

Combined Housing and Transportation Affordability in Peri-Urban Region

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Abstract:

The peripheral area is considered as a preferable location for having affordable housing. However, the transport costs that appear as a consequence of the housing location might take up a considerable share of the household's income. This study aimed to identify the combined housing and transportation (CHT) affordability in the peri-urban region of the Surabaya Metropolitan Area. A survey was conducted in three subdistricts of the Sidoarjo Regency, which are Waru, Gedangan and Sidoarjo sub-districts. The result showed that those three areas are affordable if only the housing costs are considered. However, they are unaffordable if transports costs are included. This suggests that the CHT affordability might depict the true affordability if the transportation costs are included. Therefore, this study suggests that a comprehensive land use planning might be needed in order to create sustainable development.

Introduction

The increasing number of population living in urban areas would lead to the increasing demand for land for settlement. According to a report by the UN-Habitat (2016, p.7), by 2030, the number of urban inhabitants will be doubled in the developing countries. Moreover, according to the World Bank (2018), the urban population of Indonesia has increased from 49.91% in 2010 to 54.66 % in 2017.

As an urban area grows, it increases the need for housing which is less affordable houses available at the city centres. According to the Fitoriani's study (2017), people who live in urban areas are likely not to own a house compared to those who live in rural areas. Therefore, people choose to live in the peripheral area where housing is assumed to be more affordable. As it has

suggested in some studies, the peripheral area is more suitable for residential location because it fits households' budget constraint to meet the preferable housing attributes, accessibility and land price (Rezita & Rahayu, 2017; Saputra, 2018; Serlin & Umilia, 2013). Thus, the peri-urban region development might become a response to the limited urban land in providing the needs of residential areas.

The Sidoarjo Regency, one of the peri-urban regions of the Surabaya Metropolitan Area, might experience significant growth in housing development. The Sidoarjo Regency has analysed the housing needs by forecasting the population growth. It is predicted that in 2025, 15% of total inhabitants in the Sidoarjo Regency would come from Surabaya City. Moreover, it is also predicted that the housing needs in

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2024 are 565.345 units (Sidoarjo Regency Local Government, 2014).

However, people may not consider the commuting cost that is associated with their housing location choice. Whereas, the transportation expenditure was noticed to have the second-highest share in household income (CTOD & CNT, 2006; Hamidi, Jahan, & Moazzeni, 2018). Meanwhile, the Sidoarjo Regency contributes to the third-highest number of vehicles in East Java Province. Also, the growth of motorbike ownership is 5,7% annually (Baidhowi, 2019).

Although the peri-urban regions considered as affordable for residential locations, it might burden the people by increasing the transportation cost because people rely more on private vehicles. Thus, it is important to highlight that there is one issue that the housing cost to income ratio, which is usually evaluated to make an estimate of the housing affordability, may not capture the whole problem of affordable housing. This is because transportation cost also contributes to the total share in household expenditure (Mattingly & Morrissey, 2014).

Considering this issue, recently, housing affordability has become a major concern in housing studies. Many experts have developed measurements in order to analyze the housing affordability in various urban settings. Some measurements consider housing affordability as a component of the housing cost itself and consider the transportation cost that one household has to bear as a part of the cost of living in that location. For example, some studies in London and Paris have developed an index-the housing and transportation index-in order to explain the correlation between housing and transportation (Cao & Hickman, 2017; Guerra & Kirschen, 2016). In the Indonesian context, Dewita, Yen, & Burke (2018), based on their study in Bandung, mentioned that the

housing located in the peripheral area is more affordable when measured without considering the transport cost. However, when the measurement includes the transport cost, the results appear differently based on the socio-economic conditions of the households (Dewita et al., 2018; Saberi, Wu, Amoh-gyimah, & Smith, 2017).

Although there are a number of studies on housing affordability, studies that focus on the context of Indonesian cities are still limited (e.g. Dewita et al., (2018); Indrianingrum, (2017)). Moreover, it seems that there is little discussion that pays attention to the peri-urban areas. The peri-urban areas are important because they are the key aspects of sustainable cities, especially if they maintain a good connection with the urban and rural areas (N Rukmana & S A Widyastuti, 2018).

In order to capture the different contexts of housing affordability in Indonesia, this study will investigate the housing affordability with a focus on the peri-urban region of the Surabaya Metropolitan Area (SMA), especially in the Sidoarjo Regency. In that context, this study wishes to understand how the housing affordability index can be depicted in the context of the Indonesian cities.

Literature Review

This chapter describes a number of previous studies related to housing, housing affordability, and the CHT (combined housing and transport) affordability.

a. Housing

House is functioned to meet not only a physical-needs as a shelter but also other needs as a place for people to define their identities, personalities, as well as to develop a livelihood (Santoso, 2017). Additionally, a home dynamically grows as an individual grows so that one views a house as a living object, more than just a commodity (Budihardjo, 2009). According to Indonesian Law 11,

year 2011 on Housing and Settlement, housing is defined as “a collection of houses as part of settlements, both urban and rural, which is equipped with infrastructure, facilities and public utilities as a result of efforts to fulfill livable homes (Indonesia, 2011).

b. Housing Affordability

In order to acquire a housing, people need to sacrifice their resources. According to Turner (1976), people would only spend their resources limited at the amount they can afford in order to get an adequate housing. In deciding which dwelling they buy, people would make a priority of the housing criteria based on their knowledge (Turner, 1976, p.51). Therefore, people might determine the housing value based on a rational consideration.

However, one might not purchase a house out of their financial power, it becomes a major concern of experts in defining the housing affordability. Housing affordability has been discussed among experts as a term used to define a burden in home-ownership (Hulchanski, 1995; Stone, Burke, & Ralston, 2011).

Housing affordability is described as the ability of a household in fulfilling housing needs without sacrificing other basic needs. One of the most common measures of housing affordability uses the proportion of housing expenditure to households' income (Hulchanski, 1995; Stone et al., 2011). The common standard to measure housing affordability is that households' expenditure on housing is less than 30% of the income at any level of income (Aribigbola, 2011; Hulchanski, 1995). However, this approach of using 30% of the housing expenditure-to-income ratio can barely depict all other expenditures that are shared with the income, in particular

transport costs (Jana, Bardhan, Sarkar, & Kumar, 2016).

c. CHT (Combined Housing and Transportation) Affordability

Some researchers mentioned that housing affordability, when measured by considering housing expenditure only, cannot measure “the true affordability”, due to the lack in considering transportation costs which are correlated to the housing location (CTOD & CNT, 2006; Litman, 2018; Mattingly & Morrissey, 2014). Therefore, in order to measure the ‘true affordability’ some researchers have included the transportation costs (Dewita et al., 2018; Hassan, Hamdan, Abdullah, & Abdullah, 2018; Mattingly & Morrissey, 2014). Additionally, some studies stated housing affordability as the total share of housing and transportation cost is ideally 45% at maximum (Hassan et al., 2018; Litman, 2018).

Moreover, there are various method to measure the “true affordability”, especially to examine the location affordability. Mattingly & Morrissey (2014), developed an indicator in measuring housing affordability by encompassing relevant costs that associated with housing location. Using zonal data derived from household-level data of the New Zealand census, the indicator explained housing affordability in the administrative area level. Moreover, they used the median data for the housing costs and transportation costs in order to prevent outliers from skewing the results, while the average data used for the commuting costs to address various modes of transport (Mattingly and Morrissey, 2014).

On the other hand, Dewita et al. (2018), also used the CHT affordability to examine the housing efficiency or

affordability. The study used mean data of households' income, housing costs, and transportation costs, that obtained from a designed survey in order to measure the housing affordability in the neighborhood (housing location) level. They further argued that the approach used in their study provided a more objective measure of affordability and establishes an affordability benchmark (Dewita et al., 2018).

Meanwhile, another study used the housing affordability to explain the significant contribution of geographical location on housing. In order to define housing affordability, Hassan et al., (2018), used median household income, mean housing expenditure and mean transportation expenditure that collected from a survey on the household level.

Thus, it is important to note which data to use in examine the locational affordability. This study used the median household total expenditure as a proxy to the household income. Furthermore, this study employed the median household housing costs and mean of transportation costs, which include the cost of owning the private vehicle, vehicle operating costs and others transportation expenditures.

Research Method

This section presents the method employed and the area in which this study was conducted, which include research location and time, research approach, data collecting method, and data analysis.

Research Location and Time

This study was conducted in 2019 in three sub-districts in the Sidoarjo Regency, which include the Waru, Gedangan and Sidoarjo sub-districts. According to Septanaya & Ariastita (2012), these three subdistricts have three different characteristics in terms of the spatial structure of peri-urban area.

Moreover, these three sub-districts have a difference in terms of the distance to Surabaya City as the center of the Surabaya Metropolitan Area. Therefore, further analysis would depict a real comparison of housing affordability in three different locations.

Waru Sub-district is one of the Sidoarjo Regency sub-districts where located in the northernmost area, bordered to the north by the Surabaya city. This sub-district consists of 17 villages with a total area of 3,032 hectares. According to the data of Waru sub-district in Figures published by BPS, the area of Waru subdistrict is covered by mostly dry land with a total of 81.16%. Furthermore, the total population in 2017 is 214,915 (BPS Sidoarjo, 2018b).

Meanwhile, Gedangan Sub-district is one of the Sidoarjo Regency sub-districts where located on the south of the Waru subdistrict. This sub-district consists of 15 villages with a total area of 2,368 hectares. According to the data of Gedangan sub-district in Figures published by BPS, the area of Gedangan subdistrict is covered by mostly dry land with a total of 68.52%. Furthermore, the total population in 2017 is 118,919 (BPS Sidoarjo, 2018a).

On the other hand, Sidoarjo Sub-district is one of the Sidoarjo Regency sub-districts where located on center of Sidoarjo Regency. This sub-district consists of 24 villages with a total area of 6,256.01 hectares. According to the data of Sidoarjo sub-district in Figures published by BPS, the area of Sidoarjo sub-district is covered by mostly dry land with a total of 92.84%, and the rest are paddy land. Furthermore, in 2017, the total population is 209,402 inhabitants (BPS Sidoarjo, 2018a).

Research Approach

This study used a quantitative approach which using the existing theories and previous studies to examine the factual condition in the study area.

Data Collecting Method

This study used a household survey that conducted in 2019. The survey was conducted in three sub-districts with a total of 110 respondents, which consist of 41 respondents from the Waru Sub-district, 28 respondents from the Gedangan Sub-district, and 41 respondents from the Sidoarjo Sub-district. These respondents might represent the total inhabitants in those three sub-districts as it is proportionally distributed as illustrates in the table 1 below.

Table 1. Respondent in Each Sub-District

Sub-districts	Total Population ^{*)}	Number of respondents
Waru	227,486	41
Gedangan	100,912	28
Sidoarjo	214,915	41
Total	543,313	110

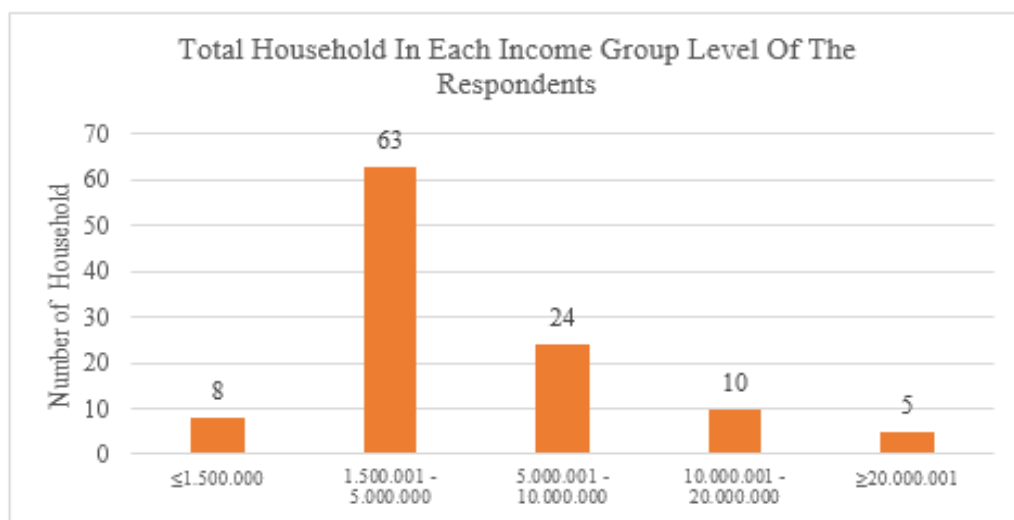
*) Data taken from Sub-districts in Figure (BPS Sidoarjo, 2018c, 2018a, 2018b).

The respondents also from different level of income group which the biggest number of households are from the income level between 1,500,000 and 5,000,000 rupiah. The detailed of respondent income group can be seen in the Figure1 below.

Data Analysis

In order to answer the research questions, this study employed the quantitative approach by calculating the CHT affordability for measuring the housing affordability and analysing the correlation between CHT affordability and several factors.

The calculation of the housing affordability index used the “affordability index” based on the analysis and theory developed by CTOD & CNT (2006), which also used in Dewita, Burke, & Yen, (2019), Dewita et al. (2018), including fuel and/or public transport fares. Transit costs, especially for middle to low-income groups, are associated with a household’s housing location choice. In many cases, households are making trade-offs by either spending more on housing in the inner city, with lower transport costs, or choosing more affordable housing in suburban areas, with higher commuting cost. As such, transport and housing costs are interrelated not only due to their substantial share in household budgets, but they are also linked as fundamental elements of urban systems. Understanding the pattern and linkages of both transport and housing affordability is important to support the formulation



Source: Author Analysis, 2019

Figure 1. Total Household in Each Income Group Level of the Respondents

of transport policies. This paper aims to quantitatively examine transport and housing affordability by exploring middle-to low-income household's transport and housing expenses in the Bandung Metropolitan Area (BMA study as follows:

$$CHT\text{ Affordability} = \frac{HC + TC}{I}$$

where CHT affordability are Combined Housing and Transport affordability; HC are Housing costs; Transportation Costs; and I are Income.

In order to define the location affordability, this study used median income and housing costs as well as mean transportation costs.

After the index was calculated, the housing affordability was categorized based on the degree of affordability. The categories used in this study were adopted from Hassan et al.'s (2018) study, which was based on Litman's study. The categories have been adjusted based on the calculations used in this study, which calculate the ratio of combined housing and transport expenditure to the total expenditure instead of the residual income. Table 2, below describes the housing affordability categorization.

Table 2. CHT Categorization

Rating	CHT affordability index
Affordable	<0.45
Slightly unaffordable	0.45-0.6
Moderately unaffordable	0.61-0.75
Severely unaffordable	>0.76

After identifying the CHT affordability, the analysis followed by analysis the correlation between CHT affordability, housing location, and transport mode choice, which detailed in the Table 3.

Table 3. Respondent Correlation Analy-sis

Variables	Indicators	Measure unit	Cor-relation analysis	
1. The correlation between CHT affordability, and housing location				
Dependent Variable			Pearson cor-relation analysis	
CHT af-fordability	CHT afford-ability index	-		
Inde-pendent Variables				
Housing location	Commuting distance	km		
	Distance to main road	km		
	Distance to public transport facilities	Km		
	Distance to center of Regency	Km		
	Distance to center of Province	Km		
2. The correlation between CHT affordability and travel behavior				
Dependent Variable			Pearson cor-relation analysis	
CHT af-fordability	CHT afford-ability index	-		
Inde-pendent Variables				
travel behavior	Number of private vehicles owned	In num-ber		
	Number of Commuter	In num-ber		
Transportation mode choice		-		Crosstab analysis

Result and Discussion

Analysis of housing affordability has been conducted by using surveyed data in three sub-districts in the Sidoarjo Regency which are Waru, Gedangan and Sidoarjo

Sub-districts. The result showed that the location affordability is varied in those three sub-districts as illustrated in the table 3 below.

According to Table 4, it can be seen that in terms of location affordability, only the Sidoarjo sub-district is affordable when only consider the housing costs. When the transportation costs are taken into consideration, the affordability among those three subdistricts is notably different. The Waru sub-district was categorized as severely unaffordable, given that the CHT affordability index is higher than 0.75. Meanwhile, the Gedangan sub-district was categorized as seriously unaffordable, and Sidoarjo Sub-district was categorized as affordable. It means that people in the Waru sub-district, regardless of the income group, experience the highest in terms of unaffordability in housing and transportation.

Tabel 4. Housing Affordability and CHT Affordability in Selected Sub-Districts in 2019

Sub-districts	HA	CHT
Waru	0.417	0.960
Gedangan	0.333	0.694
Sidoarjo	0.211	0.423

Source: Author Analysis, 2019

The result also showed that people in Waru Sub-district might spend the highest transportation costs among the others. Thus, it caused a significant difference in terms of housing affordability from 0.417 to 0.960 after the transportation costs are included. This means that people spend more than half of their total expenditure on transportation costs. Meanwhile, the transportation expenditure of people in the Gedangan and Sidoarjo sub-districts takes 36.1% and 21.2% out of their total expenditure respectively. This result indicates that none of these sub-districts considered as affordable location in terms of transportation affordability, which recommended to take 15% of the income at maximum.

Table 5. The Pearson Correlation of the CHT Affordability and The Housing Location in Waru, Gedangan, and Sidoarjo Subdistricts

	CHT	Commuting distance	Distance to main road	Distance to nearest public transportation facilities	Distance to center of regency	Distance to center of Province
CHT	1.0000					
Commuting distance	0.1857	1.0000				
Distance to main road	-0.1202	-0.0777	1.0000			
Distance to nearest public transportation facilities	0.1815	-0.0120	0.2034	1.0000		
Distance to center of regency	0.1142	-0.2072	0.1583	0.2114	1.0000	
Distance to center of Province	0.0342	0.1158	-0.0492	0.0376	-0.2713	1.0000

Source: Author analysis, 2019

At the household level, there was a various degree in terms of CHT affordability as it is shown in figure 2. For example, in the affordable category, it can be seen that more than 50% of households reside in the Sidoarjo sub-district still enjoy affordable housing. Meanwhile, in the Waru and Gedangan sub-districts, there are 27% and 34% of people living in affordable housing. Meanwhile, the rest experienced unaffordable in terms of CHT affordability with various degrees of unaffordability.

By having the CHT affordability analysis, it can be seen that the transportation costs which incorporated with the housing location choice might take a considerable share of total household expenditure. Although The Sidoarjo Regency, is considered as a preferred residential location because of the relatively lower rate of housing price in the Sidoarjo Regency compared to the price in Surabaya City (Serlin & Umilia, 2013), all selected sub-districts in this study appear to be unaffordable when considering the transportation costs.

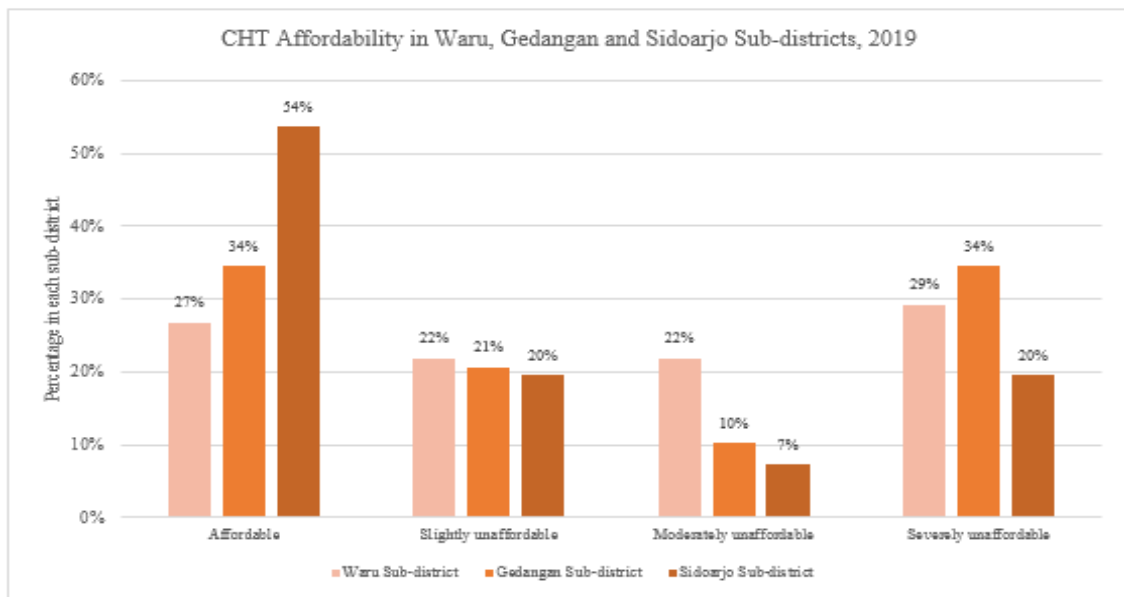
Therefore, one might consider transportation costs that appear as a

consequence of the housing location because it may take up a considerable share of household income.

According to the CHT affordability analysis, it can be seen that the shorter distance to the city center (Surabaya City), the more severe the degree of unaffordability of the housing as well as the transportation costs. Thus, the peri urban areas might not become preferable locations for people to reside because the housing and transportation costs are higher than they recommended to.

This study also tried to analyze the correlation of CHT affordability and the housing location in the three sub-districts. The housing location factor is determined by the commuting distance, distance to the main road, nearest public transportation facilities, the center of regency, as well as center of the province.

The correlation analysis result shows that among the location variables, all indicators have a statistically low positive correlation to CHT affordability except the distance to the main road. It means that the more distance the housing from the main road, the more affordable (lower



Source: Author Analysis, 2019

Figure 2. CHT Affordability in Waru, Gedangan and Sidoarjo Sub-districts, 2019

CHT affordable) the house is. The result of correlation analysis is shown in the Table 5.

The result also shows that the commuting distance appears to have relatively the strongest association among all the location indicators with the Pearson coefficient 0.1857. Thus, the place of main activities might be taken as the first consideration of the household in determining the housing location.

In addition, the distance to the public transport facilities seems to have about the same coefficient with the commuting distance with the Pearson coefficient 0.1815. This statistical result means that the distance to public transportation facilities has a positively low correlation with the CHT affordability. Regardless of the transportation modes household use for the daily commute, the housing access to the facilities, such as nearest bus stop, bus terminal, or road where *angkot* (local transportation) pass through, may contribute to the housing price that also contribute to the CHT affordability.

For the correlation analysis between CHT affordability and housing location, it showed that the closer the housing location to Surabaya City, the highest the CHT affordability index is. This result also supports the previous explanation by looking into the Pearson coefficient in both correlation tests using the IFLS data and survey data. It showed that the CHT affordability has a positive correlation with the distance to the center of the province. Although it appeared a low coefficient, it still showed that the distance to the

province might have a contribution to the CHT affordability. It also indicates that the Surabaya Metropolitan Area is a monocentric city. Comparing to the result Dewita et al. (2018), study on a similar correlation analysis, it showed a negative relationship in Bandung Metropolitan Area (BMA). It means that the BMA follows a polycentric city, where there are several centers of economic activity taken place in the BMA.

Furthermore, the correlation of CHT affordability and travel behavior was examined used the household survey in three subdistricts. The travel behavior was analyzed using the total private vehicle owned and the total number of commuters in the household. The result showed that there is a positive relationship between the CHT affordability, and those two variables contested.

The result (Table 6) showed that among the two variables, the total private vehicle owned by household has higher correlation coefficient, meaning that this factor gave higher contribution to the CHT affordability. Meanwhile, the highest number of commuters within household does not necessarily significantly associated with the CHT affordability although it showed statistically positive correlation.

Additionally, this study also analyzed the household transportation mode choice. By looking into head of household choice, it can be seen that the motorcycle is the most favorable among other means of transport which used by 73.58% of respondents. The Figure 2 also illustrates that the use of car is

Tabel 6. Housing Affordability and CHT Affordability in Selected Sub-Districts in 2019

	CHT Affordability	Total of Private Vehicle	Total number of Commuter
CHT Affordability	1.0000		
Total of Private Vehicle	0.1368	1.0000	
Total number of Commuter	0.0631	0.4292	1.0000

Source: Author Analysis, 2019

the second highest with the total percentage of 17.92%. On the other hand, the use of public transportation, both by train and bus, is considered very low with total less than 2%.

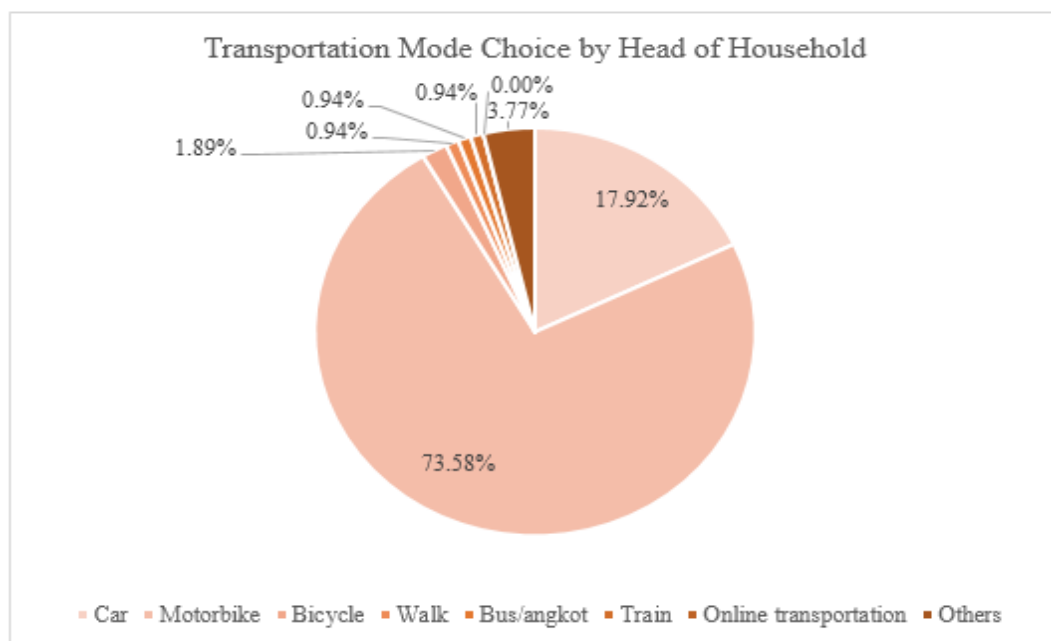
Although the most head of households using motorbikes for the daily commute, it is found that not all the commuters within the family use the same mode choice. The survey also obtained household public transportation expenditure. Some households are noted to have public transportation expenditure someway.

The subsequent analysis has been done on the transportation mode choice by using crosstab analysis. The crosstab analysis used the data of household transportation choice by categorizing them whether the households have public transportation expenditure or not. Moreover, the CHT affordability was grouped into two categorized only. The CHT affordability of more than 0.45 would be classified as unaffordable. The detailed result of the

crosstab analysis is shown in Table 6.

According to the table 7, it indicates that households that expend in public transportation with affordable housing are lower, with a total of 32.35% comparing to them with unaffordable housing. On the other hand, more households without public transportation expenditure that experience unaffordable housing with a total of 58.44%. Having the above result indicates that spend in public transportation does not mean that the house would be affordable. This might be caused by the fact that the households also give a particular share of their income in private vehicle costs. However, it might be noted that the households that rely on private vehicles only, might endure the unaffordability in terms of CHT affordability.

The correlation analysis on CHT affordability and the transportation choice mode might not capture a clear association. However, it might be noted that the use of private vehicles might contribute to the



Source: Author Analysis, 2019

Figure 3. Transportation Mode Choice by the Head of Household in the Waru, Gedangan and Sidoarjo Sub-districts

higher CHT index, which means more unaffordable. This result may support the Cao & Hickman (2017) study, which stated that high rates of car ownership, a high proportion of car travel, and restricted access to public transport might cause potential problems in the suburbs of Outer London.

Table 7. Cross-tabulation of the CHT affordability and the transportation modes

Trans- portation mode	CHT affordability		Total
	afford- able	unaffor- dable	
Public transport	11	23	34
	32.35	67.65	100.00
	25.58	33.82	30.63
No Public transport	32	45	77
	41.56	58.44	100.00
	74.42	66.18	69.37
Total	43	68	111
	38.74	61.26	100.00
	15.57	84.43	100.00
Pearson chi2(1) = 0.8422			Pr = 0.359

Source: Author Analysis, 2019

Conclusion

Having the analysis above, we may conclude that there is a major different in terms of housing affordability after including the transportation costs. The CHT affordability might depict a real illustration on whether the people live in peri-urban areas are enjoy the lower budget allocation on housing and transportation needs. This study showed that the shorter distance to the city center (Surabaya City), the more extreme the degree of housing affordability. Moreover, it showed that there is a positive relationship between the CHT affordability and housing location, and the travel behavior. This indicates that the housing location and the travel behavior might affect the housing affordability. Thus, household also may consider the

transportation mode choice in order to decrease the spending on transportation. A number of implications are suggested. First, households might consider transportation costs that appear as a consequence of the housing location because it may take up a considerable share of household income. Second, a comprehensive land use planning is suggested in order to create sustainable development. Third, a public housing provision is recommended, especially for middle to low-income groups. In sum, after having the above discussion, this study hopes to expand the understanding on the major role of the peri-urban areas, especially in anticipating the housing development in the metropolitan area context.

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