Effect of Weather for Demand of Online Transportation in Tembalang, Semarang

A R Rakhmatulloh[1], D I K Dewi[1], Wijayanti[2], J Winarendri[3]

[1]Urban Regional Planning Department, Faculty of Engineering, Diponegoro University, Jl. Prof Sudharto,SH Tembalang, Semarang,Jawa Tengah, Indonesia
[2]Architecture Department, Faculty of Engineering, Diponegoro University, Jl. Prof Sudharto,SH Tembalang, Semarang,Jawa Tengah, Indonesia
[2]Wageningen University & Research, Netherland

E-mail: anita.ratnasari.r@pwk.undip.ac.id

Abstract. Estimates of online transportation users in an area need to be known because it can be used to analyze how much the dependence of the traveler on online transportation. So that it can be seen how the travel patterns of online transportation users. However, research on the impact of weather variables on the selection of modes of online transportation has not been widely implemented. This study aims to evaluate the influence of the weather by entering dry season and rainy season variabel related to daily travel behaviour on online transportation. This research was conducted at Tembalang Semarang, and the target of respondents was students. The analytical results show that, in general the existence of rainfall is associated with a certain degree of online transpotation user of go car/grab car increase. So we can conclude that weather-related variables were found to routine/daily trips.

Keywords: weather, demand of online transportation, education area, daily trip

1. Introduction

Online transportation is part of smart mobility. Users are spoiled by services that can be controlled by smartphones. So that users can more easily make movements according to the start mobility and its frequency. Transportation is usually also influenced by the weather. Research on weather and transportation modes has been carried out in several countries, but the numbers are still minimal. It should be one of the important topics in a study, because weather is a factor that has a significant influence on a person's decision in transportation mode choice.

Factors that influence a person to choose transportation modes such as online transportation are among others influenced by the number and quality of services provided, economic factors, social factors, spatial factors such as service coverage areas of a transportation mode, and others [1]. One other factor that can affect demand of online transportation, but not yet widely discussed is the weather factor. Most studies that focus less on the weather on daily conditions in travel behaviour such as the choice of modes and destination of travel. According to research conducted previously by A. Singhal, C. Kamga, and A. Yazici [2], the weather had a negative impact on the demand for city transportation in New York for example the Metropolitan Transit-New York Transit (MTA-NYCT) subway in particular on passengers.

This study aims to determine the effect of weather by including variables of dry and rainy weather related to user profiles and choice of modes for regular trips in Tembalang, Semarang City. Tembalang area is interesting because this area is a region of education, so it has high demand for online transportation. Most users of online transportation are in their 20s and as student. This study uses primary data with reference to several articles that have conducted research related to the choice of transportation modes and weather. These articles will be discussed in the next section. This study focuses on the characteristics of users and modes of transportation used for routine trips in the Tembalang education area, Semarang. In previous studies taking into account the impact of weather on the selection of modes of transportation such as bicycles, private vehicles, and public transportation. While in this study using weather data and transportation modes that focus on online transportation services, because online transportation has many modes of choice at different prices. So users can adjust their needs. The results are expected to know the characteristics of transportation mode selection by students in the education area based on weather conditions.

2. Literature Review

Online transportation is a high technology applied to transportation sector. Currently online transportation is one of the transportation preferred by the public. The easiness and services of online transportation are one of the reason why people leaving conventional transportation (public transportations). The advantages of online transportation are the clear information about the price and dwelling time for the user. Online transportation also offers online order via smartphone without the users go to the traditional taxi bike station [15]. Online transportation also provides two ways of pay: cash or non-cash. Online transportation also attempts to provide security and convenience to the users [3].

Research on the impact of weather on transportation has been done before, one of which is the impact of weather conditions on macroscopic urban travel time. It was explained that inclement weather conditions may result in substantial reductions of roadway capacities and thus, operating speeds [4,5]. Additionally, traffic demand may be largely affected by the weather, since the latter has a considerable impact on a series of humans decisions such as transport capital choice, trip distribution, trip cancellation or postponement; altering roadway users' valuation of actual transport costs and travel times [6]

In addition, research on the weather effects of various modes of transportation has also been carried out, such as the transportation air [7], rail based transport [8], and ground vehicles [4,9] and everything is done in the country 4 seasons like countries in America and Europe.[10] The modes of transportation used in several of these studies include modes of private transportation, rent, and public transportation. Saneinejad et al (2012), mention that other weather indicators such as temperature affects the one's journey using all transport mode without exception.[10] The occurrence of a shift in the selection of modes of transportation when it is rainy or rain is from motorbikes or open vehicles to cars, public transportation such as the subway.

According to Kim et al. [11] individual travel movements are influenced by many factors, particularly the weather. In this Swedish study, attitudes toward cycling during the rainy were generally, and in relation to rainy, there were clear differences in fashion choices between seasons. The number of car trips increased 27% from dry to rainny while the number of bicycle trips decreased by 47%. The number of car trips increases with distance while the number of bicycle trips decreases, and the decline is even more significant in rainny than in dry. There are differences of opinion between the two categories of cyclists, about what factors influence the choice of modes of transportation for travel to work. Temperature, rainfall and road conditions are the most important factors for those who cycle to work in the dry but not in rainny [12].

Knowledge and information about the weather became important to be known by those who would travel, especially for users of unprotected vehicles such as bicycles, motorcycles and walking [13]. The information the rider obtained will determine the decision on the trip, as described by [13]. Weather conditions such as Rain, temperature difference, wind speed difference will make the service of transportation network change [14]. In research conducted by Hranac at al. [15] shows that it turns out that rain will significantly change the flow of vehicle traffic on the road network [10].

Weather can influence decisions about the journey that must be made, where to go, and what mode to choose. This paper identifies specific weather conditions that have a significant impact on number of pedestrian at 13 locations in Alameda County, CA. This shows the importance of taking into account the weather when analyzing pedestrian volumes. The results show that some weather variables have a significant influence on pedestrian volume over a period of time. Rain has the greatest effect on the volume of pedestrians in certain locations, although clouds, wind, and dry and cold temperatures have also been shown to reduce volume. This study shows the importance of weather calculations when analyzing pedestrian volumes [16].

Studies conducted by Shaaban and D. Muley [17] investigated the impact of temporal and weather characteristics on pedestrian volumes in dry climatic conditions. The main environment located in urban areas in Doha, Qatar was chosen as the location of the case study. Low pedestrian activity is seen in all seasons. Pedestrians walk more during weekdays in rainny, and during weekends in dry and spring. Generally, pedestrian volume is higher at night. The results show that pedestrian volume has a log-linear relationship with weather characteristics. Temperature is the only parameter that significantly affects pedestrian volume. This shows that the weather has a strong influence on a person's decision in choosing a mode of transportation.

3. Methodology

This research was conducted in Tembalang District, Semarang City, where there were several universities in Tembalang District. The Tembalang area is included in the education area, so most of the area is inhabited by students from outside the city. There are four universities in the Tembalang area, namely Diponegoro University (UNDIP), Pandanaran University (UNPAND), Semarang State Polytechnic (POLINES), and Semarang Health Polytechnic (POLTEKKES). Then for the main activity is learning with the aim of regular movement to campus. Then indirectly, every day students need a mode of transportation to get to campus.

The data used in this study are primary data sourced from the questionnaire. The questionnaire was distributed to students who were enrolled in tertiary institutions in the Tembalang area. This study used 100 randomly selected samples. The analytical method used in this study is descriptive statistics. Data used include the characteristics of users of transportation modes, data on weather conditions (dry season and rain season) and choice of transportation modes.

4. User Characteristics Mode of Transportation in Tembalang

Tembalang area is one of the tertiary education areas in the city of Semarang and most of it is inhabited by university students. There are four universities, namely Diponegoro University (UNDIP), Pandanaran University (UNPAND), Semarang State Polytechnic (POLINES), and Semarang Health Polytechnic (POLTEKKES). In this study, the intended respondents were students who were studying in the Tembalang education area. To fulfill their routine travel needs, they need transportation modes to reach destination locations such as campus. In addition to private transportation modes, students can also make online transportation, public transportation as a choice of transportation modes.

5. Result and Discussions

5.1. Weather

Weather or temperature is one factor that is quite influential in choosing the mode of transportation that will be used in the trip. Based on the survey conducted, 92.9% of respondents answered that the weather had an effect on the choice of transportation mode. Indonesia is a tropical country with two types of seasons, namely the dry season and the rainy season. Where in the dry season it has a dry temperature/sunny and in the rainy season it has cold temperatures/rainfall. This weather difference is expected to have an influence on the mode of choice behaviour in the Tembalang education area. As previously explained, the Tembalang education area has been served by several modes of transportation such as online transportation and public transportation. In addition, these modes of

transportation are also affordable. Since online transportation, both online motorbikes and online taxis, have helped the routine movements of students. For example, when it rains, you can choose to use a car to get to the campus even if you don't have a car, that is by using an online taxi service (Figure 1).
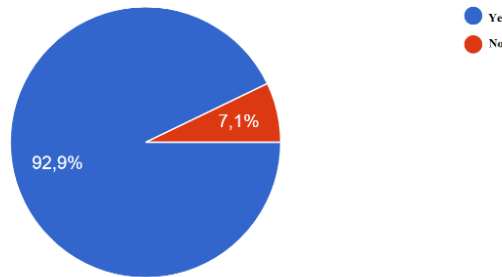

Figure 1. Effect Weather towards the Choice of Transportation Mode By Respondents

Dry Season in the Tembalang region there are no holidays during the dry season (Figure 2). They continue to carry out their activities as usual, such as studying to campus. The temperature during the dry season in this region can reach 32º Celcius.
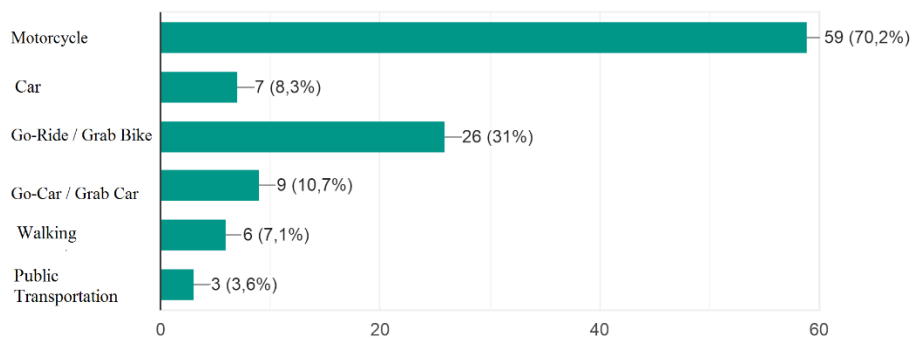

Figure 2. Mode Choice in Dry Season

Based on the survey conducted by distributing questionnaires, it shows that a total of 70.2% of respondents use motorized transportation modes even though the conditions are quite dry. The reason for respondents using motorbikes as a mode of transportation on their way to campus is to be comfortable, the time during the trip is faster than other modes, other transportation cannot reach the residential area or boarding house. Then the choice of transportation modes that are quite attractive besides motorbikes are shuttle services from online transportation, better known as the Go-Ride / Grab Bike. 31% of respondents chose to use the Go-Ride / Grab Bike as a mode to fulfill their travel needs. The reason for respondents using this mode is not having a private vehicle, no need to bother to park, comfortable, safe, and able to reach residential locations that are not affordable by public transportation. If the choice of mode of transportation when dry season is distinguished by sex, a number of 25.6% of respondents who are male choose to use a motorbike as a mode of transportation in their routine movements, for example, to go to campus. Only small proportions choose cars and online transportation as their mode of transportation. Then for female respondents, 43% also chose to use the motorbike as their mode of transportation. And, a total of 17.4% chose online two-wheeled transportation or often known as Go-Ride or Grab Bike. For more details, see the Table 1.

Table 1. Mode Choice based on Male and Female preference in Dry Season

		Mode of Transportation				Total
		Motorcycle	Car	Go-Ride / Grab Bike	Go Car / Grab Car	
Gender	Male	25,6%	1,2%	4,7%	0,0%	31,4%
	Female	43,0%	4,7%	17,4%	3,5%	68,6%
Total		68,6%	5,8%	22,1%	3,5%	100,0%

5.2. Rainy Season

During the rainy season, the temperature feels colder than the dry season (Figure 3). Rain occurs throughout the day, where morning to evening is the time to carry out routine activities, studying to campus.
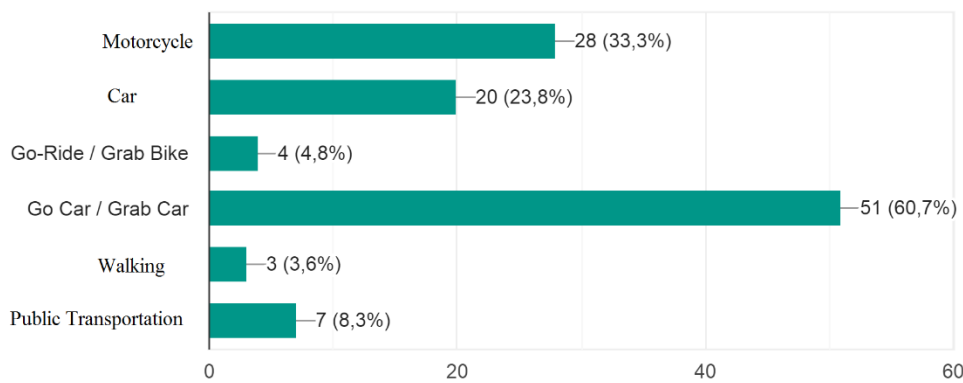

Figure 3. Mode Choice in Rainy Season

Based on the survey conducted with the distribution of questionnaires, it shows that 60.7% of respondents chose to use the shuttle transportation mode from online transportation, better known as the Go Car / Grab Car. Respondents chose to use Go Car / Grab Car as a mode to fulfil their travel needs. The reason for the respondents using this mode is not to bother using raincoats, more efficient because they do not need to wait for the rain to stop, be comfortable, safe because they are not wet from rain and do not have to bother looking for a parking space. During cold or rainy temperatures, 50% of respondents choose Go-Car or Grab Car as a mode of transportation in meeting their travel needs, which consists of 12.8% of respondents are male and 37.2% of respondents are female. In this study, users of online transportation services such as online motorcycle taxi and taxi were dominated by women. This is due to the sense of security and comfort provided by online transportation services. Feel safe because the route is tracked and the driver's identity is clear (Table 2).

Table 2. Mode Choice based on Male and Female preference in Rainy Season

		Mode of Transportation					Total
		Motorcycle	Car	Go-Ride / Grab Bike	Go Car / Grab Car	Public Transport	
Gender	Male	9,3%	7,0%	2,3%	12,8%	0,0%	31,4%
	Female	17,4%	8,1%	3,5%	37,2%	2,3%	68,6%
Total		26,7%	15,1%	5,8%	50,0%	2,3%	100,0%

5.3. Weather Variables is Found to Affect People's Attitude Toward Online Transportation Dry Season

Based on a survey that has been conducted through distributing questionnaires to students in the Tembalang education area, it shows that there is a change or shift in the behaviour of the choice of transportation modes used in routine trips. A total of 89% of respondents did not show changes in the behaviour of the choice of transportation mode. More is dominated by modes of transportation of two-wheeled vehicles such as motorbikes and motorcycle taxis online. Then a total of 11% experienced changes in the behaviour of the choice of transportation modes, from motorbikes to cars or taxis online. The reason for the change in the choice of transportation modes is, among others, more comfortable and not exposed to heat.

5.4. Rainy Season

Based on a survey that has been conducted through distributing questionnaires to students in the Tembalang education area, it shows that there is a change or shift in the behaviour of the choice of transportation modes used in routine trips. A total of 51% of respondents indicated a change in the behaviour of the choice of transportation mode. Students choose to use modes of online transportation such as online cars or taxis and public transportation. However, the percentage is more to use online transportation because it is easier to order, convenient, and safe because the routes are tracked. Students prefer to take a car or taxi online because they avoid rain or cold temperatures. This will have an impact on increasing traffic congestion due to those who normally or mostly use motorbikes or online motorbikes switching to online cars or taxis so that congestion occurs.

Rainny or when it rains is a season that has a significant influence on the choice of transportation modes, while dry is not very influential. This is in accordance with our research, namely the shift in the selection of transportation modes during rain or cold, for example from motorcycles shifting to cars or taxis online. And in the dry or dry season the shift in choice of modes is not too significant, because it still uses transportation modes that are usually used in routine trips.

6. Summary and Discussion

This study to explore the impact of changing weather conditions on a daily basis on online transportation use in Tembalang's educational area.The analytical results show that, in general the existence of rainfall is associated with a certain degree of online transpotation user of go car/grab car increase. Rainy season has effects for online transpotation user on mode shift between other modes (e.g. motorcycle, car, go ride/grab bike, and public transport). So we can conclude that weather-related variables were found to routine trips. These results indicate that round trip, mostly carried out during rush hour, is strongly influenced by changes in weather, especially rain.

The findings of this study enrich the existing literature concerning the impacts of weather on urban transportation. Conditions of temperature, weather and road conditions are important factors for those who use motorbikes in the dry season but not in the rainy season. Bad weather conditions such as rainy and cold seasons result in the shifting of transportation modes used, namely from open mode to closed or protected transportation modes [1,2,12,18–20]. This is shown in this study, where there is a shift in the selection of transportation modes during rain or cold. When the rainy weather shows respondents choose to use cars both private cars and public transportation and also online transportation services such as online taxis with the reason to avoid rain and cold. In addition, this study also shows that the number of car trips has increased from dry to the rainy season. Based on the survey, 49% of the respondents chose not to change the modes of transportation used during the rainy season, they still chose the mode of transportation commonly used on their regular trips. It can be concluded that there are quite clear differences in the selection of transportation modes in the two seasons in the Tembalang education area.

The limitation of this study is only on the influence of weather on the choice of modes in the Tembalang education area which is focused on routine travel only. So that it has not been able to answer travel behavior in full. Inputs for subsequent research include, among others, peak hours and non peak

hours, differences in rates at peak hour and nonpeak hours, and also differences in routine trips and additional trips.

7. Acknowlegment

8. References

[1]   Stover V W and McCormack E D 2012 The Impact of Weather on Bus Ridership in Pierce County, Washington *J. Public Transp.* **15** 95–110

[2]   Singhal A, Kamga C and Yazici A 2014 Impact of weather on urban transit ridership *Transp. Res. Part A* **69** 379–91

[3]   Dewi N K and Rakhmatulloh A R 2018 The Characteristic of Online Transportation Services and Provision in Semarang City *J. Tek. Sipil dan Perenc.* **20** 90–7

[4]   Martin P T, Perrin J, Hansen B and Quintana I 2000 Inclement weather signal timings *Univ. Utah, Mt. Consort.*

[5]   Koetse M J and Rietveld P 2009 The impact of climate change and weather on transport: An overview of empirical findings *Transp. Res. Part D Transp. Environ.* **14** 205–21

[6]   Tsapakis I, Cheng T and Bolbol A 2013 Impact of weather conditions on macroscopic urban travel times *J. Transp. Geogr.* **28** 204–11

[7]   Changnon S A 1996 Effects of summer precipitation on urban transportation *Clim. Change* **32** 481–94

[8]   Chapman L 2007 Transport and climate change: a review *J. Transp. Geogr.* **15** 354–67

[9]   Chung E, Ohtani O, Warita H, Kuwahara M and Morita H 2006 Does weather affect highway capacity *5th international symposium on highway capacity and quality of service, Yakoma, Japan*

[10]   Ismaili A F 2017 Pengaruh Cuaca Terhadap Perilaku Pengendara Sepeda Motor di Daerah Istimewa Yogyakarta *Semesta Tek.* **20** 132–8

[11]   Kim D, Park J and Hong A 2017 The Role of Destination 's Built Environment on Nonmotorized Travel Behavior : A Case of Long

[12]   Magnusson R 2003 Potential of transferring car trips to bicycle during winter **37** 649–66

[13]   Liu C, Susilo Y O and Karlström A 2015 The influence of weather characteristics variability on individual's travel mode choice in different seasons and regions in Sweden *Transp. Policy* **41** 147–58

[14]   Khattak A J and De Palma A 1997 The impact of adverse weather conditions on the propensity to change travel decisions: a survey of Brussels commuters *Transp. Res. Part A Policy Pract.* **31** 181–203

[15]   Hranac R, Sterzin E, Krechmer D, Rakha H A, Farzaneh M, Arafeh M and others 2006 Empirical studies on traffic flow in inclement weather

[16]   Schneider R J, Arnold L S and Ragland D R 2010 Effects of Weather Variables on Pedestrian Volumes in Alameda County , California Effects of Weather Variables on Pedestrian Volumes in Alameda County , California

[17]   Shaaban K and Muley D 2016 Investigation of Weather Impacts on Pedestrian Volumes *Transp. Res. Procedia* **14** 115–22

[18]   Smith B L, Byrne K G, Copperman R B, Hennessy S M and Goodall N J 2003 An Investigation Into The Impact Of Rainfall

[19]   Nankervis M 1999 The Effect of Weather and Climate on Bicycle Commuting **33**

[20]   Böcker L, Dijst M and Prillwitz J 2012 Transport Reviews: A Transnational Impact of Everyday Weather on Individual Daily Travel Behaviours in Perspective: A Literature Review Impact of Everyday Weather on Individual Daily Travel Behaviours in Perspective : A Literature Review 37–41