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The Effects and Potential Strategies of Plastic Usage during and after COVID-19 Pandemic

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Abstract: *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 summarize the factors that cause increasing production and usage of plastic, highlight the effects of producing and using a large amount of plastic, and propose some ways to deaden the environmental problems caused by the mass production of plastic products under the epidemic. Several factors are pushing the production and usage of plastics, including changes in people's behavior, demand for protective equipment, and laws and regulations. These factors drive the production of plastic substances, bringing with them a series of serious environmental, economic, and human health problems. Thus, we propose three ways, including the government leadership, social participation, and individual responsibility, to de-escalate the detriment caused by the 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*

1. Introduction

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[1]. 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[2]. 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[3]. 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. 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 predict the future trends and challenges of plastic production.

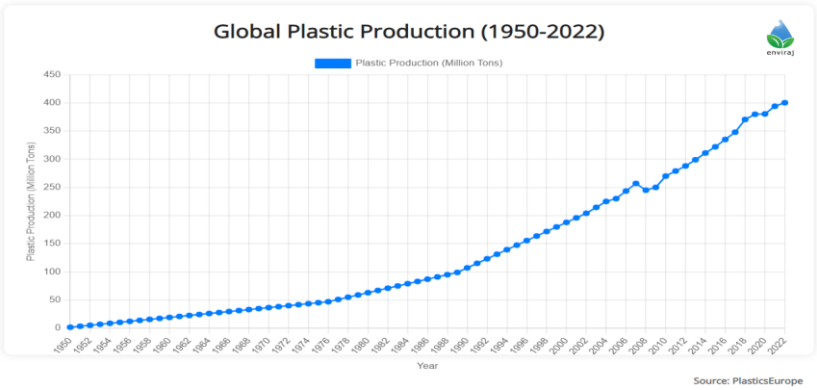

Figure 1: The Global Plastic Production from 1950 to 2022

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2. Effects

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

2.1 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[4]. 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[5, 6].

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[7](see Figure 2).

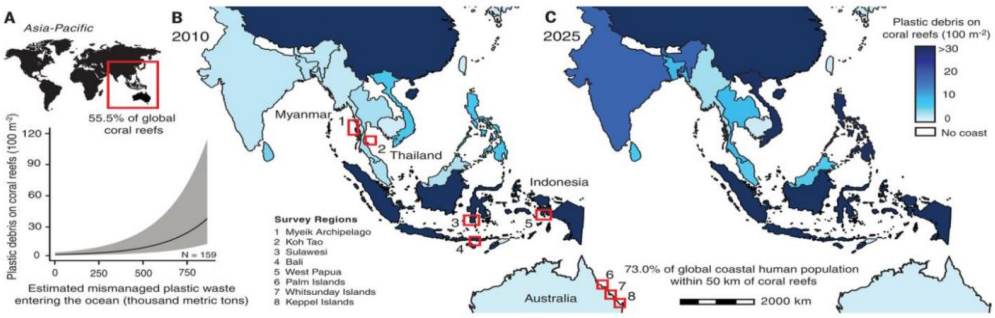

Figure 2: Estimated plastic debris levels on coral reefs.

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.

2.2 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[8]. 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[5].

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.

2.3 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[9]. 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[5].

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3. Factors

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.

3.1 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[10]. 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% (see Fig. 3)[11]. 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.

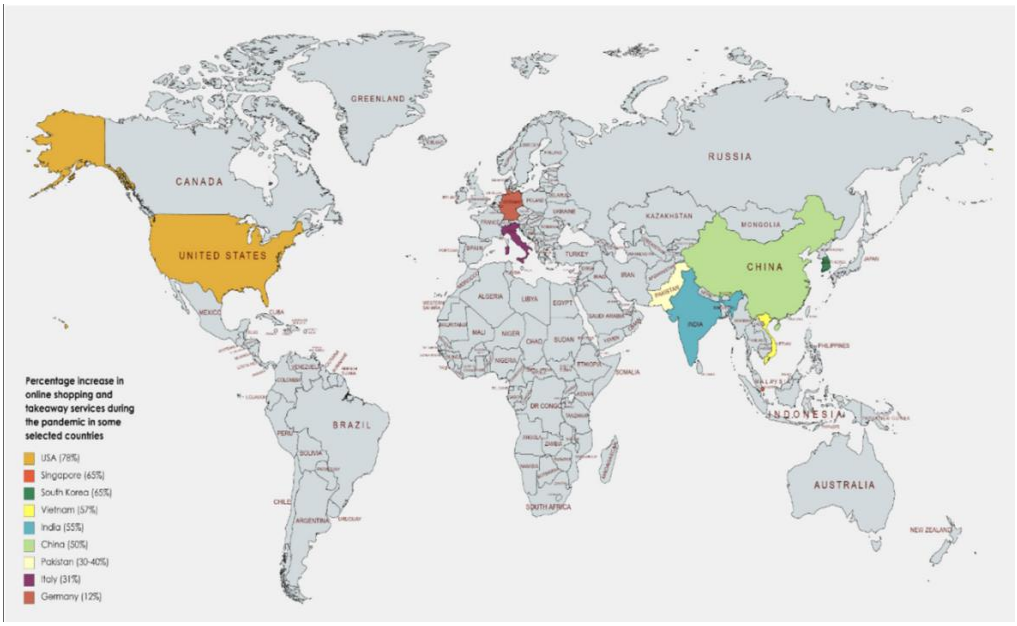

Figure 3: Percentage increase in online shopping and takeaway services during the pandemic in some selected countries.

3.2 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[12]. According to FT-IR spectroscopy analysis conducted by Sungyup Jung and other co-authors[13] (see 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[14], 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[15]. 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.

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Table 1: FT-IR spectroscopy analysis

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)

3.3 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[16]. Also, the European Plastics Converters (EuPC) announced a revocation of the ban on SUP among states of the European Union[17]. 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[18]. 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[5].

4. Recoveries

4.1 Existing Recovery Strategies

To ameliorate environmental and societal damages set off by plastic during the epidemic, people have adapted several strategies in government, company, and individuals aspects, as Figure 4[19] shows. By implementing these actions, people wish to build a sustainable plastic usage society.

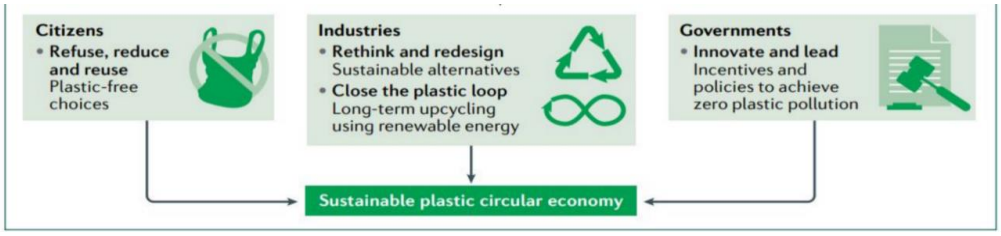

Figure 4: A proposed shift toward a circular plastic economy.

4.2 Extended Producer Responsibility (EPR)

Since its introduction in the 1990s, EPR has effectively controlled plastic usage globally. Owing to the increased demand for single-use plastic, new adjustments have been made in the era of COVID-19 and have further supported this initiative.

Firstly, under EPR's new proposals, governments and industry associations can introduce incentives and funding programs to encourage actions that phase out non-recyclable products. These incentives aim to reduce reliance on single-use plastics and accelerate the transition towards more environmentally friendly packaging products. Some countries have already put these policies into practice during COVID-19. 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[20] 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 set its goal to have plastic "100% recyclable" by 2027[21]. Seeing pioneers' endeavors can greatly reduce environmental impact in the near future, 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[22].

Moreover, producers can be urged by EPR to invest in better sustainable alternatives. One potential

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substitute is biodegradable plastics. One advantage of this product is that it can be entirely and quickly broken down by nature by microorganisms. This not only contributes less to landfills and contamination, but also only non-toxic components will be released, and a 500% reduction in carbon emission will be reached[23], reassuring its safety and mildness in utilization. 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[19]. Therefore, after considering its overwhelming superiority and trustworthiness, along with EPR's enforcement, the production of degradable plastics can help to mitigate the stress put on the environment to a great extent.

4.3 Education

Apart from the actions taken by companies and government, individuals in society also play an essential role. Education awareness is an indispensable aspect of children's education. Schools and communities should be involved in courses and activities that help kids to establish and fortify their sense of environmental protection -- Recycle, reuse, and reduce plastic[24]. Additionally, due to our extensive access to digital platforms and the inconvenience of going out during the pandemic, we can also spread relevant knowledge and tips online, such as holding virtual recycle programs or seminars. By creating hashtags like #ReducePlasticWaste and collaborating with influencers on social platforms, the information can be spread quickly to a wide range of people.

5. Conclusion

We focus on plastic production during the pandemic, summarize the factors driving plastic production, analyze the impact of increased plastic production, and suggest ways to improve it. The factors and impacts we present are innovative and provide a unique and multiple perspective on the plastics industry during the epidemic. The improvements we advocate are feasible and can contribute to the achievement of UN Goal 17 on Sustainable Development. However, our paper has some shortcomings. We focused on marine life in our impact analysis and did not focus on 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. Our research will help future research on other factors of environmental pollution in COVID-19 and suggest more precise measures to improve the environment.

References

[1] United Nations. (2024). Goal 12 | Ensure Sustainable Consumption and Production Patterns. https://sdgs.un.org/goals/goal12

[2] World Health Organization. (2020, March 3). Shortage of personal protective equipment endangering health workers worldwide. https://www.who.int/news-room/detail/03-03-2020-shortage-of-personal-protective-equipment-endangering-health-workers-worldwide

[3] Huizen, J. (2021). How COVID-19 has changed the face of the natural world. Medical News Today. https://www.medicalnewstoday.com/articles/how-covid-19-has-changed-the-face-of-the-natural-world

[4] Asia, O. (2020). Estimated 1.56 billion face masks will have entered oceans in 2020-OceansAsia Report. https://oceansasia.org/covid-19-facemasks/

[5] World Health Organization. (2024). Coronavirus Disease (COVID-19) Pandemic. https://www.who.int/europe/emergencies/situations/covid-19

[6] Zolotova, N., Kosyreva, A., Dzhalilova, D., Fokichev, N., & Makarova, O. (2022). Harmful effects of the microplastic pollution on animal health: a literature review. PeerJ, 10, e13503.

[7] Lamb, J. B., Willis, B. L., Fiorenza, E. A., Couch, C. S., Howard, R., Rader, D. N., True, J. D., Kelly, L. A., Ahmad, A., & Jompa, J. (2018). Plastic waste associated with disease on coral reefs. Science, 359(6374), 460-462.

[8] Roy, P., Mohanty, A. K., Wagner, A., Sharif, S., Khalil, H., & Misra, M. (2021). Impacts of COVID-19 outbreak on the municipal solid waste management: Now and beyond the pandemic. ACS Environmental Au, 1(1), 32-45.

[9] Carrington, D. (2017). Plastic fibres found in tap water around the world, study reveals. The Guardian. https://www.theguardian.com/environment/2017/sep/06/plastic-fibres-found-tap-water-around-world-study-reveals

[10] Ferguson, N. M., Cummings, D. A. T., Fraser, C., Cajka, J. C., Cooley, P. C., & Burke, D. S. (2006). Strategies for mitigating an influenza pandemic. Nature, 442(7101), 448-452.

ISSN 2616-5872 Vol.6, Issue 6: 45-50, DOI: 10.25236/AJEE.2024.060607

[11] Hazlegreaves, S. (2021). The plastic timeline: How did we get here? Open Access Government. https://www.openaccessgovernment.org/the-plastic-timeline-how-did-we-get-here/1 02481/
[12] Nanehkaran, Y. A., Licai, Z., Azarafza, M., Talaei, S., Jinxia, X., Chen, J., & Derakhshani, R. (2023). The predictive model for COVID-19 pandemic plastic pollution by using deep learning method. Scientific Reports, 13(1), 4126.
[13] Jung, S., Lee, S., Dou, X., & Kwon, E. E. (2021). Valorization of disposable COVID-19 mask through the thermo-chemical process. Chemical Engineering Journal, 405, 126658.
[14] Centers for Disease Control and Prevention. (2023). Interim infection prevention and control recommendations for healthcare personnel during the coronavirus disease 2019 (COVID-19) pandemic. https://www.cdc.gov/coronavirus/2019-ncov/hcp/infection-control-recommendations.html
[15] Shruti, V. C., Pérez-Guevara, F., Elizalde-Martínez, I., & Kutralam-Muniasamy, G. (2020). Reusable masks for COVID-19: a missing piece of the microplastic problem during the global health crisis. Marine Pollution Bulletin, 161, 111777.
[16] Parashar, N., & Hait, S. (2021). Plastics in the time of COVID-19 pandemic: protector or polluter? Science of the Total Environment, 759, 144274.
[17] Evans, J. (2020). Plastic straws and stirrers ban delayed because of coronavirus. Financial Times. https://www.ft.com/content/8182d6db-f903-49a1-9e68-43341ad932ce
[18] Hicks, R. (2020). Coronavirus-induced oil price plunge is hurting the circular economy for plastic. Eco-Business. https://www.eco-business.com/news/coronavirus-induced-oil-price-plunge-is-hurting-the- circular-economy-for-plastic/
[19] Schleicher, A. (2021). COVID-19 exacerbates plastic waste: Researchers advocate biodegradables, EPR and chemical recycling. Packaging Insights. https://www.packaginginsights.com/ news/covid-19-exacerbates-plastic-waste-researchers-advocate-biodegradables-epr-and-chemical-recycling.html
[20] Kasikorn Research Center. (2020). Thailand's ban on single-use plastic bags led to the production of over 400 million eco-friendly bags in 2020. https://www.kasikornresearch. com/CH/ analysis/ k-social-media/Pages/FB-plaBag-04-02-20.aspx
[21] VietnamPlus. (2022). Thailand bans single-use plastics, styrofoam packaging in national parks. https://en.vietnamplus.vn/thailand-bans-single-use-plastics-styrofoam-packaging-in-national-parks-post 224823.vnp
[22] Rachal, M. (2024). Minnesota becomes 5th US state with packaging EPR law. Packaging Dive. https://www.packagingdive.com/news/minnesota-packaging-producer-responsibility-walz/ 716743/
[23] Polystar Plastics. (2020). 7 Benefits of Biodegradable Bags. https://www. polystar.co.uk/news/seven-benefits-of-biodegradable-bags/
[24] Wang, Q., Zhang, C., & Li, R. (2023). Plastic pollution induced by the COVID-19: Environmental challenges and outlook. Environmental Science and Pollution Research, 30(14), 40405-40426.