Peer-reviewed academic journal

Innovative Issues and Approaches in Social Sciences

IIASS – VOL. 12, NO. 2, MAY 2019

Innovative Issues and Approaches in Social Sciences

IIASS is a double blind peer review academic journal published 3 times yearly (January, May, September) covering different social sciences: political science, sociology, economy, public administration, law, management, communication science, psychology and education.

IIASS has started as a SIdip – Slovenian Association for Innovative Political Science journal and is being published by ERUDIO Center for Higher Education.

Typeset
This journal was typeset in 11 pt. Arial, Italic, Bold, and Bold Italic; the headlines were typeset in 14 pt. Arial, Bold

Abstracting and Indexing services
COBISS, International Political Science Abstracts, CSA Worldwide Political Science Abstracts, CSA Sociological Abstracts, PAIS International, DOAJ, Google scholar.

Publication Data:
ERUDIO Education Center

Innovative issues and approaches in social sciences, 2019, vol. 12, no. 2

ISSN 1855-0541

Additional information: www.iiass.com

DO THE ECONOMIC LOSSES FOR ROAD USERS DUE TO TRAFFIC CONGESTION: EVIDENCE FROM JAMBI, INDONESIA?

Amril Amril[1], Junaidi Junaidi[2]

Abstract
This study aims to examine: 1) the degree of saturation/level of congestion on roads in Jambi City; 2) economic losses that certified by road users as a result of congestion that occurs on roads in Jambi City; 3) factors affecting amount of economic loss that certified by road users as a result of congestion that occurs on roads in Jambi City. The research was carried out on four road section: a) road to shopping center; b) road to office center; c) road to housing center; d) road to the education center. The data were collected by carrying out road geometric survey, traffic flow surveys and interview with road users. The results are 1) commonly, the degree of saturation/level of traffic congestion in Jambi City ranged from category B (stable current) to D (unstable current approaching capacity); 2) The average economic loss / willingness to accept (WTA) of road users as a result of congestion in Jambi City is Rp. 765,731 per month; 3) The amount of economic loss due to congestion is significantly influenced by gender, education, main activities of road users, a vehicle that usually used, and the duration of traffic congestion experienced..

Keywords: Degree of Saturation, Congestion, Economy Loss

DOI: http://dx.doi.org/10.12959/issn.1855-0541.IIASS-2019-no2-art8

Introduction

The road has the main function as vehicle infrastructure, supports the accessibility of goods, services and community activities. Nevertheless, in reality, an imbalance in the midst of the growth rate of the road and the growth rate of the vehicle in the city. Road growth is generally much slower than the vehicle growth rate. This condition causes excessive loading on the road, which in turn results in traffic congestion.

[1] Amril Amril, Drs., is associate professor at Economics Department, Faculty of Economics and Business, Universitas Jambi. Contact email address: amril@unja.ac.id
[2] Junaidi Junaidi, Dr., is assistant professor at Economics Department, Faculty of Economics and Business, Universitas Jambi. Contact email address: junaidi@unja.ac.id

The economy and development of various fields in Jambi City have grown rapidly. It can be seen by the development of various socio-economic activities of the community.

In order to the necessity of vehicle increased rapidly, it can be seen a starting from the increase in traffic volume both as a result of increasing vehicles and of increasing frequency of community travel. The increase in traffic volume is apparently unable to be offset by an increase in road capacity. Since the last five years (2012-2017) the growth of two-wheeled vehicles in Jambi City reached out 28.68 percent per year and four-wheeled vehicles reached out 26.42 percent (BPS, 2017). On the other hand, the length of the road in those periods did not increase. This condition causes high levels of congestion at the main road segments in Jambi City during rush hour. The reduction of traffic congestion is one of the main targets that must be carried out in the vehicle policy of Jambi City. It is necessary for a view of the large economic losses caused by traffic congestion.

Policies can be carried out by Jambi City to reducing congestion e.g. traffic management, increasing road capacity, applying congestion costs to road users, etc. Nevertheless, in order to run policies effectively and on target it requires a study of the level of congestion and an analysis of economic losses due to congestion in this city.

The study purpose to 1) examine the degree of saturation/level of congestion on roads in Jambi City; 2) investigate economic losses certified by road users as a result of congestion that occurs on roads in Jambi City; 3) explored the factors that affect the amount of economic loss certified by road users as a result of congestion that occurs on roads in Jambi City

Theoretical review

Traffic congestion occurs as the volume of traffic is almost close to road capacity. Congestion results in economic and inhuman losses such as causing stress due to frustration at the goal (Alhadar, 2011). Congestion increases when the current is so large that the vehicle is very close to each other. Total congestion occurs when the vehicle must stop or move very slowly (Tamin, 2000).

In the point of view for road service level, congestion occurs when the LOS (level of services) <C (capacity). If LOS <C, the condition of traffic flow starts to become unstable, vehicle speed decreases relatively quickly due to obstacles that arise and freedom of movement is relatively small. If the LOS has reached a certain point, the flow of traffic becomes

unstable so there is a heavy delay, which is called traffic congestion (Tamin and Nahdalina, 1998).

The approaches to the valuation of losses/economic impacts of congestion. However, among these various approaches have two main approaches, the Loss of Earning (LoE) method (Hufcmidt, et al (1992) and the Contingent Valuation Method (CVM) (Yakin, 1997). Loss of Earning (LoE) method is one method of economic valuation to assess environmental costs based on a market-oriented approach. Estimation of benefits with this method uses the actual market price of goods and services. Therefore, the use of this method is easy to use because it follows the current market price. CVM is used to determine the value or the price of a commodity that does not have a market such as environmental goods. This study is utilizing the CVM approach to estimate economic losses that people feel due to congestion. According to Fauzi (2006), the CVM approach initially was introduced by Davis (1963) in research on hunting behavior in Miami, Hawaii, United States of America. This approach is called contingent because, in the practice, the information obtained depends on the hypothesis. For instance, how much is the cost to be certified, how much the payment is, and so on (Fauzi, 2006).

In order to look at CVM essentially aimed, firstly, the willingness to pay or WTP from the community, for example, to improve environmental quality, and secondly, willingness to accept or WTA damage to an environment (Fauzi, 2006; Anwar, 2009). CVM approach is based on fundamental assumptions about tenure rights (Garrod and Willis, 1999), if a person does not have tenure rights to goods and services produced from natural resources, the relevant measurement is the maximum willingness to pay to get the item. On the other hand, if that person has the right to resources, the relevant measurement is the willingness to accept the minimum compensation for the loss or damage to the natural resources he has.

The road user basically has the right to road resources, so WTA approach is more appropriate to use for the measurement of economic losses due to congestion. The measurement can be carried out directly (direct method) through surveys and interviews with the community, or indirectly (indirect method) by calculating the value of the decrease in environmental quality that has occurred. The interview method is not much different from the PAP. Hanley and Spash (1993), they have 4 (four) methods used to obtain an offer of the amount of the respondent's WTA value, such as 1) the bidding game, which is carried out by asking the respondent whether he is willing to accept a certain amount of

money proposed as a starting point. If "yes" then the amount of money is reduced to the agreed level, 2) Open-ended questioning method is carried out by asking the respondent directly how much money is received due to changes in environmental quality. 3) Payment Card Method, which offers the respondent a card consisting of various grades of ability to accept so that the respondent can choose a minimum value that suits his preference, 4) Method of the dichotomy choice question (closed-ended referendum), which offers the respondent amounts to a certain amount of money and ask the respondent whether they want to accept or refuse a certain amount of money due to changes in environmental quality.

Previous studies have shown that congestion in cities in Indonesia and other countries had an impact on relatively large congestion costs. Dodgson and Lane in Santos (1999) estimated congestion costs for the UK of £ 6.9 billion during 1996 at the price of 1996 ($ 11.73 billion). Research conducted by Malkhamah (2007) in Yogyakarta, Indonesia found that the cost of congestion that had to be certified by the community in 2006 was around Rp. 600 billion, if it was assumed that the value of time per person was Rp. 2,000.00 per hour. Traffic congestion, in addition to being detrimental in terms of time, also has an impact on the environment, especially air and sound pollution (Yulifianti and Malkhamah, 2004).

The research carried on the same city (Yogyakarta) such as in Malioboro area conducted by Sugiyanto et.al (2011) also found that the cost of the private car in actual conditions of 1.40 km is Rp. 5,986.03 while in perceived cost of Rp 2,707.52. The cost of congestion of private cars in the Malioboro area is Rp. 3,500.00.

Furthermore, research conducted by Indrayana, Indrayana, et al. (2013) on Imam Bonjol Street, Denpasar City found that the amount of travel costs due to traffic delays experienced by road users due to traffic delays is Rp. 1,174,089,940/day. It made the cost per year was Rp. 428,542,828 452.

In the United States found that congestion costs in the United States, for 85 cities, reached the US $ 63.3 billion in 2002, for the time value of US $ 13.45/hour (Harford, 2006). Pollution costs have also been studied by World Bank (1993), La One (2002). According to Deng (2006), the contribution of motorized vehicle pollution in China contributes to 30% of pollutant particles in the air (PM10). It caused an increase in cardiovascular mortality by as much as 40% and an increase in respiratory disease. It is estimated that in 2000 as many as 1,876 people

died from illness by air pollution and the costs were reaching 3.26% of GDP in Beijing.

Research method

Data collection method

The research was conducted on the main roads in Jambi City. They have 37 main roads in Jambi City. For the road sections, four road sections were designated as the research locus through the following stages: 1) Initial survey to classify the roads based on four categories: a) the road to the shopping center; b) the road to office center; c) the road to the housing center; d) the road to education center, 2) randomly selected one road segment in each category as a research locus.

Instruments and method for primary data in this study consist of:

1. To examine the degree of saturation/congestion level, data are used in the form of a) geometric and barriers beside the selected main road segment; b) the volume of traffic on the selected main road segment. Data was collected through survey methods on selected roads. The length of each road surveyed is 1 (one) kilometer. The survey is divided into two groups of surveys, such as: a) Road Geometric Survey. Performed by measuring the width of the road, the width of the sidewalk, parking layout, as well as other data about the road links associated with the study. The measurement was done by using measuring tape. b) Survey of traffic flows. Every vehicle passing on the observation post was calculated based on the type of vehicle, with the time interval used is per hour. The survey was conducted for 10 days (5 working days in 2 weeks). The survey was carried out for two hours each day, on peak hours of the road.
2. Questionnaire for collecting primary data to selected respondents. This questionnaire contains various questions related to WTA, individual socioeconomic characteristics, congestion experience, and perception of congestion.

The research sample is divided based on three groups of respondents of road users, such as. Drivers of four-wheeled vehicles (private and public), drivers of private two-wheeled vehicles, and public transport passengers. Each selected road segment, 20 respondents were assigned to each group of respondents, so the sample for each road was 60 respondents. The technique to do sampling was using accidental sampling.

Analysis tool

The degree of saturation/congestion level is the ratio of traffic flow to road capacity. The degree of saturation is calculated by the LOS (Level of Services) method, with the equation:

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

whereby:
Ds = Degree of Saturation (Level of Services= LoS)
Q = Traffic Flow (pcu/hour)
C = Road Capacity (pcu/hour)
pcu : passenger car unit

Calculation of road capacity is based on the 2014 Indonesian Road Capacity Guidelines, taking into account road width adjustment factors, direction separators, side barriers, and the size capacity of the city. Furthermore, based on the degree of saturation, the traffic flow characteristics can be classified into:

Table.1 The standard value for urban street saturation degrees

Degree of Saturation	Ds	Characteristics
A	0,00 – 0,20	Free flow, low volume, and high speed, the driver can choose the desired speed
B	0,20 – 0,44	Stable current, speed is limited; the driver can still be free in choosing the speed.
C	0,45 – 0,74	Stable current, speed can be controlled by traffic
D	0,75 – 0,84	The current starts to be unstable, low speed and vary, volume approaches capacity
E	0,85 – 1,00	Unstable current, low speed and different, volume approaching capacity
F	≥ 1,00	Obstructed current, low speed, volume above capacity, traffic jams often occur for quite a long time.

Source: Traffic Planning and Engineering, snd Edition Pergamon Press Oxword, 1979

Economic loss valuation of the community due to congestion is based on the value of the compensation fund (Willingness to Accept/WTA) that is willing to be accepted by the public. Furthermore, to obtain the WTA value the CVM approach is used through the following stages:

1. Developing Hypotheses Market: A hypothetical market is formed with a scenario that the Jambi City government will impose a policy of

providing compensation funds to people affected by congestion as a form of government responsibility for losses caused by congestion. The amount of compensation or WTA is asked by the respondent for the implementation of the policy where the WTA reflects the number of individual losses in rupiah.

2. Obtaining Tender Value: The method used to obtain the bid value in this study is an open question method, which is carried out by asking the respondent directly how much money is the minimum amount of money to be received due to congestion.
3. Calculating The Average of WTA: If the WTA value has been obtained, then the average calculation is needed. This stage is usually ignored by rebuttal bids (protest bids). Rebuttal bid is the response of respondents who are confused to determine the amount they want to receive because they have no desire to participate in this government policy.

The factors that affect the economic loss of the community due to traffic congestion, was used through the regression equation as follows:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_{4D1} X_{4D1} + \beta_{4D2} X_{4D2} + \beta_{5D1} X_{5D1} + \beta_{5D2} X_{5D2} + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + ei$$

Y = WTA
X1 = Age
X2 = Gender; 1= Man, 0 = Woman
X3 = Formal Education Level; 1 = College graduates, 0 = Other
X4 = Prime Activity (Other Base Category)
X4D1 1 = Work, 0 = Other
X4D2 1 = School, 0 = Other
X5 = Commonly Used Vehicle (Base Category of Public Transportation)
X5D1 1 = Private Car, 0 = Other
X5D2 1 = Two-Wheeled Vehicle, 0 = Other
X6 = The proportion (%) was affected by congestion in the past week
X7 = Duration (minutes) of congestion experienced in the past week
X8 = Feeling stressed /tired/bored; 1 = Feel, 0 = Unfeel

Result and discussion

Degree of saturation/level of congestion in Jambi City

Analysis of the degree of saturation / level of traffic congestion in Jambi City is carried out on four sample road sections, viz. 1) The road to office center is Mayjen H.M. Yusuf Singadekane street; 2) The road to education center is Arif Rahman Hakim Street; 3) The road to housing center is R.K. Sjahbuddin - Ismail Malik Street; 4) The road to shopping center is Raden Pamuk Street

The road to institution center

Mayjen H.M. Yusuf Singadekane is a street located in Sungai Putri Village, Telanaipura District in Jambi City. Based on spatial plans (RTRW) of Jambi City in 2013-2033, this region is located in BWK (part of the city area) VI with the main function as the center of government in Jambi Province as well as trade, services, and education.

This street is a divided four-lane two-way road (4/2 D). The effective width per lane is 3 meters. Thus, the effective width per direction (each direction has two lanes) is 6 meters. There is a roadside on both directions with a width of 1.5 meters each. Based on the surveys and the calculation of the actual traffic capacity, the degree of saturation of Mayjen H.M. Yusuf Singadekane Street is presented at Table 2.

Table 2. The Degree of saturation of Mayjen H.M. Yusuf Singadekane Street, Jambi City

Type of Vehicle	Amount of Vehicle		Passenger Car Equivalence (EMP)	Passenger Car Unit (PCU)	
	Lanes A	Lanes B		Lanes A	Lanes B
Heavy vehicle	44	37	1.2	53	44
Light Vehicle	1241	1379	1	1241	1379
Motorcycle	2590	3790	0.25	738	948
Amount per line	4235	5206		2031	2371
Total of both lines				4402	
Actual traffic capacity of both lanes				5594	
Average degree of saturation in both lanes				0,79	
Category of degree of saturation of the average of both paths				D	

The degree of saturation in rush hour on Mayjen H.M. Yusuf Singadekane Street is 0.79 (category D). It means "unstable currents, where almost all drivers are limited in speed and the volume of traffic almost reaches the street capacity."

The road to education center

Arif Rahman Hakim is a street located in Simpang IV Sipin Village, Telanaipura District, Jambi City. Based on the spatial plans (RTRW) of Jambi City in 2013-2033, this street is in BWK (part of the city area) VI with the main function as the center of government of Jambi Province as well as trade, services, and education. Arif Rahman Hakim Street is included in the category of the primary collector.

This street is a divided four-lane two-way road (4/2 D). In each lane, there are road markers that separate lanes on each direction. The effective width per lane is 3.5 meters, thus the effective width per direction (each direction has two lanes) is 7 meters. There are shells on both directions with an effective thickness of 1 meter each. In detail, the degree of saturation of Arif Rahman Hakim Street is presented at Table 3.

Table 3. The Degree of saturation of Arif Rahman Hakim Street, Jambi City

Type of Vehicle	Amount of Vehicle		Passenger Car Equivalence (EMP)	Passenger Car Unit (PCU)	
	Lanes A	Lanes B		Lanes A	Lanes B
Heavy Vehicle	14	28	1.2	17	34
Light Vehicle	618	805	1	618	805
Motorcycle	1770	1721	0.25	443	430
Amount Per Line	2402	2554		1077	1269
Total of both lines					2346
Actual traffic capacity of both lanes					5274
Average degree of saturation in both lanes					0,44
Category of degree of saturation of the average of both paths					B

In general, the degree of saturation in rush hour of Arif Rahman Hakim Street is 0.44 (category B). It means “steady flow, speed starts to be limited, but the drivers are able to switch (maneuver)”.

The road to housing center

RK Sjahbuddin-Ismail Malik is a street located in the Mayang Mangurai Village, Kota Baru Subdistrict, Jambi City. Based on the spatial plans (RTRW) of Jambi City in 2013-2033, this region is located in BWK (part of the city area) V with the main function as a hub for regional transportation, settlements, city-scale health care centers and trade and services.

This street is an undivided two-lane two-way road (2/2 UD). The effective width per lane is 4 meters. There are sideroads on both lanes, with an effective width of 0.8 meters each. The degree of saturation of RK Sjahbuddin-Ismail Malik Street can be seen at Table 4.

Table 4. The Degree of saturation of RK Sjahbuddin-Ismail Malik Street, Jambi City

Type of Vehicle	Amount of Vehicle	Passenger Car Equivalence (EMP)	Passenger Car Unit (PCU)
Heavy Vehicle	21	1.2	25
Light Vehicle	1051	1	1051
Motorcycle	2937	0.35	1028
Traffic flow (SKR/hr)			2104
Actual traffic capacity per lane (SKR/hr)			2773
Average degree of saturation on both lines			0,76
Category of degree saturation			D

The degree of saturation in rush hour of RK Sjahbuddin-Ismail Malik Street is 0.76 (category D). It means “unstable traffic flow, decreasing speed. Almost all drivers are limited in speed; traffic volume is close to the road capacity”.

The road to shopping center

Raden Pamuk is a street located in Beringin Village, Pasar Jambi Subdistrict, Jambi City. Based on the spatial plans (RTRW) of Jambi City in 2013-2033, this region is located in BWK (part of the city area) I with the main function as the center of regional and national scale trade and service activities.

This street is an undivided four-lane one-way road (4/1 UD). The effective width per lane is 3.25. Thus, the effective width of the road is 13 meters. There are shells on both lines with an effective width of 1 meter each. Based on the surveys and calculation of the actual traffic capacity, the degree of saturation of the Raden Pamuk Street is presented at Table 5.

Table 5. The degree of saturation of Raden Pamuk Street, Jambi City

Type of Vehicle	Amount of Vehicle	Passenger Car Equivalence (EMP)	Passenger Car Unit (PCU)
Heavy Vehicle	68	1.2	82
Light Vehicle	1234	1	1234
Motorcycle	4041	0.25	1010
Traffic Flow (SKR/hr)			2326
Actual traffic capacity per lane (SKR/hr)			5062
Degree of Saturation			0,46
Category of Degree Saturation			C

The degree of saturation in rush hour on Raden Pamuk Street is 0.46 (category C). It means “stable traffic flow, the driver is limited in speed”.

The impact of traffic congestion on road users

Although in general the degree of saturation of the four streets surveyed has not yet reached a relatively high degree of saturation, congestion has turned out to be a crucial problem to be dealt immediately in Jambi City. Because of certain hours and at certain points (in front of a school, in front of offices or in front of shopping centers), traffic congestion is felt by road users.

It can be seen by the fact that more than half (55.00 percent) of road users claim that they often or always experienced traffic jams. Only 2.08 percent stated that they had never experienced congestion and 10.83 percent stated that they rarely experienced congestion.

Table 6. Distribution of street users according to congestion experience in Jambi City in 2018

Congestion Experience	Frecuency (person)	%
Never	5	2.08
Seldom	26	10.83
Sometime	77	32.08
Often	95	39.58
Always	37	15.42
Totally	240	100.00

Source: Field Survey, 2018

In terms of the feelings experienced by road users when experiencing congestion, only about a third said that they did not feel stressed, tired or bored in traffic jams. The rest, most of the others (about two-thirds) said

they were stressed, tired or bored when they were stuck on the road in Jambi City.

Table 7. The proportion of road users based on the feeling when experiencing congestion in Jambi City in 2018

Feeling	Experienced	No/Less Experienced	Totally
Stress	64.68	35.32	100.00
Tired	65.11	34.89	100.00
Bore	71.06	28.94	100.00
Total	100.00	100.00	100.00

Source: Field Survey, 2018

Based on Table 7, out of a total of 240 respondents, 232 respondents (96.67 percent) agreed and strongly agreed that congestion is an adverse situation. The remaining 8 respondents (3.33 percent) said they did not care about the impact of congestion. The eight respondents were those who had never / rarely experienced congestion and who considered the congestion in Jambi City had not been too crucial to deal with.

Based on road users who agreed and strongly agreed that congestion was an adverse situation, there were various reasons stated. The main reason is they lose their time due to the congestion (95.69 percent). In the second place, it is reducing work/study hours stated by 39.66 percent of road users followed by spending money/costly stated by 39.22 percent of road users.

Table 8. The proportion of street users according to the perception of congestion impacts in Jambi City in 2018

Congestion Impact	Yes	No	Total
Wasting Time	95.69	4.31	100.00
Wasting Working/Studying Hour	39.66	60.34	100.00
Spending Money	39.22	60.78	100.00
Other Environment Pollution	29.31	70.69	100.00
Air Pollution	24.14	75.86	100.00
Sound Pollution	17.67	82.33	100.00
Reducing Income	11.64	88.36	100.00

Source : Field Survey, 2018

Willingness to accept (WTA) of road users for congestion

WTA of road users in Jambi City is carried out by asking 240 respondents about their willingness to disclose the economic loss due to the congestion. Nevertheless, not all road users were willing to express

their economic losses. A number of the total respondents, 171 respondents (71.25 percent) were willing to express their loss due to congestion, while 69 respondents (28.75 percent) were not willing to disclose it. The respondents who were not willing to disclose their economic losses are identified as the rebuttal bids.

Two main reasons from road users that were not willing to state their losses due to congestion. 31 road users (44.93 percent) stated that their losses such as loss of time and so on could not be valued with money or loss so large that they could not disclose their loss in the form of money. The remaining 38 road users (55.07 percent) stated that their losses do not need to be converted to money.

Furthermore, the total respondents who were willing to state their losses due to congestion, it is found that the average value of WTA of road users in Jambi City is approximate Rp. 765,731 per month. Based on the vehicle commonly used, it is seen that the average WTA value for public vehicle passengers is Rp. 560,475 per month, for road users of two-wheeled vehicles, is Rp. 689,679 per month and for road users of four-wheeled vehicles is Rp. 1,058,036 per month. These values reflect the amount of the loss of each road users affected by congestion.

Table 9. Distribution of WTA of road users in Jambi City in 2018

Notification	Public Passenger	Motorcycle	Car	Total
Total WTA (Rp 000)	33,068	38,622	59,250	130,940
Frequency (person)	59	56	56	171
Average WTA (Rp)	560,475	689,679	1,058,036	765,731

Source : Field Survey, 2018

Factors affecting the economic losses of communities due to congestion in Jambi City

Estimation of factors that affect the economic loss (WTA) of communities due to congestion in Jambi City is presented at Table 10. Based on the F test, all variables in the model have a significant effect on the amount of economic loss felt by road users who experience congestion. The coefficient of determination of 0.6208 shows that the amount of the road users' economic losses due to congestion, 62.08 percent is caused by variables in the model and 37.92 percent is caused by other variables outside the model.

Table 10. Estimation of factors affecting the economic loss of the community due to congestion in the Jambi City in 2018

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	90784	161909	0.56	0.576
X1	6511	4224	1.54	0.125
X2	197549	70650	2.80	0.006
X3	259985	85320	3.05	0.003
X4				
X4D1	-526924	123392	-4.27	0.000
X4D2	-374634	99090	-3.78	0.000
X5				
X5D1	240909	98516	2.45	0.016
X5D2	136202	84124	1.62	0.107
X6	-1688	1602	-1.05	0.294
X7	4816	461	10.45	0.000
X8	333068	93523	3.56	0.001
R-squared	0.643112	Mean dependent var		765731
Adjusted R-squared	0.620806	S.D. dependent var		662916
S.E. of regression	408215.1	Akaike info criterion		28.73914
Sum squared resid	2.67E+13	Schwarz criterion		28.94124
Log likelihood	-2446.197	Hannan-Quinn criter.		28.82114
F-statistic	28.83197	Durbin-Watson stat		0.405388
Prob(F-statistic)	0.0000			

Partially the age of road users does not affect the amount of economic loss due to congestion. Sex/Gender has a real influence on economic losses due to congestion. Economic losses experienced by men are greater (Rp. 197,549) than women. Formal education also has a real influence. Road users who have a higher level of education have a greater loss (Rp. 259,985) than those who have only gone to senior high school, junior high school or elementary school.

Road users' main activities have a significant effect on economic losses due to perceived congestion. Thus, the results of this study are relatively different from the initial assumptions. From the magnitude of the regression coefficient X4D1 shows that road users with the main activities of work feel less economic losses (Rp. 526,924) than those with other main activities (looking for work, income recipients and household affairs). Likewise, from the regression coefficient X4D2 shows

that road users with the main activities of the school, feel a smaller economic loss (Rp. 374,634) than those with other main activities.

In terms of the vehicles that are usually used, it is seen that drivers of four-wheeled vehicles (private and public) feel greater economic losses (Rp. 240,909) than those with public transport vehicles. Nevertheless, no difference in economic losses of two-wheeled vehicle users with road users with public vehicles. It can be seen from the insignificance of the X5D2.

The proportion of experiencing congestion also does not affect the number of economic losses felt by road users. However, the duration of congestion seems to have a significant effect. The regression coefficient shows that every minute of congestion increases the economic loss of road users by Rp. 4,816. The feeling of stress/tired/board also has an impact on the economic loss of road users. Road users who feel stressed/tired/bored felt a greater economic loss (Rp. 333,068) than road users who did not experience that feeling.

Conclusion and recommendation

Conclusion

Based on the results and discussion earlier section, it can be concluded as follows:

1. In general, the degree of saturation/ level of traffic congestion in Jambi City ranges from category B (stable current) to D (unstable flows close to the actual road capacity). High degree of saturation (category D) is found on road to offices and housing center, and the lowest degree of saturation is found on the road to education center. A road to shopping center is in category C where the flow is stable, but the driver is limited in speed.
2. The average economic loss (WTA) felt by road users due to the congestion in Jambi City is Rp. 765,731 per month. Based on the vehicle commonly used, the average WTA value for public vehicle passengers is Rp. 560,475 per month, for road users of two-wheeled vehicles, is Rp. 689,679 per month and for road users of four-wheeled vehicles is Rp. 1,058,036 per month.
3. The amount of the economic loss due to the congestion felt by road users is significantly influenced by sex/gender, level of education, road users' main activities, commonly used vehicles and the duration of traffic congestion experienced.

Recommendation

In terms of traffic flow, basically, the degree of saturation in Jambi City has not been above its road capacity. Even so, the government of Jambi City still has to strive to increase road both in quantity and quality in order to anticipate the relatively high pace of population growth, activities, and vehicles in Jambi City. In addition, the government needs to regulate the flow of traffic at certain locations and at certain hours (in front of the school or office on the beginning and the end of working time). It's because long congestion often occurred at certain locations and certain hours, even though in general the traffic flow of those streets has not reached its actual road capacity.

References

Alhadar A. (2011). Analisis Kinerja Jalan dalam Upaya Mengatasi Kemacetan Lalu Lintas Pada Ruas Simpang Bersinyal di Kota Palu. Jurnal SMARTEK. 9(4):327-336

Anwar S.H, Aditya. (2009). Nilai Ekonomi Akibat Kerusakan Jalan Berdasarkan Pendekatan Willingness to pay dan Willingness to Accept di Jalan Lintas Timur Sumatera. Jurnal Sosial Ekonomi Pekerjaan Umum. 1(2); 36 -55

BPS (2017). Jambi dalam Angka 2017. BPS. Jambi

Deng, X. (2006). "Economic Cost of Motor Vehicle Emissions in China: a Case Study." Transportation Research Part D: Environment. Vol. 11; 216-226.

Directorate General of Highways, Ministry of Public Works. (1996). Indonesian Highway Capacity Manual Part I. Urban Road. Directorate General of Highways, Ministry of Public Works, Jakarta.

Fauzi, A. (2006). Ekonomi Sumberdaya Alam dan Lingkungan. PT. Gramedia Pustaka Utama. Jakarta.

Garrod, G. & K.G. Willis. (1999). Econoimic Valuation of Environment : Method and Case Studies. Edward Elgar, USA.

Hanley, N & C.L. Spash. (1993). Cost Benefit Analysis and environmental. Edward Elger. Publishing . England: Hardin, Garret

Harford, J.D. (2006). "Congestion, Pollution and Benefit to Cost Ratios of US Public Transit System." Transportation Research, Part D: Environment. Vol. 11; 45-58.

Hufschmidt, et al. (1992). Lingkungan, sistem alami dan pembangunan : pedoman penilaian ekonomis, UGM Press. Yogyakarta.

Indrayana, IGNGA., Wedagama, DMP., Suparsa, IGP. (2013). "Analisis Kinerja Ruas Jalan dan Biaya PerJalanan Akibat Tundaan Pada Ruas Jalan (Studi kasus: Segmen Simpang Gunung Soputan-Simpang Teuku Umar Barat)". Jurnal Ilmiah Elektronik Infrastruktur Teknik Sipil. 2(2); 1-7

La One. (2002). “Perhitungan Pajak Kendaraan Bermotor Berdasarkan Biaya Penyelenggaraan Transportasi (Studi Kasus di Kota Yogyakarta).” Thesis. Yogyakarta, Magister Sistem dan Teknik Transportasi. Universitas Gadjah Mada.

Lembaga Afiliasi Penelitian dan Industri (LAPI) ITB. (1996). “Laporan Akhir Studi Perhitungan Biaya Operasi Kendaraan Kendaraan.” PT. Jasa Marga. Bandung, Institut Teknologi Bandung (ITB).

Malkhamah, S. (2007). “Keuntungan Penyediaan dan Penggunaan Angkutan Umum untuk Masyarakat Perkotaan.” Speech for Inauguration of Professor Position at Faculty of Engineering Universitas Gadjah Mada. 21 February 2007.

Santos, G. (1999). Road Pricing on The Basis of Congestion Costs: Consistent Results from Two Historic UK Towns. Cambridge, Inggris, Department of Applied Economics. pp. 1-16.

Sugiyanto, G., Malkhamah, S., Munawar, A., & Sutomo, H. (2011). “Model Biaya Kemacetan Bagi Pengguna Mobil Pribadi di Kawasan Malioboro Yogyakarta”. Dinamika Teknik Sipil. Vol. 11 (1); 81 – 86

Tamin, O.Z. & Nahdalina. (1998). Analisis Dampak Lalu Lintas (Andall). Jurnal Perecanaan Wilayah dan Kota. ITB: Bandung

Tamin, OZ, (2000). Perencanaan dan pemodelan transportasi, Penerbit ITB. Bandung

World Bank. (1993). Marginal Health Cost (MHC) Indonesia: Energy and the Environtment.

Yakin, A. (1997). Ekonomi Sumberdaya dan Lingkungan : Teori dan Kebijaksanaan Pembangunan Berkelanjutan. Akademika Presindo. Jakarta.

Yulifianti & Malkhamah, S. (2004). “Tingkat Pencemaran Udara Oleh Lalu lintas di Lingkungan Kampus Universitas Gadjah Mada.” Proceedings Forum Studi Transportasi Antar Perguruan Tinggi (FSTPT). November 2004.