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An Analysis on E-Scooter Preference for the First and Last Mile Trip in Tourist Area

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Abstract: Bali government plans to use electric vehicles to create a sustainable tourist area, especially North Kuta, makes e-scooter sharing services an opportunity to apply. This paper aims to determine the value of tourists' willingness to pay to use the e-scooter sharing service as the first and last mile mode of transportation, the potential demand for e-scooter sharing, and determine the amount of CO_2 emission reduction by implementing this service. The stated preference method was employed to design the questionnaire and conduct interviews to collect the data. Furthermore, the data were analyzed using the binary logit method, and the backward elimination method was employed to obtain significant parameters. Moreover, to determine the best utility models, we used the maximum likelihood approach. The results of the study show that the willingness to pay value for using e-scooter sharing services is that if there is a saving of US $1.5 in travel costs for 15 minutes extra travel time, the number of tourists who want to switch to using the e-scooter sharing service from the existing mode is as many as 1908 person trips with reduced CO_2 emissions from the trips is 2,231,814.85 g CO_2 person trips. This study also revealed that respondents accompanied by environmental awareness crave to pay $ US 0.4 or 21% higher to use e-scooter sharing services than the respondents no matter to the environment.

Keywords: first and last mile; e-scooter sharing; stated preference; sustainable

1. Introduction

The transportation sector is the second highest contributor to produce CO_2 emissions at 25% global[1,2]. Meanwhile, the number of CO_2 emissions from transportation is predicted to grow annually in Indonesia because based on calculations the amount of passenger cars increases by approximately 3.7% per year[3]. Many countries endeavor to decrease CO_2 emissions to follow up sustainable development goals (SDGs) on the sustainable cities and communities agenda by emphasizing controlling air pollution in urban areas and attempting to hold world temperature enhancement at 1.5˚C through environmentally friendly car adoption[4], even in several nations have the policies to prohibit the usage of internal combusted engines in the next 20 years[5]. Electric vehicles (EVs) are trusted to be an alternative solution to solve energy and environmental problems because EVs reduce the consumption of fossil fuels and decrease CO_2 emissions [6–8]. Electric Vehicles (EVs) also would be the best choice to decrease noise pollution if safety issues resolved in EVs problems[9]. Changing from internal combustion engine to electric vehicles (EVs) also help out the government in reducing carbon emission[10]. One type of electric vehicle is personal light electric vehicles (PLEVs), and the most famous of PLEVs are e-scooters, electric bicycles, and electric motorbikes. The advantages of using personal light electric vehicles (PLEVs) are they can affect the movement of first and last miles in urban areas, environment friendly, and can reduce congestion [11,12]. E-scooter was chosen because the characteristics of an e-scooter are more suitable to the characteristics of the study area where the estimated longest distance between the transportation node and the tourist's accommodation location is around 4 km. According to previous research, e-scooters are usually employed for 0.5 km – 4 km travel distances.[13]

Bali was chosen as the object of the study because The Governor of Bali Province's goal is to create sustainable tourism to maintain Bali's image as a world-class tourist destination. In recent years, there has been an increase in tourist arrivals. For instance, In 2023, the number of tourist arrivals will be around 4 million, an increase of nearly 200% compared to 2022, where the number of tourist arrivals will be 1.3 million. This phenomenon makes Bali more crowded, and it has the potential to create congestion on several roads. Furthermore, this is made worse by the fact that the number of motorized vehicles in Bali province is higher than 8% compared to the total population. To overcome the congestion problem on several roads, the government has provided subsidized bus transportation services consisting of Trans Sarbagita with two corridors and Trans Metro Dewata with five corridors.

Another way for the government to achieve sustainable tourism is by implementing electric vehicles in several tourist areas like Nusa Penida, Ubud, Sanur, Kuta, and North Kuta [14]. Especially in the North Kuta area, the local government is concerned about Kerobokan Kelod, Canggu, and Tibubeneng because those areas have congested roads and air pollution. Even the Bali Province government has an idea to enforce a dedicated line for electric vehicles [14].There is a need for a model for capturing the potential demand and CO_2 reduction in the touristic area, i.e., North Kuta, Bali. The model contributes to directing the transport policy for a sustainable tourism ecosystem.

The North Kuta tourist region is a district located in Badung Regency, Bali Province. The North Kuta district has 33.86 km^2 wide and contains six villages; Kerobokan Kelod, Kerobokan, Kerobokan Kaja, Tibubeng, Canggu, and Dalung. The population number in the North Kuta Regency is 95,189 peoples. Moreover, based on Central Agency of Statistic data, the North Kuta district have 52,892 unit of motorcycles, and the other type has variate numbers [16].

Considering that the aim of implementing electric vehicles for several tourist areas in Bali Province is to create sustainable tourist zones by increasing the area quality, namely tourist areas that are not jammed and low in air pollution, the use of electric scooters (e-scooters) as an alternative mode integrated with public transportation suitable for applied [17]. Previous study also shows E-scooter sharing adoption in tourist zones as an alternative mode is fascinating because it can raise tourist interest, prevent traffic congestion if implemented in many routes and integrated with public transportation, and be more sustainable[18].

As a follow-up to the Provincial Government of Bali's scheme to create a sustainable tourist zones in the North Kuta tourist area and to find the potential of e-scooter application, it is necessary to find out tourist preferences to use e-scooters as an alternative mode for short-distance travel around the area particularly for first and last-mile transportation integrated with public transports; i.e., buses. This research objective is to determine the preference value of tourists' willingness to pay using e-scooter sharing services as an alternative mode and to decide the amount of CO_2 emission reduction as an impact of switching from the existing mode to using e-scooter sharing.

The novelty of this research is related to the willingness to pay (willingness to pay) to use e-scooter sharing services in tourist areas where the North Kuta tourism area, based on observations, most of the population are tourists, both domestic and international, which is indicated by the majority of buildings in the area being accommodation. , hotels, villas, etc.

2. Literature Study

Generally, e-scooter sharing services use for short distances, leisure trips, and tourist activities[19]. The previous study shows that e-scooter generally use for 0.5 to 4 km travel distances and equal to walking for 5 to 45 minutes[13]. The earlier research in Portland reveals e-scooter ridership tends: most Portland citizens viewed e-scooter positively, Portlanders commonly employs e-scooter for transportation, e-scooter drivers choose to ride on bicycle lanes and low-speed roads, and e-scooter enchanted new users to active transportation[20].

In terms of first and last-mile issues, many solutions offer recent years to drive mode switch away from automobiles, i.e. park and ride and develop bicycle sharing access. On the other hand, these solutions are commonly restricted by tourist stamina, landscape limits, and the availability of technology. Based on these barriers, e-scooter can be a new first and last-mile solution that solves these limits[20]. The other research describes that e-scooter and bike shares offer travelers the freedom they need to obtain simple transportation to and from public transportation points since they are not bounded to reach locations in urban areas. The main objective of employing an e-scooter is the quick and dependable aspect. They raise mobility and can be a piece of a multimode transportation system[21]. A previous study in San Francisco reveals that e-scooters have both companion and substituting impacts on the transportation network. In general, e-scooter replaces walking, followed by public transit or automobile[22].

Tourist preference to employ e-scooter sharing services is affected by population density, and the area with a higher density is more intensive to use e-scooter sharing services. Income level also influences the tourists to use e-scooter sharing, where tourists with higher income tend to use this service. In addition, location parameters impacted e-scooter sharing users; the area around the university, CBD, restaurant, bar, and market has more potential to utilize e-scooter sharing. The presence of bus stops, bike share stations, and dedicated lanes for bikes increases the public opportunity to use e-scooter sharing. On the other hand, the existence of bus stations has no significant impact on the adoption of e-scooter sharing services[23]. Further, environment awareness has a massive effect on tourists' willingness to use e-scooter. For example, the research conducted on university student in Taiwan reveals that attitude, subjective norm, and control of behavior has a significant influence on willingness to use e-scooter sharing services [24]. Another study shows that gender and jobs have an outstanding impact on mode choice[25]. Moreover, the critical parameters that affect people's preferences to use e-scooter sharing services are age, income, and pleasure with public transportation[26)].

To analyze tourist preferences to choose a mode of transportation, commonly use a discrete choice model. The type of discrete choice depends on how many options the respondent has. For example, if the respondent faces two alternatives the analysis process uses binary choice. On the other hand, if the study gives more than two alternatives that employ multinomial to analyze data. For instance, the study on Middle East and North Africa (MENA) regions regarding transport mode choice casualty and perceived barriers to sustainable mobility use multinomial logit (MNT) to analyze their data, because respondents faced four situation options: the reason for not walking, the reason for not cycling, the reason for no public transport use, and reason for car use[27)]. Another example is research on mode choice in Jakarta, where respondent faces two options for mode transportation: Jakarta LRT or Transjakarta Bus. In this case, the binary choice model is employ to analyze respondent preference data[28)].

The discrete choice postulate is people's probability to choose one option among several alternatives given that socioeconomic characteristics function and relative attractiveness from that choice[29)]. To describe attractiveness value from an option that used the utility concept. An alternative does not generate a utility, but the utility is derived function from people's trip characteristics.

One type of discrete choice model is the binary choice that is employed when in a decision process just given only two alternative options [30)]. For instance, if we notate the choice set with C_n and alternatives choice in i and j, that probability we select an alternative i is:

$$P(i \mid C_n) = P\,r(U_{in} \geq U_{jn}, \forall j \in C_n) \quad (1)$$

Or when notate C_n as {i,j} that probability alternatives choice i by traveler is :

$$P_n(i) = Pr\left(U_{in} \geq U_{jn}\right) \quad (2)$$

That

$$P_n(j) = 1 - P_n \quad (3)$$

General forms from binary choice model are the linear probability model, logit model, and probit model. Binary logit model is originally from the assumption that $\varepsilon_n = \varepsilon_{jn} - \varepsilon_{in}$ is logistic distribution, and we should note that logistic distribution has fatter tails. With the assumption for ε_n logistics distributed, the probability chosen alternatives i is:

$$Pn(i) = \frac{e^{Uin}}{e^{Uin} + e^{Ujn}} = \frac{1}{1 + e^{-(Uin - Ujn)}} \quad (4)$$

The maximum likelihood method is the most and easiest method to determine estimator. Meanwhile, the maximum likelihood estimator is the value of observed parameters with the highest possibility, so it can be stated: a higher likelihood value means the model is better and soaring opportunity to occur.

3. Methodology

3.1 Data Collection

Respondent data collection employs the interview method and uses the stated preferences method to make the questions. The authors preferred the state preference method because saving cost value set questions to using e-scooter were determined to avoid high bias among respondent answers due to e-scooter sharing being a new scheme and not yet familiar in Indonesia. The cluster sampling method employs to decide respondents from each block in the Nort Kuta tourist zones. The limitations of data collection are all respondents are international travelers from the entire world who are active in The North Kuta tourist area. Because built upon the initial survey, almost tourists in North Kuta are from abroad. We determined the number of samples from each block based on calculating results from population data, where the number of respondents was divide by the number of blocks.

Sample estimation based on the margin of error value. This study employs margin of error 10% because of limited time and research funding. A lower margin of error; a higher number of samples, but it is more representative. Additionally, this research uses the Slovin equation to calculate sample quantity[31)].

$$n = N/(N.\alpha^2 + 1) \quad (5)$$

The analysis result by Slovin equation with population number 7697 and margin of error 10% then generated a minimal 100 respondents. ~~This~~ The number divides into three blocks (Tibubeneng, Kerobokan Kelod, and Canggu blocks), and each block has 33 to 34 people as the samples. After determining the number of specimens, we did the data collection process. Primary data obtained through tourist interviews in North Kuta based on a questionnaire form, and the questionnaire started with an explanation of the survey content and the length of time following the survey. The next question is socioeconomic parameters such as age, gender, income, job, staying location, education, and existing mode. We also ask about respondents' environmental awareness and experience using e-scooter sharing beforehand. That needs attention when we make a choice option for the socioeconomic part. We have to be more careful in the gender question because during the interview process, several respondents complained about the male or female option because they have neutral gender. The secondary data are community density, spatial planning of the North Kuta district, number of guest rooms, villas, hotels, etc. Further, we gain secondary data from related agency websites.

Table 1. Explanatory Variables Description

No	Description	Choice Set	
X1	Gender	Male	Female
X2	Age	0: 15 - 19 Years	5: 40 - 44 Years
		1: 20 - 24 Years	6: 45 - 49 Years
		2: 25 - 29 Years	7: 50 - 54 Years
		3: 30 - 34 Years	8: 55 -59 Years
		4: 35 - 39 Years	9: > 60 Years
X3	Education	1: < JHS	4: BD
		2: JHS	5: Master or DD
		3: SHS	
X4	Occupation	1: Government staff	4: Student
		2: Private Sector	5: Other
		3: Businessman	
X5	Income per month	0: $ 0-333	5: $ 2,000-2,666
		1: $ 334-666	6: $2,667-3,999
		2: $ 667-999	7: $4,000-6,667
		3: $ 1,000-1,332	8: > $ 6,667
		4: $ 1,333-1,999	
X6	Location of Stay	1: Kerobokan Kelod	4: Kuta
		2: Tibubeneng	5: Legian
		3: Canggu	6 : Other
X7	Environment Awareness	Yes	No
X8	Existing Mode	1: Bicycle	5: Rent Car
		2: Private Motorcycle	6: Taxi
		3: Rent Motorcycle	7: Online Transport
		4: Private Car	8: Other
X9	Experience	Yes	No

3.2 Study Location

The study was conducted in Kerobokan Kelod, Tibubeneng, and Canggu. These three villages include tourist areas of The North Kuta district, which become precedence areas to be developed by the local government because many international tourists live there.

3.3 Stated Preference Survey

The last part of the questionnaire is state preferences and questions about tourists' willingness to pay value to use e-scooter sharing as an alternative mode for first and last-mile trips. The questionnaire contains hypothetical questions regarding traveler preference. The state preference method is employed to capture people's willingness to pay for using e-scooter sharing services by providing direct questions during interviews with several choices of willingness to pay values designed beforehand to avoid too high a value bias between answers respondents because the e-scooter sharing service is a new mode that is not yet popular in Indonesia. The stated preference method is a method that employs answerer preference in a set of transportation mode choices to guess utility function and the options describe transportation conditions or situations created by the observer[32].

The state preference question begins with the lowest saving value of respondent willingness to pay to use e-scooter sharing at US $ 1.5 as reciprocity for increasing travel time at 45 minutes and their concern to reduce energy consumption and decrease CO_2 emission. If respondents contradict the earlier option, that question continued with a higher saving cost alternative. This process repeated until the respondent accepted the agreeable cost of adopting e-scooter sharing.

Table 2. Stated Preference Set Choices

No	Increase In Travel Time	Travel Cost Savings
1	45 Minutes	1.5 US Dollars
2	30 Minutes	1.5 US Dollars
3	15 Minutes	1.5 US Dollars
4	45 Minutes	2.5 US Dollars
5	30 Minutes	2.5 US Dollars
6	15 Minutes	2.5 US Dollars
7	45 Minutes	3.5 US Dollars
8	30 Minutes	3.5 US Dollars
9	15 Minutes	3.5 US Dollars

3.4 Data Analysis

The first step to analyzing data is determining significant variables that affect utility and deciding the estimator value based on the respondent's preference to make a model. A general approach to determining an estimator is linear regression which expresses with an equation [32] :

$$U = \alpha_1 x_1 + \alpha_2 x_2 + \cdots + \alpha_n x_n \quad (6)$$

The next step is determining significant variables using the backward elimination method by deleting unimportant variables one by one until all variables have significant values. The third procedure is making several alternatives model and then deciding the best model with a maximum likelihood approach. Moreover, the best model has the highest log likelihood value. And also, to find out the utility model value, we use R studio software.

After we obtain the best model, we conduct further analysis with a discrete choice model with a binary logit approach because this study only uses two options: using e-scooter sharing or not. Binary logit model based on probability logistic cumulative function based on equation 2 and 4.

Where for convenient we assumpt $\mu = 1$, and $\varepsilon_{jn} - \varepsilon_{in} = 1$, $U_{in} = V_{in} + \varepsilon_{in}$, $U_{jn} = V_{jn} + \varepsilon_{jn}$. Because in this analysis we use a binary choice model, the assumption we use for random error is independent and identic Gumbel distribution (IID) [30].

4. Analysis

4.1 Respondent Profile

In this research, 100 international tourists who conduct activities at the North Kuta tourist zones participated as respondents. More than half of the respondents were male, making up 55% of the total, and the majority of respondents' ages ranged from 25 to 29 years old, making up 32% of the total. Furthermore, the top percentage for education variables is a bachelor's degree at 46%. Based on the survey outcome, most of the respondents' income is in the range of US$ 2000 to 2666 per month at 23%, and the bulk of the respondents have jobs in the private sector at 43%. Moreover, rented motorcycles became travelers' favorite mode at 53%.

4.2 Respondent's Willingness to Pay

The following process to analyze data is to create the willingness to pay diagram based on the utility function graph from the best model. We conduct an initial analysis using the R Studio program to find out the estimator value of each variable, the analysis result shows that only three variable has significant value: time, cost, and income. Meanwhile, other parameters have no significant value: gender, age, education, occupation, existing mode, location of stay, environment awareness, and experience using e-scooter.

Table 3. Initial Analysis Statistic Model

	Est	Std.er	t-value	Pr (>r)	Sig
ASC. Scoter	-1.0846	0.6797	-1.596	0.1105	
Time	-0.0547	0.0076	-7.166	0.0000	***
Cost	1.8586	0.1353	13.731	0.0000	***
Gender	-0.2901	0.2002	-1.449	0.1472	
Age	-0.0739	0.0523	-1.411	0.1582	
Education	-0.0604	0.1093	-0.553	0.5805	
Occupation	0.0697	0.1125	0.620	0.5353	
Income	-0.1582	0.0468	-3.380	0.0007	***
Location	-0.0145	0.0302	-0.481	0.6307	
Mode	0.0018	0.0494	0.037	0.9704	
Environment	0.3444	0.3209	1.073	0.2831	
Experience	-0.1342	0.1969	-0.682	0.4952	
Log-likelihood	-394.298				

***) Significant at α 0.1%

Furthermore, we use the backward elimination method to search for factors that affect tourists' willingness to pay value and decide the best model. After analyzing using the backward elimination method, the significant variables are time, cost, age, and income.

Table 4. Analysis Statistic Model

Parameter	Model				
	Est	Std. er	t-value	Pr(>t)	Sig
ASC. Scoter	-0,8938	0,3634	-2,459	0.0139	*
Time (X1)	-0,0543	0,0076	-7,127	0.0000	***
Cost (X2)	1,8471	0,1346	13.713	0.0000	***
Age (X3)	-0,0971	0,0487	-1.992	0.0463	*
Income (X4)	-0,1681	0,0416	-4.035	0.0000	***
Log-likelihood	-396,707				

Table 5. Utility Function

Utility Function	
WTP_{Ess}	U = -0,8938 – 0,0543*X1 + 1,8471*X2 - 0,0971*X3 -0,1681*X4

Based on the utility function in Table 5, each sign indicated the traveler's willingness to pay to use e-scooter sharing as an alternative mode for the first and last mile. For instance, the age parameter shows a negative correlation with a willingness to pay value, which means the older person has a lower cost and vice versa. A similar trend was described in a previous study in which the younger respondents had a higher desire to use e-scooter sharing services[26,33]. The results of both studies may be similar in the biggest respondent age group, where the research reveals the highest respondent percentage is in the 20 to 30-year age group with 35%. On the other hand, the study also shows the biggest age group is 20 to 29 years.

The income parameter reveals the same indication that tourists with higher incomes showed a lower willingness to pay value. On the other hand, the previous study describes different outcomes, the studies reveals people with higher incomes tend to pay more to use e-scooter sharing services when compared to those with lower incomes[26,34]. An opposed result is possible since a discrepancy in the coefficient estimator value, whereas Lee et al. show a positive value (0.863), whereas in this study negative (-0.168). The differences may occur because of set choice in the questionnaire, where this research set alternatives using saving cost value and the other studies it was not.

A tourist's willingness to pay depends on the probability value from the utility function. If we compared traveling time with e-scooter sharing integrated with public transport versus rent motorcycle with an additional time travel of 15 minutes to use an e-scooter on the first and last-mile, we obtained willingness to pay value shown by the intersection point in the probability demand graphic to use e-scooter at probability 50%. Figure 1 describes traveler willingness to pay value to use e-scooter sharing as the first and last-mile integrated with public transport if that traveling has cost saving US $1.5 with 15 minutes extra time. Additionally, this study uses sample case trips from Canggu village to Ubud with a distance of 30 km and time travel of 55 minutes by motorcycle.

Further analysis to determine more practical willingness to pay value to use an e-scooter is employing existing travel cost using rent motorcycle from Canggu to Ubud is US $ 4.5 per trip, the rate subtraction with US $1.5 equals US $ 3 minus again subsidized bus fares at US $ 0.25 per trip[35], that tourist's willingness to pay value for using an e-scooter is US $ 2.75, because e-scooter employ as a first and last-mile transportation mode, US $ 2.75 divided by 2 equals US $ 1.375 per trip. Previous research describes the average velocity of the e-scooter user as 10 km/hour[36], whereas the longest trip distance is 4.4 km, and the travel time is 26.4 minutes. The result is that tourist willingness to pay value is US $ 1.37 per 26.4 minutes or US $ 1.56 per 30 minutes.

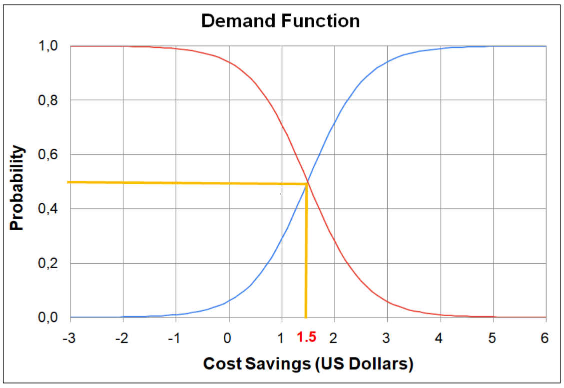


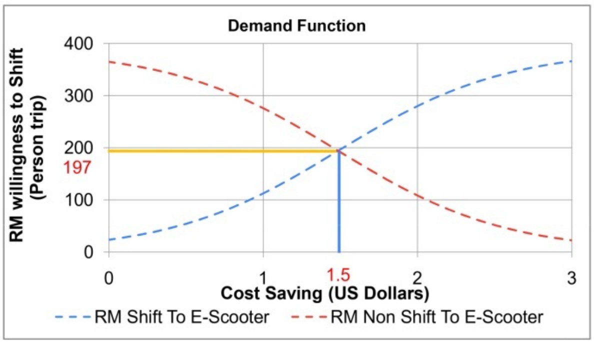
Fig 1. Traveler Willingness To Pay Value to Use E-Scooter Sharing Integrated With Public Transport.

If we compared tourists' willingness to pay rate in this study result with e-scooter sharing rent prices in several countries, we found they have higher rates. For example, in Germany and UK, the rent fare for e-scooter sharing is US $ 6.94 per 30 minutes[31,38], and similar trends reveal in Australia, where rent fares are near US $ 14.5 per 30 minutes[39]. But, a different value shows in Russia, where the rental rate for e-scooter sharing is US $ 0.8 per 30 minutes[40].

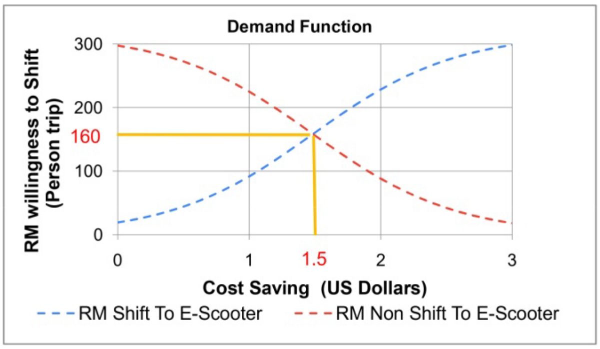
4.3 Potential Demand to Use E-Scooter Sharing

The probability demand using e-scooter sharing services is calculated based on tourists' existing mode proportion who stay in the North Kuta tourist area. The traveler numbers compute by the availability of room times with the occupancy rate. The total quota of guest rooms in the North Kuta tourist zones is 7697 rooms (based on data from the Bali tourism office websites and survey on gmaps) with an occupancy rate of 80% during the peak season[41], so the number of tourists who stays in the North Kuta tourist area is 6158 people.

The survey result conveys that the respondents using rent motorbikes who stay in the North Kuta tourist area is 53% proportion, and the highest three proportions for trip generation from the Kuta region to other destinations are Ubud, Kuta, and Tabanan at 9.7%, 11.9%, and 43,6%, respectively [42]. Further calculation shows that the number of trips from North Kuta to Ubud with probability demand at 100 % is 316 people (53% x 6158 people x 9.7%). With the interpolation process, the proportion at 50% is equivalent to 160 person trips (Fig. 2 (a)) for travel cost saving as big as US $ 1.5. For another route from North Kuta to Kuta zones, the number of traveling at 100% is 388 people (53% x 6158 people x 11,9%), so the probability demand is 197 person trip (Fig. 2 (b)). Tourist trip demand from North Kuta to Tabanan probability demand at 100% is 1418 (53% x 6158 people x 43,6%), and the probability demand for this route is 719 person trip (Fig. 2 (c)).



(a)



(b)

(c)

Fig 2. Probability Demand Willingness to Shift from Rent Motorcycle (RM) User to E-Scooter Sharing (a) North Kuta to Ubud, (b) North Kuta to Kuta, (c) North Kuta to Tabanan.

Furthermore, we can calculate demand potency from other modes with a similar method. Total number of demand for e-scooter sharing shows in table 6. The probability demand for travelers shifting to use e-scooter sharing service is 1908 person trips, and this amount is equivalent to 30,98% of total tourists who stay in the North Kuta tourist area.

Table 6. Willingness to Shift Demand from Existing Modes to E-Scooter Sharing Services

Route	Transportation Mode					
	RM	OT	Taxi	PM	PC	RC
Kuta Utara – Tabanan	719	231	136	122	54	14
Kuta Utara – Kuta Selatan	197	63	37	33	15	4
Kuta Utara - Ubud	160	51	30	27	12	3
TOTAL	1076	345	203	182	81	21
GRAND TOTAL	1908 (person trip)					

4.4 Potential for Reducing CO_2 Emission from E-Scooter Sharing Adoption

Analysis for a potential decrease in CO_2 emissions focuses on emissions that produce CO_2 from shifting mode existing to e-scooter sharing service as an alternative mode for first and last-mile integrated with public transport. Previous study reveals CO_2 emissions from e-scooter are 3.7 g CO_2/km [43)], and CO_2 emissions from gasoline motorcycle are 31.81 g CO_2/km[44)], In addition, the CO_2 emissions from electric buses are 32 g CO_2/km, and gasoline passenger cars produce 275 g CO_2/km [45)]. Based on the analysis, the number of CO_2 reductions in each mode shows in tables 7 to 12.

Table 13 describes the total number reduction of CO_2 emissions as an effect of e-scooter adoption as an alternative mode for first and last-mile integrated with public transport, and the estimated number of CO_2 emissions decreasing is 2,231,814.85 g CO_2 person trip per day.

Table 7. Reducing Emissions Due to Shifting Mode from Rent Motorcycle to E-Scooter Sharing Integrated With Public Transport

Route	Number (Person trip)	Gasoline Rent Motorcycle Emission (g CO_2/km)			E-Scooter Emission (g CO_2/km)			E-Bus Emission (g CO_2/km)			Emission Reduction (g CO_2)	Emission Reduction (g CO_2 person Trip)
		Dist	Em	Total	Dist	Em	Total	Dist	Em	Total		
a	b	c	d	c x d = e	f	g	f x g = h	h	i	h x I = j	e - h - j = k	b x k = l
North Kuta – Tabanan	719	17	31.81	540.77	4.4	3.7	16.28	12.6	32	403.2	121.29	87207.51
North Kuta – South Kuta	197	22	31.81	699.82	4.4	3.7	16.28	17.6	32	563.2	120.34	23706.98
North Kuta - Ubud	160	30	31.81	954.3	4.4	3.7	16.28	25.6	32	819.2	118.82	19011.2
TOTAL	1076											129925.69

Table 8. Reducing Emissions Due to Shifting Mode from Online Transportation to E-Scooter Sharing Integrated With Public Transport

Route	Number (Person trip)	Online Transportation Emission (g CO_2/km)			E-Scooter Emission (g CO_2/km)			E-Bus Emission (g CO_2/km)			Emission Reduction (g CO_2)	Emission Reduction (g CO_2 person Trip)
		Dist	Em	Total	Dist	Em	Total	Dist	Em	Total		
a	b	c	d	c x d = e	f	g	f x g = h	h	i	h x I = j	e - h - j = k	b x k = l
North Kuta – Tabanan	231	17	153.4	2607.89	4.4	3.7	16.28	12.6	32	403.2	2188.405	505521.55
North Kuta – South Kuta	63	22	153.4	3374.91	4.4	3.7	16.28	17.6	32	563.2	2795.43	176112.09
North Kuta - Ubud	51	30	153.4	4602.15	4.4	3.7	16.28	25.6	32	819.2	3766.67	192100.17
TOTAL	345											873733.82

Table 9. Reducing Emissions Due to Shifting Mode from Taxi to E-Scooter Sharing Integrated With Public Transport

Route	Number (Person trip)	Taxi Emission (g CO_2/km)			E-Scooter Emission (g CO_2/km)			E-Bus Emission (g CO_2/km)			Emission Reduction (g CO_2)	Emission Reduction (g CO_2 person Trip)
		Dist	Em	Total	Dist	Em	Total	Dist	Em	Total		
a	b	c	d	c x d = e	f	g	f x g = h	h	i	h x I = j	e - h - j = k	b x k = l
North Kuta – Tabanan	136	17	200	3400	4.4	3.7	16.28	12.6	32	403.2	2980.52	405350.72
North Kuta – South Kuta	37	22	200	4400	4.4	3.7	16.28	17.6	32	563.2	3820.52	141359.24
North Kuta - Ubud	30	30	200	6000	4.4	3.7	16.28	25.6	32	819.2	5164.52	154935.6
TOTAL	203											701645.56

Table 10. Reducing Emissions Due to Shifting Mode from Private Motorcycle to E-Scooter Sharing Integrated With Public Transport

Route	Number (Person trip)	Private Motorcycle Emission (g CO_2/km)			E-Scooter Emission (g CO_2/km)			E-Bus Emission (g CO_2/km)			Emission Reduction (g CO_2)	Emission Reduction (g CO_2 person Trip)
		Dist	Em	Total	Dist	Em	Total	Dist	Em	Total		
a	b	c	d	c x d = e	f	g	f x g = h	h	i	h x I = j	e - h - j = k	b x k = l
North Kuta – Tabanan	122	17	31.81	540.77	4.4	3.7	16.28	12.6	32	403.2	121.29	14797.38
North Kuta – South Kuta	33	22	31.81	699.82	4.4	3.7	16.28	17.6	32	563.2	120.34	3971.22
North Kuta - Ubud	27	30	31.81	954.3	4.4	3.7	16.28	25.6	32	819.2	118.82	3208.14
TOTAL	182											21976.74

Table 11. Reducing Emissions Shifting Mode from Rent Car to E-Scooter Sharing Integrated With Public Transport

Route	Number (Person trip)	Private Motorcycle Emission (g CO_2/km)			E-Scooter Emission (g CO_2/km)			E-Bus Emission (g CO_2/km)			Emission Reduction (g CO_2)	Emission Reduction (g CO_2 person Trip)
		Dist	Em	Total	Dist	Em	Total	Dist	Em	Total		
a	b	c	d	c x d = e	f	g	f x g = h	h	i	h x I = j	e - h - j = k	b x k = l
North Kuta – Tabanan	14	17	275	4675	4.4	3.7	16.28	12.6	32	403.2	4255.52	14797.38
North Kuta – South Kuta	4	22	275	6050	4.4	3.7	16.28	17.6	32	563.2	5470.52	3971.22
North Kuta - Ubud	3	30	275	8250	4.4	3.7	16.28	25.6	32	819.2	7414.52	3208.14
TOTAL	21											103702.92

Table 12. Reducing Emissions Due to Shifting Mode from Private Car to E-Scooter Sharing Integrated With Public Transport

Route	Number (Person trip)	Private Car Emission ($g\ CO_2/km$)			E-Scooter Emission ($g\ CO_2/km$)			E-Bus Emission ($g\ CO_2/km$)			Emission Reduction ($g\ CO_2$)	Emission Reduction ($g\ CO_2$ person Trip)
		Dist	Em	Total	Dist	Em	Total	Dist	Em	Total		
a	b	c	d	c x d = e	f	g	f x g = h	h	i	h x I = j	e - h - j = k	b x k = l
North Kuta – Tabanan	54	17	275	4675	4.4	3.7	16.28	12.6	32	403.2	4255.52	229,798.08
North Kuta – South Kuta	15	22	275	6050	4.4	3.7	16.28	17.6	32	563.2	5470.52	82,057.8
North Kuta - Ubud	12	30	275	8250	4.4	3.7	16.28	25.6	32	819.2	7414.52	88,974.24
TOTAL	81											400,830.12

Table 13. The Number of CO_2 Reduction Consequence Shifting Mode to E-Scooter Sharing Integrated Public Transport

No	Existing Mode	Reduction ($g\ CO_2$ Person Trip)
1	Rent Motorcycle	129,925.69
2	Online Transportation	873,733.82
3	Taxi	701,645.56
4	Private Motorcycle	21,976.74
5	Rent Car	103,702.92
6	Private Car	400,830.12
TOTAL		2,231,814.85

Table 13 describes the total number reduction of CO_2 emissions as an effect of e-scooter adoption as an alternative mode for first and last-mile integrated with public transport, and the estimated number of CO_2 emissions decreasing is 2,231,814.85 g CO_2 person trip per day.

4.5 Environment Awareness Influences The Willingness To Pay Value To Use E-Scooter Sharing.

As an environmentally friendly mode, e-scooters are fascinating to people with environmental awareness. Previous research in Canada shows people with environmental concerns are more likely to use e-scooters[46]. A similar result is revealed in this study, based on further analysis by dividing the respondents into two groups i.e. environment awareness group and not. The analysis result describes that both groups have different estimator values, as shown in Table 14.

Table 14. Estimator Values of Respondents Environment Awareness

Parameters	Environment Awareness		No Matter the Environment	
	Est	Sig	Est	Sig
ASC. Scoter	-0,8773	*	-1,0832	
ΔTime	-0,0536	***	-0,0657	*
ΔCost	1,8782	***	1,7237	***
Age	-0,1161	*	0,3767	
Income	-0,1729	***	-0,3911	.
Log-likelihood	-357,062		-36,5495	

Table 15. Utility Function of Respondents Environment Awareness

Utility Function
U_{Envi} = -0,8773 – 0,0536*X_1 + 1,8782*X_2 - 0,1161*X_3 - 0,1729*X_4
U_{No} = -1,0832 – 0,0657*X_1 + 1,7237*X_2 + 0,3767*X_3 - 0,3911*X_4

Further analysis was conducted based on utility function to know the respondent's willingness to pay values between respondents with environmental concerns and not. Analysis result from both respondent groups describes different values where groups of respondents who care about the environment are willing to use e-scooter sharing if there are savings in travel cost for $ US 1.5. On the other hand, a respondent group with no environmental awareness shows $ US 1.9, which means respondents who have environmental awareness crave to pay $ US 0.4 or 21% higher than another group to use e-scooter sharing services. This result has a related conclusion to another study in Germany regarding residents' willingness to use e-scooter sharing services where citizens with environmental awareness will pay higher costs to use e-scooter sharing services[47].

4.6 The Policy and Managerial Implications To Local Government

The discussion in the previous chapter shows that the benefits of implementing e-scooter sharing services include the potential to reduce emissions produced by motorized vehicles at 2,231,814.85 g CO2 per trip per day and tourist interest in using e-scooter sharing services high enough at 30.98% of the number of tourists. Tourists who care about the environment are willing to pay more to use e-scooter sharing integrated with public transportation as their first and last-mile transportation.

Generally, the use of e-scooter-sharing services has the potential to be applied, so local governments need to carry out further preliminary studies before implementing e-scooter sharing service as an alternative mode, especially to accommodate crucial issues such as safety aspects and determine areas where special lanes can manage to deploy e-scooters.

If the operator providing the e-scooter sharing service will expand market in the North Kuta tourist area, it is necessary to carry out related studies comparing travel time using existing modes with e-scooters integrated with public transport, so they can determine the right price according to tourists' so that they can increase the willingness to switch modes to e-scooter sharing.

5. Conclusion

E-scooter sharing schemes for first and last-mile transports integrated with public transport are prospective to be adopted to increase the quality and sustainability of tourist regions including Bali province. This study was conducted in The North Kuta tourist areas to capture tourist preferences to use e-scooter sharing services as first and last-mile transportation modes. Further analysis shows socioeconomic characteristics that influence travelers to use e-scooter sharing are age and income. Moreover, tourists prefer to use e-scooter sharing services when the presence of a travel cost saving of US $1.5 with extra travel time 15 minutes. The forward analysis reveals the potential demand for e-scooter sharing service is 1908 person trips per day, which means it can reduce CO_2 emission at 2,231,814.85 g CO_2 person trip per day. This study also revealed that respondents accompanied by environmental awareness crave to pay $ US 0.4 or 21% higher to use e-scooter sharing services than the respondents no matter to the environment. To decide which area has the potential to apply e-scooter sharing services as a choice mode for the first and last mile in tourist areas, the government of Bali province needed to conduct further research to deal with necessary concerns such as safety issues. Furthermore, The operator must research comparison journey time from the existing mode with e-scooter sharing services as first and last mile mode to determine the proper cost for renting an e-scooter to grow up willingness to shift to use e-scooter sharing. Further research can analyze domestic traveler desire to pay for e-scooter sharing services and compare it with the result in this study to find out the best willingness to pay rate in tourist areas.

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Nomenclature

$P(i \mid C_n)$	probability an alternative i
$P_n(i)$	probability alternatives choice i
$P_n(j)$	probability alternatives choice j
ε_n	logistic distribution
n	sample quantity
N	population
U	utility value
ASC. Scoter	alternative specific constants for e-scooter
RM	rent motorcycle
OT	online transportation
PM	private motorcycle
PC	private car
RC	rent car
Dist	distance (km)
Em	emission (g co_2)
$\Delta Time$	extra time travel
$\Delta Cost$	travel cost saving
U_{Envi}	utility function for environment awareness group
U_{No}	utility function for no matter the environment group

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