Consideration of Microplastics as an Environmental Disaster

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Abstract

Due to the convenience and economy of daily life, plastic that is indiscriminately produced and consumed has become a threat to humans. In particular, microplastics have emerged as global environmental issues and are urging a paradigm shift to solve them. Microplastics are pieces of plastic with a length or diameter of 5 mm or less and are produced through various natural and artificial decomposition processes of plastic waste. Microplastics that are invisible and are not easy to collect affect the ecosystem and health, so countermeasures are urgent. Therefore, this paper presents the current status and problems of microplastics and countermeasures to the problems

Key words: Plastic, plastic waste, environmental disasters, microplastics

I. Introduction

Disasters today are very complex and take on various aspects. In terms of the type, content, and scale of disasters, disasters in modern society are unpredictable, so the scale of human and material damage is increasing. In particular, in recent years, large-scale natural disasters such as heavy flooding, hot weather, drought, cold weather, and earthquakes have occurred all over the world due to abnormal weather phenomena. (Lee Jae-eun, 2015:13)

The same is true of environmental disasters. Environmental disasters caused by climate change are very closely related to human life, and greenhouse gases that pollute the Earth's atmosphere and cause a greenhouse effect are the main causes. Plastic was first developed in the United States in 1909, and has developed since World War II, and is one of the most familiar resources for mankind. Humanity, which has enjoyed a convenient life through long research and scientific and technological advances, is also called the plastic era. Humans live surrounded by plastic from birth to the moment they die. (Green Swan:163) Rather, it became a threat to us.

It takes 500 to 700 years to decompose plastic silver. Incineration generates fine dust or greenhouse gases. Abandoned plastic accumulates in the soil and oceans and has a fatal impact on the ecosystem. An autopsy on the whale carcasses washing up on the beach showed tens of kilograms of plastic waste

Microplastics are classified into microplastics with a diameter of 5 ㎜ to 1 ㎛, and nanoplastics with a diameter of less than 1 ㎛, as plastic is divided by the environment, and are difficult to collect because they are not visible. It is said that 100,000 microplastics are accumulated in 1 ㎡ of the beach in Korea. Sea creatures such as plankton, shrimp, clams, and fish consume it first, and eventually enter the human body through the food chain. It is also detected in glaciers and bottled water in the atmosphere and polar regions. According to a 2019 study by the World Natural Conservation Fund, a person consumes about 2,000 microplastics every week. It weighs about 5g and measures about 1 credit card.

Therefore, the purpose of this study is to examine the current status and problems affecting ecosystem destruction and human health due to the plastic waste problem that will continue to occur in the future, and to derive countermeasures at the government or private level in terms of the circular economy.

II. Theoretical Discussions

1. Plastic and environmental issues

Plastic originated from the ancient Greek word plasticikos (plastikos, casting, molding). It refers to a polymer compound made by combining simple organic compounds, a plastic material that is processed into a desired shape by applying heat or pressure, molding, and mold, that is, an artificial material that can make the desired shape or an object made of the

material (synthetic resin).

Fossil fuels such as petroleum, coal, and natural gas are made from plastic. It can be easily made of any shape, does not rust, does not rot, is lightweight and strong, can be made in any color, and has the advantage of not being able to use heat and electricity. Therefore, it is used in everything, including daily miscellaneous goods, furniture, building materials, electrical parts, and parts of vehicles and ships.

Between 1950 and 2015, the cumulative production amounted to 8.3 billion tons. According to researchers at the University of California, Santa Barbara (UCSB), 78 percent, or 6.3 billion tons, became plastic waste, and only about 9 percent, or 600 million tons, was recycled. About 800 million tons, or 12 percent, were incinerated, and 4.9 billion tons were buried or discharged into nature. According to the report "New Plastic Economy: Consideration of the Future of Plastic" by the World Economic Forum, global plastic production is expected to reach about 1.124 billion tons by 2050. (Kibum Kim et al., 2021: Hyang Shinmun) Only 14 to 18 percent of all plastic products are recycled, and 25 percent of the remaining waste is incinerated, 58 to 62 percent landfilled, or neglected.

2. Concept and Characteristics of Environmental Disasters

Disasters are those that can damage the lives, bodies, property, and the state of the people, and can be classified into natural disasters and social disasters. (Framework Act on the Management of Disasters and Safety) Natural disasters refer to disasters such as typhoons, floods, heavy rains, strong winds, cold waves, and heat waves. Social disasters refer to damages beyond the scale prescribed by Presidential Decree due to fires, collapses, explosions, traffic accidents, chemical accidents, environmental pollution accidents, etc., and damage due to fine dust under the Special Act on Reduction and Management of Fine Dust. In 2019, the National Assembly plenary session passed the bill with the contents of defining fine dust as a social disaster

Natural and social disasters have legislation and support systems for response and recovery at the national level, but climate problems and plastic pollution problems are not classified into existing disaster types. Environmental disasters are not classified as natural or social disasters, and show special patterns that occur in the form of natural disasters due to artificial causes.

An artificial disaster is an accident caused by human carelessness, indifference, mistakes, and insufficient follow-up management, and the process of disaster occurrence has a sudden character and the intensity of shock is strong. The possibility of damage is unpredictable, so it is difficult to cope with it, has a wide and long-term impact with recent scientific and technological advances, and the risk is increasing. (Lee Jae-eun et al., 2005:58-59)

III. Microplastics Status and problems

1. Microplastic concept

The term microplastics first appeared in the academic world in 2004, and in the 2010s, research on pollution conditions, ecological impacts, and human impacts began to be conducted. As its seriousness began to be known, the United Nations Environmental Program (UNEP) announced microplastic pollution as one of the top 10 environmental issues worldwide in 2014. (Kyunghyang Newspaper, January 15, 2021)

Microplastics are synthetic high-molecular compounds with a diameter of 1 μm to 5 mm and a diameter of less than 1 μm, which are either intentionally produced or refined by carving existing products. The materials discharged into the environment are not only physically small in size but do not decompose over time, so they are widely accumulated from the coasts of land and oceans to the ocean, and in the surface and deep sea. (Kim Kang-hee et al., 2019:635)

Microplastics are classified into primary microplastics and secondary microplastics according to the generation process. Secondary microplastics include resin pellets (plastic raw materials of 2-5mm size), microbeads in face wash and toothpaste, and industrial abrasives. Secondary microplastics refer to plastic fragments that have been fragmented and refined by artificial actions or natural weathering after plastic products are used or discarded. Microplastics are too small

to be filtered out of sewage treatment facilities, but flow into rivers and seas, polluting marine ecosystems and damaging marine life. (Im Soo-hyun, 2021: 374)

2. Microplastic Occurrence Status

Firstly, it is necessary to standardize the definition of disaster management resources within South Korea's disaster management legal framework. Currently, the Basic Act on Disaster and Safety Management defines disaster management resources as "equipment, materials, and supplies." In the regulations regarding the classification and use of disaster management systems, disaster management resources are defined as personnel, equipment, materials, and supplies.

Secondly, among natural disasters, the risk of typhoons and heavy rains appeared to be high in most areas of our country, and heavy snowfall showed a high risk of damage in the west coast and some east coast areas (Kim, et. al., 2018: 394). In the sea, islands that are not on a map are being built. The North Pacific Garbage Island (hehe) is said to be 15 times the size of Korea. Penguins live on the South Pacific Garbage Island. Only 4 percent of the marine litter is wealthy, 77 percent is submerged in the sea, and 19 percent is washed ashore.

Microplastics account for 96.3 percent of the inflow into the ocean from land. They include paper, wood, metal, fiber, and glass, but plastics are the most common. They account for 82 percent of the total and 57 percent of the weight. Three factors are synthetic fiber (washing), tire dust and urban dust, followed by road paint (7%), ship paint (3.7 percent), and personal care products such as toothpaste and face wash (0.3 percent). It is estimated that there are more than 5 trillion microplastics floating in the ocean around the world.

3. Problems with Microplastics

As the apex predator of the food chain of ecosystems that consume seafood and salt, it is inevitable for humans to be exposed to microplastics. It is clear that various chemicals and pollutants caused by plastic pose a risk not only to animals but also to human health. (Im Soo-hyun, 2021:375)

Microplastics have a significant impact on the environment and health. Marine organisms such as plankton, shrimp, and fish are ingested, and eventually enter the human body through the food chain when they are split into microplastics due to exposure to waves or ultraviolet rays.

100,000 microplastics are accumulated in 1 ㎡ of beach in Korea. In November 2019, nearly half of the sea life species surveyed, including fish, crabs, and mussels, at the Greek Ocean Research Center, were found to have ingested microplastics. Recently, it has been detected in glaciers in the polar regions (movement through vapor evaporation), 93% of 259 bottled water from 11 brands in 9 countries, and detected in the atmosphere.

According to the 2019 World Wildlife Conservation Fund (WWF) and Newcastle University in Australia, a person consumes more than 2,000 microplastics (5g, one credit card) every week, and it can disrupt the endocrine system and cause cancer.

IV. Microplastic Response Plan

1. Microplastics as Environmental Disasters

Plastic was produced from 1950 to 2015 as much as 8.3 billion tons due to its convenience in manufacturing and use, and 6.3 billion tons of plastic was discarded accordingly 1). In many cases, waste plastics have a problem that they are not easily decomposed. About 80% of waste plastics are known to be landfilled or speculated in the land and sea, and if this trend continues, the number of waste plastics buried or speculated is expected to reach 12 billion tons by 2050. (Sanghoon Lee, 2019: 4)

According to a paper published by an international research team including the University of Strathclyde in the UK, tire wear and agricultural vinyl are discharged into the atmosphere and travel to the poles, and microplastics and nanoplastics that fall from the sky to the sea every year are estimated to be up to 25 million tons per year.

In 2019, fine dust was classified as a social disaster and the Framework Act on Disaster and Safety Management was revised in consideration of the fact that the cause of fine dust was artificial. Damage caused by fine dust is defined as a disaster, where emergency measures such as school closures are possible depending on the concentration of fine dust.
The plastic waste problem is also a very important environmental disaster. In particular, the microplastic problem, which is invisible and not easy to collect, is a serious problem that has a significant impact on the ecosystem and human health. It is urgent to solve the plastic waste problem closely related to all human lives due to the convenience of manufacturing to use. It is important to recognize and set up environmental pollution problems caused by plastic use as environmental disasters.

As we saw above, the plastic waste problem has become a threat to us in all directions. National measures are needed. It is time for social awareness and consensus to solve problems so that everyone can share them. Just as fine dust is set as a disaster and legally institutionalized, plastic waste should be set as a disaster and dealt with.

2. Countermeasures for Microplastic Problems

The microplastic problem, which has emerged as a global environmental issue, is sending us continuous warnings and raising the need for improvement. Marine organisms consume microplastics adsorbed on toxic substances, and humans eventually consume them. Currently, Korea is not technically established other than support for marine waste collection. Therefore, it is necessary to promote management and countermeasures to reduce the use and emission of plastic, which are fundamental problems.

2.1 Legalization

Legal institutionalization for strong regulation is needed. Social awareness of the dangers of fine dust, especially ultrafine dust, has spread, and it is recognized as a social disaster, and a special law on fine dust reduction and management has been enacted.

The same is true of the microplastic problem. The European Union (EU) introduced strong plastic regulations on January 1, 2021, imposing a tax of 0.8 euros (80ct) per kg on non-recyclable plastic waste. However, in Korea, there are no individual laws and regulations dealing only with microplastics or plastic problems. (Hyundai Marine, February 12, 2024.) In Korea, under the current laws, regulations on the use and generation of microplastics are partially implemented by administrative legislation such as「Act on the Safety Management of Household Chemical Products and Biological Products」,「Cosmetics Act」,「Pharmaceutical Affairs Act」,「Act on the Promotion of Resource Saving and Recycling」 and notifications based on them. However, it was mainly limited to the contents related to the reduction of primary microplastics. (Jeong Seong-jin, 2024: 203-204)

Microplastics have a very wide range of pollution and the process for solving them is complicated. Considering the seriousness and risk of microplastic problems, it should be enacted in the Framework Act on Disaster and Safety Management. Rather than individual legal amendments, an integrated response is needed through special laws. (Energy Daily, March 05) Comprehensive measures should be prepared at the government and local governments level to reduce microplastics.

2.2 Civil society's response

There is a need for an active response from civil society to share the plastic problem and the seriousness of microplastics. Hundreds of volunteers collected the grains at the site after millions of plastic grains poured from six containers stranded on Spain's northwestern coast left. (ESG Economy, January 15, 2024) Volunteers consisted of local fishermen, civic individuals, and environmental organizations.

In Korea, a solidarity organization has been formed centering on civil society to respond to the plastic waste problem

and is promoting activities. Social response and citizenship are needed to reduce and recognize the use of plastic. Public relations and campaigns to share the seriousness of the plastic waste problem and continuous civic practice education should also be carried out.

2.3 Restrict plastic use and promote circulation

In Korea, a solidarity organization has been formed centering on civil society to respond to the plastic waste problem and is promoting activities. Social response and citizenship are needed to reduce and recognize the use of plastic. Public relations and campaigns to share the seriousness of the plastic waste problem and continuous civic practice education should also be carried out.

It is compelling to use plastic products that have penetrated deeply into everyday life. At the consumer level, it is necessary to reduce the daily use of plastic and to select eco-friendly products or products that can be circulated and recycled instead of items that are difficult to recycle. It is also important to expand recycling facilities to establish a plastic treatment system such as promoting plastic recycling and developing recycling technologies.

The role of the government and businesses is very important. The government should strengthen the regulation and countermeasures against plastic use, and companies should pursue eco-friendly solutions in the plastic manufacturing process. They should be responsible for the entire production and consumption process of plastic products. It is also important to use renewable materials and develop recyclable products.

2.4 Survey and treatment of plastic pollution

It is necessary to investigate the pollution of microplastics, which has recently emerged as a major cause of marine pollution. In 2017, the Ministry of Environment conducted a survey on the content of microplastics in domestic tap water with the opportunity of an overseas study that 83% of microplastics were detected in tap water. As a result of the study, it was announced that there is no need to worry about microplastics in Korean drinking water. (Green Economy Newspaper, November 23, 2017)

It is difficult to accurately judge this because the investigation guidelines and standard analysis methods created by synthesizing domestic and foreign microplastic research cases have not been established. The cause of plastic pollution should be microplastic analysis infrastructure school and continuous investigation according to the characteristics of the living environment in the surrounding area such as land, sea, and air. (Hwaseong Times, February 20, 2023)

The government should also consider ways to collect and dispose of plastic waste that has already been exposed or discarded in nature. The government collected 130,000 tons of marine waste from across the country last year. This year, the government plans to increase the budget to reduce marine waste. (Lee Korea, June 14, 2024)

2.5 Investigation of the impact of ingested microplastics on life and health 5.

Since they are exposed to microplastics for a long period of time by eating or breathing in seafood, the risk of microplastics should be evaluated through animal experiments under similar conditions. However, studies on toxicity by mid- to long-term exposure to microplastics using rodents began about 3-4 years ago, so there are not many research results yet. The target institutions for toxicity studies were diverse, including reproductive organs, heart organs, digestive organs, and nervous systems (Park Ji-ah et al., 2021:446). We need to prevent ourselves from contaminating seafood food by human waste plastic.

V. Conclusion

Fully chemically synthesized plastics were invented about 100 years ago, but large-scale production and use of plastics began in the 1950s. Plastic is lightweight, but it is used in various fields due to its high durability, low production and market cost, and high usability, so it penetrates very deeply into our lives. (Kim Yong-jin et al., 2021:378)

As plastic consumption increases, microplastic pollution has emerged as a global environmental problem, and we are considering countermeasures to solve the problem. In several international organizations, including the United Nations Environmental Plan (UNEP), microplastic pollution problems such as impact on ecosystems and health and risk assessments caused by microplastic pollution have reached a serious situation.

Therefore, this paper suggested five ways to manage and cope with microplastics. The first is to enact a special law containing strong regulations and institutionalize it into a law. Although microplastic regulations are being enacted in some individual laws, the Framework Act on Disaster and Safety Management must define them as disasters and enact them as special laws. Second, it requires an active response from civil society. Solidarity organizations have been formed and are active to cope with the plastic waste problem at home and abroad. Citizens also need to raise awareness of the seriousness of microplastics.

Third, it is necessary to limit the use of plastic and use products that can be circulated and regenerated. At the government and corporate level, consumers should have an eco-friendly sense of responsibility in the manufacturing process and regulations on the use of plastic. Fourth, plastic pollution surveys should be conducted thoroughly, and measures to collect and treat pollutants already exposed to the natural world should be considered. The last one is to investigate the impact of microplastics on life and health. From 2020 to 2021, the Ministry of Food and Drug Safety analyzed the pollution level of microplastics in a total of 11 types of 102 items, including seaweed, salted fish, and food that have been reported to have microplastic contamination in Korea, and announced that one citizen is eating 16.3 microplastics a day. (Health Chosun, July 12, 2023) It is clear that no adult or child can avoid microplastic exposure, but the impact of microplastics on the human body is yet to be known because there is not enough data to clearly explain.

Korea is the fourth-largest producer of plastic, and the amount of plastic consumed per year reaches 142 kg, making it the highest in the world. Efforts to truly solve the plastic problem are urgently needed. For a sustainable society, Korea must stipulate regulations and countermeasures based on the above five measures, and a strong international plastic regulation agreement is required.

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