Jeepney Service Operation and Demand in Baguio City, Philippines

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Abstract: The jeepney is a very unique public transport mode not only as a vehicle but also in the ways it is operated and utilized by passengers. This paper presents the characteristics of the public utility jeepney service operation and demand in Baguio City. The analysis is made on the basis of various field surveys conducted. The rationalization of color-coded trunklines (Red, Blue, Green and Yellow) of jeepneys comprising 116 jeepney lines and associations and 4208 units are thought to determine the exact number of vehicles on the road to complement the carrying capacity of the city's roads. Results show that the average jeepney load factor computed is 0.82 or 82%, the average jeepney trips per day is 7.47, the average seating capacity is 20.97. Moreover, the average speed of jeepneys is at 10.228 kph at an average distance of 4.140 kilometers. The Aurora Hill and Trancoville lines obtained the highest demand with values of 43,973 and 37,689 passengers per day, respectively. This paper provides an initial analysis regarding the demand and supply of jeepneys serving particular routes in Baguio City.

Keywords: Jeepneys, Public Transport, Jeepney Color-coded Trunklines

1. INTRODUCTION

The Philippine Jeepney is one of the most popular, the most convenient and cheapest mode of public transportation in the country. These public utility jeepneys (PUJs) are not only one of the most popular icons of Filipino creativity and innovativeness today, but also the most prominent mode of public transportation in the Philippines, with a total of 220,114 registered units in year 2012 (Bacero, 2009).

A series of consultations with the stakeholders in Baguio City indicates that one of the most pressing concerns with regard to transport in Baguio City is the congestion and vehicle population increase resulting from increasing tourist arrival and the capacity of the population to buy private vehicles. The challenges in limiting the volume of vehicles on the road are further aggravated by the lack of parking management strategy to effectively reduce private vehicles, and to ensure space for the loading and unloading zones of public utility vehicles; the lack of centralized public transport terminal; the inadequacy of infrastructure for non-motorized transport and public transportation; compliance of public utility vehicles to vehicle emission standards, and; lack of implementing body and authority to manage all transport and traffic operations, rules and standards, engineering, and education of public transport operators (CLUP-Baguio City, 2010-2020).

In order to cope with the ever-increasing traffic congestion in Baguio City, the local government and the Department of Transportation (DOTr) would like to come up with a network-based approach in determining the number of vehicles required to serve the

estimated passenger demand.

The primary aim of this paper is to present the public transport route operational characteristics of jeepneys and demand in Baguio City as a public transport vehicle serving particular routes. The more specific objectives of this paper are the following:

- Determine the factor that affect the service operation of jeepneys; and
- Conduct public utility jeepney survey to determine jeepney load factor, average seating capacity, average speed and utilization ratio.

2. BAGUIO CITY PROFILE

2.1 Physical Setting and Urban Growth

Baguio City, also known as the "Summer Capital of the Philippines" is located in the Province of Benguet. The City is landlocked within the province of Benguet, thus bounding it on all sides by its different municipalities, on the North by the capital town of La Trinidad, on the East by Itogon and to the South and West by Tuba. It lies in a mountain range approximately 250 kilometers north of Manila with an area of 57.49 square kilometers enclosed in a perimeter of 30.98 kilometers. The developed portion of the city corresponds to a plateau that rises to an elevation of 1,400 meters. Most of it lies in the northern half of the city.

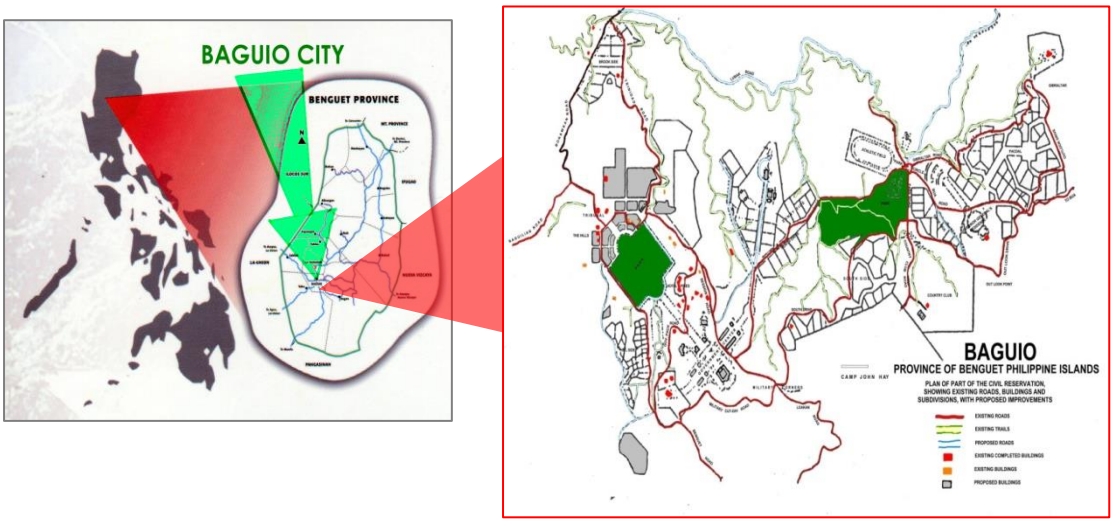


Figure 1. Geographical Location of Baguio City

The City, composed of 129 barangays is considered as one of the highly urbanized cities of the country due to its role in the regional and national development as prime tourist destination and center of quality education.

2.2 Demography

The City of Baguio registered a total population of 367,053 persons as of May 1, 2016. This registered an increase of 8,283 persons over the total population of 358,770 persons in 2015, giving the city an annual population growth rate of 2.31 percent.

The Services sector continues to be the major employment generator in the City. The annual per capita poverty threshold is Php19,140.00 that would translate to Php95,700.00 for a family of 5 which is the average number of family in CAR and at the National level. The

number of households in 2010 rose to 78,313 or an increase of 26,011 households over the 2000 figure which is 52,302. The average household size decreased from 4.3 persons in 2007 to 4.0 persons in 2010.

2.3 Income Distribution and Car Ownership

According to the record of the Department of Transportation, the number of vehicles registered in Baguio City shown in Figure 2 was approximately 9,815 in the second quarter 2015 and 11,672 in 2016, an increase of about 15.9%. Its composition by vehicle type is shown in Figure 1. The total number of private cars registered in the second quarter of 2016 is 2,870 (45% of the total), taxis: 806 (12%), jeepneys or public utility jeepneys: 834 (13%), buses: 20 (0.31%) and motorcycles: 1919 (30%).

Table 1 shows the car-ownership by income level based from the travel behavior survey conducted. An average car-ownership ratio is about one for every 5 household who owns an average of 1.3 cars. However, car-ownership doesn't vary significantly by income level. The 11% of the households who belong to the lower income group own an average of 1.4 cars which is identical with upper income group.

Table 1. Car Ownership by Income Level, 2016

Household Income Level (Php/month)	% Household (N=401)	Average Number of Cars
less than 20,000	62%	1.5
20,001 - 40,000	11%	1.4
40,001 - 60,000	14%	1.0
60,001 - 80,000	9%	1.4
80,001 and above	4%	1.0
Total	100%	1.3

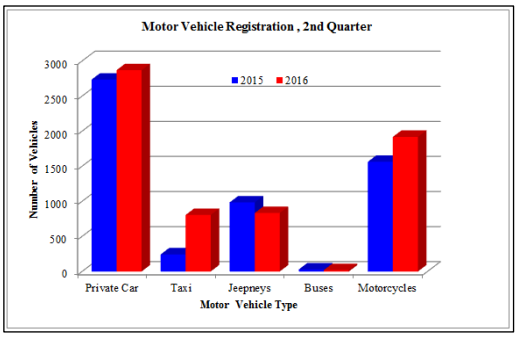


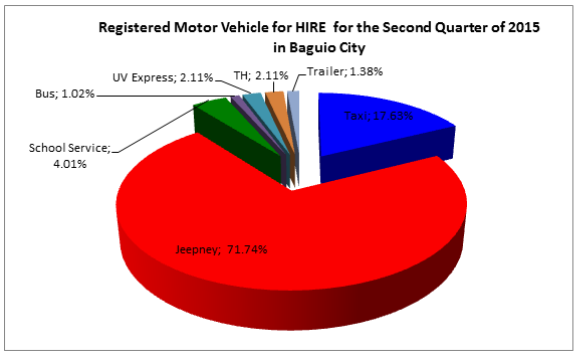
Figure 2. Motor Vehicle Registration in Baguio City, 2nd Quarter 2015, 2016

2.4 Urban Transportation Characteristics

Baguio City serves as a major urban center in the North. Public transport is relatively convenient with at least sixteen (16) bus companies servicing the Luzon Island interprovincial from Metro Manila to the city of Baguio. These provide transport services mostly in Metro Manila, Ilocos Region, Cordilleras and Cagayan Valley to as far as Zambales and Quezon Province. Licensed public utility vehicles that operate specific intra municipality and intercity routes complement the existing provincial bus lines. Within the city, the usual route is from a specific neighborhood or Barangay to the Central Business District and vice versa. Out of town destination reach as far as La Trinidad and other adjoining towns of Itogon, Sablan, Tuba and Tublay all in Benguet.

Figure 3 shows the percentage of registered motor vehicle for the second quarter of 2015 and 2016 in Baguio City. Registration made by public utility jeepney comprises 71.74% of the motor vehicles registered for public use in the second quarter of 2015. It shows that jeepneys have the largest number of registered motor vehicles for public conveyance. The popularity of this mode is attributed to the following: (1) local availability – manufacturing technology is locally available and parts such as second-hand engines and imported chassis

are readily available; (2) intermediate size or capacity – compatible to road network and configuration, enabling it to easily move, stop, load and unload passengers as well as penetrate even the local interior roads; and (3) accessibility – providing a door-to door service at practically any time and place (Bayan, 1995 and Ebata, *et al*., 1996).



Registered Motor Vehicle for HIRE for the Second Quarter of 2015

	Baguio City	CAR Region
Taxi	242	314
Jeepney	985	1512
School Service	55	57
Bus	14	45
UV Express	29	16
TH	29	66
Trailer	19	22

Figure 3. Motor Vehicle Registration for Hire/Public Use in Baguio City
Source: DOTC – CAR, 2015

As of year 2012 (Table 2), the city's road system total 320.924 kilometers, of which 29.709 percent are classified as national roads and bridges, 70.291 percent are city/barangay roads.

Table 2. Road Network, 2012

TYPE OF ROAD	TYPE OF PAVEMENT (in km)		TOTAL (in kilometers)	PERCENT
	CONCRETE	ASPHALT		
National/Bridge	73.353	21.991	95.344	29.709
City/Barangay*	153.691	71.889	225.580	70.291
TOTAL	227.044	93.880	320.924	100.000
PERCENT	70.747	29.253	100.000	

Data Source: DPWH –Baguio City District Engineering Office

Jeepney Trunklines in Baguio City. Administrative Order (A.O.) of the City of Baguio No. 162, series of 2011 deals with the rationalization of all public utility jeepneys was issued in the city as basis for the Baguio City Police Office Traffic Management Branch to apprehend violators of said order. The AO was issued after a series of meetings of the Traffic and Transport Management Committee (TTMC) as to enforcement of traffic regulations in the city targeting motorists and the general public.

Figure 4. Color – Coded Jeepney Trunkline located along Staging Areas

The move for jeepney rationalization deals with entry and exit points of specific routes, staging and loading areas, and exact number of units for loading and staging in the City. Accordingly, the rationalization determines the exact number of running vehicles on the road and those on rest days to complement the carrying capacity of the city's roads.

The jeepney lines in Baguio City are grouped into four different trunklines according to their routes in the city. Figure 5 presents the four existing trunklines as drawn using EMME/4 software.

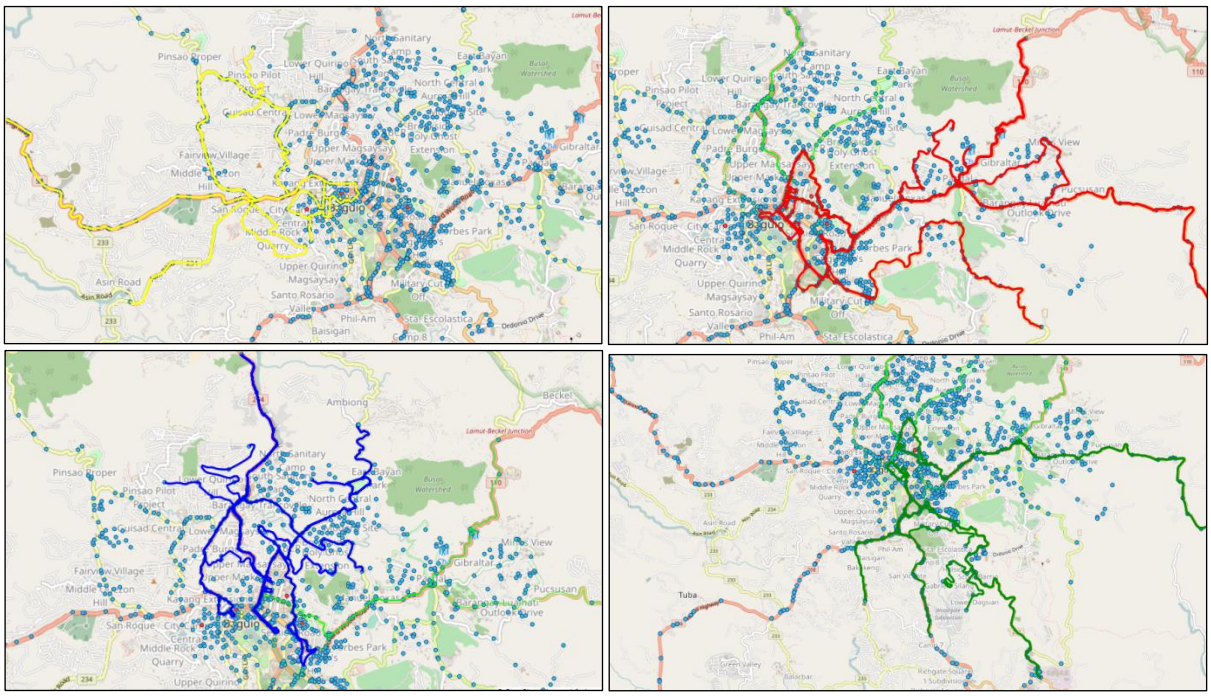


Figure 5. Color – Coded Jeepney Trunkline Route

Yellow Trunkline. The yellow trunkline consists of jeepney lines coming from western part of Baguio City and those passing through Naguilian Road and Quirino Highway. As of 2012, there are 16 jeepney lines and associations comprising of 683 jeepney units and 100 parking allocation, but with the rationalization move, there are 98 units at the loading areas and 353 staging points. The yellow trunkline terminals are located along Upper and Lower Kayang Street, Shugum Street and Shugem Street.

Red Trunkline. The red trunkline consists of jeepney lines coming from eastern part of Baguio City and those passing through Leonard Wood Road or Teacher's Camp Area. As per Administrative Order 162, Series of 2011, there are 65 units allocated at their loading areas located along Rajah Soliman, Lakandula Street, Mabini Street, Otek Street and Kalantiao Street. Moreover, there are 509 jeepney lines and associations.

Blue Trunkline. The blue trunkline consists of jeepney lines coming from the northern part of Baguio City and those passing through Magsaysay Avenue and Bonifacio Street. This trunkline has out-of-town routes including that of Atok, Kapangan, La Trinidad, Sablan and Tublay. Some jeepney lines running within the Central Business District (CBD) are Aurora Hill and Trancoville encompasses of the most number of units plying in the CBD of Baguio City, which are 342 units and 423 units respectively. These units have no terminal points and parking allocation (also termed as Express) in the CBD.

Blue trunkline terminals and loading stations are mostly located along Shuntug Street, P. Burgos Street, Dagohoy Street, Dangwa Tranco, Tabora Park, Rajah Soliman and Rajah Matanda. As of 2012, blue trunkline comprises of 2054 units and 51 staging allocations.

Green Trunkline. The green trunkline consists of jeepney lines coming from southern part of Baguio City and those passing through Kennon Road and Marcos Highway. As of 2012, there are 1008 jeepney lines and associations and 88 parking allocation in the central business district. The terminals are mostly located along Perfecto Street, Shugem Street, Lakandula Street, Governor Pack Road, Carantes Street, Lapu-Lapu Street, Otek Extension and Diego Silang.

3. LITERATURE REVIEW

Each Asian country has its own unique type of public transport. For example, opelet and bemo in Indonesia, minibas in Malaysia, rot song tao and silor in Thailand and jeepney in the Philippines. Jeepneys symbolize the history of the Philippines in the 21st century. They also stand as evidence to Filipino mechanical genius. The “jeepneys” is the Filipino version of the “jitney,” the taxi/minibus that travels along a fixed route, found in many countries. They were originally built by modifying leftover army surplus Willys and Ford military jeeps after WWII (Bacero, 2009).

Barwell *et al*. (1985) provided a detailed description of the jeepneys, its ordinary routine and the average revenue and operating expense based on the interviews with six jeepney operators. On the other hand, Bautista (1995) identified several components that contributed to the increasing number of serious accidents in the City of Manila as well as the locations where such transpired. One of his findings was that jeepneys ranked second in terms of proportions of accident by vehicle. Edata *et al*. (1996) studied the jeepney supply system and structure in order to address the problems related to the goals of achieving a sustainable and stable jeepney business in Metro Manila. Bacero (2009) revealed in his study that most jeepney manufacturing firms have varied specifications with regard to capacity, dimensions and weight of the vehicle and similar specification on the parts and equipment of the jeepney vehicle.

The jeepney has been the predominant mode of public transport in Metropolitan Manila, accounting for 55% of the daily person trips (Ebata *et al*, 1996). Based on the Databook on Philippine Transportation prepared by the University of the Philippines, National Center for Transportation Studies, the highest mode share of total person trips per day belongs to jeepneys, estimated at 46% in 1974, 59% in 1980, 56% in 1985 and 50% in 1989. However, the trend is decreasing due to the introduction of the other modes. In 1994, the Jeepney industry accounted for 40 % of the total vehicles registered in the National Capital Region (NCR) and there were about 350,000 units plying the major and minor routes in the metropolis (Sevilla, 1994).

According to Kurokawa (1984), the average car-ownership ratio is about one for every ten thousand owned an average of 1.4 cars. However, car –ownership varies significantly by income level. Only 3% of the households belonging to the lowest income group own a car per household, while 67% of those who belong to the upper income group own more than 2 cars per household.

Route Measured Capacity (RMC) represents the "public necessity" requirements in the franchising procedure, it represents the number of services required in a given route therefore "in Bus or PUJ units", while in other countries it is represented as preferred "headway", it attempts to represent the demand in terms of unit(s) requirement. RMC is an attempt to define

the "seats required" of a given route. "Seat requirement" is a public transport analyses jargon widely adopted in the transport planning world. It represents the levels of service of a passenger service taking into consideration the trips generated and/or attracted by a certain route structure and proposing a certain level of operation while ensuring the viability of operation. All these analyses and inputs submit to market acceptability principles (Manresa *et al*, 2013).

Japan International Cooperation Agency (1984) used boarding and alighting survey in estimating the demand for public transport in Metro Manila. The objective of the survey in the study was to create a public transport database, as well as to provide a planning basis for rerouting the existing public transport route in view of implementation of LRT. Apilado and Perez (2013) estimated the supply and demand of public transport of the six routes in UP Campus. The survey was conducted for the two peak days of the week. Results of the study show that there is relatively enough supply of jeepneys that meets the demand.

4. METHODOLOGY

Basically, in order to capture the passenger demand and supply characteristics of jeepneys, the following surveys were conducted.

4.1 Volume Count, License Plate Survey and Frequency Survey

Volume count was conducted along the four (4) jeepney trunklines to identify which routes are used most to either improve that road or provide an alternative if there is an excessive amount of traffic. Location of the survey was based on the entrances and exits of vehicles entering and leaving the Central Business District of Baguio City (Figure 6) located along Marcos Highway, Naguilian Road, Leonard Wood Road (Teacher's Camp), Upper Session Road Extension, Rimando Road and Magsaysay Avenue. The survey was conducted in a Friday of November 25, 2016 during peak hours from 06:00 a.m to 09:00 a.m., 11:00 a.m. to 01:00 p.m. and 04:00 p.m. to 06:00 p.m. Figure 6.2 shows the location of entries and exits in the Central Business District of Baguio City where volume counts were conducted.

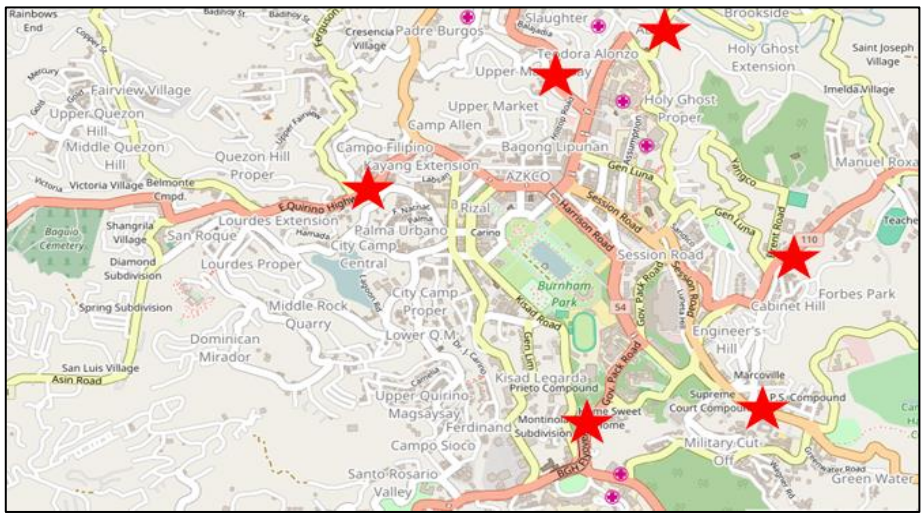


Figure 6. Location of Entrances and Exits in CBD Area for Volume Count
Data Source: Openstreet map

License Plate Survey was conducted at the same time with volume counts to obtain the frequency of jeepneys operating for a day. This data were used to estimate the passenger demand for a day by expanding the average occupancy of each jeepney to one (1) day. Other data including number of round trips and utilization rate may also be obtained in this survey. The time a jeepney was observed and recorded.

Surveyors were assigned at stations wherein they recorded the body number of every jeepney observed. The stations for the survey were established on the entrances of the CBD area.

4.2 Boarding and Alighting survey

Boarding and Alighting Survey was conducted to estimate the occupancy or the current passenger volume of jeepneys at different loading and unloading stations along the jeepney Route. Also, the average occupancy was determined which was used in the calculation of the passenger demand along the route.

In this survey, the surveyor initially rides a specific public transport vehicle at a specified starting point. In each station, the number of boarding and alighting passengers are counted and recorded. Once the vehicle has traversed the whole route, the surveyor rides another vehicle and repeats the process for the remaining time of the survey. The surveys were conducted during peak periods (06:30 a.m. – 09:00 a.m., 11:00 a.m. – 01:00 p.m., 04:00 p.m. – 06:00 p.m.) in two – day period of Tuesday and Wednesday, January 10 and 11 of 2017.

A total of 41 jeepney routes were observed out of the total existing 116 jeepney routes that had been identified in the existing jeepney lines. The jeepney lines were randomly selected in the different trunklines namely: 10 jeepney lines for the blue, yellow and red trunklines and 11 jeepney lines for the green trunklines. A total of 84 round trips were covered for jeepneys. The number of round trips was determined depending upon the origin and distance of the route from the Central Business District of Baguio City.

4.3 Origin-Destination Survey.

Origin-Destination Survey was conducted to determine the ultimate origins and destinations of passengers of the different PUJ transport line. Onboard interviews and road side interviews were used as a data gathering technique wherein the passengers of the transport line were asked about their ultimate origins and destination. The survey was conducted from 08:00 a.m. – 05:00 p.m. from December 2016 to January 2017. There were 568 out of 600 samples were considered valid during the survey. The surveyor initially rode a jeepney from its origin and interviewed on-board passengers until the jeepney was back at terminal where the surveyor rode another jeepney. The process was repeated until the end of the survey period.

5. RESULTS AND DISCUSSIONS

The findings noted and the facts made clear on the analysis of the data collected in the surveys.

5.1 Traffic Density

Volume studies were conducted to determine the volume of traffic moving on the roads at a

particular section during a particular time. Figure 7 presents the volume of vehicles entering and leaving the central business district of Baguio City taken along the entry points of the different trunklines as presented in Figure 6. Green and red trunklines ought to have the highest volume of vehicles entering the CBD area located along Marcos Highway, Leonard Wood Road and Upper Session Road during peak hours in the morning, afternoon and evening with a volume of 7,289 units and 14,119 units, respectively. The peak hour volume happens during 06:30 a.m. – 07:30 a.m. (6,001 units); 11:00 a.m. – 12:00 nn (5,262 units) and 05:00 p.m. – 06:00 p.m. (5,104 units). The three other major entry points, Naguilian Road, Magsaysay Avenue and Rimando Road experience almost the same volume of vehicles entering the central business district with a volume of 4,662, 4661 and 4159, respectively.

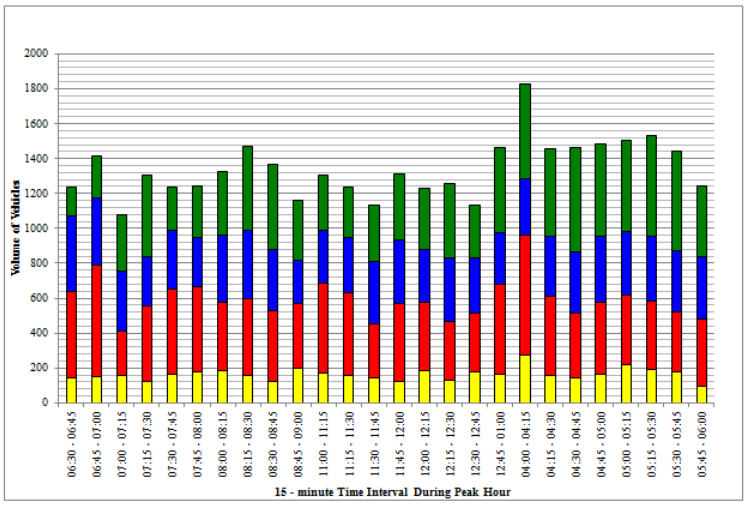


Figure 7. Volume of Vehicles (by trunkline) Entering the CBD of Baguio City

Moreover, Figure 8 shows the volume of vehicles exiting the central business district of Baguio City with the same location indicated in Figure 6. Marcos Highway in the green trunkline appears to have the highest volume of vehicles exiting the CBD with a value of 10,539 units during peak hours in the morning, afternoon and evening. The highest volume of vehicles occurs during 07:45 a.m. – 08:45 a.m. (5,400 units), 12:00 nn – 01:00 p.m. (5,087 units) and 04:00 p.m. – 05:00 p.m. (6,229 units). Results indicate that there is almost equal number of vehicles entering and exiting the central business district with a volume of 34,890 units and 34,854 units, respectively.

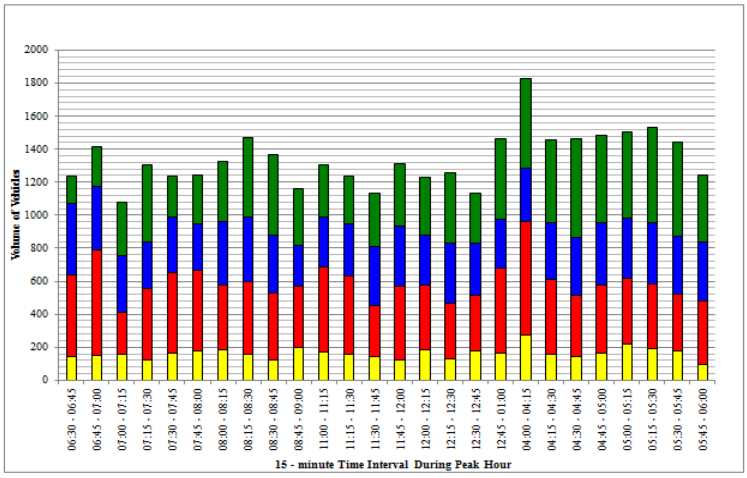


Figure 8. Volume of Vehicles (by trunkline) Exiting the CBD of Baguio City

Furthermore, the highest volume of vehicles in the CBD area of Baguio City takes place in the afternoon peak hour from 04:00 p.m. to 05:00 p.m. with a value of 11,289 units. Private cars comprise of 28% (3,179 units) of the total number of vehicles during peak hours, taxis: 27% (3,070 units), jeepneys: 23% (2,548 units).

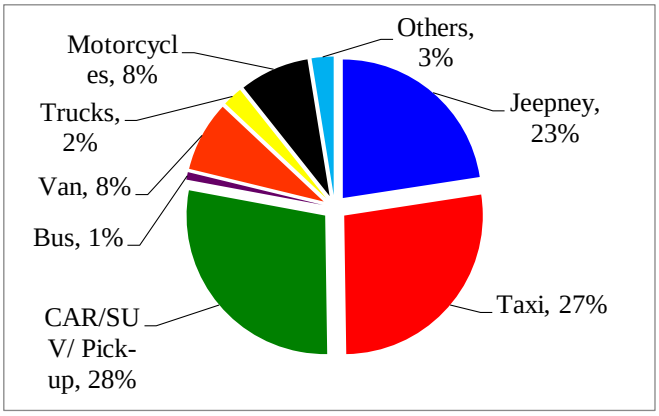


Figure 8. Distribution of Vehicle Type Entering and Exiting the Central Business District of Baguio City

Data Source: Calculated based on Volume Studies conducted by the researcher, 2016

Capacity is defined as the maximum hourly rate at which vehicles can reasonably be expected to traverse a point or uniform section of a lane or roadway during a given period of time under prevailing roadway, traffic, and control conditions. Traffic engineers rely on the capacity and level of service analysis to determine the width and when expanding existing facilities that are already experiencing congestion problems. Table 3 presents the computed level of service along the streams entering and exiting the Central Business District of Baguio City based from the four (4) trunklines.

Table 3. Level of Service along the Entry and Exits of CBD in Baguio City

Trunkline	Location	Peak Hour Volume (pcu/hr)	v/c	LOS
Yellow	Naguilian Rd	1662	0.54	LOS
Red	Teacher's	2403	0.77	LOS
Red	Upper	2420	0.78	LOS
Blue	Magsaysay	1729	0.56	LOS
Blue	Rimando	1894	0.61	LOS
Green	Marcos	3765	1.21	LOS

Data Source: Calculated based on Volume Studies conducted by the researcher, 2016

The level of service along Naguilian Road, Magsaysay Avenue and Rimando Road was LOS C with a volume – capacity ratio of 0.54, 0.56 and 0.61, respectively. As such, the level of service is in the zone of stable flow, but speed and maneuverability are most closely controlled by higher volumes. Most of the drivers are restricted in the freedom to select their own speed, lane changing, or overtaking maneuvers. The level of comfort and convenience declines noticeably. Red trunklines along Teachers Camp Leonard Wood Road and Upper Session Road Extension experience LOS D with a volume-capacity ratio of 0.77 and 0.78 which approaches to an unstable flow in the area. Driver experiences a generally poor level of comfort and convenience. On the other hand, the green trunkline along Marcos Highway and Kennon Road experiences the worst level of service during peak hour which is LOS F with a

volume-capacity ratio of 1.21. It implies that the amount of traffic approaching a point exceeds the amount that can traverse the points. The operation within the queue is characterized by stop-go-waves and is extremely unstable. It is the point at which arrival flow causes the queue to form.

5.2 Boarding and Alighting Surveys

The purpose of the onboard survey is to determine the travel time, number of boarding and alighting passengers, load factor of jeepney by trunkline for two different periods of hours of a weekday; morning (6:00 to 9:00 a.m.) and afternoon (4:00 to 6:00 p.m).

5.2.1 Jeepney Load Factor

Passenger load factor is an important parameter for the assessment of any transport system. Load factors measures the capacity utilization of public transport services like jeepneys determining the ratio of passenger-kilometres travelled to seat – kilometres available.

Green trunkline obtained the highest load factor of 0.92 or 92%. It indicates that the seating capacity of the green trunkline jeepneys are maximized or even exceeds the maximum capacity. Camp 7, Santo Tomas and Tuba jeepney lines were found have load factors of 1.10 and 1.06 where jeepneys tend to overload passengers as shown in Figure 9. The scenario applies in areas where the average trips per day ranges from 3 – 4 trips per day with less number of jeepneys are in operation and areas that are underserved.

Figure 9. Overloading of jeepneys and inadequacy of jeepneys during peak hours.
Data Source: www.google.com, Photo captured by Cassandra (2016)

Furthermore, the average load factors of all other trunklines were 0.78, 0.77 and 0.83 for red, blue and yellow trunklines respectively. All load factors were consistently higher than the comparable load factors in Metro Manila which is equivalent to 0.44 to 0.73.

Load factors of jeepneys indicate that they do not vary much by area nor by trunkline but by average trips per day. This relates the current fare structure that the fare per trip is the same within the first four (4) kilometres. It is considered that there is a tendency that jeepney units are distributed in such a way that the income per vehicle would be fairly equal.

Although jeepneys usually operate along the fixed routes, they sometimes alter their routes as to avoid traffic congestions. Inter municipality public utility jeepneys (PUJs) are prohibited from picking up passengers along existing Baguio City PUJ routes as implemented by the Ordinance Numbered 08, Series of 2017. However, the tenets of the resolution regulating the PUJs route are ignored.

Table 4. Computation of Jeepney average load factor and average speed

Trunkline	Jeepney Line	Average Seating Capacity	Av No. of Passengers on board	Average Load Factor	Average Trips per day	Average Distance (in km)	Average Travel Time	Average Speed
RED TRUNKLINE	Bag Country	21.50	18.75	0.87	6.25	6.567	0.529	12.414
	Beckel	21.00	15.00	0.71	2.25	5.802	0.508	11.421
	Lucnab	21.75	17.50	0.80	7.50	6.090	0.438	13.904
	Maria Basa	20.50	17.75	0.87	6.50	3.949	0.363	10.894
	Mines View	20.00	17.25	0.86	8.00	5.772	0.450	12.827
	Navy Base	20.00	15.50	0.78	10.00	2.930	0.383	7.650
	Pacdal Liteng	21.50	13.25	0.62	9.75	4.694	0.679	6.913
	Ucab	21.00	15.50	0.74	2.75	10.500	0.742	14.151
	Average (Red)	**20.91**	**16.31**	**0.78**	**6.63**	**5.79**	**0.51**	**11.27**
GREEN TRUNKLINE	Bakakeng	22.00	18.00	0.82	6.00	3.620	0.292	12.397
	Balacbac	20.50	20.50	1.00	6.50	4.820	0.442	10.905
	Camp 7	21.00	23.00	1.10	3.00	3.340	0.458	7.293
	Campo Sioco	21.50	17.00	0.79	12.00	1.650	0.163	10.123
	Crystal Cave	22.50	22.50	1.00	6.50	3.210	0.463	6.933
	Dontogsn	22.00	20.75	0.94	6.25	4.820	0.429	11.235
	Loakan	23.00	22.75	0.99	8.25	3.190	0.592	5.389
	Military Cut-off	16.50	16.25	0.98	8.50	1.650	0.375	4.400
	PMA Kias	24.00	17.00	0.71	6.00	9.170	0.521	17.601
	Santo Tomas	17.00	18.00	1.06	3.00	4.490	0.367	12.234
	Scout Barrio	17.25	10.00	0.58	11.00	2.900	0.346	8.382
	SLU SVP	22.00	20.25	0.92	5.67	4.770	0.533	8.949
	Tuba	25.00	26.50	1.06	3.50	4.490	0.575	7.809
	Average	**21.10**	**19.42**	**0.92**	**6.63**	**4.01**	**0.43**	**9.51**
BLUE TRUNKLINE	Aurora Hill	17.75	13.25	0.75	14.75	3.554	0.358	9.927
	Brookside	19.00	16.00	0.84	8.00	3.787	0.367	10.319
	Honeymoon	20.50	12.50	0.61	6.33	3.317	0.279	11.887
	La Trinidad (B)	21.00	20.00	0.95	7.00	5.310	0.667	7.961
	La Trinidad (M)	21.40	18.20	0.85	6.00	4.750	0.243	19.547
	Leonila Hill	20.50	13.25	0.65	11.25	3.094	0.429	7.211
	Pinget	23.67	19.00	0.80	7.00	3.173	0.375	8.461
	Quirino Hill	21.50	19.50	0.91	9.50	2.290	0.350	6.543
	Trancoville	20.50	11.00	0.54	9.00	3.217	1.083	2.970
	Average (Blue)	**20.65**	**15.86**	**0.77**	**8.76**	**3.61**	**0.46**	**9.43**
YELLOW TRUNKLINE	City Camp	20.50	18.75	0.91	7.50	1.980	0.375	5.280
	Fairview	23.00	18.00	0.78	7.75	1.850	0.429	4.312
	Guisad	22.00	20.25	0.92	8.50	1.950	0.354	5.508
	Irisan	21.00	16.75	0.80	10.00	7.140	0.471	15.159
	KM 6 Asin	22.00	22.00	1.00	6.00	3.840	0.167	22.994
	Lourdes	21.00	11.75	0.56	9.25	2.010	0.150	13.400
	Pinsao Proper	22.00	21.25	0.97	5.00	3.120	0.363	8.595
	Quezon Hill	20.00	18.50	0.93	8.25	3.890	0.404	9.629
	San Carlos	20.00	17.75	0.89	7.50	7.140	0.438	16.301
	San Luis	21.00	12.00	0.57	9.00	3.830	0.654	5.856
	Average	**21.25**	**17.70**	**0.83**	**7.88**	**3.68**	**0.38**	**10.70**
	Average	20.97	17.32	0.82	7.47	4.27	0.45	10.228

Data Source: Boarding and Alighting Survey Conducted by the researcher, 2017

5.2.2 Jeepney Average Trips

The average trips per day obtained from the survey is equal to 7.47. One trip is from an origin terminal to the destination and back. Aurora Hill jeepney line has the highest number of

trips per day equal to 14.75 trips where routes are within the Central Business District running express. On the other hand, Beckel obtained the lowest number of trips per day with a value of 2.25.

Camp 7, Santo Tomas and Tuba jeepney line have values of 3.00 and 3.50 trips, respectively. The obtained values show some constraint of having 3 – 4 roundtrips per day that can be a result of passengers needing to fall in line in the respective terminals especially during peak hours in the morning and afternoon.

5.2.3 Jeepney Average Speed

Jeepney routes are relatively short. The average route length is around 4.27 kilometers. The minimum fare, Php8.50 corresponds to the first 4 kilometers travelled in the City of Baguio. The computed average speed for the 41 jeepney lines surveyed is 10.228 kilometers per hour. Though, the computed values for jeepneys plying within the central business district and congested areas travel at 9 kph and less while jeepneys traveling outside the CBD have an average speed of 10 kph and more. The farthest jeepney line, Nangalisan, Asin Road has an average speed of 23 kph. The average travel speed of jeepney is fairly higher than the jeepneys travelling in Metro Manila which is equal to 8 kph or less. This closely relates to the similarity in operational attitudes when loading and unloading of passengers and jeepneys tend to stop anywhere to serve passengers.

5.2.4 Commuters Trip Characteristics

The statistical data of commuters based from the origin – destination survey are presented in Figures 10 and 11. Out of 600 people surveyed, 568 responded on the survey questions with respect to trip purpose, household income, car ownership, transport mode use and their ultimate origins and destinations.

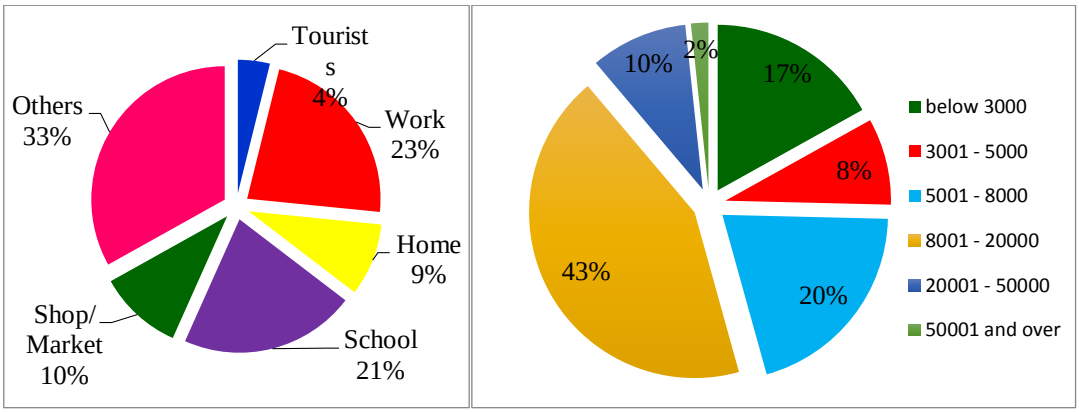


Figure 10. Commuter Trip Purpose and Household Income
Data Source: Origin-Destination Survey Conducted by the researcher, 2016-2017

From the data gathered from the origin – destination survey, Fig. 8 shows that 33% of the total respondents use jeepney as a mode of transport for other purposes like business or for personal use. Also, 21% of the respondents use jeepney in going to school, 23% in going to work, 10% in going to the market and 9% in going home. Moreover, 43% of the respondents belong to the average family income of Php 8,000.00 to Php 20,000.00. Higher bracket income tends to have the lowest percentage of 2% which has a value above Php 50,000.00.

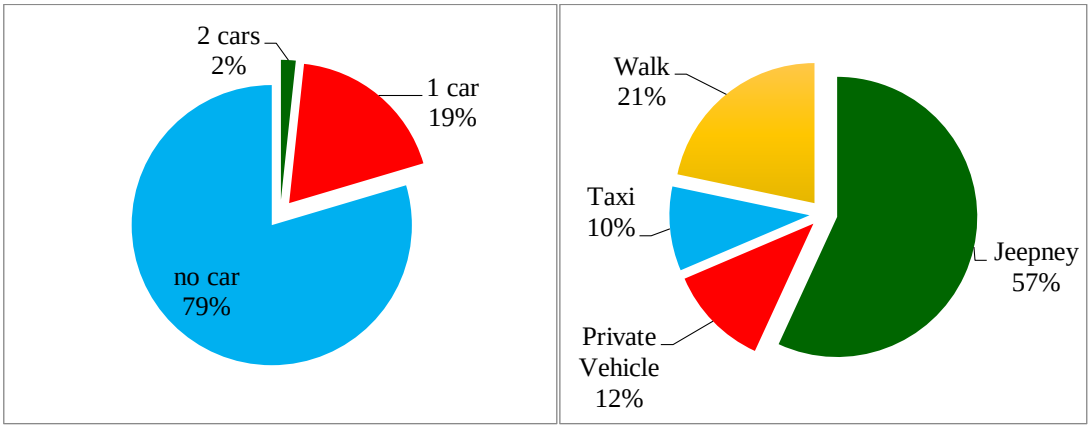


Figure 11. Car Ownership and Transport Mode Use
Data Source: Origin-Destination Survey Conducted by the researcher, 2016-2017

Furthermore, Figure 11 indicates that 57% of the respondents prefer to use jeepney as mode of transport, 21% of the respondents choose to walk specifically for short distances and 12% prefer to use a private vehicle for their trips. It implies that commuters prefer jeepney over taxis since it is the cheapest mode of transportation.

5.2.5 Boarding and Alighting Survey Results using EMME/4

Figures 11 and 12 present sample boarding and alighting survey data using EMME/4 software. Data were calibrated based from the volume count results gathered from the study.

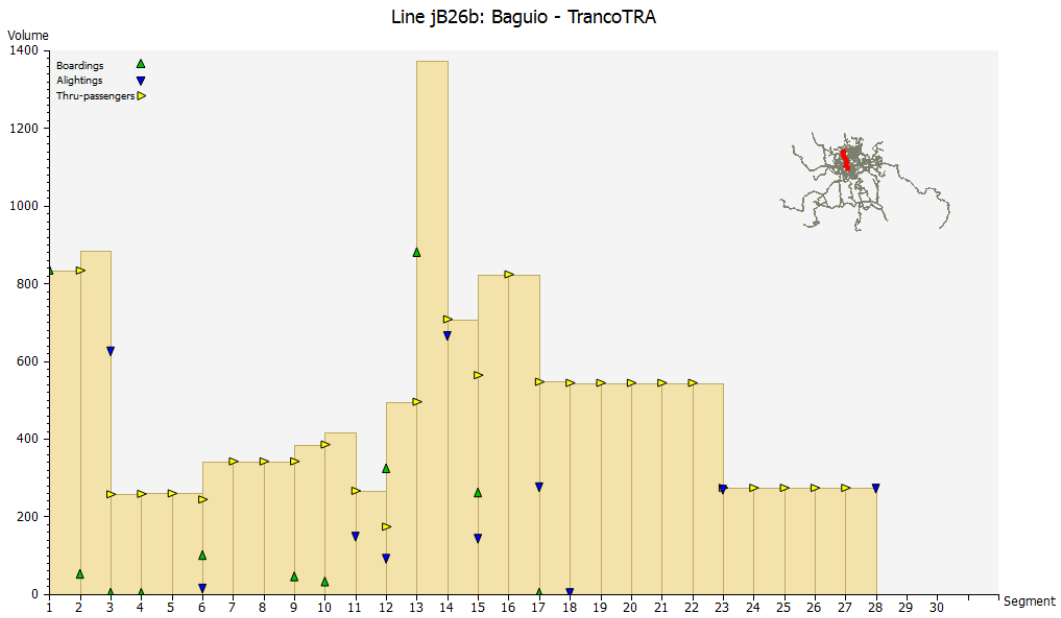


Figure 12. Sample Boarding and Alighting Survey Results (Baguio – Trancoville)
Data Source: Origin-Destination Survey using EMME/4, 2017

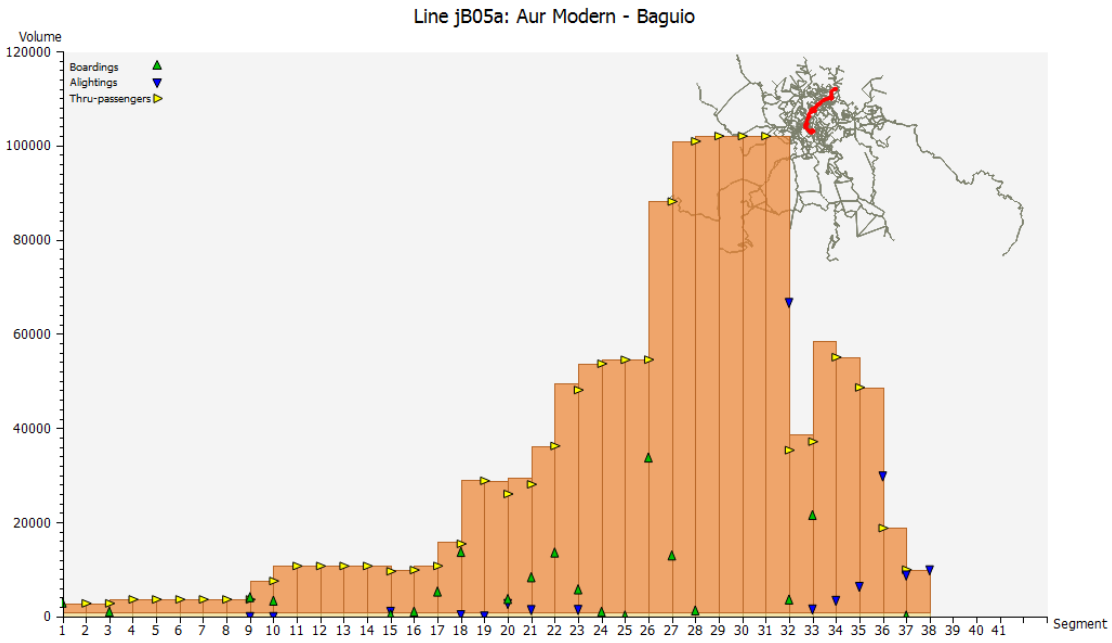


Figure 13. Sample Boarding and Alighting (Aurora Hill – Baguio CBD)
Data Source: Origin-Destination Survey using EMME/4, 2017

5.2.6 Passenger Origin-Destination Survey

The frequency of trips from one zone to another is illustrated in Figures 14 and 15. The Origin – Destination Matrix was generated based on commuters' original origins and final destinations. The number of trips from one zone to another was then placed in the Origin – Destination Matrix shown in Figure 14.

The top 5 barangays with the highest number of origins were: (1) Session Road Area, (2) Barangay Pacdal, (3) Gibraltar, (4) La Trinidad Entry-Exit Areas and (5) Ambuklao Road Entry-Exit Areas. On the other hand, the top 5 destinations were: (1) Session Road Area, (2) Andres Bonifacio, (3) Abanao-Zandueta-Kayang-Chugum-Otek (AZKCO), (4) Harrison-Claudio Carantes and (5) Barangay Pacdal. The identified OD can be helpful in transportation planning which may include design purposes and route modification.

BARANGAY	DESTINATION	A. Bonifacio-Caguioa-Riman	Abanao-Zandueta-Kayang-C	Alfonso Tabora	Ambiong	Andres Bonifacio (Lower R	Apugan-Loakan	Asin Road	Atok Trail	Aurora Hill Proper (Malvar-	Aurora Hill, North Central	Aurora Hill, South Central	Bagong Lipunan (Market-A	Bakakeng Central	Bakakeng North	Bal-Marcoville (Marcoville)	Balsigan	Bayan Park East
ORIGIN		1096	1110	1100	1069	1155	1137	1064	1134	1074	1075	1094	1167	699	704	1145	1162	1070
A. Bonifacio-Caguioa-Rimando (ABCR)	1096	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0
Abanao-Zandueta-Kayang-Chugum-Ote	1110	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0
Alfonso Tabora	1100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ambiong	1069	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Andres Bonifacio (Lower Bokawkan)	1155	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0
Apugan-Loakan	1137	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Asin Road	1064	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Atok Trail	1134	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aurora Hill Proper (Malvar-Sgt. Floresca)	1074	0	1	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0
Aurora Hill, North Central	1075	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Aurora Hill, South Central	1094	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bagong Lipunan (Market Area)	1167	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bakakeng Central	699	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Bakakeng North	704	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0
Bal-Marcoville (Marcoville)	1145	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Balsigan	1162	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bayan Park East	1070	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Bayan Park Village	1071	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bayan Park West (Bayan Park)	1068	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
BGH Compound	1163	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Figure 14. Origin – Destination Matrix of Commuters using Jeepneys
Data Source: Origin-Destination Survey Conducted by the researcher, 2016-2017

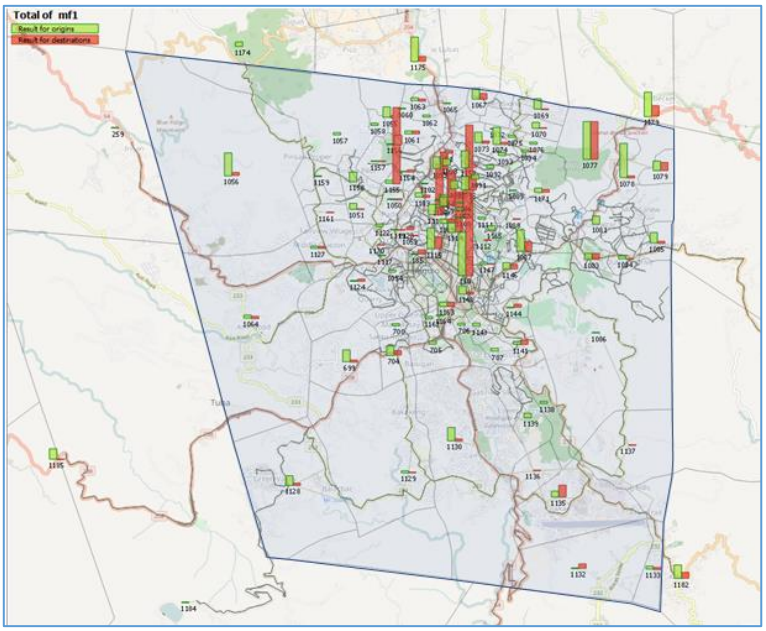


Figure 15. Results of Zone Values Aggregation (Origins and Destinations)
Data Source: EMME Software Analysis, Origin-Destination Survey Conducted by the researcher, 2016-2017

Figure 15 provides the graphic estimate of trips produced and trips attracted to the 138 zones the city was divided according to the total number of barangays in Baguio City and the number of entrances and exits in the City.

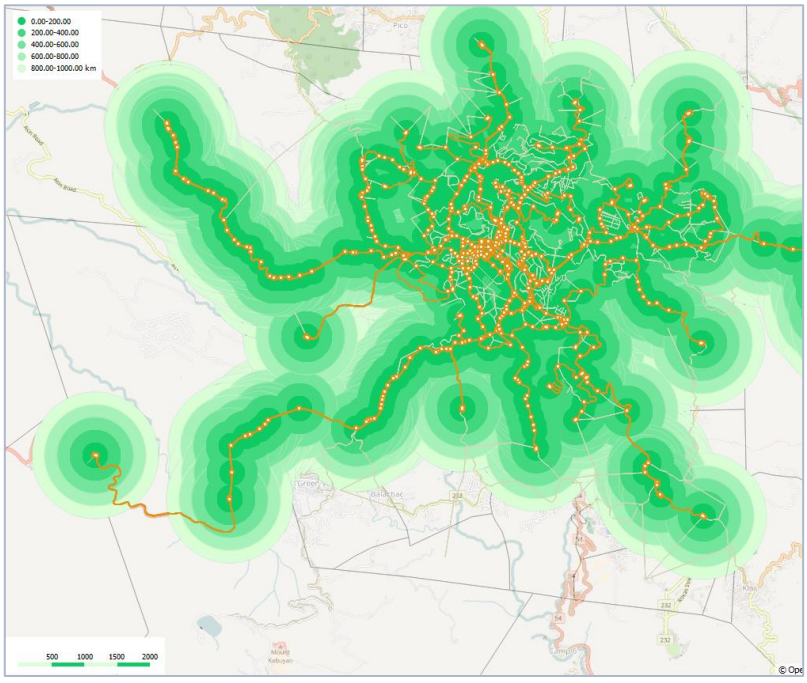


Figure 16. Transit Stop Catchment Area

A buffer operation was produced using transit routes covered by jeepneys with a distance of 200 meters. Buffer operations are performed on data tables with a geometry column. Buffer operations are often useful to visualize catchment area as shown in Figure 16. The transit catchment areas are now visible on the figure shown. The areas covered by the

buffer zone indicate the affected area served by transit lines otherwise areas that were not covered by the buffer zone means there inaccessibility in those areas.

6. CONCLUSIONS

On the basis of the results of the analysis and findings made, the following can be concluded; the urban public transport system in Baguio City provides relatively high level of services at a good affordability to the majority of people. The rationalization of the color – coded trunkline determined the exact number of running vehicles on the road to complement the carrying capacity of the city's roads; but this has not solved the problems on traffic and transportation in the City.

Moreover, limited road space has been saturated by the increasing number of vehicles wherein jeepneys contribute considerably to the traffic congestions on many sections of the roads. Along some major roads, jeepneys share 23% of the total volume of vehicles in the central business district and can travel at a speed of 9 kph. Congestions at many terminal areas are so serious that they affect the capacity of the road extensively.

The reduction of units brought about by the inoperative of some jeepney and removal of some units in the respective associations as disciplinary actions to the drivers contributes to undersupply of some jeepney lines.

In order to maintain the advantage of the jeepneys, it is time to consider the level of supply and role of jeepneys in the total urban transport system with a limited road capacity and to identify a way to introduce proper regulation to jeepney vehicles and its operation in the problem areas. The study suggests the following: (1) to re-evaluate the existing color – coded trunkline with respect to the number of units allocated, staging allocation and loading allocations; (2) to extend the road network into the city's undeveloped barangays and improve other access for re-routing of the current traffic scheme; (3) to increase the seating capacity of jeepneys using high capacity jeepneys to increase the number of trips per day especially or underserved areas meeting the passenger demand.

Addressing the demands for modern transport infrastructures of central terminals for public utility vehicle is a challenge in the City of Baguio considering its mountainous terrain and limited space. The development of a Central Public Utility Complex is taken into consideration by the City. The project is intended to provide a common terminal for south and north bound buses outside the Central Business District, which includes the provision of a restaurant and lodging facilities and parks. There are two sites being considered for this project; (1) the GSIS property located at Marcoville Barangay (at the back of SM) and other possible sites: (2) Area at the Bureau of Animal Industry (BAI) located at Dontogan Barangay near Marcos Highway.

Public transit service like jeepneys is an important general public good of transit – dependent populations. The creation of an independent and highly technical body (Traffic and Transportation Office / Authority like MMDA) focused on traffic and transportation planning and management is envisioned by the City Government of Baguio which is self – liquidating in due time where the strategy on three E's: Engineering, Education and Enforcement will be adopted.

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