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The Effectiveness of Car Free Day Activity in Surakarta is Reviewed from the Anthropogenic Results: Waste and Fuel Emissions

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ABSTRACT. Car Free Day is one of the programs held with the aim to reducing air pollution in urban environments. This research was conducted during Car Free Day on Slamet Riyadi Street, Surakarta. The composed article aims to determine the total fuel emissions from trading activity during Car Free Day activities. This article also aims to determine the amount of waste generated, and to find out how effective the Car Free Day program is as an effort to reduce air pollution in Surakarta. The analysis of data was obtained by using a qualitative descriptive method. The data collection was carried out using a direct approach, namely interviewing, and observation methods are also carried out to present realistic information. Within the Car Free Day, there is no reduction of pollution but instead centralizes the pollution to that point. Based on the research during Car Free Day, the community produces output from the activities carried out in the form of waste and emissions. It is shown by the total emissions of LPG 27,33526 ton/year, gasoline 1,911259 ton/year and charcoal 10,77839 ton/year and the total waste is 18 kg. Therefore, Car Free Day is considered less effective in order to reduce air pollution.

Keywords: Air Pollution, Car Free Day, Density, Emissions, Waste.

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1. Introduction

Indonesia is an Archipelagic State with a large area that came along with a high population. The total area of Indonesia is 1,890,754 km^2. Indonesia is the fourth most populous country in the world (Satiti, 2019). In 2020, the total population in Indonesia reached 268 million. This amount of population is unequally distributed in Indonesia. Therefore, several cities in Indonesia have an extremely high population density, especially in big cities. The high population density brings various negative impacts on the environment such as high air pollution and high waste production. These kinds of issues often occur in countries with high population density such as China and India.

Garbage is a major problem that often occurs, especially in big cities. As the human population increases, it will cause the increase of waste produced (Sari, 2016). This is also exacerbated by inadequate trash bins and ineffective waste management. In addition, the lack of awareness and willingness of the community in disposing and managing waste is also a major problem causing the large amount of waste in Indonesia. Low concern for the environment and the consumptive lifestyle of urban communities affect the increase in waste piles in cities (Candrakirana, 2015). According to Mahyudin (2017), waste management in Indonesia is the main problem because as the population grows, the amount of waste produced also increases. Garbage itself is a waste product due to human and animal activities, both organic and non-organic in the form of solids that are no longer useful and must be managed so as not to endanger the environment and development.

Apart from the waste problem, air pollution is also one of the main problems in several big cities in Indonesia. Air contaminants or pollution occurs due to human activities that can endanger humans themselves (Handayani, 2017). The main source of air pollution comes from the transportation sector (Fauziah et al., 2017). About 70% of the exhaust gas produced by vehicles is a source of pollution which causes air pollution (Arwini, 2015). The exhaust gas produced from the combustion of fuel transportation could be CO2 and CH4 (Samita, 2015). Besides, the source of high levels of air pollution in several cities in Indonesia come from the industrial sector, electricity production and the use of fuel for cooking and heating (Aunan et al., 2019). According to WHO, pollution can have an impact on health issues. An estimated 6.5 million people die every year due to air pollution. In

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Indonesia, 16.000 people die every year due to air pollution where 1 in 10 people suffer from upper respiratory tract infections and 1 in 10 children suffer from asthma (Kurniawati et al., 2017).

One of the cities in Indonesia that has a high population density is Surakarta. This is because Surakarta is one of the cities that has not too large an area, but has a large population. The large number of residents in Surakarta is due to the fact that the city of Surakarta is enlisted in the second rank of the most habitable city in Indonesia. This has led to an increase in activities that have taken place in the city of Surakarta, triggering various problems such as increasing in population (Aditama et al., 2016). The escalating number of population that occurs every year is always followed by an increase in the volume of vehicles, so that air pollution increases too. The city of Surakarta is classified as a secondary city or middle class city which continues to develop and has the potential to become a metropolitan city. An increase in motorized vehicles traffic due to increased economic activity affects population growth in Surakarta, which then has consequences for transportation systems and patterns (Andriani and Yuliastuti, 2013).

To solve the problem of air pollution, several cities in Indonesia, especially Surakarta, have held a Car Free Day. Car Free Day is one of the programs that is carried out to mitigate air pollution caused by motor vehicles (Indria and Ali, 2017). The government hopes that the air pollution will be reduced by the Car Free Day program even though it only happens once a week. Hence, This article aims to determine the total fuel emissions from trading activity during Car Free Day activities. This article also aims to determine the amount of waste generated, and to find out how effective the Car Free Day program is as an effort to reduce air pollution in Surakarta.

2. Materials and Methods

2.1 Location

This research was conducted during Car Free Day on Slamet Riyadi Street, Surakarta 2019 at 3 segments. The research segments are Loji Gandrung - Stadion Sriwedari, Stadion Sriwedari - Graha Wisata Niaga, and Pizza Hut – Solo Grand Mal. This research was conducted by observing. For garbage data was obtained by collecting waste inside trash bags which is then weighed. Motor vehicle data around the CFD location was conducted by counting the number of motorbikes in idle conditions in the parking area. Meanwhile, the emission data generated by traders at CFD locations was obtained by interviewing the types of fuel they used. All data collected is written on a tally sheet for further analysis.

2.2 Data Analysis

In calculating a fuel emission, both from the emission factors of CO2, PM 2.5, and VOC, the standard emission estimates can use the formula based on the IPCC as follows:

$E = AD \times EF$

AD = Amount of fuel one year × NCV

Note: E : total emissions (tonnes)

AD : activity data

EF : emission factor

The analysis of data was obtained by using a qualitative descriptive methods, because the data collection was carried out using a direct approach, namely interviewing traders at the location. In addition, observation methods are also carried out to present realistic information on behave or incidents, such as observing the activity of littering by visitors and traders.

3. Result and Discussion

Table 1
Waste Data

Segment	Total (kg)
Loji Gandrung - Stadion Sriwedari	8
Stadion Sriwedari - Graha Wisata Niaga	8
Pizza Hut - Solo Grand Mal	2

Based on Table 1, the waste found is dominated by plastic, styrofoam, and paper waste. This waste is divided into two categories, namely organic and non-organic waste. Plastic, cans, and styrofoam waste are classified as non-organic waste. Meanwhile, organic waste that was found were fallen leaves. Most of the waste generated comes from the activities of traders and visitors who carry out selling and buying activities. It resulted in the environment in the Car Free Day area becoming polluted due to scattered garbage.

Based on data from Table 1, the most abundant waste found is in Loji Gandrung to Graha Wisata Niaga. This is because at that point, many people visit and it is the most crowded place due to the large number of traders and an activity/event that attracts the attention of visitors. Meanwhile, the waste produced at Pizza Hut to Solo Grand Mall is only 2 kg because there are rarely traders at that location. In addition, the locations from Pizza Hut to Solo Grand Mall are used by some visitors to go to sport, so that there is not as much waste as in other locations. The Car Free Day activity actually produces new waste with a larger volume.

Based on research conducted by Devi et al. (2016) Economically, the Car Free Day activity has a positive impact on traders, that is increasing income because it does not need large production and distribution costs with a high level of visitor consumption. However, this actually has the opposite impact on the environment because the waste generated during the Car Free Day is more than usual. Moreover, the garbage boxes at the Car Free Day locations are not evenly distributed, so that many visitors and traders litter.

Table 2
Motor Vehicles Data

Segment	Total (Unit)
Loji Gandrung - Stadion Sriwedari	701
Stadion Sriwedari - Graha Wisata Niaga	1696
Pizza Hut - Solo Grand Mal	313

In the segment that is located at Pizza Hut to Solo Grand Mall, there are only 313 motor vehicles. This segment is where the motorbikes are found least in comparison to the other segments. This is because at that location there is no parking space for visitors, so the vehicle is only parked on the sidewalk. This is also affected because there is not enough

area for parking space. Meanwhile, motor vehicles are mostly found in the Stadion Sriwedari to Graha Wisata Niaga, this is because there is a lot of parking space for visitors.

Based on observations, most visitors still used motor vehicles to get to the location. In fact, it is often found some visitors who are still passing by in the Car Free Day area using motor vehicles. This contradicts with the purpose of holding Car Free Day.

Table 3
Fuel Emission Calculation Result

Segment	Type of Fuel	Number of trader	Number Of Fuel (kg or L)	Amount per year (ton)	AD (GJ)	CO_2 Emissions	PM 2,5 Emissions	VOC Emissions
Loji Gandrung - Stadion Sriwedari	LPG	14	48.4	2.3232	108.49344	6.845936064	0.000130192128	0.000206137536
	Gasoline	2	5.25	252	8.7696	0.60773328	0.00017539	0.00021924
	Arang	2	3.5	0.168	4.923576	4.657702896	0.003687758424	0.0029541456
Pizza Hut - Solo Grand Mal	LPG	23	99	4.752	721.9184	14.00305	0.000266	0.000421645
	Gasoline	1	3	144	5.0112	0.347276	0.0001	0.00012528
	Arang	4	27	1.296	37.98187	3.593085	0.028448	0.022789128
Stadion Sriwedari - Graha Wisata Niaga	LPG	23	0.9	0.4464	102.77736	6.485251416	0.000012333	0.000195277
	Gasoline	1	8.25	396	13.7808	0.95500944	0.000275616	0.00034452
	Arang	5	3.75	0.18	25.7784	2.43863664	0.019308022	0.01546704

Based on the data in Table 3, the largest emitters of CO2 and PM2.5 by total are produced through LPG fuel in the Pizza Hut to Solo Grand Mall segment. These emissions are produced by 23 traders who use LPG gas with a total fuel volume of 0.099 tons/year. However, if it is seen not based on the total, the largest emitters of CO2 and PM 2.5 comes from charcoal. From Table 3, it can be seen that even though there are only a few trades using charcoal, the resulting emissions are very large. This is suitable with research conducted by Nugrahayu et al. (2017), which says that the emissions resulting from charcoal fuel are greater than LPG. Apart from CO2 and PM 2.5 emissions, charcoal fuel also produces the largest VOC emissions.

Based on Table 3, the total users of Gasoline from the three segments do not reach 10% of LPG users. There are only 4 traders who use Gasoline during the Car Free Day activity. Therefore, the emission produced is the least amount compared to other materials, either in the form of CO2, PM2.5 or VOC.

Based on the observations, Car Free Day that was held in Surakarta is actually still not effective. This is due to the large number of visitors who bring motor vehicles to get to the Car Free Day location so that these programs are not realized as the main purpose. There are so many traders on Car Free Day locations using fuel. According to Aida et al. (2019), the amount of emissions that exist when the Car Free Day activities and normal days, conclude the pollutant emissions between the two are not much different.

4. Conclusion

Based on the research in 3 segments of the Car Free Day area, total emission from LPG is 27.335 ton/year, total emission from gasoline is 1.911 ton/year and the total emission produced by charcoal is 10.78 ton/year. Moreover, Car Free Day program also produced about 18kg of waste. Most of the waste found at the area was non-organic waste from food wraps. From these results, it can be concluded that Car Free Day is not effective in reducing pollution in cities, but only centralized on pollution in the area of the Car Free Day. Car Free Day program produce new emission. This is evidenced by the high emissions generated by traders in Car Free Day area. It reached 40.024 ton/year from fuel emission and some of the visitors were still using motor vehicles to get to the location. It is proven by the data obtained from the research results that 2,710 motor vehicles were found in 3 segments of the Car Free Day area.

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