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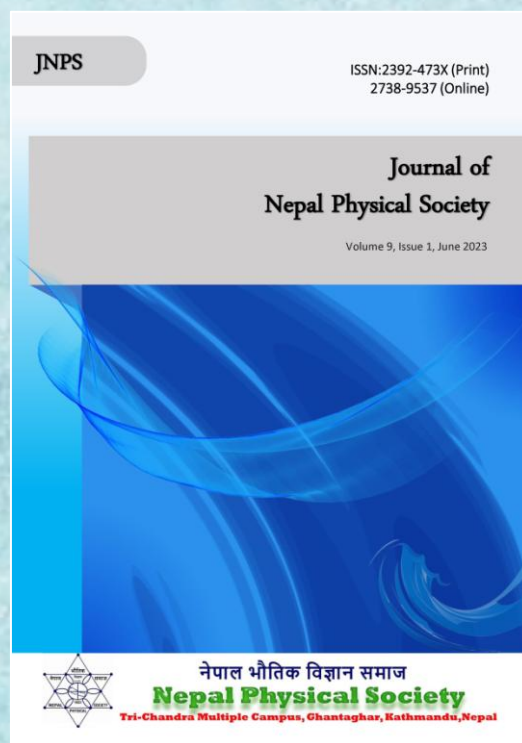
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Plastic: A Boon but Also a Curse to the Environment

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ABSTRACT

Besides being a significant part of our daily lives, plastic has a detrimental negative environmental impact thanks to its non-degradable nature. The dependency and impacts of plastics have been carefully analyzed in order to investigate their effects on the environment. The paper studies large scale production, use and the impacts of plastics on the environment. Investigation on the ways plastics affect soil, atmosphere, water and health of living beings have been done. Similarly, the statistical data about their use and effects have been presented and future projections have been made.

Keywords: Plastic, Synthetic polymer, Environmental pollution, Health hazard.

1. INTRODUCTION

Plastics are widely utilized in a variety of products, including bottles, food packaging, clothing, medical supplies, electronics, construction material, etc. The environmental burden of plastic garbage pollution is already generally understood, especially in the aquatic environment where there are persistent biological problems. Electronic waste (e-waste) is increasingly posing serious environmental and public health risks due to the high plastic content of this material and the lack of effective treatment methods in many countries [Saha *et al.*, 2021]. Although plastics used for sheeting and packaging are typically thrown away after use, they are pervasive and persistent in the environment because of their durability [Ugoeze *et al.*, 2021]. The reports so far are concerning, notwithstanding the fact that research on the monitoring and impacts of plastic wastes is still in its infancy. Humans frequently utilize plastics made of gasoline in their homes and places of employment. When these polymers reach the end of their useful lives, they are frequently landfilled with other solid waste. Electronic waste (e-waste), which contains a lot of plastics and isn't properly treated in many countries, is posing a serious risk to the environment and public health on a global scale.

1.1. Environmental pollution due to plastics

Demand for plastics and plastic products has increased as a result of the increasing human population. Indiscriminate disposal of waste from plastics and plastic products can result in environmental pollution, which is visible in a number of ways, such as the degradation of the environment's natural beauty, the entanglement and death of aquatic organisms, the clogging of sewage systems in towns and cities, particularly in developing nations, the creation of an environment that is favorable for the breeding of mosquitoes and other disease-carrying vectors, and the production of foul odors.

1.2. Soil Pollution

Plastic goods are widely used in the workplace and in domestic settings. Plastic pollution and plastic product contamination can harm and contaminate the terrestrial ecosystem and then spread to the aquatic environment. Despite the fact that roughly 80% of the plastic garbage present at sea comes from sources associated with land, there isn't as much data on the amount of plastic waste on land as there is on plastic debris in marine ecosystems [Alabi *et al.*, 2019]. Plastic additives (such as stabilizers, harmful colorant moieties, plasticizers, and heavy metals) can leach and eventually

percolate into various aspects of the environment, causing soil and water contamination. Dumping plastics on land or landfilling plastics causes abiotic and biotic degradation of the plastics. According to reports, sewage sludge and soils might still contain microplastics and synthetic polymer fibers five years after their application [Yang *et al.*, 2021]. Chlorinated plastics have the ability to release hazardous compounds into the soil, which can then leak into nearby aquatic systems or underground water, damaging the environment [Lamizana *et al.*, 2018].

1.3. Water Pollution

Approximately about 199 million tons of plastic wastes are expected to be present in the water resources by 2020, while an average of about 13 million tons is released every year into the water resources. Almost 6 trillion plastic pieces are expected to be floating on these resources as of 2020 [Alabi *et al.*, 2019]. Plastics in the water typically disintegrate over the course of a year, though not fully. Water pollution can result from the release of harmful compounds like polystyrene and BPA into the water during this plastic degradation process [Alabi *et al.*, 2019]. About 80% of the waste discovered in the water is made of plastic [Alabi *et al.*, 2019]. Sea animals can quickly colonize floating plastic waste, and because it remains on the ocean surface for a long time, this may slow the spread of 'alien' or non-native species. Because microplastics are present in benthic and pelagic environments and are tiny, they are accessible to a wide range of marine life. Plastics have been shown to concentrate and absorb pollutants found in saltwater from several other sources within the marine ecosystem [Bhatt *et al.*, 2021]. Examples of these pollutants include PCBs, dichlorodiphenyldichloroethylene (DDE), nonylphenol, and phenanthrene, which have the ability to accumulate on plastic trash at a rate many times greater than in the surrounding saltwater. More than 260 species of marine organisms, including turtles, invertebrates, seabirds, fish, and mammals, consume or become entangled in or with plastic trash, which reduces their ability to move, forage, reproduce, heal wounds, and ultimately kills them [Alabi *et al.*, 2019].

1.4. Air Pollution

When plastic wastes that are landfilled finally begin to break down, carbon dioxide and methane are released into the atmosphere. An estimated 850 million tonnes of carbon dioxide equivalent (eqCO₂) were released into the atmosphere in 2019 as a

result of the breakdown of solid waste in landfills [Vetter, 2022]. Burning plastics and plastic items also releases carbon dioxide into the atmosphere, and this gas has the ability to retain radiant heat and prevent it from escaping the earth, causing global warming [Edmond, 2022]. More than 6 million deaths linked to environmental pollution are attributable to air pollution, which is one of the biggest environmental risks to public health [Vetter, 2022]. Open burning of plastics and plastic items emits pollutants such as heavy metals, dioxins, PCBs, and furans that, when breathed in, provide a health concern, particularly for respiratory conditions. It is impossible to overstate the contribution of plastics to air pollution in emerging and underdeveloped nations of the world, and the effects on future generations could be profound.

1.5. Effects of Plastic Waste on Animals

Animals poisoned by poisonous substances from plastic garbage and plastic items can have a negative impact on human food sources. Large amounts of plastic garbage entering the world's oceans have been reported to pose a threat to the survival of large marine mammals. Ingestion and entanglement are the two main ways that animals are exposed to plastic garbage, however ingestion happens more frequently than entanglement [Ryan, 2019]. The majority of oceanic animals mistake plastic debris deposited there for food and eat it [Parker, 2016]. Furthermore, marine animals may suffer harm, damage, or even pass away as a result of becoming entangled in plastic items like nets. According to reports, over 260 distinct species of vertebrate and invertebrate creatures consume plastics or become entangled in plastic or plastic-related goods, leading to the deaths of more than 400,000 marine mammals [Alabi *et al.*, 2019]. Because they frequently mistake discarded plastic bags for jellyfish, sea turtles and other species whose primary food source is jellyfish are significantly harmed by marine pollution caused by plastic trash. Similar situations frequently occur with fish and seabirds, both of which can mistake plastic garbage for their natural prey. Fish can also mistake plastic waste for cuttlefish.

2. MATERIALS AND METHODOLOGY

Plastic, as a part of almost each activity in our daily lives is a very important factor on which human beings have to depend on. To understand the wide application and the effects of plastic, different articles have been studied, analyzed and the results from the past have been discussed. By studying the

different articles, the conditions about the past and present have been presented. Different reports have been looked upon and their results have also been discussed. Furthermore, different graphs and tables have been sketched on the basis of these data so as to have an enhanced understanding of the application and effects of plastic. On the basis of the data, a few future projections have been made. Finally, some suggestions have also been given on the basis of reports.

3. RESULTS AND DISCUSSION

The study's description and major findings have been covered in this section. In addition to future

situations being predicted, several statistical facts have been highlighted. The section tries to display several forms of facts addressing how plastic affects soil, water, and the atmosphere. The analysis conducted by earlier academics has been mentioned in the section as support for this. Data are presented individually below as we discuss the use and effects of plastics:

3.1. Use of Plastics by Countries

Plastic is a major part of our everyday life. It may be impossible to sustain our life if there were no plastics. The following Figure (1) gives the description of plastic waste produced per person, per nation:

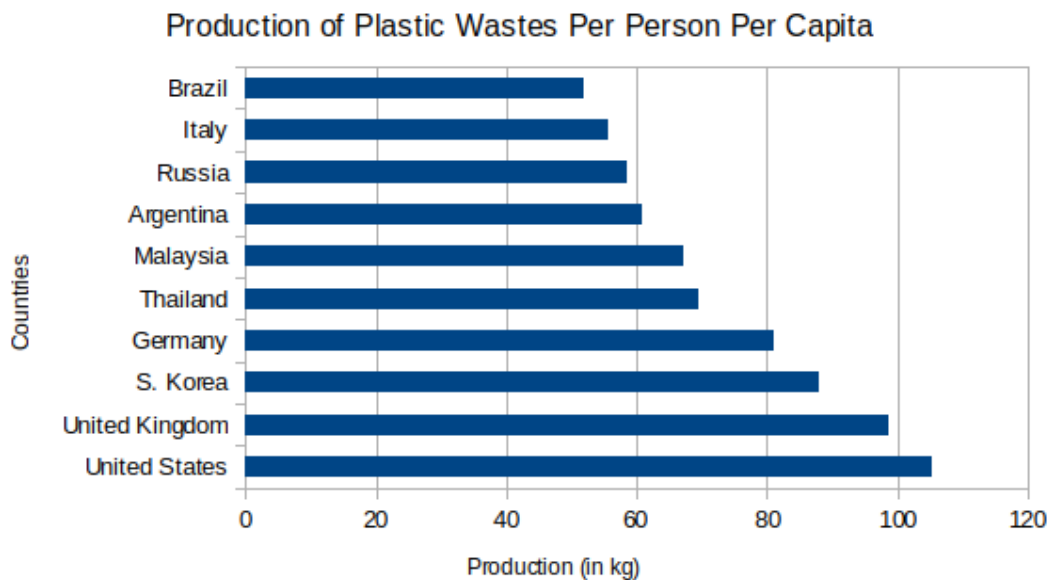


Fig. 1: Use of Plastics per person, per nation.

Source: www.forbes.com (November 11, 2020)

As the graph indicates, the United States uses the most plastic bags due to its large population and frequent retail sales of goods. It may come as a surprise that the UK, with its extremely low population, came in second. Other nations from all across the world follow these two. It may come as a surprise that China and India, two of the most populated nations on earth, are not included on the list given that it is commonly believed that they would produce the most plastic garbage.

3.2. Use of Plastics by Types

Different types of plastics like PVC, polypropylene, thermocol and much more are used by the people in their daily lives. The following Figure (2) shows the use of plastic by its types.

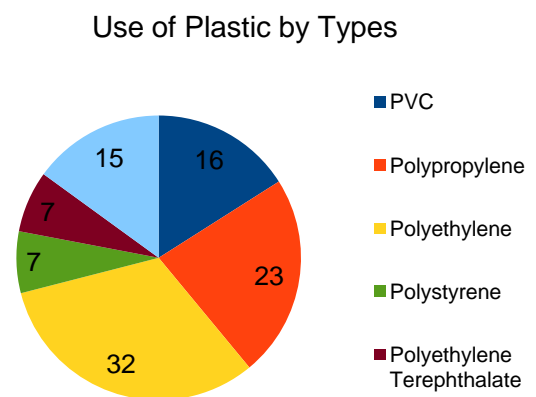


Fig. 2: Use of Plastics by its types.

Source: timesofindia.indiatimes.com (December 8, 2018)

According to the accompanying chart, polyethylene is the plastic used the most frequently. Given that this kind of plastic is used to produce bottles, transport commodities, and other things, it makes perfect sense. Similar to polyethylene, polypropylene is also utilized extensively due to its numerous uses in the production of buckets, cutlery, etc. The other polymers that are utilized extensively include PVC, polystyrene, and PET.

3.3. Use of Plastics in Different Purposes

Plastic, as a major part of our daily life, is used for different purposes. The following Figure (3) discusses the use of plastics by its purposes.

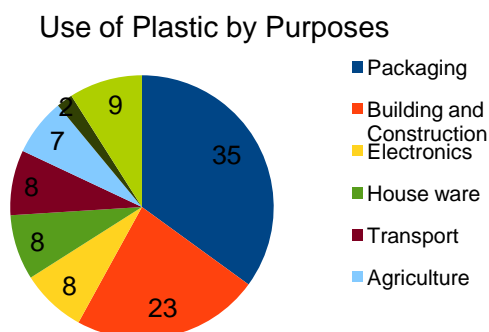


Fig. 3: Use of Plastic by its Purposes.

Source: www.researchgate.com (December 2006)

Given that practically everything is packaged in plastic, the given chart implies that the majority of plastic that we consume in our daily lives is used for packaging. Plastics are extensively used in construction and building. In addition, a lot of

plastic is used in agriculture, housewares, transportation, and electronics.

3.4. Effect of Plastics on Atmosphere

Our daily use of plastics has a significant impact on the environment. It emits into the atmosphere a variety of hazardous gases, including CO₂ and CH₄. As of 2019, 850 million metric tons of greenhouse gases are anticipated to be released by plastic, according to data collected by CIEL [Vetter, 2022]. Even more, according to analysts, this data might total 2.8 gigatons by the year 2050 [Vetter, 2022]. Globally recognized experts predict that the emission of plastics is responsible for about 4% of the greenhouse gases created [Kamara et al., 2021]. Researchers even contend that 6 million deaths worldwide are brought on annually by open burning of plastics. Heavy metals, dioxins, PCBs, and furans are primarily released due to open burning of plastics and plastic products. Additionally, it is even believed that burning plastic contributes significantly to the ozone layer's deterioration. Even more dire predictions state that the number of deaths annually from the air pollution brought on by plastic could reach 12 million by the year 2045 [Kamara et al., 2021].

3.5. Effect of Plastics on Water

More so than on land or in the air, researchers contend that plastic has a fatal impact on the marine ecosystem. More than 260 species of marine animals are expected to suffer injury and finally perish as a result of the discharge of plastics in water. More than 400000 marine animals are reportedly killed annually as a result of plastic garbage, according to scientists [Alabi et al., 2019]. How plastic wastes harm marine species is depicted in the following Table (1).

Table 1: Effects of plastics on marine animals [Alabi et al., 2021]

Species	Specie Variant	Plastic Type	Effect
Sea Bird	Greater Shearwater	Plastic bottle cap	Starvation due to gastrointestinal obstruction
	Magellanic penguin	Fragments, line and straws	Stomach perforation
Sea Turtles	Green sea turtles	Plastic bags and other debris	Impediment of hatchling movement towards the sea, exposure to predators
	Leatherback turtle	Plastic bags and debris	Blocked and injured cloaca, impedes laying of eggs
Fish	Bigeye tuna	Fragment line	Ingestion of plastic fragments
	Japanese medaka	Particulate plastic	Hepatic stress from exposure to plastic pollutant
	Orchid dottyback	Plastic bags	Leached nonophenol additives caused mortality

	Larva Perch	Microplastic particles	Inhibited hatching, decreased growth rate and altered behavior
Mammals	Fur seal	Plastic particles	Bioaccumulation of particulate plastic from prey fish
	Sperm Whale	Plastic bags and debris	Stomach rupture and starvation
	Australia Sea lion	Plastic fishing gear	Entanglement caused mortality
Invertebrates	Urchin larva	Polyethylene pellets	Plastic leachates caused abdominal development
	Mussels	Microplastic particles	Accumulation of microplastic in circulatory system
	Oyster	Microplastic particles	Interference with energy uptake and reproduction
	Norway lobster	Plastic strands and particles	Ingestion and accumulation of plastics in the gut

The above table unequivocally demonstrates how plastic trash in water affects the majority of aquatic creatures. Their digestive, circulatory, and reproductive systems could all be impacted, and it could even result in death.

3.6. Effect of Plastics on Land

Plastic consumption is anticipated to have a significant impact on land as well. According to research on plastics on land, plastic waste that is dumped close to natural resources is one of the main causes of disasters like erosion, landslides, floods, etc. A lot of reports show that disposing of plastic has a detrimental effect on the earth. It causes the soil's top layer to deteriorate, render it infertile, and emit dangerous chemicals that contaminate the crops. According to estimates, this affects more than a quarter million people a year, and the effects are getting worse [Edmond, 2021].

3.7. Overall Calamities Caused by the Use of Plastics

According to a study conducted by academics, plastic pollution contributes to a significant number of ailments. People appear to have lung issues as a result of harmful chemical emissions and plastic burning. Furthermore, it is anticipated that incorrect plastic disposal on land will leak hazardous chemicals into the soil, making the soil unusable. Researchers even contend that the discharge of plastic in water endangers the lives of numerous marine species. According to reports, one of the main factors contributing to the ozone layer's depletion is the use of plastic. According to experts,

such a huge consumption and incorrect disposal of plastic might terminate all of civilization.

4. CONCLUSION

Plastic plays a significant role in practically every aspect of our everyday lives and work. It is utilized in the construction, packaging, textile, and other industries, making it a highly important component of our daily lives. However, the same plastic that we have been using in such large quantities also has a number of negative impacts on the environment. Plastic trash is a significant environmental issue, according to studies on worldwide plastic manufacturing and related environmental contamination.

Plastic is incredibly helpful in our daily lives, but we must not ignore the hazardous substances it releases. The overall harm that plastic has done to our lovely planet is truly catastrophic. Another issue that has to be brought up is the burning of plastic, which has been destroying the ozone layer for decades. The calamities, catastrophes, sicknesses, etc. that plastic has produced cannot be hidden, despite the fact that it plays a significant role in our daily lives. The harm that plastic consumption has done to the world is just fatal.

This research paper comes to the conclusion that, despite playing a significant role in our daily lives, the usage of plastic also poses risks and harms. It is one among the elements contributing to the general degradation of soil, air, and water. This is a very significant issue that needs to be resolved right

away. In order to decrease both the expense and the pollution, a solution that is equally affordable and versatile as plastic should be considered. The likelihood of having a clean environment and a healthy society will rise when toxins from plastic wastes are exposed to less of the community. Enacting and enforcing environmental rules that would oversee the manufacture, use, and disposal of plastics is urgently needed by government organizations and health authorities. Additionally, some dangerous chemical components utilized in the manufacture of plastics, such as phthalates and BPA, should be prohibited in consumer goods and plastic items that come into contact with children, food, and beverages.

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