ACCESSIBILITY OF THE BRAZILIAN LOW-INCOME HOUSING PROGRAM IN THE CITY OF RIO DE JANEIRO

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ABSTRACT

The negative effects of individual motorized mobility have long been known. Land use planning can and should play an important role in achieving a sustainable level of mobility. The work presented here evaluates the accessibility of dwellings licenced under the Brazilian housing program for the low-income population, provided without connection to urban development strategies and sustainable mobility. To evaluate the accessibility of the program's target population, a case study was carried out in the city of Rio de Janeiro, where 57,000 homes licensed under the program were analysed using georeferencing tools, considering the present public transport network and the locations of the homes. These were classified in three categories, according to the income level of the population served. The analysis looked at the time taken to access public transport and the relation to the principal urban opportunities. Then the same analysis was performed for the future network and the results of the two situations were compared, in order to identify the scope of the legacy generated by investments for the year 2016.

Keywords: Transport, Cities, Sustainable Development.

1. INTRODUCTION

It is recognized that to achieve quality of life in cities today is necessary to investment in providing a good level of urban mobility. Currently, investment in environmentally sustainable transport modes (walking, cycling and mass transport) are basic requirements for providing good quality urban mobility.

For decades, the role of transport in cities has been discussed, bearing in mind that this can be either a factor driving urban development or a cause of its atrophy, depending on its effectiveness in facilitating contact and providing accessibility to the activities. Just as

Cervero's "Transit Metropolis" shows how built environments can shape the transport demand, and investments in transport shape built environments, numerous authors have indicated that the interaction between transport and land use is fundamentally important to the planning process and should represent the starting point for the analysis of transport policies (Ewing and Cervero, 2010; Litman, 2012a). Moreover, several studies in the area of transport and land use have shown that investment in transport infrastructure (accessibility modification) raises land values (Chen et al., 1998; Diaz, 1999; Cervero and Duncan, 2001; Siethoff and Kockelman, 2002) and, on the other hand, that the decentralization of activities has provoked automobile use more out of necessity than by choice (Owens, 1995). The importance of the relationship between transportation and land use to urban planning is an indisputable fact.

The conventional approach to transport planning is a passive response to the demand. In other words, planning is designed around the main transport arteries, assuming the urban context as an exogenous situation and with no conection to inductive city planning. Without internalizing the exogenous costs of traveling by car, transportation planning has allowed the speed to increase faster than the travel costs (Banister, 2008). The existing market distortions have reduced consumers' transport choices and induce greater car use than would occur in a more neutral market (Litman, 2012b). Hence, the public transport modes, along with non-motorized ones, have become less attractive, resulting in a higher value of use being attributed to the private automobile.

At the beginning of the 21st century, transport planning was facing new challenges, where mobility is seen to be increasingly important in people's and organizations' lives, but also when new values make expansion more difficult, particularly in relation to awareness of its negative impacts. This means that the traditional "predict and provide" approach is no longer an option in transport planning (Hull, 2008; Bertolini et al., 2008), especially if it aims for sustainability.

According to the United Nations Human Settlements Programme (UN-HABITAT), having more sustainable transport options is part of the current agenda of the big cities, in order to reduce traffic, as well as cutting greenhouse gas emissions by half, by the year 2050, if not sooner, in line with the global agenda set by the IPCC (Intergovernmental Panel on Climate Change).

Following this reasoning, a change can be seen in the paradigm (as in Kuhn) from the "predict the demand so as to provide the on road supply" of the traditional approach to transportation planning, to one that involves notions of sustainability (Owens, 1995; Hull, 2008). In other words, the change in transportation and land use planning for the 21st century involves one that not only addresses the provision of transport infrastructure, but also a land occupation model that deals with the urban space and the location of activities in an integrated to the transport infrastructure (Banister, 2008), in order to balance transport supply and demand and also combine sustainable practices in energy, construction and waste disposal with high quality transport accessibility, in order to substantially reduce the environmental impact associated with car-oriented suburban development (Cervero and Sullivan, 2011). This entails a more comprehensive analysis of the impacts, including assessment of the indirect and cumulative impacts, as well as taking into consideration a broader range of solutions than generally occurs and more effective public participation in the transport planning process (Litman and Burwell, 2006; Litman, 2012b).

2. THE PROBLEM

2.1 Challenges of planning in Brazil

Brazil is the most populous country in South America, with 190 million inhabitants, and is a land of considerable contrasts, ranging from geographical to socioeconomic. Some of these contrasts are intense when we analyse the urban environment, more specifically the major cities, where issues such as mobility and housing are directly perceived by the population affected by them. Most of the Brazilian population is now urban (84%), with the nine largest metropolitan areas holding 30% of the urban population and, most notably, the majority of the poorest.

The current urban production model of Brazil's metropolises leads to horizontal expansion and emptying of the traditional centres, guided by the logic of always putting up new buildings. Even for the low income population, this same logic is reproduced in the form of peripheral housing real-es tate developments. This urbanization pattern of continual horizontal low density expansion, right at the urban limits, is one of the most significant causes of the current problems of urban mobility, compounded by an infrastructure model that ensures the best possible conditions for getting around in private automobiles (MCid, 2004a).

As a result, there is in practice an urban planning model that presumes the separation of city uses (functional zoning) and of urban functions (e.g. transport and land use), creating new areas for expansion that are totally unrelated to the effective needs of the communities that will live there; where road transport (especially individual) is their main form of access; and generates social problems due to urban sprawl, the main adverse effects of which are peripheralization and socio-spatial segregation (Barandier, 2012).

In Brazil, the social dimension carries more weight in the "triple bottom line" of sustainable development than it does in European countries and the U.S.A., mainly due to the far greater social inequality. In the field of transport planning, the Brazilian situation calls for the multiplication of social practices, based on strengthening the right of access to job opportunities, public facilities and social services (health and education), and to activities that reinforce human dignity and social integration (leisure, shopping, etc.) (MCid, 2004b). In other words, universal access to public transport.

2.2 "Minha Casa, Minha Vida" Program

It was in the midst of a lack of integration between transport and land use policies that the federal government, in 2009, launched a housing package called "Minha Casa, Minha Vida" ("My Home, My Life"). The program was developed with the dual aims of stimulating the economy through the construction industry, in the light of the 2008 international financial crisis (economic policy), and reducing the housing deficit (social policy), by creating mechanisms to encourage the building and purchasing of new dwellings for low-income families (Cardoso and Leal, 2010).

The goal of the first phase of the program was to build 1 million new dwellings across the country, for families with income up to 10 minimum wages (*salário minímo* – SM in portuguese). The program was divided into three family income segments (0-3 SM, 3-6 SM and 6-10 SM). The justifications for the creation of this housing program were the precariousness of the housing of part of the population, fighting the spread of slums and the occupation of peripheral areas, and stimulating the industry and job creation.

Nevertheless, "Minha Casa, Minha Vida" (PMCMV) was launched with no connection to urban development and sustainable mobility strategies that could prevent such peripheral growth, urban fragmentation and impacts that generate urban diseconomies and social costs arising from the transport system. So, at the beginning of the 21st century, a program that relies on federal government funding was introduced with no integrated treatment between urban space and the location of activities and without balancing the transport supply and demand.

Presented in such a way, "Minha Casa, Minha Vida" repeats the practice of the urbanization model that has no commitment to sustainability, reproduces the conditions of peripheral growth and urban fragmentation, creates impacts that generate urban diseconomies and increases the social costs through the prevailing model for getting around.

3. CASE STUDY

3.1 Study area

The city of Rio de Janeiro is the second most heavily populated in Brazil, with 6.4 million inhabitants[1] spread over a metropolitan area of 1,224.6 km², of which the urban area is 567.3 km². The municipality is divided into five Planning Areas (AP - 1 to 5) and 161 districts. (see Figure 1).

Planning Area 1 (AP 1) is the city's oldest urban space, the downtown or Central Business District, which has the greatest influence within the metropolitan area. AP 2 comprises the

[1] Data source: 2010 Population Census, IBGE.

Northern and Southern Zones of the city of Rio de Janeiro, the wealthiest part of the city and main point of reference in terms of the city's national and international image, since it contains almost all the tourist attractions that are known inside and outside Brazil. AP 3 is the Suburban Zone, into which the city expanded during the first half of the 20th century, spurred by rail transportation. AP 4 is the area of Barra and Jacarepaguá, which long remained preserved and outside the urban network. Only in the last third of the 20th century was the area definitively inserted within the metropolitan area, as a result of new road access, following the modernist master plan of architect Lucio Costa. Finally, AP 5 comprises the Western Zone, which for a long time was treated as the last urbanization frontier of the city of Rio de Janeiro and began to undergo urbanization pressure as from the 1960s.

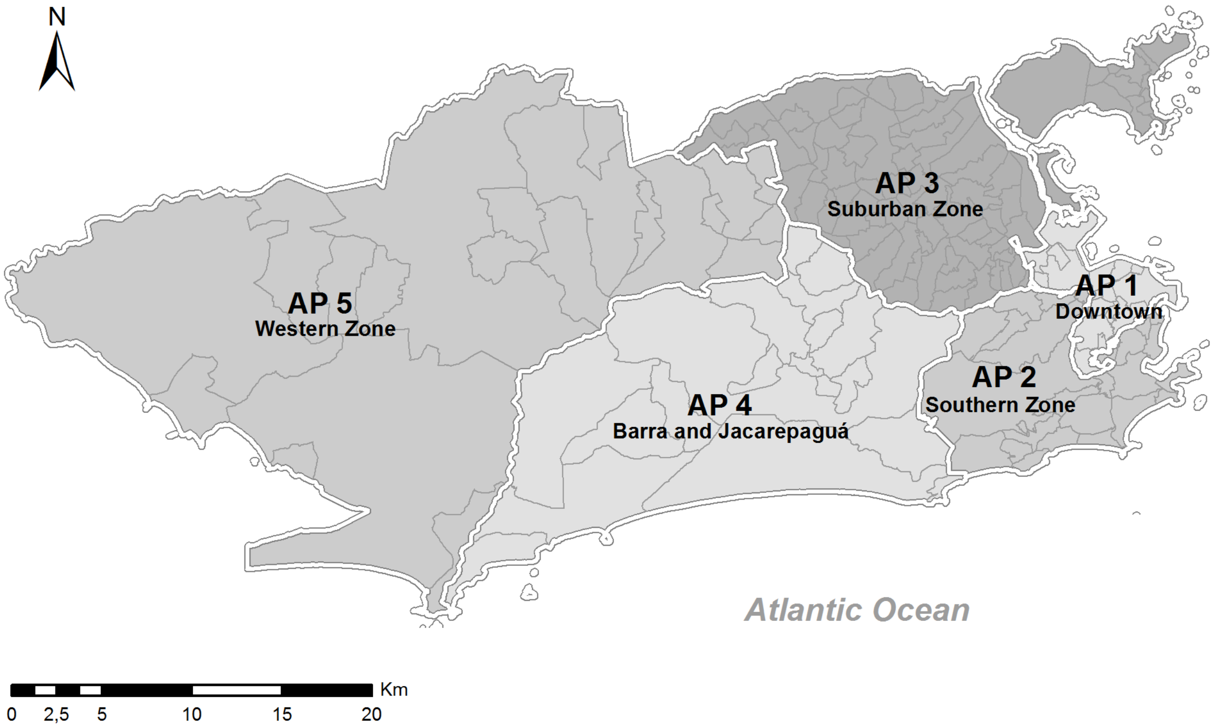

Figure 1 – Planning Areas of the city of Rio de Janeiro.

3.2 Location of dwellings

According to PMCMV data for the city of Rio, obtained between the beginning of 2009 and the end of 2011, it was ascertained that the Municipal Urban Planning Department (SMU) issued 272 building licenses for dwellings under the program, for a total of 58,680 units licensed in 44 of the city's 161 districts. Figure 2 shows that, of that total, 778 units are located in AP 1 (Downtown), 48 are in AP 2 (Northern and Southern Zones), 11,367 are in AP 3 (Suburban Zone), 7,481 are in AP 4 (Barra and Jacarepaguá) and 39,006 are in AP 5 (Western Zone). Looking at Figure 2, one can see that, of the districts with PMCMV housings, just twelve of them account for 82% of the licensed units, with seven of these in AP 5, three in AP 3 and two in AP4. While two districts in AP 5 - Campo Grande and Santa Cruz - have 51% of the total licensed PMCMV units in the city of Rio, the districts in AP 1 and AP 2 have a mere 1.4% of the total.

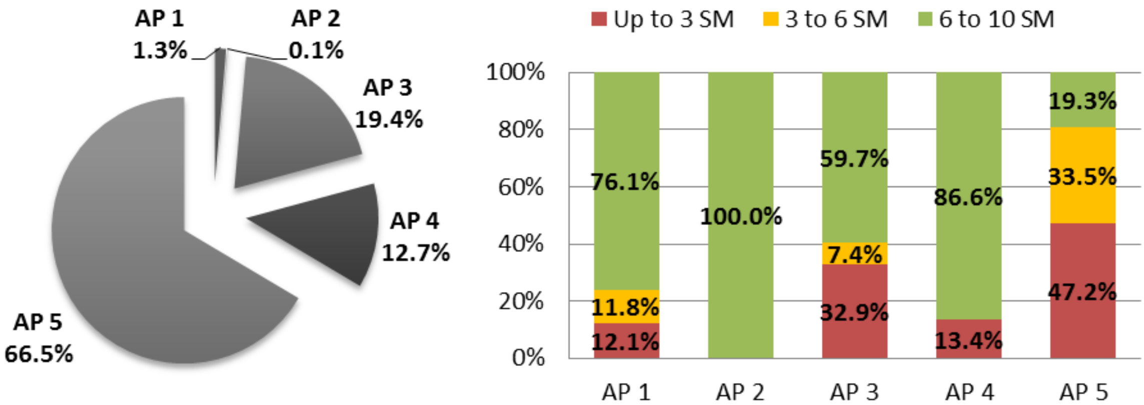

Figure 2 - Distribution of housing units, by AP and by family income level. Data source: prepared with data from SMU/PCRJ.

The relationship between the location of the housing units and the income groups can be seen in Figure 3, which shows the predominance of 6-10 SM (higher income, green symbols) in the neighbourhoods closest to the downtown area. As we move away from the centre, the predominance shifts to 3-6 SM (middle income, yellow symbols) dwellings, in the area between Campo Grande and Santa Cruz, after which, finally, the predominance shifts to dwellings for families with incomes of up to 3 SM (lower income, red symbols), in the region of Santa Cruz.

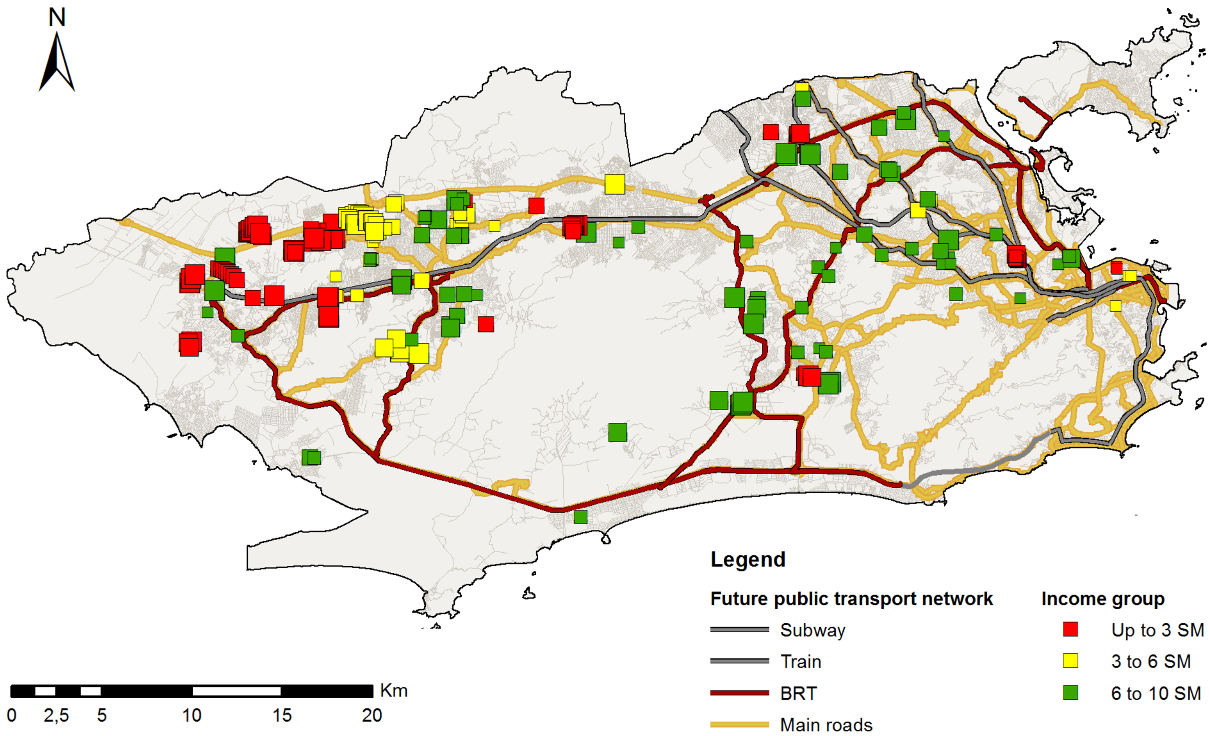

Figure 3 - Location of dwellings.

3.3 The current transport network

According to the Rio de Janeiro Metropolitan Transport Master Plan (PDTU), presented in 2005, 68.7% of all trips made in the city of Rio are by motorized vehicle. Of these, 72.4% are by public transport mode and 27.6% are by private means. Thus, one can say that half of the trips made in the city are by public transport.

The current public transport network is based on buses (normal and exclusive lane), trams, subways, trains, ferries, and more recently, cable cars. Of these, the bus system is currently the only one under municipal jurisdiction. The other systems are the responsibility of the state government, including the tram and subway systems that cater exclusively to the municipal area.

In Figure 4, one can see that the city of Rio structural transport system comprises basically the subway and railway networks. In the city of Rio, the present supply distribution of structural modes within the urban area is not evenly balanced. There is no hierarchy of services or complementarity between the currently available modes.

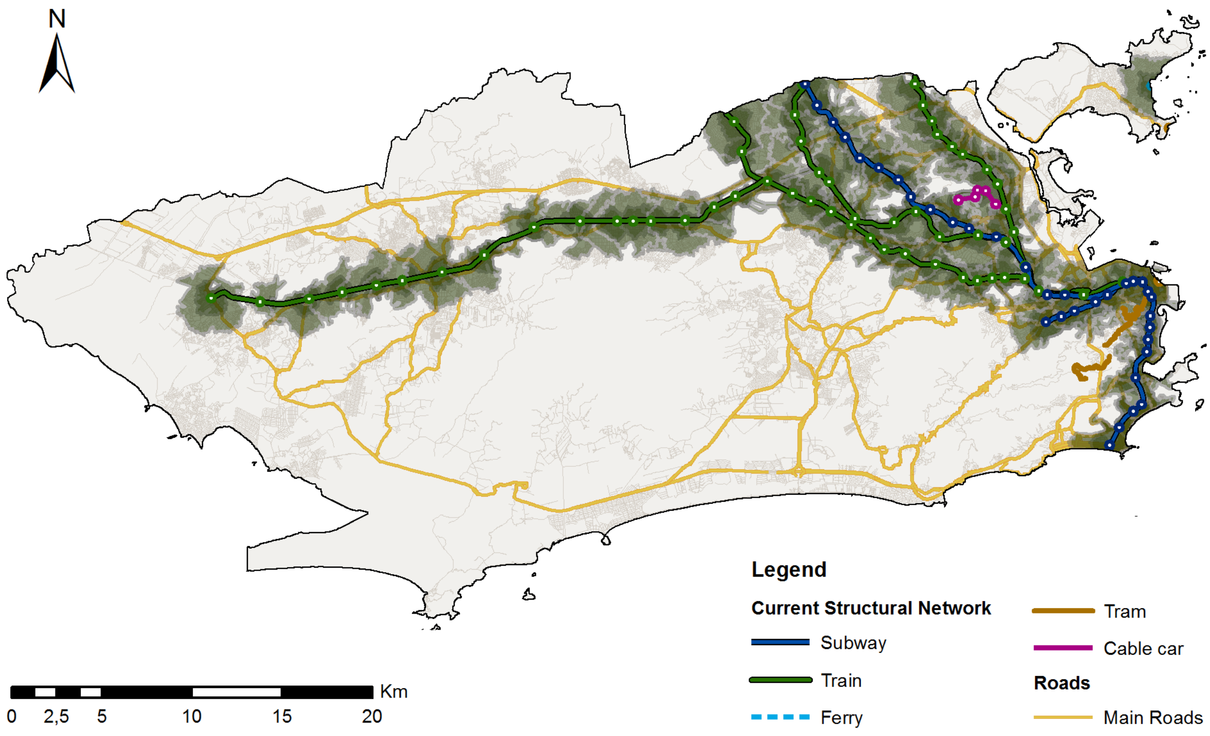

Figure 4 - Isochrones, based on 30 minutes on foot, applied to the current transport system structure.

3.4 The future transport network

The transport supply in the city of Rio has been undergoing a process of change in the last three years. Historically characterized by the existence of different modes that are in direct competition to attract users and have no defined logic, in terms of structural and complementary sub-systems, the transport network has now begun to receive investment with a view to the mega-events of 2014 and 2016.

Most of the expansion of the physical network under way in the city of Rio is through the implementation of exclusive bus corridors - the BRT. The buses move along exclusive lanes and ticketing takes place at purpose-built stations along the routes. Two lines are already in the process of being implemented, the Transoeste and the Transcarioca, with the former scheduled to come into operation later in 2012 and the second in November 2013. The other two, the Transolímpica and the Transbrasil and are in the planning stage and are forecast to begin implementation in 2013. The BRT system will provide structural public transportation for districts in the west of Rio de Janeiro, as well as linking them with districts in the suburbs and with the international airport. Moreover, the state government is investing in extending the present subway line to the Barra and Jacarepaguá region (see Figure 5).

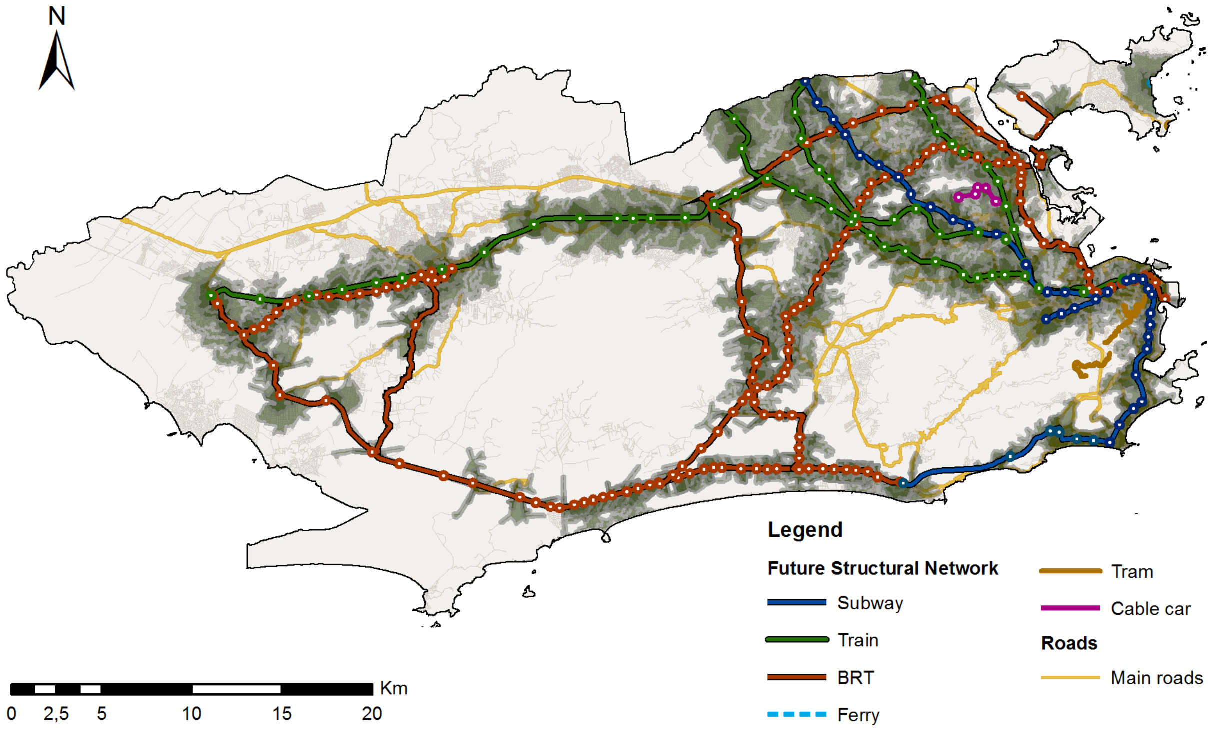

Figure 5 - Isochrones, based on 30 minutes on foot, applied to the future transport system structure.

3.5 Analysis

The focus of this analysis is to evaluate the accessibility of the PMCMV target population to the opportunities that the city offers, whether for work, study, business or leisure, that can be measured in terms of the distance (time or physical) between the housing (point of origin) and the activities' locations (destinations), which must be overcome by means of public transport modes and the walking that is necessary to access them.

Surveys carried out in the Metropolitan Region of Rio de Janeiro indicate that travel time is the most critical aspect of the transport system, and one that users point as number 1 in importance in all research.

Thus, the analysis was divided into three parts. The first analyzes the accessibility to the current public transport structural network (existing in the River City), the second evaluates the accessibility to the future public transport structural network (in development for the year 2016) and the third evaluates the accessibility to urban opportunities that generate more trips in the City (ie. employment and education).

3.5.1. Accessibility to the current public transport structural network

To determine the catchment area of the public transport stations, and the consequent evaluation of the PMCMV dwellings that have access or not to a particular public transport mode, isochrones were marked out for every 5 minutes from each station, up to a limit of 30 minutes. As shown in the example in Figure 6, the isochrones were calculated from existing routes, using GIS databases provided by the municipality of Rio de Janeiro and marked through the real walking path.

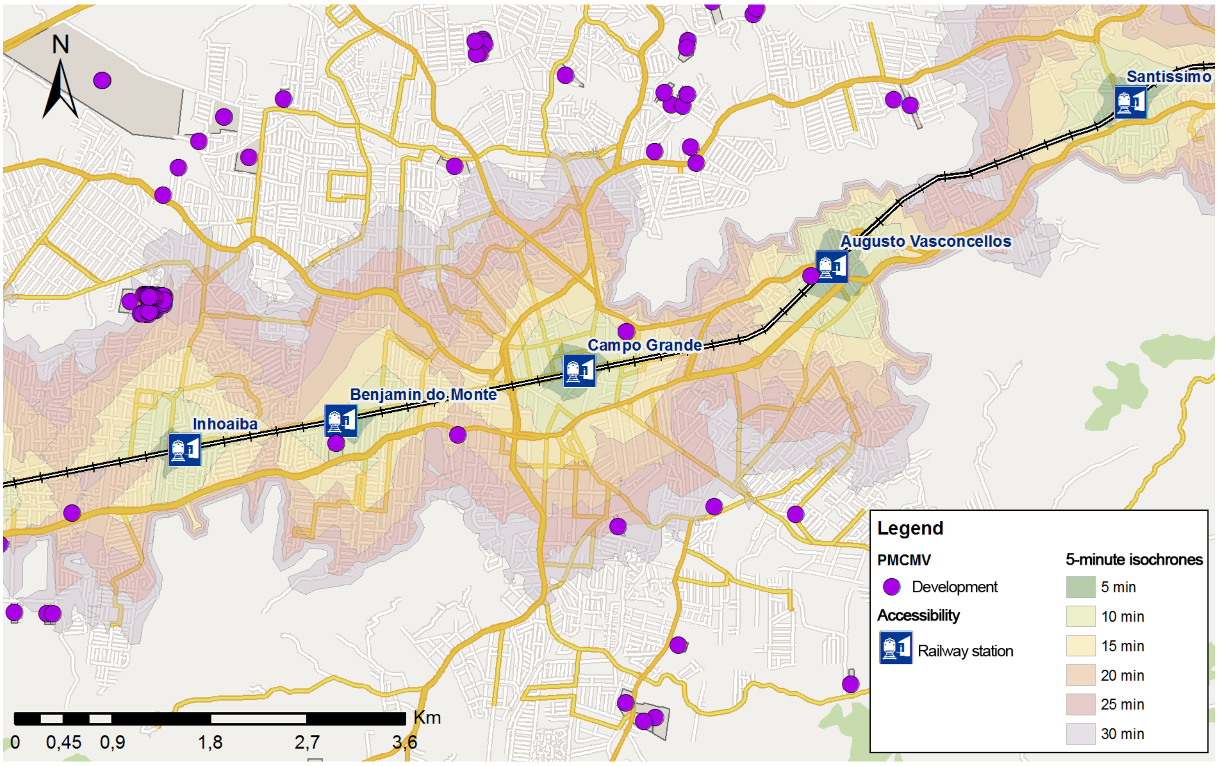

Figure 6 – Example of 5-minute isochrones applied to the railway stations

Using the isochrones around public transport stations and stops, spatial analyses were performed in relation to the centroids of the housing condos, thus identifying the number of housing units that are within a determinate walking distance. Of the 58,680 PMCMV units licensed in the city of Rio between 2009 and 2011, a total of 58,102 whose geographically plotted location was available at the municipal urban planning and housing departments were analysed, equivalent to 99.01% of total licensed units.

Thereby, this part of the analysis investigates the walking distance, in terms of time between the PMCMV dwellings and the nearest train, subway, ferry and BRT system (operating with exclusive lanes). The results of this analysis were compared with those of the complete network (which includes normal bus stops), in order to ascertain the degree of accessibility the PMCMV dwellings target population will have to the public transport structural network (see Figure 7).

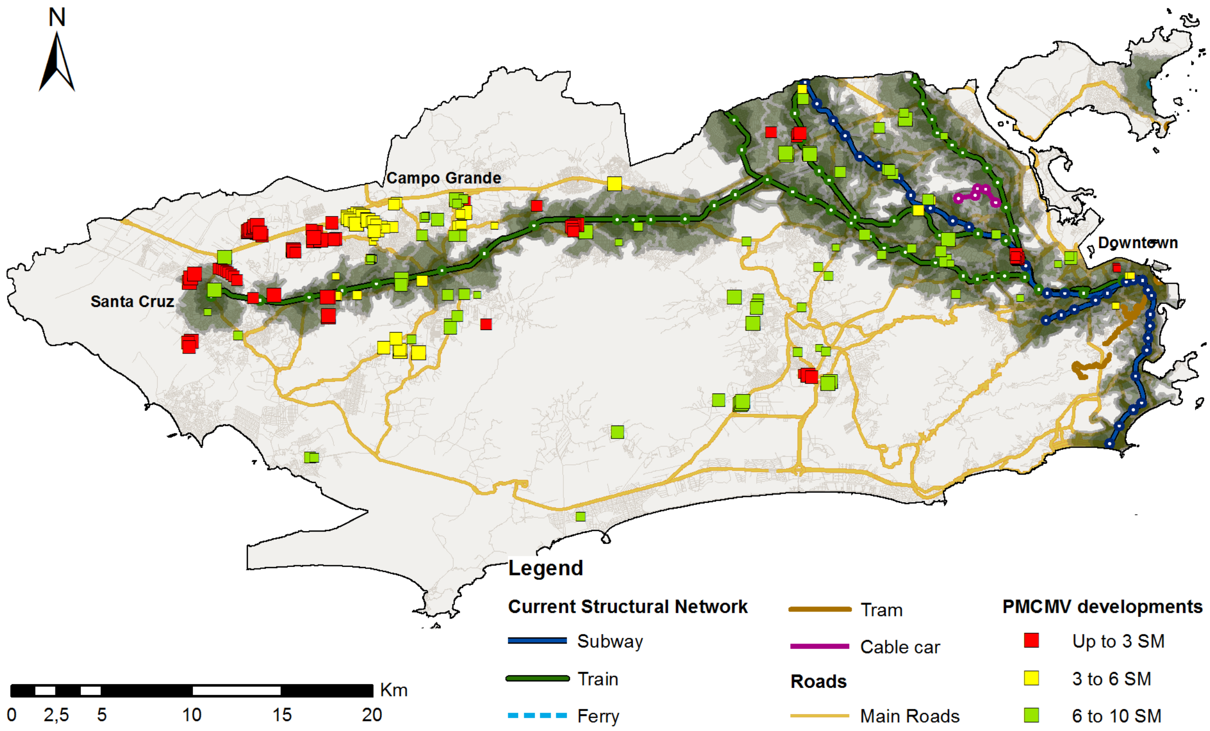

Figure 7 - Relationship between PMCMV dwellings and accessibility to the current public transport structural network (30-minute isochrones).

Figure 8 shows the results of the analysis of walking distance (in time) to the current network structure and even to the bus network (complete network). It was found that 55% of the units are located within 5 minutes of a station or bus stop and only 8% are located more than 15 minutes away. However, looking only at the network structure, the figure shows that only 13.5% of the units are located within a 10-minute walk, while most of the units (60.4%) will be located at a distance greater than a 30-minute walk. The comparison with the bus network (complete network) shows that the target population of the program will be highly dependent on the city's bus system.

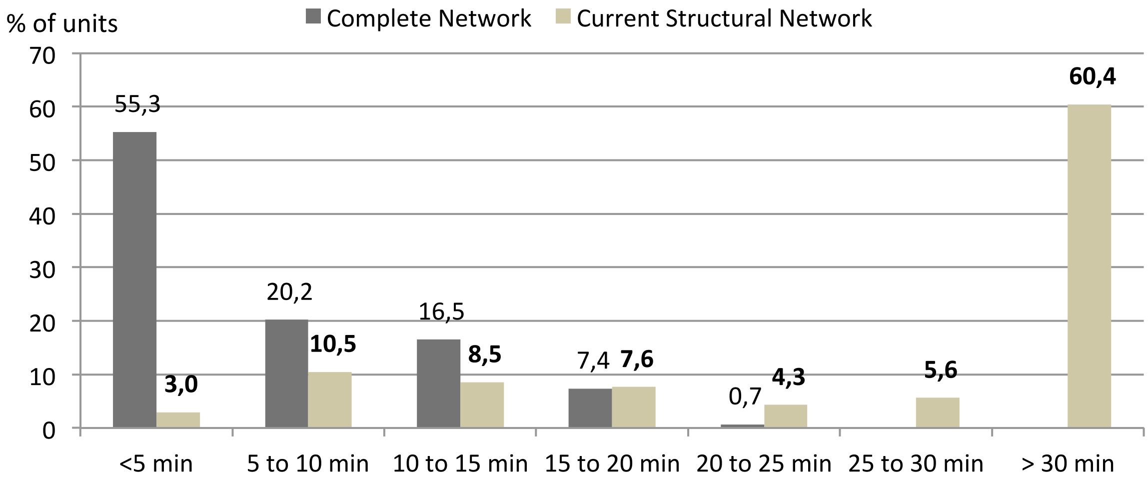

Figure 8 - Distribution of units by walking time from the current network structure and the complete network.

Analysis by income group shows a relative balance in the distribution of units by walking time to the current structural network. Among the units that are more than a 30-minute walk from the structural network (60.4% of the total), the three income groups are similarly divided. Of the units that are less than 30 minutes away, 48% are the range of 0 to 3 SM, 10% are in the range of 3 to 6 SM and 42% are in the range of 6 to 10 SM (see Figure 9).

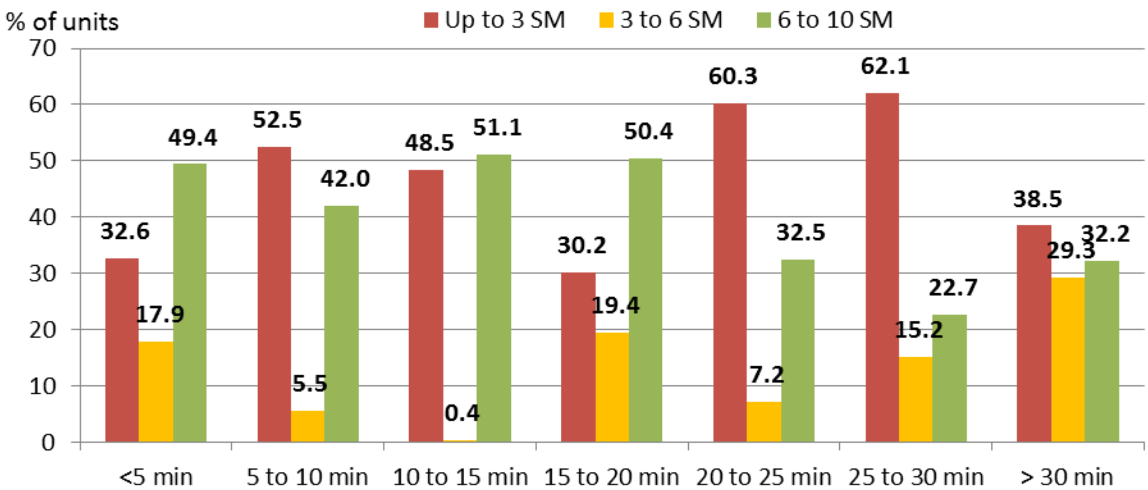

Figure 9 - Units by walking time to the current structural network, by income group.

Analysing the information according to the city of Rio's Planning Areas, AP 3 (Suburban Zone) has the best accessibility to the PMCMV dwellings. This area, which is served by train and subway systems, has 45% of the units within a 10 minute walk of a station and 100% of them are less than 30 minutes away. All the other APs have low percentages of accessibility on foot to the network structure. Although they are the best supplied areas, the units in AP 1 (Downtown) and AP 2 (Southern Zone) are located more than 10 minutes away in 83% and 100% of the cases, respectively. In AP 4 (Barra and Jacarepaguá), which is only accessibility by road, 99% of the units will have no access to the structural network and the other 1% will have to walk between 20 and 25 minutes to the nearest station. AP 5 (Western Zone) has access to the urban rail network, but only 7% of the units will be less than 10 minutes from a station and 72% will be more than 30 minutes away, on foot (see Figure 10).

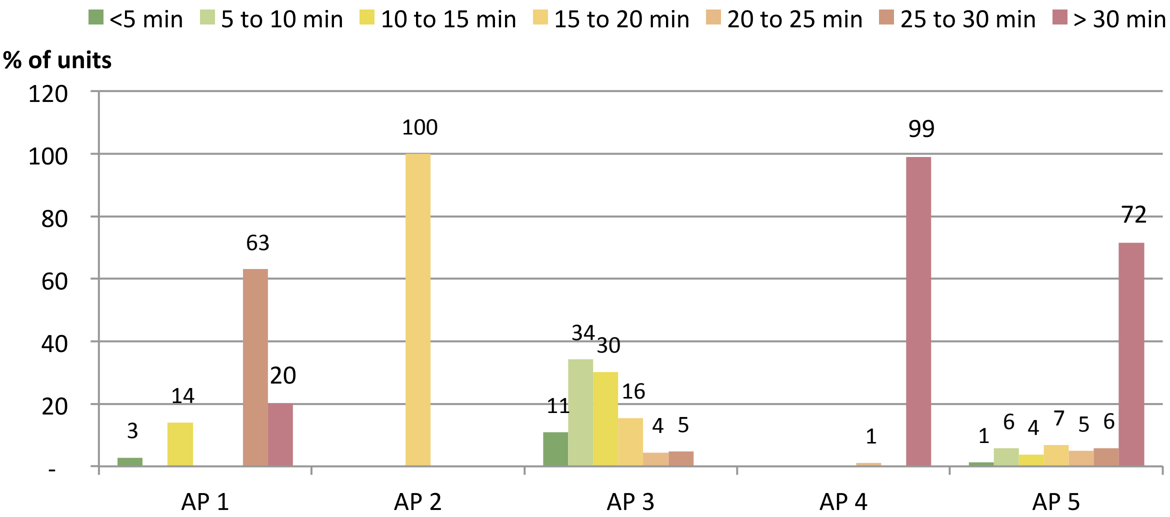

Figure 10 - Distribution of the units by walking distance, measured in time, by AP.

3.5.2. Accessibility to the future public transport structural network

Analysis of the future structural network includes systems planned or under construction in the city of Rio until the year 2016, namely: the four BRT lines (Transcarioca, Transoeste, Transolímpica and Transbrasil), the extension of subway Line 1 to Barra da Tijuca and the Light Rail line in downtown Rio. The results of this analysis were compared with those obtained for the current network structure, in order to investigate the impacts that the new systems will have on the PMCMV dwellings target population (see Figure 11).

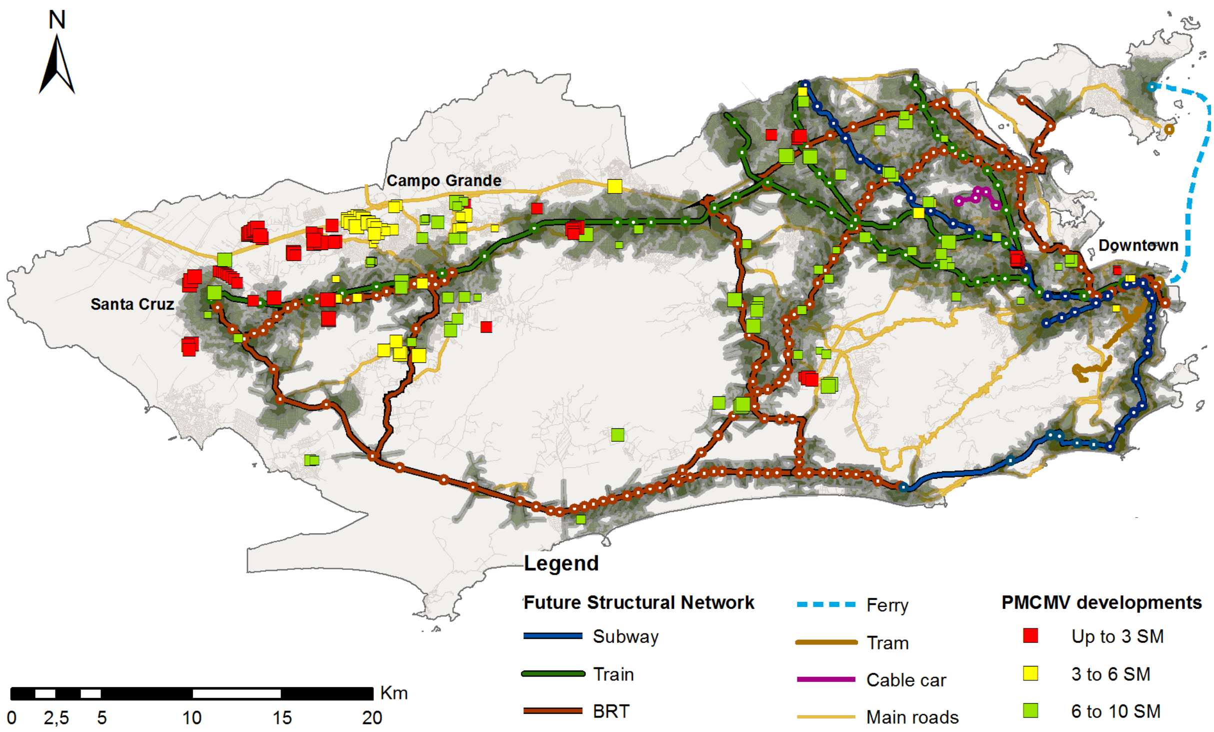

Figure 11 - Relationship between PMCMV dwellings and accessibility to the future structural transport network (30-minute isochrones).

One can see from the map that the largest number of PMCMV dwellings to benefit from the implementation of the future structural network are concentrated within AP 4 (Barra and Jacarepaguá), and especially in Jacarepaguá, which currently has no access to any structural mode. Another area to significantly benefit, although not to the same degree, is that in the southern part of Campo Grande, in AP 5 (Western Zone).

Figure 12 shows the change that will occur in accessibility, as a result of the implementation of the future structural network. One can see that the new network will bring a reduction of 15 percentage points in the number of units located more than 30 minutes' walk away. That means that the percentage of PMCMV units with access to the structural network, which was previously 39.6%, will increase to 54.5%. The percentage of units that are less than a 10-minute walk away will double, from 13.5% to 26.3%.

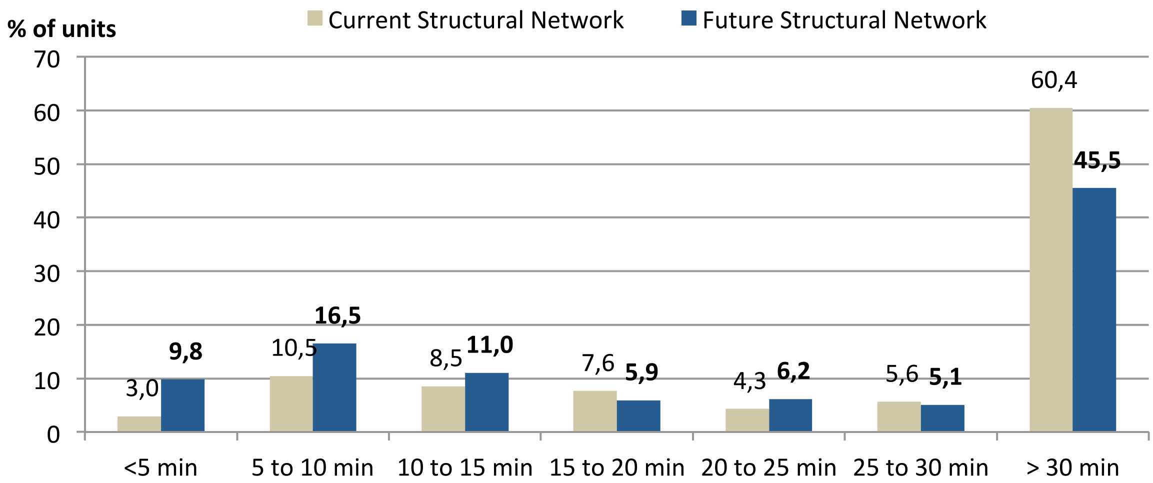

Figure 12 - Distribution of units by walking time from the future and current network structures.

On the other hand, analysis of the accessibility to the future structural network according to income group reveals that the relative equilibrium of the distribution in each isochrone will change. Among the units that are more than 30 minutes' walk away (45.5% of the total), which previously had similar shares, one can now see from Figure 13 that the proportion of units for the lower income segment (47% in the range 0 to 3 SM) has increased. Among the units within 30 minutes' walk, there is an almost inverse weighting, where 38% will be in the 0 to 3 SM range, 14% belong in the 3 to 6 SM range and 48% will be in the 6 to 10 SM range.

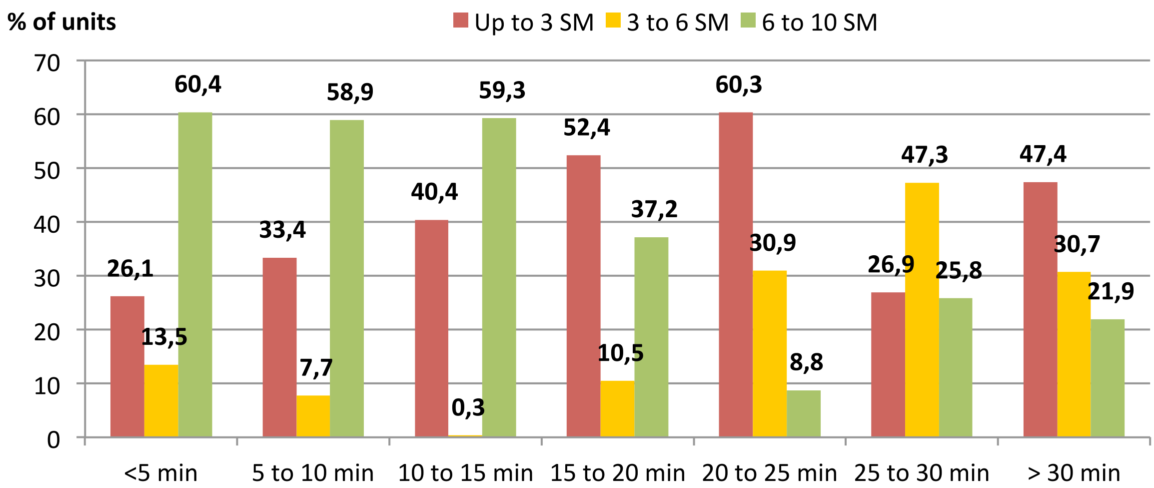

Figure 13 - Units by walking time to the future structural network, by income group.

The imbalance of the income groups detected in the isochrones is due to the greater attention given by the new systems to the higher income groups. Comparing the percentage of units that are more than 30 minutes' walk from the current and future network structures, one sees that the 6 to 10 SM range shows the greatest change. The higher income group and the 0 to 3 SM range each accounted for around a third of the units without access to the current network structure. With the future network, the 0 to 3 SM range will rise to about half of the units without access to structural modes, whereas the 6-10 SM group will be reduced to 28%.

This is due to the fact that AP 4 is the Planning Area that will most benefit from the changes. As a result of being served by three of the four new BRT lines that are being implemented in the city, the percentage of units with on foot access to the structural network will soar from 0.02% to 79%, and 41% of the AP 4 units will be less than 10 minutes from the future network (see Figure 14).

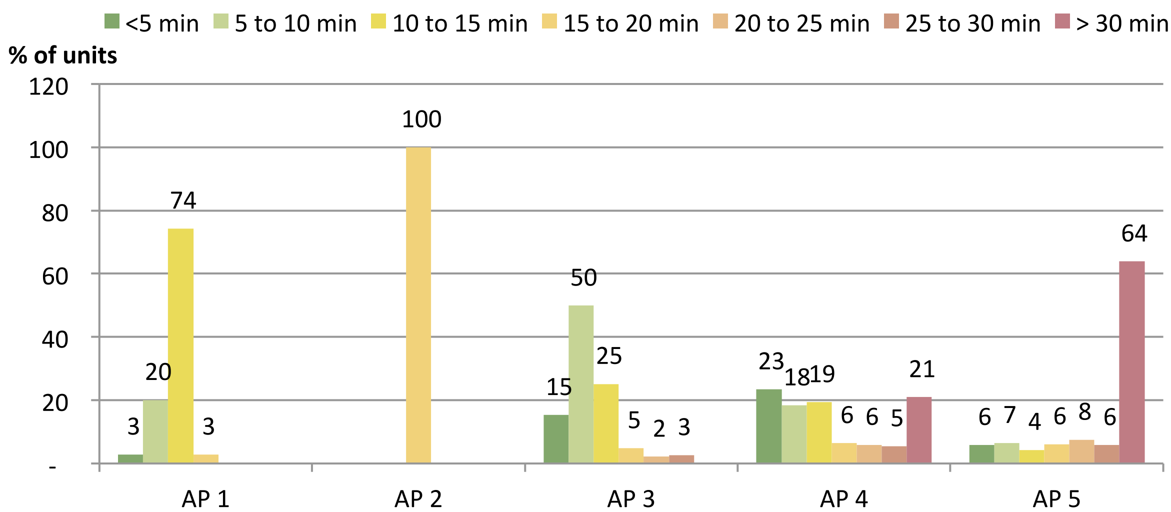

Figure 14 - Distribution of the units by walking distance, measured in time, from the future structural network, by AP.

3.5.3. Accessibility to urban opportunities

The employment concentration model is responsible for commuting trips that create macro accessibility problems. The district with the highest concentration of formal jobs in the city of Rio is Centre (AP 1), which accounts for 28% of the total. On the other hand, the highest concentration of the MCMV dwellings occurs in the Western Zone (AP 5), the area farther from the Centre and that has the lowest number of jobs for people in the city. Figure 15 shows the relationship between the location of housing units and the districts with the highest number of jobs per inhabitant.

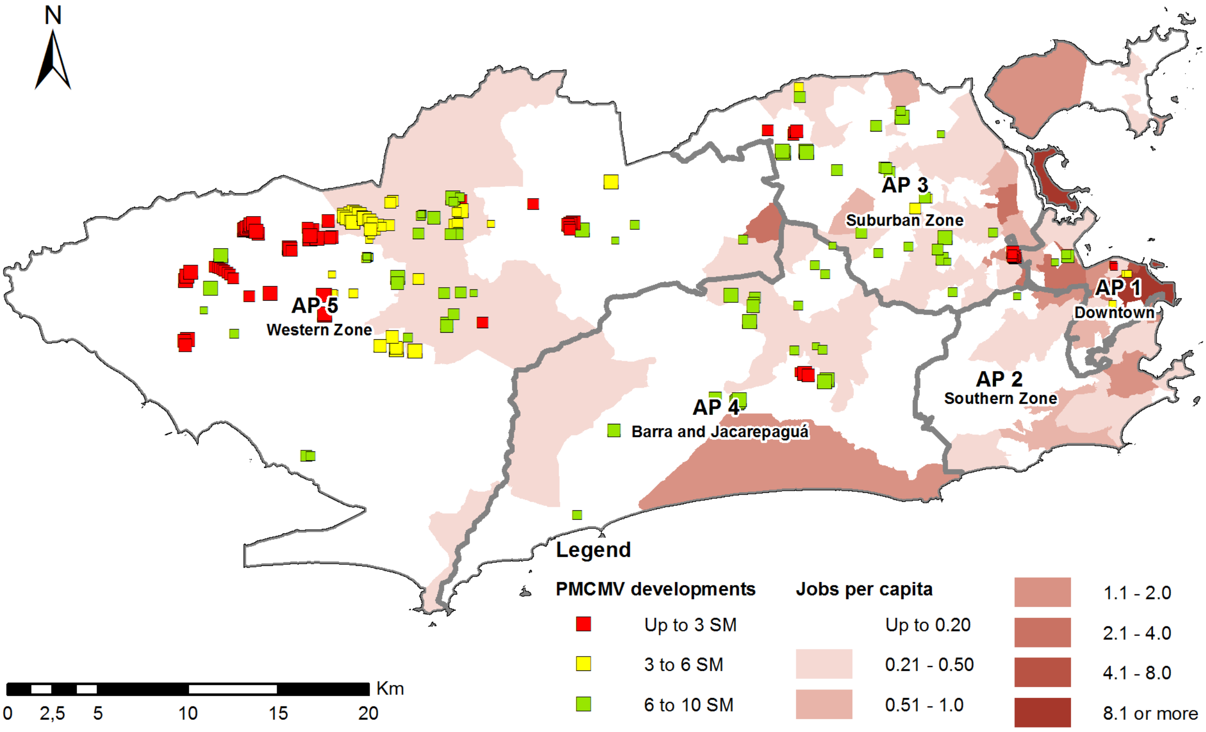

Figure 15 – PMCMV dwellings and jobs per district.

The challenge of accessibility to urban opportunities for the PMCMV dwellings target population can be seen in Figure 16, which shows the distribution formal jobs and the PMCMV units, according to distance from the city centre (downtown).

It can be seen that, while 53% of the formal job opportunities are concentrated within a group of districts that are less than 10 km from the city centre, 60% of the housing units licensed under the program are located more than 50 km from it. The most evenly balanced areas lie between 20 and 30 km from the city centre. This is explained by the number of formal jobs in the Barra district (urban expansion area) and the large number of PMCMV units licensed in the neighbouring district of Jacarepaguá. A description of the dwellings shows that 87% of the units in this area are aimed at the higher-income group, in the 6 to 10 SM range.

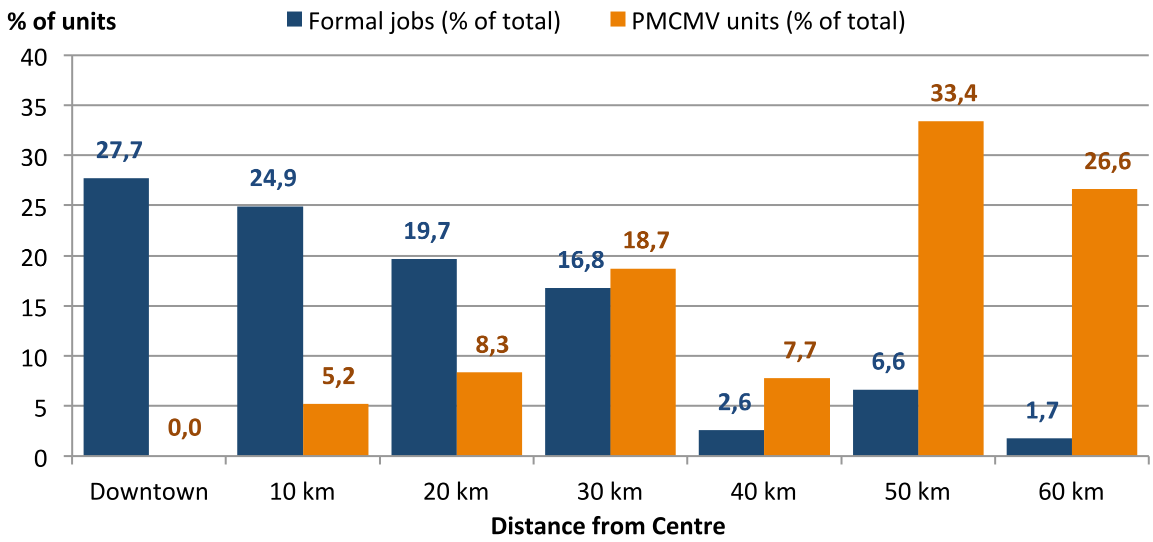

Figure 16 - Distribution of formal jobs and PMCMV units, by distance from the city centre.

Another important point in analysing the accessibility to urban opportunities is with regard to school access, particularly to state schools, given the level of family income of the PMCMV dwellings target population. To this end, Figure 17 shows that 75% of the PMCMV units are located within a 15-minute walk from a municipal school and less than 1% of them are located more than 30 minutes' walk from one.

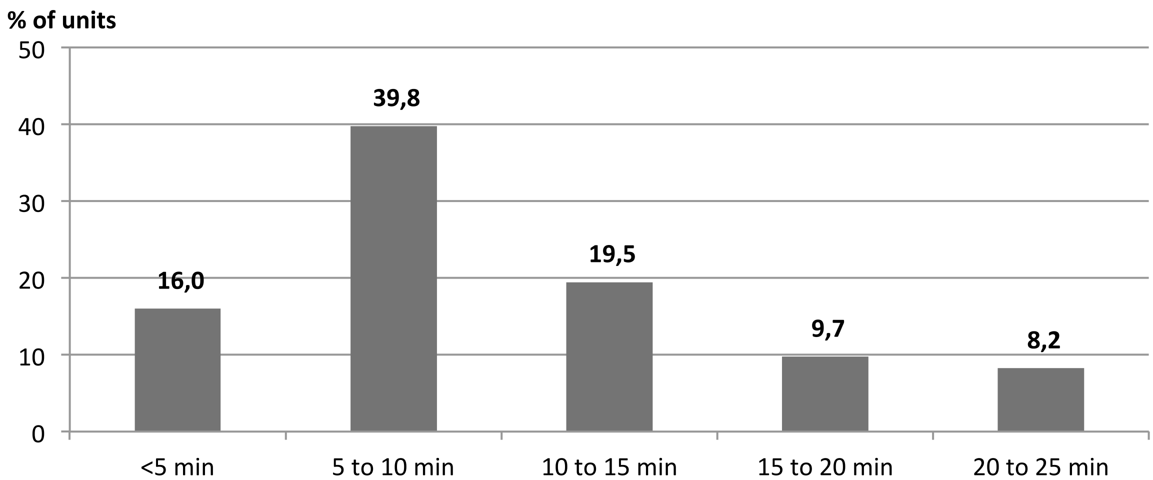

Figure 17 - Units, by walking distance, measured in time, from the nearest municipal school.

As can be seen in Figure 18, the analysis by Planning Area shows that 100% of the licensed units in AP 1 and AP 2 are located within 15 minutes' walk from a municipal school. This proportion decreases as one moves away from the centre. In AP 3, 86% of the units are less than 15 minutes away from a municipal school, whereas in AP 4 it is 80% and in AP 5 it is 71%. The AP 5 is the only area with units that are more than 30 minutes' walk, with 1% of the units in this situation.

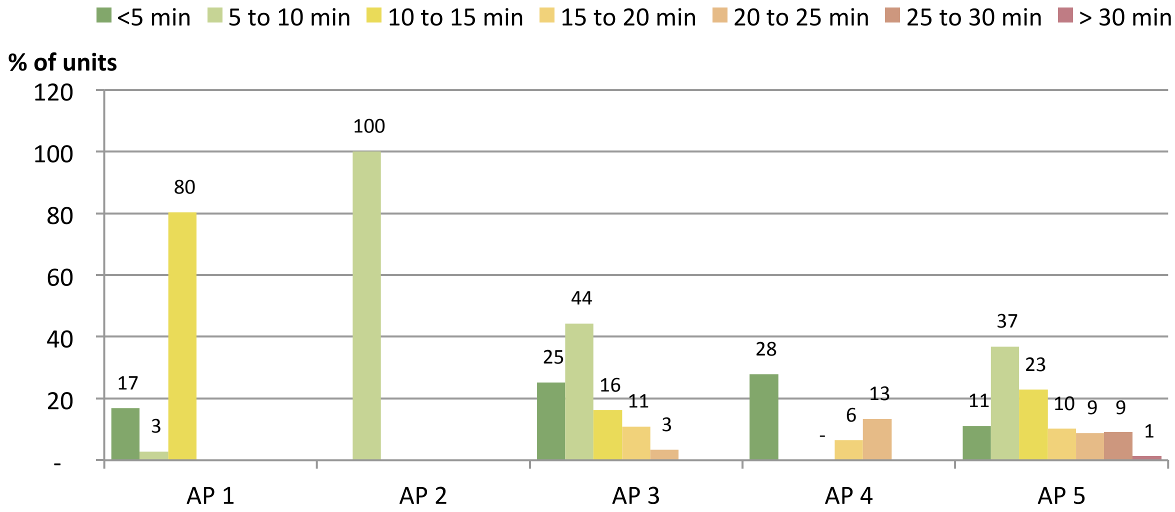

Figure 18 - Units, by walking distance, measured in time, from the nearest municipal school.

CONCLUSION

This study sought to evaluated the accessibility of the target population for the low-income housing program "Minha Casa, Minha Vida" (My Home, My Life, or the PMCMV), in the city of Rio de Janeiro. To this end, it documented how an urban planning model that was not integrated to transport planning was one of the causes of the current urban mobility crisis in Brazil.

The types of land occupation and use provoke, to a greater or lesser degree, the need for long journeys in motorized transport, particularly cars. The deteriorating level of accessibility to job opportunities, caused by the increase in commuting travel time, is one of the most serious quality of life problems in the big cities. So, planning can and should make a positive contribution to reducing the distance travelled by car, with shorter distances encouraging greater variety in the use of different modes (Banister, 2012).

However, with regard to the first phase of the PMCMV in the city of Rio, the study found that, offered without connection to other urban policies, the dwellings are only viable in areas with reduced access to the transport network structure and urban opportunities. Moreover, in the way is being implemented, the future transport network could accentuate the existing socio-spatial segregation, by mainly benefiting the population of higher income districts, while having a lesser impact on the lower income PMCMV groups.

In the interest of developing public policy, it is important to examine the factors determining worker commuting time, such as the provision of housing. However, most previous studies were limited to examining the factors governing land use and the socio-economic characteristics of the workers, while neglecting institutional factors. As a result, policies designed to curb the increase in travel time have concentrated on improving the transportation infrastructure to meet the demand for ever longer journeys, while little attention has been given to institutional innovations in development management that could bring about reductions in travel time. Understanding the influence of institutional factors on travel time is a first step that politicians and planning specialists must take to resolve the problem of job accessibility, which has been worsened by the increased travel time, through policy innovations geared to development.

The effective implementation of sustainable mobility requires the engagement of the key players, but the message that the federal government is sending still favours the use of individual motorized transport. The incentives to car ownership and use endow cars with comparative advantages over the use of public transport modes. At the same time, given the nature of the housing program, it can be seen that the need to find large areas of land induces peripherization, due to the scarcity of large empty areas in locations that have infrastructure. This phenomenon of peripheral expansion reproduces the inequality between the wealthy, with infrastructure, and the poor, who are underserved. On top of all this, it can be seen that the program's target population is located in areas with reduced access to job opportunities. The combination of the concentration of opportunities in a fragment of the city and peripheral occupation, at increasing distance from the centre, affects the demand for travel, with ever longer journeys at greater cost.

Hence, the "Minha Casa, Minha Vida" program - an initiative funded by the federal government - maintains the status quo, without looking for a model of land occupation that treats urban space and the location of activities in an integrated manner, in order to balance transport demand with supply. In other words, it ignores the guidelines for sustainable urban development and mobility.

It follows, then, that the PMCMV is a policy that is not directed at sustainable urban development nor at sustainable transportation, since it has been conceived in isolation, without organized planning and without complying with the sustainability guidelines examined here.

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