investment to finance its development.

Laos is facing significant growth in the economy, this has led to an increase in demand for goods and services resulting to increase waste pollution. There are several challenges in the management of waste in Laos. This includes its poor infrastructure, insufficient funds, low awareness, and inadequate policies.

The Ministry of Public Works and Transport (MPWT) and the Ministry of Natural Resources and Environment (MoNRE) have the main responsibility for policy around municipal solid waste management. The legislative basis for waste management in each city and area is by provincial decree, The Urban Development and Administrative Agency (UDAA) of each city is responsible for the collection and disposal of waste.

In Laos, waste collection services are limited. This is due to the lack of extant collection services and the inability of individuals to afford to pay for these services, which are not government-subsidized. The vehicle fleet for most collection services is old with limited functionality, such as the ability to collect different types of wastes and recyclables. There are a limited number of controlled landfills in Laos with only the capital Vientiane and the four secondary towns of Luang Prabang, Thakhek, Savannakhet, and Pakse using them for solid waste disposal. Other towns and rural areas have unmanaged dumps, which are often poorly designed, controlled, and managed.

Awareness of plastic pollution in Laos is still relatively low, particularly in rural areas where people may not have access to information about the issue. However, there are some efforts underway to raise awareness and educate people about the negative impacts of plastic waste. In urban areas, there are some campaigns and initiatives aimed at reducing plastic use and

promoting recycling. There have been efforts to encourage businesses to switch to more sustainable packaging options. There are also some environmental NGOs working in Laos that are raising awareness about plastic pollution and promoting waste reduction and recycling.

The biggest challenge in relation to the consumption of single-use plastics comes from changing consumer habits. As well as Changes in waste management must take into account the impact on the existing informal sector that is engaged in the collection, sorting, and processing of recyclable materials.

Laos faces challenges in enforcing environmental regulations due to limited financial and technical resources and political will. The government has limited funding for environmental protection and relies heavily on foreign aid and investment to finance projects aimed at mitigating environmental problems. This limited funding often means that environmental concerns are not given a high priority in government decision-making.

Waste management in Laos is facing several challenges, here are major challenges that we can conclude:

1. Lack of Infrastructure: Waste management infrastructure is limited in Laos, especially in rural areas. Many communities do not have access to waste collection services or proper disposal facilities.
2. Open Dumpsites: Most waste in Laos is disposed of in open dumpsites, which can lead to environmental pollution and pose health risks. These dumpsites are often located near residential areas and waterways.
3. Limited Resources: Waste management requires significant resources, including financial, human, and technological resources. Laos, being a developing country, does not have adequate resources to manage waste effectively.
4. Low Awareness: Many people in Laos don’t be aware of the negative impacts of improper waste management on the environment and human health. This can lead to littering and dumping of waste in public spaces, worsening the waste management situation.
5. Informal Waste Sector: The waste management sector in Laos is dominated by informal waste pickers and collectors. While they play a crucial role in recycling and waste collection, they often work in unsafe and unregulated conditions.

6. Inadequate Policies: While the Lao government has implemented policies and initiatives to address waste management, there are gaps in policy implementation and enforcement, which can hinder progress.

## 4.2. Discussion

Most countries take more than one action, which shows that no single answer can work on its own. When different policy methods are put together, that is when they can really work. For example, discouraging or banning certain types of single-use plastic products often needs to go hand in hand with promoting better choices, like reuse models or single-use products with better environmental performance.

Investments in **awareness-raising** around plastics issues are essential, both to bring about behavior change and to increase acceptance of regulations or charges. However, awareness-raising and education must be in line with available services and infrastructure. For example, campaigns promoting collecting recyclables can do more harm than good if there is no separate collection system in place.

**Bans**

Banning plastic products has an indirect contribution to economic growth. The plastic ban creates a cleaner environment since there is no more plastic thrown onto the street. This is indirectly helpful in attracting tourism, unmanaged plastic waste management can reduce the overall economic activities of a country by reducing its level of tourism. Banning plastic products from the market could directly contribute to solving the improvement in the agricultural sector because these plastic products are serious problems for these activities.

Many countries around the world, particularly in Africa and Asia, are opting for a ban on plastic bags rather than a tax. As evidence, in early 2000, among Bangladeshi plastic bag users, between 85 and 90% of plastic bags in Dhaka were discarded on city streets after use. As a result, the Bangladeshi government prohibited the use of plastic bags in 2002. Furthermore, the experience gained from Rwanda shows that, after prohibiting the use of plastic products in 2008, the country became the cleanest city in the world. On the other hand, banning of plastic products may result in some short-term unemployment especially people who are involved in the production and distribution of plastic bags.

Banning plastic products can be effective but are more likely to be successful with the following conditions:

• High level of awareness around plastic issues and the need for change.

• Phase-in period to allow businesses to prepare and adapt.

• Availability of alternatives with lower environmental impact.

• Availability of alternatives that are affordable and convenient.

• Adequate enforcement capacity and motivation among government officials.

• Penalties that create strong disincentives.

**Alternative Products and Materials**

Biodegradable bags and packing can be suitable in some situations, but there is a chance that people don't understand how these things work. Most biodegradable plastics on the market don't break down quickly in nature or in home composting, and they can be just as dangerous as regular plastics. For them to break down quickly, they need to be treated in large-scale composting centers, which are not easy to find. Some bioplastics break down faster, even in normal yard compost, but they aren't used very often yet. To have a low effect on the environment, plastics that break down quickly need to be treated in the right way, such as by aerobic composting. If they end up in waste, they can easily make methane, which is a strong greenhouse gas.

There are also other issues with biodegradable plastics. These materials can take a lot of energy to make, which increases their overall environmental impact. Furthermore, if biodegradable plastics are combined with conventional plastics that are collected for recycling at the waste stage, the recycling process might be disrupted, resulting in low quality and poor functioning in recycled materials. These biodegradable plastics are typically difficult to identify and separate from regular plastics.

**Taxing**

Taxing or Mandatory charges can play a role where bans are not feasible. The willingness to accept charges can be higher if the money collected is earmarked for specific projects, for example, to protect or clean up the local environment, rather than going to central treasuries.

Putting a tax on plastic products is a key factor in changing people's attitudes toward material recycling. A plastic tax is helpful for influencing both the manufacturer and the consumer. Taxed plastic products increase the price of plastic per user which can lead people to be motivated to consume less plastic. People are generally found to be loss-averse and do not want to pay for something that was previously "free," or "cheap." For that reason, they often perceive a tax in a negative light and tend to avoid it. Furthermore, decreasing customer demand leads manufacturing companies to look for other options and indirectly decreases the output level of plastic products. To this end, a tax on plastic could further push manufacturers, scientists, and academic researchers to focus on more research and development regarding innovations to improve the efficiency of plastics.

Putting a tax on plastic products is a key factor in changing people's attitudes toward material recycling. Taxing plastic products can be the best policy to reduce its impact as well as generate revenue, particularly in poor and developing countries. The revenue generated by taxing plastic production can be used to fund various projects on waste management, while also indirectly creating job opportunities for society. At the same time, taxing on plastic products also has a disadvantage. For example, it will have disproportionate impacts on poorer members of society if low-cost alternative products are not available.

Although Laos lacks significant investment in infrastructure and services, manual costs are low, giving the country an advantage. Laos is in a good geographic position, surrounded by countries that have wide experience in managing waste and reprocessing materials such as plastics. This opens up the possibility of developing partnerships with neighboring countries.

Laos has strong culture and traditions as well as the respect that people have for the environment. Despite the country's businesses being comprised of small, medium, and micro enterprises, there are a number of well-established industry bodies and business associations that can provide platforms to help initiate and drive change. There are also a number of well-informed NGOs present in Laos, who already have good experience in establishing various

initiatives around sustainable consumption and production, reducing litter, and improving waste management.

Laos has several opportunities to improve the environment and promote sustainable development. One key opportunity is the country's natural resources, including its forests, rivers, and biodiversity. By protecting and sustainably managing these resources, Laos can ensure their long-term viability while also promoting economic development through industries such as eco-tourism and sustainable agriculture.

Laos also has the opportunity to benefit from international cooperation and investment in environmental protection. The country is a member of several international organizations focused on sustainable development, including the United Nations Framework Convention on Climate Change (UNFCCC) and the Mekong River Commission. These organizations provide opportunities for Laos to collaborate with other countries in the region to address common environmental challenges.

Moreover, there is growing global awareness of the need to address environmental issues such as climate change and plastic pollution, which provides an opportunity for Laos to access funding and technical support for environmental projects. By leveraging this support, the country can implement effective measures to address environmental challenges and promote sustainable development.

Laos also has the opportunity to develop and adopt innovative technologies and practices to improve environmental management. For example, the country can invest in renewable energy and promote sustainable development. Similarly, the adoption of circular economy principles can help to reduce waste and promote resource efficiency. Finally, there is growing awareness and interest among the population in environmental issues, particularly among young people. This provides an opportunity for the government and civil society to engage with the public and promote sustainable practices and behaviors. By fostering a culture of environmental awareness and action, Laos can create a more sustainable future for its people and the environment.

# 5. SUMMARY

Environmental problems are one of the most serious problems in our society. As we can see in our daily lives with rising temperatures, air pollution, and sea level rise. Waste pollution, particularly plastic pollution, is one of the issues we face daily. Dealing with plastic waste is difficult in every country because many factors must be considered. These are policies, customer behaviors, and financial circumstances.

Laos, like many other countries, is affected by plastic pollution. Laos is a landlocked Southeast Asian country. Laos' economy has grown significantly over the last ten years. This has resulted in an increase in demand for goods and services, as well as an increase in waste pollution. Waste management in Laos is fraught with difficulties. This includes inadequate infrastructure, insufficient funds, low awareness, and ineffective policies.

This report has provided clear evidence of how Laos is dealing with waste pollution and waste management challenges, which has had an impact on the environment while also having an indirect impact on the economy. Especially single-use plastics, which are designed and used for a limited time. These plastics are commonly used in food and non-food packaging, carrier bags, business-to-business packaging, and agricultural applications. Laos lacks comprehensive policies for sustainable production and waste management, as well as public awareness about the issues of inappropriate use and waste disposal. It also lacks the services and infrastructure to collect, sort, and safely process post-consumer waste. However, there are possible ways to reduce plastic pollution like many countries are using and adapting policies to reduce plastic pollution, such as taxing certain types of products, banning, providing alternative products, and raising awareness.

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**STUDENT DECLARATION**

Signed below, *Sitthiphon Sanaxonh* , student of the Szent István Campus of the Hungarian University of Agriculture and Life Science, at the BSc/MSc Course of *Environmental Engineering* declare that the present Thesis is my own work and I have used the cited and quoted literature in accordance with the relevant legal and ethicalrules. I understand that the one-page-summary of my thesis will be uploaded on the website of the Campus/Institute/Course and my Thesis will be available at the Host Department/Institute and in the repository of the University in accordance with the relevant legal and ethical rules.

Confidential data are presented in the thesis: yes (no)

Date: 2023/5/4

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**SUPERVISOR'S DECLARATION**

As primary supervisor of the author of this thesis, I hereby declare that review of the thesis was done thoroughly; student was informed and guided on the method of citing literature sources in the dissertation, attention was drawn on the importance of using literature data in accordance with the relevant legal and ethical rules.

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Approval of thesis for oral defense on Final Examination: **approved** not approved *

Date: 2023/05/05

Dr. Jancsovska Paulina
signature