

Forum: United Nations Environment Programme (UNEP)

Issue: Reducing Microplastics in Ecosystems

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Introduction

Throughout the day, there is no doubt that you have encountered plastic in many forms. Plastic is one of the most common materials being used in the 21st century, but the environmental impacts of its usage have caused drastic increases in pollution and the destruction of habitats. According to a scientific finding published in 2019, estimates between 4.8 and 12.7 million tons of plastic move into the ocean every year, with the possibility of this figure increasing as our plastic usage continues to grow. Additionally, about 8 million pieces enter our oceans every day. With 5.25 trillion pieces of plastic weighing approximately 300,000 tons, the plastic pollution crisis is a serious situation that must be resolved.

Plastic pollution has had a direct effect on wildlife. A study conducted at the University of Exeter and Plymouth tested 50 marine animals, concluding that microplastics were identified in every subject tested. Further reviews found plastic pollution in 100% of sea turtles, 59% of whales, 36% of seals, and 40% of seabirds. This impact on animals may seem to not affect humans, but these microplastics in marine animals' bodies can easily transfer into the bodies of humans. Not including the number of inhaled plastics, people consume around 39,000 different microplastic particles per year. Since the introduction of plastic has been recently introduced in the 20th century, researchers have not fully developed all of the possible dangers of microplastics in the body, but there could be many implications for one's health.



Caption #1: Plastics found in an Albatross

Plastic is used throughout all of the socio-economic sectors of society, however those in poverty suffer from its usage. The resource is attracted to people due to its cheap cost and accessibility, which allows those in poverty to be able to purchase more goods than they would not have been able to do before. This leads to excessive pollution or the overflowing of landfills, which can result in the clogging of sewers in many of those poor communities. Privileged people use plastic as well, but negligence on its effects and the convenience of the material leads to the group continuing their usage of the substance.

Definition of Key Terms

Microplastics

Microplastics are extremely small pieces of plastic debris in the environment coming from the disposal and break down of consumer products and industrial waste.

Biodegradation

Biodegradation is the decomposition of organic material by microorganisms. This term is often used in relation to sewage treatment, plastic materials, and bioremediation.

Microbeads

Microbeads are small, solid, manufactured plastic particles that are less than 5 millimeters in size and do not degrade or dissolve in water. Rinse-off cosmetics, personal care, and cleaning products contain microbeads for a variety of purposes.

Bioremediation

Bioremediation is the use of either naturally occurring or deliberately introduced microorganisms to consume and break down environmental pollutants in order to clean a polluted site.

Environmental Pollution

Environmental pollution is the contamination of the physical and biological components of the atmosphere or earth system to a range that normal environmental processes are detrimentally affected. Pollutants can be naturally occurring substances but are considered contaminants when they damage a certain system.

Microorganism

Microorganisms are microscopic organisms such as a bacterium, virus, or fungus.

Polyethylene

Polyethylene is made from the polymerization of ethylene (or ethene) monomer. It is the most popular plastic in the world. Grocery bags, shampoo bottles, and children's toys are all made of this kind of polymer.

Polyvinyl chloride

Polyvinyl chloride is a kind of synthetic plastic polymer, also called PVC, and comes in two forms: flexible and rigid. It is the world's third most widely produced synthetic plastic polymer after polyethylene. Every year, 40 million tonnes of PVC are produced. PVC is used in a variety of applications such as health care, electronics, and other sectors. Products ranging from pipes, blood bags, windshield system components and more all contain PVC.

Background Information

Microplastics in water, air, and soil

Microplastics in water

Microplastics appear in a lot of places and are mostly found in water. They are too small in size to be filtered in sewage treatment plants so they enter the ocean without difficulty. One main source of microplastic pollution in freshwater ecosystems is wastewater. Wastewater can transport plastics from many different sources. Microplastics can come from hygiene products such as toothpaste, facial scrubs, and soap. These personal healthcare products all contain microbeads. Pieces of microplastics (those in size of about the diameter of a hair) can pass through organisms, like humans, however, smaller particles could conceivably pass through digestive sections and get stuck.

Microplastics in air

There are also microplastics floating around in the air we breathe in and are not visible. Research shows that plastic fibers released from synthetic clothes and furniture are the microplastics found in the air indoors. Even out in open mountain regions, microscopic pieces of plastic pollution are raining down from the sky. They have become a new atmospheric pollutant and can move everywhere as long as it is carried by wind or water.

Microplastics in soil

Microplastics can have environmental impacts on soil habitat and even threaten human health. Although microplastics have been widely discovered in aquatic ecosystems, their existence in soil environments remains mostly unexplored. In soil environments, mulching film, sludge, atmospheric deposition, and wastewater irrigation are the main sources of microplastics. From the wastewater treatment plants, sludge is produced and then used as fertilizer on agricultural fields. This gives benefits to soil fertility in many countries all over the world, however, the use of sludge is a passageway for microplastics to enter soil environments. Earthworms are essential to the farmland soil ecosystem. However, they feed on the soil and also ingest the microplastic particles. This causes digestion failure, limitation of absorption of nutrients and reduction of growth. They start to lose weight and eventually fail to thrive. Other than influencing worms, the microplastic particles also decrease soil pH. The diversity of organisms living there are directly affected. These particles do not remain in the soil; they end up in human bodies.

Causes of microplastic pollution

Where do all the microplastic pollution come from? Before diving into the pollution, we must determine what plastic is. Plastic is extremely long-lasting synthetic polymers. Most plastics are thrown away within a year. As the population of the world continues to increase, so does the amount of garbage people produce. The amount of microplastics in the environment is likely going to expand with the rising amounts of plastics being produced. Human activity is the biggest contribution to plastic pollution. The majority of the debris comes from sources such as plastic manufacturers, processors, sewage overflows, landfills, and litter. Plastic is even being used in concrete, roads, bricks, and paints. Widespread accumulation of plastic debris and waste management problems have been contaminating the natural environment. Plastic enters the ocean and breaks down into microplastic particles that can be easily ingested and can be found everywhere.

Mass amounts of plastic produced

People rely heavily on plastic because they can be used for so many products that make daily life convenient. For example, plastic packaging protects products from contamination or damage by light, insects, humidity, gases, moisture, and microorganisms. It also preserves products, prevents spillages, allows products to be transported over long distances, and saves space through stacking objects. Plastics are the optimal packaging material for a variety of modern products since there are many types of them that have particular functional properties such as being heat and chemical resistant, transparent, opaque, flexible and safe for food. Generally speaking, plastic packaging is used to make our lives easier, but too much of it turns into waste that contaminates our environment. Since six decades ago, mass production of plastics has increased so quickly that 8.3 billion metric tons of products have been created.

Plastic takes more than 450 years to degrade, so most of it still remains in our environment in some form.

Plastic going into our environment

The plastic one discards could make its way into the ocean even if one lives miles away from the coast. Once it gets into the ocean, the plastic degrades very gradually, breaking down into very small pieces known as microplastics that can damage the sea life incredibly. 80% of the plastic in the ocean comes from sources on land. Most of the plastic is not thrown off ships but is discarded carelessly on land and in rivers. After that, it gets washed or blown into the ocean. Beaches are littered with plastic waste that can trap and kill young marine creatures and seabirds. This is not the result of one family vacation but is the result of how people get rid of products after we are done. Although most of the waste that washes ashore comes from much farther inland, rapid growth in tourism still holds some responsibilities for the plastic littering. Millions of marine animals get killed by the ocean every year. About 700 species, including endangered ones, have been affected. Most species are harmed invisibly: from whales to zooplankton, marine species of all sizes are eating microplastics. Others are strangled by abandoned six-pack rings or discarded fishing nets. From sediments on the deepest ocean floor to ice in the Arctic, microplastics have been found everywhere that researchers have looked at.

Effects of microplastic pollution

The largest scale problem affecting the marine environment is plastic pollution. Plastic pollution contributes to climate change and threatens food safety and quality, ocean health, and human health.

Impacts on marine life

Marine wildlife such as turtles, fish, whales, and seabirds mistake plastic debris for food and as their stomachs are filled with plastic waste, most die of starvation. These species also suffer from internal injuries, reduced ability to swim, cuts and wounds, and infections. Floating plastics contribute to the spread of invasive species. This can cause disruption in the environment. To sea creatures, plastic may also look like a home to them. Evidence of barnacles, crabs and fish living in nets, plastic water bottles and body care product packaging were found in the Great Pacific Garbage Patch. Plastic is now a part of the sea.



Caption #2: Various fish and sea creatures interact with debris from a fishing net

Impacts on food and health

Invisible tiny pieces of plastic have been present in all of the world's oceans, including the Arctic and identified in tap water, beer, and salt. Plastic products release various chemicals that are cancerous and can damage the body's endocrine system. This would cause immune, reproductive, neurological and developmental disorders in both wildlife and humans.

Due to prolonged exposure to seawater and sunlight, toxic contaminants also build up on the surface of plastic debris. These contaminants enter the digestive system of the organism when they take in the plastic waste. As time passes, the toxic contaminants accumulate in the food chain. It has been identified that the transfer of contaminants between humans and marine species through the intake of seafood is a health hazard. The human food chain is being polluted by plastic debris.

Other than finding plastic in the ocean that could be harmful to human health, plastic pollution in the air is also an issue. Most uses of plastics are used as packaging. The plastic packaging can be processed in three ways: recycling, landfill or incineration. Waste incineration creates a large amount of greenhouse gas emissions and most incineration facilities are built near communities of low-income and color populations. People who are suffering from the pollution incinerators created are often the ones who are least responsible for the trash and have to bear the aftermath of the impacts. Incinerator workers and people living close to the facilities are exposed to the pollutants that the burning waste releases.

Impacts on climate change

Plastic pollution is not just an ocean problem, it is also a climate problem. Although plastics are cheap, durable, and lightweight, they originate as fossil fuels and emit greenhouse gases.

The making of plastic starts with oil and gas development. In order for plastics to be made, there must be coal, gas, and oil. They are the fossil-fuel part of plastics. Through fracking, oils and natural gases are extracted from the Earth. Wells are then drilled into the ground until the rock layer is reached. After that, they turn 90 degrees and drill horizontally. Sand, chemicals or water is injected so the rocks break up and release gas and oil.

Extraction and transportation of these fossil fuels emit plenty of carbon dioxide into the atmosphere. Greenhouse gas emissions also come from land disturbance. To create the perfect zone of cleared land for pipelines, millions of acres of land have been cleared. Not only does clearing land emit metric tons of carbon dioxide, it also impacts a lot of forests.

Major Countries and Organizations Involved

China

According to a 2010 study by the Wall Street Journal, China has approximately 8.80 million pieces of mismanaged plastic waste, marking it as one of the top producers of plastic waste in the world. Additionally, the country, as with many Asian countries, has been a location in which other countries have sent their waste. China has responded to this issue by establishing its own ban on the importation of plastic waste in 2017. Another initiative the country has taken is a ban on free plastic bags, which has led to a 66% decrease in plastic bag usage. Despite its efforts, China still is a mass producer of plastic pollution.

Indonesia

Following China, Indonesia is the 2nd largest contributor to plastic waste in oceans, with the use of 3.22 million tons per year. Indonesia's rivers—Brantas, Solo, Serayu, Progo—are included in the top-ranked polluted rivers, solidifying Indonesia's addition to plastic pollution. One situation in the city of Bandung had the assembling of the army due to the overwhelming amount of plastic pollution. In order to solve this problem, the country has developed a target goal to reduce its plastic waste by 70% by 2025.

The Philippines

The Philippines has had issues in decreasing waste material, with its Freedom Island engulfed with single-use sachets used for shampoo, toothpaste, etc. Sachets are one of the most-used plastics in the Philippines, due to its accessibility for those living in poverty. About one-third of the population in the Philippines are under the poverty line, making plastic and attractive material for items. According to The Global Alliance for Incinerator Alternatives, the country utilizes around 60 billion sachets per year. Along with countries such as Indonesia, Thailand, Vietnam, and China, the Philippines is responsible for 60% of

the world's marine plastic. International companies, such as Nestlé, account for the widespread use of sachets and other plastics. The company stated they are aiming to find alternatives in order to end plastic pollution, but neither the government nor the company has made significant changes to end the crisis.

Vietnam

Vietnam is another strong contributor to international plastic pollution, accounting between 28 to 73 million tons of plastic per year, which is around 6% of the total volume of plastic waste. Ho Chi Minh City generates around 250,000 tons of plastic, with around 19% of that plastic being sent to landfills and the remaining waste either to recycling plants or the environment. This leads to the country having polluted beaches and oceans, causing the deaths of thousands of marine wildlife. There are many different organizations that have originated in Vietnam to solve this issue, such as Change VN, Vietnam Green Generation Network, and CleanUp Vietnam. Other than the help of non-governmental organizations (NGOs), the government has made a goal to raise taxes on plastic bags and stop the use of non-recyclable plastics countrywide by 2025.

Greenpeace

Greenpeace is an NGO founded with the purpose of protecting the planet and striving to help the environment. Thus, the rise of plastic pollution has been an important topic for the group. Movements, such as “the Reuse Revolution” and the “Plastic-Free-Future Campaign” have been promoted by the NGO in order to convince people to decrease their plastic usage. Additionally, the NGO has strived to help companies such as Nestlé to limit their plastic production. Greenpeace has published many plastic reports and created petitions as well, solidifying its stance as an anti-plastic organization.

Coca-Cola

Coca-Cola is, for the second year in a row, the most polluting brand of plastic. There have been 11,732 found plastic pieces from 37 countries around 4 continents, not including pieces that have not been found so far. Coca-Cola is the highest source of plastic in Africa and Europe, being second in Asia and South America. In North America, Coca-Cola ranked 5th as the most-responsible for plastic waste. The company has stated that it has strived to increase its recovery of plastic bottles, creating its own organization in Vietnam and a recycling facility in the Philippines. Additionally, the company has developed a plastic bottle made from marine plastic, along with a pledge to recover “the equivalent of every bottle or can it sells globally.”

Nestlé

Along with Coca-Cola, Nestlé is another top producing company of plastic pollution. Nestlé is the top producer of plastic in North America. In the Philippines, the company was named the top producer,

which led to environmental activists declaring the company has created a “plastic monster.” The plastic-producing company has aimed to make 100% of its packaging either recyclable or reusable by 2025 by shifting towards food-grade recycled plastics. Also, the company has partnered with other organizations, such as Project STOP and the New Plastics Economy Global Commitment to address and target plastic pollution. Any Nestlé facilities are said to eliminate non-recyclable single-use plastics as soon as possible.

Timeline of Events

Date	Description of event
1841	Alexander Parkes' Parkesine
1869	Hyatt's development of the first synthetic polymer
1907	Creation of Bakelite, the first fully synthetic plastic
1997	Charles J. Moore discovers the Great Pacific Garbage Patch
2002	Bangladesh as the first country to ban lightweight plastic bags
31 December 2017	China begins a ban on imported plastic waste
2018	Microplastics found in human feces for the first time
24 October 2018	EU Parliament approves a ban on single-use plastics

Relevant UN Resolutions and Treaties

- Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, 22 March 1989
- Marine plastic litter and microplastics, 4 August 2016, **(UNEP/EA.2/Res.11)**
- Oceans and seas, 4 August 2016, **(UNEP/EA.2/Res.10)**

Possible Solutions

One of the central ways to combat microplastics already present in the ocean is for countries, organizations, or companies to **research different techniques and possibilities to remove plastics from the ocean**. One example of technology already developed is hyperspectral imaging technology, which allows people to quickly identify microplastics in the sea. Despite the value of detecting these

impurities in seawater, a disadvantage of these new technologies is the amount of money to produce these products, which disrupts its effectivity. However, with the possibility of funding to allow scientists and inventors to develop technology, this could have a powerful change to reduce microplastics.

Another solution is to offer **financial incentives and convince corporations to decrease their net plastic usage**. Many governments have not made as many valiant efforts on reducing plastic due to its involvement in each country's economy. The limiting of plastic products could lead to a decrease in consumers for certain companies due to possible lack of convenience and high costs. Thus, incentives such as plastic taxes, tariffs on exported plastics products, and lowering interest rates for corporations may be used by these countries. Examples of some countries that have either banned or placed a tax on plastic bags are India, Kenya, Uganda, Germany, and Indonesia. However, financial incentives are not commonly placed is due to major corporations swaying the views of government officials, due to the financial benefits both parties receive from the use of plastic.

Limiting the amount of microbead use or banning it completely would do marine life and our environment a huge favor. In 2015, the US enacted the Microbead-Free Waters Act to ban microbeads. The law prohibits the manufacturing, packaging, and distribution of rinse-off cosmetics that contain plastic microbeads. Countries such as the United States of America, Canada, Sweden, the Netherlands, and New Zealand are countries that have banned the use of microbeads in products. Microbeads could be easily removed and be replaced by more environmentally friendly alternatives. However, due to the population heavily relying on these certain products, completely removing all microbeads would take extreme devotion and effort.

Lastly, countries should regulate single-use plastic. Biodegradable products are also known as "bio-waste". They are beneficial to our environment since it reduces waste and saves energy. Most plastics the human population is using right now are single-use plastics and cannot be completely broken down properly. There are biodegradable plastics already existing in the world, which are called bioplastics, and they are made from material such as plants rather than fossil fuels. Bioplastic can be degraded by microbes, turned into biomass, water, and carbon dioxide. They also do not release chemical contaminants when being broken down. There are at least 127 countries that have accepted some form of legislation to regulate plastic bag use. In the Marshall Islands, importation, manufacture and use of single-use plastic bags, styrofoam cups and packaging have been banned. Although banning single-use plastic may seem effective, many countries only favor partial bans over full bans. Partial bans do not completely ban all plastic bags but instead include requirements on the plastic bag thickness or composition. Even when plastic pollution is becoming a greater issue, there are still virtually no countries that restrict the manufacturing and production of plastic bags.

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