

# Mobilities, climate change and rights of city

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**Abstract**— *This article analyzes the relationship between mobility, climate crisis and the right of city in Salvador, capital of the state of Bahia, Brazil. In addition to briefly describing the history of the city's mobility and its fundamental role in social relations, we demonstrate how it has been the subject of countless conflicts over the 19th and 20th centuries. Using bike sharing system data, we also demonstrate how active modes of transport are an important practice in central areas. Using the bicycle as a means of transportation can not only mean a reduction in the use of cars, but also a reduction in greenhouse gas emissions in the atmosphere. In the analysis of data on the movement of bicycles shared between April 2018 and April 2019 in the old center of Salvador, we noticed that the routes suggest routes and practices aligned with Transit-Oriented Development, a concept coined in the 90s and aimed at building democratic, sustainable and diverse cities.*

**Keywords**— *Bike sharing, Climate change, Mobilities, Right of city, Salvador.*

## I. INTRODUCTION

Since the new mobility paradigm was created [1], we can verify in field that the movement of people, ideas and things is able to explain our socio-cultural history. More than that, the world is being built on the relationship between mobility and people and, especially in the city, they are decisive in our lifestyle. In the Anthropocene era [2], mobilities have an important contribution to make and discussions about them become central, especially concerning climate change.

This article will show how mobility issues are important in Salvador, capital of the state of Bahia, Brazil, and how they are fundamental in understanding conflicts in urban space and the right of city [3]. On the other hand, mobility, especially the movements with the bicycle, can show us how to solve circulation problems in the city center, as well as indicate issues of climate change that should be considered in the near future.

We present the mobility data from the Tembici [4] bike sharing app in the years 2018-2019 and how they are marked by gender issues. We were also able to calculate the greenhouse gas amount that was not emitted in the old city center of Salvador (OCS). In addition, we realize that

these paths are aligned with TOD - Transit-Oriented Development [5] in the context of active mobility.

## II. SALVADOR: A MOVEMENT CITY

When the Portuguese started the colonization of the lands where is Salvador, they knew about the enormous challenge that awaited them. If the city had the advantage of placing itself in the fortification of high hills, which could protect the colonial project, they still needed search strategies to bring the upper and lower parts of the city together. Lisbon has presented the same mobility problems since its foundation. Over time, the two cities built solutions for accidental topography, first with enslaved human labor, then with elevators and other mechanical inventions.

It did not take long for the first conflicts to arise. The pioneering workers' strike involved issues related to mobility and enslaved black workers. Until the 19th century, they were one of the main labor forces in Salvador, moving things and people, and were known by the name of "ganhadores" (winners) [6]. For ten days, people were unable to go anywhere because the "cadeirinha de arruar" (street chair), perhaps the first shared transport service, performed mainly by freed slaves,

was out of service. Food and other services provided by these workers also ceased in 1857.

This century was extremely important for thinking about mobility. Due to the influence of European modernity, a series of inventions such as electric trams, bicycles, steam powered cars by steam and then fossil fuel changed the customs, behaviors and lifestyles in the tropical city. Before the colonial presence, traditional forms of travel, such as hiking and sailing, were essential means of transportation. The boats called “igapebas” and “igaras” [7] have been used for centuries by the Tupinambás tribes that inhabit these lands surrounded by the sea.

The modernity not only changed the Salvador lifestyle, but also changed the urban space. Milton Santos [8] was the first researcher to observe this impact of transport engineering. Electric trams and asphalt with their cars allowed the growth of the city and, at the same time, contradictorily, the escape of the population and the economy. With the possibility of circulation, the city maintained its port, a speculative and colonial character that founded it in the 16th century. In addition, conflicts quickly began to occur between citizens, transportation companies and public authorities, mainly due to the elitist character that these technologies have had since their creation. In fact, today, who can use expensive and inefficient public transport in an underdeveloped country?

In 1930, we will be occupied with the first great mobility conflict of the 20th century: the “Quebra-Bonde” (1), a popular revolt that destroyed the electric tram system due to its inoperability and poor service, added to the political instability experienced in the country with the Revolution of Getúlio Vargas.



Fig. 1: “Quebra-Bonde”, 1930.  
Public Archive of the State of Bahia



Fig. 2: “Revolta do Buzu”, 2003.  
Photo by Marcelo de Trói

It was the first of other revolts. The public transportation inefficiency will be a reason for enormous riot throughout the 20<sup>th</sup> century. In 1983, “Quebra Quebra” destroyed 343 buses and another 10 were set on fire because of the high ticket price. In 2003, another revolt marked Salvador, the so-called “Revolta do Buzu” (Bus Uprising) (2), when the city was totally paralyzed by students who occupied the urban space, preventing the movement of people. The bus uprising was especially important because it was the origin of a social movement that sought to eliminate urban public transport fares and which would return with strength 10 years later: in 2013, a new demonstration initiated by the “Movimento Passe Livre” (Free Pass Movement) reached the entire Brazilian territory and was configured as one of the biggest urban turbulences in the recent history of the country with political impact until today [9].

These examples show how the transportation issue is central to understanding the right of city and the importance of mobilities for the urban population. Furthermore, these conflicts demonstrate a certain inability of governments to solve delicate problems for citizens and its other fields of life influences, such as housing, work and well-being.

### III. TRANSIT-ORIENTED DEVELOPMENT

The 1980s were marked by the beginning of a new way of thinking about urban mobility issues, especially in the case of development habits, mobility and climate change, which would be accelerated from the 1990s onwards. If economies grow, it was evident that transport activities grow as much as human activities and urbanization. Actually, it is estimated that transport is responsible for 23% of the total related to energy consumed worldwide and 13% for global emissions [10].

The concept of TOD - Transit-Oriented Development appears to help cities solve problems related to this. In this trend, institutes such as ITDP - Institute of Transport and Development Policies have emerged intending to thinking about these issues, which created models for analyzing standards on aspects involving mobility and development. Standards such as pedestrian mobility, active and collective modes of transport, connections and soil diversity are taken into account [11]. In this paper, we have no intention of making a thorough analysis of TOD in the old center of Salvador, but it is important to understand how this territory presents favorable conditions for the establishment of these standards: first for its plan topography, second for the diversity of the population and land-use diversity of this central area, and third for the various connections with bus stations, cultural, education and health facilities.

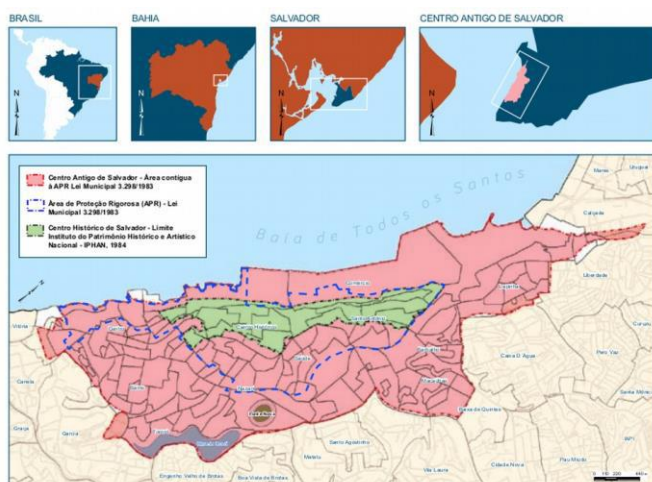


Fig. 3: OCS - Old Center of Salvador (Centro Antigo de Salvador) in the red selection, with the historical center (green area). Source: SEI, 2013 [12]

The old center of Salvador (OCS) is one of the most privileged area city (3). Besides the beautiful “Baía de Todos os Santos” (All Saints Bay) view in the south Atlantic Ocean, this territory is rich in identities, cultures and services access. The OCS has numerous symbolic values and is considered one of the places with the largest heritage site in Latin America, mainly in terms of colonial and baroque architecture.

Although there are people in a social vulnerable situation, the territory is occupied by a modest middle class, which means a monthly income of less than two minimum wages, the proportion of the poor being less than the rest of this city. About 77 thousand people live in this area, which corresponds to 2.9% of the total population of Salvador - almost 3 million inhabitants. It's important to

highlight some demographic data such as 54.9% of women, 78% of black people and 73.6% of people have medium schooling. Concerning mobilities 79.8% don't own a car and 78% of the population take half an hour to get to work [12].

Recently, the hall city promoted a series of changes encouraged by new mobile practices due to the increased cyclist number besides to other policy guidelines in function of the new climate policy.

This means that the public administration should encourage projects related to reducing travel rates, non-automotive travel and pedestrians. The data we explore in this paper indicate that the bicycle sharing system Tembici has been used by students and workers who live in this area and this experience can inspire political transport to other regions of the city, especially those located in peripheral and suburban areas.

#### IV. BIKE SHARING SYSTEM AND SALVADOR

Begun in the 1960s in Amsterdam, the BSSs - Bicycle-sharing schemes is a reality in all major Western metropolises. Of the 1,600 bike sharing systems in operation, 95% of them have been in operation for over a decade. In 2015, there were approximately 1.2 million shared bicycles accessible to the public worldwide, which demonstrates the potential for this technology [13].

In Brazil, the initiatives on BSS started 10 years ago. In operation since 2011, Tembici (formerly called Bike Itaú) is one of the most known and nowadays it operates in the cities of São Paulo (state of São Paulo), Rio de Janeiro (state of Rio de Janeiro), Belo Horizonte (state of Minas Gerais), Recife, Olinda, Jaboatão dos Guararapes (state of Pernambuco) and Salvador. Since 2017, the system has started to offer aluminum bicycles produced by a Canadian company, with a rim 24 and roller brake system on two wheels. The new system was made available in Salvador in 2018, linked to the “Salvador Vai de Bike” Movement, a city hall program created as one of the responses of the city administration to the 2013 demonstrations, already mentioned in this article.

The application has a certain elitist character, first due to the distribution of stations, which does not reach the periphery of the city, second because the system requires the user to have a credit card to obtain one of the paid plans. The bicycle is released either from an application installed on the cell phone or directly on the totem pole for daily plans. Or the bicycle can be removed through the “Salvador Card” (after registration), a ticket for integrating

municipal public transport, which was also implemented in 2014 as a claim of the 2013 demonstrations.

We analyzed the system's trips throughout the city of Salvador between April 2018 and April 2019. The data provided by the company Tembici contained information on bicycle pickup and delivery, the corresponding station with details of day, month, year and hours exact times of use, in addition to the user's age and gender. With some insistence, we managed the number of users in this period, estimated at 33,782 people.

Our methodology for analyzing and interpreting these data was to articulate the neighborhoods in the old center of Salvador (OCS) that contained the Tembici stations as transmitters and receivers of the system's trips. In other words, we were interested in all the trips in the city that had as their final destination the old center, as well as all the trips that left the central stations with any other destination.

Of the 50 stations of the Tembici system in operation during the studied period, 10 were within the studied area. We tried to select all trips that had the OCS stations as their final departure or destination. Therefore we came to some consolidated data regarding travel across the city and those restricted to the center. Of the total of 400,177 trips made in the city of Salvador in the analyzed period, 71,943 had their arrival or departure to the OCS region. In total, trips of this type accounted for 15 to 20% of trips across the city. In the analysis of the period of one year of trips made with the Tembici app, we account for trips that left or departed the old center of Salvador. The total kilometers traveled with bicycles reached a total of 194,852 kilometers.

Table.1: Tembici OCS/gender (April 2018-April 2019)

Gender	Total Trips	%
Male	53,592	74.49
Female	13,529	18.81
Not declared	4,822	6.70
Total	71,943	100%

The data above (1) demonstrated what the observational field research already signaled: the system is mostly used by male people. We consider this as a hypothesis, which is evident in the very history of bicycle creation. Although the women were instrumental in the creation of the modern and safe bicycle in the 19th century

[13], which was previously restricted to the male world, they still do not feel fully confident in facing the brutality of traffic in the city. In 6.70% of the trips, it was not possible to determine the gender. In this case, we have three possible hypotheses: the person did not identify with the binarism attributed by the system's registration, the person did not want to identify himself or, more likely, the data were not consolidated by the system, which is common, especially with regard to the sex and age categories that rely on the user to put the information in the system.

Table.2: Tembici OCS/age (April 2018-April 2019)

Age groups	Total Trips	%
26 - 35	23,589	32.79
18 - 25	23,186	32.23
36 - 45	11,448	15.91
46 - 55	5,257	7.31
56 - 65	2,364	3.29
Less 18	1,736	2.41
+ 65	640	0.89
Not declared	3,723	5.17
Total	71,943	100

The age group of most users was between 18 and 45 years old, a category that concentrates more than 70% of the total trips. Surprisingly more than 10% of the trips were made by people between 46 and 65 years old. In the not declared data, corresponding to 3,723 trips, it was not possible to assign age to the user because the table with the data was missing or because it contained the year 2018 or 2019, which would give to a person with 01 year, presenting an error in filling out the form system (2).

The data analyzed in the period also showed that the system was used mostly on weekdays, which may indicate that bicycles were used less for leisure than for daily mobility in the OCS.

Table.3: Tembici OCS/distance in kilometers (April, 2019)

Distance	Total Trips	km
Up to 5 km	8,738	17,901.5

Between 5.1 and 10 km	603	4,033
Between 10.1 and 20 km	60	694.1
More than 20 km	1	24.7
Total	9,402	22,653

Another important factor to be analyzed and which is directly related to the concept of TOD is the distance per trip (3). According to the concept of TOD, the ideal bicycle locomotion is 8 km for complete journeys and 3 to 5 km for complementary journeys (those that are performed with the combination of other modes). When analyzing only the April 2019 data, of the 9,402 trips that left or arrived at the OCS, less than 700 trips had routes between 5 km and 10 km, and only one trip was above 20 km (in January 2019 there were two trips greater than 20 km). In other words, 8,738 trips had routes of up to 5 km, which indicates that users traveled shorter distances, within the OCS itself, indicating interests and motivations in that space, reinforcing the utility use of the system. The hypothesis was reinforced through direct observation of the field without participation. For comparison, in January 2019 trips up to 5 km were the majority (9,055 trips), but routes between 5.1 and 10 km increased by 31 trips, perhaps due to school holidays

The analysis of these trajectories shows that active mobility policies intended to workers and students use can have excellent results and adherence, which means reducing the use of motorized modes in the central areas, increasing the interaction of people in the urban space, avoiding emissions of greenhouse gases, according to the simulation that we have also prepared from the total kilometers of trips in the OCS (194,852 km):

Table.4: Tembici OCS - CO<sub>2</sub> / year compensation simulation (\*exchange rate R\$1 = US\$ 5,63 in Oct. 26, 2020)

Vehicle type/scenario	tons / CO <sub>2</sub>	number of trees	dollar US\$*
A - Gasoline car 1.5 / 2.0	553.12	1,533	7,760
B - Biofuel car 1.5 / 2.0	214.65	595	3,011

C - Diesel bus	62.23	173	875
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We used a CO<sub>2</sub> emission calculator to find out how many emissions would be emitted (4), if that mileage were achieved by motor vehicles with only one passenger. Thus, we simulated three possible scenarios: “A” - gasoline car with 1.5 / 2.0 engine; “B” - biofuel car with 1.5 / 2.0 engine and “C” - diesel collective bus. The amount of CO<sub>2</sub> is expressed in tons, the number of trees that must be planted to neutralize the emission of gases and the corresponding dollar value for planting them.

Among the three simulations, the gasoline car would be the most polluting and the trip with the collective transport to which it emits least *per capita*, considering 30 people transported in the bus.

Thus, it is suggested that an ethics based on climate policies, using public transport for commuting from the city would be the first option, followed by automobiles powered by biofuel. The simulation was done thinking about only one occupant per car and, not by chance, once in direct field observations, we noticed that most automobiles were and still are always with only one person. It is urgent to create concrete measures against the emission of greenhouse gases into the atmosphere and the automotive system has been the biggest villain in this respect [15].

## V. CONCLUSION

The preliminary data shows the mobilities such a central question for urban studies in old center of Salvador.

Although the purpose of this investigation, which is still ongoing, is not to make a rigorous calculation regarding the study of trajectories and CO<sub>2</sub> compensation, we can see from these data that tons of CO<sub>2</sub> are no longer released into the atmosphere by the simple use of Bike Sharing System. A precarious and somewhat shy system with little access if we think about the population of OCS and the entire city of Salvador. Still it shows an enormous potential for dissemination as a practice of cycling, especially among workers and students.

Even if measures are taken to reduce greenhouse gas emissions, which means radically changing the form of global mobility, the effects of the current transport policy and its environmental impacts are already being felt.

High temperatures should be more frequent in Salvador until the end of the century, increasing the risk of illness and death, especially among the elderly, babies and people

with chronic medical conditions. The risks are even greater for the low-income population, the majority in the case of the capital of Bahia [9].

Emphasizing active modes, valuing human propulsion, especially for those in physical and structural conditions, is a way of relieving mobility systems and urban roads. Only new practices can modify urban structures and guarantee the right to the city.

This article dealt with specific issues in the old center of Salvador, a privileged area, but which has always been the scene of disputes and conflicts involving mobilities. Expanding this investigation to peripheral areas, for people with disabilities, is essential to have a broader and more representative view of the city of Salvador. This can help to guide society and its elected officials towards the construction of a better and more democratic city with regards to mobility.

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