Volume 9, Issue 7, July – 2024 International Journal of Innovative Science and Research Technology
ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24JUL1505

The Relationship and Influence of Side Obstacles Due to Market Activities on Traffic Characteristics

Ahmad Fauzan Hakim[1]; Puguh Budi Prakoso[2]
[1]Student, Master of Civil Engineering Department, Faculty of Engineering, Lambung Mangkurat University
[2]Lecturer, Master of Civil Engineering Department, Faculty of Engineering, Lambung Mangkurat University

Abstract:- Traffic jams are a common phenomenon in most parts of Indonesia, especially in market centers, resulting in delays and decreased road performance. Problems in this research area show a decrease in road performance which is characterized by frequent delays which cause traffic jams on the highway due to activity in the market, thus making traffic flow slightly hampered. There are 7 (seven) market points studied on the roads of South Borneo Province and Central Borneo Province Roads, namely Walangku Market in Hulu Sungai Tengah Regency, Kelua Market in Tabalong Regency, Pamarangan Market in Tabalong Regency, Pasar Panas Market in Tabalong Regency, Jaar Market in East Barito Regency, Dayu Market in Tabalong Regency. East Barito, Ampah Market in East Barito Regency and Patas Market in South Barito Regency.

The aim of this research is to determine the extent of the influence of market activity and no market activity on traffic characteristics. The parameters observed are traffic volume (V) and speed (S) on the road section studied. The research methods used to analyze the mathematical relationship between volume, speed and density are the Greenshields Model, Greenberg Model, Underwood Model and Bell Model. And to analyze the influence of side obstacles on traffic characteristics using correlation analysis and multiple linear regression.

Based on the results of the analysis using mathematical relationship models in both conditions, the best models are found in the Bell model for market days and the Grenberg model for normal days at each market location. And for the results of correlation analysis and multiple linear regression on market days, the factors that influence traffic characteristics are market area (X2), vehicles stopping or parking on the road shoulder (X3), and effective lane width (X5). Meanwhile, on normal days the influencing factors are market length (X1) and effective lane width (X5). An alternative to improving the performance of roads in market areas is by increasing the effective lane width by 2 meters and implementing signs that prohibit parking or stopping on the shoulder of the road when market activity occurs. So the results obtained in the capacity value increased compared to market days by 4% and the resulting speed also increased compared to market days, namely by 6% and density also decreased after improving the performance of the road section, namely down by 3%.

Keywords:- *Volume, Speed, Side Obstacles, Market Activity*

I. INTRODUCTION

A market is a place of interaction between sellers and buyers of goods or services from more than one person. Activities carried out in the market by someone have various purposes. Every activity carried out in the market can affect road performance. On market days, with high side barriers, there are several impacts on surrounding traffic, where there is a buildup of vehicles during peak hours, causing traffic flow to become obstructed. According to Widodo et al. (2012) which states that an increase in traffic volume can cause changes in traffic behavior so theoretically, there is a fundamental relationship between volume (flow) and speed and density.

In this research, the market studied is a market located on a provincial road, namely between South Kalimantan and Central Kalimantan Provinces. There were eight (8) market points studied, namely Walangku Market in Hulu Sungai Tengah Regency, South Kalimantan Province, Kelua Market in Tabalong Regency, South Kalimantan Province, Pamarangan Market in Tabalong Regency, South Kalimantan Province, Panas Market in South Tabalong Regency, Kalimantan Province, Jaar Market in East Barito Regency, Central Kalimantan Province, Dayu Market in East Barito Regency, Central Kalimantan Province, Ampah Market in East Barito Regency, Central Kalimantan Province and Patas Market in South Barito Regency, Central Kalimantan Province. This route is one of the logistics routes between the city center, namely Banjarmasin, and other district cities, so many heavy vehicles pass through it.

The limitation of the problem in writing this article is that the location of the roads observed is that there are 8 (eight) market points on the South Kalimantan and Central Kalimantan Provincial Roads. Data collection time is carried out one day during the market day for five hours. The parameters observed are traffic volume (V), speed (S), and density (D) on the road section studied. Then, the extent of the influence of market activity on traffic characteristics.

II. THEORETICAL BASIS

➢ *Traffic Characteristics*

The general characteristics of traffic movement are often expressed by traffic volume, speed, and traffic density. Traffic volume, speed, and traffic density are interconnected with each other in traffic operations on the road.(Lubis et al., 2022)

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24JUL1505

➢ *Mathematical Relationship of Volume, Density, and Traffic Speed*

- *Greenshield Model*

This model is the earliest model recorded in an attempt to observe the characteristics of traffic flow on the highway. Greenshield obtained the result that the relationship between speed and density is linear. This linear relationship between speed and density is popular in reviewing traffic flow movements, considering that the relationship function is the simplest and, therefore, easy to apply.

- *Greenberg Model*

The Greenberg model assumes that the mathematical relationship between speed-density (S-D) is not a linear function but a logarithmic function (Tamin, 2008). The Greenberg model assumes that traffic flow has similarities to fluid flow or the continuity equation of fluid motion equations.

- *Underwood Model*

Underwood hypothesized that the relationship between traffic variables (speed and density) is a negative exponential relationship. The Underwood model can be applied in low traffic density conditions because it can produce speed values that are the same as free-flow speeds.

- *Bell Model*

Bell assumed that the mathematical relationship between speed-density (S-D) was not a linear function but an exponential function.

III. METHOD

This research was carried out by collecting primary data directly at the research location, followed by secondary data collection and traffic performance analysis using Greenshields, Greenberg, Underwood, and Bell. The data collection location was carried out at the market on the South Kalimantan and Central Kalimantan Provincial Roads, as seen in Figure 1.

Fig 1 Data Collection Location

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24JUL1505

Primary data was obtained by surveying traffic flow volume, traffic flow speed, obstacle road geometry, and sides. Secondary data was obtained via Google Earth in the form of a map of the research location. The research stages can be seen in Figures 2 and 3.

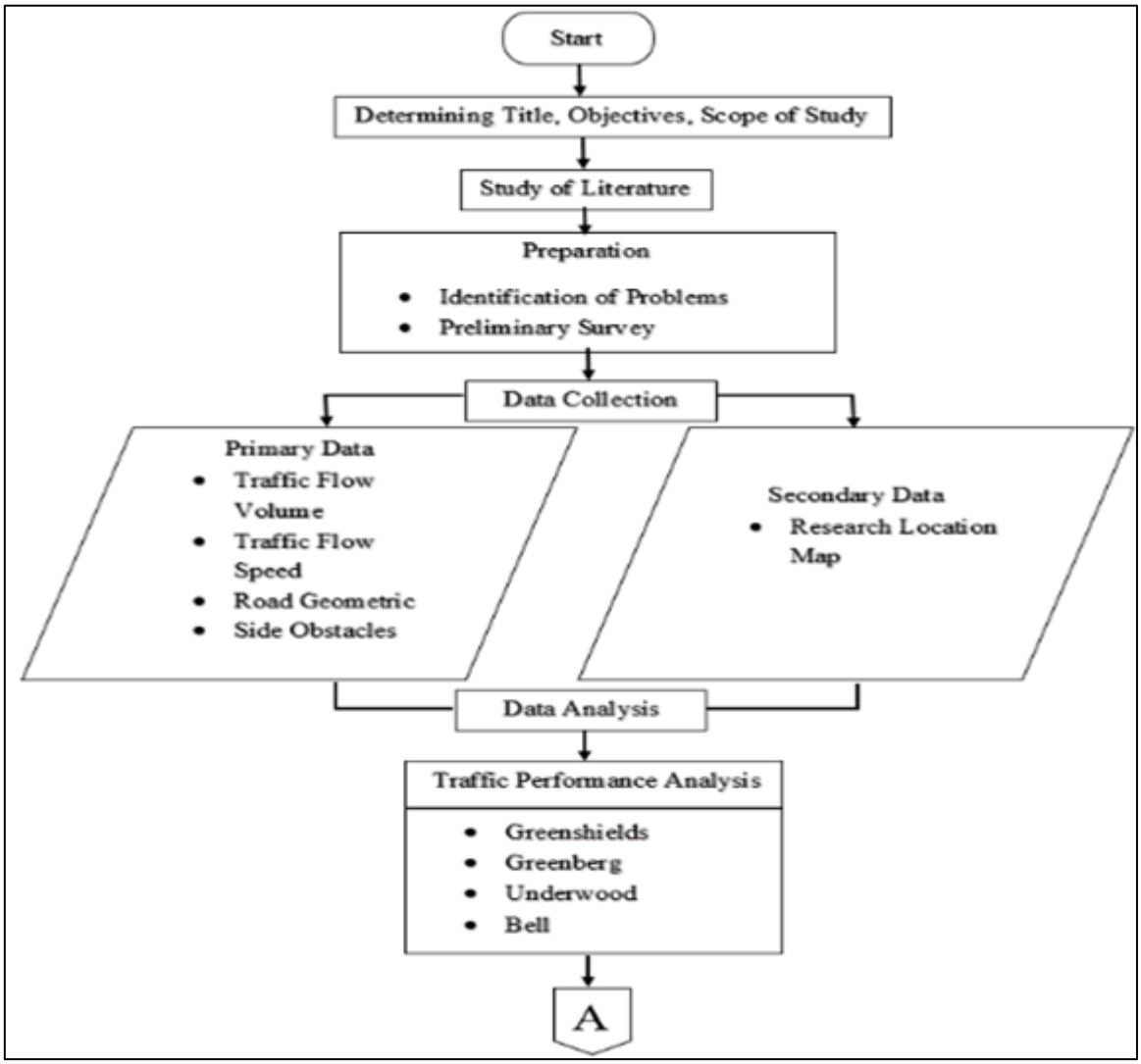

Fig 2 Research Diagram

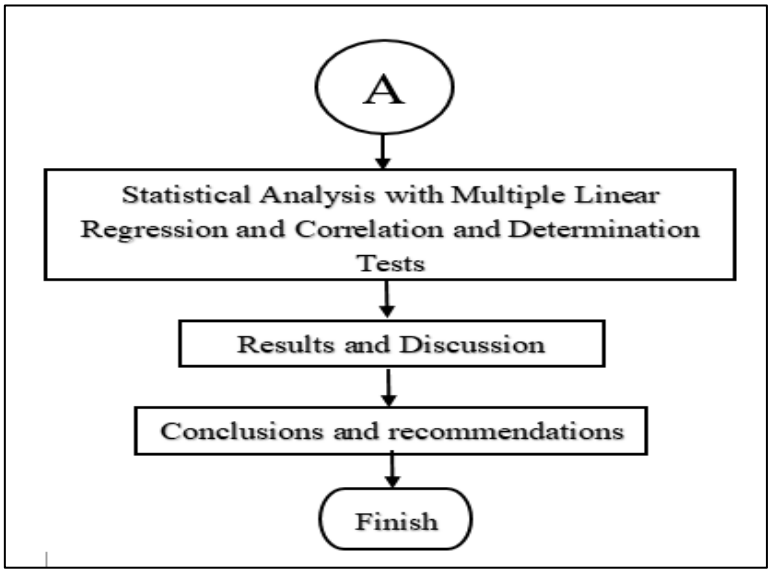

Fig 3 Advanced

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24JUL1505

IV. RESULT AND DISCUSSION

➢ *Traffic Volume, Speed, and Density Data*

The results of the traffic volume, speed, and density data survey can be seen in the following image:

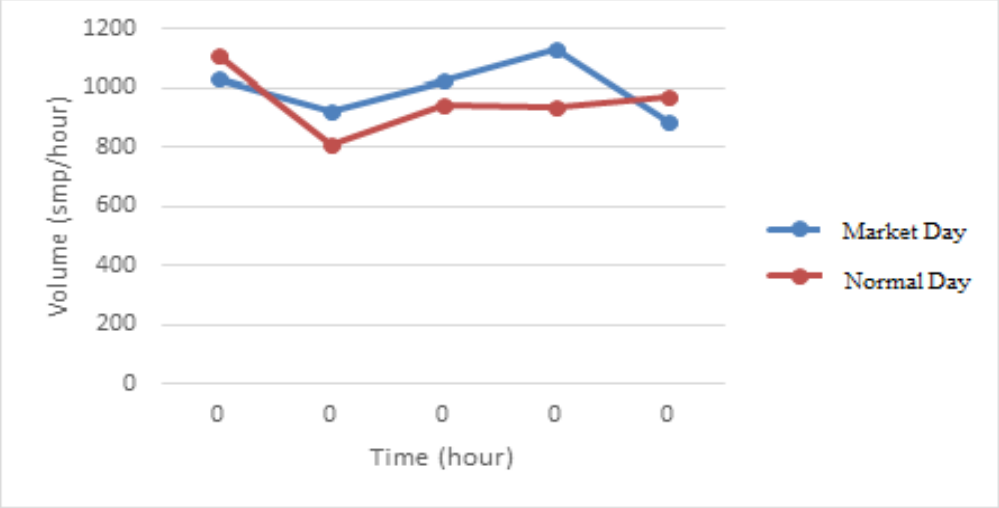

Fig 4 Traffic Volume Chart

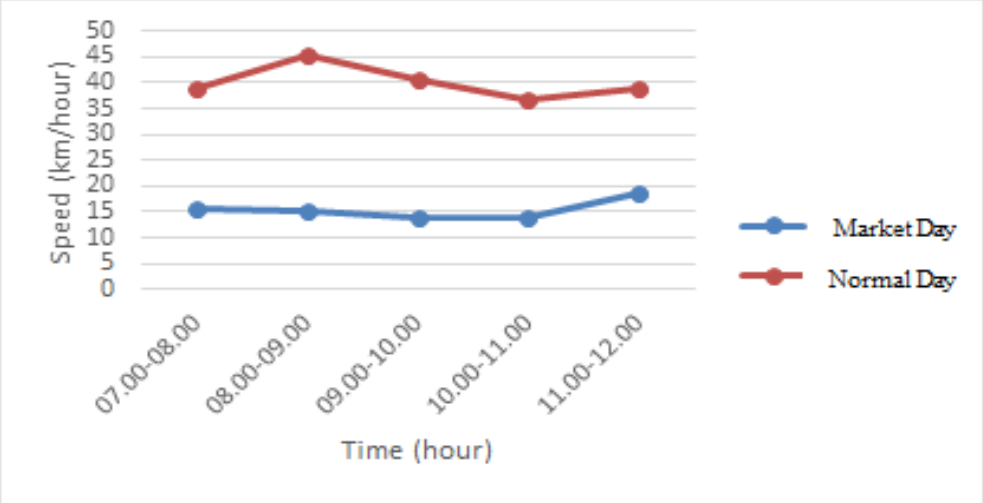

Fig 5 Traffic Speed Graph

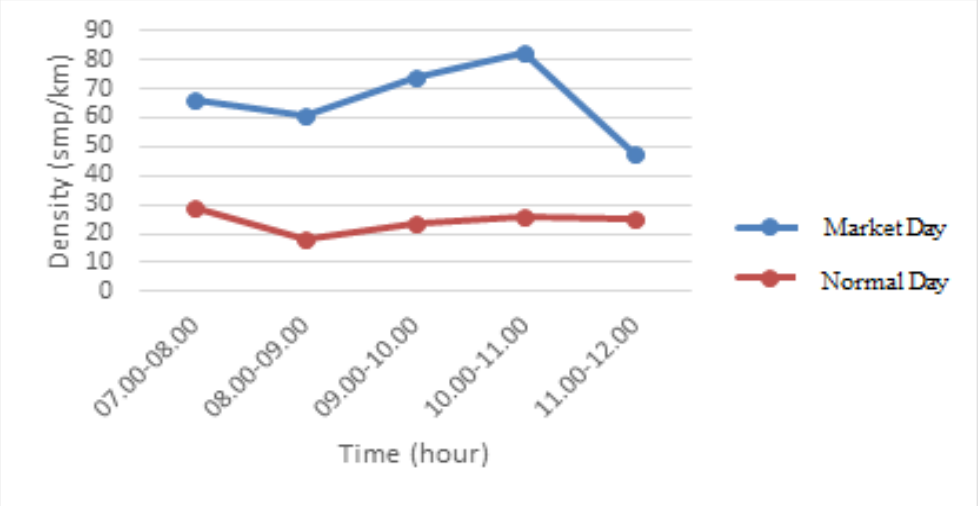

Fig 6 Traffic Density Graph

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24JUL1505

In Figure 4, it is known that the largest traffic volume occurs at 07.00 - 08.00 WITA for normal days with a value of 1108.7 pcu/hour, while for market days, it has a value of 1131.5 pcu/hour at 10.00-11.00. In Figure 5, it is known that the highest traffic speed on a normal day occurs at 08.00 - 09.00 WITA with a value of 45.48 km/hour. Meanwhile, on market days, the highest speed occurs at 11.00 - 12.00 WITA with a value of 18.71 km/hour. In Figure 6, it is known that the highest traffic density during normal day conditions occurs at 07.00 - 08.00 WITA with a value of 28.58 pcu/km. Meanwhile, for market day conditions, the highest density occurs at 10.00 - 11.00 WITA with a value of 82.56 pcu/km.

➢ *Side Obstacle Data*

Table 1 Side Obstacle Data

Market	Market Length (m)		Market Size (m^2)		Number of Vehicles Parked on the Road Shoulder		Number of Vehicles Entering and Exiting the Market	
	Market Day	Normal Day	Market Day	Normal Day	Market Day	Normal Day	Market Day	Normal Day
Walangku	120,96	114,74	9322,20	9482,07	31	10	102	9
Kelua	292,09	32,71	15144	1417,02	55	27	175	59
Pamarangan	60,68	57,82	2926,50	815,6	42	5	82	9
Panas Market	117,56	35,34	5695,80	162,65	47	8	96	17
Jaar	99,81	25,63	3197,20	210	40	3	134	5
Dayu	44,00	113,44	3261,40	10676,7	26	2	90	2
Ampah	273,19	78,36	15710,4	2616,88	50	35	235	69
Patas	132,06	114,74	7407	9482,07	35	12	69	26

In Table 1, it is found that the data on side obstacles consists of data on the length of the market, the area of the market, the number of vehicles stopping or parking on the side of the road, and the number of vehicles entering and exiting the market at each research location point.

➢ *Relationship of Volume, Speed, and Density*

The models used to analyze the relationship between volume, speed, and density are the Greenshields, Greenberg, Underwood, and Bell models. The relationships analyzed are:

- the relationship between speed (S) and density (D)
- the relationship between volume (V) and density (D)
- the relationship between volume (V) and speed (S)

After the analysis is carried out, the highest determination value (R2) of the relationship between speed (S) and density (D) is taken to be entered into a summary table, which is then used for regression analysis. An example of manual calculation analysis using the Greenberg model with Ampah Market data during market day conditions is as follows:

Tabel 2 Calculation Procedure for Greenberg Model Analysis of the Ampah Market

Hour	V (pcu/hour)	S = Yi (km/hour)	D = V/S	Log_eD = Xi	Xi*Yi	Xi^2
07.00-08.00	1030,3	15,54	66,32	4,19	65,16	17,59
08.00-09.00	917,4	15,135	60,61	4,10	62,12	16,85
09.00-10.00	1024,2	13,94	73,47	4,30	59,90	18,46
10.00-11.00	1131,5	13,705	82,56	4,41	60,49	19,48
11.00-12.00	884,7	18,72	47,27	3,86	72,16	14,87
Σ	4988,1	77,03	330,24	20,87	319,83	87,25
Average		15,41		4,17		

From the table above, the values A and B can be calculated using the following equation:

$$B = \frac{(5).(319,83) - (20,87).(77,03)}{(5).(87,25) - (20,87)^2} = -9,0480$$

$$A = (15,41) - (-9,0480).(4,17) = 53,1640$$

Next, by obtaining the values A and B, a value is produced $b = \frac{1}{9,0480} = 0,1105$ and $C = e^{\frac{53,1640}{9,0480}} = 356,3026$. By using the values of b and C, the following mathematical relationship is obtained:

Speed - Density Relationship: $S = 53,1640 - 9,0480\ LnD$

Volume - Density Relationship

: $V = 53,1640D - 9,0480\ LnD$

Volume - Speed Relationship

: $V = 356,3026\ S \exp(-0,1105).S$

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24JUL1505

Then, by entering the value D = 0; you get the value Sff = ∞. The same thing happens when you enter the value S = 0; you get the Dj value as follows:

$$LnDj = \frac{53,1640}{9,0480} = 5,8758$$ so value Dj = 356,30 pcu/km.

Maximum volume can be calculated using the equation above, namely the relationship between volume and density or the relationship between volume and speed.

$$\frac{\partial V}{\partial D} = 0 \text{ we get } Dm = \frac{C}{e} = 131,08 \text{ pcu/km}$$

$$\frac{\partial V}{\partial S} = 0 \text{ we get } Sm = \frac{1}{b} = 9,05 \text{ km/hour}$$

By entering the value Dm = 131.08 pcu/km or Sm = 9.05 km/hour into the equation for the relationship between volume and density or the relationship between volume and speed, we get the value Vm = 1185.98 pcu/hour. It can be concluded that the maximum volume occurs when the density is Dm = 131.08 pcu/km, and the speed is Sm = 9.05 km/hour. As for the manual calculation analysis on other models, namely Greenshields, Underwood, and Bell, it is almost the same as the example of manual calculation analysis on the Greenberg model. The graphs of the relationship between speed and density (S-D), volume and density (V-D), and volume and speed (V-S) on the selected model in one of the markets can be seen in Figure 7, Figure 8 and Figure 9.

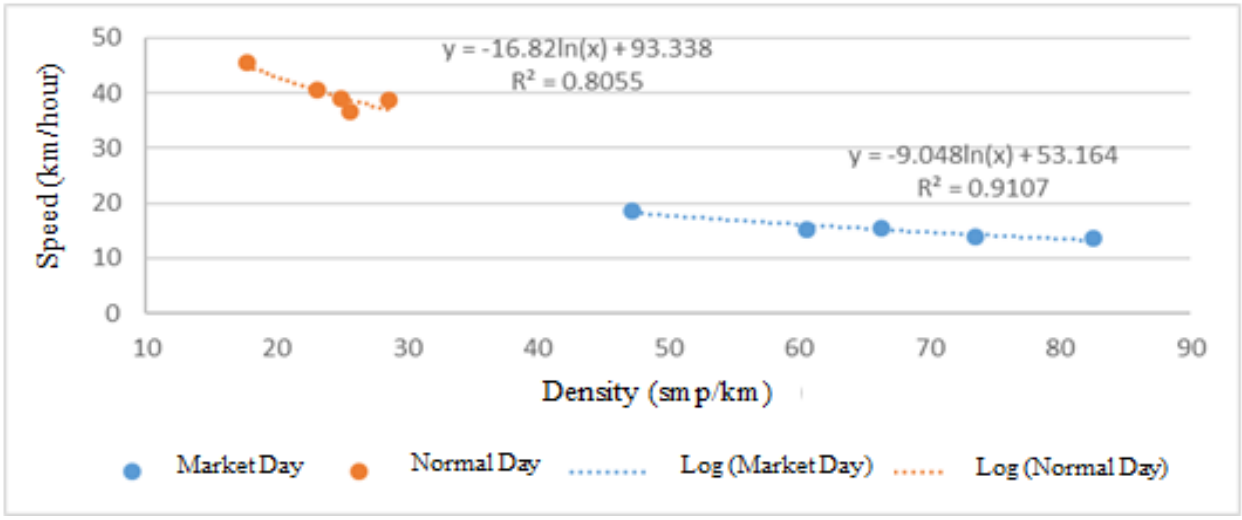

Fig 7 Graph of the Relationship between Speed and Density of the Ampah Market

Figure 7 shows a graph of the relationship between speed and density in one of the markets, namely the Ampah Market, during market and normal days. On market days, the best model is the Greenberg model with the equation resulting from this relationship, namely Y = 53.164 - 9.048. Ln (D) with the determination result (R2) obtained, which is 0.91. Meanwhile, on normal days, the best model is the Greenberg model with the equation resulting from this relationship, namely Y = 93.338 - 16.82. Ln (D) with the determination result (R2) obtained, which is 0.80. In the graph of the relationship between speed and density, it can be seen that the higher the density, the speed will decrease, and vice versa; if the density is smaller, the speed will be higher.

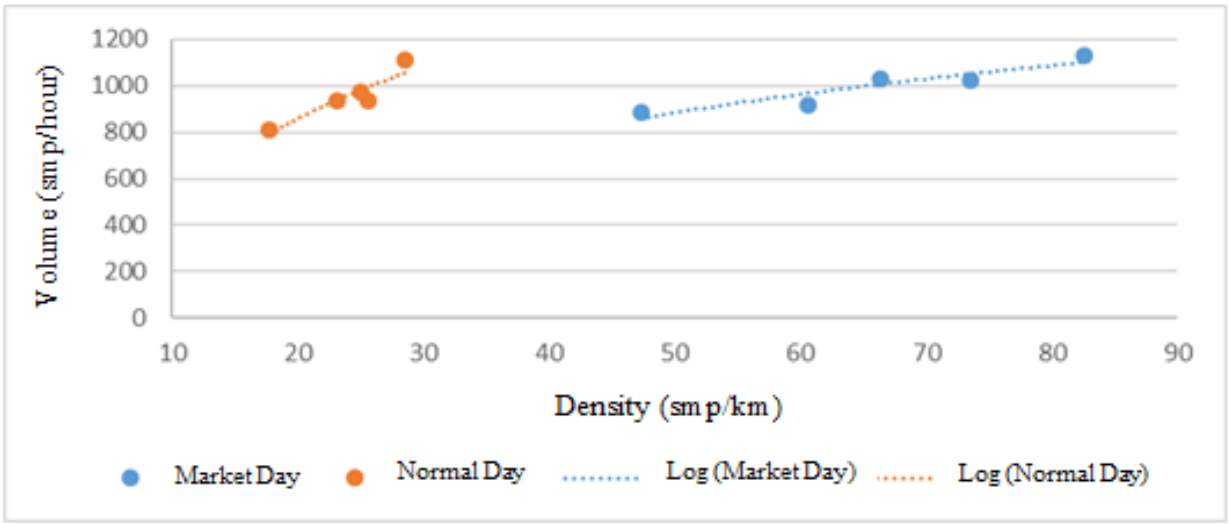

Fig 8 Graph of the Relationship between Volume and Density of the Ampah Market

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24JUL1505

Figure 8 shows a graph of the relationship between volume and density in one of the markets, namely the Ampah Market, during market and normal days. From this relationship graph, it can be concluded that the higher the volume, the higher the density.

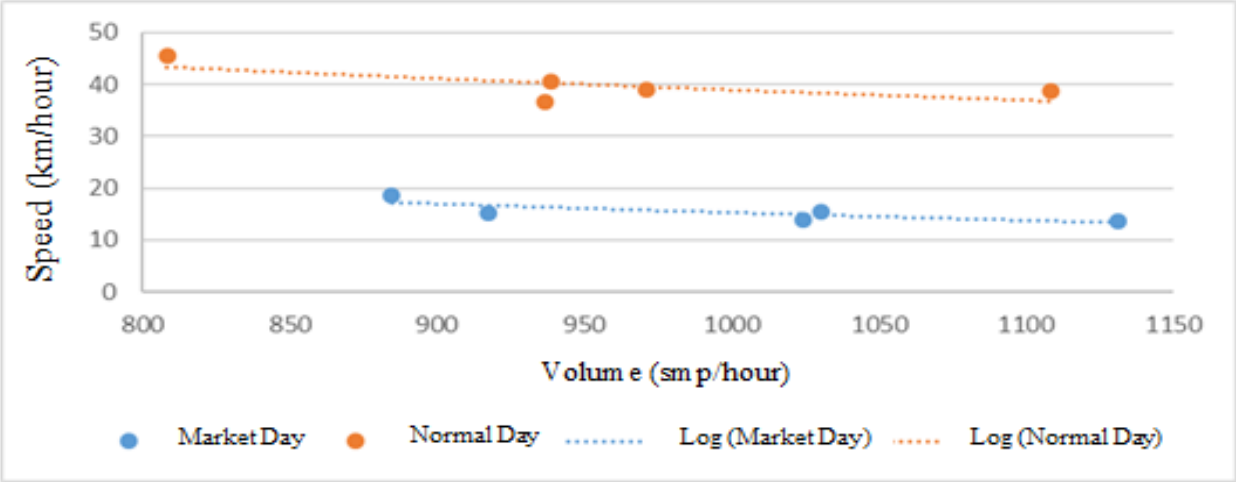

Fig 9 Graph of the Relationship between Volume and Speed of the Ampah Market

Figure 9 is a graph of the relationship between volume and speed in one of the markets, namely the Ampah Market, during market day and normal day conditions. In this graph, it can be seen that the higher the volume, the lower the speed, and vice versa; if the volume is small, the speed will be higher. For a graph of the relationship between volume and speed (V-S) of selected models in other market locations, see the attachment. Moreover, the equations resulting from the relationship between speed and density (S-D), the relationship between volume and density (V-D), and the relationship between volume and speed (V-S) at each market location point and the two conditions, namely market days and normal days, are in the attachment. Based on the results of the analysis of the relationship between volume, speed, and density, the best results are obtained from each model in two conditions, namely on market days and normal days at each location point in the market area, as in Table 3 and Table 4.

Table 3 Model Analysis Results on Market Day Conditions

Market	Vm	Sm	Dm	R^2	Best Model
Jaar	484,62	12,76	37,98	0,99	Underwood
Kelua	1353,91	8,53	158,80	0,98	Greenberg
Pamarangan	446,69	14,01	31,88	0,98	Bell
Ampah	1185,98	9,05	131,08	0,91	Greenberg
Dayu	346,72	18,28	18,96	0,89	Bell
Walangku	381,13	13,43	28,39	0,86	Greenshield
Patas	439,12	11,32	38,78	0,85	Underwood
Panas Market	583,38	16,79	34,75	0,79	Bell

Table 4 Model Analysis Results on Normal Day Conditions

Market	Vm	Sm	Dm	R^2	Best Model
Panas Market	613,44	23,87	25,70	0,99	Greenberg
Walangku	454,08	26,01	17,46	0,97	Greenberg
Pamarangan	541,15	23,06	23,47	0,91	Greenberg
Dayu	435,86	33,28	13,10	0,90	Bell
Kelua	1377,53	19,19	71,79	0,83	Greenberg
Ampah	1589,79	16,82	94,51	0,80	Greenberg
Patas	470,22	29,65	15,86	0,77	Underwood
Jaar	579,95	21,67	26,76	0,73	Greenberg

Table 3 and Table 4 are the results obtained from the analysis of selected models with the highest determination or R2 at each market location during market day and normal day conditions. For correlation and determination, the relationship between speed and density (S-D) is used. The selected model is a model that matches the traffic characteristics at each market location point during market day and normal day conditions. The results of the model analysis in these two conditions will be used as dependent variables for statistical analysis, namely capacity (Vm), speed (Sm) and density (Dm).

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24JUL1505

Furthermore, after getting the results of the relationship between volume, speed, and traffic density, a correlation test was carried out to determine the relationship between capacity, speed, and density with side obstacles and multiple linear regression analysis to determine the magnitude of the influence of side obstacles on traffic characteristics. The results of the correlation analysis of Y1 with the independent variables on market days are in the following table:

Table 5 Results of Correlation Analysis of Y1 with Independent Variables on Market Days

	Y1	X2	X3	X5
Y1	1			
X2	0,8709	1		
X3	0,8483	0,6057	1	
X5	0,7067	0,6368	0,6530	1

In the table above, we can see the variables that influence capacity, namely market area (X2), vehicles parking or stopping on the roadside (X3), and effective lane width (X5) during market day conditions. Meanwhile, for normal days, the variables that influence traffic characteristics are market length (X1) and effective lane width (X5). The results of other correlation analyses on market days and normal days are in the attachment. After the correlation analysis is carried out, multiple linear regression analysis is carried out using the Regression Tools found on the Data Toolbar then select Data Analysis, then select Regression. The results of the analysis of the two parameters are in Table 6 for market days and Table 7 for normal days.

Table 6 Results of Multiple Linear Regression Analysis on Market Days

Regression Statistics	Y1	Y2	Y3
Multiple R	0,96	0,84	0,95
R Square	0,92	0,70	0,90
Adjusted R Square	0,86	0,41	0,82
Standard Error	144,46	2,62	22,33
Observations	8	8	8

Table 7 Results of Multiple Linear Regression Analysis on Normal Days

Regression Statistics	Y1	Y2	Y3
Multiple R	0,94	0,91	0,91
R Square	0,88	0,82	0,82
Adjusted R Square	0,84	0,75	0,75
Standard Error	182,92	2,67	2,67
Observations	8	8	8

Table 6 and Table 7 are the results of multiple linear regression analyses between the dependent variable (Y) and the independent variable (X). The Multiple R results show that the parameters, namely Y1, Y2, and Y3, have a very good correlation, namely more than 0.7. Moreover, the resulting R Square also has a very good value. This explains that side obstacles due to market activity, namely market area (X2), vehicles parking or stopping on the roadside (X3), and effective lane width (X5), affect these three parameters, capacity (Y1) by 96%, speed (Y2) of 70% and density (Y3) of 90%. Meanwhile, on normal days, the variables that influence capacity, speed, and density are market length (X1) and effective lane width (X5) with each determination value, namely capacity (Y1) at 88%, speed (Y2) at 82% and density (Y3) of 82%.

The models selected with the highest determination values are mostly the Greenberg model for market days and the Underwood model for normal days. Where the model selected at each market location point is a model that matches the traffic characteristics on the road section at each location point in the market area. The results of the data analysis obtained are the value of capacity (C) or maximum volume (Vm), speed (S) or speed during maximum volume conditions (Sm), and density (D) or density during maximum volume conditions (Dm) at each market location point. The best model is obtained from the highest determined value of the speed and density relationship graph.

The independent variables that have a significant influence on traffic characteristics on market days, namely capacity (Y1), speed (Y2), and density (Y3), are market area (X2), vehicles parked or stopped on the roadside (X3), and effective lane width (X5). With each determination value or R Square obtained, namely at 96% capacity, 70% speed, and 95% density. Meanwhile, on normal days, the independent variables that influence our market length (X1) and effective lane width (X5) with each determination value or R Square were obtained, namely at 88% capacity, 82% speed, and 82% density. Then, the equation resulting from multiple linear regression analysis is used to find capacity, speed, and density values using variable data for each market. For the results obtained from the equation, namely the average

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/IJISRT24JUL1505

capacity of market days, the results obtained are 691.49 pcu/hour. In normal day conditions the average capacity of normal days is higher by a difference of 16%, meaning that the value of normal day capacity will be higher because there is no influence of side obstacles due to market activities so that traffic flows smoothly. Moreover, the average speed value on market days is 12.96 km/hour, while for normal days, the speed obtained is almost double compared to market days, namely 23.93 km/hour. For density on market days, the average density is 64.60 pcu/km, while for normal days, the density is smaller, with a difference of 40%, namely 38.74 pcu/km.

In research conducted by (Senduk et al., 2018) States that the main factors that influence speed are vehicles parking and stopping. Therefore, it is necessary to install no-parking signs on both sides of the road as well as police guard posts to regulate and maintain existing sign regulations, or it is necessary to make government regulations regarding the ownership of private parking lots for each building that is in front of the main road. By looking at the conditions in the field, the most effective alternative if in the future there is an increase in traffic volume that results in congestion is to increase the effective lane width by 1 meter with the assumption of controlling traders selling on the side of the road so that the effective lane width (X5) increases and implementing signs. -Signs prohibit parking on the shoulder of the road during market activities. So, the results obtained in the capacity value increased compared to market days by 5%, and the resulting speed also increased compared to market days, namely by 12%. The density also experienced a very small decrease after improving the performance of the road section, namely only decreasing by 1%.

V. CONCLUSION

Based on the results of the research and discussion, it can be concluded that the mathematical relationship of the three parameters, namely volume, speed, and density, using the Greenshields, Greenberg, Underwood, and Bell models, shows that the selected model with the highest determination value is mostly found in the Greenberg model for market days and the Underwood model. for a normal day. Then, market day conditions that have a significant influence on traffic characteristics on market days are market area (X2), vehicles parked or stopped on the roadside (X3), and effective lane width (X5). Looking at the factors that influence the characteristics of traffic sticks due to market activities and conditions in the field. The most effective alternative in improving traffic performance in the market area is to increase the effective lane width by 2 meters with the assumption of curbing traders selling on the side of the road so that the effective lane width (X5) increases and implementing no parking signs on the roadside at all times. Market activity occurs.

REFERENCES

[1]. Departemen Pekerjaan Umum. 1997. Manual Kapasitas Jalan Indonesia (MKJI). Jakarta: Kementerian Pekerjaan Umum dan Perumahan Rakyat Direktorat Jenderal Bina Marga Direktorat Bina Jalan Kota (BINKOT).

[2]. Lubis, M., Batubara, H., & Athaya, M. F. (2022). Analisa Karakteristik Arus Lalu Lintas Dengan Model Metode Greenshields Greenberg Underwood Pada Ruas Jalan A. H. Nasution Medan Johor STA 3+350 S/D 3+. *Jurnal Teknik Sipil (JTSIP)*, *1*(2), Article 2.

[3]. Saputra, Bagas, Savitri Dian. 2021. Analisis Hubungan Antara Volume, Kecepatan, dan Kepadatan Lalu Lintas Berdasarkan Model Greenshield, Greenberg dan Underwood. Jurnal Manajemen Aset Infrastruktur & Fasilitas – Vol.5, No.1. Surabaya: Universitas Negeri Surabaya.

[4]. Senduk, T. K., Rumayar, A. L. E., & Palenewen, S. C. N. (2018). Pengaruh Hambatan Samping Terhadap Kinerja Ruas Jalan Raya Kota Tomohon (Studi Kasus: Persimpangan Jl. Pesanggrahan – Persimpangan Jl. Pasuwengan). *JURNAL SIPIL STATIK*, *6*(7), Article 7. https://ejournal.unsrat.ac.id/v2/index.php/jss/article/view/19881

[5]. Tamin, Ofyar Z. 2000. Perencanaan dan Pemodelan Transportasi Edisi Kedua. Bandung: Institut Teknologi Bandung.

[6]. Tamin, O. Z. (2008). *Perencanaan, Pemodelan, dan Rekayasa Transportasi: Teori, Contoh Soal dan Aplikasi*. Institut Teknologi Bandung.

[7]. Widodo, W., Wicaksono, N., & Harwin, H. (2016). Analisis Volume, Kecepatan, dan Kepadatan Lalu Lintas dengan Metode Greenshields dan Greenberg. *Semesta Teknika*, *15*(2), Article 2. https://doi.org/10.18196/st.v15i2.1361