Sustainable Urban Development Essay:

São Paulo

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Introduction

In 1804, the global population reached 1 billion people, mid-way through the time period that most Historians consider to be the first Industrial Revolution (The World Bank, 2023). Since this time, the extent of industrialization around the world has continued to increase. As a result, living standards have improved and urbanization has emerged as the most efficient way to provide the resources necessary to support large numbers of people. However, this apparent progress has also been accompanied by uncontrolled population growth and widespread environmental degradation. Of the over 8 billion people currently living on Earth, over half of them live in cities, and this proportion is only expected to increase (The World Bank, 2023). Thus, ensuring that human lifestyles within cities is sustainable for future generations has become a primary objective around the world, especially given the potential for severe environmental problems in the near future. The aim of this study is to identify the main challenges and opportunities for the city of São Paulo based on the three prongs of sustainability: environmental, economic, and social conditions. My analysis draws on a variety of sources discussing topics such as the city's Ecological Footprint, inequalities, and future policy plans.

Background

Over the course of the 20th century, São Paulo became the focal point of industrialization in Brazil, as the economy shifted its focus from coffee exports to manufacturing. During the 1940s and 1950s, the city was referred to as the locomotive "pulling the rest of Brazil," referencing the city's automobile manufacturing (Leite et al, 2023). By 1960, São Paulo surpassed Rio de Janeiro to become the most populous city in Brazil, despite having a population that was ten times smaller just before the turn of the century. Fast forward to today and São

Paulo stands as a cosmopolitan megacity with a population exceeding 12 million people (Leite et al, 2023). In addition, its metropolitan area is home to over 21 million people, making it the largest metropolitan area in the Southern Hemisphere as well as the fourth largest worldwide (United Nations, 2019). The city has successfully diversified its economy beyond coffee and manufacturing, emerging as a global financial center and an incubator for startups and tech companies.

There is a great deal of academic literature regarding how to evaluate urban sustainability within a global context. The Sustainable Development of Energy, Water, and Environment Systems (SDEWES) Index is one prominent method, which is currently being used to track the status of 120 cities around the world (SDEWES Centre, 2023). The index is calculated using 7 dimensions, drawing on a total of 35 main indicators and about 25 sub-indicators. These 7 dimensions are Energy Usage and Climate, Penetration of Energy and CO2 Saving Measures, Renewable Energy Potential and Utilization, Water Usage and Environmental Quality, CO2 Emissions and Industrial Profile, Urban Planning and Social Welfare, and R&D, Innovation and Sustainability Policy. Alas, the SDEWES Index currently lists São Paulo as a "Challenged City," scoring in the bottom 25% of the cities that were analyzed (SDEWES Centre, 2023). São Paulo scored particularly low on the dimension regarding the Penetration of Energy and CO2 Saving Measures, emphasizing the need to develop a better action plan for reducing the city's energy-related CO2 emissions.

Methodology

To assess the sustainability of São Paulo from a global perspective, I looked at the calculation of the city's Ecological Footprint from a 2012 report by the World Wildlife Fund

(WWF). Ecological Footprint is a sustainability indicator measuring the amount of biologically productive land that a given population uses for the production of consumed resources and absorption of generated waste (Haberl, H., et al., 2004). Measured in global hectares (gha) and normalized such that 1 gha has a globally average biological productivity, its calculated by taking the sum of the amount of land used for carbon (i.e., the forest land needed to offset carbon emissions), fisheries, cropland, built-up areas, forest products, and grazing land. This analysis provided me with a general understanding of sustainability in São Paulo, helping me to think through both the challenges and opportunities that the city faces.

Furthermore, to consider more challenges and opportunities related to sustainability, I also looked at additional sources. For local environmental challenges, I looked at sources discussing soil degradation, Particulate Matter (PM) air pollution, and the future impact of climate change in São Paulo. Regarding economic and social challenges, I looked at São Paulo's poverty rate and Gini coefficient, which measures a population's income inequality on a scale of 0 to 1. Lastly, to better understand the opportunities to improve sustainability in São Paulo, I looked at the Climate Action Plan for the state of São Paulo, which was prepared for the 2021 United Nations Climate Change Conference (COP26).

Current Challenges

From the perspective of promoting global sustainability, São Paulo still has several areas to address so that its practices are sustainable at a global scale. The WWF report from 2012 determined São Paulo's average Ecological Footprint to be 4.38 gha/person, over 2.5 times larger than the average available biocapacity worldwide that year (Global Footprint Network, 2023). Of the six ecological resources, grazing land (36%) and cropland (27%) were the largest

components, together representing over 60% of the city's footprint (WWF, 2012). These resources are almost entirely used for food production, suggesting that it may be difficult for São Paulo to sustainably provide food to their growing population in the future. In addition, forest products also made up a substantial portion (18%) of the footprint (WWF, 2012). Deforestation represents one of the most important environmental concerns for Brazil, and thus, the implementation of policies to halt deforestation may in turn make it more difficult for São Paulo to meet demand for forest products like wood, paper, and fibers.

At a local level, environmental challenges for São Paulo include high rates of soil sealing, increasing air pollution, and the threats from climate change. As a result of the high rates of soil sealing, there has been widespread soil degradation in São Paulo, which has made some of the land much less biologically productive (Caetano et al, 2021). If this trend continues, it could mean that certain ecosystem services might become harder to provide in São Paulo, in addition to urban green spaces potentially becoming less common in the city and even the surrounding metropolitan area. In terms of São Paulo's air pollution, the ambient concentration of Particulate Matter with an aerodynamic diameter less than 2.5 micrometers (PM2.5) is increasingly becoming an issue for the city. One study found that, from 2009 to 2011, enforcing the PM2.5 standards set by the World Health Organization (WHO) would have allowed São Paulo to prevent 5,012 premature deaths and save US$15.1 billion (Abe & Miraglia, 2016). As São Paulo continues to develop and grow in population, city officials will likely have to consider the effects of air pollution more than they have in the past. Thirdly, São Paulo faces threats from climate change that are likely to become increasingly apparent in the coming decades. By 2100, average temperatures are expected to rise between 2.5 to 3 degrees Celsius, and rainfall is projected to increase by 25% to 30% (Giulio et al, 2018). Thus, it is important that the local government

develops technology that allows them to monitor urban growth and solve issues related to spatial planning, as this adaptive infrastructure is necessary to deal with the increase in heat islands, flooding events, and prolonged droughts.

Moreover, the residents of São Paulo also face several economic and social challenges impacting development, including poverty, housing deficits, health inequalities, and violence. Despite São Paulo having the second highest income per capita among municipalities in Brazil, about one-third of the city's metropolitan area live in poverty (UN-HABITAT, 2010). In addition, all of the social challenges facing São Paulo appear to be exacerbated by the extremely high level of income inequality, represented by the city's high Gini coefficient. Table 1 compares São Paulo's Gini coefficient to recent estimates for South Africa, Brazil, the United States, the United Kingdom, and Denmark. So long as income inequality is at such a high level in São Paulo, it will be difficult to address issues pertinent to sustainable development. The local government must ensure that they are prioritizing equity in their efforts to make the city more sustainable and not only serving the interests of wealthy residents.

City/Country	Gini coefficient	World ranking	Source
South Africa	0.63	1	CIA, 2014
São Paulo	0.57	N/A	UN-HABITAT, 2010
Brazil	0.489	15	CIA, 2020
United States	0.415	46	CIA, 2019
United Kingdom	0.351	99	CIA, 2017
Denmark	0.277	163	CIA, 2019

Table 1. The Gini coefficient of São Paulo compared to that of South Africa, Brazil, the United States, the United Kingdom, and Denmark.

Development Opportunities

Even though São Paulo faces many significant challenges, there are also a large number of development opportunities that the city has. Looking at the Ecological Footprint, carbon made up a relatively small amount (14%) of the city footprint compared to the global average (WWF, 2012). The main reason for this is because the city's electricity grid comes almost entirely from hydropower, which is an almost entirely carbon-free way to produce electricity (WWF, 2012). Being able to generate clean electricity means that the city can provide residents with more amenities and increase their quality of life while simultaneously not contributing to climate change.

Furthermore, there are several specific initiatives that the São Paulo state government has recently planned that have a tremendous opportunity to help enhance sustainability in the city of São Paulo. In the state's Climate Action Plan, the state government outlined policy initiatives centering around five main goals: accelerated electrification, advanced fuels, systemic efficiency, resilience and nature-based solutions, and green finance and innovation (São Paulo State Government, 2021). The first two goals center around the potential for expansion of energy derived from solar, wind, and biomass. The state as a whole has the potential to produce 512 terawatt hours of electricity every year from solar panels, in addition to 13 terawatt hours from wind power (São Paulo State Government, 2021). For comparison, this is almost enough to supply all of the electricity consumed in Brazil in 2020. Expanding the use of solar and wind energy will be very helpful to meet increasing demand for electricity, especially as more buildings and transport vehicles are electrified. The state of São Paulo is also a major producer of sugarcane, which can be used to produce biofuels. For example, hydrotreated vegetable oils can replace diesel for transportation vehicles, dramatically reducing vehicle emissions. The third goal for systemic efficiency focuses on creating green building standards as well as further promoting

the use of sustainable transportation through creating more bike-share programs, bike lanes, and electric railways (São Paulo State Government, 2021). In addition to lowering emissions, better public transport will also help to lessen social inequalities by providing low-income individuals with the means to efficiently travel around the metropolitan area.

The fourth goal regarding resilience and nature-based solutions concentrates on developing programs that allow for the natural recovery of land areas. In specific, programs such as the Ecosystem-Based Adaptation and Environmental Regularization Program want to increase soil permeability and maintain native vegetation, with a priority for doing so in watershed protection areas (São Paulo State Government, 2021). Lastly, the fifth goal is about promoting green finance and innovation. One example of this is a federal law in Brazil whereby tax revenue is directed to the budgets of municipalities that have a high amount of land covered with natural vegetation. Another example is investment in climate research, which is being done in São Paulo through collaboration among groups focused on development, investment, and research (São Paulo State Government, 2021). Taken together, these five goals and their accompanying action plans provide impactful opportunities for sustainable development, and it is essential that the state and local government continue to move forward and focus on the implementation of these policies.

Conclusion

Ultimately, São Paulo is confronted with both challenges and opportunities in its quest to achieve sustainability. Rapid urbanization has led to improved living standards but also caused uncontrolled population growth and environmental degradation. To ensure sustainable urban lifestyles for future generations, São Paulo must address environmental challenges, including the

city’s high Ecological Footprint, soil degradation, air pollution, and climate change threats. Simultaneously, it is just as important to address the city’s economic and social challenges, such as poverty and income inequality. Despite these challenges, São Paulo has opportunities for sustainable development. The city's relatively low carbon footprint, which can be attributed to its reliance on hydropower for electricity generation, provides a solid foundation. In addition, there is a tremendous opportunity at the current moment to press for the comprehensive implementation of the policies outlined in the state’s Climate Action Plan. Expanding renewable energy sources, electrifying buildings and vehicles, investing in public transportation, allowing for the natural recovery of land areas, and promoting green finance will all be essential next steps. Through implementing sustainable policies and prioritizing equity, São Paulo can create a resilient city for future generations and serve as a global model for what sustainable development looks like.

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