SUPPLY AND DEMAND CARRYING CAPACITY IN DEVELOPING PARK AND RIDE SCHEME IN EAST CORRIDOR OF BANDUNG CITY (CILEUNYI DISTRICT AND ITS SURROUNDING)

Miming Miharja
Professor
Department of Urban and Regional Planning, School of Architecture, Planning and Development Policy (SAPPK)
Institut Teknologi Bandung
Jln. Ganesha 10,Bandung
mimiharja@yahoo.com;

Handini Pradhitasari
Assistant
Regional and Urban Infrastructure System research Group,
Institut Teknologi Bandung
Jln. Ganesha 10,Bandung
085724824292
Handini.p@gmail.com

Marselly Dwiputri
Assistant
Regional and Urban Infrastructure System research Group, Institut Teknologi Bandung
Jln. Ganesha 10,Bandung
marselly_dwiputri@yahoo.com

Abstract

Bandung strategic position causes an interdependences of its surrounding the cities, including Cileunyi District which triggers suburbanization and comuting activity. Vast movement from the commuters needs to be comprised without enlarging supply by transportation demand management (TDM) scheme. TDM concept proposed in this study is a park and ride scheme using the shuttle bus modes. In this paper, we examine both demand and supply carrying capacity through a descriptive exploratory method. Carrying capacity identified by the willingness of potential users to pay for the facilities. The willingness of users to pay parking fees is about Rp. 5,001 - 10.000, while the willingness to pay the bus fare is in the range of Rp. 3,000 to 5,000 . Carrying capacity from the supply side is the availability of parking, terminal, and sufficient road network to carried four route of shuttle bus.

***Keywords**: parking lot, route, shuttle bus, tariff, willingness to pay (WTP)*

Abstrak

Posisi Kota Bandung yang strategis menyebabkan tingginya ketergantungan wilayah di sekitarnya terhadap kota ini, termasuk Kecamatan Cileunyi yang memicu suburbanisasi dan aktivitas komuting. Pergerakan komuter yang sangat tinggi perlu diwadahi melalui suatu skema pengelolaan permintaan transportasi (TDM) Konsep TDM yang diusulkan dalam studi ini adalah skema park and ride menggunakan moda shuttle bus.. Metode analisis yang digunakan dalam analisis ini adalah deskriptif eksploratif untuk mengidentifikasi daya dukung supply dan demand. Daya dukung dari sisi demand diidentifikasikan dengan kesediaan calon pengguna untuk membayar fasilitas pendukungnya. Kesediaan membayar pengguna baik untuk tarif parkir adalah sekitar Rp. 5.001-Rp.10.000, sedangkan kesediaan membayar bus adalah pada rentang tarif Rp. 3.000-Rp.5.000. Daya dukung dari sisi supply adalah ketersediaan lahan parkir, terminal juga jaringan jalan yang akan dilalui oleh empat rute moda bus.

Kata Kunci: lahan parkir, moda bus, rute, tarif, willingness to pay (WTP)

INTRODUCTION

The rapid population growth impacts significantly to demand for housing and spaces for work and school. On the other side, supply for land is getting limited with a high prices which eventually rises the suburbanization phenomenon. According to Ptacek and Szczyrba (2007), suburbanization is a spatial overflow outside the city limits to open a new land for various activities. Suburbanization has two forms, commercial and residential within a regular form (smart growth) or irregular (urban sprawl). Phenomenon that occurs due to the spillover effects of Bandung to the surrounding area will create new problems when it is unplanned (sprawl). The rapid settlement construction without supporting infrastructure in suburbs implies to comuting activity.

Bandung City as the core of Bandung Metropolitan Area (BMA) is expected to have a highly internal flow which is triggered from suburbs surround Bandung, such as Bandung Regency, Cimahi City, and West Bandung Regency. One of the area that is projected to have such an impact to Bandung City is Cileunyi District. The district located at the eastern side of Bandung City and connected with education area such as universities and other higher education facilities in Jatinangor, Sumedang Regency. Cileunyi also has a significant impact to regional transport since there is a toll road access that shortens distance and eases acces to some parts of Bandung City, as well as other regencies.

The number of commuter from Cileunyi District is expected to keep increasing. Hence, it arises a necessity for a mass rapid transit system to serve BMA. Park and ride scheme with shuttle buses as a mode of public transportation Cileunyi-Bandung proposed in this study can be used to support the plan and are expected to reduce the negative impact caused by the traffic problem. To determine the extent to which the park and ride is doable, this study will identify carrying capacity from supply and demand perspectives.

From the demand perspective, the support for park and ride scheme would covered the potential users' willingness to use the proposed park and ride scheme, which is emphasized into their route trip, willingness to pay and order of priority for each facilities. The input from demand side will be matched with supply side, covering the availability of land for parking lot, road network and bus routes.

In general, this study is examined doability of park and ride on the eastern corridor of Bandung City as a periurban and home of commuters. The identified carrying capacity would direct to an initial findings to conduct park and ride scheme, such as supporting system, obstacles, and impediments. Furthermore, this study will lead to policies, incentives and disincentives to support park and ride as an alternative solution in reducing traffic volume in Bandung City.

LITERATURE REVIEW

Transport Demand Management (TDM) is an application to the extent of strategies which oriented to reduce or modify demand for transport system. TDM intends not to solve the problem comprehensively. It focuses on shifting demand rather than increasing the supply, to enhance the efficiency of transport system. TDM strategies have various types, it is intended to modify behavior of road user by reducing number of trip, changing time to trip or accommodating a less trip. TDM assists in forming a balanced transport system by lowering dependencies to private cars. According to Meyer (1999), TDM is a set of action aimed to affecting travel behavior by using alternatives of mobility and decreasing the traffic. TDM is also defined as a paying used to described various action to reduce or modify demand to service and transport facilities (Gifford dan Stalebrink, 2001). One of the emerging concept of TDM is park and ride scheme. It is useful to pursuing public transit utilization and reducing traffic load in the downtown.

One of the various strategies to make people's movement being more efficient is public transport utilization (Putranto, 2008). It is regarded as a traffic management scheme to control inefficient traffic (Larasati, 2012). Hence, it should be triggered by several efforts, one of them is park and ride scheme. Park and ride is a TDM concept by attracting demand of private car to shift into mass public transit and providing a parking incentive. According to its terminology, park and ride would be a benefit for commuters who work in the downtown and live in the suburbs, because they don't have to look for parking lot and

facing traffic jam in the city center. In addition, park and ride will increase the ridership of public transit .

Parking lot facility connects to public transit must be feasible to be reached and safety, so that people could leave their vehicles and continuing their trip by provided public transit (such as bus, train) or carpool. Underlying concept of carpooling is to store the vehicles by the time people started their activities and taken aback after finishing their activities. Park and ride usually located on the edge of the city or in transportation nodes, such as terminal and station. In terms of park and ride scheme, parking lot is an important element since it is a transshipment point before people shift to other modes. Thus, parking lot's level of service has to be prioritized so that parking lot will be suitable. Level of service for parking lot divided into five categories, amenity, security, affordability (price), accessibility, and availability of space. Besides parking lot, other main component of park and ride is shuttle bus. Similar to parking lot, there are several categories to determining the bus' service priority; amenities, security, price, safety, and reliability. The order of priority was obtained from the previous study of Larasati in 2012. Based on this study, it is conclude that order of priority must be fulfilled as a basic requirement to design park and ride facilities. Furthermore, a sufficient and reliable facility will encourage people to shift from private car to public transit.

METHODOLOGY

Data collection is carried out in two stages; primary survey and secondary survey. Primary survey is conducted by field observation, traffic counting and spreading questionnaires. Field observation is conducted in arterial or connecting roads between Bandung and Cileunyi, including toll road access of Cileunyi – Bandung (Pasteur, Buah Batu, Pasir Koja, Moch Toha dan Kopo). Traffic counting is conducted during road observation for two hours, by assuming that the peak hour is held at 06.30 – 08.30. Second assumption is considering similarity of commuters' pattern, so we could obtain number of private cars from Cileunyi to Bandung. By traffic counting, it is recorded that there were 5008 cars. It is assumed that by 85% of which are commuters, so there were 4257 vehicles moved to Bandung.

Number of vehicles to Bandung is converted by the occupancy rate of private car as of 1.5 pcu so that estimated number of people moving to Bandung is 6385 person. This number will be a basis to figure the sampe of questionnaire to the commuters in Bandung – Cileunyi corridor. A minimum sampling is set at 90% degree of confidence. Using the formula of Slovin, thus the obtained sampling number is 98 questionnaires.

$$n = \frac{N}{N\,\alpha^2+1} \tag{1}$$

n = number of sample
N = number of population
α = significant, 10%

Purposive sampling technique, which is determined based on certain criteria (Sangadji & Sopiah, 2010) was used in distributing questionnaires. The object of the questionnaire is people who travels from Cileunyi to Bandung on weekdays using private cars. Questionnaire that distributed to the respondents contained several questions in order to identify social and economy characteristics, trip destination and purpose, priority of

parking and bus facilities and their willingness to pay. Questions that being asked are covering the issues of monthly income, transportation expenses, vehicle ownerships, trip purpose (school, work, social), trip routes, willingness to use the facilities, willingness to pay for the tariff and priorities for each facilities.

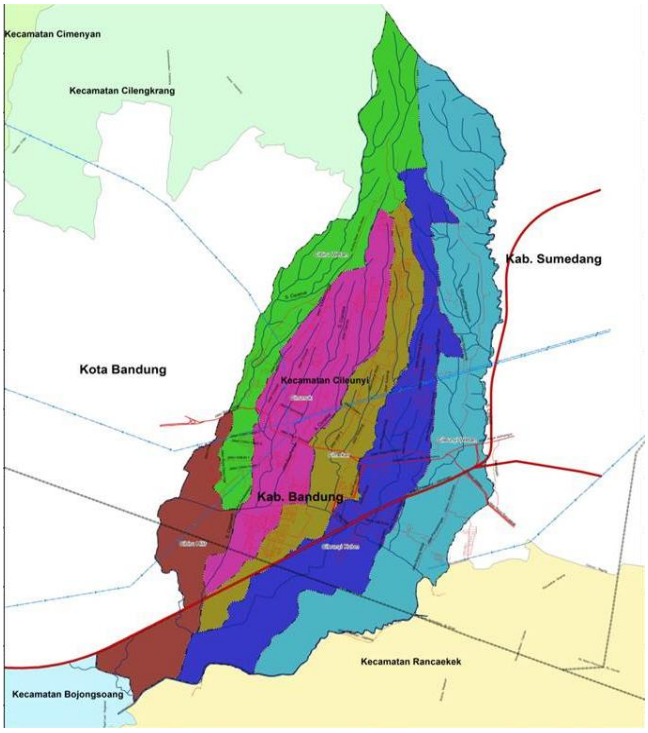
The conditional questions were asked regarding to explain the concept of park and ride, in terms of wether they are willing to park their car and pay for the parking rent, then how much is the suitable tariff. The other question is whether they are willing to utilize bus to continue their trip, and what are criteria that should be fulfilled to provide parking lot and shuttle bus. To get use into park and ride concept, respondents were also triggered by several introduction questions deal with home based movement (route and destination) to Bandung City.

Analysis of potential support, constraint, benefit and disadvantage of park and ride development in commuter corridor of Cileunyi – Bandung is utilizing a descriptive explorative method based on questionnaires' tabulation. This method tries to describe and interprete objects naturally (Creswell, 2004 in Larassati, 2012). The description is intended to answering a research question in form of identification socio-economic characteristics of the trip maker and potential user, while explorative method is a tool that is trying to fing causalities from an event (Dane, 2000 in Sangadji & Sopiah, 2010). Statistical tools used to explain the survey tabulation data are: tables, distribution frequencies and pie charts.

To strengthen the analysis result, this research also used the ex-ante evaluation. Ex – ante evaluation is an evaluation covering the premises value and prospective features which conducted before the actions occurred (Dunn, 2000). This evaluation referes to three effectivity criteria, namely effectivity, responsiveness and adequacy, but in this paper, the evaluation will only cover the responsiveness term. The responsiveness term concerns on how far the proposed scheme could satisfy demand or user preferences, which measured by respondents' willingness indicator in using park and ride scheme.

AREA OF STUDY

Cileunyi is a part of Bandung Regency which located strategically by the national toll road of Purbaleunyi (Purwakarta-Bandung-Cileunyi). Besides, Cileunyi is an important connector between national center of activity (PKN) in Bandung and center of education area in Jatinangor (Sumedang Regency). Cileunyi has an area of 31,47 km^2 and consists of five villages: Desa Hilir, Desa Cibiru Wetan, Desa Cileunyi Kulon, Desa Cileunyi Wetan, Desa Cimekar, dan Desa Cinunuk.



Administratton Map of Cileunyi District

Source: RDTR Cileunyi 2011

Cileunyi adjacents to Sumedang Regency in the north and east side, Rencaekek District of Bandung Regency on the south side and adjacents to Bandung City on the east side. By a regional perspective, Cileunyi is a buffer area of Bandung City which carried the needs of commuters in term of supply for housing. Looking at perspective of traffic and transportation, Cileunyi is an assembly point of vehicles from north (Tasikmalaya and Garut), and from the east (Sumedang-Cirebon).

ANALYSIS

Demand Analysis

There were several results regarding to the demand and supply carrying capacity in using park and ride scheme. It is revealed that most of commuters are disposed to use park and ride facilities. There were 77% respondents who agreed to use parking lot and 82% of total 98 respondents agreed to use shuttle bus. Generally, there were more people who demands shuttle bus than use parking lot. The next step is to determine specification or criteria of parking lot and shuttle bus services; aspect of priorities, including expected charge and fare to meet their willingness and ability. Level of public transport services should be made as much as possible to match level of private vehicles, so that public transport could be effectively used by the public. From the survey and data processing, it is revealed that security is the most important aspect in parking lot provision, while safety is the main aspect for shuttle bus (transport mode).

Table 1 Order of Parking Service Priorities

Priority	Parking Lot Order of Priority				
	Amenity	Security	Price	Access	Parking Lot Availability
1	32.47%	35.06%	7.79%	15.58%	9.09%
2	25.97%	32.47%	6.49%	18.18%	16.88%
3	19.48%	20.78%	29.87%	16.88%	12.99%
4	10.39%	6.49%	23.38%	44.16%	15.58%
5	11.69%	5.19%	32.47%	5.19%	45.45%

Source: survey tabulation, 2013

Safety is the main priority for parking lot facility, as being the first and second in order. This should be handled by a sufficient security system by using CCTV's or security person. The other aspect to be considered is affordability or price. A parking charge should be affordable for people who will store their vehicle, since they have to spare more for bus riding. Accessibility being the fourth priority, means that parking lot should be easy to reached by modes from all direction. Last priority is availability of parking lot. Hence, there has to be a sufficient space and accessible to store all vehicles.

Price or tariff is one of the most important factors that affect people's willingness to use a facility, the less the price, the more people willing to use. In this study, values of tariff (willingness to pay – WTP) is obtained by using a tariff benchmark from several office or commercial buildings. The range of WTP was adjusted to their transport expenses. To encourage users, the price should be less than a usual parking lot, considering they have to connect their trip by using bus, which implies another expenses for daily transport. Nevertheless, questionnaire tabulation shows that the price is not the first priority, but the third priority after security and amenity. The result implies that price is not the biggest constraint to use park and ride, because they believe that the price will be comparable with the service provided.

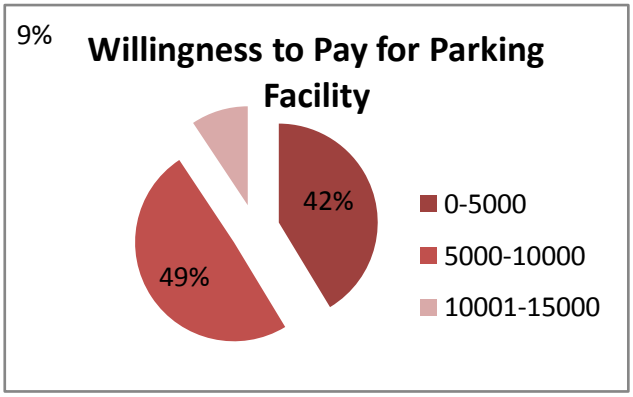


Figure 1 Willingness to Pay for Parking Facility

Source : survey tabulation, 2013

From the figure 1, it's inferred that the user charge has to be proportional. In other words, the price to pay for the facility should not exceed cost of using private car. The survey resulted in 49% of respondents are will to pay Rp. 5,000 – Rp.10,000, followed by less

than 5,000 and least respondents will to pay more than Rp. 10,000. Thus, the proposed charged for the parking facility is between 5,000 – 10,000 considering the safety and practicability when storing their vehicles.

Tabel 2 Order of Shuttle Bus Service Priorities

Priority	Order of Shuttle Bus Service Priorities				
	Amenity	Security	Price	Safety	Reliability
1	58.54%	9.76%	7.32%	13.41%	10.98%
2	21.95%	42.68%	12.20%	10.98%	12.20%
3	12.20%	23.17%	26.83%	23.17%	14.63%
4	3.66%	15.85%	14.63%	45.12%	20.73%
5	3.66%	8.54%	39.02%	7.32%	41.46%

Source: survey tabulation, 2013

First priority in shuttle bus service is amenity or comfortability. The terms of comfortability in public transport is not has to be precise with private car, but it can be created as comfort as possible so that people will be able to move from private car to public transit. The second priority is security, followed by affordability (price), safety and reliability. The price is not being emphasized by respondents, since they will pay as much as they able as long as the service quality meets their expectation, but this hypothesis is not fully suitable with survey result.

Respondents in Cileunyi District suggested a less shuttle bus tariff than the parking lot. In fact, they recommend the least out of three proposed tariff. Most of respondent (68%) chose tariff betweenRp. 3,000 – 5,000, followed by Rp. 5,000 – 10,000 by 29% and only 3% of respondent will to pay more than Rp. 10,000 – 15,000.

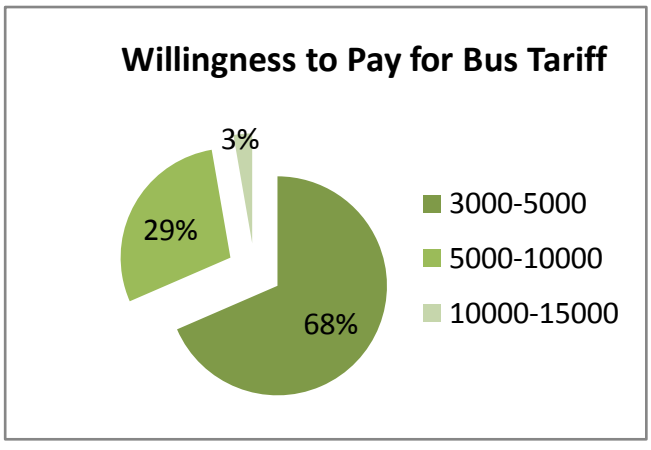


Figure 2 Willingness to Pay for Shuttle Bus

Source : primary survey, 2013

The suggested tariff is affordable for user but could not cover the operational cost. Hence, government should interfere with subsidy to ensuring a service quality and affordable price at the same time. This is an ordinary scheme in big cities, such as Jakarta. Mass transport

such as Trans Jakarta is supported with set of institution to manage operation while financial scheme is guaranteed by Provincial Government.

Supply Analysis

Supply side analysis is very important regarding to the operational phase and sustainability of park and ride scheme. It comprises the use of facilities such as terminal/parking lot and bus route. Terminal or parking lot will be utilized to store the vehicles by then users will continue their trip by shuttle bus to their destination in Bandung City. There were several proposed terminal location, as well as bus routes.

1. Terminal and Parking Lot

Terminal placement is very important while considering aspects such as security and land availability. A proposed terminal has been pointed, namely Cileunyi Terminal. Cileunyi Terminal is a "B" type terminal adjacent to the Cileunyi market which serves intercities public modes. It is very spacious and accessible. Combine with availability land on the Cileunyi market, there will be a lot of parking space and suitable for proposed park and ride scheme.

Figure 4 Cileunyi Terminal

Source: observation, 2013

Figure 5 Cileunyi Market

Source: observation, 2013

2. Bus Route Alternative

Besides terminal and parking lot, other aspect that determines people's willingness to use public transit is bus route. People are tend to use public transit but hampered with the availability route that suits their destinations. Thus, determining route must be conducted integratedly with passengers' need, road network condition and sufficiency. In this study, route selection was held to proposed bus network plan by considering road's condition and suitability in terms of width and functions.

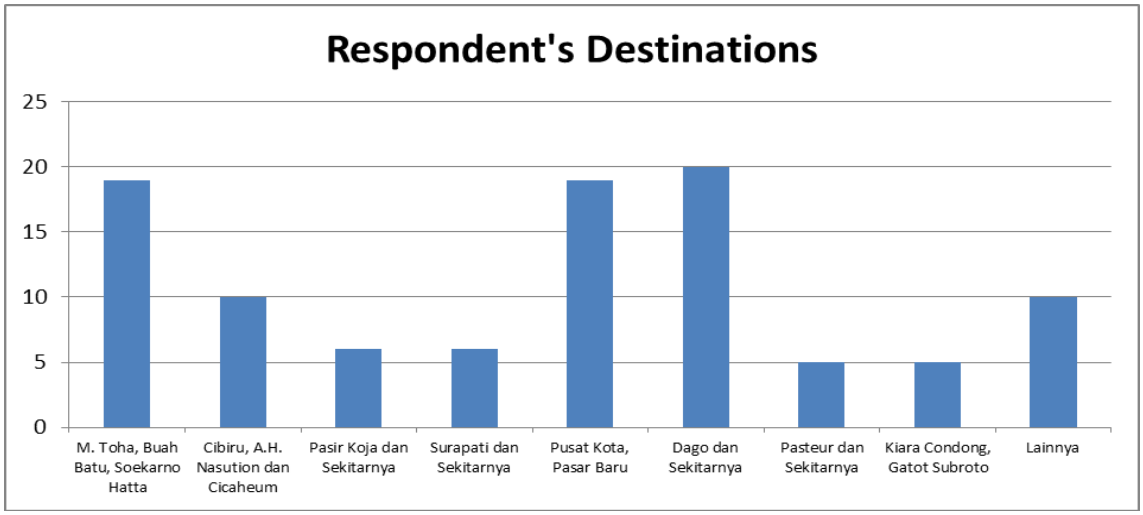


Figure 6 Respondent's Destinations from Cileunyi to Bandung City

Source: primary survey, 2013

There were three main destinations in Bandung City; Dago and its surrounding, Downtown (Alun – Alun, Pasar Baru) and Buah Batu – Soekarno – Hatta. Besides, there were also some strategical points for economic activities such as Cicaheum (terminal), Pasteur, Kiara Condong (market, station) and Surapati.

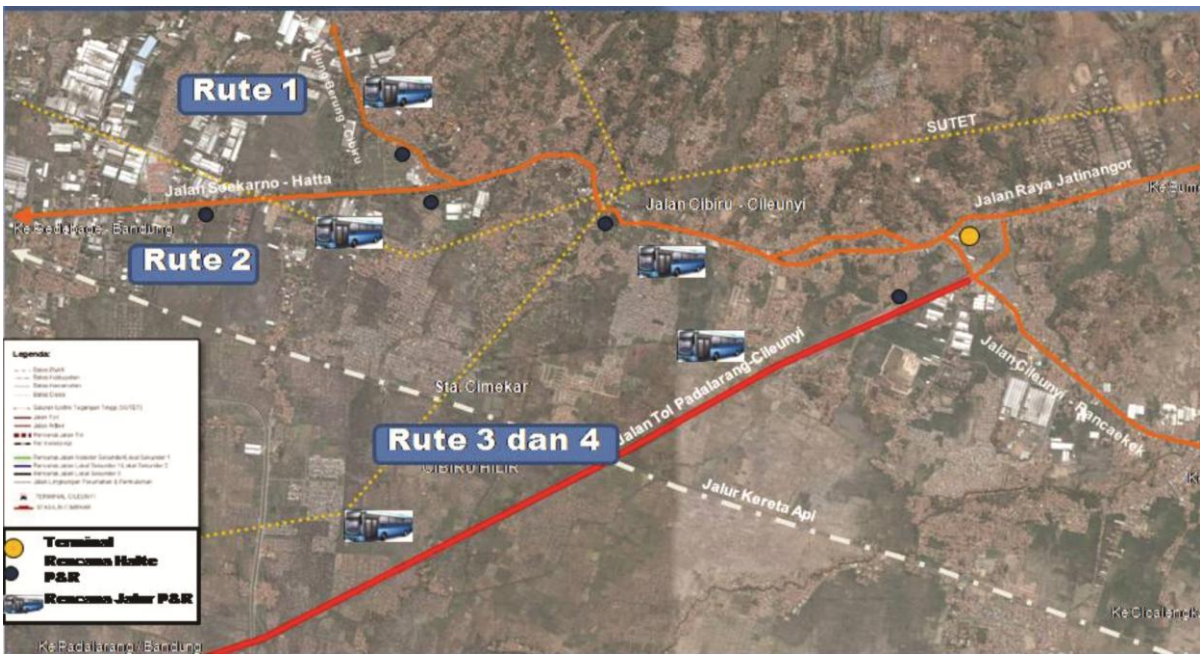


Figure 7 Proposed Bus Routes

Source: analysis, 2013

Figure 8 Public Bus Enroute From Cileunyi to Bandung City

Source: observation, 2013

To accommodate the potential users' trip, there are four proposed routes enclosed to their destinations:

1. Cileunyi – Cibiru – Ujungberung – AH. Nasution – Cicaheum
2. Cileunyi – Soekarno Hatta – Gedebage – Moh Toha – Cicaheum
3. Cileunyi – Tol Pasteur – Dago – Surapati –PHH Mustofa
4. Cileunyi – Tol Purbaleunyi – Jl. Buahbatu – Alun-alun – Asia Afrika-Pasarbaru

Four bus routes are proposed by considering majority of preference locations, suitability of existing road. The existing road network to carried bus should be in good condition and categorized as collector or arterial road. The arterial and collector road must have 6 meter width so that buses not going to burden the existing traffic any further. Supply also came in form of availability of shuttle bus. By now, transport from Bandung to Cileunyi and so forth also been served by several shuttle buses and travel cars for public. These modes could be possibly managed to encourage park and ride scheme, with some subsidies to set an affordable price with reliable service.

CONCLUSION

Proposed park and ride scheme has got a positive respond from potential user in east corridor of Bandung (Cileunyi). Demand side potential is shown by the willingness of people to use park and ride facilities. There were 77% of respondent who are agree with the parking concept and willing to use the parking lot, while 82% of respondent are agree to use shuttle bus. The parking lot has to meet security criteria, while shuttle bus should be comfortable to meet users' demand. People's willingness to pay for the parking charge is at Rp. 5,000 – 10,000 and their willingness to pay for the bus fare ranged from Rp. 3,000 to Rp. 5,000. A low willingness to pay for the bus fare must be anticipated by the local government or other institutions in form of subsidy to achieve certain level of service.

Based on the survey tabulation, it could be generalized that people in Bandung periurban will support park and ride scheme which encourage them to use public transit. Nevertheless, proposed park and ride scheme must be complement with appropriate facilities with several conditions: comfortable, safe and secure, also affordable in price. Besides, the most considerations also came from people's routes or trip destrinations.

Thus, demand potential must be managed with the promptness of road network, and availability of parking lot, also shuttle bus to reach several routes.

Thus, the support for park and ride scheme should be seen also from supply side. The parameters for supply's sufficiency are land availability, road network and existing shuttle bus. From land perspective, there were two alternatives of parking location in Terminal and Cileunyi Market which are accessed directly to toll road and regional road. Road network to convey shuttle bus should be an arterial or primary collector class, which also matched with commuters' route. Hence, there are four main routes proposed for bus shuttle. Bus routes comprises the nearest access to the center activities in Bandung City such as Dago, downtown (Alun – alun), Pasar Baru and Soekarno – Hatta corridor. Bus lanes will be placed on arterial and primary collector road by considering existing traffic in order to reduce VCR in some nodes.

REFERENCES

Gifford, J.L.dan Odd J.S (2001). Transportation Demand Management.

Handbooks in Transport - Handbook 3: Transport Systems and Traffic Control. edited by Kenneth Button and David Hensher. Elsevier Science Ltd. pp. 199-208

Larasati, O. 2012. Studi Pengembangan Skema Park and Ride di Koridor Komuter Kota Cimahi – Bandung. Tugas akhir Program Studi Perencanaan Wilayah dan Kota Institut Teknologi Bandung

Meyer, M. (1999) Demand Management as an Element of Transportation Policy:

Using Carrots and Sticks to Influence Travel Behavior, Transportation Research Part A 33, p. 575-599

Ptáček, P and Szczyrba, Z. (2007). Current Suburbanisation Trends in The Czech Republic and Spatial Transformation of Retail. Revija za geografijo 1-2, 2007, 55-65

Putranto, L. S. 2008. Rekayasa Lalu Lintas, Cetakan ke-1. Jakarta: PT. Macanan Jaya

Cemerlang.

RDTR Kawasan Perkotaan Cileunyi dan Peraturan Zonasi. Badan Perencanaan Pembangunan Daerah Kabupaten Bandung

Sangadji, E.M., Sopiah, 2010. Metodologi Penelitian: Pendekatan Praktis dalam Penelitian