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Analysis of generation and attraction in Bogor Regency (Case study: Tenjolaya sub-District, Tamansari sub-District and Tenjolaya sub-District)

Qonita Zakiyah, Tedy Murtedjo, Nurul Chayati

Civil Engineering Departement Ibn Khaldun University Bogor, INDONESIA
E-mail: zakiyahqonita@gmail.com

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ABSTRACT

Tenjolaya Subdistrict, Tamansari Subdistrict, and Ciomas Subdistrict of Bogor District has an area of 61.74 km^2, divided into 25 villages, and 1 urban-village with those total populations density are 4,819.7 people/km^2. The increasing population and significant development in the region has increased the movement of traffic flows to and from the region, which is expected to cause some particular problems in traffic congestion on Road segments. This research aims to make the model of the trip generation and the trip attraction caused by land use such as education area, medical, office, lodging, physical fitness center and tourism in the three sub-districts. MKJI 2017 is used as a data processing guideline for the method of calculation of transport analysis. Then use Trip Generation Manual and modelled into SATURN software. Total trip generations from 3 sub-districts of the study area are 4,403.78 trips/hour, and with total trip attractions are 6,165.33 SMP/hour. The design of the transportation modelling equation for Ciomas subdistrict, Tamansari District, and Tenjolaya subdistrict is 21,230 – 0,950 (X). The Model of trip generation and trip attraction has a value of R2 = 0,9687. The level of service is obtained index in the range of A until D, with an average is B, indicating a relatively stable condition. although in some areas, it is still necessary to repair and improve road network infrastructure, and strive for a comfortable and efficient alternative public transport system (time, cost, energy) to transfer people from private vehicles to Public transport.

Key word: trip generation; trip attraction; traffic counting; modelling.

INTRODUCTION

The high rate of development in an area can have an effect on the movement of traffic flows and the pattern of transportation services in the internal and external zones. According to the 2018 Bogor District Statistics Agency (BPS), in his book Bogor Regency in Figures 2018, Tenjolaya District has an area of 23.83 km2, which is divided into 7 villages, with a population density of 2,478.64 people / km2; Tamansari District has an area of 21.61 km2, which is divided into 8 villages, with a population density of 4,854.79 people / km2; and Ciomas Subdistrict has an area of 16.30 km2, which is divided into 10 villages and 1 kelurahan, with the highest population density of 11,093.44 people / km2. In this research area, several health institutions, educational institutions, trade places, agriculture, plantations, animal husbandry, accommodation, restaurants and natural and artificial tourist destinations were built. Thus, it causes the movement of the generation and attraction of the trips of people and goods which are expected to cause several problems, especially in the decline in the performance of the road segments.

There are good and bad road conditions in Bogor district. This condition adjusts the appropriate research location. A good adjustment will determine a good path too. So that the road will find its shape after a very thorough research that will determine the strength of the road. This strength reflects the actual quality of the road (Syaiful S, Rusfana H, 2022; Syaiful S et.al, 2022; Syaiful S, Pratama Y, 2019). The quality of the road is also influenced by the shape and type of the road, the vehicles that pass through the road and the materials on the road that has been built. This condition will have a good impact if it is in accordance with the standards that have been applied (Syaiful S, Hariyadi D, 2019; Syaiful S et.al, 2020; Syaiful S, Fadly A, 2020; Syiaful S et.al, 2021). This standard really must be considered properly so as to get a very appropriate form. This form will

maintain the actual road structure. This road structure maintains the strength of the road (Syaiful S et.al, 2021).

It should also be noted that the rise and pull of a city will reflect the density of the city in accommodating vehicles. The number of vehicles will greatly affect the form of treatment imposed on them. Vehicle density will have an impact on noise. This noise is a very classic problem in every city in developing countries. Developed countries are no longer experiencing what is called pollution either sound or air (Syaiful S et.al, 2022; Syaiful S, Mudjanarko SW, 2019; Syaiful S et.al, 2021; Syaiful S, 2020; Syaiful S, Andana R, 2021; Syaiful S, Irbah AF, 2021).

Generation and withdrawal of movement

Awakening is the number of movements originating from one land use (zone) to another land use, while the pull is the amount of movement towards a zone. The generation and pull model is used to determine the amount of movement that enters or leaves a zone.

Several classifications of movements that are often used include (Tamin, 2000):

1. Based on purpose
2. Based on time
3. Based on the type of person

The output of the traffic generation calculation is trips / hour and traffic pull in the form of vehicles, people, or goods per unit of time, for example vehicles / hour.

Movement distribution

The distribution of movement aimed at moving within one area will cause problems, such as: congestion, air pollution, noise, delays and so on. One way to be able to find solutions to these problems is to understand the current and future movement patterns. Understanding patterns can be identified by searching data about the origin and purpose of movements, the magnitude of the movements, and when the movements occur.

Matrix origin destination (MAT)

Origin Destination (MAT) matrix is a two-dimensional matrix that contains information about the amount of movement between locations (zones) within a certain area. The row represents the zone of origin and the column represents the zone of destination, so the matrix cell represents the amount of flow from the zone of origin to the zone of destination. In this case, the Tid notation states the amount of movement flow (vehicles, passengers, or goods) moving from the origin zone i to the destination zone d during a certain time interval (Tamin, 2000).

Degree of saturation

The amount of the degree of saturation or Volume Capacity Ratio (VCR) for roads is obtained based on the analysis of traffic volume divided by road capacity. The results of the analysis are described in quantitative and qualitative terms or the so-called Level of Service and are presented in the following figures below.

Service of level	Related operating characteristics
A	• Free flow • Average travel speed ≥ 80 km / hour • V / C ratio ≤ 0.6 • Load factor at the intersection = 0
B	• Current is stable • Average travel speed decreased to ≥ 40 km / hour • V / C ratio ≤ 0.7 • Load factor ≤ 0.1
C	• Current is stable • Average travel speed decreased to ≥ 30 km / hour • V / C ratio ≤ 0.8 • Load factor ≤ 0.3
D	• Approaching unstable current • Average travel speed decreased to ≥ 25 km / hour • V / C ratio ≤ 0.9 • Load factor ≤ 0.7
E	• Current is unstable, blocked, with intolerable delays • The average travel speed is about 25 km / hour • Volume at capacity • Load factor at intersections ≤ 1
F	• Current stuck, jammed• Average travel speed <15 km / hour • V / C demand ratio exceeds 1 • Saturated intersection

Figure 1. Service Levels for Secondary Arterial Road Classification and Secondary Collectors

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Simulation and Assignment of Traffic on Urban Road Network (SATURN)
SATURN is a computer software developed by the Institute of Transport Studies, University of Leeds. This program has four basic functions, namely:

1. As a combination of simulation and traffic assignment models for the purposes of traffic management planning analysis that includes a relatively local network (generally up to 100 or 200 nodes),
2. As a loading model for analysis on larger road networks (for example up to 3000 sections),
3. As a simulation model for an intersection, and
4. As a network database and analysis system.

RESEARCH METHODS

Place of execution

The research sites are in Tenjolaya District, Tamansari District, and Ciomas District which have main roads, education, health, lodging, offices, shopping centers, gas stations, and recreation areas.

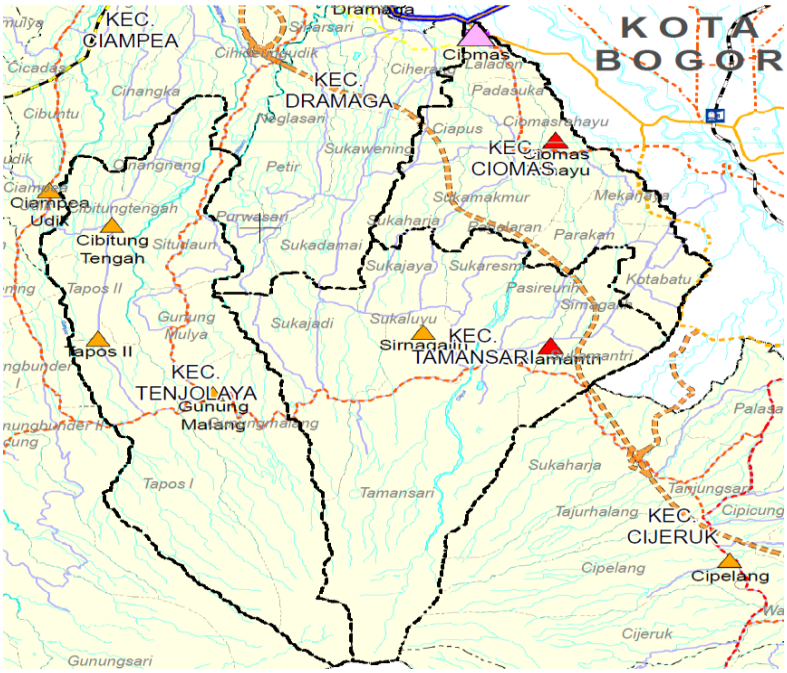

Figure 2. Map of Ciomas District, Map of Tamansari District and Tenjolaya District. Source: RTRW Map for Bogor Regency, 2016

Research time

The time of the research was conducted at the peak hours seen based on the daily traffic habits of each road section in 3 sub-districts using google maps.

Materials and tools

1. The materials needed in this study are primary and secondary data obtained from the results of the analysis and related agencies in the form of growth data for Bogor Regency, the existing conditions of Bogor Regency, and 2016 RTRW Map data for Bogor Regency.
2. The tools needed consist of: a traffic counting questionnaire form, stationery, a mobile application, namely a multi counter, a computer, the 2017 Indonesian Road Capacity Manual (MKJI 2017), the MS application. Excel 2010, MS. Word 2010, SATURN Version 10.9.22, printer, A4 paper for printed planning results.

Procedure

The way this research works is described based on the stages that have been designed in the research flow diagram shown in figure 3.

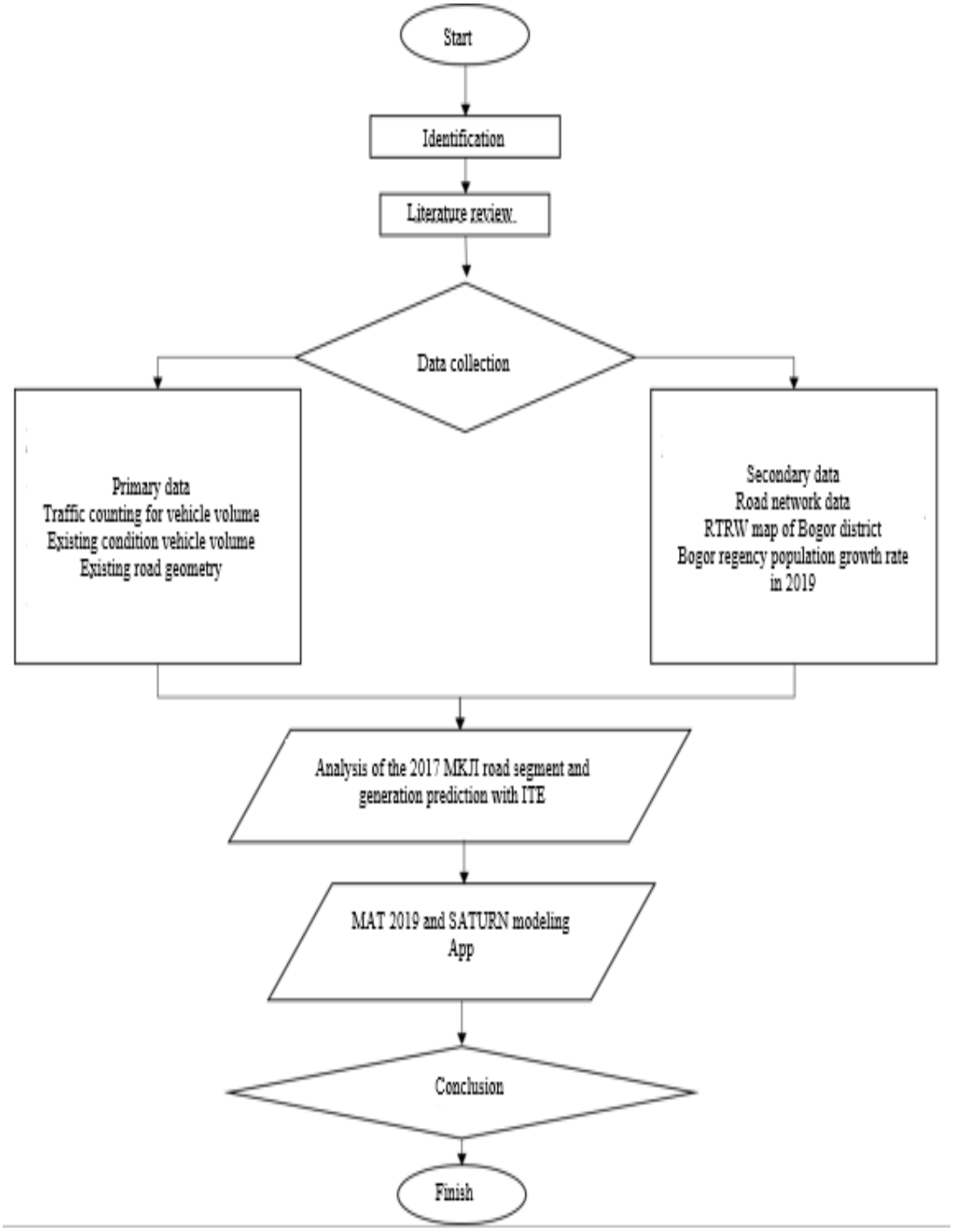

Figure 3. Location of Traffic Counting and Generation Prediction. Source: Google Maps, 2019

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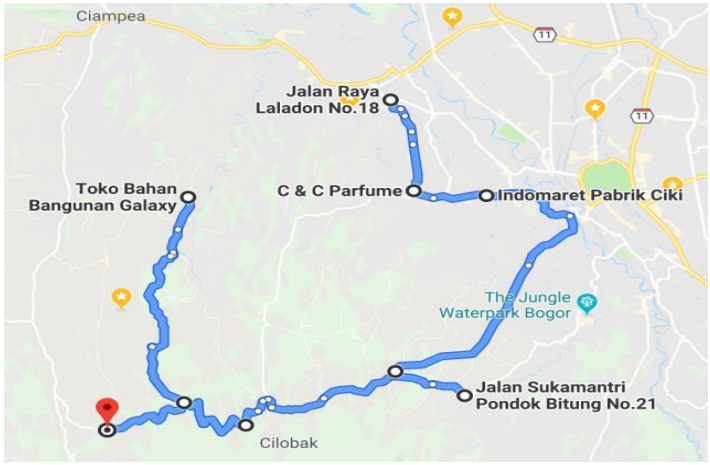

Figure 4. Location of Traffic Counting and Generation Prediction. Source: Google Maps, 2019

The following is an inventory of road segments based on the 2016 RTRW Map of Bogor Regency, and the conditions that cause congestion are shown in table 1.

Table 1. Road Segment Inventory.

No	Road of name	Road of type	Width of the road	Function of road
1	Jl. Raya Taman Pagelaran	2/2 TT	5,5 m	Secunder collector I
2	Jl. Raya Taman Pagelaran Kreteg	4/2 T	2,75 m/lajur	Secunder collector I
3	Jl. Raya Ciomas	2/2 TT	5,5 m	Secunder collector I
4	Jl. Sukamantri Pondok Bitung	2/2 TT	4,7 m	Secunder collector I
5	Jl. Hegarmanah Tamansari	2/2 TT	5,4 m	Secunder collector I
6	Jl. Hegarmanah Tenjolaya	2/2 TT	5,4 m	Secunder collector I
7	Jl. Curug Luhur Indah	2/2 TT	3,95 m	Secunder collector I
8	Jl. Gunung Malang	2/2 TT	5,5 m	Secunder collector I
9	Jl. Situdaun	2/2 TT	5,5 m	Secunder collector I
10	Jl. Tapos 1	2/2 TT	4,1 m	Secunder collector I

Source: Analysis Results

Vehicle surveys were carried out on many roads based on the 2016 RTRW of Bogor Regency, then adjusted based on the densest daily times from the Google Maps application, then the total volume was calculated and the total vehicle flow was calculated.

The flow of vehicle volume between Jl. Lieutenant Ibrahim Adjie and Jl. Raya Taman Show.

Table 2. Vehicle Volume Flow between Jl. Lieutenant Ibrahim Adjie (for West and East Directions) and Jl. Raya Taman Pagelaran (to the South).

08:30 - 09:30		SM	KR	KBM	BB	TB	Volume Total Q	SKR/hours	Average Q
	West	912	364	42	0	0	1318	1508,8	
Toward	East	982	332	36	0	4	1354	1560,8	1303,733
	South	574	356	22	0	0	952	841,6	

Source: Analysis Results

The flow of vehicle volume between Jl. Raya Taman Pagelaran and Jl. Raya Ciomas.

Table 3. Vehicle Volume Flow between Jl. Raya Taman Pagelaran (for North Direction) and Jl. Raya Ciomas (for West and East Directions).

09:30 - 10:30		SM	KR	KBM	BB	TB	Volume	Total Q SKR/hours	Average Q
Toward	North	1634	306	14	0	0	1954	1303,2	1081,333
	West	1090	222	30	0	0	1342	912	
	East	1232	256	28	0	0	1516	1028,8	

Source: Analysis Results

The flow of vehicle volume between Jl. Raya Ciomas and Jl. Raya Ciomas-West Bogor.

Table 4. Vehicle Volume Flow between Jl. Raya Ciomas (for West Direction) and Jl. Raya Ciomas-West Bogor (to the East)

09:30 - 10:30		SM	KR	KBM	BB	TB	Volume	Total Q SKR/hours	Average Q
Toward	North	1634	306	14	0	0	1954	1303,2	1081,333
	West	1090	222	30	0	0	1342	912	

Source: Analysis Results

The flow of vehicle volume between Jl. Raya Pondok Bitung and Jl. Sukamantri Pondok Bitung.

Table 5. Vehicle Volume Flow between Jl. Raya Pondok Bitung (for North and South Directions) and Jl. Sukamantri Pondok Bitung (for West Direction)

16:45 - 17:45		SM	KR	KBM	BB	TB	Volume	Total Q SKR/hours	Average Q
Toward	West	666	66	5	0	0	737	666	515,6
	East	582	32	0	0	0	614	582	
	South	498	46	0	0	0	544	498	

Source: Analysis Results

The flow of vehicle volume between Jl. Hegarmanah Tamansari and Jl. Hegarmanah Tenjolaya.

Table 6. Vehicle Volume Flow between Jl. Hegarmanah Tamansari (for the East Direction) and Jl. Hegarmanah Tenjolaya (for West Direction)

17:15 - 18:15		SM	KR	KBM	BB	TB	Volume	Total Q SKR/hours	Average Q
Toward	North	364	32	0	0	0	396	323,2	270,6
	West	236	22	6	0	0	264	218	

Source: Analysis Results

The flow of vehicle volume between Jl. Hegarmanah Tamansari and Jl. Hegarmanah Tenjolaya.

Table 7. Flow of Vehicle Volume between Jl. Hegarmanah Tamansari (for the East Direction) and Jl. Hegarmanah Tenjolaya (for West Direction)

17:15 - 18:15		SM	KR	KBM	BB	TB	Volume	Total Q SKR/hours	Average Q
Toward	West	644	60	0	0	0	704	575,2	613,2
	East	768	80	4	0	0	852	651,2	

Source: Analysis Results

The flow of vehicle volume between Jl. Tapos 1 and Jl. Tapos 1 - Pamijahan.

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Table 8. Vehicle Volume Flow between Jl. Tapos 1 (for East Direction) and Jl. Tapos 1 - Pamijahan (for West Direction)

13:45 - 14:45		SM	KR	KBM	BB	TB	Volume	Total Q SKR/hours	Average Q
Toward	West	170	30	0	0	0	200	132	152
	East	186	16	6	0	0	208	172	

Source: Analysis Results

The flow of vehicle volume between Jl. Situdaun and Jl. Situdaun - Ciampea.

Table 9. Vehicle Volume Flow between Jl. Situdaun (for the South Direction) and Jl. Situdaun - Ciampea (for North Direction)

15:00 - 16:00		SM	KR	KBM	BB	TB	Volume	Total Q SKR/hours	Average Q
Toward	North	152	20	2	0	0	174	144	142,4
	South	144	16	8	0	0	168	140,8	

Source: Analysis Results

The flow of vehicle volume between Jl. Gunung Malang (to the north) and Jl. Beautiful Luhur Waterfall

Table 10. Flow of Vehicle Volume between Jl. Gunung Malang (for the North) and Jl. Curug Luhur Indah (for West and East Directions)

16:45- 17:45		SM	KR	KBM	BB	TB	Volume	Total Q SKR/hours	Average Q
	North	216	20	0	0	0	236	192,8	
Toward	West	292	60	0	0	0	352	293,6	293,0667
	East	400	68	4	0	0	472	392,8	

Source: Analysis Results

Road Speed and Capacity Calculation

Based on the results of the road classification survey, the road speed is calculated which will then be processed according to the 2017 MKJI.

Speed Calculation

$$V_B = (V_{BD} + V_{B,W}) \cdot FV_{B,HS} \cdot FV_{B,KFJ} \text{ .....(1)}$$

Table 11. Average Speed of Outer-Urban Road Classification Section

No	Road of name	V_{BD}	V_{BL}	FV_{BHS}	FV_{BFJ}	V_B (km/hours)
1	Jl. Raya Taman Pagelaran	68	-7	0,85	0,94	48,74
2	Jl. Raya Taman Pagelaran Kreteg	65	-3	0,85	0,94	49,54
3	Jl. Raya Ciomas	65	-7	0,87	0,94	47,43
4	Jl. Sukamantri Pondok Bitung	68	-9	0,91	0,94	50,47
5	Jl. Hegarmanah Tamansari	61	-4,8	0,91	0,94	48,07
6	Jl. Hegarmanah Tenjolaya	61	-4,8	0,96	0,94	50,71
7	Jl. Curug Luhur Indah	61	-9	0,96	0,94	46,92
8	Jl. Gunung Malang	61	-5,5	0,96	0,94	50,08
9	Jl. Situdaun	65	-7	0,96	0,94	52,34
10	Jl. Tapos 1	61	-9	0,96	0,94	46,92

Source: Analysis Results

The calculation of Road capacity in accordance with MKJI 2017 is stated in the following table:

$C = C_0 \times FC_W \times FC_{PA} \times FC_{HS}$.....(2)

Table 12. Capacity of Outer Urban Roads

No	Roads	Co	FC_{Lj}	FC_{PA}	FC_{HS}	C
1	Jl. Raya Taman Pagelaran	3100	0,8	1	0,84	2083,20
2	Jl. Raya Taman Pagelaran Kreteg	3100	0,91	1	0,9	2538,90
3	Jl. Raya Ciomas	3100	0,8	1	0,87	2157,60
4	Jl. Sukamantri Pondok Bitung	3000	0,69	1	0,84	1738,80
5	Jl. Hegarmanah Tamansari	3000	0,778	1	0,84	1960,56
6	Jl. Hegarmanah Tenjolaya	3000	0,778	1	0,88	2053,92
7	Jl. Curug Luhur Indah	3000	0,69	1	0,88	1821,60
8	Jl. Gunung Malang	3000	0,8	1	0,88	2112,00
9	Jl. Situdaun	3100	0,8	1	0,88	2182,40
10	Jl. Tapos 1	3100	0,69	1	0,88	1882,32

Source: Analysis Results

Existing Service Level

Existing Service Level (Level of Service, LoS) of roads in the Study Area in 2019.

Table 13. Existing Service Levels of Secondary Collector Roads 1 Study Area in 2019

Roads	Type	Width of the road	Volume	C	VCR	LOS
Jl. Raya Ciomas	2/2 TT	5,5 m	1954	2157,60	0,906	D
Jl. Hegarmanah Tamansari	2/2 TT	5,4 m	330	1960,56	0,168	A
Jl. Hegarmanah Tenjolaya	2/2 TT	5,4 m	778	2053,92	0,379	B
Jl. Situdaun	2/2 TT	5,5 m	171	2182,40	0,078	A
Jl. Tapos 1	2/2 TT	4,1 m	204	1882,32	0,108	B

Source: Analysis Results

Table 14. Existing Service Levels at the "STOP" Priority Intersection of the Study Area in 2019

Roads	Type	Width of the road	Vehicle delay (seconds/pcu)	LOS
Jl. Raya Taman Pagelaran – Jl. Letnan Ibrahim Adjie	2/2 TT	5,5 m	10	B
Jl. Raya Taman Pagelaran Kreteg – Jl. Raya Ciomas	4/2 T	2,75 m per lajur	10	B
Jl. Sukamantri Pondok Bitung – Jl. Raya Pondok Bitung	2/2 TT	4,7 m	10	B
Jl. Curug Luhur Indah – Jl. Gunung Malang	2/2 TT	4,7 m	10	B

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Source: Analysis Results

Prediction of Generation and Withdrawal Calculations in the Study Area

In calculating the generation, an assumption is made of the number of units based on the area at this early stage until an agreement is reached on the area of schools, offices, hotels, markets, gas stations, health centers, recreational areas, and the extent of retail stores in the study area. Furthermore, to get the total number of pcu / hour pulls, the assumption is that the proportion of vehicles is uniform with the traffic counting data which is changed based on the vehicle coefficient on MKJI. Estimation of generation and attraction using the Trip Generation Manual ITE (Institute Transportation Engineers).
The results of the analysis of the generation and pull calculations in Ciomas District.

Table 15. Calculation of Generation and Withdrawal in Ciomas District

Description/ITE Code	Description /ITE Code	Units	Width Sqm / Unit Of measure	Coeffisien ITE	ITE Trip of generation (trip/hours)
SDN Kotabatu 08	Institutional	KSF^2	650	1,21	8,47
SMPN 3 Ciomas	Institutional	KSF^2	8174	1,19	104,70
SMKS Nurul Hidayah 2 Bogor	Institutional	KSF^2	600	0,97	6,26
Pasar Mini	Retail	KSF^2	40	0,88	0,38
TB. Subur Makmur	Retail	KSF^2	335	4,49	16,19
Kantor Desa Kotabatu	Office	KSF^2	627	1,21	8,17
Puskesmas Badak Putih Kotabatu	Medical	KSF^2	213	0,93	2,13
Klinik Nurul Medika	Medical	KSF^2	500	5,18	27,88
Seahorse Cycling Club Bogor	Recreational	KSF^2	215	5,96	13,79
SPBU Kotabatu	Services	Fueling Position	3	13,51	40,53
SDN Parakan 02	Institutional	KSF^2	1363	1,21	17,75
Bakso Gogin Dampit	Services	KSF^2	68	7,49	5,48
Kantor Desa Mekarjaya	Office	KSF^2	782	1,21	10,19
KRR Sports Club & Futsal KRR	Recreational	KSF^2	5.780	1,45	90,21
SDN Parakan 03	Institutional	KSF^2	1500	1,21	19,54
SMKS YASPI	Institutional	KSF^2	380	0,97	3,97
Kantor Desa Parakan	Office	KSF^2	782	1,21	10,19
SDN Ciomas 07	Institutional	KSF^2	800	1,21	10,42
Pasar Ciomas	Retail	KSF^2	860	0,88	8,15
Kantor Desa Ciomas	Office	KSF^2	638	1,21	8,31
Klinik Arafi	Medical	KSF^2	144	5,18	8,03
SDN Ciomas 05	Institutional	KSF^2	1500	1,21	19,54
SMPN 2 Ciomas	Institutional	KSF^2	6000	1,19	76,85
SMAS Ma'arif NU	Institutional	KSF^2	4700	0,97	49,07
SMKS Ma'arif NU	Institutional	KSF^2	200	0,97	2,09
Kantor Desa Pagelaran	Office	KSF^2	360	1,21	4,69
Kantor Kecamatan Ciomas	Office	KSF^2	3843	1,21	50,05
Gor dan Kolam Renang Zam-Zam Tirta	Recreational	KSF^2	10780	1,45	168,25
Bagus Aerobic & Fitness	Recreational	KSF^2	1423	3,53	54,07
Saung Hijau	Office	KSF^2	706	1,07	8,13
Puskesmas Ciomas	Medical	KSF^2	530	5,18	29,55
SDN Ciapus 01	Institutional	KSF^2	891	1,21	11,60

Description/ITE Code	Description /ITE Code	Units	Width Sqm / Unit Of measure	Coeffisien ITE	ITE Trip of generation (trip/hours)
SMPN 1 Ciomas	Institutional	KSF^2	9683	1,19	124,03
Kantor Desa Sukamakmur	Office	KSF^2	310	1,21	4,04
Puskesmas Ciapus	Medical	KSF^2	470	5,18	26,21
SDN Ciapus 05	Institutional	KSF^2	1538	1,21	20,03
Kantor Desa Ciapus	Office	KSF^2	160	1,21	2,08
SDN Ciapus 03	Institutional	KSF^2	1500	1,21	19,54
SMP Dharma Nusa	Institutional	KSF^2	3600	1,19	46,11
SMAN 1 Ciomas	Institutional	KSF^2	10325	0,97	107,80
Kantor Desa Sukaharja	Office	KSF^2	1100	1,21	14,33
SDN Taman Pagelaran	Institutional	KSF^2	1134	1,21	14,77
SMP Informatika Bina Generasi	Institutional	KSF^2	2657	1,19	34,03
SMKS Informatika Bina Generasi Bogor	Institutional	KSF^2	1503	0,97	15,69
Kantor Desa Padasuka	Office	KSF^2	600	1,21	7,81
Ruko Permata Zam-Zam	Office	KSF^2	880	1,29	12,22
TB. Aneka Jaya	Retail	KSF^2	635	4,49	30,69
Toserba Yogya	Retail	KSF^2	1000	9,48	102,04
Klinik Pelita Sehat	Medical	KSF^2	95	5,18	5,30
SDN Ciomas 02	Institutional	KSF^2	350	1,21	4,56
Ruko Ciomas	Office	KSF^2	2.400	1,29	33,33
Gor Ananda Ciomas	Recreational	Courts	4	3,35	13,40
Hall Victory	Recreational	Courts	4	3,35	13,40
SDN Laladon 01	Institutional	KSF^2	1500	1,21	19,54
SMP Ibnu Aqil Bogor	Institutional	KSF^2	4505	1,19	57,70
SMA Ibnu Aqil Bogor	Institutional	KSF^2	4950	0,97	51,68
SMKS Ibnu Aqil Bogor	Institutional	KSF^2	2009	0,97	20,98
SMKN 1 Ciomas	Institutional	KSF^2	6410	0,97	66,93
Pasar Laladon	Retail	KSF^2	6102	0,88	57,80
Terminal Laladon	Port & Terminal	Acres	0,75	6,55	4,91
Kantor Desa Laladon	Office	KSF^2	200	1,21	2,60
Puskesmas Laladon	Medical	KSF^2	400	5,18	22,30
Total					**1785,99**

Source: Analysis Results

The results of the analysis of the calculation of generation and attraction in the Tamansari District.

Table 16. Calculation of Generation and Withdrawal in Tamansari District.

Description /ITE Code	Description/ ITE Code	Units	Width Sqm/ Unit of measure	Coeffisien ITE	ITE generation (trip/hours)
SDN Gadog 02	Institutional	KSF^2	5000	1,21	65,12
SMPIT Al-Muttaqien	Institutional	KSF^2	5000	1,19	64,05
SMK Satria Bangsa	Institutional	KSF^2	1000	0,97	10,44
The Highland Park Resort Hotel	Lodging	Rooms	79	0,42	33,18
Curug Nangka Green Glamping Motel	Lodging	Rooms	15	0,47	7,05
Air Terjun Curug Nangka Indah	Recreational	Acres	170000	0,07	1,19
Kantor Desa Sukajadi	Office	KSF^2	875	1,21	11,40

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Description /ITE Code	Description/ ITE Code	Units	Width Sqm/ Unit of measure	Coeffisien ITE	ITE generation (trip/hours)
SDN Sukaluyu 01	Institutional	KSF^2	1500	1,21	19,54
SMAIT Nurul Fikri Boarding School	Institutional	KSF^2	2520	0,97	26,31
TBM Lentera Pustaka	Institutional	KSF^2	150	1,21	1,95
Vihara Saddharma (Myohoji) NSI	Institutional	KSF^2	4275	0,55	25,31
Sawargiloka Waterland	Recreational	Acres	15000	0,09	0,14
Blessing Resort Ciapus	Lodging	Rooms	6	0,42	2,52
Kantor Desa Sukaluyu	Office	KSF^2	660	1,21	8,60
Teater Pavita	Recreational	Seats	100	0,02	2,00
SDN Gadog 01	Institutional	KSF^2	3600	1,21	46,89
SMP Al-Hidayah	Institutional	KSF^2	5665	1,19	72,56
Resort Highlander	Lodging	Rooms	30	0,42	12,60
Kantor Desa Sukajaya	Office	KSF^2	627	1,21	8,17
Puskesmas Tamansari	Medical	KSF^2	400	0,93	4,00
SDN Pasirangsana 02	Institutional	KSF^2	2315	1,21	30,15
SMPN 2 Tamansari	Institutional	KSF^2	6000	1,19	76,85
Vihara Saung Paramita	Institutional	KSF^2	5250	0,55	31,08
KANTOR DESA Sukaresmi	Office	KSF^2	512	1,21	6,67
Puskesmas Sukaresmi	Medical	KSF^2	385	0,93	3,85
Pabrik Sepatu Boggae/Yongki Komaladi	Industrial	KSF^2	1.000	0,26	2,80
Sdn Pasireurih 05	Institutional	KSF^2	1500	1,21	19,54
Kantor Desa Pasir Eurih	Office	KSF^2	1000	1,21	13,02
Kampung Budaya Sindang Barang	Recreational	KSF^2	8.600	1,45	134,23
SDN Tamansari 01	Institutional	KSF^2	3000	1,21	39,07
MTS Al-Hidayah	Institutional	KSF^2	6256	1,19	80,13
SMKS Nurul Hidayah 1 Bogor	Institutional	KSF^2	1200	0,97	12,53
Toko H. Marwan	Retail	KSF^2	105	6,82	7,71
Kantor Desa Tamansari	Office	KSF^2	158	1,21	2,06
Klinik Nurul Medika	Medical	KSF^2	500	5,18	27,88
Situ Tamansari	Recreational	Acres	16.716	0,07	2,79
SDN Sukamantri 01	Institutional	KSF^2	2000	1,21	26,05
SMP Al-Minhaj Tamansari	Institutional	KSF^2	6570	1,19	84,16
SMA Al-Minhaj Tamansari	Institutional	KSF^2	6500	0,97	67,87
PT. Nirwana Tirta	Industrial	KSF^2	1972	0,76	16,13
Pasar Bersih	Office	KSF^2	15364	1,29	213,34
SDN Sirnagalih 05	Institutional	KSF^2	1500	1,21	19,54
SMPN 1 Tamansari	Institutional	KSF^2	8610	1,19	110,29
SMKS Informatika Bina Generasi 3	Institutional	KSF^2	1303	0,97	13,60
Kantor Kecamatan Tamansari	Office	KSF^2	1150	1,21	14,98
Puskesmas Sirnagalih	Medical	KSF^2	465	0,93	4,65
Kolam Renang Taman Raya	Recreational	Acres	1.293	0,09	0,01
Total					**1483,99**

Source: Analysis Results

The results of the analysis of the calculation of generation and attraction in Tenjolaya District.

Table 17. Calculation of Generation and Withdrawal in Tenjolaya District.

Description / ITE Code	Description /ITE Code	Units	Width Sqm/ Unit of measure	Koefisien ITE	ITE generation (trip/hours)
SDN Tapos 04	Institutional	KSF^2	1550	1,21	20,19
SMP Insan Nur Muhammad	Institutional	KSF^2	3170	1,19	40,60
SMAN 1 Tenjolaya	Institutional	KSF^2	6665	0,97	69,59
Kantor Kecamatan Tenjolaya	Office	KSF^2	1000	1,21	13,02
Puskesmas Tenjolaya	Medical	KSF^2	680	0,93	6,81
Pondok Bengka Permai	Residential	Beds	315	0,22	69,30
Curug Luhur	Recreational	Acres	14.420	0,09	0,13
SDN Gunungmalang 02	Institutional	KSF^2	1527	1,21	19,89
SMP PGRI Tenjolaya	Institutional	KSF^2	630	1,19	8,07
Pemandian Air Panas Gunung Malang	Recreational	Acres	10000	0,09	0,09
PB. Berkah Bogor	Retail	KSF^2	136	4,49	6,57
Kantor Desa Gunung Malang	Office	KSF^2	455	1,21	5,93
Balai Pengobatan Basmallah	Medical	KSF^2	357	5,18	19,91
Lapangan Hegarmanah	Recreational	KSF^2	3.815	5,96	244,74
SDN Tapos 01	Institutional	KSF^2	1944	1,21	25,32
SMPIT Majmul Bahrain	Institutional	KSF^2	3500	1,19	44,83
SMAS Al-Hikmah	Institutional	KSF^2	2500	0,97	26,10
Salaca Santri	Recreational	Acres	60.000	0,09	0,54
Kantor Desa Tapos 2	Office	KSF^2	235	1,21	3,06
SDN Situdaun 02	Institutional	KSF^2	1200	1,21	15,63
MTS Nurul Anwar	Institutional	KSF^2	692	1,19	8,86
SMKS YAPURA 1	Institutional	KSF^2	2380	0,97	24,85
Toko Bahan Bangunan Galaxy	Retail	KSF^2	650	4,49	31,41
Kantor Desa Situdaun	Office	KSF^2	313	1,21	4,08
Lapangan Footsal	Recreational	KSF^2	1640	5,96	105,21
SDN Cibitung 03	Institutional	KSF^2	1443	1,21	18,79
SMPN 1 Tenjolaya	Institutional	KSF^2	5155	1,19	66,03
SMK Putra Pelita	Institutional	KSF^2	5000	0,17	9,15
Pasar Jum'at	Retail	KSF^2	2261	0,88	21,42
TB. Putra Mandiri	Retail	KSF^2	528	4,49	25,52

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Description / ITE Code	Description /ITE Code	Units	Width Sqm/ Unit of measure	Koefisien ITE	ITE generation (trip/hours)
Kantor Desa Cibitung Tengah	Office	KSF^2	300	1,21	3,91
SDN Cinangneng 02	Institutional	KSF^2	1440	1,21	18,76
SMP Cendekia	Institutional	KSF^2	2000	0,17	3,66
Toko Bahan Bangunan Galaxi	Retail	KSF^2	768	4,49	37,12
Kantor Desa Cinangneng	Office	KSF^2	370	1,21	4,82
Puskesmas Desa Cinangneng	Medical	KSF^2	213	0,93	2,13
SDN Gunung Malang 01	Institutional	KSF^2	1840	1,21	23,96
SMPS Al-Jihad	Institutional	KSF^2	5500	1,19	70,45
SMAS Al-Jihad	Institutional	KSF^2	2500	0,17	4,57
SMK Zenia Rahmat	Institutional	KSF^2	3264	0,17	5,97
Kantor Desa Gunung Mulya	Office	KSF^2	216	1,21	2,81
Total					**1133,81**

Source: Analysis Results

Study Zone Conditions and MAT 2019

The study area in three sub-districts has 26 zones, which are 25 villages and 1 kelurahan in each sub-district.

Table 18. Zoning of the Study Area.

Zona	Kelurahan	District
1	Kota Batu	Ciomas
2	Mekarjaya	Ciomas
3	Parakan	Ciomas
4	Ciomas	Ciomas
5	Pagelaran	Ciomas
6	Sukamakmur	Ciomas
7	Ciapus	Ciomas
8	Sukaharja	Ciomas
9	Padasuka	Ciomas
10	Ciomas Rahayu	Ciomas
11	Laladon	Ciomas
12	Sukajadi	Tamansari
13	Sukaluyu	Tamansari
14	Sukajaya	Tamansari
15	Sukaresmi	Tamansari
16	Pasir Eurih	Tamansari
17	Taman Sari	Tamansari
18	Sukamantri	Tamansari
19	Sirnagalih	Tamansari
20	Tapos I	Tenjolaya
21	Gunung Malang	Tenjolaya
22	Tapos II	Tenjolaya

23	Situ Daun	Tenjolaya
24	Cibitung Tengah	Tenjolaya
25	Cinangneng	Tenjolaya
26	Gunung Mulya	Tenjolaya

Source: Survey Results

The results of the existing 2019 Origin Destination Matrix for study area 3 are shown in the following table:

Table 19. MAT Existing Study Area 2019

2019		KOTA BATU	MEKARJAYA	PARAKAN	CIOMAS	PAGELARAN	SUKAMAKMUR	CIAPUS	SUKAHARJA	PADASUKA	CIOMAS RAHAYU	LALADON	SUKAJADI	SUKALUYU	SUKAJAYA	SUKARESMI	PASIR EURIH	TAMANSARI	SUKAMANTRI	SIRNAGALIH	TAPOS I	GUNUNG MALANG	TAPOS II	SITU DAUN	CIBITUNG TENGAH	CINANGNENG	GUNUNG MULYA	oi	Oi	Ei (%)
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26			
KOTA BATU	1	0	144	144	144	112	112	112	87	96	115	105	22	32	22	41	41	32	41	41	12	28	18	11	12	11	16	1694	2619	2
MEKAR-JAYA	2	495	0	495	495	384	384	384	298	329	397	360	75	109	75	142	142	109	142	142	42	97	61	39	41	39	54	5827	573	10
PARAKAN	3	61	61	0	61	47	47	47	37	41	49	44	9	13	9	18	18	13	18	18	5	12	8	5	5	5	7	718	32	4
CIOMAS	4	91	91	91	0	71	71	71	55	61	73	66	14	20	14	26	26	20	26	26	8	18	11	7	7	7	10	1071	69	6
PAGELARAN	5	863	863	863	863	0	671	671	521	574	692	628	130	189	130	248	248	189	248	248	73	170	107	69	71	69	94	1016	466	5
SUKA-MAKMUR	6	770	770	770	770	598	0	598	464	512	617	560	116	169	116	221	221	169	221	221	65	151	96	61	63	61	84	9062	1033	11
CIAPUS	7	9	9	9	9	7	7	0	5	6	7	7	1	2	1	3	3	2	3	3	1	2	1	1	1	1	1	106	-2	1
SUKAHARJA	8	825	825	825	825	641	641	641	0	549	661	600	124	181	124	237	237	181	237	237	70	162	102	65	68	65	90	9711	1047	11
PADASUKA	9	203	203	203	203	157	157	157	122	0	162	147	31	44	31	58	58	44	58	58	17	40	25	16	17	16	22	2386	75	3
CIOMAS RAHAYU	10	104	104	104	104	81	81	81	63	69	0	75	16	23	16	30	30	23	30	30	9	20	13	8	9	8	11	1222	48	4
LALADON	11	116	116	116	116	90	90	90	70	77	93	0	18	25	18	33	33	25	33	33	10	23	14	9	10	9	13	1369	13	1
SUKA-JADI	12	208	208	208	208	161	161	161	125	138	166	151	0	46	31	60	60	46	60	60	18	41	26	16	17	16	23	2445	65	3
SUKA-LUYU	13	100	100	100	100	78	78	78	61	67	80	73	15	0	15	29	29	22	29	29	9	20	12	8	8	8	11	1181	34	3
SUKA-JAYA	14	172	172	172	172	134	134	134	104	114	138	125	26	38	0	49	49	38	49	49	15	34	21	14	14	14	19	2024	59	3
SUKA-RESMI	15	258	258	258	258	200	200	200	156	172	207	188	39	57	39	0	74	57	74	74	22	51	32	20	21	20	28	3038	127	4
PASIR EURIH	16	185	185	185	185	144	144	144	111	123	148	134	28	41	28	53	0	41	53	53	16	36	23	15	15	15	20	2177	59	3
TAMAN-SARI	17	166	166	166	166	129	129	129	100	111	133	121	25	36	25	48	48	0	48	48	14	33	21	13	14	13	18	1958	46	2
SUKA-MANTRI	18	320	320	320	320	248	248	248	193	213	256	232	48	70	48	92	92	70	0	92	27	63	40	25	26	25	35	3763	72	2
SIRNA-GALIH	19	137	137	137	137	107	107	107	83	91	110	100	21	30	21	39	39	30	39	0	12	27	17	11	11	11	15	1617	33	2
TAPOS I	20	184	184	184	184	143	143	143	111	122	147	134	28	40	28	53	53	40	53	53	0	36	23	15	15	15	20	2162	44	2
GUNUNG MALANG	21	124	124	124	124	97	97	97	75	83	100	90	19	27	19	36	36	27	36	36	11	0	15	10	10	10	14	1463	-111	1
TAPOS II	22	41	41	41	41	32	32	32	25	27	33	30	6	9	6	12	12	9	12	12	3	8	0	3	3	3	4	479	-4	1
SITU DAUN	23	52	52	52	52	40	40	40	31	35	42	38	8	11	8	15	15	11	15	15	4	10	6	0	4	4	6	612	4	1
CIBITUNG TENGAH	24	60	60	60	60	46	46	46	36	40	48	43	9	13	9	17	17	13	17	17	5	12	7	5	0	5	7	701	7	1
CINANG-NENG	25	34	34	34	34	27	27	27	21	23	28	25	5	8	5	10	10	8	10	10	3	7	4	3	3	0	4	406	5	1
GUNUNG MULYA	26	30	30	30	30	23	23	23	18	20	24	22	5	7	5	9	9	7	9	9	3	6	4	2	2	2	0	355	2	1
Dd		5752	5752	5752	5752	4467	4467	4467	3468	3825	4610	4181	868	1261	868	1654	1654	1261	1654	1654	488	1131	714	457	472	457	628	1	67712	

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2019	KOTA BATU	MEKARJAYA	PARAKAN	CIOMAS	PAGELARAN	SUKAMAKMUR	CIAPUS	SUKAHARJA	PADASUKA	CIOMAS BAHAGIA	LALADON	SUKAJADI	SUKALUYU	SUKAJAYA	SUKARESMI	PASIR EURIH	TAMANSARI	SUKAMANTRI	SIRNAGALIH	TAPOS I	GUNUNG MALANG	TAPOS II	SITU DAUN	CIBITUNG TENGAH	CINANGNENG	GUNUNG MULYA	oi	Oi	Ei (%)
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26			
dd	5752	5752	5752	5752	4467	4467	4467	3468	3825	4610	4181	868	1261	868	1654	1654	1261	1654	1654	488	1131	714	457	472	457	628	67712		
Ei	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1			

Source: Analysis Results

Road Network Modeling in the 3 sub-district study locations is shown in the following Figure 4 below.

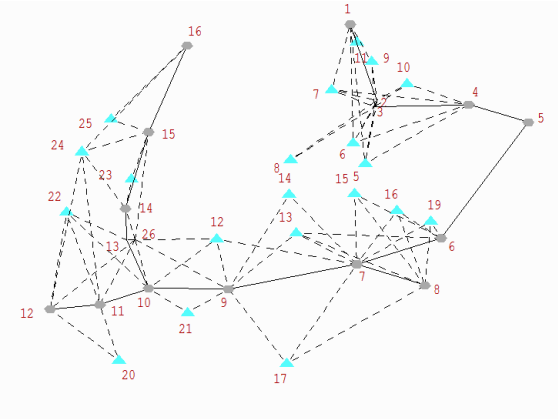

Figure 5. Study Location Road Network. Source: Analysis Results

The following is a picture of the road loading (VCR Variable Intensity) of the study location.

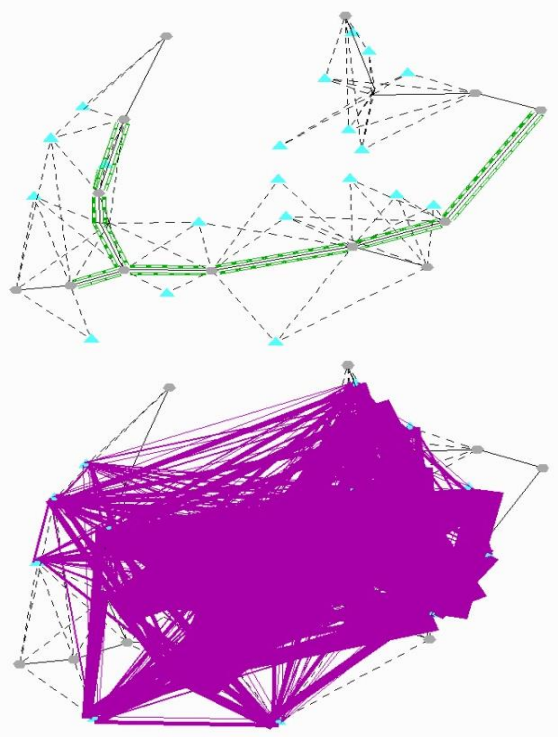

Figure 6. VCR Variable Intensity. Source: Analysis Results

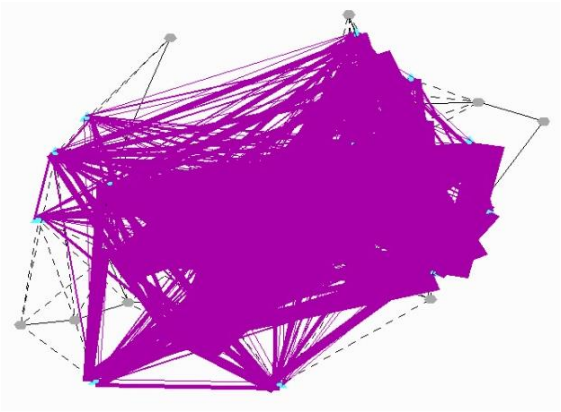

Figure 7. Generation and Withdrawal Patterns of Existing Study Sites 2019. Source: Analysis Results

The origin destination matrix is charged to the road network and calibrated to obtain rsq for the design of the transportation modeling equation in the four study districts, namely Y = 21.230 - 0.950 (X). This generation and attraction model has a value of R2 = 0.9687 which is presented in the following figure:

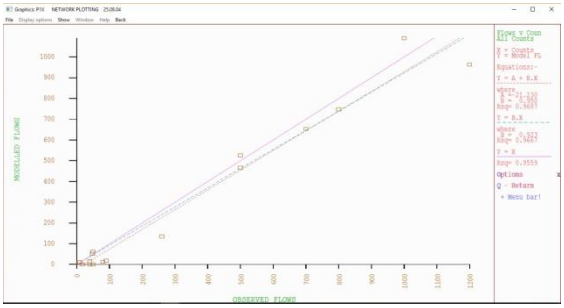

Figure 8. Calibration Results of the 2019 Study Location Network. Source: Analysis Results

CONCLUSION

Based on the results and discussion that has been described, the following conclusions can be drawn, the growth of motorbikes is very large, resulting in a lack of interest in light vehicle transportation in Bogor Regency. The existing condition of the road network in the study areas of Ciomas, Tamansari, and Tenjolaya Districts, shows that all service levels are vulnerable, namely A to A. D, with the highest level of service, namely B. This occurs because the value of traffic flow has a smaller number than the available road capacity so that the LoS is relatively stable. The number of resurrections in education, health, lodging, offices, shopping centers, gas stations, and recreation areas in Ciomas District, Tamansari District and Tenjolaya District is 4,403.78 trips / hour. While the amount of attraction from the 3 sub-districts is 6,165.33 pcu / hour. With each in Ciomas Subdistrict it produces a generation of 1,785.99 trips / hour and an attraction of 4,178,467 pcu / hour. Tamansari District has a generation of 1,483.99 trips / hour and an attraction of 786.2 pcu / hour. And Tenjolaya District has a total number of generation of 1,133.81 trips / hour with an attraction of 1133.81 pcu / hour. The design of the transportation modeling equation in the three case study sub-districts (Ciomas, Tamansari, and Tenjolaya) is Y = 21,230 - 0,950 (X).

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