Investigating the relationship between housing affordability and mobility in Metro Manila, Philippines

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Abstract: The growing metropolitan region of Metro Manila is currently facing challenges in mobility and housing affordability. These challenges are compounded in the event of meteorological disturbances. The paper provides an analysis to show how access to transportation services varies in the event of flooding. Mobility, in the form of access to transport services, is considered as a contributing factor to housing costs. It is believed that households closer in proximity to key trip attractors (such as Central Business Districts or CBDs) and to transportation services offer greater mobility and are less affordable. Data from household interview surveys were analyzed using a transportation modeling software and presented using Geographic Information System (GIS). The analysis showed that changes in transportation access are significant in areas where flooding is common. If flooding events become more frequent, several areas in Metro Manila would become more difficult to access and less attractive to live in. Not considering the combined problem of housing costs and mobility might cause an oversight in transport planning in Metro Manila and would grow in severity in the future. Hence, areas that are further away from CBDs and are more prone to flooding incidents should have better transportation accessibility. In return, this would ease housing affordability issues by reducing transportation costs incurred for living in these areas.

Keywords: housing, flooding, public transportation, Metro Manila

1. INTRODUCTION

The need for more affordable housing increases as an urban region continues to grow and develop. Similar to purchase goods, prices normally depend on both supply and demand of real estate properties. The prices of housing properties are affected by different parameters such as time-on-market, rental rates, urbanization, population growth, interest rates, taxes, location, size and layout, age of property, and negative events, among others. Considering these parameters, it is expected that properties in urban areas cost higher than those located in rural areas. The relationship of the different parameters to property prices is often studied in various researches. This paper explores the relationship of the location of properties with respect to its accessibility to Central Business Districts (CBDs) and the potential effect of flooding on the value of properties in Metro Manila, Philippines.

The Housing Preference and Affordability Survey of Metro Manila Families (Ramos, Marquez, Selda Jr., Magtulis, & Castillo, 2010) showed that 82% of the total respondents lived on residential areas (i.e., villages or subdivisions). Those who lived along "danger areas" were inclined to acquire real estate property. However, those who lived along railroads and road easements indicated no plan to move out from their present locations.

Table 1. Respondents' Housing Location and Plan of Acquiring a Lot

Physical Location of Housing Unit	All Families	With Plans to Acquire House and/or Lot	With No Plans to Acquire Real Estate Property
Residential Area	82.35%	27.47%	72.53%
Blighted area	13.30%	25.33%	74.67%
Along rivers, creeks, canals, or esteros	3.02%	18.68%	81.32%
Inside cemetery	0.08%	25.55%	74.45%
Along railroad	0.27%	44.40%	55.60%
Easements of roads and highways	0.38%	23.89%	76.11%
Others	0.60%	-	-
Total	**2,462,266 (100%)**	**26.95%**	**73.05%**

Similarly, the results showed that 82% of the respondents preferred single detached units, while condominiums were preferred by only 1.73%. Condominium preference is essential because most condominiums are often located near large trip attractors such as business districts, higher educational institutions (HEIs), and government institutions among others. The low preference of condominiums could be attributed to its unaffordability with price-to-income ratios reaching to 20.5 (Cruz, 2008).

In terms of location, respondents preferred houses located in the second district[1] of Metro Manila. On the other hand, Manila City is the least preferred location of availing a new property.

Table 2. Respondents' Preferred Location of Property

Preferred Location	Number	Percentage (%)
First District	38,800	9.74
Second District	153,327	38.50
Third District	102,304	25.69
Fourth District	103,820	26.07
Total	398,251	100.00

Lastly, 23% of the respondents from Metro Manila prefer to live near their place of work. More than half of the respondents wanted to live near a school, church, hospital, or market. With these preferences, it is reasonably expected that areas located near the central section of Metro Manila would be most preferred and might be most expensive.

Travelers who live far from places of work or trip activities rely on private vehicles or available public transport services. Currently, there are four major public transport services existing in Metro Manila, namely: buses (air-conditioned and ordinary), jeepneys, Asian utility vehicles (AUVs), and rail systems (LRT1, LRT2, MRT3, and PNR). The existing public transport routes are shown in Figure 1, with the thicker lines representing roads that carry more transit routes. Combining the transit lines show that majority of the portions of NCR are served by public transport and most public transport service routes converge at Epifanio delos Santos Avenue (EDSA). Looking at the hierarchy of public transport service in the region, the LRT1, LRT2, MRT3, and PNR systems are considered as the top of the hierarchy. Buses, jeepneys, and AUVs follow the rail systems, while tricycles and pedicabs serve local areas (mostly residential villages or subdivisions) and feed into other transport modes. Transport service is currently deregulated, which makes it a free-for-all business. As a result, road-based transport service had rapidly expanded thus making it very accessible. The

[1] Based on the Philippine Standard Geographic Codes (PSGC) the different districts of Metro Manila comprised of the following cities/municipalities: First District: Manila; Second District: Quezon City, Mandaluyong, Marikina, Pasig, and San Juan; Third District: Caloocan, Malabon, Navotas, and Valenzuela (CAMANAVA); Fourth District: Las Piñas, Makati, Muntinlupa, Parañaque, Pasay, Pateros, Taguig

accessible public transport service in Metro Manila led to an increasing high modal share of 70% of total trips done (Japan International Cooperation Agency, 2015).

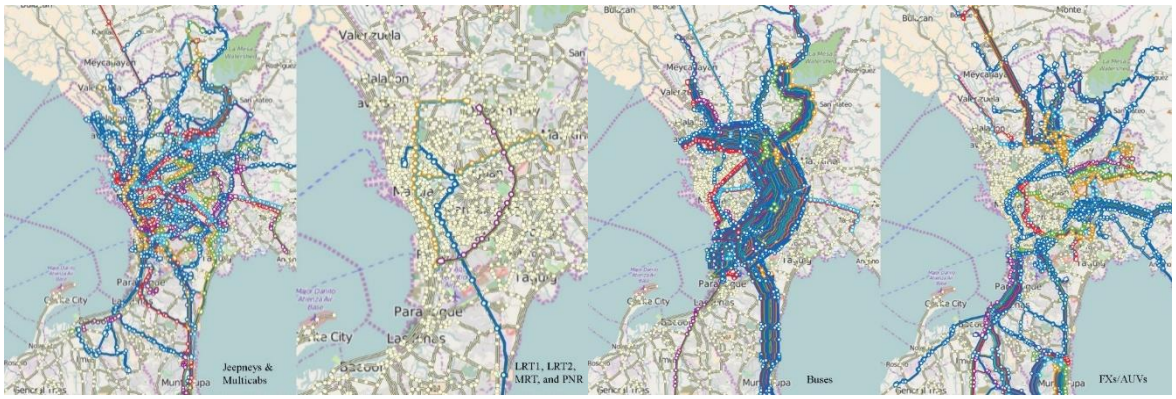

Figure 1 Public Transportation Routes in Metro Manila

Despite the abundance of transport operators in the region, service is debilitated during heavy rainfall mainly because of its inability to tread flooded areas. The situation is similar for travelers using their private vehicles. Torrential rains trigger flash floods at certain locations in Metro Manila that cause traffic jams in major roads. As shown in Figure 2, roads become partially or completely inaccessible, forcing travelers either to change their travel behavior or wait until flood waters recede. Overall, this scenario results in negative impact on the user's travel experience. As such, there is a need for a resilient transit service to maintain the connectivity of different areas within the metropolis.

Figure 2 Effects of flooding to the transportation network and its operations[2345]

With several areas in Metro Manila heavily affected by severe weather disturbances and flooding, the demand for properties that are located in areas that are less flood-prone or

[2] Cayabyab, M. J. (2015, September 16). 2 Metro flood projects done before Aquino steps down—Singson. *Philippine Daily Inquirer*. Retrieved from http://newsinfo.inquirer.net/722504/2-metro-flood-projects-done-before-aquino-steps-down-singson

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[4] Andrade, J. I., & Dizon, N. (2013, August 20). 'Habagat' paralyzes Metro Manila, floods Luzon. *Philippine Daily Inquirer*. Retrieved June 10, 2016, from http://newsinfo.inquirer.net/469427/habagat-paralyzes-metro-manila-floods-luzon

[5] (2013, August 20). Retrieved June 10, 2016, from Inquirer.net: http://technology.inquirer.net/28351/netizens-snap-more-flood-photos/flood-maring-3

easily accessible by public transportation is higher. This paper would like to investigate the relationship of flooding on the transportation network and housing prices. It is hypothesized that areas that have good access to transport services and are less prone to flooding have higher housing costs and vice-versa.

The methods employed in this paper involved analyzing public transportation trips going to CBDs. These areas were determined by identifying common destinations of home-to-work trips from household interview surveys (HIS) that were conducted in 2012. Demographics of households and individual respondents were analyzed and visually compared using Geographic Information Systems (GIS). Finally, a transportation modeling software was used to analyzed the access distance under three different scenarios, namely, base, complete transit line deletion, and shortened transit lines.

2. RELATED LITERATURE

Aside from property location, access to transport services also contribute to the commercial value of houses. One of the main advantages of having a property with accessible transport facilities is the increased mobility it would provide. Different studies have established the relationship of property prices to the accessibility of transportation services. In Bangladesh, the rent of a multi-unit dwelling decreases by 0.0239% for every percent increase in access distance to the nearest major road (Mitra & Saphores, 2016). Chen & Haynes (2015) showed the impact of housing values due to a High Speed Rail line in China. Their study showed that medium and small cities absorb more significant impact than capital cities. Increases in property values when access to transport facilities are increased were likewise observed in China, Korea, Colombia, Thailand, and Turkey (Zhang & Wang, 2013; Anderrson, O.F., & Fu, 2010; Cervero & Kang, 2011; Chalermpong, 2007; Munoz-Raskin, 2010; Celik & Yankaya, 2006). In these studies, the common variables used to assess accessibility are distance to city center and transportation facilities such as train, tram, bus stops or stations, and rail stations.

Disastrous events such as frequent flooding negatively impact on housing properties as these incidents make the latter more prone to damage. Aside from that, transport accessibility is also affected if the place of origin of the traveler is inundated. Weather conditions also play a role in transit ridership. The number of trips decrease when the weather is described as windy or rainy, and increase when temperatures increase (Arana & Peñalba, 2014).

Flooding also has a significant impact on the travel behavior of individuals. Lu, Zhang, Peng, & Rahman (2014) modeled travel behavior using stated choice experiments to reveal differences in attitudes and responses to flooding and extreme weather in coastal and inland locations. The authors used an orthogoal design for three flooding scenarios. Results showed that road disruption, isolation by flood water, and flood frequency are significant factors affecting travel behavior choice. In response to the travel disruptions, most trips are either canceled or travelers changed destinations. In the findings of Zanni and Ryley (2015), travelers did not considerably alter their plan following the disruption for long distance travels. Moreover, the origin and destination and the presence of children in their travels had significant effects on their behavior.

3. METHODOLOGY

Data from HIS conducted by the Philippines' Department of Transportation (DoTr) in 2012

were used in this study. Specifically, the data includes household socio-economic demographics and individual trip characteristics. Considering the large scope of the study area and comparison purposes, all demographics are presented using GIS.

From the individual trip data, CBDs were located by determining the proportion of destination zones with high shares of home-to-work trips. For this research, zones that generate a total of 50% or more work trips would be considered CBD.

Housing costs were individually collected from real estate property websites such as Lamudi.com, property24.com.ph, or mitula.com.ph. It is assumed that the values posted on these websites are tax-exclusive and only considers the commercial value of the property.

A transportation modeling software was used in determining the impacts of flooding on transportation accessibility. Flood hazard maps were overlain to determine service routes that are affected. Two flooded scenarios were developed, namely, complete transit line deletion and shortened transit line service. The first scenario was based on the idea that operators would not run their fleet because it would only be disrupted along the route. On the other hand, the latter scenario was based on the assumption that operators would still run their fleet but on shortened service when it reaches flooded areas. Extended transit assignment was performed on all three scenarios with optimal strategies considering that travelers would still choose the service that is least costly. Path-based analysis was performed to determine the access distance of travelers from their respective origins and their initial boarding points. Results were expressed in changes as compared from the base scenario.

4. DATA ANALYSIS

4.1. Location of CBDs

Processing the raw data from DOTC (2012), it can be seen in **Error! Reference source not found.** that most of the home-to-work trips were located in the central portions of Metro Manila. Specifically, these areas could be found in Manila (Intramuros, Malate, Sta. Mesa), Makati (Ayala Center), Mandaluyong (Ortigas), and San Juan (Greenhills), and Quezon City (Cubao) where most business districts are located. For purposes of this research, only zones that produce 50% or more to-work trips would be considered as CBD.

Figure 3. Proportion of work trips per zone

4.2. Flood hazard in Metro Manila

This study takes a look at different annual exceedance probabilities or AEPs. AEPs are normally used in defining the maximum amount of rainfall within a specific period. As an example, a 5-year AEP would mean that the amount of rainfall experienced would be equivalent to the maximum rainfall within a 5-year period. Higher AEPs would denote greater rainfall volumes with lower probabilities of occurrence. In 2009, Metro Manila was inundated because of heavy rainfall that is said to occur only once within 100 years (1% AEP).

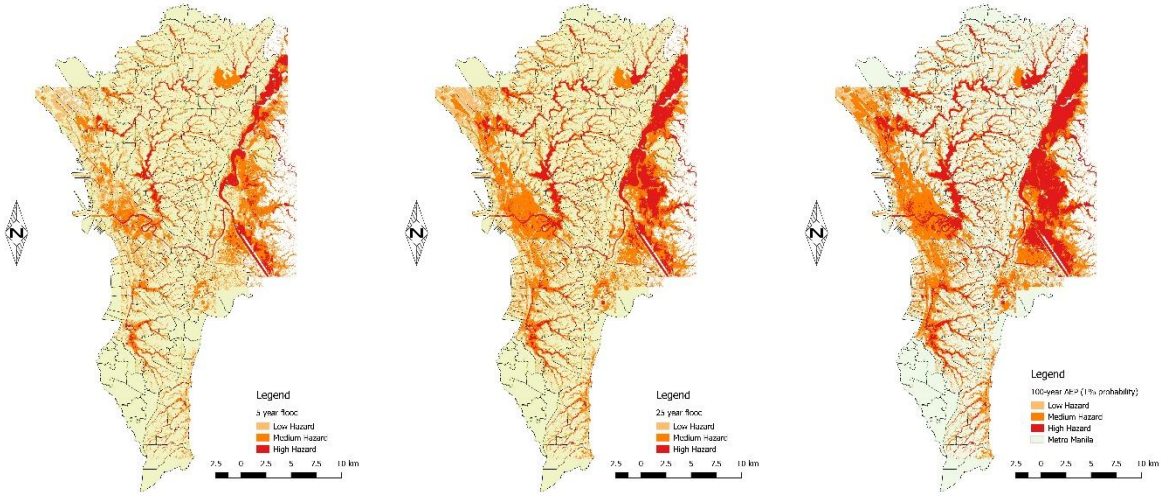

Figure 4 Flood hazard maps for 5-year (left), 25-year (middle), and 100-year (right) AEPs

For a 5-year AEP, it is clear that several areas around Metro Manila are already affected. Specifically, both Eastern (Caloocan, Malabon, Navotas, and Valenzuela) and Western (Marikina) portions would be inundated by flood heights 0.5m and above. Flood

heights that exceed 1.5 meters are observed in areas located near waterways. Hence, informal settler families (ISFs) that often live along waterways would be immediately affected. As the AEPs increase, flooded areas expanded and have higher flood heights. For the 100-year AEP, Marikina and the North Eastern part of Quezon City would be inundated by flood heights greater than 1.5 meters. Meanwhile, majority of the city of Manila would also be inundated. Similar to the 5-year AEP, waterways would be severely affected and may affect neighboring spaces. For this research, the 5-year AEP would be used considering that it has the highest probability of occurrence and shorter return period.

The areas that are not often affected by flooding are located in the southern portion of Metro Manila. It can be seen that the cities of Las Pinas, portions of Muntinlupa, Makati, and Mandaluyong are not entirely affected by floods. It would be significant to point out that among the identified CBDs, only those located in Makati and Mandaluyong were least affected by flooding.

4.3. Housing Costs

Consequently, it can be observed that areas nearer to the defined CBDs are where the more 'luxurious' homes are located. The houses located in Makati, Mandaluyong, San Juan, and Quezon City are priced at values starting at ₱ 50,000 and above per square meter of residential area. The housing costs are based on the prices posted at online property advertisements. Furthermore, it can be seen that most properties that are located within the CBDs are more expensive and properties farther from CBDs are less expensive. Meanwhile, the cities of Manila and Quezon registered higher housing prices as these areas are where most government offices and higher educational institutions are located. Manila City also posted high historical values considering that it is the capital city of the country. It should be noted that there are some properties far away from CBDs that are expensive. For example, Ayala Alabang Village, an executive village located at the southern portion of Metro Manila, have properties that cost above ₱ 50,000 per square meter.

Overlaying the flood hazard map to the housing cost map as shown in Error! Reference source not found., resulted in showing areas surrounding Makati and Mandaluyong CBDs that are not that affected by flooding. Therefore, it is reasonable to say that these areas are more expensive, considering its proximity to a trip attractor and its less likelihood of being affected by floods. Meanwhile, the northwestern and northeastern portions of Metro Manila are most affected by flooding and farther from the CBDs. Hence, these areas have lower property values.

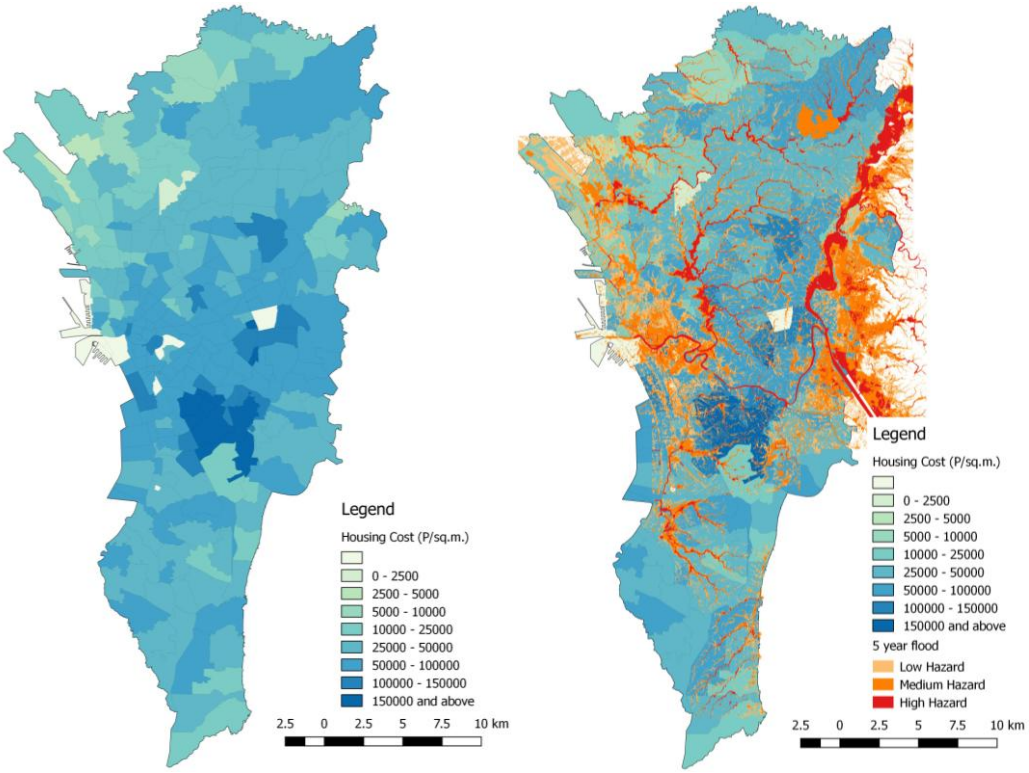

Figure 5. Housing costs (₱ / sq.m.) and 5-year AEP flood hazard map over housing costs

4.4. Socio-demographic Characteristics of Survey Respondents

The socio-demographic characteristics of the survey respondents showed that household incomes in Metro Manila were almost the same across all zones. Moreover, households that were nearer to CBDs of San Juan, Quezon City, Makati, Mandaluyong, and Manila had higher household monthly incomes. This only shows that property values within these areas could be afforded by those classified under higher income classes. Zones that posted higher vehicle ownership per household corresponded to the zones that registered high household income.

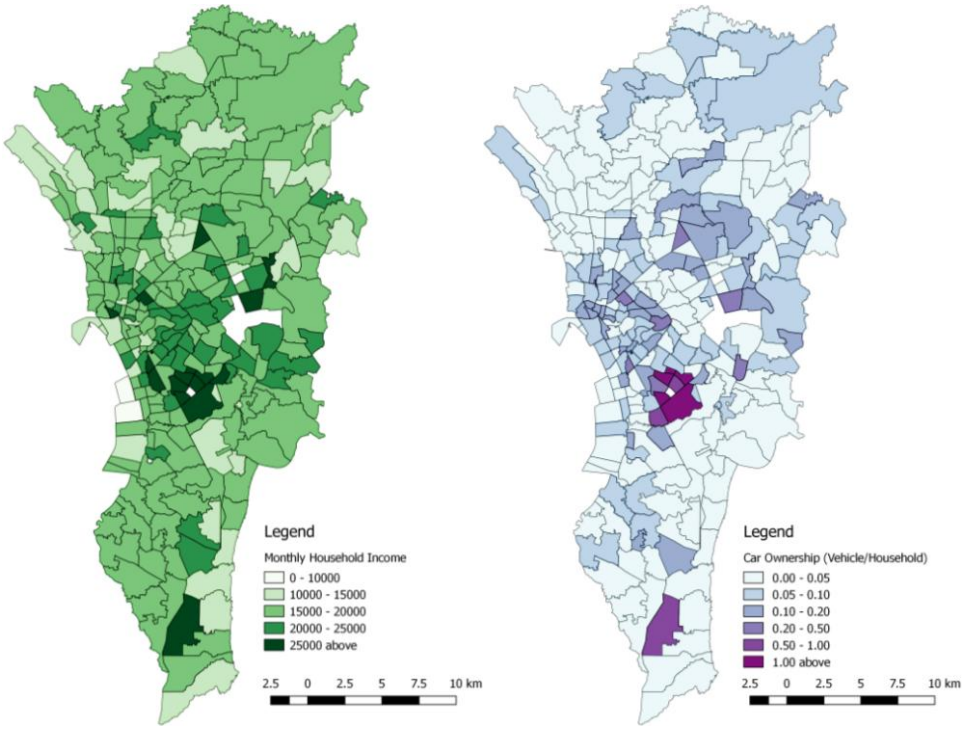

Figure 6. Monthly household income (left) and vehicle ownership (right) per zone

4.5. Access distance to CBD (from origin to initial boarding)

The abundance of transport services in the central section of Metro Manila has given it the smallest access distance for trips going to CBDs. At base conditions, it can be seen that zones near the periphery of the metropolis have higher access distances. This only shows that even at base conditions, these zones should be provided with better transport services.

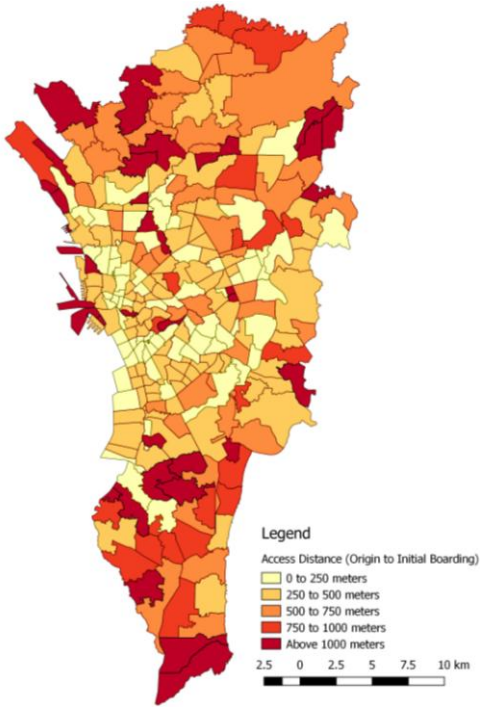

Figure 7. Access distance of trips made using public transportation

At flooded conditions wherein transit services are discontinued or shortened, the effects are evident as access distance increase significantly in zones away from CBDs. In both conditions, however, travelers residing in zones near the central portion of Metro Manila experienced the least effects of increased access distance. When transit services were discontinued, the increase in access distance was so significant with some zones located in Muntinlupa, Parañaque, Caloocan, Malabon, Navotas, and Marikina experiencing an increase of access distance by a factor of 8 to 10. Shortened transit services resulted in lesser increase in access distance to almost all zones. Residents from Malabon, Marikina, Muntinlupa were heavily affected. Both conditions show that there is a need for improved access to transport services in the affected areas.

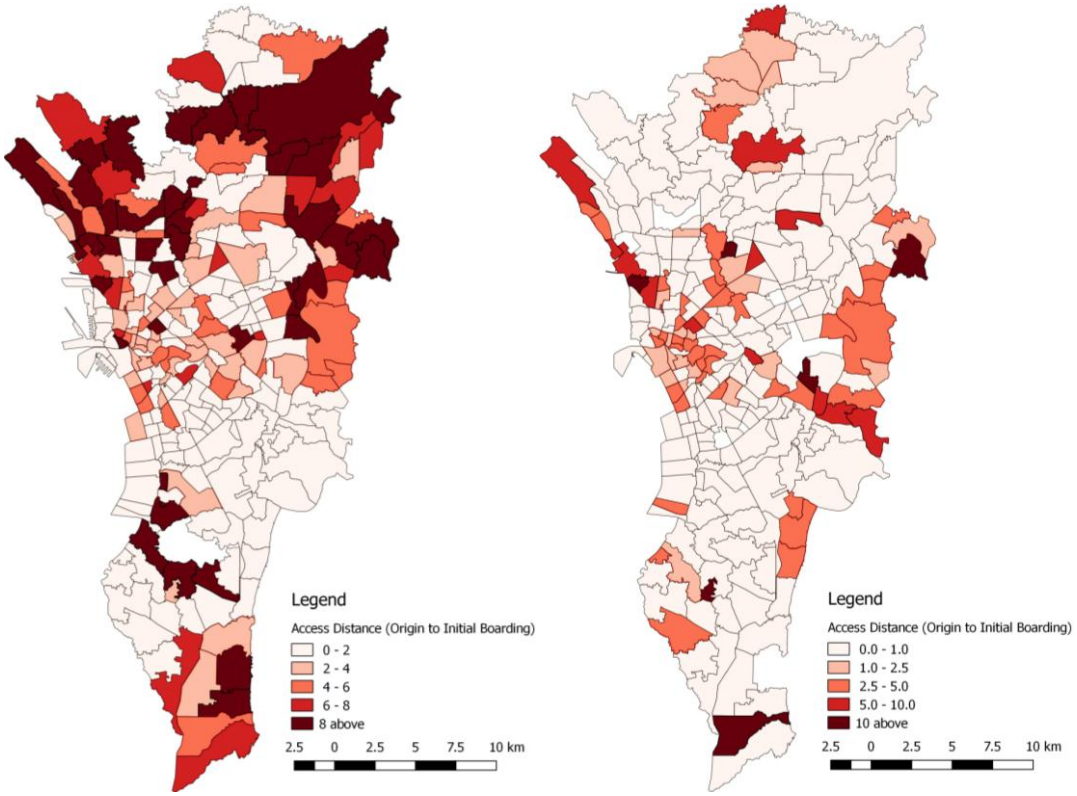

Figure 8. Multiple change in access distance for discontinued service (left) and shortened service (right)

Comparing the housing costs and the changes in access to transport facilities under flooded scenarios, it was observed that areas that are severely affected by flooding have lower property values. The Caloocan, Malabon, and Navotas (CAMANAVA) area on the northeastern portion have the cheapest property values in Metro Manila. Subsequently, these are the areas most affected by transit service disruptions caused by flooding. However, for some areas where significant impacts on transit service accessibility is high, their corresponding property values are also high. This might imply that access to transport service is not a contributor to the property values. However, it should be noted that under base conditions, these areas (i.e., Northern Quezon City, Marikina, Muntinlupa, Las Piñas) already suffer from high access distance. Hence, it only stresses the need for high quality transit services in these areas and that the value of transportation accessibility has not been considered yet for properties in those areas.

5. CONCLUSION

This research investigated the relationship of transportation accessibility and commercial prices of real estate values. Data from HIS were analyzed to determine the socio-demographic characteristics of trip makers in Metro Manila. The data showed that most CBDs are located in the central portion of Metro Manila. A zone was considered as a CBD when 50% of home-to-work trips were made to that particular zone. Analysis of commercial prices of real estate properties showed that residential areas near the identified CBDs are more expensive than those away from CBDs. The high value of these properties is attributed to its proximity to large trip attractors. The closeness of these properties to CBDs validates the preference of Metro Manila respondents living near their place of work. Furthermore, areas that are less flood-prone have higher commercial property values.

Accessible transport is considered a factor in determining the commercial value of real estate properties as proven in different researches. This research looked at access to transportation services by modeling the network under different scenarios, namely: base, flooded with terminated transport services, and flooded with shortened transport services. Under the base condition, access distances to CBDs are shorter in the central portion of Metro Manila. The shorter access distances on these zones are a result of a saturation of transport services in the central portion of Manila. On the other hand, transport services are less in suburban areas away from CBDs. When transport services are disrupted due to flooding, access distance changed significantly. Likewise, zones that are far away from CBDs are most affected with changes in access distance by a minimum of 8 and 5 times for discontinued and shortened services, respectively. Hence, transport services at locations away from CBDs are drastically debilitated and urgently needs attention.

Finally, comparing the impacts of flooding and access distance to housing costs, it was shown that areas severely affected by flooding have lower property values. The CAMANAVA area has the cheapest property values in Metro Manila and is most affected by travel disruptions caused by flooding. On the contrary, some properties on the eastern and southern sections of Metro Manila have high property values but with high flooding impact on transit service accessibility. This does not imply that access to transport service do not affect commercial value of houses. However, under the base condition, these areas already have high access distances. Hence, the value of transportation service accessibility has not yet been considered and the needs for high quality transit services in these areas are yet to be addressed.

To conclude, this research shows the relationship of access distance to transportation services to commercial values of properties. The previous section highlighted the relationship of different socio-economic and trip characteristics of travelers, flooding, and transportation accessibility to the commercial value of properties. It also exposed areas that need improvements in transportation service. The proponents of this research recommend pursuing an in-depth analysis of transportation accessibility, flooding, and housing costs to see how each factor plays a role in the commercial value of houses.

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