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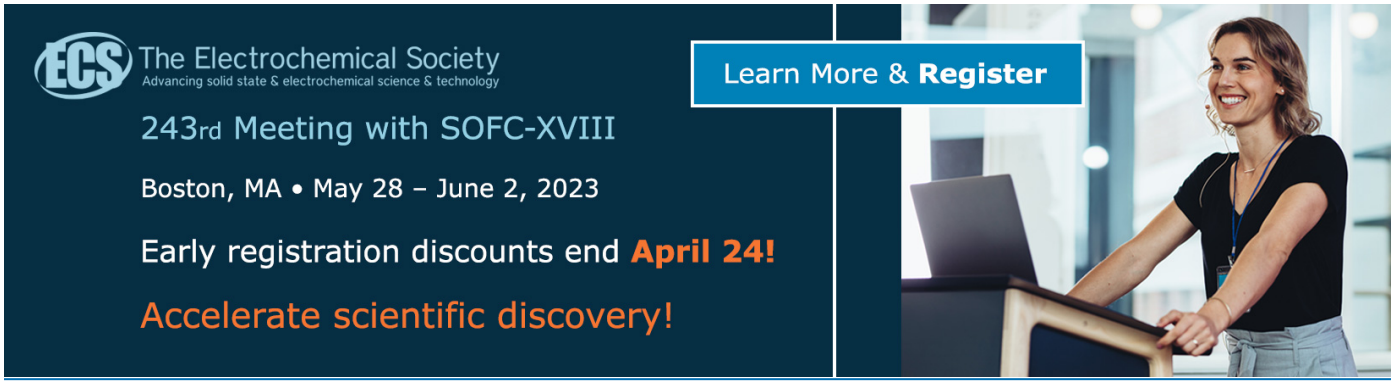

Impact of pandemic COVID-19 on solid waste compositional trends in pasar awam maharani Muar

N Isa[1,2,3], P Tamunaidu[1,2], A H M Ali[1,2], M Goto[1,2], L P Yen[1,2], V B[1,2], N M Huzir[2], M B Rosly[2], M H Hussin[2] and A N Rasyid[2]

[1]Department of Chemical and Environmental Engineering, Malaysia-Japan International Institute of Technology (MJIIT), Universiti Teknologi Malaysia (UTM), 54100 Kuala Lumpur, Malaysia

[2] Malaysia-Japan Advanced Research Centre (MJARC), Universiti Teknologi Malaysia Pagoh, Eduhub Pagoh, 84600, Pagoh, Muar, Johor, Malaysia

[3] Malaysian Institute of Chemical and Bioengineering Technology (MICET), Universiti Kuala Lumpur (UniKL),78000 Alor Gajah, Melaka, Malaysia.

Corresponding author: pramila@utm.my

Abstract. The world was astounded by the emergence of the deadly virus COVID-19 at the end of 2019. In March 2020, Malaysia's first Movement Control Order (MCO) was initiated to stop the spread of the virus that ended in June 2021. Hence, this paper was initiated to study the impact of the pandemic and MCO on the generation of waste in Pasar Awam Maharani Muar (PAMM). The waste generation rate and the trend of waste accumulation according to different categories were recognised. The PAMM operates 8 hours daily, and the area strictly observes Standard Operating Procedures (SOP) established by the government. The compositional study was performed two times for 14 days in a month. The solid waste was segregated, and the weight were measured accordingly. The average total solid waste generated from 30 stalls was around 1.5 tonnes daily. It was further established that 38.5% of the waste comprised of chicken and fish waste, 36.3% formed inorganic waste, and 25.2% constituted vegetable and fruit waste. Several limitations were acknowledged in this research which was the short operational time, unpredictable weather, public holidays, and the closure of PAMM on Sundays. Observations also showed that some stall owners were highly mindful of the solid waste segregation and some of the organic wastes were reused as ruminant feed and some for composting.

1. Introduction

The generation rate of municipal solid waste is expected to advance to 2.2 billion tonnes per year by 2025 worldwide [1]. Consequently, waste to energy technologies offers encouraging technologies to convert waste into energy [2]. Municipal solid waste management (MWM) in Malaysia has become an arduous undertaking due to the growth of population, industrialisation and an expansion in quantity and variation in the types of waste generated. Solid Waste Corporation Malaysia (SWCorp) documented that 17,000 tonnes of organic waste, mainly food waste, was generated daily, which could potentially feed around 1,300 persons three times daily. Since the coronavirus pandemic (COVID-19) prompted severe social and economic upheaval worldwide, this pandemic also affected our municipal solid waste management (MWM). Generated waste in Malaysia comprises 45% organic waste, 24% plastics, 7% paper materials, 6% metal and 18% glass and others [3][4].

This organic waste consists of carbohydrate polymers, lignin, proteins, lipids, organic acids and smaller inorganic parts with high moisture content and readily biodegradable biomass. Accordingly, this organic waste can be recycled and reused for energy recovery besides being dumped in the open landfill, which creates a lot of environmental issues [5]. Therefore, it is paramount to investigate the rate of solid waste generation and the trend of waste accumulation according to different categories before any prospective execution manoeuvring.

2. Methodology

This study focused on the impact of COVID-19 on solid waste generation at Pasar Awam Maharani Muar (PAMM) during the pandemic. The PAMM plays a vital function in delivering fresh agro products and is one of the historical tourism spots around the town of Muar as the market has existed for more than 30 years. This study was done according to the Malaysian Standards MS2502-2012 [6], solid waste includes waste retained for other purposes and discarded for collection. There are 15 components of solid waste, but only six primary components are usually pertinent for general solid waste study, i.e. organic waste, paper, plastic, glass, and metal/aluminium.

2.1 Location of study

This analysis was conducted in Muar with 1,392 km^2 of land area and a population of 281,500 (statistic in 2017). Muar is known as Bandar Maharani located along Sungai Muar. The area experiences boosted population and development as a historical tourism spot. The PAMM was selected as the strategic site for this investigation because most market sources like vegetables, fruits, meats, fish and seafood are stationed here before being transferred to other locations around Muar District. The total area of PAMM is 3124 square meters, with 30 stalls covering dry (vegetables, fruits, florist and spices) and wet (chicken, fish, seafood and meat) areas. The solid waste was measured and weighed at Station 1, Station 2 and along the alleys from one stall to the other stalls, as shown in Figure 1.

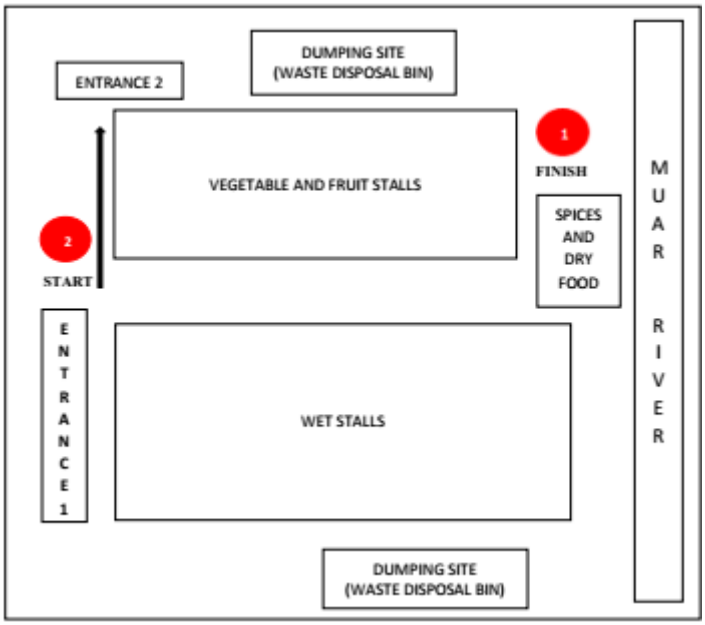

Figure 1. Layout of Pasar Awam Maharani Muar.

2.2 List of Equipment

Basic sampling equipment and personal protective equipment (PPE) involved in this waste sampling activity. The PPE included gloves, masks and anti-bacterial hand soap and sanitiser. Whereas the sampling equipment included a weighing scale, plastic bags and containers which were used to sort and

measure the produced solid waste. This sampling activity was done in accordance to the Standard Operating Procedures (SOP) instructed by Kementerian Kesihatan Malaysia.

2.3 Waste Sampling.

The waste sampling was conducted to explore the trends of solid waste generated for 14 days (18 April – 1 May 2021). Due to the pandemic, the market operated for only eight hours from 6.00 am to 2.00 pm daily except Sundays. Prior to the sampling activity, it was essential for the researchers to monitor the temperature and use the MySejahtera apps to follow the Standard Operating Procedures (SOP) specified by the government. The waste sampling activity was done twice a day at 9.00 am and 2.00 pm, respectively. It was imperative to provide ample time for the stall owners to sort and remove all the dried and rotten vegetables and fruit. The wet waste comprising chicken/meat and fish waste was also measured. Moreover, other wastes like paper, plastic, glass, and metal/aluminium were measured to identify the total solid waste produced in the market every day.

The organic waste was categorised as dry waste (vegetables and fruits), wet waste (chicken/meat and fish) and others. The weight of the organic, wet and other waste was registered every day and tabulated accordingly. Figure 2 shows the flowchart of the sampling activity, which covers the segregation process, collection of solid waste in plastic garbage bags and the measurement of weight. Figure 3 shows the methodological framework of the compositional study done.

Figure 2. Flowchart of the sampling activity.

2.4 Data Calculation

The organic waste generation rate was computed according to Equation 1 to identify the amount of organic waste produced daily. Meanwhile, the percentage of organic waste was calculated using Equation 2 to determine the percentage of organic waste from the total solid waste generated by the sampled stalls [7].

$$Rate\ of\ organic\ waste\ generation = \frac{Weight\ of\ organic\ waste\ (kg)}{No\ of\ stall\ \times No\ of\ days\ involved} \quad (1)$$

$$Percentage\ of\ organic\ waste = \frac{Weight\ of\ organic\ waste\ (kg)}{Total\ weight\ of\ municipal\ solid\ waste\ (kg)} \times 100 \quad (2)$$

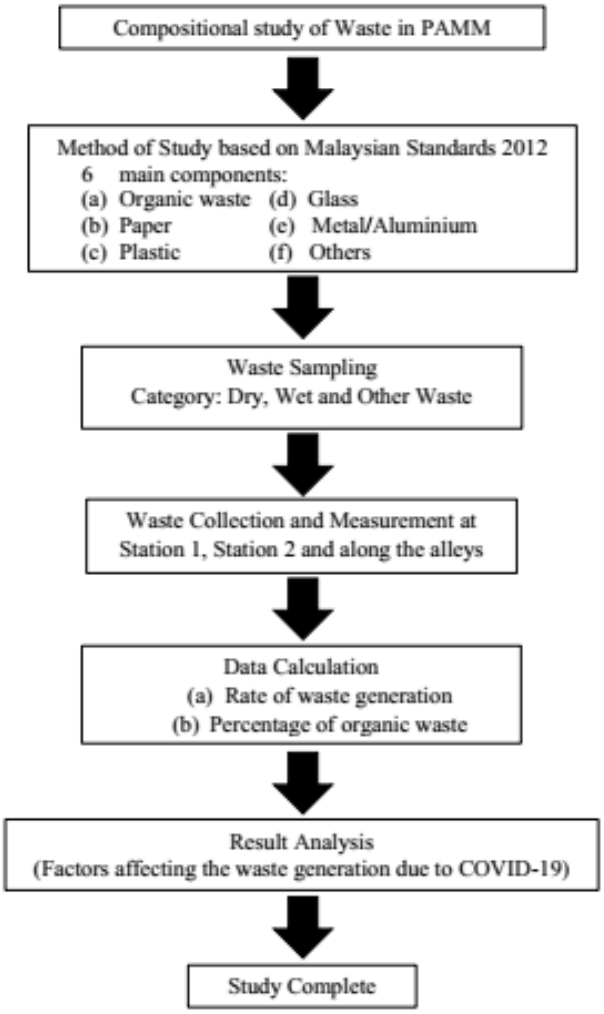

Figure 3. Methodological Framework of the study.

3. Results and Discussion

The solid waste generated by 30 stalls in PAMM is shown in Table 1. The total solid waste generation for two weeks were 22,069.60 kg, which is wet waste (chicken, fish and meat waste) amounting to 8,492.00 kg, followed by other wastes (polystyrene, paper, plastic and others) with 8,019.40 kg and dry waste (vegetable and fruits) with 5,558.20 kg, respectively. The organic waste generation rate was expressed in kg per stall per day and was estimated at 33.45 kg/stall/day, compared to inorganic waste which is estimated at 19.09 kg/stall/day only. All the waste generated were disposed in the roll-on roll-off (RORO) bins alloted by Perbadanan Pengurusan Sisa Pepejal dan Pembersihan Awam (SWCorp).

The waste generated will be sent to the landfill nearby and unfortunately, landfills are becoming scarce in Malaysia, and most existing ones are almost filled up [4].

Table 1. Waste Generation in Pasar Awam Maharani Muar (PAMM) for 14 days.

	Category	Total Waste Generation (kg)	Generation Rate (kg/stall/day)
Organic Waste	Dry Waste (Vegetable and Fruits)	5,558.20	13.23
	Wet Waste (Fish, Chicken and Meat)	8,492.00	20.22
Inorganic Waste	Polystyrene, paper, plastic and others	8,019.40	19.09
	TOTAL	22,069.60	52.54

The trends of solid waste generated every day from 18th April to 1st May is shown in Figure 4. There were three categories: dry waste (vegetable/ fruit waste), wet waste (chicken/meat/fish waste), and other waste covering plastic, paper, polystyrene, and many more. The highest generation of dry organic waste, was on 21st April 2021 corresponding to 504.9 kg, wet organic waste was on 27th April 2021 with 855.0 kg and other waste on 1st May 2021 with 751.4 kg, respectively. Most waste generation are observed in the mid-week due to arrival of new stock and removal of old stock.

Most fruits and vegetables are left to rot and later discarded if the stall owners cannot sell them by mid-week. The sales may have been disrupted due to lack of consumers. Many lost their jobs and some chose to avoid crowded places due to pandemic. Also, direct delivery services from hypermarkets and supermarkets were preferred during the pandemic which may have also influenced the generation of waste in PAMM.

Corresponding to the daily waste generated, a summary is shown in Figure 5 which shows the percentage of solid waste generation according to categories. Throughout these 14 days of sampling, the highest waste generated was the wet organic waste with 39%, followed by other waste with 36% and finally the dry organic waste with 25%.

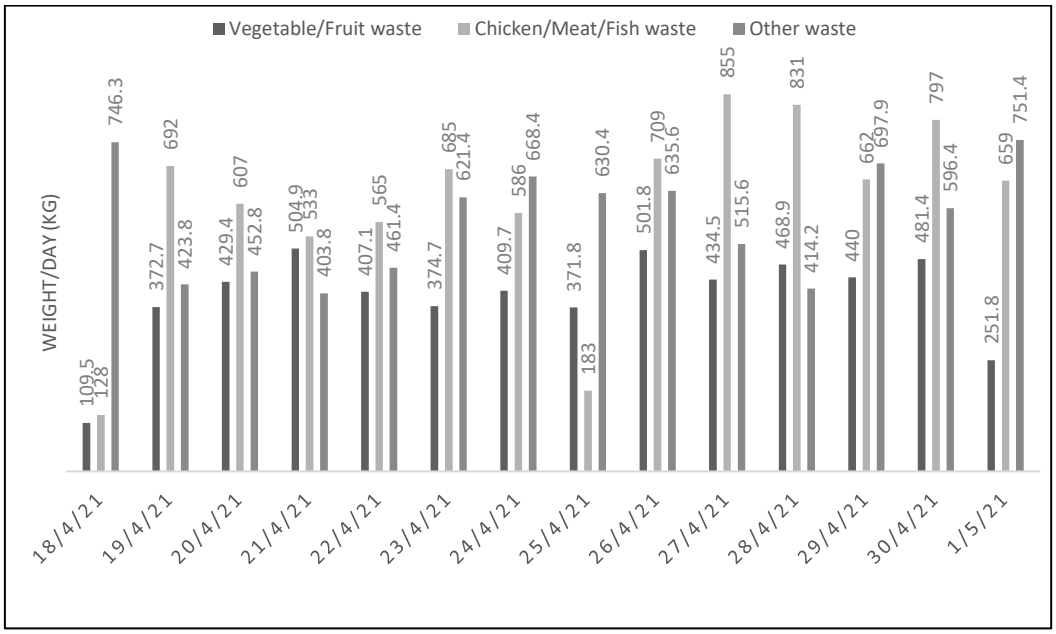

Figure 4. Daily waste generation trends in Pasar Awam Mahaharani

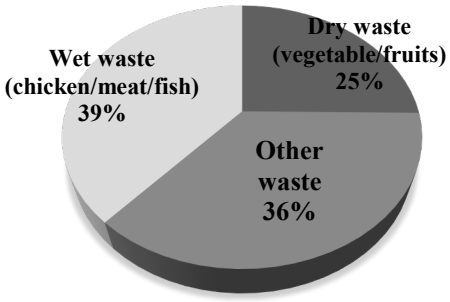

Figure 5. Waste percentage according to different categories

4. Conclusion and Recommendation

Based on the data analysis, the generation of solid waste in the country is still alarming although during pandemic Covid-19 with a majority of organic waste left to rot and later discarded. Therefore, it is quintessential for the Muar City Council to create an ecosystem whereby unsold vegetables and fruits could be given away for free before it rots. For inedible organic waste, a better management system to improve energy recovery efficiency is needed. This strategy may be successful since the stall owners exhibited basic segregation proficiency. The researchers propound that the government run awareness campaigns as preparatory steps towards receding the waste production.

Acknowledgement

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References

[1] Guimaraes C S, Maia D R S, Serra E G 2018 Construction of biodigesters to optimise the production of biogas from anaerobic co-digestion of food waste and sewage. *Energies.* 11
[2] Moya D, Aldas C, Lopez G, Kaparaju P 2017 Municipal solid waste as a valuable renewable energy resource: A worldwide opportunity of energy recovery by using waste to energy technologies. *Energy Procedia.* **134**:286-295
[3] Sadeghi O, Fazeli A, Bakthiarinejad M, Sidik N A C 2015 An overview of waste to energy in Malaysia. *Applied Mechanics and Materials*. **695**:792-796
[4] Zainu Z A, Songip A R 2017 Policies, Challenges and Strategies for Municipal Waste Management in Malaysia. *Jostip.* **3(1)**
[5] Ye M, Liu J, Ma C, Li Y, Zou L, Qian G, Xu Z P 2018 Improving the stability and efficiency of the anaerobic digestion of food waste using additives: A critical review. *Journal of Cleaner Production*. **192**:316-326
[6] Malaysian Standard 2012 *Guidelines for sampling household solid waste-Composition and characterisation analysis*.
[7] Yaacob N N F, Manaf L A, Ash'aari Z H 2019 Quantifying the organic waste generated from the fresh market in Kundasang Town, Sabah. *Journal of the Malaysian Institute Planners*. **17(2)**: 112-122
[8] Ismail, S N S, Manaf L A 2013 The challenge of future landfill: A case study of Malaysia. *Journal of Toxicology and Environmental Health Sciences.* **5(6)**:86-96
[9] Environmental Consulting Inc. 2013 *Organic Waste Composition Composition*. https://www.researchgate.net/publication/315569956