



A Critical Review of the Impact of COVID-19 on Plastic and Food Waste

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ABSTRACT

This research aims to show the positive and negative indirect effects of COVID-19 on municipal solid waste management systems, especially for plastic waste and food waste. The COVID-19 pandemic has affected the entire waste management sector. As the pandemic spread and lockdowns were enforced in many countries, government and municipal waste operators had to quickly adapt their waste management programs and procedures to the situation. In the pandemic condition, waste generation has switched from industry and commercial to domestic areas. Reduced recycling activities have made municipal waste collection and disposal more difficult. This paper focuses on all the challenges and it's possible resolutions for managing food and plastic waste during the pandemic of COVID-19.

INTRODUCTION

The outbreak of the pandemic, which forced the closure of businesses and educational institutions, raised concerns among the general public about how the COVID-19 pandemic might influence the composition and pattern of waste generation. This may also be taken to mean that, depending on the place, the pandemic may cause the waste level to rise or fall. When places like educational institutions, businesses, and industrial facilities that produced enormous volumes of waste were shut down, waste production also decreased. The generation of domestic, medical, and agricultural waste has increased in some places, however, not all groups are completely closed (Naughton 2020). While the world has observed the favorable environmental consequences of COVID-19 national locks like the clear sky and clean rivers, municipal solid waste management systems are facing various challenges at different levels (Gardiner 2020). The spread of COVID-19 changed the dynamics of waste generation, causing despondency among sanitation workers and policymakers (Calma 2020). Various kinds of hazardous & medical waste are generated during an outbreak, including used gloves, masks, and other protective equipment, along with a huge amount of similar non-infected items (Calma 2020). Though medical waste is not part of municipal solid

waste but pandemic has made masks and gloves essential for daily routine. Therefore such infectious waste started coming with municipal solid waste. Hence inappropriate collection may cause contamination of municipal solid waste and may cause transmission of disease risk because the virus will live hours to days in cardboard, plastic, and metals (Aylin & Gal 2020, Chasan & Kaufman 2020, Van Doremalen et al. 2020a). Fig. 1 shows the duration of survival of the virus on different surfaces, according to the data, the virus survives on a mask for a period longer than any other surface. Indiscriminately tossing or disposing of such waste will cause risk to the lives of waste management staff. In developing, nations where waste management employees are not provided with adequate personal protective equipment (PPE), this may cause the condition much more serious (Jerie 2016). Across these areas, rag pickers and informal waste collectors are at the high-risk region of contamination from virus-infected waste. Pre-pandemic waste-treatment devices planned for moderate variability may now function abnormally due to drastic volume and waste content shifts. The pandemic resulted in major challenges in the management of Solid municipal waste (SMW) and medical hazardous waste. Hence proper management of this type of waste is a key function of effective emergency response (Kulkarni & Anantharama 2020, Sharma et al. 2020).



Fig. 1: Survival time of the SARS-Cov-2 virus on different surfaces (Gal 2020).

Few early news articles reported the rise in recyclable, domestic, and agricultural waste. Such a rise forced the recycling industries in Ohio, New York, South Carolina, and Arizona to recycle 45 percent more waste than the previous year (Staub 2020). Initially hit hard by the pandemic, New York City had an increment of 3.3% in municipal solid waste and a 13.3% increase in organic waste over the previous year (Staub 2020). Many recycling plants had to bring down their capacity to protect their workers from infection, which diverted their goods to dump sites (Staub 2020). Even if most of the crops were disposed of on-site, large amounts were overturned with disturbance to food-supply chains (Naughton 2020). COVID-19 Social distancing measures led to the closure of businesses and schools which minimized the generation of waste but the contribution had shifted to households. In addition, COVID-19 led to many Americans purchasing online articles and foodstuffs that contain more packaging waste. Americans also harvested food and items that could lead to some spoilage waste.

The paper focuses on the rising problems and global challenges of managing municipal solid waste in the current scenario of the COVID-19 crisis. This paper also highlights the new trend of biomedical, plastic, and food waste production as a result of the pandemic, aside from its exposition of existing worldwide biomedical waste management practices. Furthermore, it seeks to investigate ingenious approaches in the management of the current crisis, and suggests viable changes to existing practices to minimize and address the identical situation in probable future pandemics. This paper also highlights various paths which are useful in the development of effective MSW management systems for policymakers and regulators in the pandemic and post-pandemic world.

Effect of the Pandemic on Plastic Waste Generation

One of the pandemic's immediate environmental consequences is the rapid increase in the production and usage of disposable goods to protect the general population,

doctors, community staff, and services from infection. Since the human-to-human coronavirus transmission news, there was a hike in the requirement for masks, gloves, hand sanitizers, and other important safeties. WHO forecasted that there will be an annual need for 89 million surgical masks and 76 million test gloves, although worldwide demand for goggles was 1.6 million a month (WHO 2020). Widespread usage of safety equipment globally because the pandemic causes major upstream production chain instability and downstream waste management issues, therefore infectious contamination is not limited to clinics and facilities. Market patterns are expected to coincide with the worldwide pandemic trend of many plastic products, including PPE, gloves and masks, disposable plastic products for life-support systems, respirators, and general syringes (Klemeš et al. 2020). The plastic products used are often contaminated and should be treated as hazardous waste. Before the beginning of the COVID-19 pandemic, plastic waste management was seen as a major environmental problem because of growing pollution concerns in land and marine ecosystems (Rajmohan et al. 2019). In developing nations current waste management system is inefficient in managing plastic waste whereas the imminent rise in COVID-19 waste quantity created more challenges for current waste and healthcare systems. Although virus retains on plastic for a longer period disposability is seen by customers as a significant hygiene advantage (Kampf et al. 2020, Sharma et al. 2020, Van Doremalen et al. 2020b). This has led to increased use and disposal, even for non-medical applications, of plastic products. In contrast, plastic demand in the probable global economic recession, other sectors (e.g. automotive and aviation applications) are declining. The demand for packaging used to supply food and foodstuffs to houses has also increased due to Lockdown. Such an inevitable scenario may intensify the environmental issues with the waste plastics that were already

there before the pandemic. In particular, metrics should be created and fully used for the design and comparison of alternatives and their footprints on the environment. With total locks and the closure of food stores (cafés) as well as in restaurants worldwide to promote physical distancing, the demand for food supply and food services has increased, which has resulted in increased production of common plastic packaging waste-polypropylene (PP), Polyethylene Low Density (LDPE), Polyethylene High Density (HDPE), Terephthalate polyethylene (PET), Polystyrene (PS), etc. (Tenenbaum 2020, Sharma et al. 2020). Due to the outbreak of the coronavirus and reduced recycling (Emily & Kaufman 2020) the management of plastic waste has become a new challenge for the waste management sector. In addition, the demand for critical medical logistics worldwide is expected to rise in the volume of waste plastic from medical sectors (Chasan & Kaufman 2020). In line with existing public health concerns, individuals can opt to use single-use plastic which contradicts the limitations on their use imposed by many countries. (Tenenbaum 2020).

According to the press releases of the State Council's Joint Mechanism for Prevention and Control in China, on 11 March (Chinese Government Network 2020), the generation of MSW was cut down by 30 percent during the lockdown period. However, medical waste generation in Hubei Province increased sharply (approx. 370 percent) with a high percentage of plastic. The total stockpiled medical waste in China was observed as 207 kt from 20 January to 31 March. Such waste rose from 40 t.d⁻¹ to a peak of 240 t.d⁻¹ in Wuhan, which is more than the defined capacity of incineration i.e. 49 t.d⁻¹ (Weike 2020). Compared to USD 14.1 per ton of MSW (Weike 2020), Therefore the cost of incineration of hazardous medical waste has increased from USD 14.1 per ton to USD 281.7–422.6/t in China. Fig. 2 (Klemeš et al. 2020) shows worldwide waste flow trends in comparison with treatment capacity, which indicates that

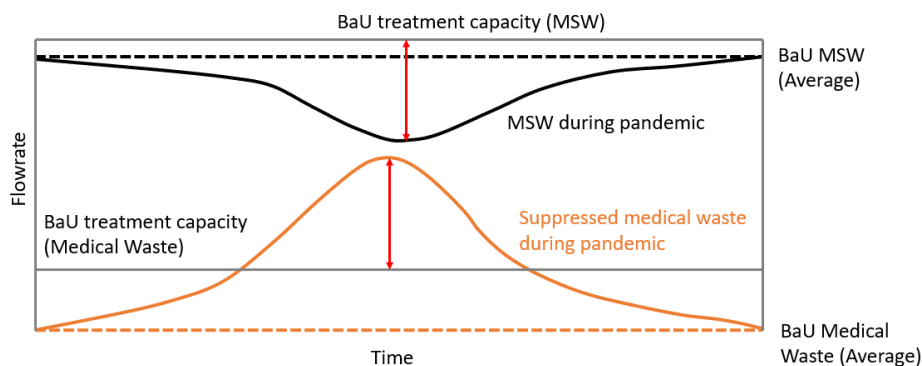


Fig. 2: Flow trend- MSW Vs Medical waste (Klemeš et al. 2020).

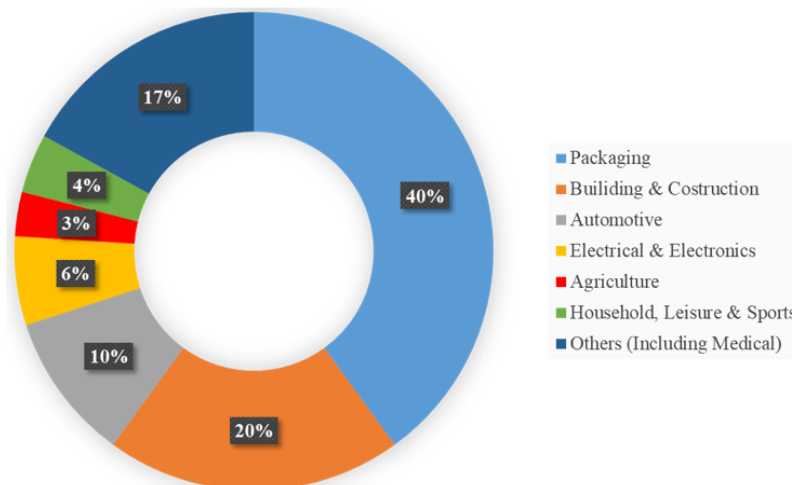


Fig. 3: Sources of plastic waste.

waste treatment systems have tackled drastic changes that led the system to irregular operations.

Technical analysis is important if these systems are to be able to handle the pandemic's dynamic and evolving nature. The fact that much is unknown about the virus itself is another challenge as the products and procedures available to handle the pandemic are not yet clear. The COVID-19 crisis highlighted the major role of plastics in daily life. Virus management requires single-use plastic even if, in most other applications, disposability is seen to be largely an environmental liability (Greenpeace USA 2020). An efficient evaluation tool can summarize the major impact of plastic products on the environment. Fig. 3 (PlasticsEurope 2019) shows the different sources of plastic waste in the environment. Medical product and packaging demand rise rapidly during the period of the pandemic. Therefore countries are working together for changing the quantity and quality of plastic waste.

Whereas a strong strategy to manage plastic waste can be helpful to bring down the unexpected effects on living species. Efficient handling of medical waste needs a suitable approach for identification, collection, segregation, storage, transportation, treatment, disposal, and other essential precautions like disinfection, personnel protection, and training. Fig. 4 (AISBL ACR+ 2020, Centers for Disease Control and Prevention 2015, Klemeš et al. 2020, Marshall 2020, UK Health Security Agency, 2021) explains the process to treat the waste during the pandemic, where the source of contaminated waste is not limited to hospitals.

Even hospitals with modern equipment have failed in coping with the fast-growing numbers of COVID-19 patients. The one with mild symptoms goes for self-isolation at home

itself and causes virus-laden waste. This needs a sustainable change in the waste management infrastructure. In European Union, the entire Corona body safety kit is required to be packed in double bags. In Germany recyclable food containers are now will be considered hazardous waste as they may be contaminated with viruses (AISBL ACR+ 2020). It was also precautionary advised that if a house is found with a positive or suspected corona patient, so follow the specified municipal waste management guidelines (AISBL ACR+ 2020). However such practice promotes the usage of plastic and a neutral response toward source segregation.

Treatment of hazardous medical waste through incineration and steam sterilization (90 min, 120°C) is the most widely used approach (Centers for Disease Control and Prevention 2015). In Germany, it is advised strictly to maintain 1000°C just to achieve a safe treatment of medical waste (AISBL ACR+ 2020). WHO has also recommended maintaining 900 to 1200°C for the thermal treatment process (WHO 1999). Due to COVID-19, the hike in waste generation is demanding high-capacity treatment facilities also. In Spain, the incineration of contaminated waste by cement plants has been adopted for future reference (AISBL ACR+ 2020).

The Repercussion of COVID-19 on Food Waste and the Food Supply Chain

COVID-19 has given a severe impact on industry on several fronts (Kahlert & Bening 2020). Few cases like the U.S. food producers struggled due to the non-operational restaurants, schools, and other institutions that generally demand large amounts of food. A significant amount of food waste was produced during the beginning of the lockdown (Waste 360

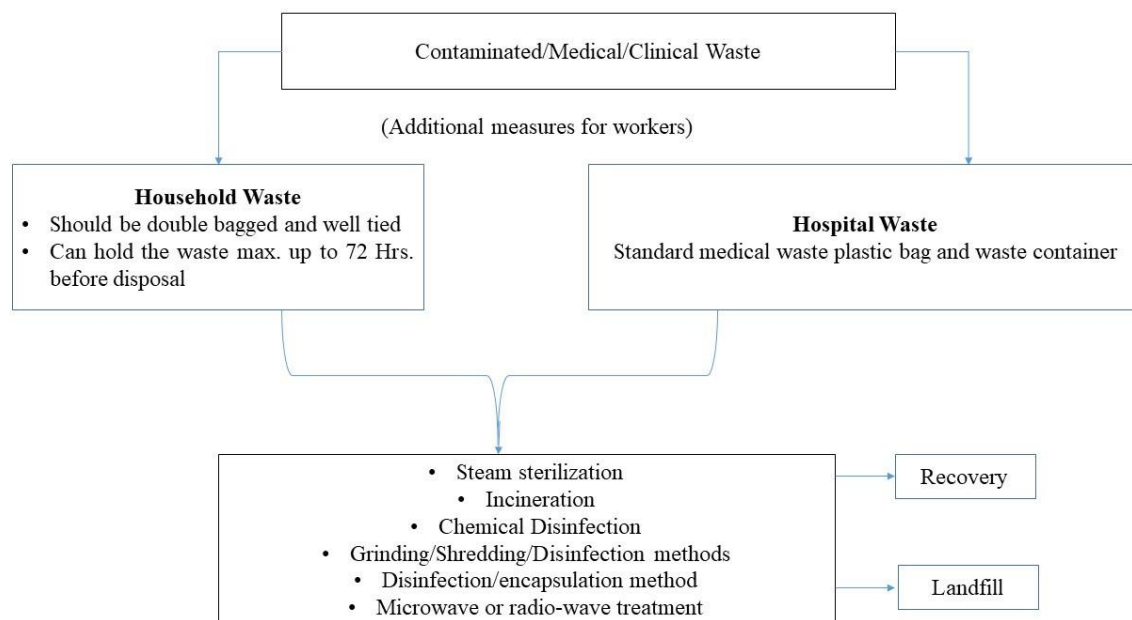


Fig. 4: Process of managing the waste during COVID 19.

2020). The United States Environmental Protection Agency (US EPA) reacted to the emergency of COVID-19 by issuing recommendations for recycling and sustainable management of food waste. These guidelines target household, institutional and business-level food waste management (US EPA n.d.). In India, the lockdown started parallel with seasonal crop harvesting. The plants of wheat, paddy, and barley were ready for harvest, and vegetables and fruits were also ready for the consumer. However, most goods were wasted due to the sudden shutdown in the country (Pothan 2020). The Indian government has also made attempts to tackle the diversion of perishable goods to implement an economic stimulus package. Food inspectors have worked to ensure that food products are distributed to restaurants, stores, and impacted individuals. Importantly, initiatives like food distribution allowed the government to reach localized and remote communities, to ensure successful food management and food waste reduction (Pothan 2020). Storage of food products leads to disrupted dynamics of food waste generation (Sharma et al. 2020), whereas the fractured supply chain leads to the dumping of food, milk, and fruits at local dumpsites/landfill or on the roadside (Sharma et al. 2020). Therefore a flexible supply chain system needs to be developed

Household Food Waste Generation

COVID-19-induced panic buying, where lockdowns forced the population to store refrigerated edible items and ignore

their expiry dates. Mandating statistics on shelf-life and public recognition of its importance can be an efficient way to minimize food waste. Authors (Jribi et al. 2020) stated that the pandemic situation has drawn people’s attention toward food waste due to anticipated supply shortages. The report, however, indicated that this pro-behavioral shift was motivated by socioeconomic background, not just because of environmental concerns. Moreover, in the current scenario, consumers tend to stock rather than dump, resulting in less waste generation (Durante & Laran 2016, Jribi et al. 2020). It is also noted that consumer-conscious food purchases as confirmed by other research undertaken during the extreme recessions in Greece and Italy (Fanelli & Florio 2016, Jribi et al. 2020, Martinengo 2015). Nonetheless, the study also indicated that the storage limits, weak cooking habits, or overcooking and overstocking brought the downfall in the generation of household food waste during the complete lockdown.

Supply Chain

COVID-19 reached urban areas deeper than rural areas. Consequently, COVID-19’s effect on food production was attributed, given the availability of farm labor, to the lack of resource materials for agricultural activities. Moreover, fear of getting infected, limits on the commute, and lockdowns in cities and towns have stopped food supply employees from continuing to provide their services. Therefore, people are

scared of resourcing food and its transportation from storage facilities to markets. Furthermore, the closing of borders has made interstate food transportation, complicated and time taking. Furthermore, the food supply chain was disrupted in the containment zone. Owing to the lack of sufficient manpower and the use of available manpower under the strict surveillance of social distance, the food processing, and packaging industry was hit hard. This scenario not only affected the food supply but also caused the devastation of food products in stores and fields. The following media articles are showing the cases of burial and dumping of food items due to the damaged supply chain.

- **The New York Times:** The New York Times, the Insider, and the Milwaukee newspaper sentinel reported that due to closed restaurants, hostels, and schools, farms are forced to dump the fresh vegetables, milk, and eggs, that can not be sold anymore (Barrett 2021).
- **Times of India:** According to the Times of India, farmers in Punjab are worried about their business and its ongoing losses, and they demanded a rest in the shutdown to sell their goods and their crops in fields (Kamal 2020).
- **Business Line:** In another case from India, it was reported that the transport network got disconnected with the lockdown and the entire supply chain got crumpled. This leads to the dumping of vegetables and fruit supplies in Mumbai and Pune (Jadhav 2020).
- **CNA:** In Singapore, farmers are unable to work on the farms, and transporters are struggling to supply food to markets due to the lockdown. CNA Singapore reported huge amounts of fruits were left abandoned or thrown on dumpsites (Jadhav 2020).
- **Anadolu Agency:** Due to the unavailability of manpower and transport facilities during the lockdown period, millions of farmers in India & Pakistan are going through another tragedy, seeing their goods rot in their fields. Professionals believe the scenario will have a negative impact on food security (Jadhav 2020).

Way-Forward to Managing Food Waste During the Pandemic

Although the current crisis brought some problems, it also created the right set of circumstances to unveil new solutions for viable, efficient supply chains. These solutions could help for preparing nations for such pandemics. The food supply chain starts with sourcing seeds, processing, inventory, and transport, and finally ends with consumers. COVID-19's spread has affected this chain's efficiency at different levels. Therefore, at each level, innovative solutions are needed to tackle food shortages and reduce food waste.

Second, the supply of raw materials should be hassle-free and the group delivery channel should route this. The local governing and other voluntary bodies such as NGOs will distribute seeds, equipment, resources, etc. directly to a community that belongs to the grower. This approach can help to make the system mechanized for easy storage and minimizing food waste. Food items may be stocked in local warehouses in partnership with government or private entities for the intermediate duration. Food stocked in warehouse units requires adequate transport and distribution releases. Special licenses must be held for trucks transporting food, such as interstate charges and tolls. Proper provision for truck drivers, warehouse workers, and other support teams of safety equipment, food, water, and washroom facility should be guaranteed. Such measures will contribute directly to a decrease in food waste while at the same moment providing food quality that is less likely to spoil because of lack of storage, transportation, or packaging material contamination (Parfitt et al. 2010, Saini & Kozicka 2014, Va et al. 2007).

As online delivery gains prominence from COVID-19, Online service providers can pool capital to obtain and distribute food supplies. The participation of local administrative bodies like Residence Welfare Associations (RWAs) in municipal areas, panchayats in village areas, and Non-Governmental Organizations (NGOs) are important for providing food supplies. Such public bodies will run on mobile applications (apps) for collecting essential orders. An app will be used to collect the list of household essentials, on which local administration will arrange weekly markets. The Apps will also have information on appropriate ways of storage, helps to avoid overbuying the food, clarify the difference between non-essential and essential goods, and pass on the details of suppliers, food service providers, etc. It is necessary to promote and support organizations like religious organizations, and NGOs working tirelessly to provide food to the poor and facilitate food supply. Another alternative may be to use the nearby restaurant and dining joints. Since they buy bulk raw food, these raw food material stocks can be sourced and sold to customers. A temporary food market would emerge as a result of this approach, generating income for the restaurant. Customers would also benefit from a food supply. This activity will also lessen food waste (Sharma et al. 2020). In the fight against pandemics, "hotspots" of poor food security Due to hoarding, inadequate storage, and improper food supply channels, chains can contribute to food waste.. Therefore, drone distribution can be coordinated in these cities, through which food supply can be managed with a contactless approach. Therefore, wholesale markets can supply perishables to the food market at lower bulk prices, selling them directly to customers through their retail networks.

Due to lockdowns and social distances, the labor force is left unemployed. This labor can be absorbed by the supply chain, for the operation of trucks, the loading and unloading of inventories, and the maintenance of warehouses. Throughout the pandemic, small-scale enterprises and cooperatives will remain involved. Development models such as AMUL (Umarji 2020) and Shri Mahila Griha Udyog Lijjat Papad (Naik 2005) can serve as prototypes in India. Such industries do not require large manpower. Households must be self-reliant to any degree as regards food production and the elimination of food waste. Sustainable cultivation and permaculture activities should be promoted to ensure food security during the potential pandemic. It may not have many effects because it combines the production of food waste by limiting purchases to goods that are not made or cultivated at home. As a result, the food supply chain will be significantly impacted by this technique.

CONCLUSION

This paper discussed the current scenario of municipal solid waste management in the world that appeared in the ongoing COVID-19 crisis. The entire focus is on the issue specifically food and plastic waste, because food waste and plastic waste are the two components of MSW that stand out the most and harm the environment. On one side where minimized commercial affairs bring out clean air and water as stated in many cases, the new trend in the generation of plastic and food waste has brought big trouble in the area of waste management and handling on another side. Discarded corona protective body kits like gloves and masks are causing severe health hazards to sanitary workers. The increasing demand for corona safety body kits will also increase the amount of plastic waste in the environment. The adverse effects may be minimized by plotting the efficient facilities for handling the manufacturing and recycling facilities. Similarly, a few socioeconomic factors such as rationing, and conscious shopping caused a low generation of domestic food waste during lockdowns. Large amounts of food were wasted as a result of a disruption in the food supply chain, which calls for the use of cutting-edge technology solutions. To combat comparable potential future pandemics, creating sustainable supply chains against food crises and wastage will be more beneficial. To prevent similar crises in the future, an adaptable socioeconomic-environmental approach must also be devised.

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