Impact of the Covid-19 Pandemic on Traffic Performance on Urban Roads in Kupang City, Indonesia

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Keywords: Covid-19, Pandemic, Traffic, Volume, V/C Ratio.

Abstract: The relationship between transportation and people can also be seen when transportation is affected by major changes in society, such as the COVID-19 pandemic. The City of Kupang until this research was carried out by the Government of the City of Kupang had extended the Implementation of Community Activity Restrictions (PPKM) up to 4 times. Therefore measuring traffic performance is very important for government agencies managing traffic and individuals planning trips, especially when special events occur. The aim of this study was to measure the impact of COVID-19 on transportation to better guide institutions and communities to respond appropriately to changing traffic patterns. This research was conducted with basic principles based on the Indonesian Road Capacity Guidelines (PKJI2014) published by the Ministry of PUPR. The results showed that due to this pandemic, the Cak Doko road segment was the road that experienced the biggest change in the v/c ratio, namely from 2019 to 2021 the v/c ratio was 0.69, 0.29, and 0, respectively. 33. As for the other three roads, there were no significant changes due to the COVID-19 pandemic.

1 INTRODUCTION

Transportation plays a very important role in the development of civilization by meeting the needs of people's travel and transportation needs of goods. In both developed and developing countries, most people travel daily for work, shopping, and various social activities (Hurwitz et al, 2015). Especially in Indonesia, transportation is facilitated by several modes, such as air, rail, highway, and waterways. Most passenger trips are made by car for shorter distances which means using the road. in traffic engineering, it is known that given the travel demand curve, the cheaper the travel costs, the higher the demand. This effect implies that the induced traffic does not depend on the capacity itself but on the resulting reduction in travel time or cost (Goodwin and Noland, 2003). As a result, the higher the traffic demand, the higher the road congestion and greenhouse gas emissions (Boriboonsomsin and Barth, 2008), and it has also been shown that traffic congestion impacts the economy by slowing down economic growth (Sweet, 2014).

The link between transportation and people can also be seen when transportation is affected by major changes in society, such as the COVID-19 pandemic. In Indonesia itself, the first positive case was reported on March 12, 2020, which then continued with the discovery of cases in other provinces. The City of Kupang itself found its first case on April 9, 2020, and until the time this proposal was written the Kupang City Government had extended the Enforcement of Community Activity Restrictions (PPKM) up to 4 times. Therefore measuring traffic performance is very important for government agencies managing traffic and individuals planning trips, especially when special events occur. The COVID-19 pandemic has significantly affected almost every aspect of daily life, including urban traffic patterns. Therefore, it is important to measure the impact of COVID-19 on transportation to better guide institutions and communities to respond appropriately to changing traffic patterns (Cui et al, 2020).

In a study in Greece it was proven that the reduced traffic volume due to social restrictions by the government, caused a slight increase in vehicle speed by 6-11% from before the pandemic (Katrakazas et al, 2020). In a study conducted by Jenelius & Cebecauer (Jenelius and Cebecauer, 2020) they analyzed the impact of COVID-19 on daily public transport passengers in the three most

Wadu, A., Sodanango, M. and Ar, Z.
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DOI: 10.5220/0010941600003260
In *Proceedings of the 4th International Conference on Applied Science and Technology on Engineering Science (iCAST-ES 2021)*, pages 161-166
ISBN: 978-989-758-615-6; ISSN: 2975-8246

populous regions of Sweden (Stockholm, Västra Götaland and Skåne) during spring 2020, the decline in public transport public transport (40% -60 % for cross-regional transportation).

In a study conducted by Du (Du et al, 2021) that reducing traffic demand is a very effective method to reduce traffic congestion and air pollution. A 15% reduction in traffic demand for a congested network can result in a 60% reduction in delays.

Based on the above explanation about the current condition of Kupang City and studies that have been conducted in various places, the main purpose of this study is to show the impact of PPKM in Kupang City regarding COVID-19 on traffic volume in relation to traffic performance in Kupang City. . The results of this study will be useful for operational and strategic planning of recovery efforts and for dealing with future pandemics. Changes were explored for 5 main road sections in Kupang City, that i.e Timor Raya street, Soeharto street, Street Sudirman, and Street Tom Pello.

2 TRAFFIC DURING COVID-19 PANDEMIC

As soon as the WHO gave COVID-19 a pandemic status, countries around the world began to prepare for closures of various types in the near future, which translated into changes in daily travel patterns, namely changes in the use of public transport systems, but also resulted in a decrease in volume. total traffic. Although a national disaster emergency in Indonesia was declared on April 13, 2020 by the President, emergencies and stay-at-home measures are implemented differently in different provinces. However, in general, after a gradual reduction in activity, the country began to report a decrease in traffic volumes in mid-March. The impact of this decline is very large for commercial and recreational activities.

In a study in Greece it was proven that the reduced traffic volume due to social restrictions by the government, caused a slight increase in vehicle speed by 6-11% from before the pandemic. During March and April 2020, which are the months where the spread of COVID-19 is at its peak. On the bright side, accidents in Greece were reduced by 41% during the first month of action triggered by COVID-19 and driving in the morning (00:00-05:00) the accident risk rate dropped to 81%. They recommended that the government concentrate on setting new speed limits and ensuring greater space for cycling and pedestrians in order to increase the distance between users to maintain a better level of road safety and prevent the spread of COVID-19 (Katrakazas et al, 2020).

In research in the United States, in general there is a 30% –50% decrease in traffic volume in mid-April; then, in early May, traffic volumes started to increase, and in late July and mid-August, traffic volumes still remained about 10% below the normally observed values (Goenaga et al, 2021).

3 RESEARCH METHODS

The research stages start from literature study, data collection, data analysis, to the results in the form of conclusions and recommendations for handling. Beginning with a literature study, the main roads to be investigated were identified as Timor Raya street, Frans Seda Street, Piet A. Tallo Street and Tom Pello street. This stage is carried out to find out the traffic volume in 2021, namely during the implementation of community activity restrictions (PPKM) implemented by the Kupang City government. At this stage, concentration points for the study area were also carried out, which in 2019 and 2020 a traffic survey was conducted in order to obtain accurate comparative data. With the scope of the problems to be discussed. The analysis stage is a follow-up after data processing is completed. The purpose of this stage is to understand and analyze the processing results in depth. The analysis was carried out by comparing traffic conditions before the COVID-19 pandemic and during the COVID-19 pandemic, namely with the PPKM policy by the Kupang City government, with traffic considerations based on the 2014 Indonesian Road Capacity Guide (PKJI) (Gautama et al, 2021). Recommendations for traffic operations during the pandemic and during recovery from the pandemic to anticipate the possibilities that will occur in depth in the future in the event of a pandemic like this.

3.1 Road Geometric

Geometry is the shape and size of the road above the ground surface both vertically and horizontally with the assumption that the body / shape of the earth's surface is uneven. The goal is to create a good relationship between time and space according to the needs of the vehicle concerned, to produce road sections that meet the requirements of comfort, safety, and optimal efficiency values. In building highways, geometric roads are influenced by

topography, social, economic and community.

The collection of geometric road data in this study using the manual method was carried out directly at the survey location by measuring road width, sidewalk width, and parking layout, as well as other data about roads related to this study using a meter.

3.2 Traffic

Traffic is a system consisting of components. The first major component or a head way system (time between two successive vehicles when passing a point on a road) includes all types of infrastructure and facilities of all types of transportation available.

3.2.1 Traffic Flow

Traffic flow is formed from the movement of individual drivers who interact with one another on a road segment and their environment. Traffic flow on a road segment characteristics will vary both based on time.

The survey conducted in this study was a classified volume survey using the manual traffic counts method in accordance with Pd.T-19-2004-B concerning the manual traffic count survey, on 5 main roads in Kupang City, namely Street Timor Raya, Street Suharto, Street Sudirman, and Street Tom Pello. The survey was carried out by placing the surveyor at a fixed point on the side of the road, so that he could clearly observe passing vehicles at the specified point. Data recording is filled in on the survey form according to the vehicle classification that has been determined. The implementation period starts from 06.00 to 20.00 for 7 days.

3.2.2 Side Friction

Side friction are expressed as interactions between traffic flow and roadside activities which can be in the form of pedestrians, public transport and other vehicles that stop, vehicles that run slowly, and vehicles entering and leaving the land beside the road. The side friction survey was conducted with the aim of obtaining activities on the side of the road and obstacles that are useful for calculating the capacity of the road segment. This service was conducted on a 200 meter/hour road segment according to the 2014 Indonesian Road Capacity Guidelines (PKJI). The survey was conducted by 10 surveyors in 2 survey sessions (Session 1 at 06:00 to 14:00; Session 2 at 14: 00-20:00), in which each surveyor surveys the number of pedestrians (pedestrians), stopped vehicles, vehicles entering and leaving the side of the road, and slow vehicles on each road segment.

3.3 Level of Service

Road service level analysis was conducted based on the PKJI 2014 Indonesian road capacity guidelines. The level of road service to passing traffic is usually measured by the v/c ratio or commonly referred to as the degree of saturation. The degree of saturation (Ds) is the ratio between the traffic volume (V) and the road capacity (C), the magnitude of which is theoretically between 0 - 1, which means that if the value is close to 1 then the road condition is close to saturation.

$$Ds = \frac{Q}{C}$$

Where

Ds = Degree of Saturation

Q = Traffic flow (pcu/hour)

C = Capacity (pcu/hour)

4 RESULTS AND DISCUSSION

4.1 Traffic Composition

Based on the average daily traffic data in semester 1 of 2021 in Figure 1, it shows that the types of light vehicles on the Frans Seda road section are the highest, namely with 13207 vehicles/day for direction 1 and 13862 vehicles/day for direction 2. weight is the type of vehicle that passes at least the four roads. As for the type of motorcycle vehicle, it only dominates on the Timor highway with a total of 8159 vehicles/day for direction 1 and 6838 vehicles/day for direction 2. previously in the city of Kupang motorcycles dominated (Wadu et al, 2020); (Wadu et al, 2019) changed to the dominance of light vehicles.

To see more details, see the percentage of types of vehicles that cross the 4 main roads in Kupang City in Figure 2. The percentage of motorcycles on the Piet A. Tallo, Timor Raya, Cak Doko, and Frans Seda roads, respectively, is 40.90%, 48.40%, 30.41%, 36.58%. This clearly shows that during the pandemic the level of motorcycle use was not as dominant as it was before the pandemic. There has been a shift in the pattern of using motorized vehicles by Kupang city residents. Based on the data on the percentage of light vehicles in Figure 2 on the Piet A. Tallo, Timor Raya, Cak Doko, and Frans Seda roads, respectively, they are 55.56%, 42.36%, 66.22%, 59.94%. From the four roads, it can be seen that light vehicles are only less dominant on the

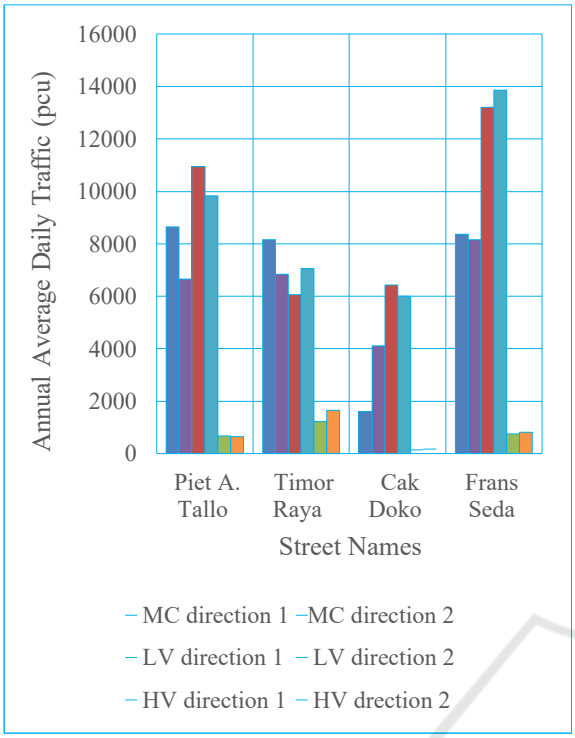

Figure 1: Average Annual Daily Traffic 2021.

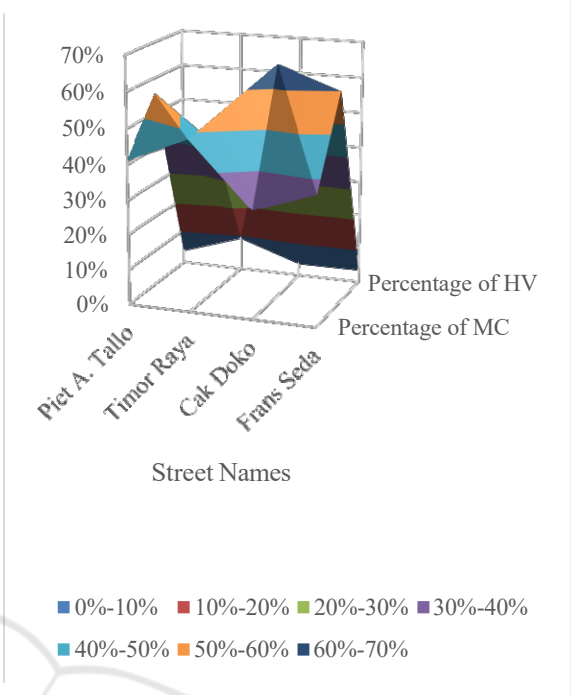

Figure 2: Percentages of Light Vehicle.

Timor Raya road, with a percentage of 42.36%, while on the other three roads there are more types of light vehicles, even on the Cak Doko road, the dominance of light vehicles reaches 66.22%.

4.2 Traffic Volume Comparison Last 3 Years

Data on positive confirmation of COVID-19 in Kupang City obtained from www.covid19.nttprov.go.id starting from the first case found on April 9, 2020, then a spike began in November 2020 with data as of November 1, 2020, there were 154 cases. positive confirmed case of covid-19. Even the number of confirmed cases rose sharply in January. Based on data as of January 1, 2021, there were 993 confirmed cases of COVID-19. The latest data obtained when this research was conducted the number of positive confirmed cases in Kupang City as of June 1, 2021 had reached 6937 cases. With the continued increase in the number of positive confirmed cases of COVID-19 in Kupang City, the Kupang city government itself has enforced the implementation of community activity restrictions (PPKM) since January 2021 and is still ongoing until the time this research was conducted.

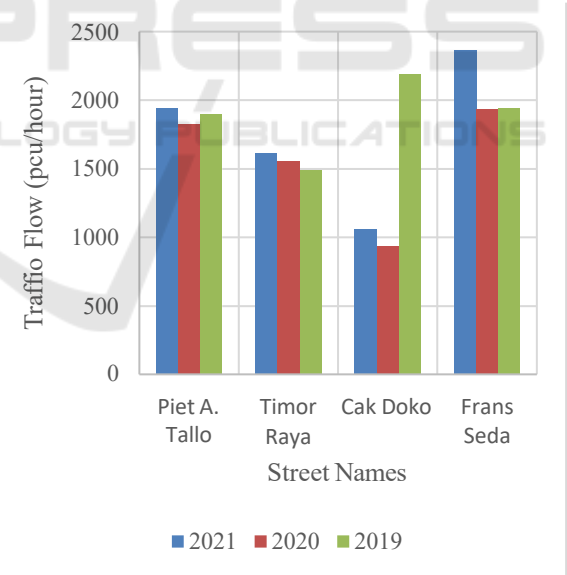

Figure 3: Traffic Flow on Peak Hour In The Last 3 Years.

Based on the traffic volume data in Figure 3, it can be seen that the implementation of PPKM in Kupang City does not have a large effect on peak hour traffic volume in Kupang City. The impact can only be seen on the Cak Doko road section which is in the Educational environment, there are several high school, junior high, and vocational schools

where in 2019 before the covid-19 pandemic the traffic flow reached 2189 units of light vehicles per hour while in semester 1 of 2021 it occurred decrease in peak hour traffic volume which only reached 1057 units of light vehicles per hour. This shows that the impact of online school from home implemented by the government has a major impact on traffic flow.

Meanwhile, on the other 3 roads, namely Piet A. Tallo, Timor Raya, and Frans Seda roads, there was no decrease in traffic volume during peak hours. Even on the Frans Seda road, the traffic flow in semester 1 of 2021 reached 2368 units of light vehicles per hour, this is an increase when compared to traffic flow in 2019 which only reached 1945 units of light vehicles per hour.

Based on the average daily traffic data in semester 1 of 2021 in Figure 1, it shows that the types of light vehicles on the Frans Seda road section are the highest, namely with 13207 vehicles/day for direction 1 and 13862 vehicles/day for direction 2. weight is the type of vehicle that passes at least the four roads. As for the type of motorcycle vehicle, it only dominates on the Timor highway with a total of 8159 vehicles/day for direction 1 and 6838 vehicles/day for direction 2. previously in the city of Kupang motorcycles dominated (Wadu et al, 2020); (Wadu et al, 2019) changed to the dominance of light vehicles.

4.3 Roadside Activities

Based on the data shown in Figure 4, pedestrian activities and on-street parking are the most dominant activities occurring on 4 main roads in Kupang City. Parking activity on the Frans Seda road is the highest when compared to other roads, with 106 frequency of occurrences per hour per 200 m. This happens because on the Frans Seda road there is a Kartini hospital. Hospitals are the busiest health centers during this pandemic. Meanwhile, the highest pedestrian activity occurs on the East Timor highway with the number of occurrences per hour per 200 m reaching 88.

As for the side barriers that occur due to traffic movements, Figure 4 shows that the incidence of entering and leaving vehicles on the Frans Seda road section is the most frequent, reaching 580 frequency events per hour per 200 m. while the side barriers due to vehicles slowing down on the road are not too many on the four roads.

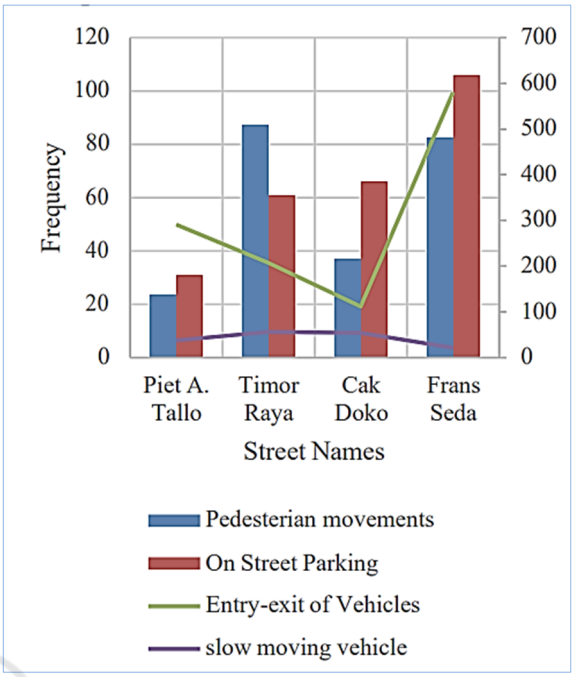

Figure 4: Side Friction.

4.4 V/C Ratio

Based on the v/c ratio data in Figure 5, it is shown that as a result of this pandemic the Cak Doko road segment is the road that has the biggest change in the v/c ratio, namely from 2019 to 2021, the v/c ratio is 0.69 in a row, 0.29, and 0.33. As for the other three roads, there were no significant changes due to the COVID-19 pandemic. On the Piet A. Tallo road the v/c ratio from 2019-2021 is 0.80, 0.77, 0.82, respectively, while for the Timor Raya v/c rato road segment for 2019-2021 it is 0.51, 0.53, respectively. 0.55, and for the Frans Seda road the v/c ratio in 2019- 2021, respectively, is 0.73, 0.73, 0.89.

Based on the data in Figure 5, it further illustrates that the PPKM carried out by the Kupang City government only affects school activities. It can be seen that the most significant decrease in the v/c ratio only occurred on the Cak Doko road section which is the center of education from junior high, high school to vocational school. A slight increase in saturation on the Frans Seda road that occurred due to the presence of the Kartini Hospital on that road segment.

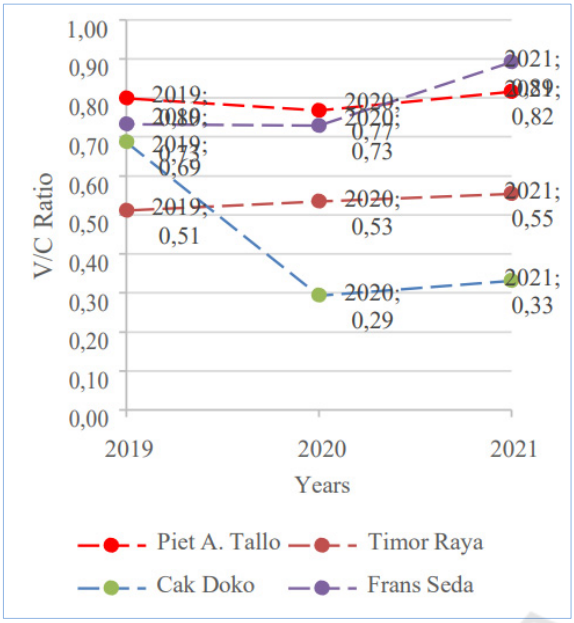

Figure 5: V/C Ratio.

5 CONCLUSIONS

Based on the results and discussion, it can be concluded that during the COVID-19 pandemic, in the City of Kupang there was a shift in the use of motorized vehicles from motorcycles to light vehicles, meanwhile the implementation of community activity restrictions (PPKM) carried out by the Kupang City government only had a major impact on roads that Usually there are school activities that have little impact on other community activities.

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