

# The Sustainability of Transport Mode Choice among B40 Groups in Urban Areas: A Case Study of Penang Island, Malaysia

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**Abstract.** The proliferation of privately owned vehicles contributes to various urban mobility issues, including traffic congestion. This study was conducted in Penang Island, Malaysia with the aim of examining the dominant transport mode choice among B40 groups, articulating the urban mobility issues they encountered and capturing their expectations regarding transport, particularly for commuting to their workplaces. In order to achieve that objective, this study employed a mixed-method technique. For the quantitative component, a total of 306 respondents from households classified as B40 were selected from Penang's eKasih Programme in the 2016 list, using a stratified random sampling upon ratio. Meanwhile, the qualitative component was conducted with a subset of 10 automobile-dependent respondents selected from 306 respondents who commute a distance exceeding 15 kilometres to their workplaces. The findings of the study reveal that specifically 29.08% of the northeast district and 42.81% of the southwest district on Penang Island, are motorcycle-dependent. It is imperative to enhance transportation policy by implementing strategies that focus on enhancing the appeal of public transportation through refurbishment efforts and diversification of transport modes. This approach aims to ensure the provision of affordable, sufficient, and efficient public transport options that can effectively cater to varying levels of demand.

## 1 Introduction

It is crucial to improve the efficacy and availability of the public transport infrastructure, as it essentially possesses greater sustainability than private automobiles such as cars, especially for socioeconomically disadvantaged populations. In addition, the improvement of mobility networks will have a positive impact on achieving desired levels and patterns of mobility, ultimately leading to the reduction of carbon emissions [1]. Numerous recent studies have been conducted in various urban areas across diverse geographical regions, focusing on the determinants that influence individuals' choices of transportation modes. In a study conducted by Obregon-Biosca [2] an investigation was carried out to analyze the factors

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influencing the selection of transport modes in the metropolitan area of Queretaro, Mexico. The findings of the study revealed that income has a significant role in determining the preference for motorized transportation. In their study, Zhu et al. [3] investigated the determinants of transport mode selection in Hong Kong. Their findings revealed that the built environment attributes play a significant role in shaping individuals' decision-making process between public transportation and private automobiles. In a study conducted by Acheampong [4], an investigation was conducted on the selection of transportation modes in Kumansi Metropolis, Ghana. The findings indicated that those with higher incomes showed a preference for private vehicles, while those with lower incomes exhibited a tendency to commute on foot. This trend was attributed to the prevalence of informal employment among low-income groups, which often necessitates proximity to their residential regions.

In Malaysia, households with a monthly income below RM4849.00 are categorised as the Bottom 40% (B40) category, representing the lower-income segment of the country's population [5]. These particular groups exhibit a higher propensity to opt for unsustainable modes of transportation, provided that such modes are both efficient and cost-effective in enabling them to arrive at their workplace punctually. However, their choice may expose them to many hazards that have the potential to jeopardise both their overall well-being and the quality of their lives. Hence, considering the difficulties faced by low-income individuals in attaining sustainable transportation options for commuting to their workplaces in urban regions, particularly those residing in suburban areas, this research was carried out in the northeast and southwest districts of Penang Island, Malaysia. The objective of this study was to examine the dominant transport mode choice and the expectations regarding transportation, particularly for commuting to the workplace.

### **1.1 The Transportation Landscape in Penang**

In Penang, the inadequacy of the public transportation system leads individuals to choose private vehicle ownership as a means of transportation, resulting in a rise in the number of vehicles on the roads [6]. This situation leads to traffic congestion [7] which needs the improvement of the existing public bus services [8]. It is also imperative for Penang to expeditiously establish a robust public transportation infrastructure [9]. The public transportation infrastructure is necessary to be integrated, high-frequency, and dependable services to alleviate dissatisfaction and encourage individuals to transition from using owned vehicles to opting for public transportation [10]. By conducting a comparative analysis between Penang and Singapore, it is worth noting that in this particular state, just five per cent of road users opt for public transportation, in stark contrast to Singapore where a significant 67 per cent of commuters rely on public transport [7], which reflects the higher reliance on private vehicles [11]. Singapore is equipped with complete mass transit that effectively enhances the mobility of its residents and provides convenient access to various destinations [8]. Therefore, it is imperative for a densely populated urban centre like Penang to provide complete, adequate and efficient public transit as well.

### **1.2 Addressing the Challenges in Urban Mobility**

The selection of transport mode choice subsequently will impact their general well-being and satisfaction with life [12]. Nevertheless, the dependence on privately owned vehicles can indirectly contribute to the incidence of traffic congestion [13]. It is worth mentioning that urban transportation in Malaysia contributes significantly to carbon emissions, accounting for around 85% of the total emissions [14]. This amount is correlated with the demand for transportation in Malaysia and rapid population growth [15]. The phenomenon of traffic

congestion in numerous urban areas in Malaysia arises as a result of the industrialization and urbanization processes. In order to mitigate this issue, scholars have identified the possible efficacy of implementing public transportation as a viable option [16]. Significant traffic congestion is observed in urban areas of Malaysia, namely in the Klang Valley, Penang, and Johor Bahru. As a consequence, commuters experience delays in their trip to their places of employment, resulting in the squandering of time and heightened expense of fuel. According to Asia Mobiliti [17], the combined financial losses resulting from these variables have the potential to amount to billions of ringgit.

The Penang state government is developing a strategic initiative called the Penang Transport Master Plan (PTMP) to effectively tackle urban mobility challenges, with a particular emphasis on addressing traffic congestion problems. This plan aims to enhance the existing infrastructure and transport network, which are currently insufficient in meeting the demands of the region [18]. The PTMP plan encompasses the implementation of several transport infrastructure projects, including the construction of new motorways, water taxis, LRT, and train lines that would span the Penang channel in a parallel manner to the existing Penang Bridge [19]. The Penang Transport Master Plan (PTMP) is expected to bring about a revitalization of the transport sector in Penang, addressing urban mobility difficulties, with a special focus on alleviating traffic congestion.

## 2 Methodology

The research was carried out using a combination of quantitative and qualitative methodologies. Quantitative data is generally considered to possess a higher degree of objectivity compared to qualitative data, however, it may lack the same level of specificity. Quantitative data facilitates the generation of statistical sets that can be utilised for comparative analysis with other statistical measures.

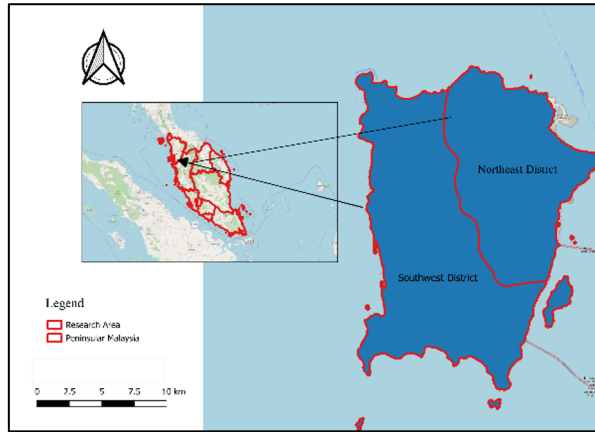
In addition, the qualitative data will yield valuable insights by emphasising specific facets of the study. Therefore, the integration of both approaches will enhance the effectiveness of each strategy, leading to improved generalisation. The study utilised quantitative data to ascertain the demographic features of the respondents and analyse their selection of transportation modes. The survey form is disseminated directly to respondents, who are provided with a designated timeframe to complete it before retrieval. The research approach employed in this study consisted of administering questionnaires to a sample of 306 respondents. The respondents in this study were chosen by a stratified random sampling method, which was based on the ratio of B40 households enrolled in the eKasih Penang welfare programme for the year 2016.

Simultaneously, the qualitative data was employed to articulate the urban mobility issues encountered by commuters who rely on privately owned vehicles for their daily trip to the workplace and to capture their expectations pertaining to transport, specifically in relation to commuting to their workplace. The qualitative component of the research entailed conducting interviews with a subgroup of ten individuals who were chosen from the original sample of 306 respondents based on their stated commuting distances exceeding 15 kilometres using private vehicles to the workplace. The qualitative respondents for this study were questioned in person for a duration of less than one hour. The data was acquired by transcribing the interaction with the respondents.

### 2.1 Research Area

Penang is a state located on the northwest coast of Peninsular Malaysia. It is characterised by a physical composition that includes both an island and a contiguous rectangular land region on the mainland. The northeast district of Penang State encompasses the urban region and

serves as the administrative centre for the Penang State, housing its capital city. The primary business centre also is situated inside this district. In contrast, the southwest district encompasses both urban and suburban regions, characterized by a significant number of unoccupied places that offer ample opportunities for a wide range of spatial activities. However, the district in question is geographically distinct from the northeast district due to the presence of a mountainous ridge running through the centre of the island. This ridge is characterized by rugged terrain and meandering roadways. The research site comprises the island region of Penang state, encompassing the districts located in the northeast and southwest (Figure 1).



**Fig. 1.** Map of Research Area in Penang State, Malaysia

### 3 Results and Discussion

Basically, the quantitative data obtained were analysed statistically through descriptive statistics analysis and cross-tabulation. Meanwhile, the qualitative data were analysed using the content analysis method. The statistical quantitative analysis part was done to oversee the transport mode choice to work among respondents. On the other hand, the content analysis for the qualitative part is mainly to obtain the expectations of the respondents about transportation to work.

#### 3.1 Demographics Characteristics

Initially, the statistical analysis of the demographic characteristics of the respondents was projected in Table 1.

**Table 1.** Demographic characteristics of the respondents

Demographic Characteristics	Northeast District		Southwest District	
	Total	Percentage (%)	Total	Percentage (%)
<b>Ethnicity</b>				
Malay	109	35.62	147	48.04
Chinese	8	2.61	7	2.29
Indian	13	4.25	22	7.19
<b>Household Income</b>				
	Total	Percentage (%)	Total	Percentage (%)

Less than RM2,500	115	37.58	166	54.25
RM2,500-RM3,169	13	4.25	8	2.62
RM3,170-RM3969	2	0.65	2	0.65

The respondents' ethnic composition reveals that 35.62% of individuals are Malay, with the majority (48.04%) residing in the southwest district. Chinese respondents constitute 2.61% of the northeast district and 2.29% of the southwest district. Additionally, individuals of Indian ethnicity account for 4.25% of the northeast district and 7.19% of the southwest district. Based on the anticipated statistics, it is evident that the predominant ethnic group in this study is Malay, with Chinese and Indian ethnicities following suit. Moreover, a significant proportion of the respondents (54.25%) residing in the southwest district reported a monthly household income below RM2500.00. Similarly, the northeast district exhibits a notable trend, as a significant proportion of respondents from this region fall into the household income bracket of less than RM2500.00, accounting for a total of 37.58%.

### 3.2 Transport Mode Choice

Further, the transport mode choice to work among the respondents was tabulated in Table 2. Based on the data, in the northeast district, the types of vehicles that respondents use to commute to work are public buses, motorcycles, cars and employers' vehicles such as buses or vans. Basically, among these four types of vehicles, only motorcycles and cars are private vehicles. Apparently, the transport mode choice pattern among the respondents of this study is dominated by motorcycles, as respectively, the majority of 29.08% of the respondents from the northeast district and 42.81% of the respondents in the southwest district are travelling to the workplace using motorcycles. Chiu [20] examined the relationship between motorcycle travel and the built environment was found that motorcycle ownership and its selection as the dominant transport mode choice are directly proportional to the population density, distance from house to central business district and distance from house to metro stations. Indirectly, this finding supports this study's finding by providing an idea that the selection of motorcycles as the dominant transport mode choice is influenced by the population density on the island of Penang and the situation of being apart between residential or workplace locations from public transport stations. Besides, Chiu and Guerra [21] elucidated that motorcycles had been chosen as a transport mode because of income, age, commuting time and commuting cost, compared to other modes. Thus, this also indirectly explains the findings of this study about the socio-economic background with low-income influences on the selection of motorcycles as the dominant transport mode for saving commuting time and costs.

**Table 2.** Transport Mode Choice to Work

District	Public Bus (%)	Motorcycle (%)	Car (%)	Employer's Vehicle (%)
Northeast	1.63	29.08	8.82	2.94
Southwest	3.92	42.81	8.50	2.29

### 3.3 Challenges and Expectations on Commuting to the Workplace

The lack of efficiency in the public transportation system in residential areas has resulted in individuals opting for private vehicles to meet their daily mobility requirements. According to Pigeon et al. [22] the primary determinants influencing individuals' decision to utilize public transportation include service-related variables, such as timeliness, scheduling,

and fares, as well as safety considerations encompassing both road and on-board safety. In a recent study conducted by Varghese et al. [23], it was observed that the absence of public transportation to meet the growing demand was partially mitigated by the services provided by informal private transport operators. However, the inefficiency of these services resulted in individuals reverting back to relying on private vehicles. This shift was driven by people's unwillingness to tolerate long queues and extended waiting times, particularly during off-peak periods. The respondent's account provides insight into the challenges faced by local inhabitants in dealing with road conditions and heavy traffic. Several participants in this survey also expressed concerns about the inadequacy of the public transportation system in this particular state.

Respondent 4 (Female, 30 years old, Motorcycle dependency mobility to work):

*"The first problem is the lack of efficient public transport. The condition of the road is not that good. Road problems are not new problems, when it rains the road will be slippery, and there are potholes on the roads. Traffic congestion problem, when there is no efficient public transport, people have to use their own transport. So, the situation will become more crowded."*

Respondent 6 (Male, 38 years old, Motorcycle dependency mobility to work):

*"Public bus from my house at Air Itam straightforward go to my workplace in Bayan Lepas if there many available, it would be so easy."*

Respondent 7 (Male, 25 years old, Motorcycle dependency mobility to work):

*"Difficulty that i had during travelling to work is traffic jam. Every day i need to face with traffic jam. Facility that i need is bus."*

Actually, most of the Penangites also hope for reliable mass transit to make daily mobility using public transport much better, just like other cities which provides urban sustainable mobility excellently and affordably to be accessed by all levels of communities. As people are involved in daily mobility for various activities, the transport demand keeps on rising. Hence, transit services such as LRT or MRT in Penang state are the mass transit which is in demand. Not everybody can afford to buy their own vehicles, especially disadvantaged groups in urban areas. This group really hoping for affordable and reliable public transport. Sidek et al. [24] found that the choice to use public transport is influenced by two main factors, namely socio-economic and travel characteristics. Mostly low-income earners with travel characteristics of major activities such as home, work and education tend to choose public transport [24]. There is a perception from a respondent who opined that mass transit such as LRT needs to be provided in Penang such as in Kuala Lumpur to overcome the heavy traffic and lack of parking space problems.

Respondent 5 (Female, 35 years old, Car dependency mobility to work):

*"If there is LRT here like in KL, it's good because there's no problem with jams, there's no problem with parking. Driving a car, parking is the big problem, if there is no parking for me, I will be in trouble."*

Respondent 10 (Female, 26 years old, Car dependency mobility to work):

*"Here should be LRT available, so we don't have to go through heavy traffic. But, the on-time ones. If available, but long queues, many people got late to work, it is also not ok."*

## 4 Conclusion

In general, the results of this study offer insights into the travel patterns exhibited by the B40 demographic, with a particular focus on their preferred mode of transportation. This circumstance arose due to a deficiency in public transport infrastructure. Nevertheless, the respondents expressed a desire for the implementation of mass transit systems, such as Light Rail Transit (LRT) or Mass Rapid Transit (MRT), citing concerns with lengthy commutes and the prevalent issue of traffic congestion. Based on the available data, policymakers can utilize it as valuable input for formulating strategies aimed at enhancing mobility requirements within the B40 demographic. It is also necessary to gather an adequate amount of data in order to effectively design the provision of public transport, taking into account the specific mobility demands of the target population. To acquire this valuable data, it is imperative for the government to establish a platform wherein members of the target demographic are periodically invited to provide updates on their mobility information. Therefore, the establishment of an urban mobility data bank will facilitate the development of more effective strategic sustainable urban mobility planning. Developing effective strategies and implementing well-informed plans based on the current demand can enable the government to adequately meet the corresponding supply requirements.

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