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Papers

Cities and the Demo-Climatic Transition in Brazil

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Abstract
The article discusses the challenges for planning and public policies in terms of adapting Brazilian cities to the future dynamics of climate transition and population transitions (demographic, epidemiologic, urban and mobility). The recursive relationship between such transitions will be decisive in defining how Urban Socio-environmental Systems, which include their populations in different sizes, densities, intraurban distributions and compositions, and the environmental, socioeconomic, morphological and functional characteristics of the cities, will have to adapt in the coming decades. The article initially discusses the characteristics of the population and climate transitions, their relationship with the modernization process, and the challenges that they represent to the adaptation of Urban Socio-environmental Systems. Next, the concept of Demo-climatic Transition is discussed as the recognition of the endogenous nature of the relationship between population transitions and global environmental changes, specifically climate change. Finally, a conceptual model for adapting Urban Socio-environmental Systems to the challenges of the Demo-climatic Transition is proposed, having as its axis the increases in urban adaptive capacity and resilience, and the construction of planning capacity and public policies in the short, medium and long term. In this context, planning, as the bridge between Policy and scientific knowledge in addition to local traditional knowledge, is a key instrument to enhance the resilience and adaptive capacity of Urban Socio-environmental Systems as a response to the climate emergency.

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INTRODUCTION

Several recent initiatives have mobilized scientific knowledge around policy proposals for adapting Brazilian cities to climate change, covering issues related to the characteristics of the most vulnerable populations exposed to disasters and the recovery or maintenance of environmental services, biodiversity and water resources. (Brasil, 2020; Rede Clima, 2019; FAPESP, 2020). The initiatives implicitly show the need for an interdisciplinary approach that encompasses the concept of "Urban Socio-environmental System", which interconnects the dimensions (or components) of socioeconomic and demographic organization to the environmental one. This concept is close to that of the "Socioecological System", which considers the relationship between society and nature in cities as a complex system of permanent evolution, adaptation and resilience building (Meerow; Newell, 2019). The Urban Socio-environmental System has two important characteristics. The first, "Resilience", refers to "the product of (1) the amount of perturbation a system can endure without losing its key functions or changing states, (2) the system's ability to self-organize, and (3) the system's capacity for adaptation and learning" (Folke *et al.*, 2002, apud Meerow; Newell, 2019, p. 311). The second, "Adaptive Capacity", refers to the capacity of the system and its actors to adapt to the impacts of exogenous shocks, such as climate change and related disasters (Barbieri *et al.*, 2022).

Understanding the articulation between the components of the Urban Socio-environmental System is key for planning and public policies aimed at building resilience and adaptive capacity to exogenous shocks. Such articulation involves, among others, morphological characteristics related to terrain and topography (for example, risk areas with high slopes or coastal areas) (Martine; Ojima, 2013) that interact with demographic factors (growth, composition and distribution patterns), functionality (supply and accessibility to goods and services, mobility, etc.) and other environmental factors to determine the vulnerability of systems to climate change.

Based on the conceptual definition of Urban Socio-environmental System, the article proposes two contributions. First, although the focus of the literature is on the relationship between climate change and components of demographic dynamics alone (fertility, mortality or migration), the article proposes the "Demo-climatic Transition" as the concept that articulates climate change with the major theories of population transitions. Such theories consider the articulation between the three components of demographic dynamics (Barbieri; Pan, 2022). The second is to rethink planning capacity and adaptation policies assuming that the populations that will occupy and consume future urban space, in their sizes, densities, compositions and spatial distributions, will present different vulnerabilities to climate extremes and disasters (Barbieri *et al.*, 2022) and will require the adaptation of urban environments in their morphological and functional aspects.

POTENTIAL IMPACTS OF CLIMATE CHANGE ON POPULATION TRANSITIONS

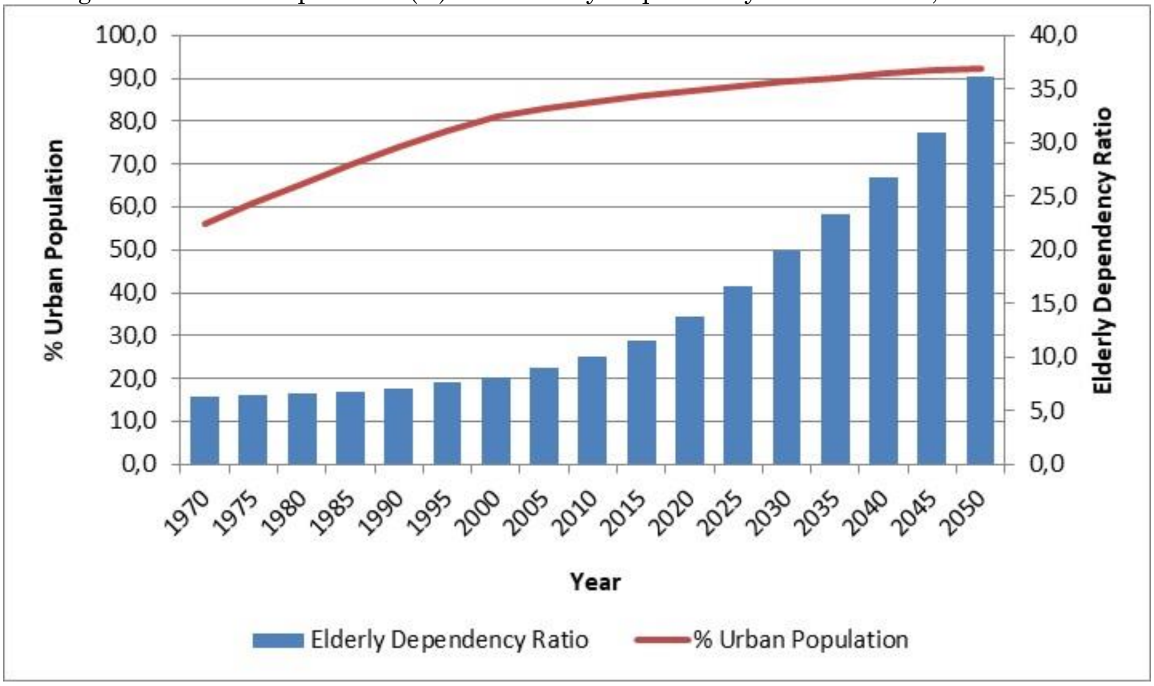
Demographic Transition

The Demographic Transition describes the implications of the modernization process (Rostow, 1959), with the transition from an agrarian and rural society to an industrial and urban society, on birth and mortality levels and consequently on the vegetative (or natural) population growth. Modernization changes individual and family reproductive preferences that lead to a decline in birth rates through, for example, greater access to reproductive health services and ideational changes related to material aspirations, the value and role of children in modern societies, and the role of women in the family and in the job market (Lee, 2003). It also involves improvements in food security, infrastructure (especially sanitation) in an increasingly urbanized society, education and public health services (including vaccination) that lead to a drop in mortality, especially among children (Lee, 2003).

Still according to Lee (2003), the Demographic Transition unfolds in four phases. The first, called "pre-transition", is characterized by a homeostatic balance in which high birth rates compensated by high mortality results in low vegetative population growth. The second and third phases represent the transition itself. In the second, there is a sharp and proportionally greater drop in mortality compared to birth rates, with the latter initially remaining high and subsequently taking on a downward trend. There is, consequently, a large vegetative population growth. In the third phase, there is a slowdown in the rate of decline in mortality and a more accelerated reduction in birth rates, ensuring positive vegetative population growth, although at a lower level compared to the second phase. Finally, in the fourth phase, there is a new homeostatic balance and low vegetative growth, but with low birth and mortality rates.

Although the projected size of the world population indicates growth from 7.8 billion in 2020 to 9.7 billion in 2050 (United Nations, 2019), the Demographic Transition will increasingly redirect discussions on adaptation to climate change away from a Malthusian discussion on population size and its deleterious effects on the environment, to discussions about the relationships between population composition and distribution and production and consumption patterns (Barbieri, 2013). In particular, population aging caused by continued fertility below that necessary to ensure the replacement or maintenance of the current population will be central for climate change adaptation policies. The elderly population in Brazil (60 years old or older), which currently accounts for 13% of the population, is expected to double in the coming decades, reaching 25% in 2043 (IBGE, 2019). Figure 1 shows that the Elderly Dependency Ratio is expected to reach around 37% in 2050, compared to the current 13.8% in 2020.

Figure 1 - Urban Population (%) and Elderly Dependency Ratio - Brazil, 1970 to 2050



Source: United Nations (2018, 2019).

[a] Ratio between the population aged 65 or over and the working population (15 and 64 years old).

This scenario will be reproduced in Brazilian urban agglomerations, being more accelerated in the south and southeast of the country and in the Federal District due to the more advanced stage of Demographic and Urban transitions. For example, the Total Fertility Rate, TFT (average number of children per woman) in the city of São Paulo, which decreased from 3.2 in 1980 to 1.7 in 2010, should reach stability at 1.6 by 2050, increasing the proportion of elderly people to approximately 30% in that year (SEADE, 2015).

The future age structure will therefore constitute a potentially factor aggravating population vulnerability to climate change (Queiroz; Barbieri, 2009; Barbieri *et al.*, 2010), reinforcing the need to adapt urban infrastructure and services, particularly housing and mobility, and investments in health services for the elderly. Queiroz and Barbieri (2009) also highlight the need to strengthen income transfer mechanisms to the poorest and elderly populations, given that the costs of the elderly are higher than those of young people and tend to rise especially in a context of precarious work and pressure on the social security system and the susceptibility of the elderly to illnesses associated with temperature changes, especially extreme heat.

Urban Transition and Mobility Transition

A consequence of the Demographic Transition and the Mobility Transition (Zelinsky, 1971), both explained by the modernization process, is the increasing population concentration in urban areas. The final stage of the demographic transition thus reflects a context of a typically urban, aging (Lee, 2003), and mobile population (Zelisnky, 1971).

In 2018, 55.3% of the world's population lived in urban areas, with large regional variations: from relatively low proportions in South Asia (34%) and sub-Saharan Africa (40.2%), to high concentrations in the European Union (75.7%), in Latin America and the Caribbean (80.6%) and in North America (82.2%) (World Bank, 2020). Figure 1 shows that, in addition to the older age composition, the percentage of the Brazilian population residing in urban areas is expected to increase from 87% (2020) to 92.4% in 2050 (United Nations, 2019). This urban concentration is well above the world average, which is expected to reach 68.4% in 2050 (United Nations, 2019).

Assuming the lack of substantial reversal in the (insufficient) current policies to reduce poverty and inequalities in Brazil, a large part of the future population stock will be concentrated in precarious urban settlements (Alvalá; Barbieri, 2017). The 2010 Demographic Census reveals, for example, that 41.4% of the Brazilian urban population lives in precarious settlements, particularly in the North Region (IBGE, 2020); and among these, eight million lived in areas prone to natural disasters (IBGE, 2019).

The impacts of climate change are already felt in this population, considering the frequency and magnitude of extreme weather events since 1950: the main "natural" disasters (a term frequently used, despite their anthropogenic component) have been related to floods, landslides, droughts, forest fires, deaths from electrical discharges and destruction from windstorms (Alvalá; Barbieri, 2017). Some disasters in recent years have been reported as "events of the century", showing evidences of greater severity (Alvalá; Barbieri, 2017) and greater exposure of the population to climate change. For example, projections for Belo Horizonte indicated a 32% increase in the relative variation to climate exposure from events associated with intense rainfall (Way Carbon, 2016). Greater population concentrations in precarious settlements in coastal areas are also expected to increase vulnerability to sea level rise (McGranahan *et al.*, 2007).

Demographic, Urban and Mobility transitions suggest the need to focus planning and adaptation policies on issues i) related to intra-urban population distribution, especially in precarious settlements, ii) the adaptation and (re)design of infrastructure and functionality of cities, especially in socio-environmentally vulnerable areas, and iii) adaptation to the future population composition, particularly the aging process.

Epidemiological Transition

The Epidemiological Transition (Omran, 2005) associates the epidemiological profile (morbidity and mortality) to the change in population size and composition that results from the Demographic Transition. According to the original narrative for developed countries (Omran, 2005), in the initial stages of the Epidemiological Transition and with the advancement of the urbanization process there is a substantial reduction in infant mortality due to greater control of infectious diseases, such as those transmitted by water, due to improvements in sanitation, food safety and public health services. As the Demographic Transition progresses, there is greater control of these diseases, and population aging causes a transition to non-communicable diseases, especially neoplasms and chronic degenerative diseases.

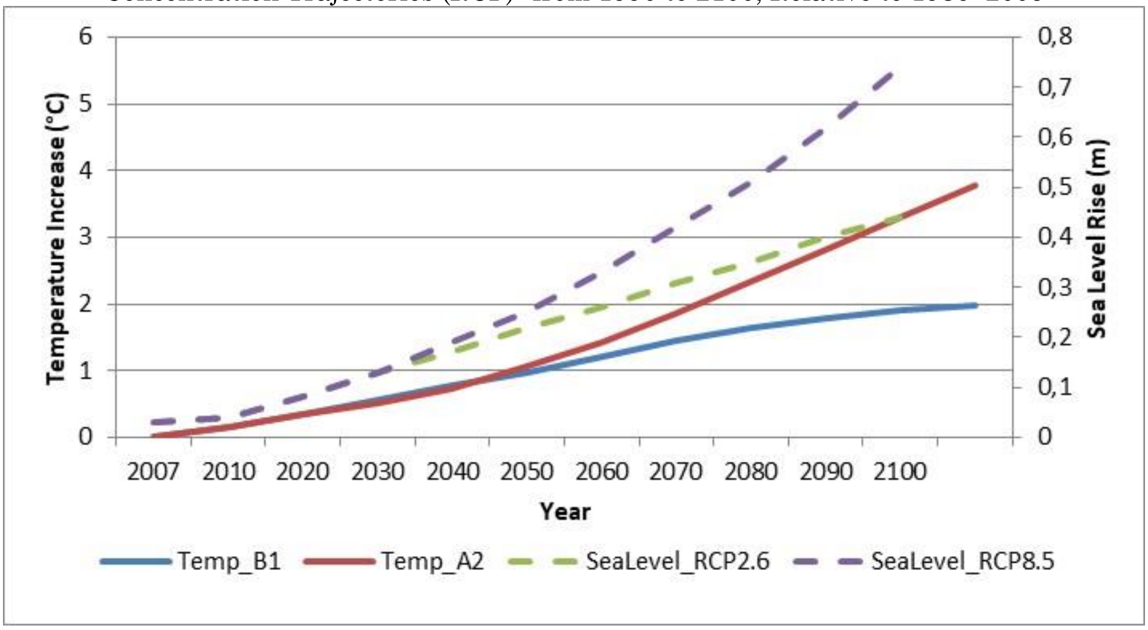
On the other hand, population aging that increases the incidence of non-communicable diseases occurs simultaneously with the persistence of a context of poverty and inequality in developing countries, causing the persistence of infectious diseases typical of the initial stages of Demographic Transition. The coexistence of these two epidemiological profiles generates an incomplete transition, in contrast to what is seen in the developed world (Prata, 1992). In the future, a third burden may be added to this "double burden of disease": the increase in morbidity and mortality from violent external causes associated with the greater intensity of disasters resulting from climate change. The "triple burden" that characterizes this hypothetical epidemiological profile would pressure cities due to the costs of adapting public health systems, housing, infrastructure and urban environmental quality. In addition to morbidity and mortality due to violent external causes, there would exist diseases sensitive to temperature extremes such as diarrhea, cardiovascular and respiratory diseases (Barbieri; Confalonieri, 2011), and vector diseases such as leptospirosis, malaria and those transmitted by *Aedes aegiptyi* (FAPESP, 2020). It is likely that certain population groups that are more vulnerable in terms of health, such as children and the elderly, may live longer with some burden of morbidity and thus become more susceptible to possible shocks caused by climate change (Queiroz; Barbieri, 2009). Barbieri *et al.* (2015) estimate that the increase in temperature in Minas Gerais between 2010 and 2040 could increase the dengue prevalence rate by 130%, and the hospital admission rates for infectious diseases and respiratory diseases by 12% and 3%, respectively.

The context described above suggests major challenges for Brazilian cities. The way in which cities produce risks for human settlements and the spread of infectious diseases is enhanced by the combination of changes in rainfall and heat regimes that modify habitats and the ecology of vectors, and the mobility of infected people between (new and old) endemic areas and urban areas (Barbieri; Confalonieri, 2011). There is, therefore, a *momentum* in the triple burden of disease that characterizes the incomplete Epidemiological Transition.

Climate Transition

Although they may be related to natural events such as volcanic eruptions and the natural emission of water vapor, the Intergovernmental Panel on Climate Change (IPCC) has discussed, since the first report (Assessment Report) in 1990, how climate change reveals anthropogenic causes associated with greenhouse gas emissions. This cause-and-effect relationship resulted from the advancement of the "modernization" process that began with the First Industrial Revolution (circa 1750, in England). As an example (Figure 2), the Fifth Report (IPCC, 2014) indicates that increases in temperature by 2100 could vary from 1.98°C to 3.79°C in SRES B1 and A2 scenarios, respectively, generating a chain impacts on hydrological cycles, circulation of pathogens that affect human, animal and plant health, increase in sea level (reaching, on average, 0.44m to 0.74m in scenarios RCP2.6 and RCP8.5, respectively), heat waves and deterioration of air quality in urban environments, greater frequency and intensity of extreme events, among other impacts.

Figure 2 – Increase in Global Average Surface Temperature (°C) Relative to 1990, SRES[a] B1 and A2 Emission Scenarios, and Global Average Increase in Sea Level (meters) in Representative Concentration Trajectories (RCP)[b] from 1990 to 2100, Relative to 1986–2005



Source: IPCC (2014).

[a] Low emission (SRES B1) and high emission (SRES A2) scenarios. Historical trajectory of greenhouse gas emissions similar in terms of demographic, social, economic and technical changes.
[b] Representative Concentration Trajectories (RCPs). Historical series of greenhouse gas emissions and concentrations. RCP2.6: least impact trajectory; RCP8.5: high impact trajectory.

IPCC (2021) mentions that the built space in cities intensifies the anthropogenic effects of local warming, increasing the severity of extreme events such as heat waves, the severity of precipitation and hydrometeorological events, the greater strength of wind circulation, and reduced rainwater runoff enhanced by soil waterproofing. For example, the expansion of the urban area in the Metropolitan Region of São Paulo (RMSP) is associated with an increase of 3°C in the last 80 years in the city center, in addition to the two to three times greater occurrence of intense rain phenomena (Nobre; Marengo, 2017).

POPULATION TRANSITIONS IN THE ERA OF CLIMATE CHANGE: THE DEMO-CLIMATIC TRANSITION

The previous discussion suggests that the next decades will bring major adaptation challenges for cities due to climate and population transitions. While modernization is the driving force of population transitions, it is also responsible for the way in which consumption and production patterns are organized in industrial urban societies that, ultimately, engender the climate transition. However, modernization theory does not explain the consequences of these patterns on population transitions in a context of climate change. Strictly speaking, the literature has privileged discussions about climate impacts on specific components of demographic dynamics (see, for example, Flatø *et al.*, 2017; Hoffmann *et al.*, 2020).

Barbieri and Pan (2022) propose the Demo-climatic Transition as a review of theories on population transitions to recognize the endogeneity between population and climate dynamics. This perspective aligns with recent demands for advances in demographic knowledge about the effects of global environmental changes on future population trends and processes (Muttarak, 2021). It is assumed that the dynamics of fertility, mortality and migration lose objective meaning when disconnected from environmental processes, particularly climate change, in the current and future context. The co-evolution of population and climate transitions will impact both the reproduction of old vulnerabilities (for example, population densities in risk areas) and new vulnerabilities (for example, epidemics and possible waves of climate refugees). The combination of these vulnerabilities will, hypothetically, imply significant changes in demographic behavior.

Barbieri and Pan (2022) associate Demo-climatic Transition scenarios with the increase in urban morbidity and mortality rates experienced by the elderly and socio-environmentally vulnerable. This includes an increase in the triple burden of disease gap between richer and poorer countries due to three factors. Firstly, due to infectious diseases that mainly affect children and the (re)emergence of zoonoses that would become adaptable to the urban context, as exemplified by COVID-19, Ebola outbreaks in West Africa, the Nipah virus in Southeast Asia, and the Zika virus in Brazil. Such diseases can quickly disperse in urban populations due to the invasion of natural space and the disruption of ecological balances, combined with climate change (Marani *et al.*, 2021) and greater human mobility. Knowledge about the relationship between hydrological cycles, temperature, land use and the dynamics of vector-borne diseases (Himeidan; Kweka, 2012; Pizzitutti *et al.*, 2015; FAPESP, 2020), as well as the hypothetical increase in areas favorable to transmission of these diseases due to climate change according to the IPCC's Sixth Assessment Report (AR6) (IPCC, 2023), suggest that existing diseases such as malaria and those related to the *Aedes aegypti* vector may expand to more populated areas in Brazil in the coming decades (Barbieri; Confalonieri, 2011).

The second factor responsible for the triple burden of diseases is the greater prevalence of non-communicable diseases associated with the advancement of the Demographic Transition and the aging process (D'Amato *et al.*, 2015; Barbieri *et al.*, 2015; Stenvinkel *et al.*, 2020), which are associated with conditions of poverty and inequality to determine greater vulnerability of elderly people in developing countries. Finally, the two previous factors combine with the increase in external causes of morbidity and mortality related to disasters and extreme events in more vulnerable areas and populations (Barbieri; Pan, 2022).

Barbieri and Pan (2022) also suggest that the Climate Transition, by affecting the productive conditions and livelihoods of populations, could induce large migratory flows or temporary forms of mobility. Such flows are associated with the large proportion of the world's population (and the urban population in particular) at risk from extreme weather events, such as in the coastal areas of the Ganges, Mekong and Nile deltas where a one-meter rise in sea level could affect 23, 5 million people (Warner *et al.*, 2019). Brown (2008), based on the 2006 Stern Report, estimates that in the “worst case scenario” of rising temperatures, the melting of polar ice caps would increase sea levels to the point of threatening around 5% of the world population (310 million people).

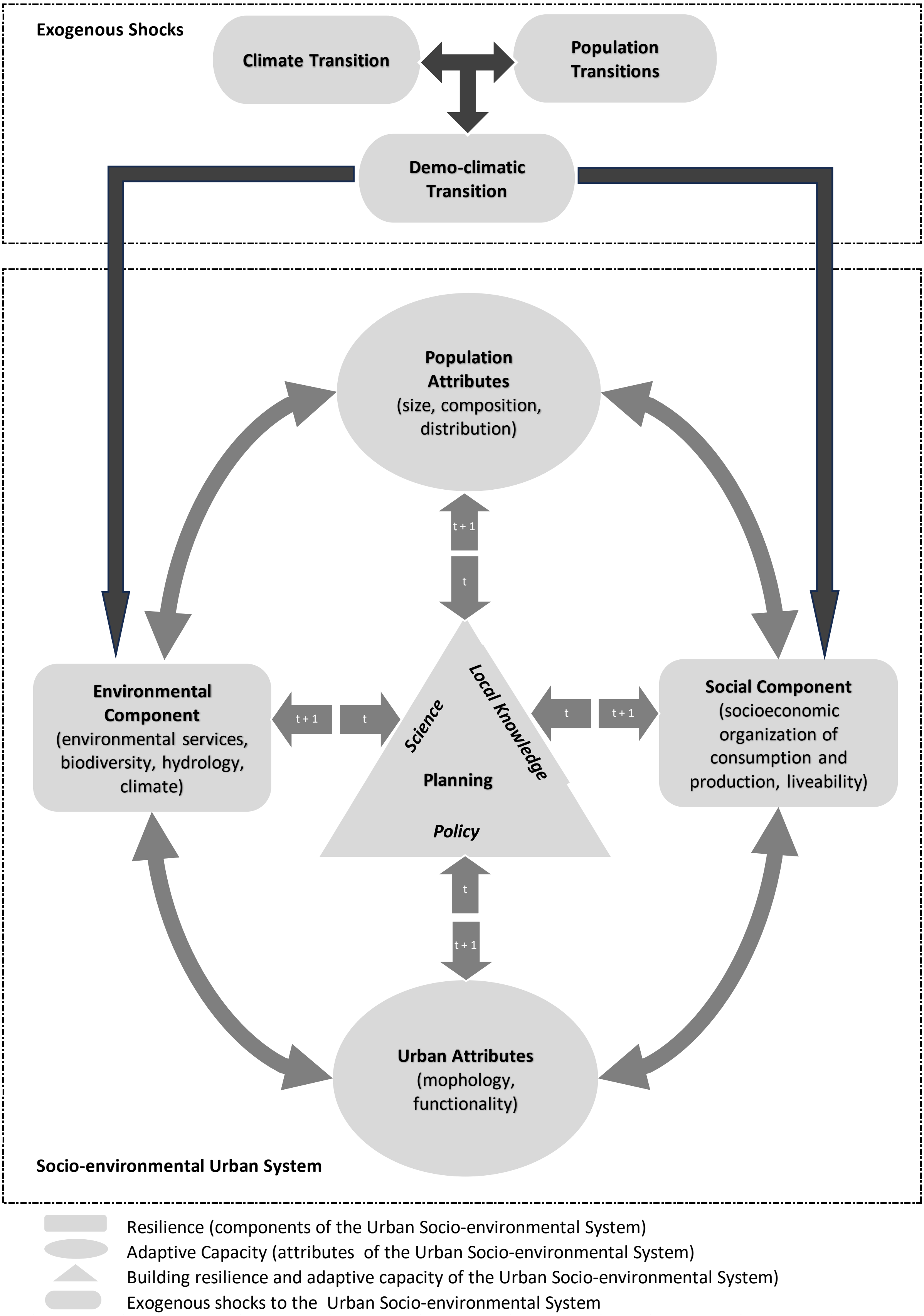
Obviously, the increase in climate migration is contingent on the effectiveness of local adaptation strategies. Furthermore, the fate of potential migrants is difficult to predict in the long term. Although it is reasonable to assume that a portion will carry out south-north movements, a more representative part must reproduce the current pattern of international migrations, that is, in south-south movements or even internal displacements (within the same country), with a likely increase in pressures on urban areas. Furthermore, the immobility of trapped populations may represent a concrete response to the inability of the most vulnerable to adopt mobility as a strategy for adapting to climate change.

Barbieri and Pan (2022) also suggest that the tendency for fertility to fall below the replacement level on a global scale - despite the longer transition time for less developed countries - will, in a neo-Malthusian inspiration, be beneficial to reduce pressure from the number of people on environmental resources, services and urban infrastructure. However, it will be innocuous if it is not combined with the reduction of the urban “ecological footprint”, that is, the negative pressures on natural resources, environmental services, energy generation and food production associated with production and consumption patterns in cities. Furthermore, lower fertility will not necessarily reduce future stocks of populations vulnerable to climate change to significant levels if they are associated with a greater concentration of population in precarious urban settlements and susceptible to extreme climatic events and, simultaneously, with compositional changes in the population that indicate greater stocks of populations at risk (such as the elderly).

THOUGHTS ON PLANNING AND ADAPTATION POLICIES OF CITIES IN A CONTEXT OF DEMO-CLIMATIC TRANSITION

Figure 3 summarizes the discussion on the relationship between the components and attributes of the Urban Socio-environmental System and the Demo-climatic Transition, and how planning and public policies can increase the adaptive capacity and resilience of the system.

Figure 3 – Conceptual Model of Adaptation of the Urban Socio-environmental System to the Demo-climatic Transition



Source: The author (2024).

Increasing the adaptive capacity of Urban Socio-environmental Systems involves prioritizing, from a planning perspective, the population characteristics (size and growth, composition and distribution) of greatest vulnerability, such as those associated with aging populations, those in homelessness situation, in occupations exposed to heatwaves (such as agricultural and construction workers), disabled people, those with chronic degenerative diseases, the poorest and those residing in areas more susceptible to extreme events. Furthermore, the co-evolution of population and climate transitions will create both new vulnerabilities and amplify old vulnerabilities.

The Brazilian experience demonstrates that simple economic growth is not enough to reduce vulnerabilities. The benefits promised by modernization, such as improvements in macroeconomic indicators and living conditions and urban liveability, are not experienced equally by the entire population; on the contrary, it has deepened inequalities and "clusters of exclusion", especially in large cities. "Incomplete modernization" represents the triumph of the hegemonic model of global capitalism that, paradoxically, renews the promises of salvation from the climate emergency with the "green modernization", through productive "greenwashed" solutions or in paradoxes such as the embedded in the concept of "sustainable development".

Unlike the concept of "sustainability", which emphasizes balance and optimization between the environment, economy and social justice, the concept of "resilience" highlights uncertainty and the construction of adaptive capacity to unexpected or imprecise future changes (Meerow; Newell, 2019). It is, therefore, less susceptible to the dubious promises of "green modernization" and suitable for rethinking a planning perspective that involves, according to Giddens (2010), the ability to deal with the challenges of climate change by internalizing long-term risk and uncertainty in public policies (*forward planning*). Planning, as the bridge between Policy and scientific knowledge (Friedman, 1987), in addition to local traditional knowledge, enhances the resilience and adaptive capacity of systems. The City, in this sense, is the "synthesis space" for learning about the risks, uncertainties and impacts of exogenous shocks on the components and attributes of the Urban Socio-environmental System (arrow representing time t, in Figure 1). This learning informs (time t+1) political action involving the convergence of agents (civil society, public sector, economic agents) to build resilience and adaptive capacity.

If "in the long term we will all be dead", according to a phrase attributed to economist John Maynard Keynes to justify the need for State intervention in the economy in periods of crisis and recession, it will depend on the protagonism of planning for adapting Urban Socio-environmental Systems to the Demo-climatic Transition. It is not a trivial task, both due to the liberalizing logic of global capitalism (the Minimum State), and the "green modernization" that demands the mobilization of public resources for mitigation policies that involve fiscal and tax incentives and subsidies for economic agents to adapt production and consumption patterns to the mitigation of greenhouse gas emissions. Although such policies are essential, they contrast with the insufficient mitigation policies associated with the expansion of legal and illegal economic activities in Brazilian biomes, as well as the insufficient adaptation policies associated with populations that are victims of the modernization model. This contradiction ultimately reveals asymmetries in political representation between economic agents and vulnerable social agents.

Planning must seek greater balance in the axis of political priorities (and consequently in resource flows) between the green modernizing logic of mitigation policies on the one hand and, on the other hand, the demands for conservation of Brazilian biomes and investments for the most vulnerable people to enhance their adaptive capabilities. This would be an effective action against the climate emergency, justified and substantiated not only by the evidence produced by science but also by the record numbers and intensities of extreme events or even the unprecedented nature of some of them, as observed in recent years. As expected, the greatest impacts have occurred in Urban Socio-environmental Systems with less adaptive capacity in terms of more vulnerable populations and precarious infrastructure, services and functionalities.

The paths for action involve the capillarization of the climate emergency in local planning instruments, such as municipal master plans and land use laws, and specific actions related, among others, to the deconstruction of infrastructures that reduced or suppressed the provision of environmental services (such as channeling water courses and sealing urban soil) and inhibiting highly impactful economic activities, such as mining in river basins that supply water to urban areas. It also involves short, medium and long-term planned relocation strategies based on the identification of socio-environmental risks that emerge from the juxtaposition between population vulnerabilities (such as poverty, age, race and gender) and urban vulnerabilities (risk areas). Planned relocation must constitute a preventive planning and risk management instrument that antagonizes reactive forms of disaster management, such as climate mobility involving displaced, homeless or removed populations, or immobility as a consequence of the lack of policies (and consequently the absence of planning) that retain populations in their current conditions of vulnerability.

Planned relocation is a secondary action in situations where there is a combination of the absence of important social impacts (mainly potential loss of human life) and high economic costs of relocation in densely populated areas with concentrations of public and private structures. In these cases, it is justifiable the focus on investments in urban adaptive capacity in terms of morphological aspects (such as slope containment solutions, flood containment basins or barriers to increase sea level) and functional aspects (such as readjustment of road systems and urban renewal projects to disassemble urban roads and restore water streams), as long as they do not reduce the resilience of the environmental component of Urban Environmental Systems. Planned relocation is the priority strategy in areas with urban concentrations highly exposed to disasters and potential loss of human life. This is the case of Vale do Taquari, in the state of Rio Grande do Sul, which in April 2024 experienced the biggest socio-environmental disaster in its history due to extreme rainfall, with huge private and urban infrastructure losses and, mainly, the loss of more than a hundred human lives. In these cases, planned relocation involves identifying risk areas that will be repeatedly exposed to disasters due to climate transition and groups with greater socioeconomic vulnerability due to the population transitions. It also involves, in addition to adapting urban attributes of morphology and functionality, the recovery or maintenance of environmental services and natural resources in risk areas and new settlements. There would thus be an increase in environmental resilience that would be combined, through the balance between these adaptation policies and mitigation policies, with the greater social resilience of the system.

Building a planning agenda to adapt to the Demo-climatic Transition requires the legal and constitutional definition, involving the three federative entities in Brazil (Federal Government, states and municipalities), of policies and plans that overcome the opportunistic logic of governmental and electoral cycles and are consistent with the long-term development of resilience and adaptive capacity in Urban Socio-environmental Systems. The later such actions begin, the more distant the long-term becomes and the closer we would be to the prediction contained in John Keynes' phrase.

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AUTHOR CONTRIBUTION

Alisson Flávio Barbieri: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Visualization, Writing – original draft, Writing – review & editing.