



## **Management of Marine Plastic Waste Generated from Land-based Sources in Viet Nam: Problems, Constraints, and Solutions**

**Gam Pham Thi<sup>1</sup>, Thang Nguyen Trung<sup>2</sup>, Sunil Herat<sup>3</sup>, Tung Nguyen Thanh<sup>1</sup>**

<sup>1</sup>*Policy and Legislations Department, Viet Nam Administration of Sea and Islands, No. 83 Nguyen Chi Thanh Street, Ha Noi city, Viet Nam*

<sup>2</sup>*Institute of Strategy and Policy on Natural Resources and Environment (ISPONRE), 479 Hoang Quoc Viet str., Cau Giay dist., Ha Noi, Viet Nam*

<sup>3</sup>*School of Engineering and Built Environment, Griffith University, Nathan Campus, Queensland 4111, Australia*

---

### **Abstract**

Viet Nam is ranked No 5 in global plastic waste contribution to marine environment. The long coastline in Viet Nam provides a livelihood for millions of households as well as the food security for the whole country. The use of plastics per capita increased nearly eleven fold, from 3.8 kg/person in 1990 to 41 kg/person in 2015. The two highly populated cities (Hanoi and Ho Chi Minh City) alone generate 80 tonnes of plastic waste every day. Landfilling is the primary treatment method of solid waste while recycling is still limited. Tax for plastic bags exists, but implementation is not efficient. Application of Extended Producer Responsibility still faces many constraints. Regular monitoring and data collection related to the status of marine plastic waste pollution are inadequate. Moving forward Viet Nam needs to focus on a number of issues including strengthening the legislation, raising awareness, promoting research on innovative recycling technologies, and promoting international cooperation. This paper investigates current issues, challenges, and constraints in managing plastic waste in Viet Nam and makes recommendations for improvement. The paper utilises an unsystematic narrative overview as the research method.

© 2021 The Authors. Published by IEREK press. This is an open access article under the CC BY license (<https://creativecommons.org/licenses/by/4.0/>). Peer-review under responsibility of ESSD's International Scientific Committee of Reviewers.

### **Keywords**

*Viet Nam, plastic waste, recycling, policies and legislation, health impact*

---

### **1. Introduction**

Viet Nam has a long coastline, high population, rapid economic growth, urbanization, and tourism development in recent years. It has a land area of 33,123 thousand hectares (Ministry of Natural Resources and Environment – (MONRE), 2016) with a coastal length of about 3,200 km, excluding the coastline of islands (Viet Nam Government Portal. (2018) with approximately 3,450 rivers, streams and 114 estuaries flowing into the sea MONRE. (2015). The total population in Viet Nam was estimated at 94.67 million people in 2018 (General Statistics Office of Viet Nam, 2018), which is expected to increase by 18% in the period between 2015 and 2030 (The World Bank, 2018). The country has also experienced rapid urbanization. However, the urban infrastructure has still not met the environmental requirements (MONRE, 2017).

Viet Nam had relatively high economic growth over the past ten years, with GDP growth increasing from 5.66% in 2008 to 7.08% in 2018 (Figure 1). Consumer industries, especially those generating plastic waste, are growing. In 2018, total commercial marketing of consumer goods and services were estimated at 4,395 trillion Viet Nam Dong (VND), an increase of 11.7%, compared to that in 2017 (General Statistics Office of Viet Nam, 2018).

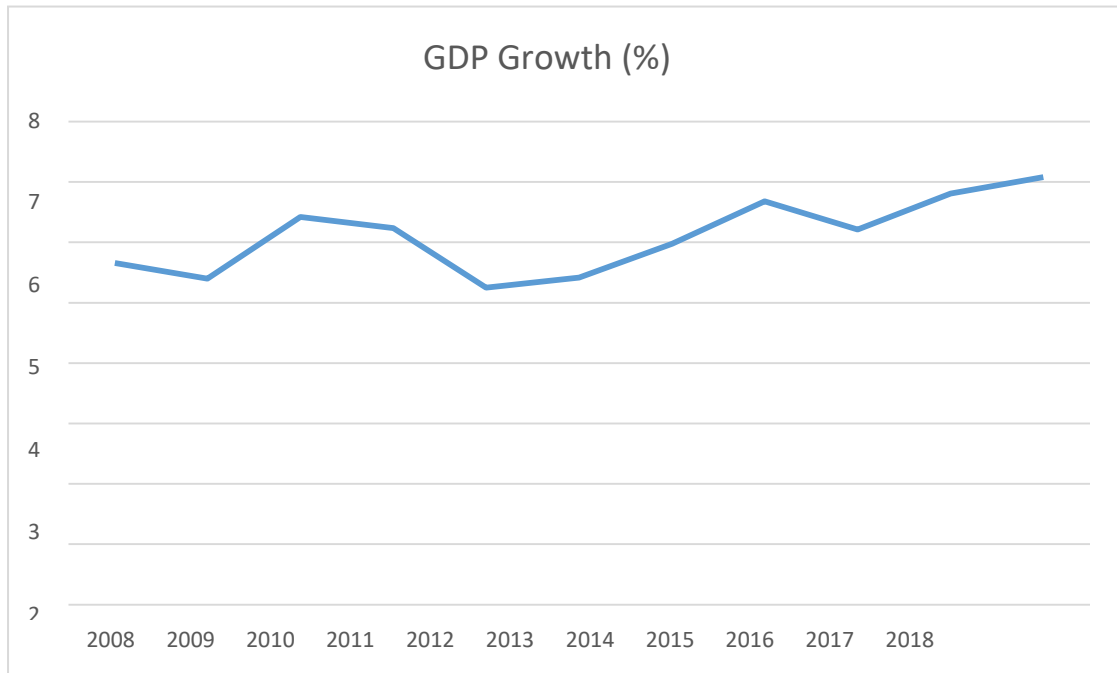


Figure 1. The GDP Growth Rate in Viet Nam during 2008-2018 (General Statistics Office of Viet Nam, 2018)

At the same time, Viet Nam tourism is also growing fast. From 2013 to 2018, the number of international arrivals has doubled and the number of domestic tourists increased by nearly 2.3 times; the revenue from tourism industry increased from 200,000 billion VND in 2013 to 620,000 billion VND in 2018 (Viet Nam National Administration of Tourism, 2019) (Figure 2).

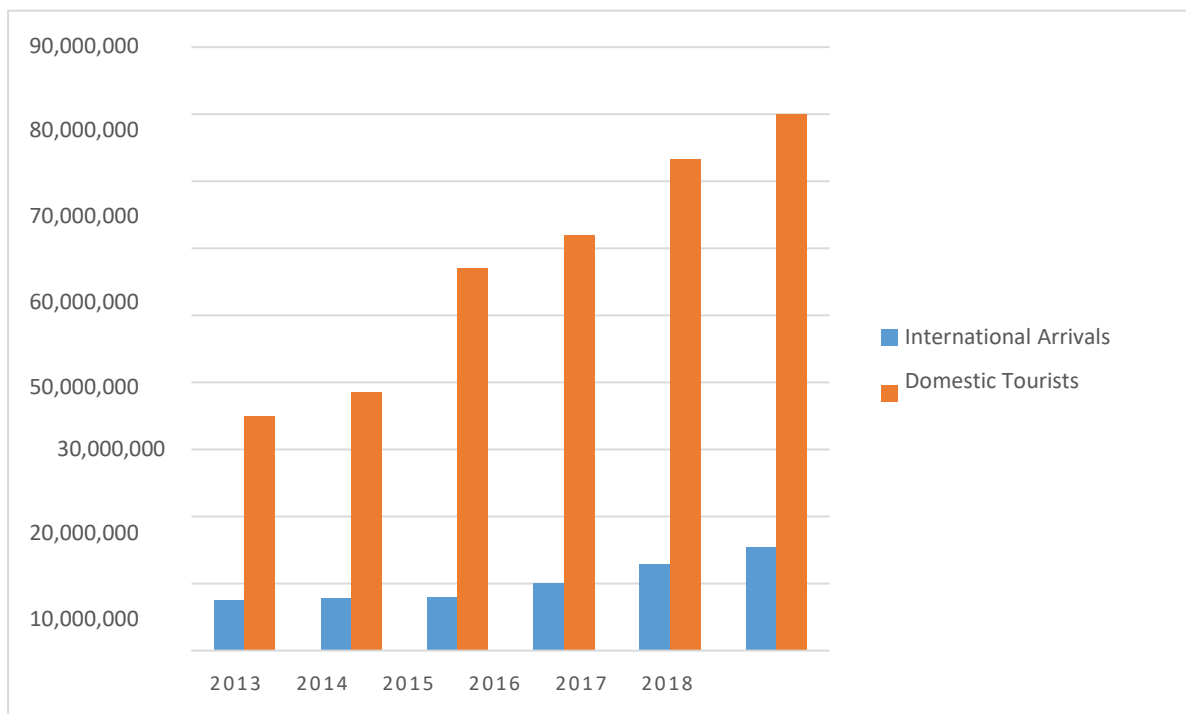


Figure 2. Number of tourists in Viet Nam 2013-2018 (General Statistics Office of Viet Nam, 2017)

The Viet Nam's plastic sector is growing rapidly increasing from 16% to 18% in the period of 2010 to 2015. The use of plastic products per capita increased nearly 11 times, from 3.8 kg/person in 1990 to 41 kg/person in 2015

(Viet Nam Plastics Association, 2015). The industrial and construction plastics account for the high proportion in plastic industry structure. However, plastic packaging had also increased due to the growth of some products such as food and beverages and non-food sectors with an increase from 2.8% to 15.1% (Kien Duong, 2018) (Table 1).

Table 1 The growth of food and non-food sector in the period of 2011-2016 (Kien Duong, (2018))

Segment	Scale (US\$mill)	2015-2016 Growth rate (%)	2011-2016 Compound Annual Growth rate (CAGR)
Instant noodle	1.388	-2,5%	2,8%
Instant coffee	251	8,3%	12,2%
Sauces and spices	970	9,6%	7,7%
Candy	1.245	8,8%	9,0%
Fisheries	7.053	7,3%	2,9%
Washing, laundry	1.082	16,3%	13,0%
Surface cleaning solution	94	8,3%	12,2%
Skin care products	280	12,3%	15,1%
Hair care products	208	5,2%	8,8%
Body care products	138	8,0%	9,6%

Despite the rapid growth of the plastic industry, domestic plastic raw materials only met 20-25%, the rest was imported (Viet Nam Plastics Association, 2015). Plastic scrap imported into Viet Nam increased from 2016 and surged in the first six months of 2018 due to the ban of scrap import of China (Table 2). Besides, the illegal import of waste in the form of plastic scrap also increased; until January 25, 2019, there were more than 24,000 scrap imported containers unclaimed for more than 90 days in all seaports (Nhan Dan Online, 2019).

Table 2 Plastic scrap import from 2016 – 2018 (Financial Times, 2018)

Year	2016	2017	The first six months of 2018
Quantity (thousand tons)	245.8	385	277.7
Values (million US\$)	43.5	70.9	63.3

This paper investigates current issues, challenges, and constraints in managing plastic waste in Viet Nam and makes recommendations for improvement. The authors utilise an unsystematic narrative overview to conduct the research. Such literature review is considered as most appropriate for the type of research required for this study. A narrative overview means the paper will condense information and resources from various sources (eg. Governmental legislations, peer-reviewed journal articles, government and international reports etc) to understand the development of the topic and develop future directions to solve issues, challenges and gaps.

## 2. Marine plastic waste pollution in Viet Nam

Together with the growing population, rapid urbanization and tourism development, economic growth in general, and the development of plastic industry, the generation of domestic solid waste have been growing in Viet Nam. The total amount of household solid waste was estimated to be 25.5 million tons in 2017, of which urban solid waste contributing to 38,000 tons per day and rural domestic solid waste contributing to 32,000 tons per day

(MONRE, 2017). With an average growth rate of 6.6% per year, the total amount of household solid waste is forecast to reach 54 million tons in 2030 (The World Bank, 2018).

The estimated amount of plastic waste contributed to about 8 to 12% of the total municipal solid waste (Viet Nam Environment Administration, 2018), which is equivalent to 2.04 to 3.06 million tons of plastic waste per year generated. With an average domestic solid waste collection rate of 55% - 65% (Ministry of Construction, 2017), the amount of non-collected plastic waste was about 0.714 to 1.377 million tons per year. In Phu Quoc island (Kien Giang province), the amount of domestic solid waste is at 155 tons per day, of which 29.5 tons (19%) being plastic waste. Of this volume, only 1.1 tons are recycled by households, 17 tons collected (~ 60%) and 11.4 tons (~40%) are still discharged directly into the environment (WWF-Viet Nam, 2018).

According to the statistics of the Ministry of Natural Resources and Environment (MONRE), Hanoi Ho and Ho Chi Minh City generates about 80 tons of plastic waste daily. Hanoi produces around 4,000 to 5,000 tons of solid waste, of which plastic waste accounting for 7-8% while Ho Chi Minh releases about 7,000 tons of waste, of which nylon waste accounting for about 10% (MONRE, 2017). This figure is 12.2% - 14.2% for Hai Phong, 6% - 18% for Phu Tho and from 3.4 - 10.6% for other provinces in Viet Nam (The World Bank, 2018).

Regarding waste collection, by 2018, the municipal solid waste collection was about 85-86% in urban area, but relatively low in rural areas with around 40-55% collection rate. It is estimated that around 8-12% of municipal domestic solid waste is recycled and 70-75% of the collection is landfilled (MONRE, 2018). By 2015, there were about 660 landfills in the whole country, with a total area of about 4,900 ha, of which, 203 landfills, (accounted for about 31%) were managed in an environmentally safe manner while the rest were just open dumping sites (The World Bank, 2018)

There is a significant amount of solid waste, including plastic waste, ending up in open environment as a result of mismanagement. Most of these plastics end up finishing in the sea because plastic waste is easy to follow rivers to the sea, owing to its lightweight under the impact of wind and flow (The World Bank, 2018). Plastic waste at sea is a significant concern of the world today because of its adverse effects on marine ecosystems. According to a recent study, Viet Nam is ranked fourth country, which contributes to the most significant volume of plastic waste entering the ocean (closely following China, Indonesia, and the Philippines) with around 0.28 to 0.73 tons per year (Jambeck, et. al., 2015).

The marine pollution caused by plastic waste on beaches and coastal areas and islands in Viet Nam is becoming a major issue. The volume of plastic waste collected is about 8-10m<sup>3</sup> per day from the bays, which belong to Cat Ba archipelago in Hai Phong city; a dozen of tons of plastic waste such as plastic bottle, plastic bag in Do Son beach, etc. (Tuoi Tre Paper, 2018). The 2018 "Let's Clean the Sea" Campaign, which was held once a week at least one area contaminated by marine debris, has collected 1,282 tons of marine debris (Summary of the Campaign 'Let's Clean the Sea', 2019). According to many fishermen in the South-Central Area, marine plastic waste in coastal areas is estimated to be three parts of fish and one part of plastic waste (Alarming Plastic Waste in Seafood Exploitation, 2019).

### **3. Environmental impacts of plastic waste**

The marine litter mainly consists of plastic waste generated inland and finding its way to oceans. Marine litter has become a problem to many countries due to its major impacts on both terrestrial and aquatic ecosystems. Due to this reason plastic waste contamination in open environment is attracting much attention from both researchers, policy makers, and the general public. Since marine organisms can ingest or become entangled plastic waste, marine litter is considered hazardous to the entire ecosystem.

A study conducted on eight regions in the Asia and Pacific Region (between Australia and China) concluded that the likelihood of disease in coral reefs increased to 96%, This would directly affect organisms that colonize these coral reefs for feeding, breeding, etc. For instance, another study concluded that the loss of integrity of coral reefs have reduced fisheries productivity by a factor of 3 (Lamb et al., 2018). A study conducted on the inshore reefs of

Australia's Great Barrier Reef revealed coral would often regard microplastics for prey and can consume up to ~50µg of microplastics (Hall et al., 2015, Hankins et al, 2018).

Ingestion of plastic waste by fish also affects human consumption and consumption by predators, such as birds. Fish samples collected from a market in Makassar, Indonesia, revealed anthropogenic debris in 28% of individual fish and 33% of individual shellfish. This raises a concern about the effects of fish consumption on human well being (Rochman et al., 2015).

Most effects on sea turtles due to marine litter arise from ingestion and entanglement. Ingestion of plastics by these sea turtles causes intestinal blockage, internal injuries, and malnutrition. This ingestion may occur directly or indirectly. There is evidence that juvenile green sea turtles ingest plastics through the consumption of macroalgae (Di Benedetto and Awabdi, 2014). Entanglement remains the most common cause of mortality in sea turtles, causing lacerations, increased drag, which may cause drowning and subsequent death (Nelm et al., 2015). Studies conducted on green sea turtles found that there was a 50% chance of mortality if a sea turtle had 14 pieces of plastic in their gut. It is also suggested that ingestion occurs most frequently in juvenile sea turtles (Wilcox et al., 2018).

#### **4. Policies and legislation on plastic waste management**

In recent years, Viet Nam has issued many policies and legislations to take measures on precaution, prevention, and treatment of solid waste, including plastic waste (Box 1). The country has also established a system of agencies from the central to local level on waste management. Accordingly, the MONRE is the focal ministry to unify the state management of solid waste, in coordination with the Ministry of Construction (MOC), the Ministry of Industry and Trade (MOIT), the Ministry of Agriculture and Rural Development (MARD), the Ministry of Health (MOH) and Provincial People's Committees.

**Box 1. Policy and Legislations documents on waste management** (Government of Vietnam, 2012, 2013, 2015a, 2015b, 2015c, 2015d, 2019)

##### **Regulations on prevention, collection, and treatment of solid waste (including plastic waste)**

- Law on Environmental Protection 2014;
- Law on Environmental Protection in 2020, which will replace the Law on Environmental Protection in 2014 and will be effective from 1<sup>st</sup> January, 2022.
- Decree 38/2015/ND-CP dated May 24, 2015, on the management of waste and discarded materials
- Decision 16/2015/QD-TTg dated May 22, 2015, on retrieving and treating discarded products
- Circular No. 34/2017/TT-BTNMT dated November 10, 2017, on recovering and processing discarded products
- Law on Marine Resources and Environment 2015

##### **Incentive regulations of environmentally friendly products**

- Decree 19/2015/ND-CP dated February 14, 2015, on the guidance of the implementation of several articles of the Law on Environmental Protection
- Law on Enterprise Income Tax in 2008
- Decree 218/2013/ND-CP dated December 26, 2013, providing detailed regulations and guidelines for the implementation of the Law on Enterprise Income Tax

##### **Environmentally friendly plastic bags and financial measures to reduce non-biodegradable plastic bags**

- Law on Environmental Protection Tax 2010
- Decree 67/2011/ND-CP dated August 8, 2011 guidance on the implementation of the Law on Environmental Protection Tax

- Circular 159/2012/TT-BTC dated September 28, 2012, amending and supplementing Circular 152/2011/TT-BTC dated November 11, 2011, issued by the Ministry Finance guiding the implementation of Decree 67/2011/ND-CP
- Circular 07/2012/TT-BTNMT dated July 4, 2012, regulating criteria, ordering, and procedures for certification of environmentally friendly plastic bags.

#### **Regulations on sanctioning administrative violations**

- Decree 155/2016 / ND-CP dated November 18, 2016, on the fining of administrative violations in the field of environmental protection

#### **Other relevant policies**

- Resolution No. 36-NQ/TW dated November 22, 2018, approved by the Central Committee of the Communist Party of Viet Nam on the Strategy for Sustainable Development of Viet Nam's Maritime Economy to 2030, with a vision to 2045.
- Decision 491/QD-TTg dated May 7, 2018, approving the adjustment of the National Strategy on Integrated Solid Waste Management to 2025, with a vision to 2050
- Decision 1216/QD-TTg dated September 5, 2012, approving the National Environmental Protection Strategy to 2020, with a vision to 2030
- Decision 582/QD-TTg dated April 11, 2013, approving the Program on strengthening environmental pollution control due to the use of non-biodegradable plastic bags in daily life by 2020.
- Decision 622/QD-TTg dated 10/5/2017 approving the National Action Plan to implement the 2030 Agenda for Sustainable Development
- Decision 1746/QD-TTg dated December 04, 2019, approving the National Action Plan on Marine Plastic Debris Management by 2030

According to the legislation on solid waste in Viet Nam, waste should be separated at the source, reduced, reused, recycled and treated. Recycling and energy recovery from waste is specially enhanced to limit landfilling. A hazardous waste generator should do registration at environmental agencies, and the waste should be managed only by licensed companies. The Extended Producer Responsibility (EPR) mechanism is applied with products and packaging materials with recyclable value for the recycling responsibility of the producers and importers in the Law on Environmental Protection 2020, which has not applied before. With regards to plastic waste, the Law on Environmental Protection Tax 2010 has imposed tax on plastic bags. Besides, Viet Nam is promoting the usage of biodegradable plastic bags in daily life, as well as regulations on certification of this kind of bags.

## **5. Problems, constraints, and reasons for plastic waste management**

### **5.1. Problems and constraints**

Firstly, a landfill is the primary treatment method of solid waste while recycling is still limited. Current policies and legislations have provided incentives for products from recycling and waste treatment activities in terms of land lease, loan, taxes, prices, and product consumption, etc. However, treatment of solid waste by landfill remains the majority, and only 25-30% are treated by intermediate process and recycling (including plastic waste). The current actual cost per tonne of solid waste treatment is estimated at \$ 24 for collection, \$ 11 for transportation and \$ 4 for landfill (The World Bank, 2018). This cost is too low, leading to creating unfair competition for other treatment methods such as energy recovery incineration and composting. Furthermore, recycling of plastic waste is carried out at many informal recycling facilities in craft villages with outdated technologies (Viet Nam Environment Administration, 2018). This activity poses a risk of environmental pollution and creates unfair competition for investors in the field of formal plastic waste recycling.

Secondly, the tax for plastic bags has been applied, but the implementation is still limited. The Law on Environmental Protection Tax in 2010 regulates taxation on plastic bags with a tax between 30,000 and 50,000 VND per kg and applying 50,000 VND per kg from January 1, 2019 (Viet Nam National Assembly, 2014, Viet Nam National Assembly Standing Committee. (2018), which is equivalent to 250-500 VND/plastic bag. It is highly likely that the environmental tax applying for plastic bags is not high enough to limit the usage of plastic bags, especially single used plastic bags (Government of Viet Nam, 2017). Also, pre-packaged goods and eco-friendly plastic bags are not taxable (Government of Viet Nam, 2012). Till May 2018, there were 43 plastic bags of 38 companies that were granted certification for such products (Viet Nam Environment Administration, 2018); however, the quality of these bags should also continue to be viewed in terms of environmental friendliness with full testing and scientific processes. Also, imported plastic bags and domestic plastic products for prepackaged goods are also not subject to this tax (The Paradox of Friendly Plastic Bags, 2019).

There are some obstacles in the collection of nylon bag tax. The total tax collected from nylon bags decreases 16 times from 2012 to 2016, while the total amount of environmental protection tax increases four times (Table 3) (Government of Viet Nam, 2017). The price of single-use nylon bags is sometimes equal to the tax rate and even lower, with prices ranging from 25,000-50,000 VND/kg. Consequently, single-use nylon bags are usually provided free of charge and it is difficult for the business of environmentally friendly bags to be viable.

Table 3. Environmental tax revenue in 2012-2016 (Financial Times, 2019)

Indicator	2012	2013	2014	2015	2016
Total revenue from environmental tax (billion dong)	11.160	11.512	11.970	27.020	44.323
Revenue from nylon bag tax (billion dong)	827	168	71	69	56

Thirdly, current policies provide for a lot of incentives to develop manufacturing industries related to plastic products; however, the implementation of EPR is still limited. The State has made a number of preferential and supportive policies to develop the plastic industry, namely: (i) production of plastic components and technical rubber (Government of Viet Nam, 2015d); (ii) supporting industries (such as synthetic fibers, electronic product components with plastic parts, rubber components; automotive plastic, plastic components in high quality, etc ... ) (Government of Viet Nam, 2015a); projects on molds and plastic equipment manufacturing are preferentially lent up to 85% of the total capital (Ministry of Industry and Trade., 2011).

Therefore, the plastic industry will have the right conditions for its development, leading to an increase in consumption and disposal of plastic products. Meanwhile, the implementation of the EPR in accordance with Decision No.16/2015/QD-TTg dated May 22, 2015 on collection and treatment of discarded products (including even plastic waste from used waste electrical and electronic equipment, batteries and transportation means) remains very limited. So far only a few large enterprises have established points for collection of discarded waste and the recovery of discarded products has hardly been implemented. Although regulations on EPR for packaging materials including plastics is regulated in the Law on Environmental Protection in 2020 they have not detailed to implement.

Fourthly, there are some obstacles in policies and laws related to collection and management of marine plastic debris. There are no clear regulations on marine waste collection responsibilities, especially marine plastic debris until the Law on Environmental Protection in 2020 is approved, however, this Law provides only general responsibility of Provincial-level People's Committees in the direction of the collection and treatment of plastic waste in its locality. Furthermore, the identification of provincial boundaries and responsibilities of state management on the sea is not specific. Up to now, the collection of waste at sea, including plastic waste, is mainly done by seasonal projects or through environmental campaign and communication events. Vehicles, equipment and resources for such work are still very limited, thus marine plastic waste collection is only carried out at some beaches.

Finally, the regular monitoring, investigation, survey, and information collection related to the state of marine plastic waste contamination are limited. The system of control and supervision of marine environmental pollution in general and contamination of plastic waste, in particular, is much less and not adequate with the length of the coastline. There are currently only three observation stations in Ha Tinh, Quang Binh and Hai Phong (MONRE, (2016). Besides, there is lack of national technical standards on seawater quality with limits related to plastic waste.

## 5.2. Reasons for problems and constraints

Firstly, there are financial constraints to carry out the end of life management of plastic waste from land-based activities. The cost of collecting, transporting and treating domestic solid waste mainly comes from the state budget (about 4,000 billion VND/year) because the revenue from environmental sanitation fees meets only about 25% of demand. However, provincial budgets are limited and local authorities cannot provide enough capital for waste management (The World Bank, 2018). At present, the average investment capital for organic fertilizer and incineration facilities is 662,972 million VND and 585,780 million VND/ton respectively, while the average investment capital for landfill is only VND 30,190 million/m<sup>3</sup> (The World Bank, 2018). Therefore, landfilling is the choice of many local authorities, leading to leakage of plastic waste into the oceans.

Secondly, human resources to protect the environment is limited, especially at the grassroots level, to effectively implement policies and laws concerning plastic waste. State management staff on environmental protection have not met the requirements in terms of quantity and quality. By 2016, the total number of state management staff on the environment is 17,724, of which 11,996 are part-time officers at the commune level (67%) (MONRE, 2016). The environmental management staff is young, lack of high expertise and experience, less trained and updated knowledge regularly.

Thirdly, there are constraints in policy enforcement, inspection, and handling of violations. There is a shortage of human resources for control in policy implementation on natural resources and environment. There are 672 inspectors in the whole country; average of 2 officials under MONRE being in charge of one province and about 07 local officials in each province doing this job. These inspectors are responsible for inspection for all the sectors under MONRE's responsibilities. In the inspection and examination plan of the localities, only 51% of the provincial Department of Natural Resources and Environment (DONREs) have activities on examining law enforcement on the environment (MONRE 2018).

On the other hand, according to regulations, waste littering, including plastic waste, is subject to strict penalties of up to 7 million VND (Government of Viet Nam, 2015a). However, although violations are prevalent, the sanctioning of these violations is almost not implemented.

Fourthly, some policies are not implemented or given unrealistic goals. In order to control and limit plastic waste, Viet Nam has developed a program to improve environmental protection by using non-biodegradable plastic bags (Government of Viet Nam, 2013). It has set targets by 2020: (i) reducing 65% of the volume of non-degradable plastic bags in supermarkets and trade establishments compared to 2010; (ii) reducing 50% of the volume of non-biodegradable plastic bags in traditional markets compared to 2010; (iii) collecting and reusing 50% of non-biodegradable plastic bag waste generated daily. However, until now, most of the projects under this Decision have not operated because of various reasons. Hence there is no doubt that the objectives mentioned above has not been achieved by 2020.

Fifthly, the coordination among agencies in waste management is not suitable. MONRE unifies the state management of environmental protection, but some management duties related to solid waste collection and treatment are assigned to the MOC. In provinces/cities, this activity is assigned to the Department of Construction (DOC) and DONRE. Recently, the Government decided to assign the MONRE to be the national focal agency on solid waste management (GOV, 2019), which is currently in the process of transferring implementation. The Ministry of Science and Technology was assigned to lead and coordinate with the MOC and MONRE to evaluate the new domestic solid waste treatment technology, which was first researched and applied in Viet Nam. However, for technology that is not applied for the first time, it is not clear which ministry is responsible. On the other hand,



the MONRE is assigned the responsibility to guide and organize the evaluation, inspection, and evaluation of waste treatment technology.

Sixthly, understanding, awareness, responsibility, and participation of stakeholders are still limited. The knowledge and appreciation of environmental protection of sectors and especially local authorities are scarce. In many places, local government leaders lose their power in this work (Environmental Officials, 2019). Violations of organizations and enterprises on environmental protection are quite widespread, for example, in 2017, 33% of the inspected establishments have committed violations (MONRE, 2018). People, especially coastal people, have a habit of littering the sea, including plastic waste such as fishing gear, bottles, nylon bags, etc. For example, 80% of fishermen in Ngu Loc commune, Thanh Hoa province, keeping their habit of discharging domestic solid waste into the sea is a stark example Tuoi Tre Paper. (2018). Consumers still have the practice of using non-disposable plastic products and discharging them into the environment.

## **6. Recommendations**

Firstly, reviewing, building and completing policies and laws on municipal waste management with special focus on plastic waste should be implemented urgently. Plastic waste management based on a circular economy approach should be strictly considered by competent authorities in Viet Nam, which is considered as a good practice in some countries such as Japan, Singapore, France, Netherlands, German, United States, etc, to control the lifecycle of plastic products and reduce the emission of plastic waste (Nguyen Hoang Nam, 2019). Furthermore, the Government should make the policies and laws to concentrate on recycling, minimizing landfilling and reducing the disposal of plastic waste. The environmental protection tax on plastic bags should be increased; tax on other single-use plastic products should be imposed. The usage of single-use products should be gradually limited and prohibited by the Vietnamese Government, which is being applied successfully in countries like Belgium, Denmark, Greece, and Israel to reduce the generation of single-use plastic waste (UNEP, 2018). The Government should also develop policies to incentivise the production and use of green products to replace the single-use plastic products. Regulations for EPR to recycle, collect and treat (directly and indirectly) plastic packaging and other plastic products should be detailed and provided enough resources to implement effectively. The Government should specify the responsibilities of stakeholders in the management of plastic waste in oceans.

Secondly, the Government should effectively implement the sorting of domestic solid waste at source, enhance the collection, treatment, recycling, and reuse of solid waste, including plastic waste. The priority should be given to urban areas and residential areas along rivers, coastal areas, and seaports. The regulations improved concerning sorting, collection and treatment of domestic solid waste regulated in the Law on Environmental Protection in 2020 should be effectively implemented to avoid the mis-management leading to the leaking of the plastic waste into the sea. Apply a landfill tax to ensure competitiveness between landfill with other waste treatment methods; prohibit burying solid waste containing plastic waste in riparian and coastal areas.

Thirdly, the focal agencies of solid waste management at all levels should be MONRE and DONRE. Responsibilities and coordination mechanisms among relevant agencies in solid waste management, including plastic waste, should be specified. Moreover, the Government should strengthen the capacity of management agencies, of which focusing on environmental management officials.

Fourthly, developing feasible strategies, planings, and specific action plans following Viet Nam's practices should be one of priorities. The Government should implement effectively the National Action Plan on Marine Plastic Debris Management by 2030; handle unsanitary landfills; invest in crucial projects on solid waste treatment, which are suitable to the conditions of sub-regions and regions; enhance research and application of modern science and technology in the collection, treatment, monitoring and supervision of marine plastic waste. The investment of Can Tho province in Viet Nam to build a solid waste treatment plant for energy recovery incineration, which treats 70% of domestic solid waste generated in this province, is a good example to apply the other provinces to limit the landfill in Viet Nam (Ngoc Han, 2020).

Fifthly, the number of national and local environmental inspectors should be increased, and their capacity should be strengthened. Inspection plans should be implemented at provinces/cities to take precaution, preventing and treating plastic waste from land-based activities to restrict disposing of plastic waste into the sea.

Sixthly, promoting and raising awareness of stakeholders on avoiding, preventing, minimizing and treating plastic waste should be enriched. Some local authorities in Viet Nam have applied successfully the involvement of stakeholders to deal with plastic waste problems and Cat Hai district in Hai Phong city is a typical example. In this District, the local authority mobilizes the participation of individuals, travel facilities and social organizations to use environmentally friendly products to replace the plastic products as well as clean the environment (Hoang Tan, 2019). Therefore, the success of Cat Hai district should be used to develop the suitable policies to adjust behaviors, habits of using single-use plastic products to familiar with the use of environmentally friendly products (. The Government should ensure adequate mechanisms to encourage successful implementation of domestic solid waste management such as sorting at source, limiting plastic waste disposal into the rivers and sea; help stakeholders to effectively implement the slogan: "reducing, reusing and recycling plastic waste".

Finally, international cooperation on marine environmental protection, including reducing and treating trans-boundary plastic waste at sea should be promoted. Viet Nam should be active in developing a comprehensive regional and global cooperation mechanism, which incorporate programs and projects aiming to coordinate and implement control and reduction of ocean plastic waste.

## 7. Conclusions

Marine plastic waste is a global environmental problem. Plastic waste is being present throughout the seas and seriously threatening the marine environment and ecosystem. Globally, Viet Nam is considered by a recent study as one of the top five countries for plastic waste discharge into the sea. The Government has been working hard to resolve this pressing issue, but there are numbers of limitations and shortcomings in policies and laws; lack of resources for implementation, inspection, examination and handling of violations; limited awareness of stakeholders on marine plastic waste problems.

Therefore, in moving forward, Viet Nam needs to focus on the following issues:

- a) To complete the legislations system on waste management by issuing decree and circulars for implementation of the Law on Environmental Protection 2020 on EPR of plastic packaging; ban on plastic bags and certain single-use plastics and; guidelines for monitoring and management of marine plastic waste. Economic instruments such as tax on landfill, waste volume-based charge (pay-as-you-throw) should be introduced.
- b) To successfully implement the National Action Plan on Marine Plastic Debris Management by 2030 through an appropriate funding program to ensure achievements of objectives of the plan. The collection, recycling and treatment of plastic waste should be further strengthened.
- c) To continuously raise awareness of people and management agencies on marine plastic waste, to implement the national campaign on prevention and reducing plastic waste through which knowledge on plastics and microplastics also to be enhanced.
- d) To promote researches and studies on different aspects of marine plastic waste management including recycling technologies, impacts of plastics and microplastics on health and environment, related standards and technical regulations, ect.
- e) To promote international cooperation on marine plastic waste management. Viet Nam should proactively participate into development of an international agreement/convention on marine plastic waste and an international center should be established in the country.

Being a rising economy in the South East Asia region, Viet Nam is standing in front of a development decade with many opportunities and challenges. In the next 10 years the country should improve its environmental management including successful solutions to resolve the marine plastic waste issue as strongly committed by the government.

## References

- Alarming Plastic Waste in Seafood Exploitation. [online] <https://vtv.vn/vtv8/bao-dong-rac-thai-nhua-trong-hai-san-khai-thac-20181105110515745.htm> (accessed 25 May 2019)
- Di Benedetto APM, Awabdi DR. 2014 How marine debris ingestion differs among megafauna species in a tropical coastal area. *Marine Pollution Bulletin* 88:86-90
- Environmental Officials: Lack and Weakness. [online] <https://baotainguyenmoitruong.vn/moi-truong/can-bo-moi-truong-thieu-va-yeu-1151991.html> (accessed 5 June 2019)
- Financial Times, the Organ of the Finance Ministry (2018) *General Review of Scrap Import Activities* [online] <http://thoibaotaichinhVietNam.vn/pages/nhip-song-tai-chinh/2018-07-31/tong-ra-soat-hoat-dong-nhap-khau-phe-lieu-60491.aspx> (accessed 8 April 2019)
- Financial Times, the Organ of the Finance Ministry. (2019) *Strictly Controlling Scrap Import*, [online] <http://thoibaotaichinhVietNam.vn/pages/nhip-song-tai-chinh/2019-01-29/kiem-soat-chat-che-phe-lieu-nhap-khau-67257.aspx> (accessed 20 May 2019)
- General Statistics Office of Viet Nam, 2017 [online] <https://www.gso.gov.vn/default.aspx?tabid=720> (accessed 9 July 2019)
- General Statistics Office of Viet Nam, Viet Nam Socio-economic Status in 2018 [online] <https://www.gso.gov.vn/default.aspx?tabid=621&ItemID=19037> (accessed 20 June 2019)
- Government of Viet Nam (GOV), (2019), Resolution No.09/NQ-CP dated on 03 February 2019 issued by the Government on Regular Government Meeting in January 2019
- Government of Viet Nam (GOV) (2012) the Decree No.69/ND-CP, dated on 14 September 2012, issued by the Government, on Amending and Supplementing Clause 3 Article 2 of the Government's Decree No. 67/2011/ND-CP dated August 08, 2011, Detailing and Guiding the Implementation of a Number of Articles of the Law on Environmental Protection Tax.
- Government of Viet Nam (GOV) (2013), Decision No. 582/QĐ-TTg dated April 11, 2013, on approval of Program on enhancing environmental pollution control by using non-biodegradable plastic bags in daily life.
- Government of Viet Nam (GOV) (2015a) Decree No. 111/2015/ND-CP dated November 3, 2015, issued by the Government, on supporting industry development, Appendix.
- Government of Viet Nam (GOV). (2015b) Decree No.155/2015/ND-CP dated on 18 November 2015, issued by the Government, to Provide for Penalties for Administrative Violations against Regulations on Environmental Protection.
- Government of Viet Nam (GOV). (2015c) Decree No.19/2015/ND-CP dated on 14 February 2015, issued by the Government, on Detailing the Implementation of a Number of Articles of the Law on Environmental Protection.
- Government of Viet Nam (GOV). (2015d) the Decree No.118/ND-CP, dated on 12 November 2015, issued by the Government, to Provide Guidelines for some Articles of the Law on Investment, Appendix I, Section B, Subsection I, Point 6.
- Government of Viet Nam (GOV). (2017) Summary Report and Assessment of the Implementation of the Law on Environmental Protection Tax. [online] [http://duthaonline.quochoi.vn/DuThao/Lists/DT\\_DUTHAO\\_LUAT/View\\_Detail.aspx?ItemID=1310&TabIndex=2](http://duthaonline.quochoi.vn/DuThao/Lists/DT_DUTHAO_LUAT/View_Detail.aspx?ItemID=1310&TabIndex=2)
- Hall NM, Barry KL, Rintoul L, Hoogenboom MO. 2015. Microplastic ingestion by scleractinian corals. *Marine Biology* 162:725-732
- Hankins C, Duffy A, Drisco K. 2018. Scleractinian coral microplastic ingestion: Potential calcification effects, size limits, and retention. *Marine Pollution Bulletin* 135:587-593.
- Hoang Van Thus. (2019) '*Domestic Waste Management in Viet Nam*'. Paper Presented at the Management Model and Technology for Domestic Solid Waste Treatment Conference, organized by the MONRE, 7 May 2019, Ha Noi, Viet Nam.
- Hoang Tan (2019), Cat Hai (Hai Phong) implements many activities to reduce plastic waste and plastic bags, available at website: <https://dangcongsan.vn/xahoi/cat-hai-hai-phong-trien-khai-nhieu-hoat-dong-giam-thieu-rac-thai-nhua-va-tui-nylon-534230.html>
- Jambeck, J.R., Andrady, A., Geyer, R., Narayan, R., Perryman, M., Siegler, T., Wilcox, C., Lavender Law, K., (2015). Plastic waste inputs from land into the ocean, *Science*, 347, p. 768-771.
- Kien Duong. (2018) *Viet Nam Plastic Industry and the Problems Depending on Raw Materials*, [online] <https://VietNambiz.vn/nganh-nhua-viet-nam-va-bai-toan-phu-thuoc-nguon-nguyen-lieu-51660.htm> (accessed 5 April 2019)
- Ministry of Industry and Trade. (2011) Decision No. 2992/QĐ-BCT dated June 17, 2011, issued by Minister of Industry and Trade, approving the Planning on Development of Viet Nam Plastic Industry to 2020, with a vision to 2025.
- Lamb JB, Willis BL, Florenza EA, Couch CS, Howard R, Rader DN, True JD, Kelly LA, Ahmad A, Jompa J, Harvell CD. 2018. Plastic Water associated with Disease on Coral Reefs. *Science* 359:460-462.
- Ministry of Construction. (2017) *Overview of Solid Waste in Viet Nam*, the Capacity Building Project on Integrated Management of Urban Solid Waste in Viet Nam, Carried out by the Department of Technical Infrastructure - Ministry of Construction and Japan Development Cooperation.
- Ministry of Natural Resources and Environment (MONRE). (2016) Decision No.2311/QĐ-BTNMT dated on 28 September 2017 issued by the Minister of MONRE on Approval and Declaration of the Result of Land Area Statistics in 2016.
- MONRE. (2015) *Viet Nam State of Environment Report in the period of 2011 – 2015* [online] <http://cem.gov.vn/Portals/0/2016/TinBai/Phan%20dau.pdf> (accessed 25 December 2018), pp 67.
- MONRE. (2016) Document of the Project on "Building the National Database on Monitoring Natural Resources and Environment"
- MONRE. (2016) Document of the Project on "Strengthening Organizational Structure and Enhancing Capacity for Officials being in Charge of Environmental Management from the Central to Local Levels in the period of 2016 - 2020, with a vision to 2030"
- MONRE. (2017) *Viet Nam State of Environment Report in 2017 – Thematic Report: Waste Management* [online] <http://ceid.gov.vn/bao-cao-chuyen-de-ve-moi-truong-quoc-gia-nam-2017-chuyen-de-quan-ly-chat-thai/> (accessed 4 April 2019), pp 38

- MONRE. (2018) Summary Report on Inspection, Examination and Settlement of Complaints and Denunciations in 2017
- Nelm SE, Duncan EM, Broderick AC, Galloway TS, Godfrey MH, Hamann M, Lindeque PK, Godley BJ. 2015. Plastic and marine turtles: a review and call for research. *ICES Journal of Marine Science* 73, 165-181.
- Nhan Dan Online, the Central Organ of The Communist Party of Viet Nam. (2019) *Drastically Releasing Undeclared Scrap Containers at Seaports* [online] <https://www.nhandan.com.vn/kinhte/item/39066402-quyet-liet-giai-phong-phe-lieu-ton-dong-tai-cac-cang-bien.html> (accessed 3 May 2019)
- Ngoc Han (2020), Waste Treatment Plant for Energy Recovery incineration in Can Tho province is Confirmed to have Completed the Environmental Protection Conditions, available at website of Ministry of Industry and Trade of Viet Nam: <https://www.moit.gov.vn/web/guest/tin-chi-tiet/-/chi-tiet/nha-may-dot-rac-phat-dien-can-tho-duoc-xac-nhan-hoan-thanh-cong-trinh-bao-ve-moi-truong-20422-129.html>
- Nguyen Hoang Nam and Nguyen Trong Hanh (2019), Implementing Circular Economy: International Experience and Policy Implications for Vietnam, *VNU Journal of Science: Economics and Business*, 35(4) (2019), 68-81
- Rochman CM, Tahir A, Williams SL, Baxa DV, Lam R, Miller JT, The F, Werorilangi S, The SJ. 2015. Anthropogenic debris in seafood: Plastic debris and fibers from textiles in fish and bivalves sold for human consumption. *Sci Rep* 5:14340.
- Summary of the Campaign 'Let's Clean the Sea' [online] <https://baomoi.com/tong-ket-chuong-trinh-hay-lam-sach-bien-nam-2018/c/28096599.epi> (accessed 4 May 2019)
- The Paradox of Friendly Plastic Bags. [online] <https://baotainguyenmoitruong.vn/moi-truong/nghich-ly-tui-ni-long-than-thien-1259884.html> (accessed 6 June 2019)
- The World Bank. (2018) Assessing the Management of Domestic Solid Waste and Hazardous Industrial Solid Waste: Options and Actions to Implement the National Strategy
- Tuoi Tre Paper. (2018) Plastic Waste Disposal into the Sea: White Pollution, No 275/2018
- Viet Nam Government Portal. (2018) *Some Information about Viet Nam Geography* [online]. <http://chinhphu.vn/portal/page/portal/chinhphu/NuocCHXHCNVietNam/ThongTinTongHop/dialy> (accessed 4 April 2019)
- Viet Nam National Assembly (2014) Law on Environmental Protection 2014, Clause 4 Article 107
- Viet Nam National Assembly Standing Committee. (2018) Resolution No. 579/ 2018 / UBTVQH14, dated on 26 September 2018, issued by Viet Nam National Assembly Standing Committee, on the Environmental Protection Tariff.
- Viet Nam Environment Administration (VEA), 2018, *Plastic Waste and Nylon Management in Viet Nam*. Paper Presented by Representative of the Viet Nam Environment Administration, at the Conference on "Policies, Technology and Treatment of Plastic Waste Treatment," organized by the MONRE, 12 November 2018, Ha Noi, Viet Nam
- Viet Nam National Administration of Tourism, Statistic Data [online] <http://VietNamtourism.gov.vn/index.php/items/13460> (accessed 4 July 2019)
- Viet Nam Plastics Association (VPA). (2015) *General Plastic Industry Report*, [online] <http://vpas.vn/gioi-thieu/tong-quan-nganh.html> (accessed 15 April 2019).
- UNEP (2018), Single-Use Plastic: A Roadmap for Sustainability, (Rev. ed., pp. vi; 6).
- Wilcox C, Puckridge M, Schuyler QA, Townsend K, Hardesty BD. 2018. A quantitative analysis linking sea turtle mortality and plastic debris ingestion. *Sci Rep* 8:12536.
- WWF-Viet Nam. (2018) Report on Baseline Study on Status and Solid waste management focus on Plastic Waste in Phu Quoc, with financial support from WWF and USAID, WWF-Viet Nam to study on "Reducing Plastic Waste in Phu Quoc."