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LIFE IN PANDEMIC ERA:

CHALLENGES AND OPPORTUNITIES TOWARD ENVIRONMENTAL SUSTAINABILITY

Building Climate-Resilient and Sustainable Cities During Pandemic

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Abstract

Pandemic Coronavirus disease (COVID-19) began to hit worldwide in December 2019 and was regarded as one of the most significant obstacles for the Malaysian government. However, with the Movement Control Order (MCO) implementation to curb the pandemic, air pollution, carbon footprint, and carbon dioxide (CO_2) emissions have decreased. There are three primary sources for releasing carbon in Malaysia: energy, transportations, and solid waste production. However, solid waste production is a significant contribution to the environmental footprint during the pandemic. The statistic substantiates that Malaysia's waste production increased tremendously from 2010 to 2020, asserts that Malaysians generate more waste even during the pandemic. This article discusses the impact of the pandemic COVID-19, with the legislation, policies, and control measures taken by the government, local authority, and Non-Governmental Organizations (NGOs) to achieve the low carbon goals to reduce Greenhouse Gases (GHGs). As a result, producing a more climate-resilient environment and more sustainable practice in the metropolis aids the city in mitigating and reducing the effects of climate change.

***Keywords*:** COVID-19 Pandemic, Movement Control Order (MCO), Air Pollution, Waste

INTRODUCTION

On 11 March 2020, World Health Organisation (WHO) had declared the coronavirus COVID-19 as a global crisis. And the world has been in a downtime state since then, and nature was sighted to be reset on its own due to less human activity. This period elucidates that the carbon emission for 2020 was the lowest because of reduced transportations, changed consumption patterns, and industry activities worldwide, especially in urban cities (Liu & Li, 2021). Before the emergence of the COVID-19, three primary sources of carbon emission in Malaysia are energy consumption, movement from public and private vehicles, and solid waste in landfills (Naderipour et al., 2021).

During these unprecedented times, COVID-19 is one of the most significant challenges that the Malaysian government faces, and most nations around the world have yet to overcome this crisis. As a result, the Malaysian government has made a concerted effort to enforce Movement Control Orders (MCO). Therefore, the level of air pollution, carbon footprint, and carbon dioxide (CO_2) emissions have decreased tremendously (Naderipour et al., 2020). Among all, solid waste production is one of the significant contributions of environmental footprint during the pandemic. This statement is proven by the statistic that substantiates that in 2020 Malaysia waste production increased 43% from 2010 to 2020, asserting that Malaysian waste generation is increasing even during pandemics (Ismail et al., 2020).

Future research should focus on exploiting this pandemic pattern to develop more sustainable and effective transportation, energy, and waste policies and trends. However, policymakers are suggested to take the current Greenhouse Gas (GHG) performance as the new benchmark for the coming years. This action is crucial since, during the COVID-19 crisis, the environment is mostly back to the better good (Arora et al., 2020). Moreover, Arora (2020) also states that this could help curb the pollution produced in specific sectors and help the environment to bounce back. In addition, short-term reductions in GHG concentrations are not a long-term strategy to cleaning up our environment. Therefore, the positive and negative impacts during this crisis should be an opportunity for the authority to consider the environmental policies and legislation in the future. Meanwhile, creating awareness in the local community to apply sustainable environmental practices during the pandemic COVID-19.

This article discusses the impact of the pandemic COVID-19 on the environment during the crisis and how the city will develop a sustainable environmental practice during this unprecedented time. Besides, it is advantageous for the government, local authority, and Non-Governmental Organizations (NGOs) during this crisis to initiate and implement the policies, awareness, and programs to the urban community. Finally, building more climate-resilient and sustainable

practices is crucial to slow down the climate change issue. It is also in line with the United Nations' 2030 Sustainable Development Goals (SDGs).

Towards Sustainable Energy Consumption

As the world's population grows, so will the demand for inexpensive energy, and an economy based on fossil fuels is causing significant climate change. To achieve SDG 7 goals by 2030, investing in solar, wind, and thermal power will improve energy productivity and ensures that everyone has access to energy. Malaysia had begun to reduce carbon emissions in energy sectors even before the pandemic strikes. For example, the Selangor State Government itself has supported this approach to make sure Selangor becomes a green technology state by creating a "green technology action plan for the state of Selangor 2016-2018". For this purpose, the Selangor State Government intends to introduce the concept of Rumah SelangorKu with green technology features such as electricity generation through solar roofs, rooftop gardens, and suitable windmills. SelangorKu homeowners can enjoy a better quality of life through this action and reduce living costs by saving up to 68% per month on electricity bills (Jawatankuasa Tetap Pelancongan, Alam Sekitar, Teknologi Hijau dan Hal Ehwal Pengguna Selangor, 2016). Residents of the SelangorKu Pangsapuri Puchong Utama Housing Project were among the first to support this initiative. Green energy products such as solar, rainwater collection systems, and LED lighting have also been introduced.

Minimizing energy consumption results from sustainable design methods such as designing buildings with solar access and natural ventilation, using climate-responsive design matter, and effective insulation materials to cope with the surrounding environment. Energy consumption savings are used to increase the role of urban public space and make it possible to create new vibrant communities and improve the population's well-being. Building design with minimum energy consumption for heating, cooling, ventilation, and lighting are seen to be technically feasible. Existing technology allows the city to operate at low energy consumption levels by using renewable energy sources, air and water flow, and a natural ecosystem in urban areas (Zareba et al., 2017).

Demand for energy needs is showing an increase worldwide. The building sector, in general, has represented a large percentage in rate values global energy consumption. Therefore, efforts to improve energy efficiency in buildings are significant. Building services include Heating systems and Ventilation and Air Conditioning (HVAC) systems, which are also in charge of large-scale building energy use (Chenari, Carrilho & Silva, 2016). In HVAC systems, ventilation is a significant problem in providing the appropriate and safe Indoor Air Quality (IAQ). In addition, it is also responsible for energy consumption in the buildings. Therefore, improving the ventilation system sustainably plays an important role, not only to improve energy efficiency in buildings but also to provide a better indoor climate for occupants as well as being able to reduce the chances of health problems in the future.

Global energy demand and consumption are expected to decline due to the COVID-19 pandemic, resulting in reduced CO_2 emissions. Global energy demand is expected to drop by 6% in 2020, compared to 2019. Commercial and industrial demand continues to decline, but residential demand keeps rising (Jiang et al., 2021). Energy demand has decreased dramatically due to governments around the world imposing strict full and partial lockdowns. Energy demand and consumption declines are detrimental to the energy business. For instance, the COVID-19 pandemic forced at least 19 energy companies in the United States industry into bankruptcy due to the low demand (Crider, 2020). In Malaysia, the MCO is unlikely to reduce overall electricity production, considering the country is small and produces just 12,000 to 13,000 GWh of electricity monthly (Yusup et al., 2020).

Reducing Traffic-Related Air Pollution (TRAP) and Towards Low Carbon City (LCC)

COVID-19 spread in early 2020 was unprecedented and highly disruptive. As a result of pandemic lockdowns, global economic and social activity decreased rapidly, as did emissions of air pollutants and greenhouse gases. Several viewpoint articles have suggested that this episode provides an unprecedented scientific opportunity to detect, attribute, and understand the impacts of anthropogenic emissions on the Earth's atmosphere at all spatial scales (Gkatzelis et al., 2021; Jia et al., 2020; Saxena & Pandey, 2020). Ground-level monitoring networks and spaceborne remote sensing instruments have documented shifts in regional air quality. In Malaysia, the first episodes of movement control order (MCO) have been developed and designated for phases 1, 2, and 3 as of 18 March 2020 (Abdullah et al., 2020). The MCO restricts government and private activity in Malaysia except for several significant services. For example, universities and schools are not allowed to undertake educational activities while daycare and retail centers are closed. It also prohibits mass gathering and limits tourism and recreation activities.

The main objective of the MCO is to limit COVID-19 nationwide transmission (Ismail et al., 2020). Meanwhile, many studies have been done on the Movement Control Order (MCO) effect on air quality in Malaysia. For example, in the study by Ash'aari et al. (2020), the average levels of Particulate Matter ($PM_{2.5}$), Carbon Monoxide (CO), and Nitrogen Dioxide (NO_2) were decreased by 23.1%, 21.74%, and 54.0%, respectively, compared with before MCO. In stations located in urban areas, the highest reduction in $PM_{2.5}$, CO, and NO_2 was observed, with 63% decreases in $PM_{2.5}$, and CO, while all stations showed significant decreases in NO_2. In addition, it was shown that, while high numbers of local hot spots were recorded simultaneously from NASA's Moderate Resolution Spectrometer (MODIS), 70.5 percent of stations recorded lower concentrations of PM2.5 during MCO in comparison with before MCO (Ash'aari et al., 2020).

The study was supported by Othman & Talib (2020); whereby, there is a significant decrease of nitrogen dioxide during MCO compared with before MCO. Lockdown reduced the number of vehicles on the roads, especially in major urban areas. Consequently, nitrogen dioxide (NO_2) gas, which mainly originates from the fuel combustion used for vehicles, has been dramatically reduced. All these findings are appealing since particulate matter (PM) and nitrogen dioxide (NO_2), which are emitted from vehicle exhaust, are the main contributors to urban air pollution (Mohd Shafie & Mahmud, 2020). Air pollution resulting from the combustion of fossil fuels in motor vehicles or TRAP (traffic-related air pollution) has been a substantial risk factor for cardiovascular illness, including hypertension (Kim et al., 2017). Children are especially vulnerable to air pollution, and accumulating data suggests that TRAP exposure might impair pregnancy outcomes and infant development (Mortamais et al., 2019).

The reduction of traffic-related air pollution during MCO is noticeable. However, the reduction is unlikely to endure, and it will have minimal impact on the total amount of greenhouse gases (GHGs) accumulated in the atmosphere over decades. Government policies and how much the people continue to rely on fossil fuels will thus define the real climate impact of the COVID-19 crisis. Prioritizing air pollution reduction and climate concerns and recognizing environmental health as an economic asset can benefit the country and its residents in various ways. One of the government initiatives that should be taken during this crisis is to achieve their target on elements of urban transportation under the Low Carbon City Framework (LCCF).

A good example is the action of Majlis Bandaraya Shah Alam (MBSA) which supports LCCF. MBSA has established efficient transportation and mobility services, such as electric cars, e-parking, community buses, free bus service (Smart Selangor), cycling tracks, and EV (electric vehicle) chargers in the Shah Alam area, as well as free car days for all Shah Alam residents (Nasrudin et al., 2020). MBSA also provides parking in areas outside the city center to encourage people to walk around the city center and upgrade disabled-friendly and

pedestrian paths (Nasrudin et al., 2020). Dewan Bandaraya Kuala Lumpur is the other city council actively participating in the Low Carbon City (LCC) initiatives. They use effective variable message signs in communicating green information to the public, such as slogans such as "Reduce Congestion; Together, We Use Public Transportation" to remind Kuala Lumpur citizens of the importance of reducing private cars usage daily (Nasrudin et al., 2020).

'Free Bus Rides inside Downtown KL' is another clever technique to encourage people to take public transportation during peak hours. DBKL has run the 'Kuala Lumpur Car Free Morning Programme' to complement the LCC activities on weekends (Nasrudin et al., 2020). To encourage residents to adopt non-motorized transportation, DBKL also constructs dedicated cycling lanes in Kuala Lumpur's downtown area. Apart from that, solar energy is used to power air-conditioned elevated pathways, reducing carbon emissions. Furthermore, both Shah Alam and Kuala Lumpur have implemented the free bus service (Nasrudin et al., 2020). In addition, the city council has started to operate the Selangor Smart Bus (SSB) for Shah Alam inhabitants. From 6 a.m. to 9 p.m., residents can take the bus every 15 minutes at a frequency of 15 minutes per stop.

MBSA and DBKL's efforts to promote public transport will be beneficial in reducing emissions since many studies have proven the efficiencies of public transportation. For example, in a study by Wang et al. (2015) in China, they determined the efficiency of all modes of transportation by comparing the share of passenger volume and carbon emission. Cars account for just 39 percent of passenger volume, but they account for 75.5 percent of carbon emissions. On the other hand, rail transportation only accounts for 20% of passenger volume but only produces 6.7 percent of carbon emissions. Thus, public transportation and buses are much more effective than cars and taxis (Wang et al., 2015).

Basagaña et al. (2018) also suggested that individuals aiming to reduce their energy consumption and carbon footprints should take advantage of public transportation by reducing travel that would typically be made private. For example, a single person commuting alone by a car who passes a 20-mile round trip commute to existing public transportation will reduce annual CO_2 emissions by 4,800 pounds per year. This reduction is equivalent to a 10% reduction in total greenhouse gas emissions. Therefore increased use in public transportation will reduce traffic congestion, resulting in higher fuel efficiency for vehicles driving along the same corridors (Buchanan, 2019).

The role of an individual is also crucial in reducing air pollution. Improvement and changes in driving habits by individuals show a significant effect on fuel consumption and carbon emission. As an example, driving with the accelerator pedal depressed slowly or without sudden bursts of speed can improve fuel economy by up to 20% (Kastanek, 2020). Additionally, poor practice during driving, such as engine idling, must be avoided. From the literature, the engine's idling has a significant impact on its fuel consumption and emissions. For hydrocarbon (HC), CO_2, CO, PM, and NO, idling emissions can be as high as 86.4 g/h, 16,500 g/h, 5130 g/h, 4 g/h, and 375 g/h, respectively (Rahman et al., 2013). However, engine idling is expected in the cities during traffic congestion, mainly in peak hours. Reducing congestion during peak hours can be achieved by systematic planning such as computerized traffic signals, ramp meters, and lane usage management. Traffic Demand Management (TDM), non-automotive travel modes, and land use management are examples of advanced management protocols implemented by the city planner (Afrin & Yodo, 2020).

Even though individual action towards traffic-related air pollution reduction is undeniably necessary, the government and city council intervention is more important in the long run. Implementing LCC concepts, sustainable transportation, and effective traffic management is a more accomplishable and sustainable way to reduce traffic-related air pollution and carbon emission. Moreover, the LCC concept also supports Sustainable Development Goals 11, targeting to promote inclusive, safe, resilient, and sustainable cities.

Sustainable Waste Management During Pandemic

The control of the Coronavirus pandemic and constraints on human activities, mobility, and the industrial sector has significantly impacted waste management in general. According to Sarkodie & Owusu (2020), increasing waste production during pandemics is critical to human development and health effects. Furthermore, researchers found that the quantity of waste production is towering globally and might have the same effect worldwide. Sarkodie & Owusu (2020) also mention that this is due to the food delivery using single-use products or plastic as well as panic buying among the people, increased production of waste and consumption of the resources, hence upsetting the efforts towards reducing plastic pollution and food waste production.

Snowballing plastic pollution and food waste by consumers elucidates of high producing carbon and methane emission to the environment. Moreover, the dumping of these wastes in open landfills contributes to the global production of greenhouse gases (Bian et al., 2021). Be that as it may, landfills produce environmental footprints such as methane and carbon dioxide, contributing significantly to GHG emissions. Thus, climate change has many negative consequences for the environment and human health. Besides, the effect of greenhouse gases will accelerate with the release of gas methane, and carbon dioxide due to excessive burning of fossil fuels in the future (Hettiaratchi et al., 2021). In short, the COVID-19 pandemic generates a large amount of waste linked to an increase in GHG emissions.

Thus, Malaysian authorities consider this is a significant problem that must be addressed. Ismail et al., (2020) mention that nationally, the country produces more waste especially food waste during the pandemic. The majority of people stay at home and practice home cooks, resulting in a rise in food waste from every household across the country. Yet, as the initiative to build a climate-resilient and sustainable cities during the pandemic, the Malaysian government, hand in hand with other organizations such as Solid Waste Cooperation (SWCorp), Petroliam National Berhad (Petronas), and local authorities like Majlis Bandaraya Shah Alam (MBSA), has started to initiate Circular Economy to replace the national Linear Economy starting 2018. The Malaysian government has also initiated Act 673, which requires every household to segregate their garbage mandatorily. Moreover, the government has three plans to reduce trash production: distributing knowledge through the media, forming partnerships, and recognizing waste segregation practices.

According to Fass (2021), the circular economy intends to improve resources and minimize consumption and waste generation. Nevertheless, specific segments and guidelines in the Environmental Quality Act 1974, Solid Waste and Public Cleansing Management Act 2007, and Environmental Quality (Scheduled Waste) Regulation 2005 correspondingly encourage national resources rotation. Other than that, the government initiatives to endorse a circular economy include integrating sustainable manufacturing and consumption, reducing 40% of GHG. Solid Waste Corporation (SWCorp) is a national organization that manages waste management nationwide. SWCorp has an initiative and now vigorously spreads awareness and promotes sustainable solid waste management services such as school campaigns, social media awareness, and providing more facilities to promote recycling.

SWCorp and MBSA have started promoting Zero Food Waste to all the food and beverage industries during the pandemic crisis, including small vendors on the street. As food waste is one of the significant sources of carbon emission, the authorities suggest the society should schedule the food production or convert the food waste to be the self-made fertilizer. Thus, this initiative can both rescue the environment and make a profit from it. In addition, if food waste is not upcycled, methane gas will be released into the atmosphere and speeding up global warming. Petronas, Malaysia's fully integrated oil and gas company, also took a step by allocating all the commercial buildings under Petronas provisions to provide the recycle bin all over the city. Petronas also proposes the New Plastic Economy by altering the mindset of plastic as a resource. They employ a holistic approach

by focusing on four areas: education, cleanups, infrastructure, and innovation (Ganapathy & Tiing, 2020).

Non-Government Organisation Zero Waste Malaysia is also one of the non-profit organizations and advocates for sustainable development and upsurges sustainable living in the cities. The vision of this organization is to encourage a zero-waste lifestyle, thus minimizing the general waste footprint and embrace a circular economy by the government (Zero Waste Malaysia, 2021). Nevertheless, Malaysia is still far beyond achieving zero waste production but it is not possible. Harun et al. (2019) stated that zero waste could be achieved by cooperation between consumers and the industries. Both parties must work together to produce and consume the alternative of plastic usage. The reduction of plastic waste is aligned with SDG Target 12.3, which seeks to halve global food waste at retail and consumer levels and reduce food loss during production and supply.

One method to achieve the target is to starts with changing the existing model, linear economy, to circular economy (Ibn-Mohammed et al., 2020). Researchers also mention that it is essential that companies and consumers change their mindsets and attitudes. Companies must be starting to design products sustainably. Moreover, consumers are suggested to use environmentally friendly products and responsibly apply the 3R rules (Reduce, Reuse, and Recycle). Thus, the wealthy and the poor, the formal and informal, businesses, governments, and the community must work together to reduce the waste and achieve SDG 12 which is to ensure responsible consumption and production patterns. During this unprecedented COVID-19 crisis, the world community has to do it much more effectively once they recognize waste management as a powerful driver of sustainable development.

CONCLUSION

To sum up, everything that has been stated so far, the urban world population nowadays is towering. To date, it is estimated that 4.4 billion inhabitants reside in the city area. Cities have become the hubs of the world economy. Thus, it is crucial for the government and NGOs to the individual to play the role to initiate and take action to build a better city environment and reduce the potential impacts of climate change. However, based on current conditions, the pandemic is anticipated to prevail in the coming 3-5 years. As a result, building a long-term systemic approach and strategy is critical for improved energy usage, traffic control, and municipal solid waste management, particularly in urban areas. Moreover, rapid urbanization is known as the major cause of environmental health hazards in many countries (Kasmani et al., 2021).

Besides, education and community awareness are fundamental actions to sustaining sustainable living during the pandemic. Proper education and awareness such as single disposable use face masks, reducing plastic consumption, taking public transport, reuse the existing food container and our daily waste are essential practices during this crisis. Unprecedented times need unprecedented measures. Therefore, spreading education and awareness at all levels of society are critical initiatives to do right now to deal and adapt to the current situation sensibly and become a habit in future sustainable environmental living practices.

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CHALLENGES AND OPPORTUNITIES TOWARD ENVIRONMENTAL SUSTAINBILITY

Movement Control Order Impact on Air Pollution in Malaysia

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Abstract

Malaysian authorities have issued a Movement Control Order (MCO) aimed at isolating the source of the COVID-19 outbreak. Mitigation and control tactics for new coronavirus disease 2019 (COVID-19) have been widely implemented in a number of nations in an effort to halt the spread of this pandemic disease. Traffic congestion and industrial emissions have decreased as a result of people working from home and the suspension of certain companies. MCO restricted people's movement, which resulted in a reduction in the number of automobiles on the road, which may have improved the country's air quality. NO2 levels decreased by an average of 40% across the board, with the greatest reduction found in Kota Kinabalu (62%). The highest decreases in CO, O3, SO2, PM2.5 and PM10 were observed in Ipoh (27%), Kota Bharu (15%), Alor Star (38%), Kuantan (9.5%) and Kota Kinabalu (17%) accordingly. Each city had a hazard quotient (HQ) value of <1 indicating that there were no non-carcinogenic health impacts. This study demonstrates to regulatory agencies that reducing human activity greatly improves human health and reduces air pollution, and thus effective air pollution mitigation techniques can have a considerable influence, particularly in enhancing human health and reducing air pollution.

***Keywords*:** Air pollution, MCO, COVID-19, Air pollutans, Malaysia

INTRODUCTION

Since the first case was registered in China in December 2019, the world has been knockout hard by the Coronavirus Disease 2019 (COVID-19) pandemic. There are 139,501,934 infected cases and 2,992,193 causalities as of April 18, 2021 as stated by World Health Organization (WHO). Due to the disease's mode of propagation, which is by air and physical touch, governments around the world have introduced lockdown commands as one of the preventive measures to prevent the disease from spreading. This mandate slowed down road traffic and slowed down economic activity. The results of COVID-19 on air contamination in France, China, the United States, India, Spain, United Kingdom, Italy, and other countries were studied by Girdhar et al. (2020). In the countries surveyed, the levels of CO, SO2, NO2, PM10, and PM 2.5 all reduced significantly.

Malaysian authorities have declared the introduction of a Movement Control Order (MCO) aimed at isolating the source of the COVID-19 outbreak. Several activities, including company operation, are prohibited during MCO, with the exception of critical services (Malaysian National Security Council, 2020). Due to the fact that the majority of companies have been forced to comply with the MCO by either ceasing operations or finding an alternative, such as working from home, these industry are interfacing a critical dilemma. Due to people working from home and the suspension of various industries, traffic congestion and industrial emanation have decreased. MCO limited people's mobility, which resulted in a decrease in the number of cars on the road, which may have improved the country's air quality. (Tan, personal communication, June 18,2021). Air pollution in Malaysia is mostly caused by open burning, industrial emissions, and motor vehicles (Latif et al., 2014; Abdullah et al., 2019). The air quality level is determined using the Air Pollutant Index (API) of six criterion pollutants, with fine particulate matter (PM2.5) being the most prevalent pollutant in Malaysia (Ismail, S., personal communication, June 14,2021).

MAJOR CONCERN OF AIR POLLUTION IN MALAYSIA

Air quality

The Air Pollutant Index (API) is derived using the concentrations of six primary pollutants: particulate matter smaller than 10 millimetres (PM10) or 2.5 microns (PM2.5), sulphur dioxide (SO2), nitrogen dioxide (NO2), carbon monoxide (CO), and ozone (O3). As shown in

Table 1, the API is classified as good, moderate, unhealthy, very unhealthy, or hazardous.

Table 1 Air Pollution Index (API)

API	Diagnosis
0 – 50	Good
50 – 100	Moderate
101 – 200	Unhealthy
201 – 300	Very unhealthy
301 – 500	Hazardous

Source: Department of the Environment (2019).

According to API, Malaysia's overall air quality was largely moderate in 2019. This is because the API measurements were derived using PM2.5 particles, which are extremely tiny and stable in the air. The rising in API due to transboundary and local haze resulted in an increase in the figure of harmful days observed in 2019 contrast to 2018.

Daily PM2.5 concentrations are shown in Fig. 1 for three categories of selected stations in the country's rural (Kapit), suburban (Kuantan), and urban (Klang) areas. The tendency towards levels of PM2.5 that exceeded ambient air quality standards, particularly in suburban (Kuantan) and urban (Klang) areas, where there were numerous open burning bustle throughout hot weather conditions. Due to the transboundary haze, rural regions such as Kapit also experienced higher PM2.5 levels than ambient air quality requirements.

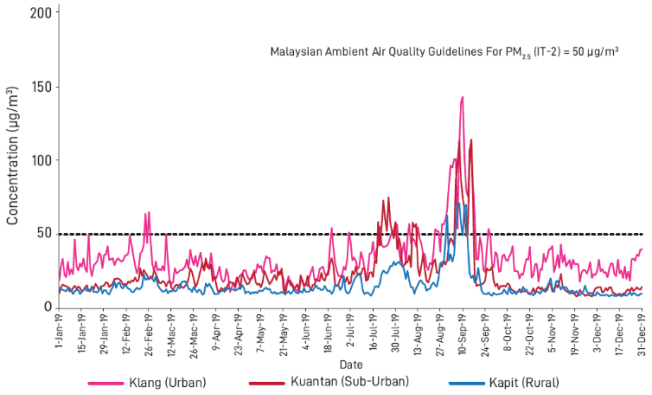

Fig. 1 Tendency of 24 Hours Concentration of Particulate Matter (PM2.5) in Malaysia. Source: Department of the Environment (2019).

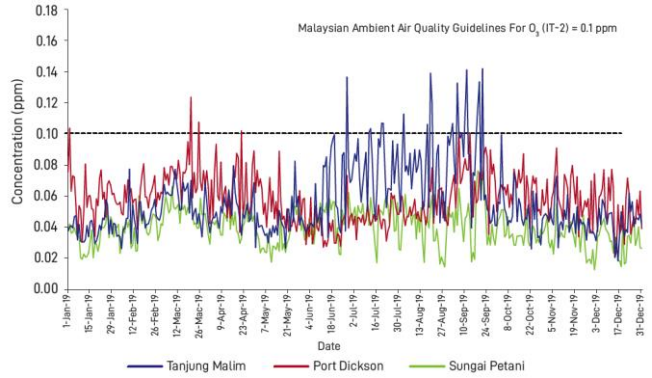

Fig. 2 Tendency of Daily Maximum 1-hour Concentration of Ozone (O3) in Malaysia. Source: Department of the Environment (2019).

Apart from PM2.5, the pollutant of concern was ozone level (O3). O3 is produced since nitrogen oxides (NOx) and volatile organic compounds (VOCs) intergrate chemically in the existence of sunshine. On hot, sunny days, the formation of O3 is accelerated. Motor vechiles and industries, especially in metropolitan areas, were the primary producers of VOCs and NOx emissions. This resulted in multiple unhealthy days, as illustrated in Fig 2, at various places. These conditions contributed to the occurrence of a figure of harmful days in certain places, particularly referring with high traffic levels in core business districts.

Source of air pollution

Air pollution in Malaysia is caused by three primary sources: transportable, stationary, and open burning (Afroz et al., 2003). In five previous years, the primary contributor for air pollution came from mobile sources such as motor vehicles covering 70-75% of the entire air pollution in the country. On the other hand, stationary sources emissions had generated 20-25% while approximately 3-5% of the air pollution came from forest fires and open burning. These pollutions created by what is known as anthropogenic air pollutants are the primary source of worry for human health, particularly in metropolitan areas where industry activity also highly developed industrialization are the primary contributors to air pollution (Tan, personal communication, June 18,2021). Between Malaysia's 11 states, Sarawak is the most severely impacted by particulate contamination and suffers the greatest figure of health collision, accounting for 23.8 percent of total health effects throughout the haze period. During the haze, the health effects on Selangor and Kuala Lumpur were also estimated to be serious, as the average PM10 of these two states is 170.6 and 131.22 mg/m3 respectively (Afroz et al., 2003).

In this period, people are more aware of the environmental consequences of fossil fuel consumption, and sustainability has developed into an ethical concept. Both of these concerns serve as a reminder to people to safeguard the natural environment. However, today's emphasis is also on long-term energy security and the environmental ramifications of diverse energy sources. The near-certainty of carbon dioxide emission fines in developing countries has significantly altered the economic prospects for renewable energy sources. In 2019, CO2 emissions from various industries' energy use in Malaysia are summarised in Fig 3. Keep in mind that transportation is almost entirely dependent on petroleum-based fuels. Transportation produces the most CO2, followed by other energy sectors that significantly rely on fossil fuels such as coal, natural gas, and petroleum.

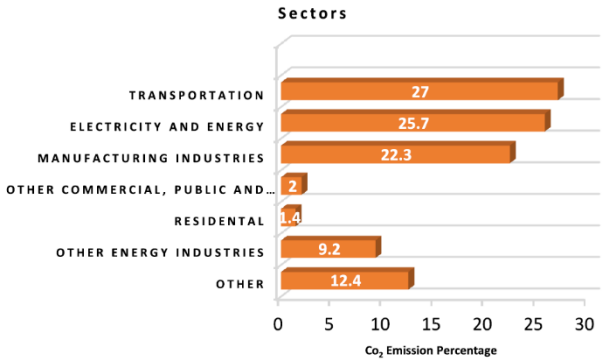

Fig. 3 CO2 emissions induced by energy consumption of different sectors in Malaysia in 2019. Source: Begum et al. (2015).

Air pollution is the most significant pollutants in the energy sector (Müezzinolu et al., 1998). It is sourced as a result of hazardous gas emissions and leakage during the combustion of fossil fuels. Table 2 summarises the quantity of CO2 emitted by several types of conventional fuels. Monthly Energy Review, 2020 (Analysis & Projections). The decrease in CO2 emissions between 2018 and 2019 indicated that some actions had been made to limit CO2 emissions from conventional fuels.

Table 2 The emissions of CO2 (in Mt) by conventional fuels.

	2018	2019	2020
Petroleum and other liquid fuels	2373	2354	2189
Natural gas	1636	1689	1670
Coal	1260	1084	885
Total energy	5280	5138	4755

Source : Amirreza et al. (2020).

Health impacts of air pollution

Air pollution exposure can have both immediate and long-term health impacts (Tan, personal communication, June 18,2021). Excessive air pollution can result in an acute condition in the short term. Additionally, limiting sunlight may promote the growth of harmful bacteria and viruses that are destroyed by ultraviolet B. (Beardsley et al., 1997). Long-term health impacts of exposure to air pollution are unknown and difficult to detect. The ingredients of smoke haze, particularly polycyclic aromatic hydrocarbons, are known carcinogens with effects that can take years to show. The effects may be more severe in youngsters, because the amount of particulate matter they breathe is quite significant in contrast to their body size.

Apart from respiratory diseases, conjunctivitis was much more prevalent throughout hazy season. In Selangor, the total number of cases jumped from 207 in June to 3496 in October. In Sarawak, the same pattern was found. Additionally, it was discovered that the daily occurence of conjunctivitis in Sarawak during September had a positive association with the API (representing PM10 concentration). Exposure to high levels of PM10 was proven to be dangerous to human health over a short period of time (Awang et al., 2000). Children, the elderly, and those with pre-existing respiratory disorders are most susceptible; nevertheless, children are also among the most resistant (Ismail, S., personal communication, June 14,2021).

The 1997 haze incident resulted in 285,227 asthma episodes, 118,804 childhood instances of bronchitis, 3889 adult instances of chronic bronchitis, 2003 respiratory hospitalisation, 26,864 emergency room visits, and 5,000,760 restricted activity days (Nasir et al.,2000). Except for Sabah, Kelantan, and Perlis, the entire populace of the nation was at danger. The entire cost of health damage was substantially more than expected due to the haze's prolonged endurance. The findings indicate that limit activity days reported for approximately 79.3 percent of the whole cost of health damage, whereas asthma attacks accounted for 10.7 percent of the entire cost of health damage in Fig 4. The alternative three health consequences, such as chronic bronchitis, hospitalisation, respiratory, and emergency department visits, had a negligible effect. The entire cost of health harm was approximated to be RM 129 million, ranging between RM 36 million and RM 258 million.

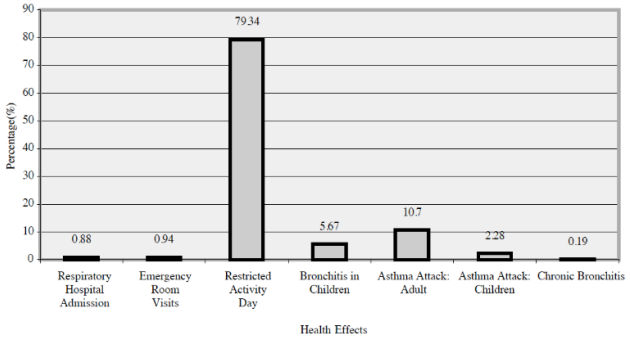

Fig. 4 Percentage distribution of health damage costs. Source: Nasir et al. (2000).

AIR QUALITY IMPACT BEFORE AND DURING MCO

Malaysia's Movement Control Order forbids any government and private businesses exclude for a few essential sectors. Learning activities in school and campuses were prohibited while no daycare and shopping complexes were allowed to operate. Mass gathering, tourisms recreational activities were also restricted. These drastic approaches were applied to lessen the transmission of COVID-19 in the country MCO has major impact on the concentration of air pollutant in Malaysia (Ismail, S., personal communication, June 14,2021). A study done by Murnira & Latif (2021) on the effect of MCO on air contamination in Malaysia revealed that Prior to the MCO, the average mean CO concentration in all towns in Malaysia was 0.53 ppm, which was 0.94 times greater than the mean concentration throughout the MCO phase. There are significant changes in CO concentration prior and throughout the MCO observed. The average of reduction is 1.2%. (Murnira & Latif et al.,2021).

Characteristics of air pollutans

Carbon monoxide (CO), sulfur dioxide (SO2), nitrogen oxides (NOx), particulate matter (PM), and ozone (O3) are the major criterion pollutants in the atmosphere (Zhang et al.,2016). The figures 5a–5f depict the average daily 24-hour concentrations of six criterion air pollutants in Alor Star, Seremban, Johor Bahru, Kuala Lumpur, Ipoh, Kuching, Kota Kinabalu, Kuantan, and Kota Bharu. The quantification were made prior to and throughout the MCO (1 January, 2020 to 17 March, 2020). (18 March to 21 April, 2020).

PM2.5 and PM10

PM2.5 and PM10 displayed identical trends, no discernible decrease in concentrations following the implementation of the MCO in all cities (Fig 5a and b). Additionally, concentration maxima were detected in Ipoh, Kota Kinabalu, and Alor Star during the early stages of the MCO, with the largest peak occurring in Kota Bharu on April 7, 2020. PM2.5 and PM10 concentrations in Seremban and Kuala Lumpur followed a similar trend.

Sulphur dioxide

SO2 concentrations in Kota Kinabalu city increased from the start of the year 2020 to the early days of the MCO and subsequently decreased after the first few days of the MCO (Fig 5c). At Kuantan, a similar trend was seen, with a sharp decline in SO2 concentrations in the middle of the MCO period. At Johor Bahru, the opposite pattern was seen, with a gradual increase in SO2 concentrations beginning in early 2020 and continuing throughout the MCO era. Both Kuala Lumpur and Seremban exhibited fluctuating values prior to the MCO, but no significant decreases in concentration was detected throughout the MCO.

Nitrogen dioxide

Except for Alor Star, where NO2 concentrations peaked throughout the MCO, all cities exhibited declining NO2 concentrations during the MCO (Fig 5d). Certain cities, like as Kuching, Kuantan, Kota Kinabalu, and Kota Bharu experienced minor changes in concentrations with no discernible peak either before or during the MCO.

Ozone

There was no discernible change in O3 concentrations across all cities during either era (pre- and post- MCO) (Fig 5e). Resemble trends in O3 were seen in Seremban and Kuala Lumpur, with the largest peak concentration occurring around the end of January 2020, prior to the MCO period, and different peak occurring during the MCO's early stages. Only Kuching, Kota Bharu, Kuantan, and Ipoh had an average percentage drop of 0.8 percent in O3 concentrations following the introduction of the MCO.

Carbon monoxide

Prior to the MCO period, the mean CO concentration in all cities was 0.53 ppm, roughly 0.94 times higher than the average concentration during the MCO period. The two largest peaks were reported in the second week of February and March 2020 for 24 hour CO concentrations in Kuala Lumpur over 1.2 parts per million, but numerous other peaks were also observed between January 1, 2020 and April 17, 2020. (Fig 5f).

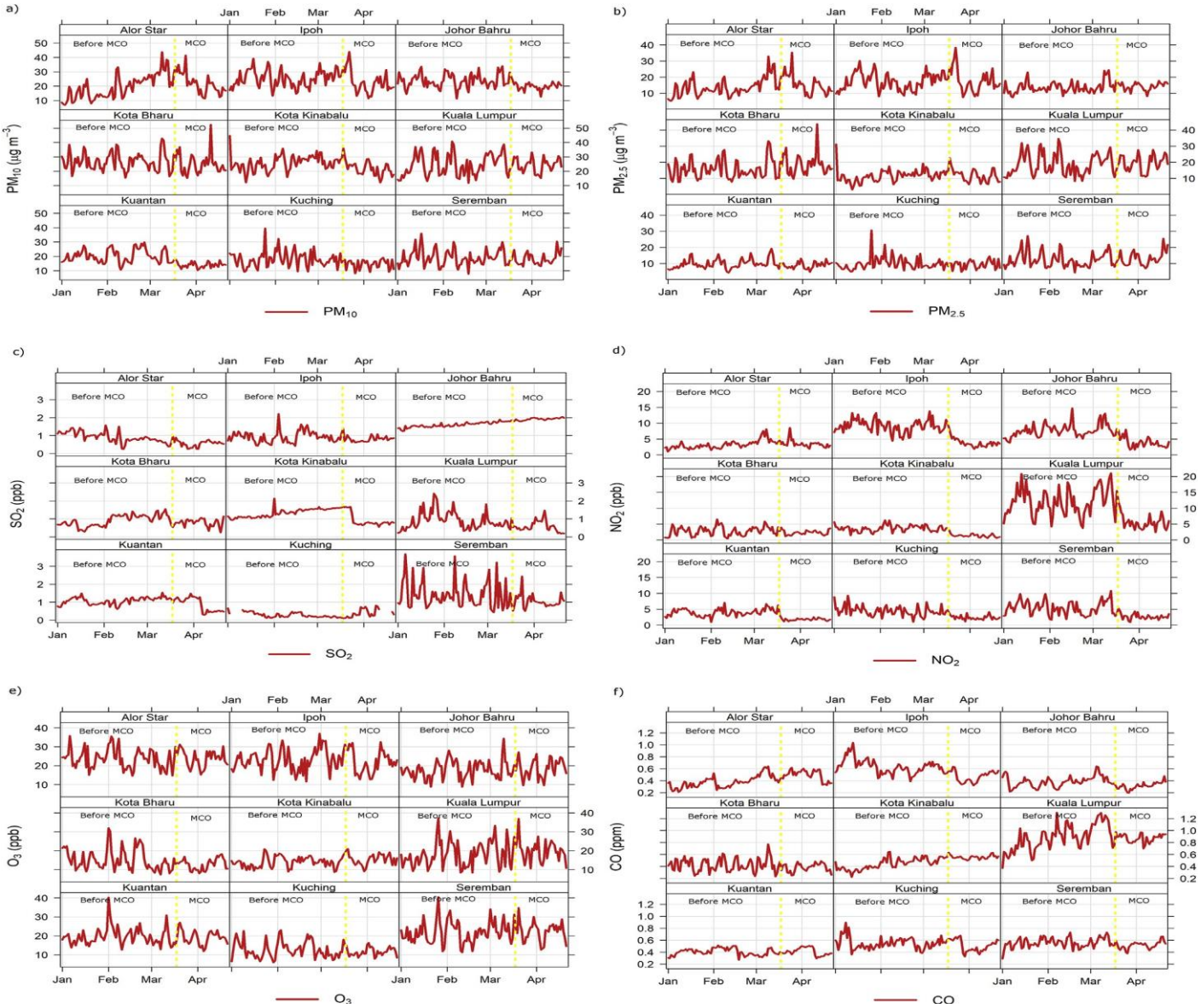

Fig 5a-5f : Daily 24 h averages of a). PM10, b). PM2.5, c). SO2, d). NO2, e). O3 and f). CO concentration of major cities in Malaysia. Source : Munira et.al (2021).

Table 3 Hazard quotient value of PM10, PM2.5, SO2, NO2, O3 and CO before and during MCO.

	PM_{10}		$PM_{2.5}$		SO_2		NO_2		O_3		CO	
	Before MCO	During MCO	Before MCO	During MCO	Before MCO	During MCO	Before MCO	During MCO	Before MCO	During MCO	Before MCO	During MCO
Kuala Lumpur	2.00E-02	1.99E-02	4.37E-02	4.53E-02	2.40E-03	1.53E-03	6.72E-03	1.14E-02	2.98E-02	3.27E-02	8.29E-03	8.19E-03
Alor Star	1.61E-02	1.79E-02	3.17E-02	3.62E-02	2.45E-03	1.51E-03	2.61E-02	7.34E-03	3.90E-02	3.90E-02	3.48E-03	4.61E-03
Ipoh	2.07E-02	1.85E-02	4.04E-02	4.06E-02	2.48E-03	2.15E-03	1.88E-02	7.81E-03	3.81E-02	3.57E-02	5.93E-03	4.33E-03
Seremban	1.56E-02	1.50E-02	2.89E-02	3.08E-02	3.80E-03	2.77E-03	1.11E-02	5.49E-03	3.60E-02	3.67E-02	5.18E-03	4.80E-03
Johor Bahru	1.95E-02	1.64E-02	3.19E-02	3.36E-02	2.58E-03	5.06E-03	8.71E-03	8.03E-03	2.93E-02	3.06E-02	3.58E-03	3.01E-03
Kuantan	1.65E-02	1.14E-02	2.31E-02	2.09E-02	2.88E-03	2.40E-03	8.18E-03	3.72E-03	6.58E-04	3.14E-02	3.77E-03	3.77E-03
Kota Bharu	2.19E-02	2.05E-02	3.66E-02	4.34E-02	2.45E-03	2.10E-03	5.77E-03	4.81E-03	2.50E-02	2.10E-02	3.95E-03	3.58E-03
Kuching	1.48E-02	1.20E-02	2.33E-02	2.22E-02	7.27E-04	9.96E-04	9.02E-03	4.91E-03	2.07E-02	1.89E-02	5.08E-03	4.71E-03
Kota Kinabalu	2.17E-02	1.79E-02	2.86E-02	2.61E-02	3.58E-03	2.42E-03	7.58E-03	2.86E-03	2.32E-02	2.53E-02	4.14E-03	5.18E-03
Total HQ	1.67E-01	1.50E-01	2.88E-01	2.99E-01	2.33E-02	2.09E-02	1.02E-01	5.63E-02	2.42E-01	2.71E-01	4.34E-02	4.22E-02

Source : Munira et.al (2021)

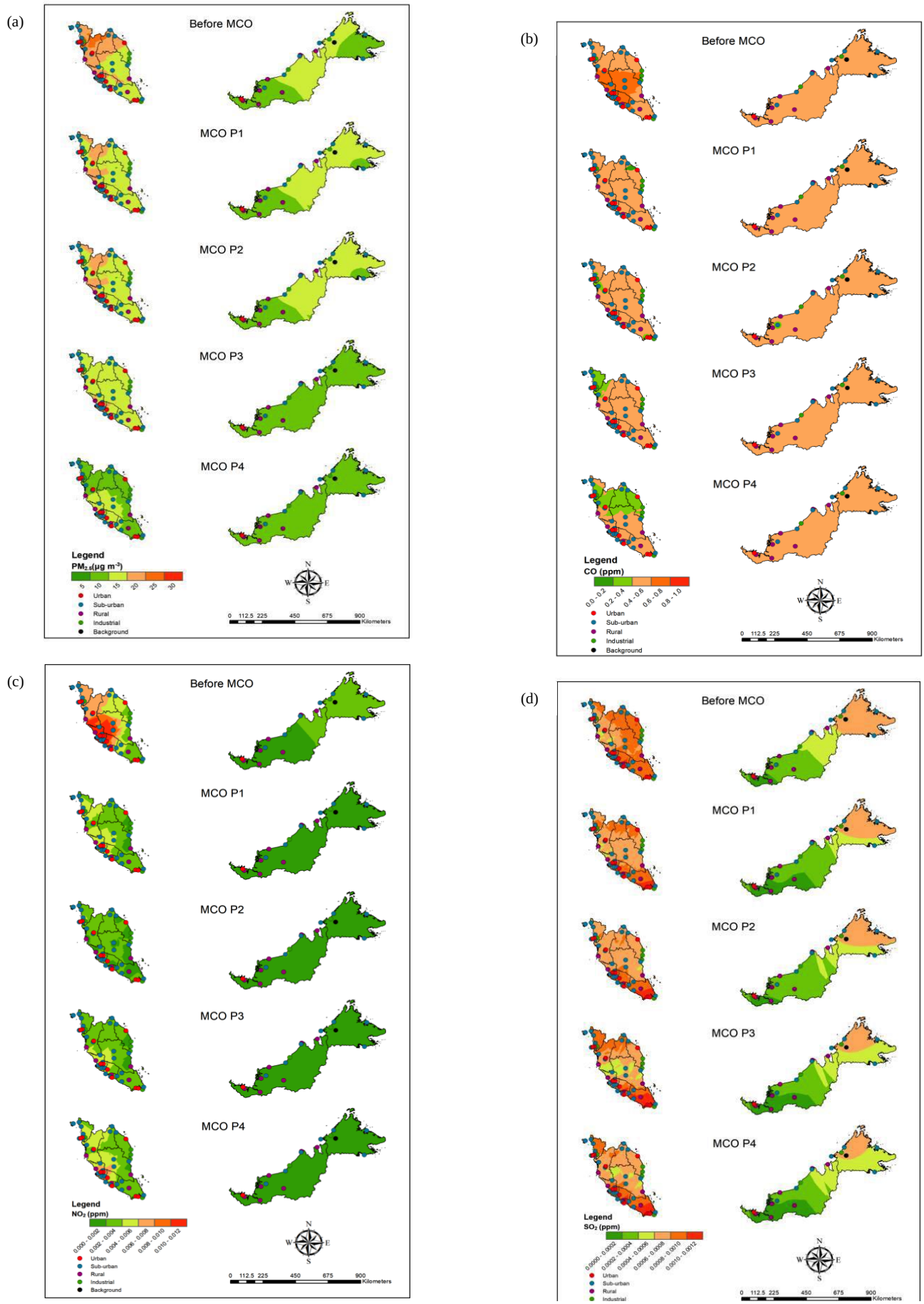

Fig 6a-6d : Spatial distribution of (a) $PM_{2.5}$, (b) CO, (c) NO_2, (d) SO_2 concentration. Source : Ash'aari et al. (2020)

The hazard quotient (HQ) values for non-carcinogenic exposure to air pollutants are summarised in Table 3. Generally, all pollutants had higher HQ values prior to the MCO than during the MCO, with the exception of PM2.5 and O3. The hazard index (HI) represents the total HQ value, which reduced by 3% for O3, 81% for NO2, 11% for SO2, and PM10, but increased by 10% for O3 and 3% for PM2.5. Kuala Lumpur reported the highest HQ values for PM2.5 (4.37E-02) and overall HQ values for air pollutants (4.53E-02) both before and during the MCO (4.53E-02) (7.43E-02 before the MCO and 1.19E-01 during the MCO). Prior to the MCO, the sequence of non-carcinogenic exposure was as follows: SO2 < CO < NO2 < O3 < PM10 < PM2.5, but the pattern was as follows after the MCO: SO2 < CO < NO2 < O3 < PM10 < PM2.5.

Spatial variations of air pollutants

Ash'aari et al (2020) stated of four major pollutants before to and throughout four MCO stages across the country (Fig. 5(a)–5(d)) shows regional heterogeneity in these pollutants (Fig. 5(a)–5(d)). The greatest variation in PM2.5 concentrations occurs in northern and central Peninsular Malaysia, which is linked with significant emissions from industry, power plants, vehicles, and local biomass burning before to the implementation of MCO (Fig. 5(a)). PM2.5 levels substantially reduced during MCO P2 and averaged less than 15 g m–3 nationwide during MCO P4. Despite this, CO and NO2 concentrations are high in central areas prior to MCO (Figs. 5(b) and 5(c)), due to the area's dense urbanisation. CO and NO2 concentrations dropped precipitously soon after MCO started, with averages falling from 0.8–1.0 parts per million before to MCO to 0.2–0.4 parts per million during MCO for CO and from 0.01–0.012 parts per million prior to MCO to 0.006–0.008 parts per million during MCO for NO2. NO2 concentrations increased somewhat during MCO P4 compared to previous MCO phases, owing to the introduction of CMCO, which allowed for the reopening of several enterprises and economic activities, particularly in Peninsular's central region. As is well known, motor vehicles and industry pollutants are the primary producers of NO2 (Awang et al., 2000; Afroz et al., 2003; Navinya et al., 2020). When SO2 levels were examined prior to and during MCO, a consistent pattern emerged. As is well known, the primary anthropogenic sources of SO2 are automobiles and fossil fuel-fired power plants. This explains why elevated SO2 levels are reported in densely populated areas such as the Peninsular's north, centre, and south.

CONCLUSION

This paper demonstrated that the Malaysian government's efforts to halt the spread of the COVID-19 pandemic have had a significant impact on the country's air pollution levels. Additionally, reduced vehicle emissions, human outdoor activities, and coal-fired power plant emissions all contribute significantly to cleaner air. Additionally, the findings of this research may help the appropriate government agency in establishing the concentration of air pollutants in each city as a baseline for and consideration of air pollution emission regulations. Thus, Malaysia must develop systematic policies that are tailored to the sources and characteristics of pollution in each city, incorporating cleaner alternatives and new vehicle technology, as the majority of cities improved their air quality while simultaneously reducing vehicle numbers during the MCO period. Additionally, each local government may adopt mitigation measures on a modest scale to decrease air pollution concentrations, which can be scaled up in the future.

Observations from 65 regulatory monitoring stations demonstrate the effect of the economic and daily activity restrictions imposed by COVID-19 MCO on reducing the concentration of key air pollutants in Malaysia's urban core areas.By contrast, variations in the decline of PM2.5, CO, and NO2 levels were seen in sub-urban, industrial, and rural locations. We observed a substantial increase in the number of hotspots during MCO P1 and a steady reduction after MCO P2. This may suggest that, despite the implementation of MCO restrictions, modest decreases in PM2.5 concentrations have occurred; nevertheless, local biomass-burning activities have continued. CO and NO2 reductions were often higher during MCO than pre-MCO in sub-urban and urban regions. Nonetheless, the diurnal and weekly trends of PM2.5, CO, and NO2 seemed to be comparable, suggesting that these concentrations are influenced by similar sources. There is no apparent pattern in the decline of SO2, indicating that SO2 concentrations vary by location and region.

ACKNOWLEDGEMENT

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LIFE IN PANDEMIC ERA:

CHALLENGES AND OPPORTUNITIES TOWARD ENVIRONMENTAL SUSTAINABILITY

Delivering Safety and Hygiene: Online Food Delivery during Crisis

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Abstract

The COVID-19 outbreak is a clinical syndrome and may cause severe acute respiratory disorder. Coronavirus was proclaimed as a pandemic by the World Health Association (WHO) on March 11, 2020. In Malaysia, the government has implemented the Movement Control Order (MCO) which suggests all non-essential sectors be closed temporarily as to prevent the spreading of COVID-19 virus. This has caused many restaurants to become prohibited for dine-in and people are advised to have takeouts instead. Therefore, food delivery service became consumer's choice during the MCO period. The government advised all food handlers to implement a complete and proper food management system so that food safety and hygiene can be assured since many people are afraid of the potential of COVID-19 being transmitted on food surfaces or packages although it is not a typical foodborne disease. This COVID-19 crisis also affected the progress achieving the Sustainable Development Goals (SDGs) by 2030 especially on the effort of achieving SDG 1 (no poverty), SDG 2 (zero hunger), SDG 8 (decent work and economic growth), SDG 14 (life below water) and SDG 15 (life on land). This paper discusses the approach on online food delivery (OFD) during COVID-19 pandemic, the government measures to ensure food safety and hygiene as well as how approach in OFD affects and helps in achieving the SDGs.

Keywords: COVID-19, crisis, online food delivery, food safety and hygiene, SDGs

INTRODUCTION

Food delivery service changed the manner in which we enjoy our daily meals. The effectiveness, speed and comfort offered by the business have attracted numerous potential clients (Sarah *et al.*, 2020). Food delivery services have begun since 1995 which delivered on-request and ready-to-eat meals. Generally, the food delivery service starts with the clients picking the menu and request through the food delivery platform by their smartphone, payment or affirmation of the order, preparation of the food ordered, riders for delivery services pick-up the ordered food and delivered to the clients. The COVID-19 disease outbreak in November 2019 from Wuhan, China is a deathly virus that may cause severe acute respiratory disorder COVID-19 (SARS-CoV-2) to people who are exposed to it. Coronavirus was proclaimed as a pandemic by the World Health Association (WHO) on March 11, 2020. Recently, the government announced the Movement Control Order, suggesting for all non-essential sectors to temporarily close down to prevent the spreading of COVID-19 virus. Restaurants, either local or fast food, are prohibited for dine-in and only allowed for the takeout service. Therefore, food delivery service become consumer's choice during lockdown period as following the government order from getting out and practicing social distancing (Sarah *et al.*, 2020). However, as we know, COVID-19 is an airborne disease in which the coronavirus from an infected person is transmitted through respiratory droplets or by touching the infected objects. This situation has frightened the public as food delivery services have potential for spreading this COVID-19 virus and different kinds of food-borne diseases (Nguyen and Vu, 2020). Nonetheless, it is questionable whether the food delivery service may have represented such a risk to its clients since this pandemic is still new and there is less research that has been done related to the food safety issues during this COVID-19 era.

Issues regarding to food safety are any biological, chemical or physical agents present in the food and exposed the consumers to any food-borne diseases, called as food safety hazard (Sarah *et al.*, 2020). Food safety hazard has been categorized as biological or chemical which are portrayed as food contamination by microorganisms that are found noticeable in air, food, water, raw materials and in the human body, and also physical agents which happened when any foreign matter coincidentally introduced in food or a naturally occurring object which can cause illness or harm to the consumers. The foreign materials are related with unsanitary conditions during production, storage and distribution of food (Singh *et al.*, 2019). These two hazards control points are determined start at the receiving stage of the ordered food via online platform, preparation of food, packaging and delivery to consumers (storage conditions and duration of transport by riders). It is undeniable that many Malaysians would gain profit from online food delivery services that is currently leading the online marketplace. It increases customer preference and comfort by enhancing food choices

include the household food vendors, market stalls and others. However, according to Mahmoud (2019), food safety issues and vulnerabilities may arise from online food delivery platform even though it provides great chances in entrepreneurship and job opportunities.

Best practice in maintaining the safety and hygiene on the Online Food Delivery (OFD) service during COVID-19 pandemic

The COVID-19 cases have been continuously rising and the Government of Malaysia has taken several precautions such as Movement Control Order (MCO) starting from 18 March 2020 to prevent the virus transmission. Despite difficulties faced by food shoppers to go out buying food and the fear of going outside during a pandemic increases the demand for online food delivery (OFD) service in Malaysia which provides many job opportunities in the food delivery sector especially in urban areas. The OFD services such as Grabfood and Foodpanda have experienced increased growth in sales during lockdown, Foodpanda increase 7.5% in new riders and with increase in rider application 37% (Razak, 2020). However, the working condition of individuals who deliver food is concerned, potential health risk they might be exposed during the process of delivering food and they also need to cater to high workload due to high demands of ordered foods (Papakostopoulos and Nathanael, 2020).

The risk of COVID-19 transmission can possibly happen in our normal daily activities such as shaking hands with other people. This is because the person that we shake our hands with might be an asymptomatic infected person if they will not show any symptoms of being infected. Other than that, people tend to touch many things other than their face during normal daily activities. So, there is a possibility that all surfaces around us have already been contaminated by an infected person carrying the virus. When this happens, the virus can be easily transmitted or transferred to the fingers of other individuals touching the contaminated surfaces (McIntosh, 2020). According to a study done by Adhikari *et al.* (2020), the human-to-human COVID-19 virus is transmitted through three main routes. The three routes are direct or indirect contact transmission, short range transmission by droplets and long-range transmission by aerosol.

According to Abdullah (Personal interview, June 11, 2021), all food riders must have a sense of responsibility while performing their duty in delivering the ordered food especially during this COVID-19 pandemic by complying with the standard operation procedure (SOP) that has been set by the government. Each of the individuals should practice self-hygiene such as washing their hands or cutting their nails short before delivering the food. Some of the SOP that should be practiced during the process of taking the ordered food from the restaurant is sanitizing their hands, checking their body temperature and maintaining social distancing from food sellers or other customers. According to another interview that was done, food riders should also prioritize their self-hygiene before they start to deliver food every day. This means that they should always take a clean bath, wear clean clothing and make sure that their transportation is clean as well (Mohd Hafiz, Personal interview, June 9, 2021).

Other than that, food riders must implement the SOP practice after picking up the food from the restaurant's counter. This can be done by keeping the ordered food inside a clean bag and making sure that the food packaging is fully covered, sealed or has no opening that can cause air to enter which might contaminate the foods. Food sellers on the other hand should place the ordered food on a designated table or area so that no contact with the food rider is made when they collect the food (Abdullah, Personal interview, June 11, 2021).

It is safe to avoid direct contact with customers upon delivering the ordered food to their home as well. Customers should choose the safer payment method which requires no direct contact with the food rider such as using the online payment. Besides that, customers should set up or prepare a specific basket so that food riders can place the food inside it. With this, there will be no direct contact between the food riders and customers as the food can just be placed in front of the door.

Even if they manage to avoid direct face-to-face contact along the process, the food sellers, food riders and customers should still always wear a protective face mask. Wearing a protective face mask is recommended in many countries as one of the important preventive measures because when the air from our nose or mouth is exhaled it will mix with the air in the breathing zone of another person who stands nearby us (Adhikari *et al.*, 2020). Hence, one should not rely fully on the face mask alone because wearing a face mask probably does not prevent the COVID-19 virus, but it can limit the spreading. Therefore, it is also important for each individual to practice a safe distancing of 1.5 metre from another individual (Adhikari *et al.*, 2020).

Measures taken by the government in ensuring the food safety and hygiene during COVID-19 pandemic

Food safety refers to handling food, planning, and packaging material and activities from production to consumption that help to avoid disease and foodborne illnesses (Aprilianti and Amanta, 2020). According to the Global Food Security Index 2020, Malaysia is considered poor in food safety which ranks at 43rd out of 113 countries in terms of food quality and safety. Food safety and health researchers have determined that millions of foodborne illness reports are confirmed per year, the exact figures are tainted with confusion because most cases go unprosecuted (Uçar, Yilmaz, & Çakıroğlu, 2016). Many ministries and agencies are involved in the process since food safety must be ensured from production to consumption. In Malaysia, Food Act 1983 is the principle of law governing food safety, came into force in October 1985 with the accompanying Food Regulations for ensuring food safety.

This pandemic could potentially affect the OFD services especially health issues of individual food riders who deliver food and also the safety of food being delivered. According to the World Health Organization (WHO) there is no evidence that COVID-19 virus could be transmitted through the contact of food or food packaging. However COVID-19 is an airborne disease that can spread the virus easily through respiratory droplets and touching items that had contact with an infected person (Mehrolia and Alagarsamy, 2021). Besides that, many food services that offer OFD are not practicing food safety handling for example some food products are not properly packed which could end up being a health issue (Limon, 2021).

COVID-19 is not a typical foodborne disease, however, people around can be infected with it if they are handling food without proper hygiene and precautions (Duda-Chodak *et al.*, 2020). According to Abdullah (Personal interview, June 11, 2020), the government has advised all food sellers, food riders and customers to have less human-to-human contact in order to prevent the spread of COVID-19 virus. Other than that, the government also advised all food handlers to wear the personal protective equipment (PPE) such as masks and gloves as it is effective in reducing the spread of viruses.

In addition to wearing PPE, the government has also introduced physical or social distancing within the food industry. Another way to maintain the food safety and hygiene during this pandemic is by making sure that that all food handlers follow good hygiene practices when they are handling and preparing foods (Ong *et al.*, 2020). This includes washing hands meticulously. Foods can be directly contaminated during the preparation and handling by individual with hands that have not been sanitized either in restaurants or at their own home. So, the infected hands of food handlers could be a potential source of the COVID-19 transmission. It has been highlighted everywhere that the COVID-19 virus is an enveloped virus. Therefore, the sufficient amount of time for washing hands by using soap will inactivate the virus, and it takes around approximately 30 seconds (Adhikari *et al.*, 2020),

Other than that, all food sellers must ensure that foods such as meat are fully and thoroughly cooked. Other than that, they must ensure that the kitchen has separate utensils to prepare and cook food in order to avoid the potential cross-contamination between cooked and uncooked

foods (Abdullah, Personal interview, June 11, 2021). According to Adhikari *et al.* (2020), food sellers should consider packing the food beforehand such as what is done in bakery product retail stores. This could help in protecting the food and minimising the risk of contamination.

In a study done by Ong *et al.* (2020), there are several actions that can be taken to reduce the possibility of COVID-19 transmission through food. First is by practicing proper hygiene. Food sellers must always clean and disinfect all potentially contaminated surfaces in their restaurants or homes, especially the area where they prepare the food. Other than that, food safety procedures such as washing and disinfecting hands, surfaces and all utensils that will be used during food preparation. One of the common ways that can be applied to disinfect all utensils is by appropriate processing temperatures to it. The procedures mentioned are the basic action and have already become well known within the food and healthcare industry to prevent pathogen contamination. It is also one of several ways to prevent viral contamination to the food or the packaging of the food (Ong *et al.*, 2020).

Second, food handlers should make sure that they are healthy and have tested for COVID-19 virus beforehand. This is because pre-symptomatic and asymptomatic people can spread the virus to other people and also to the surfaces. Ong *et al.* (2020) also stated that it is important for the people who handle food to be excluded from work immediately if they are suspected of being a virus transmitter or carrier. This should include food riders and not food sellers or food handlers only. Other than monitoring health and ensuring cleanliness of kitchen area, all food handlers are advised to take the typhoid vaccine to prevent typhoid fever which can be spread to other people (Abdullah, Personal interview, June 11, 2021).

Food delivering approach during COVID-19 pandemic in Malaysia in achieving the Sustainable Development Goals (SDGs)

In a previous study conducted by Barouki *et al.* (2020), they mentioned that this COVID-19 crisis is affecting the progress made in achieving United Nations' Sustainable Development Goals (SDGs) by 2030. In another previous study, this pandemic has shown that the efforts made in addressing poverty, hunger, good health and well-being may encounter serious problems and difficulties (Fenner and Cernev, 2021).

According to Abdullah (Personal interview, June 11, 2020), this COVID-19 crisis has affected not only the health and well-being of people but also their financial condition. This has driven many job sectors to cut off the number of workers and some sectors are forced to be closed. Moreover, this has added to the amount existing number on unemployed people who are having trouble finding a new job. This problem contributes to the challenge in achieving SDG 8 (decent work and economic growth). In addition, the efforts made to achieve SDG 1 (no poverty) and SDG 2 (zero hunger) are also facing difficulties as the number of unemployment increases and causing many people having problems due to limited access to food supplies (Nchanji and Lutomia, 2021).

Since food is one of the essential needs, many demands for it occur especially during the MCO. However, ever since the movement control order (MCO) being implemented, many people are unable to go out to buy food or dine in restaurants like before. So, the other option that is available for people is to use the OFD. This somehow opens a job opportunity to many people by becoming food riders to deliver the food from restaurants to their customers' home. This could be one of the ways to ensure the effort of achieving zero poverty and zero hunger will be continuous until it is achieved in the future (Abdullah, Personal interview, June 11, 2021).

According to Li & Mirosa (2020), OFD services also create environmental issues regarding the use of plastic. The consumer seems to believe that the use of single use food plastic packaging is more hygienic and safer to protect food from virus or contamination, thus there is a rise in the volume of food packaging during COVID-19 pandemic. Due to the increase in uses of plastics especially within food industry, it could possibly slow down the progress made towards SDG 14 (life below water) and SDG 15 (life on land) if the plastic materials did not undergo proper disposal (Mohd Hafiz, Personal interview, June 9, 2021).

Hence, post-pandemic measures should simultaneously be produced across combinations of multiple SDGs such as increasing job opportunity, reducing poverty, improvement on the environmental condition and improvement on the economic activity in order for us to deliver the SDGs by 2030 (Barbier and Burgess, 2020).

CONCLUSION

Even though there is no direct evidence that COVID-19 is a foodborne disease, the process of handling food or any contact with food cannot be considered as completely safe especially during this ongoing pandemic. Since food is a product of the first need, and therefore there is a demand for it all the time, it is very important to always monitor and check the health of staff who are in charge of handling food. It is also important to identify all infected people, especially asymptomatic carriers of the virus, while at the same time preventing its spread. To ensure the safety and hygiene of food during this COVID-19 crisis is practiced, it is safe to say that everyone ranging from food seller, food handler, food riders and customers should be responsible to take part in it.

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LIFE IN PANDEMIC ERA:

CHALLENGES AND OPPORTUNITIES TOWARD ENVIRONMENTAL SUSTAINABILITY

An Approach to Pandemic Era – Proper Handling of The Used Face Mask

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Abstract

World Health Organization (WHO) declared a SARS-CoV-2 pandemic since it has affected the whole region. The Malaysian government has made wearing face masks mandatory to prevent SARS-CoV-2 infections. This article aims to disseminate the benefits of using face masks during the COVID-19 crisis and enhancing awareness on the proper disposal of face masks towards the sustainability of the environment. Daily usage of face masks has the potential to cause harm to the environment due to the excessive production of waste. Therefore, to tackle the issues that arise from the mismanagement of the face mask disposal, material such as a short video "Proper Handling of The Use Face Mask" is needed to educate the community.

Keywords: COVID-19, waste management, face mask, disposal, environment

INTRODUCTION

On January 24, 2020, Malaysia reported the first covid-19 case, persuading the government to declare a movement control order (MCO) throughout the nation. The government had imposed a lockdown on all states in order to halt the virus from spreading. All Malaysians had to remain at home with minimal outdoor activity. A mitigating action is taken to curb the spread of disease, such as adherence to the established SOPs, developing the MySejahtera application to facilitate the government in the management and containment of the COVID-19 epidemic, and restrictions of business hours. The Malaysian government also made face masks in crowded places mandatory. Anyone who contravenes is compounded under Prevention and Control of Infectious Diseases Act 1988, a sum of money not exceeding RM 1,000. Furthermore, the new norm needs to be embraced by all Malaysians for the COVID-19 disease elimination. About 87 percent of Malaysian respondents stated that they were wearing face masks when in public places during the COVID-19 outbreak.

Epidemiological Evidence and Ecological Studies

Coronavirus is transmitted through aerosol and airborne droplets. The COVID-19 spread from one person through respiratory droplets and contact routes based on a current finding. The number of masks used has increased significantly since February 2020 (Statista, 2021). A mask is made up of three layers of non-woven fabric. It features a waterproof outer layer, which efficiently resists liquids such as salivary drops. The middle layer is a filter that prevents particles or pathogens from penetrating both directions. These three layers adequately prevent the penetration of pathogens and particles in both directions for the user and the surrounding people (Chua et al., 2020) including subsided the particles and protect the user (Prather et al., 2020).

Following the outbreak of SARS-CoV-2, many countries have issued regulations regarding the use of face masks. Research by Leung et al., (2020) indicates no coronavirus was found in the samples taken from a person with surgical masks, compared to those without masks. A study conducted in the United States (Rader et al., 2021) and China showed that using a community mask can reduce COVID-19 transmission (Wang et al., 2020). Furthermore, surgical masks provide efficient filtering and reduced microbial content expelled by any person who coughs. For the Influenza virus, surgical masks and respirators (N95) were commonly used to prevent the spread of the disease from infected patients (Johnson et al., 2009). These pieces of equipment were also effective in protecting healthcare workers from infection (Radonovich et al., 2019). A comparison was made between tea-cloth masks, surgical masks, and Filtering Face Piece2 Mask respirators. Evidence showed that tea-cloth masks provided lower protection; less than 2 times compared to surgical masks and 50 times less protection than FFP2 respirators (van der Sande et al., 2008). A surgical mask essentially reduced the transmission of COVID-19 and presented minor clinical manifestations on lab rats (Chan et al., 2020). However, it is important to remember that these masks can only protect against COVID-19 infection for a limited time. The CDC has issued a general recommendation for the use of cloth masks, which can effectively block particles and droplets up to 50-70% in various areas. However,

respirators performed extra protection than surgical masks and reusable cotton masks, as proven by the metanalysis of betacoronavirus.

The study conducted in Beijing, China, revealed that masks reduced the secondary transmission of COVID-19 by 79%. The remaining study revealed that wearing a mask when going out was highly protective, with a risk reduction of 70% for those who always wore one, but it did not look at the impact of masks on transmission from the wearer. Research by Leffler et al. (2020) in multiple regression techniques using a range of policy interventions by) geographic and socio-demographic factors to infer the connection between mask use and SARS-CoV-2 transmission. They discovered that regions without comprehensive mask usage had a transmission rate that was 7.5 times higher, a finding that was comparable to those of smaller-scale studies (Kenyon, 2020). A study conducted by researchers showed that the implementation of mask mandates or a comprehensive mask use lowered the daily growth rate in US states by 2.0 percentage points, prevented 230000 to 500000 COVID-19 cases by May 2020 (Lyu & Wehby, 2020).

Epidemiological studies have evaluated the effectiveness of wearing a mask to reduce SARS-CoV-2 transmission. During an epidemic in a hair salon in Springfield, Missouri, 67 clients who were tested were not affected by the two symptomatic stylists who attended 139 clients (Hendrix et al., 2020). All employees and clients who visited the salon were obliged to wear a mask when entering the facility. During the USS Theodore Roosevelt's COVID-19 outbreak, persons who wore masks had a 70% lower chance of being infected with SARS-CoV-2 infection (Payne et al., 2020). Furthermore, cases involving contacts and household clusters that were masked have shown significant decreases. An expanding number of ecological studies determined universal obligatory mask-wearing regulations linked to reducing infection rate and fatalities. A study conducted by researchers found that the effects of mask mandates on the growth of infections in 15 US states and the District of Columbia were slowed significantly before and after implementation of mask mandates (Lyu & Wehby, 2020).

Personal protective equipment (PPE), social isolation, travel limitations, and lockdown is currently used to reduce the extent of coronavirus transmission (Rubio-Romero et al., 2020; Sun et al., 2020). A rapid accumulation of potentially infectious waste in the solid waste stream globally was due to the increased number of personal protective equipment such as face masks, gloves, goggles, gowns used among the healthcare workers and in the general populations during the COVID-19 pandemic (Singh et al., 2020, p. 8500). To control the viral re-emergence and protecting the environment, disposal of wastes must be proper (Ma et al., 2020), as well as the achievement of the Sustainable Development Goals, especially SDG3, SDG6, SDG8, SDG12, and SDG13 (Ma et al., 2020). Any substance containing suspicious pathogens in a suitable concentration leads to disease in possible hosts and causes life-threatening diseases determined as infectious waste. Inappropriate management of solid waste, for instance, can exacerbate coronavirus transmission, especially in underdeveloped nations.

According to a recent study by Kampf et al., (2020) human coronaviruses can survive on hard surfaces (metal, glass, or plastic) for up to nine days. Insufficient solid waste dumpsters are the primary source of infectious waste contamination in the general community; the challenges are more significant in developed countries, despite the fact that certain Asian countries are still not emphasizing the appropriate procedures of waste management. Most of the countries in the developed regions (Cambodia, the Philippines, Thailand, India, Malaysia, Indonesia, Bangladesh, Vietnam, and Palestine) are known to have unsatisfactory solid waste management facilities (Ferronato & Torretta, 2019). Due to this, infectious waste is one of the many factors that will inevitably cause environmental concern if not properly handled.

On July 31, 2020, the COVID-19 pandemic database revealed the projected number of face masks worn in 49 Asian nations. Subsequently, 2,228,170,832 face masks used in Asia. The total daily face masks used in Malaysia was 7,049,901 pieces (Sangkham, 2020). According to Akber Abbasi et al. (2020), almost all face mask wastes add plastic or macroplastic pollution to the environment. It also demonstrates that the current ongoing pandemic increases environmental pollution and affects human and animal health. Therefore, while encounter the mask demand, continual solutions need to reduce environmental impacts. Polypropylene is the most commonly used material for a 3-ply surgical mask, but other fabrics such as polystyrene, polycarbonate, polyethylene, and polyester can also be used. These materials are known to cause microplastics and particulate pollution in the environment (Schnurr et al., 2018). Improper use of face masks causes a severe environmental crisis in solid waste and microplastic contamination in coastal and freshwater environments. These polymeric materials enter the water bodies in various ways, such as leaching, flooding, and by the wind. Thus, disposable face masks appeared in the environment first as disposal in landfills and dumpsites or littering at public spaces, then into the freshwater oceans as a new emerging source of microplastic fibres.

Environmental Impacts of Used Face Mask

The toxicity of plastic has been observed in various scientific papers (Wu et al., 2019; Galloway et al., 2017; Rist et al., 2018). Some of the main pollutants include phthalates, organotin, and nonylphenol. The degradation of plastic polymers can result in the release of toxic chemicals into the environment. Due to the presence of microplastics in aquatic life, many fishes were threatened as well as higher concerns about food safety and the availability of food. In addition, plastics and particles cause pollution to shore environments and, as a result, will decrease the aesthetics and recreational value of coastal areas. In addition, plastics and particles cause pollution to shore environments and, as a result, will decrease the aesthetics and recreational value of coastal areas. The existence of plastic and plastic particles will lead to drought and global warming. Climate change is expected to worsen the environment's deteriorating conditions Hence, jeopardized human social and mental stability. Plastic and particles tend to multiply microorganisms, therefore spread via the food chain and/or trigger direct access. The greater issue, from this vantage point, is microplastics establishing a niche for microbes and producing biofilms. The microbial components of an environment might differ from those of naturally occurring free-living microorganism populations in the adjacent aquatic environment. The increasing amount of microplastics in the world endangers the ecological function of the environment and disturbs human health.

According to a specified study, improper disposal of face masks, plastic and plastic particles have been identified as a major cause of pollution. In addition, face mask production also contributes to carbon dioxide missions, which can contribute to global warming. The production of N95 and surgical masks uses propylene, small aluminium strips, and polypropylene, which emit significant amounts of Carbon dioxide (CO2) (Liebsch, 2020). The N95 mask produces 50 g CO2-eq., exclusive of transportation. The surgery mask has 59 g CO2 for each person, and the major distribution is in the process of transportation.

Medical examiner’s face masks are handled cautiously as hazardous waste in hospitals. The amount of 124,000 tonnes of plastic waste, 66,000 tonnes of contaminated waste, including 57,000 tonnes of packaging, were produced, conceding that each individual used one disposable mask daily for a year (Lisa Allison et al.,). Waste generated by the general public currently does not have a dedicated stream, and most of it ends up on the streets. The COVID-19 pandemic has drawn a substantial challenge in managing urban sturdy waste and dangerous pharmaceutical waste. In addition, discarded hospital masks and mixed waste were sent to the incinerator and landfill. Due to this technique of managing those waste, plastics contained in the mask caused harm to the environment. A study also revealed that the disposal of 10 tons of waste of personal protective equipment, such as face masks, led to a

global warming potential of 2.76 kilograms CO2 when transported up to 10 kilometres (Kumar et al., 2020). Moreover, it affects the unhealthy environment for a long period of time if this condition persists

The plastic particles can enter an animal's stomach when mistakenly eaten and cause death due to starvation. Ingestion of plastic also caused developmental problems in children and was highlighted by the study of Kleme et al. (2020). Besides entanglement, the death of waterfowl and other aquatic animals may occur. Due to abiotic factors such as erosion, photodegradation, and aquatic immersion, the microplastics in the mask become fragmented. This leads to their bioaccumulating toxins in the food web.

CONCLUSION

The surgical face mask is a potential source of microplastic contaminants in the littering and water systems. To tackle the issues that arise from the mismanagement of the face mask disposal, material such as a short video is needed to educate the community. According to Ahmad et al. (2015), videos outperform pamphlets as an Environmental Education tool. The finding was an expected outcome as the video contained more enjoyable elements than the pamphlet, such as a voice-over or narration and background music. However, some respondents preferred viewing the pamphlet because of the extended video duration (approximately 14 minutes). Therefore, the short video contents we proposed will be approximately 3-5 minutes in duration, with less narration and more sequences with just visuals and background music. It allows viewers to better process and remembers the information being disseminated. According to (Vandormael et al., 2020), the media that combines entertainment and education (E-E) will increase behavioural intent toward health-related practices. During this COVID-19 pandemic, E-E media will cover millions of people without having any physical interaction. Based on the issues highlighted, a short video is designed to disseminate information on the environmental impacts of improper disposal of used face masks and educate the community about the proper way of disposing of used face masks.

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