

Plastic Usage During and Post COVID-19 Pandemic: Effects and Potential Strategies

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Abstract (Yuan Wu)

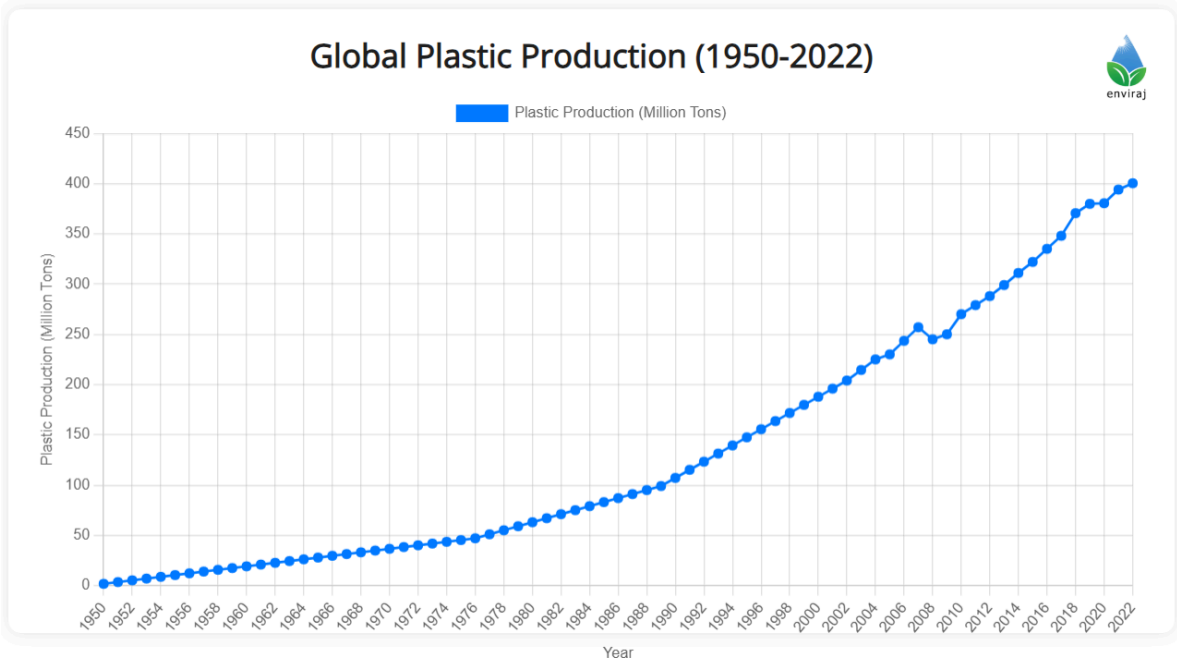
The global plastic usage and production issue during the COVID-19 Pandemic requires strategic, solid controls. In this passage, under the COVID-19 background, we highlight the effects of producing and using a large amount of plastic, summarize the factors that cause increasing production and usage of plastic, and propose some ways to deaden the environmental problems caused by the mass production of plastic products under the epidemic. The production of plastic substances brings a series of serious environmental, economic, and human health problems. Several factors are pushing the production and usage of plastics, including changes in people's behavior, demand for protective equipment, and laws and regulations. Thus, we propose three ways, including government leadership, social participation, and individual responsibility, to de-escalate the detriment caused by plastic matter.

Keywords

COVID-19, plastic waste management, single-use plastics, environmental impact, sustainable solutions, Extended Producer Responsibility (EPR), biodegradable plastics, Personal Protective Equipment (PPE), microplastics, waste reduction strategies.

Introduction (Yuan Wu)

Although plastic products are cheap and easy to use, they are a major drawback to the environment - they are difficult to degrade and will cause land pollution; they contain toxic substances that will harm people's health; and their production process will emit a large amount of carbon dioxide, leading to global climate change. The twelfth goal of 17 Sustainable Development Goals established by the United Nations is to achieve responsible consumption and production - more specifically, to reduce the production of plastic products (UN, 2023). In 2020, the fifth year of implementing this goal, the new coronavirus first broke out in China and then spread to the world, which greatly changed the lifestyle of people worldwide (WHO, 2022). At first, the growth of plastic products in 2020 was almost zero, as Figure 1 shows. One reason is that, in the early stage of the epidemic, many plastic products were forced to stop due to factory closures. Just when people thought that the momentum brought by the epidemic to slow down plastic production would continue to increase, an accident happened - the number of plastic products has risen rapidly since 2021 (Huizen, 2021). In order to reduce the infection rate, many countries do not advocate using reusable items, instead turning to disposable plastic products that can be used and discarded. This has led to a rapid increase in the number of plastic products. Furthermore, in this article, we will analyze the harm caused by plastic products to people, the factors related to the COVID-19 epidemic in the production of plastic products, and give methods to control the production of plastics.



Source: PlasticsEurope

Figure 1: The Global Plastic Production from 1950 to 2022

Effects (Shelly Han)

The increase in plastic usage during the pandemic has led to several harmful effects, including environmental consequences, economic consequences, and health hazards.

Environmental Consequences

The COVID-19 pandemic has greatly worsened plastic pollution, especially in the oceans. The increased use of single-use plastics, such as masks and gloves, led to an estimated 1.56 billion face masks entering the oceans in 2020, increasing an extra 4,680 to 6,240 metric tons of plastic waste in the sea (OceansAsia, 2020). Microplastics, originating from the degradation of larger plastic items, persist in marine environments for centuries, disrupting marine food webs.

Zooplankton and phytoplankton ingest microplastics, which then travel up the food chain to larger animals like fish and sea turtles, causing physical harm and death. For example, a study on the harmful effects of microplastic pollution on animal health found microplastic ingestion affects marine organisms' reproductive and feeding behaviors, leading to population declines (Zolotova et al., 2022).

Coral reefs are also harmed, as plastics increase the chance of coral diseases from 4% to 89%, threatening their health and, in turn, the ocean's productivity and food chain. According to a study in Science, coral reefs that come into contact with plastic are more likely to get diseases, leading to coral bleaching and death (Science, 2018)(Figure 2).

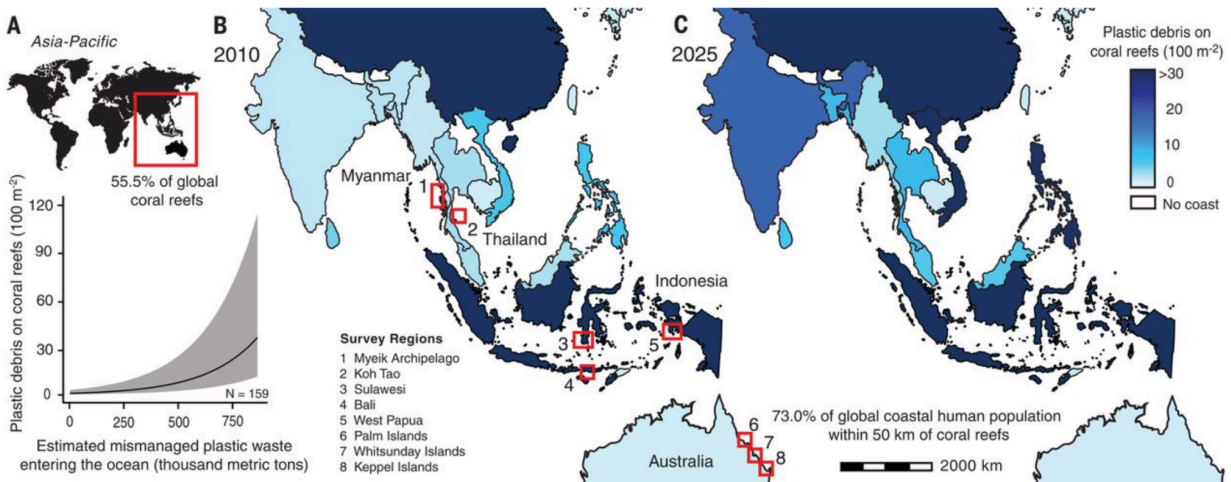


Figure 2: Estimated plastic debris levels on coral reefs.

In addition to marine environments, plastic pollution also affects air quality through toxic emissions from burning plastics and contaminates soil in landfills with microplastics.

Incineration releases harmful chemicals like dioxins and furans, contributing to air pollution, health risks, and global warming.

Economic Consequences

The economic burden of cleaning up plastic pollution has increased during the COVID-19 pandemic. Single-use plastics increased in many sectors to prevent virus spread, making waste management more difficult. Disposal costs for municipal solid waste (MSW) and solid medical waste (SMW) rose sharply, with MSW costs between \$90 and \$242 per tonne and SMW costs between \$12 and \$1530 per tonne (Roy et al., 2021). The higher costs come from increased waste and the need for special handling of contaminated materials. This has put extra financial pressure on municipalities dealing with the waste problem.

Cleanup efforts are essential to maintain public health and environmental aesthetics but come at a high price. Additionally, plastic pollution harms tourism and fisheries. Polluted environments

deter tourists, affecting local economies, and marine plastic pollution reduces fish stocks, harming the livelihoods of those dependent on these industries.

Health Hazards

The increase in plastic pollution during the COVID-19 pandemic has serious health implications due to microplastics in food and water. Studies have shown that microplastics have entered various food chains, raising concerns about their long-term health effects on humans. An article published in *The Guardian* mentioned that there are microplastics in 83% of global tap water samples and various food items (*The Guardian*, 2017). These tiny plastic particles can absorb toxic chemicals, which then enter the human body, potentially causing hormone disruption, reproductive issues, and cancer. Increased reliance on plastic-packaged food and bottled water during the pandemic has likely worsened these health risks.

Factors (Aliyah Duan)

It is undeniable that COVID-19 generated a huge impact on people's daily lives. Multifaceted factors during this period contributed to the significantly increased usage, waste, and pollution of plastic.

Changes in People's Behavior and Living Habits

First and foremost, people's behavior changed dramatically during the epidemic. People's hygiene awareness gradually increased due to fear of infection. It is reported by a research in the US that school/workplace prophylaxis could have a dramatic impact on attack rates (Ferguson et al., 2006). This led to the increased frequency of daily disposable item use, such as disposable plastic tableware. In addition, partially due to policy requirements, people had drastically reduced the frequency of going out and spent most of their time at home. So, to meet basic needs, people had to rely on takeaways and online shopping, increasing the consumption of single-use plastic items and plastic packaging. The data shows that the percentage increase in online shopping and takeaway services during the epidemic was extremely high in countries around the world, with the United States up to 78% in the sample countries, followed by Singapore and South Korea at 65% and Vienna at 57% (Fig. 3) (Neha Parashar et al., 2021). The massive use of takeaway containers as well as courier packaging has led to a sharp rise in the amount of waste plastic generated in people's daily lives during the lockdown.

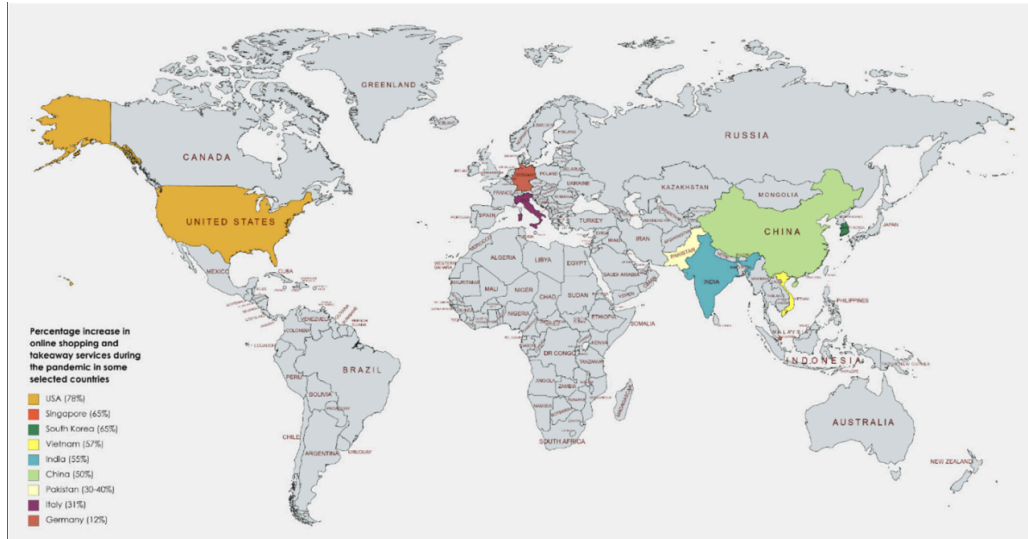


Figure 3. Percentage increase in online shopping and takeaway services during the pandemic in some selected countries.

Increased Demand and Use of Personal Protective Equipment

Besides, as the most common and principal personal protective equipment (PPE) during COVID-19, most face masks and gloves are composed of non-biodegradable polymeric substances (Yaser A. Nanehkaran et al., 2023). According to FT-IR spectroscopy analysis conducted by Sungyup Jung and other co-authors (Table 1), while face masks are divided into separate parts, polypropylene(PP) and polyethylene(PE), which are categorized as plastic, relatively account for large mass proportions. Since face masks and gloves serve as efficient means of source control (Centers for Disease Control and Prevention, 2023), in order to reduce the risk of healthcare workers' occupational exposure and generally control the number of people infected, demand for PPE surges. Further, due to concerns about the risk of coronaviruses surviving on masks, almost all masks are discarded after 1-2 uses, sharply increasing the consumption and replacement rate of one's mask usage. Based on World Health Organization (WHO) modeling, an estimated 89 million medical masks and 76 million gloves are required for the COVID-19 response each month. At the same time, it is calculated that a single disposable

mask contains around 4.5g of polypropylene (Shruti et al., 2020). These indicate that around 400.5 thousand kilograms of plastic waste is generated merely through medical masks, reflecting an enormous amount of plastic demand and tremendous pressure on the environment when treating the used plastic-made PPE.

Parts	Chemical compositions	Weight percentage (wt.%)
Filter layers 1, 3, 4	PP	73.33
Filter layer 2	PE	13.77
Ear strap	Nylon	8.27
Nose frame	Metals	4.63 (Fe: 4.58, Zn: 0.02, Ti: 0.01, Ca: 0.01, and Mn: 0.01)

Table 1

Lifting of the Plastic Ban

From the political and economic perspective, many countries like the US, the UK, Canada, and Portugal have temporarily revoked or deferred the SUP bans during the COVID-19 pandemic (Parashar et al., 2021). Also, the European Plastics Converters (EuPC) announced a revocation of the ban on SUP among states of the European Union (Financial Times, 2020). Aimed to reduce cross-contamination caused by the reuse of single-use plastics, a number of restrictions on the use of plastics have been lifted worldwide. Meanwhile, the decreased cost of plastic manufacturing led to higher plastic production. This is caused by plummeting oil and petroleum prices due to reduced transportation activities during the pandemic-induced lockdowns (Eco-Business, 2020). Simultaneous increased supply and demand for plastics and unrestricted plastic use contribute to huge plastic usage during COVID-19. The issue of microplastic pollution into the environment during the production process of plastic products and the post-use disposal of plastic products has also been exacerbated.

Recoveries (Eva Wang)

Recovery Strategies

To ameliorate environmental and societal damages set off by plastic during the epidemic, people adapt several strategies in governments, businesses, and individuals aspects, as Figure 4 (Schleicher, 2021) shows. By implementing these actions, people aim to build a sustainable plastic usage society.

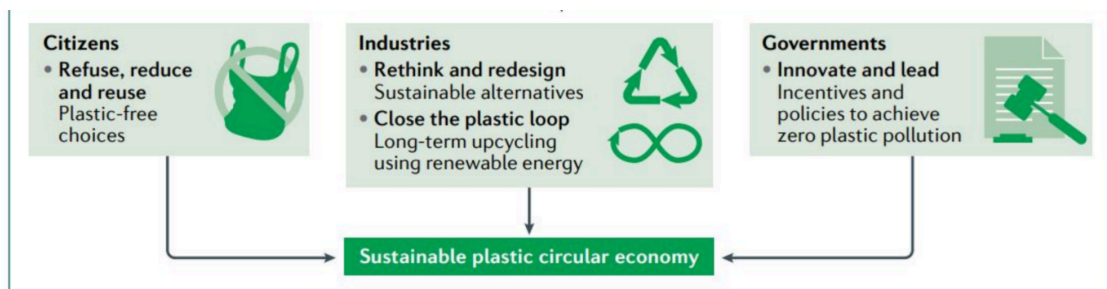


Figure 4. A proposed shift toward a circular plastic economy.

Extended Producer Responsibility (EPR) Enforced Governance

Since its introduction in the 1990s, EPR has effectively controlled plastic usage globally. Owing to the increased demand for single-use plastic in the era of COVID-19, EPR adopted new incentives and funding programs to encourage industry actions that phase out these non-recyclable products through laws and policies. Some countries have already put these regulations into practice. For example, Thailand banned the use of disposable plastic bags starting in 2020, which helped to reduce plastic bags production by more than 400 million in the country (Kasikorn Research Center, 2020) that year. Later, in 2022, Thailand also banned using styrofoam packaging and single-use plastics in national park areas to protect wildlife species. The gradual implementation of sustainable strategies would significantly help the nation restore

the balance of the environment years after COVID-19, as Thailand sets its goal to have plastic “100% recyclable” by 2027 (Vietnam+, 2022). Seeing pioneers make great environmental improvements within a few years, other countries can begin to take similar actions. As for the U.S., Minnesota is the fifth state to approve the packaging EPR law, planning to implement it by 2025 and achieve significant effect by 2029 (Rachal, 2024).

Sustainable Alternatives

Society is accelerating the transition towards more environmentally friendly packaging products as traditional plastic production is limited. One potential substitute is biodegradable plastics. This product can be broken down entirely and quickly by microorganisms in nature. Without accumulating in the environment, biodegradable plastics contribute less to landfills and contamination and only release non-toxic components during the process. A significant 500% reduction in carbon emissions will also be reached (Polystar Plastics, 2020) in the decomposition process. All of these advantages ensure biodegradable plastics' safety and mildness when utilized and help to mitigate stress put on the environment to a great extent. People's inclination also shows how promising this means can be. According to Innova Market Insight, 41% of consumers felt confident of biodegradable plastic as the "most eco-friendly" solution (Schleicher, 2021). Therefore, after considering its overwhelming environmental benefits and trustworthiness, producers should be willing to go into producing biodegradable plastics.

Education

Apart from the actions taken by governments and industries, individuals also play an essential role. Due to our extensive access to digital platforms and the inconvenience of going out during

the pandemic, we can also share relevant knowledge and tips online. Creating hashtags like #ReducePlasticWaste and collaborating with influencers on social platforms can spread information quickly to a wide range of people. Specifically, to cultivate younger generations, schools and communities should be involved in courses and activities like recycling programs or seminars that help kids to establish and fortify their sense of environmental protection -- recycle, reuse, and reduce plastic (Wang et al., 2023). Eventually, a trend protecting the environment will be formed and prevail in society.

Conclusion (Yuan Wu)

We focused on plastic production during the pandemic, analyzed the effects of increased plastic production, summarized the factors driving plastic production, and suggested ways to improve it.

The effects and factors we presented are innovative and provide a unique and multiple perspective on the plastics industry during the epidemic. The improvements we advocated are feasible and can contribute to the achievement of 17 UN Goals which highlight Sustainable Development. However, our paper has some shortcomings. We focused on marine life in our impact analysis and did not concern the impact of plastic on terrestrial life. Moreover, although we have proposed three ways to improve, we cannot avoid the challenges in implementing these methods, such as national legal restrictions, corporate inaction, or lack of supervision.

Particularly, our research will help future researchers on other factors of environmental pollution in COVID-19 and suggest more precise measures to improve the environment.

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