



PLASTICS EFFECTIVE IN THE TIME OF COVID-19 PANDEMIC

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ABSTRACT:

Plastics have become a severe transboundary threat to natural ecosystems and human health, with studies predicting a two fold increase in the number of plastic debris (including micro and nano-sized plastics) by 2030. However, such predictions will likely be aggravated by the excessive use and consumption of single-use plastics (including personal protective equipment such as masks and gloves) due to COVID-19 pandemic. This review aimed to provide a comprehensive overview on the effects of COVID-19 on macro plastic pollution and its potential implications on the environment and human health considering short term and long term scenarios; addressing the main challenges & discussing potential strategies to overcome them. It emphasises that future measures, involved in an emergent health crisis or not, should reflect a balance between public health and environmental safety as they are both undoubtedly connected. Although the use and consumption of plastics significantly improved our quality of life, it is crucial to shift towards sustainable alternatives, such as bio-based plastics. Plastics should remain in the top of the political agenda in the world, not only to minimize plastic leakage and pollution, but to promote sustainable growth and to stimulate both green and blue- economies. Discussions on this topic, particularly considering the excessive use of plastic, should start soon with the involvement of the scientific community, plastic producers and politicians in order to be prepared for the near future. Coronavirus lockdowns around the globe have led to a dramatic 5% drop in greenhouse gas emissions, according to UNCTAD estimates, but not all measures to contain the pandemic have had a positive impact on the environment. Our streets, beaches and ocean have been hit by a tidal wave of COVID-19 waste including plastic face masks, gloves, hand sanitizer bottles and food packaging.

KEYWORDS:

PLASTICS, PANDEMIC, PPE, ENVIRONMENT, PLASTIC POLLUTION.

INTRODUCTION

"Plastic pollution was already one of the greatest threats to our blue planet before the coronavirus outbreak," said Pamela Coke-Hamilton, UNCTAD's director of international trade. "The sudden boom in the daily use of certain products to keep people safe and stop the disease is making things much worse."

The COVID-19 pandemic has reemphasized the indispensable role of plastics in our daily life. Plastics in terms of personal protective equipment (PPEs) and other single-use medical equipment along with packaging solutions owing to their inherent properties have emerged as a life-saviour for protecting the health and safety of the frontline health workers and the common citizens during the COVID-19 pandemic. However, plastics have been deemed as evil polluter due to their indiscriminate littering and mismanagement amid increased plastic usage and waste generation during this unprecedented crisis. The time of pandemic are acting as protector of the public health or polluter of the environment. Considering the utilities and limitations of plastic along with its management or mismanagement, and the fate, an equitable appraisal suggests that the consumers irresponsible behaviour, attitude, poor awareness, and the stress on waste management infrastructure in terms of

collection, operation, and financial constraints as the major drivers, leading to mismanagement, turn plastic into an evil polluter of the environment. Plastic can be a protector if managed properly and complemented by the circular economy strategies in terms of reduction, recycle and recovery, and thereby preventing leakage into the environment. To safeguard the supply chain of PPEs, several decontamination techniques have been adopted worldwide ensuring their effective reprocessing to prioritize the circular economy within the system. Policy guidelines encouraging adopting safer practices and sustainable technical solutions along with consumers' education for awareness creation are the need of the hour for preventing plastic to turn from protector with high utility to polluter.

The coronavirus disease 2019 (COVID-19), a pandemic of global concern caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), the entire world has come to a halt witnessing a lifestyle that is becoming the new normal. SARS-CoV-2 is known to be easily transmissible from one person to another in 5 days), infecting on an average of 2- 3 people from just one confirmed case. The COVID-19 crisis has reemphasized the indispensable role of plastic in our daily life. Plastics have contributed immensely to the health care sector and public health safety during the pandemic. In addition to the

imposition of country lockdown, social distancing, restriction on travelling and public gathering, frequent usage of hand sanitizers along with wearing of mostly plastic-based personal protective equipment (PPEs), viz. face masks, gloves for common citizens to protective medical suits, aprons, gowns, face shields, surgical masks, and other PPEs for frontline health workers as precautionary measures have been adopted to avoid virus contamination to fight the spread of COVID-19. Plastics integrate excellent strength to weight ratio and durability with versatility. Owing to these properties, plastics are irreplaceable in the healthcare sector with major applications in single-use medical tools and equipment and packaging along with use in some surgical operation. Further, plastics have evolved as the perfect material for packaging purposes as they are light weight, flexible, and highly durable. Packaging applications account for the most extensive use of plastics worldwide. Consumers behavioural changes coupled with the dependency on online shopping and takeaway services for home delivery of essential items during the pandemic have led to a considerably increased demand for plastic-based packaging items, including single use plastic (SUPs), against the backdrop of prevailing bans or restrictions in many countries. A surge in the plastic demand during the pandemic is, therefore, primarily due to the manufacturing of PPEs and packaging materials. The majority of PPEs are made up of polymers like polyurethane (PU), polypropylene (PP), polycarbonate (PC), low-density polyethylene (LDPE), polyvinyl chloride (PVC), while the plastics used in packaging materials mainly consist of high-density polyethylene (HDPE), low-density polyethylene (LDPE), polystyrene (PS), polyethylene terephthalate (PET), etc. Among these, PS and LDPE are rarely recycled plastics, PET and HDPE are widely recycled, while PVC and PP are often not recycled. The usage and recyclability of the plastics used for PPEs and packaging materials during the pandemic.

RECYCLABILITY OF VARIOUS TYPES OF PLASTIC

Plastics bring prosperity to mankind, but also limitations and problems as their prime advantage turns out to be the main problem. Being cheaper than conventional materials, plastics allow single-use in innumerable applications with disposability is considered as a major advantage by the users prioritizing hygiene, albeit plastic is reported to be no better alternative than other materials with respect to the persistence of the novel coronavirus. This has led to an increase in the use and disposal of plastic-based items for both medical and non-medical applications during the pandemic. Hazardous COVID-19 biomedical waste (BMW) containing infected plastic-based PPEs and other disposable items from the impacted sources like COVID-19 hospitals, quarantined facilities, containment zones, along with similar non-infected items from non-impacted sources are generated (UNEP, 2020). Therefore, the COVID-19 biomedical waste generation can be directly linked to the unprecedented use of mostly plastic-based PPEs and other disposables warranted since the novel

coronavirus outbreak. The growing usage of SUPs and plastic-based packaging materials coupled with the increasing demand for medical products and packaging amid the pandemic has significantly spiked the plastic waste generation worldwide. Thus, the pandemic has presented a major environmental challenge in terms of plastic waste management. Waste management facilities are generally designed for steady-state operations with moderate variations in waste volume and composition under normal circumstances. However, the pandemic-induced change in waste generation and composition dynamics is highly likely to impact the normal operation of the existing facilities. Further, the reduction in plastic recycling due to plummeting oil and petroleum prices in view of reduced transportation activities in the time of pandemic-induced lockdowns has turned plastic waste management a huge challenge. During this unprecedented uncertainty, the consumption of different PPEs and packaging materials, including SUPs, is on the threshold of creating a plastic pandemic across the globe unless effectively managed. Mismanagement and littering of plastic waste may not only pose a risk of virus transmission but also create pollution in terrestrial and marine ecosystems.

The worsened environmental situation due to the mismanaged plastic waste during the COVID-19 pandemic. Contrary to this general viewpoint, the irresponsible and negligent attitude of the consumers in sheer mismanagement and the underutilization of the resource are the major catalysts contributing and aggravating plastic pollution. Notably, PPEs and other plastic-based medical equipment have emerged as a life-saver for protecting the health and safety of the frontline health workers and the common citizens in the time of the pandemic. However, an equitable appraisal is needed comparing all pros and cons of plastics, their management or mismanagement, and fate in the environment during the COVID-19 pandemic. In this context, the article reviews and assesses to dwell upon whether plastics in the time of pandemic are acting as protector of the public health or polluter of the environment. For the purpose of the review and the assessment, the pandemic-induced repercussions on global plastic production and usage emerging out of PPEs demand and supply, online shopping and takeaway services as well as provisional reversal or stay of SUPs bans is highlighted. Further, the impacts of the pandemic on the global plastic waste generation and associated critical issues and challenges of plastic waste management system are analyzed. The fate of plastic in the hour of the pandemic to dissect plausible short- and long-term ecological repercussions is discussed. The article also presents an assessment of different decontamination methods to reprocess and reuse PPEs to safeguard the shortage of their supply chain in commensurate with the increased demand across the globe. At last, future implications concerning innovative technical solutions and safer practices together with robust policies are presented to support legislative bodies and policymakers to deal with the current challenges of plastic waste management during

the pandemic and beyond.

DEMAND AND SUPPLY OF PPE DURING THE PANDEMIC

The human-to-human nature of transmission of corona virus necessitates the mandatory usage of plastic-based PPEs by the common citizens in addition to the frontline health workers to protect from the viral infection. Henceforth, the COVID-19 pandemic has resulted in demand for essential PPE kits, which showed a tremendous increase in plastic manufacturing and distribution across the globe. To deal with the viral infection in the current pandemic, The WHO has projected a monthly demand of Approx 89 million of facial masks, 76 million of gloves, 30 million of gowns, and 1.6 million of goggles along with 2.9 million of hand sanitizers as a part of safety measures for frontline health workers. Further, the WHO has estimated a monthly increase of 40% in the supply chain of different medical safety products worldwide during the pandemic. Similarly, the production of PPEs is projected to show around 20% spike from 2020 to 2025 (WEF, 2020). The demand and usage of various PPEs during the COVID-19 period so far in selected countries.

DEMAND AND USAGE OF PLASTIC BASED PPEs DURING COVID 19

1. India

Around 25 lakhs PPEs are required per day in the fight against COVID-19

2. Bangladesh

Around 455 million surgical masks and 1216 million gloves have been used during the first month of COVID-19 pandemic.

3. UK

Per day demand of plastic medical kits ranges between 7.5 and 12 million in the fight against COVID-19. National Health Service Hospital (NHS), UK uses more than 55 thousand masks, aprons, and gowns per day.

4. France

Around 40 million surgical masks are used weekly

5. Japan

About 600 million facial masks produced per day as of April 2020

6. China

Plastic manufacturers are producing 116 million surgical masks per day, Around 14.8 million facial masks have been produced as of February 2020.

7. Italy

Monthly demand for facial masks and medical gloves has been increased to 1 billion and 0.5 billion, respectively in the fight against COVID-19.

The monthly consumption of facial masks and medical gloves has been reported to be around 129 billion and 65 billion, respectively, for 7.8 billion populations across the

globe. According to the World Economic Forum (WEF), the daily usage of medical kits has reached a staggering level even in the areas with relatively low confirmed COVID-19 cases in the UK. For instance, around 39,500 facial masks, 11,500 medical gloves, 1500 gowns, and 4200 filtering face piece respiratory masks (FFP3) have been used in the UK during February 2020.

E-COMMERCE SHOPPING ON PLASTIC USAGE DURING THE PANDEMIC

Total lockdowns imposed in the time of pandemic in many countries across the globe have led people to rely on online shopping and takeaway services for procuring essentials, including food items and groceries. The dependency on e-commerce shopping and takeaway services for home delivery of essential items has resulted in the increased demand for carry bags and other types of plastic for packaging purposes. The pandemic has also induced a novel form of consumer demand and behavioural changes like panic buying, stockpiling of food items and groceries among the masses and thereby resulted in a surge in plastic-based packaging items in many countries. The consumers' behavioural changes as dictated by hygienic concerns, panic buying, and stockpiling have led to a considerable surge in requirement for plastic-based packing materials. This growing trend of online shopping and takeaway services further exaggerates the increased demand for plastic production and usage, which have been estimated to proliferate with a sales growth rate of 14% in the US and 40% in Spain (WEF, 2020). The estimated growth of plastic packaging is projected to surge from USD 909.2 billion as of 2019 to 1012.6 billion by 2021 with the annual growth rate of 5.5% impact of the COVID-19 pandemic on plastic products consumption.

PLASTIC WASTE GENERATION DURING THE PANDEMIC

The pandemic has brought about a change in waste generation and composition dynamics and thereby posed a stiff challenge for the local authorities, service providers, policymakers, and regulatory agencies. The unprecedented usage of mostly plastic-based PPEs by the frontline health workers and common citizens has resulted in the increased plastic waste generation globally. Further, the disposal of many plastic-based parts of the coronavirus testing kits employing reverse transcription polymerase chain reaction (RT-PCR) after single use for hygienic concerns has given rise to the plastic waste generation. Moreover, the increased usage of plastic-based packaging materials for e-commerce shopping and takeaway services amid the pandemic has spiked the plastic waste generation further additionally, plastic packaging waste is increasingly getting generated due to the growing global demand for medical products and packaging in the time of pandemic. During the pandemic, the Biomedical Waste stream mostly comprises of infected plastic-based PPEs and other disposable items from the impacted sources as well as similar non-infected items from non-impacted

sources are generated. The COVID-19 Biomedical waste generation with a greater proportion of plastics has been directly linked to the excessive use of mostly plastic-based PPEs, and other disposables necessitated since the novel coronavirus outbreak.

PLASTIC: PROTECTING HEALTH OR DAMAGING THE ENVIRONMENT DURING COVID-19 PANDEMIC

The general notion of plastics as evil polluter has become more intense due to their mismanagement amid increased plastic usage and waste generation during the COVID-19 pandemic. However, it is necessary to acknowledge that we are witnessing and surviving in a new normal where the current situation is not the same as it is used to be during the pre-pandemic situation. Plastics cover a whole group of complex polymers and co-polymers, substrates, and laminates that have been used to secure and safeguard human wellbeing since the novel coronavirus outbreak in terms of PPEs and single-use medical equipment, and packaging for e-commerce utilities. Major applications of plastic in the healthcare sector include protective gear, medical tools and equipment, and packaging owing to its flexibility and durability. Further, a certain class of plastics is not only the most advantageous and proficient for packaging and carrying goods, but they are additionally the most ecologically viable option too. They are lightweight, low-volume, durable, inexpensive, and high-quality material having good insulating properties that play a significant role across environmental, social, and economic dimensions of environmental sustainability. Several studies have acknowledged that the flexibility and strength of certain polymers like films and foils have reduced the total packaging weight, which otherwise would have been increased by fourfold, leading to increased plastic waste up to 60%. Therefore, it would not exaggerate to infer that the world's major health crisis has eased by our dependency on plastic-based safety kits and packaging solutions in the present scenario. Though the usage and consumption of plastics have ensured the improved quality of life and public health protection during this unprecedented uncertainty, it is important to maintain a balance between public health protection and environmental sustainability. Considering the pros and cons of plastic in the time of the pandemic, an equitable appraisal suggests that the consumers' irresponsible behavior, and attitude and poor awareness, and the stress on waste management infrastructure in terms of collection, operation, and financial constraints as the major factors, leading to mismanagement, turn plastic into an evil polluter of the environment. Plastic can be a protector if managed properly and complemented by the circular economy strategies in terms of reduction, recycle and recovery, and thereby preventing leakage into the environment. To curb the ongoing plastic pandemic and beyond, sustainable solutions and safer practices include scientific decontamination of PPEs for reprocessing and reuse boosting the circular economy, plastic reduction policies, product redesign and innovation, and automation

in plastic waste management to overcome the challenges of protecting public health without damaging the environment. Policy guidelines encouraging adopting sustainable waste management practices and consumers' education for awareness creation are the need of the hour for preventing plastic to turn from protector with high utility to polluter.

CHALLENGES FOR THE CURRENT WASTE MANAGEMENT SYSTEMS

The most extensively used techniques of plastic waste management across the globe are mechanical recycling, incineration, and land filling. Ellen McArthur Foundation estimates the global mechanical recycling rates of waste plastics at 16%. In comparison, the remaining waste plastics were either incinerated (25%), sanitary or unsanitary land filled (40%), or gets leaked into the environment due to mismanagement (19%). However, these techniques are far from perfect in containing the whole problem of plastic waste; let alone, with increased waste generation during the COVID-19 crisis, the woes only became much worse.

Polymer cross-contamination, presence of additives, inorganic impurities, irregular or inadequate segregation at source or during collection, and partial polymer degradation has always been the major constraints for mechanical recycling of waste plastics. It has been a successful endeavour for the recycling industry to recycle some of the single-stream plastics with minimal impurities like Polyethylene Terephthalate (PET) bottles with almost 80% recycling rates in countries like India. However, the success could not be replicated with all the types of plastics, especially with single-use plastics (especially, film and foam) and multi-layered plastics that have low reward to effort ratio in their collection, high pre-processing costs, technological constraints, and weak integral structure (UNEP, 2018). Moreover, the plummeting of oil prices during COVID-19 caused a dramatic decrease in the value of virgin plastics affecting the competitiveness of recycled plastics in the market. Furthermore, shortage of staff due to the fear of viral transmission during the collection and handling of waste plastics and restricted transportation have crashed the plastic recycling industry. The unorganized recycling sector, which is predominant in the developing countries, has suffered the most with frequent cash crunches due to low collection efficiency and unavailability of the market for recycled plastics. These disruptions in the recycling industry, causing an inability to utilize its full potential, along with an increased generation of plastic waste could result in mismanagement leading to their leakage into the environment. The shift of production, use, and recycling markets from North America and Europe to Asian countries with weak waste management systems and infrastructures is also proving to be another problem contributing to low plastic recycling rates.

RECOMMENDATIONS

To overhaul the plastic waste management sector we need

to induce the necessary personal behavioural and social institutional changes. Building an appropriate institutional framework along with policy-level directions will help facilitate the required change. The necessary inclusive and sustainable plastic waste management can be achieved when both personal behavioural and social institutional changes take place gradually and simultaneously. Few short-term and long-term recommendations based on the detailed study are listed below for policymakers to bring out necessary changes to combat the inevitable rise in the use and disposal of single-use plastics, post-pandemic.

1. Design of policies the psychological and behavioural barriers, including mistrust over hygienic of reused and recycled products creating awareness among the public against the perception of single-use plastic as protection rather than a problem.

2. Specific colore bags might be provided by the local authority to households to dispose of PPE kits (mask, gloves) in sealed bags, which makes them easy for separation and treatment along with biomedical wastes. Specific colored bins might be provided in community places to improve the collection of such wastes.

3. Local production and consumption (one of the principles of the circular economy) will help a reduced generation of plastic packaging waste. The demand for creating local consumption practices can be done by stimulatory measures like tax cuts for locally made products and providing fiscal security at the time of global crises.

4. It is necessary to restructure the policies to incentivize efficiency in the recycling industry which also includes incentivizing sustainable technologies. Recognizing and rewarding efficiently functioning recycling plants and highlighting it in media to inspire others is necessary.

CONCLUSIONS

The COVID-19 crisis has highlighted the essentiality of plastic as a protector in the healthcare sector and public health safety owing to its intrinsic properties. However, the general perception about plastic as an evil polluter has been further strengthened due to its mismanagement and underutilization of resource value considering the pandemic-induced surge in plastic usage and waste generation. An equitable appraisal by comparing the functionalities and shortcomings of plastic suggests that the consumers attitude and behavioural aspect of poor social awareness and the inadequacies of the existing waste management system as the key drivers make plastic an environmental polluter. It is important to acknowledge that plastic could be a protector rather than a polluter if the circular economy approaches are properly integrated. To prioritize the circular economy, continued progress must be made in reprocessing and reusing the PPEs. Further, research and product innovation in developing eco-friendly and reusable PPE kits and carry bags made of bio-plastics with higher recyclability should be encouraged. Chemical recycling to manage mixed plastic waste into valuable products such as fuels and chemicals

would certainly help in achieving circularity.

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