

"Environmental Risks and Social Inequalities: Facing the Challenges of Global Changes in the Metropolitan Region of Baixada Santista (Brazil)"

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Summary

The aim of this study was to achieve an analysis of the socio-spatial inequalities and of the environmental vulnerability of the population in the Metropolitan Region of Baixada Santista located in the south coast of Sao Paulo State (Brazil). This region is facing an important social challenge of global changes caused by an urbanization process with a significant population growth and the increase of pressures on the environment.

The idea was to recognize the relation between urban sprawl and environmental degradation, for example, people living in areas of flooding or landslide as a result of urban expansion. In the following methodology, were identified different patterns of land use, considering the environmental changes like deforestation. In this case it was important to distinguish the processes that provoked significant transformations in the land use patterns caused by socioeconomic and political decisions that might have put the coastal population at risk. To identify the characteristics of population in these situations it was considered the census data about head household income.

As result it was observed that the metropolitan expansion brings together not just the increasing of urban complexity with the nucleus desconcentration and peripheral extension, but also evidence of an increase of the socio-spatial inequalities that can be observed by the stratification of the space in different social layers where the poor classes were pushed for distant and less valuable places with the worst conditions of infrastructure. Besides, many forested areas were converted in non-forest land for urban and industrial use without any ecological criteria. This region has experienced a significant destruction of its wetlands, Atlantic forests and restingas occupied mainly by residential and industrial expansion. So, it becomes urgent the establishment of strategies for a more efficient occupation of the territory and use of the natural resources seeking to reduce environmental threats that put the coastal population at risk.

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1. Introduction

Despite growing awareness of many environmental problems that we face today, degradation of the natural environment by human activities still continues on a large scale. Thus far, most of mankind has been unable to establish a sustainable relationship with nature (Groot, 1992).

This has become clearly visible and may be illustrated with a long list of environmental hazards and disasters, including desertification, soil erosion, deforestation, air pollution, water and soil as well as the destruction of habitats by flooding and landslides (Groot, 1992).

Apart from many different socio-economic and political factors (including population growth and unequal distribution of resources and wealth), one of the main reasons for the continued degradation and loss of natural ecosystems is the fact that the importance of nature and a healthy natural environment to human welfare is still not fully reflected in economic planning and decision making (Groot, 1992).

It is therefore extremely important to investigate ways for helping policymakers (and society as a whole) to design policies to better adapt to changes and extreme events by carrying out studies that characterize risk, vulnerability and adaptive capacity.

The connections and interactions between urbanization and environmental changes are increasingly intertwined. Environmental changes affect and are affected by most urban processes. Despite their growing importance, urban areas have been understudied in the analysis of environmental change. Much more attention is needed to study the impacts of environmental changes on urban areas and the people who live in them (Schneider, 2006).

The main objective of this paper is to understand the impact of urban sprawl in the Baixada Santista Metropolitan Region. The argument is that this phenomenon is producing an important land use transformation, inducing the destruction of the natural environment around the Metropolitan Region.

Additionally, urban sprawl leads to the occupation of parks and environmentally protected areas, such as the Atlantic Forest of the Serra do Mar State Park (with 315.390 hectare). Finally, we also present a brief policy recommendations on how urban policies could be improved by considering. This paper is organized under three main headings: consequences of urban sprawl to the environment; population growth and local vulnerabilities. The vulnerability of urban systems is an important area of research. The urbanization related to environmental changes in the spatial structure has brought an increase

in the urban risk and in the different levels of household exposure to hazards and extreme events.

In this case, it was illustrated that there are some critical emerging linkages between urban sprawl and inadequate or illegal settlements. The marketing around housing and urban land, the rise of a private real state of economy makes desirable sites in the region increasingly valuable since in those areas environmental amenities are accessible.

As a corollary to quest for environmental amenities by the richer members of the urban society, poorer residents might be forced or encouraged to relocated away from expensive locations which are often marginal or otherwise hazard prone, such as flood plains, alongside highways or adjacent to polluting industries.

In order to maintain the market value of high price sites, developers, property owners, and other interested parts through political and economic pressure also attempt to simultaneously secure additional amenities for the areas and push any locally unwanted land uses which would negatively affect property assessments.

Especially within large and decentralized metropolitan regions, the upper classes are now able to spatially distance themselves by living in socially controlled enclaves or even in the gated communities, and by displacing environmental externalities onto poor or otherwise marginal populations in distant other parts of the urban region.

The case of Baixada Santista Metropolitan Region (Brazil) illustrates this suite of phenomena. The important question here is: how to achieve intensive and sustainable utilization of land through transforming modes of economic development, adjusting urban land-use structure and upgrading spatial structures? Urban sprawl leads to the shift from a natural steady state of abundant and well-connected natural land to a second steady state of greatly reduced and highly fragmented natural land.

The sprawl state is characterized by a low density urban pattern, highly fragmented landscape, increasing substitution of ecological functions with human functions and highly reduced capacity of ecological functions to support human functions (Alberti et al., 2006).

Quantitative research at the interface of land use patterns, urbanization and environmental processes has been pursued within several disciplines: Earth observation/remote sensing science, land use change science, urban economics, politics, geography and urban ecology.

These fields are still disconnected (although the first informs the others through the identification of evolution of urban morphology and the trajectory of land use patterns for the study of urban growth).

Understanding the mechanisms connecting socioeconomic and political environments, urban form and ecology can provide an insight for policy makers in order to achieve sustainable or minimum impact cities (in order to decreasing the risk and vulnerability of societies and ecosystems). Therefore, it could contribute to the understanding of the potential of this analysis to enhance effectiveness of environmental planning and risk management.

This research is connected with the *Decisions and Governance* issue that investigates the presence of risk and uncertainty influences the design of successful policies in the areas of environmental management, climate change policy and decision making.

Growing awareness of importance of urban activities and its impact on the environment has led to investments in monitoring, making inventories, building models and carrying out impacts studies and assessments. Municipalities, local area, government authorities and schools are increasing aware of the importance of a functioning monitoring system.

Therefore it is an opportunity to share experiences, to improve our capacity to understand and act on existing knowledge, and to learn from those efforts which illustrate that relationships between society, policy and practice can be improved.

2. A brief overview of Baixada Santista

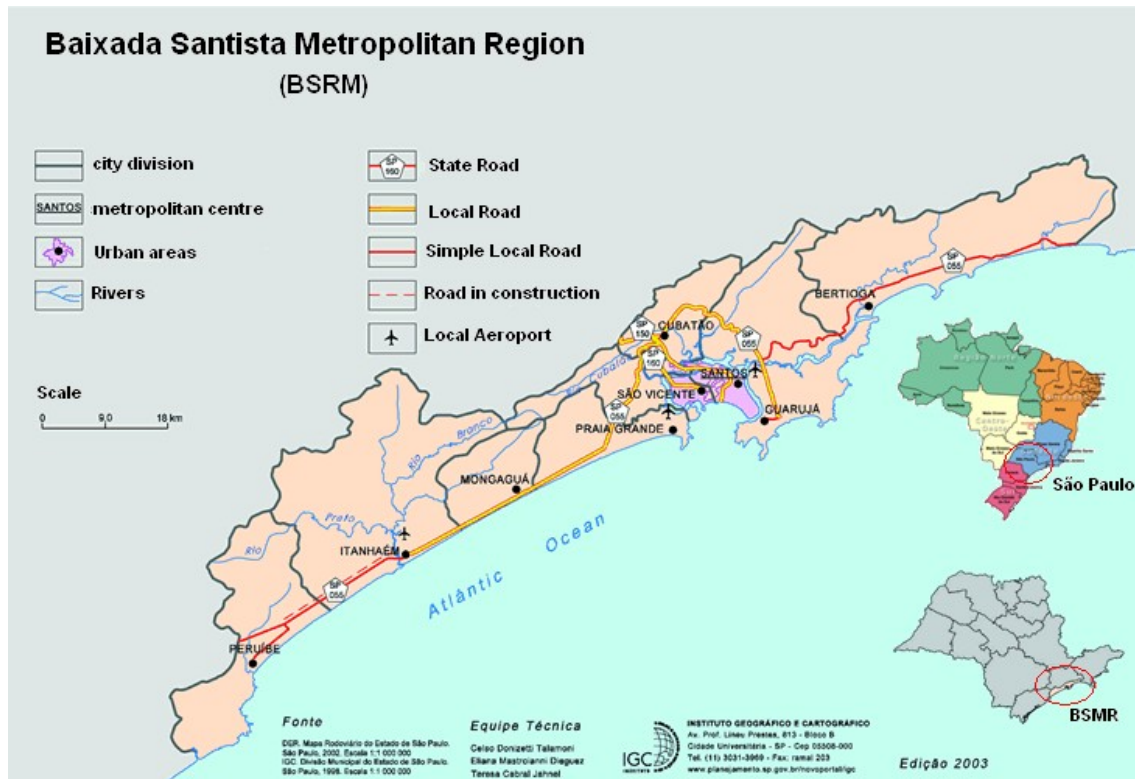
Located in south of São Paulo State Coast (Figure 1), with almost 1,5 million of habitants in 2000, the Baixada Santista Metropolitan Region is composed of nine municipalities (Santos, São Vicente, Cubatão, Guarujá, Praia Grande, Itanhaém, Mongaguá, Bertioga and Peruíbe). This region has 2,3 mil km² of extension and approximately 425.000 housing.

Between the 1970s and the 1990s, the rate of population growth declined remarkably in Santos (central area of Baixada Santista Metropolitan Region), from 1.9% to 0.01% in this period. Different demographic projections, such as the one produced by the State of São Paulo Bureau of Statistics (SEADE) project a stable population for Santos in the future. However, the expectations of a more sustainable development have not being fulfilled in this case.

While the centre of the region is “losing” population (low growth), some municipalities around the centre are still growing. For instance, between 1991-2000, Mongaguá presented taxes from 6,1% to 7,0%, Itanhaém from 4,8% to 5,1%, and Cubatão from 1,3% to 1,9%. As a result of this urban dynamics, the region still demands strong public

investments in terms of transportation and other urban infrastructure, followed by considerable environmental impacts.

Figure 1: Location of the Baixada Santista Metropolitan Region



Overall, the most general argument presented in this paper is that the connection between population growth and urban environment should not be considered in an abstract form, as if all urban environments and institutional contexts were the same. The interplay between population and environment must be considered in “concrete territories”, with all their social and environmental diversity and their institutional complexity (Torres et al., 2002a).

In the case of Brazilian Metropolitan areas, we propose that particular dynamics of the land market - affected by land use regulations, as well as public policies (i.e., transportation and housing) - strongly influence the urban sprawl dynamics and its environmental impacts.

3. The process of urban sprawl in the metropolitan region

It is possible to observe (Table 1) that the demographic growth of the region was very different in the past decade. In the last two decades, the central area of the region (Santos) practically didn't have population growth (in absolute terms). There are municipalities located in the outskirts of the city that have a significant growth (i.e. Bertioga, Mongaguá, Itanhaém, Peruíbe e Praia Grande).

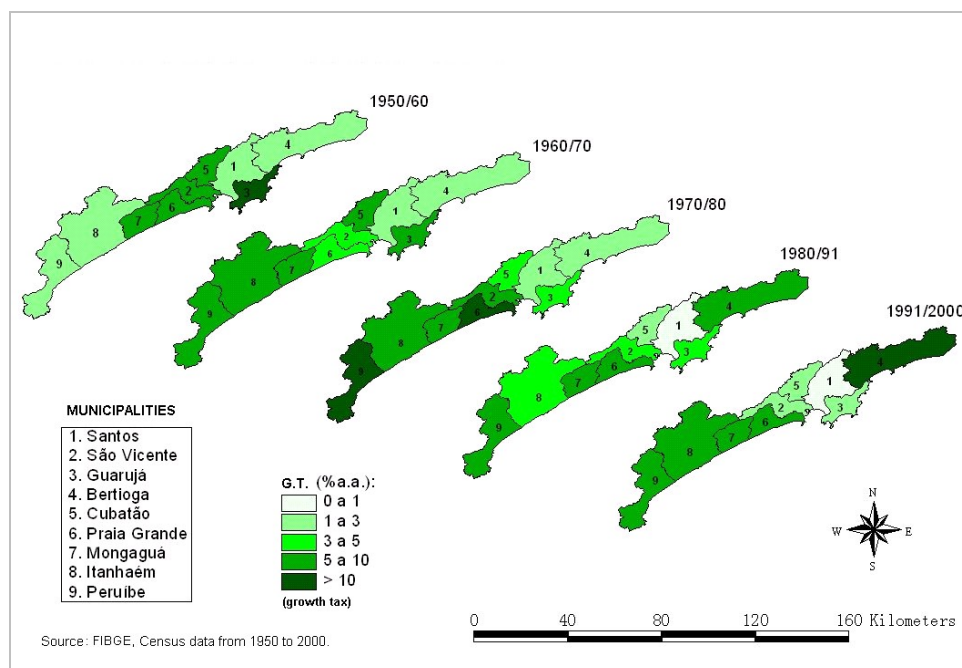
Table 1: Resident Population, Annual Taxes of Growth and Level Concentration of Population
Baixada Santista Metropolitan Region and São Paulo State, 1970 - 2000

Municipality	Total Population (absolute numbers)				Taxes of Growth (% a.a.)			Level of Concentration			
	1970	1980	1991	2000	70/80	80/91	91/2000	1970	1980	1991	2000
Bertioga	3.575	4.233	11.473	30.039	1,7	9,5	11,3	0,5	0,4	0,9	2,0
Cubatão	50.906	78.631	91.136	108.309	4,4	1,4	1,9	7,8	8,2	7,5	7,3
Guarujá	94.021	151.120	210.207	264.812	4,9	3,0	2,6	14,4	15,7	17,2	17,9
Itanhaém	14.515	27.464	46.074	71.995	6,6	4,8	5,1	2,2	2,9	3,8	4,9
Mongaguá	5.213	9.928	19.026	35.098	6,7	6,1	7,0	0,8	1,0	1,6	2,4
Peruíbe	6.966	18.411	32.773	51.451	10,2	5,4	5,1	1,1	1,9	2,7	3,5
Praia Grande	19.694	66.004	123.492	193.582	12,9	5,9	5,1	3,0	6,9	10,1	13,1
Santos	345.630	416.677	417.450	417.983	1,9	0,0	0,0	52,3	42,9	34,2	28,3
São Vicente	116.485	193.008	268.618	303.551	5,2	3,1	1,4	17,8	20,1	22,0	20,6
Total RMBS	653.430	961.243	1.220.249	1.476.820	3,9	2,2	2,1	0,037	0,038	0,039	0,040
Estado SP	17.771.948	25.042.074	31.588.925	37.032.403	3,5	2,1	1,8	100	100	100	100

Source: FIBGE, Brazilian Institute of Geographic and Statistics, 1970 e 2000

The Figure 2 presents the rate of population growth in different periods. In contrary to the American medium-high income urban sprawl (Duany, Zyberk and Speck 2000), the demographic growth of the Baixada Santista peri-urban region occurs due to the extension of existing areas (less valuable or public areas) that were occupied by poor people.

Figure 2: Spatial distribution of population in the BSMR (% of growth per year)

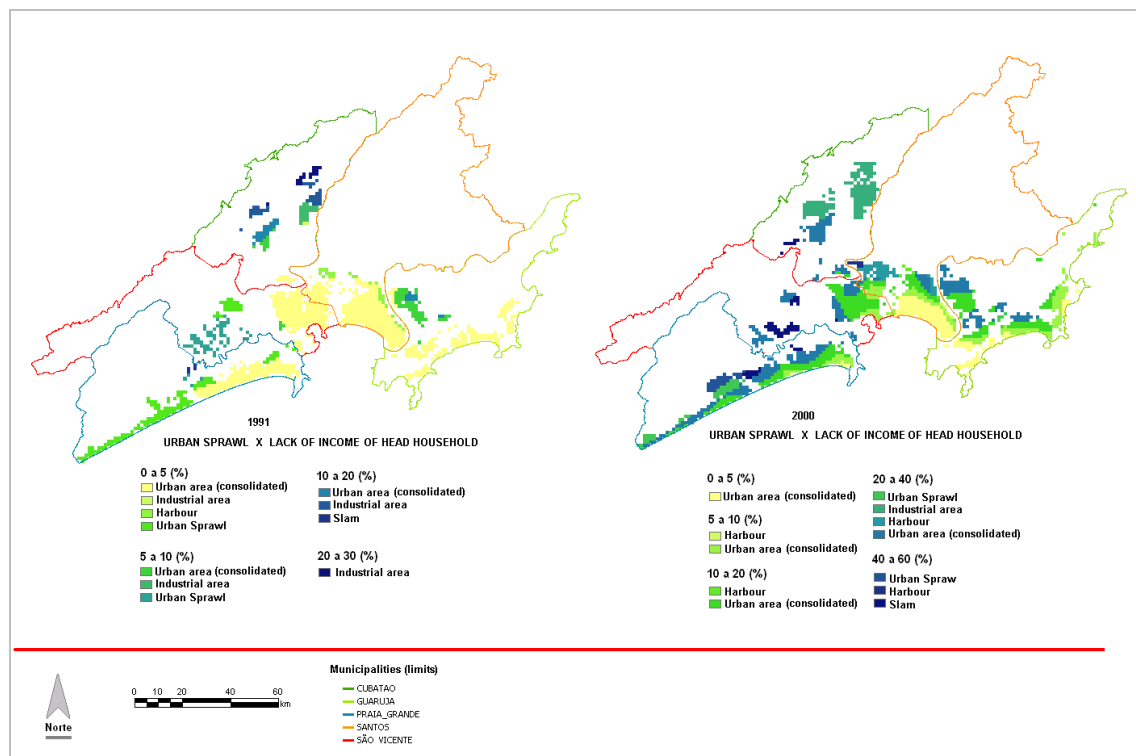


The connection between population urban growth and average income in different areas of Baixada Santista is not necessarily universal, but we can observe (Figure 3) that poor people is have the tendency to occupy distant sites (far from the ocean). Observed that, in this figure were represented five municipalities of the region (around the centre).

As mentioned, intense demographic variations of income distribution have important consequences for public policies. The expectation that a slower population growth rate would reduce the pressure on public services is only partially true.

The persistent horizontal growth of the city requires a continuous extension of the network of public services to the peri-urban areas, even when the equipment located in the central areas are not used to its full potential because it is not available for all population.

Figure 3: The relation between urban sprawl and lack of income head household



It is also important to keep in mind that this region corresponds to an average extension of 2,3 mil km² and the transportation system is crowded and expensive. In other words, it is not realistic to imagine that peri-urban residents would easily access services only available in central areas.

Besides having a significant population growth rates, some cities (in the peri-urban areas) also unsurprisingly show the worst socioeconomic indicators, with high levels of poverty. The average family income (from 5 to 10 salaries) in the slow growth areas is more

than twice of those observed in the peri-urban areas (from 1 to 2 salaries), with the income per capita of the average family almost three times higher (Young et al., 2008).

These income differentials are associated with high levels of unemployment and illiteracy. These differentials are additionally expressed in terms of sanitation indicators, such as water supply, garbage and sewage collection (Young et al, 2006; Young et al., 2008).

The urban sprawl has also significant environmental consequences in terms of transportation and pollution, because frequently the poor people live in shantytowns or substandard housing (slums) near the highways of the region (PRIMADH, 2005).

On the other hand, poor peri-urban areas also mean a lack of sanitation and pollution of the river and the streams as well as deforestation and destruction of natural landscapes.

The well-to-do move toward high amenity areas from which the poor and working class are excluded. In turn, this lower income groups are pushed toward places with comparatively fewer amenities and/or with great risks. In general, poor people live in areas of flooding or landslide (PRIMADH, 2005).

Neo-liberal reform policies encourage political and economic fragmentation and the development of extended metropolitan regions around core cities and satellite cities (Leichenko and Solecki, 2006).

These far-flung urbanized zones often stretch for a hundred kilometers or more. Within this extended patchwork of varying populations, physical conditions, and institutional capacities, one also finds a highly varied hazard landscape and widely varying levels of vulnerability.

As a result, when an extreme event occurs (i.e. landslide, flooding), some locations within the metropolitan area are much more impacted than others. In some cases, the wealthy areas of metropolitan region might be only minimally affected; meanwhile, lower income communities in the region could be severely impacted.

The consequences of disaster can linger longer in severely impacted lower income communities because they lack the independent resources necessary to recover, and are often “invisible” to large regional governance authority once they are not critical to primary business and government activity of the region or are remote from high profile locations such as urban core or central business district.

4. Urban Sprawl and Environmental Changes

The most significant environmental impacts of the urban sprawl in the Baixada Santista Metropolitan Region are reflected on the massive destruction of the Atlantic Forest, as well the wetlands and restingas (typical vegetation of the coast areas). The Atlantic Forest is one of the most endangered eco-systems in the world. Different studies on deforestation estimate that less than 10% of the original forest remains are preserved, and the rate of destruction is still high (Fundação SOS Mata Atlântica, 1998).

Baixada Santista Atlantic Forest has been partially preserved mainly in those cases where the topography of remaining areas did not allow (admit) its occupation. But, many areas were intensively occupied by a population who comes from other region without any financial resource (for the purposes of living and working).

More recently, the São Paulo State Government has taken some political actions in order to remove this people of these areas. The so-called “law of protection” has not been able to prevent the urban expansion on the forestry remains.

On the contrary, the law has produced a decrease of the land prices, which led to a raise of illegal occupation and the consequent pollution of the water sources and deforestation of important remnants of native forest with medium to advanced stages of forest succession.

In poor suburbs several public areas were invaded and turned into shantytowns and illegal settlements. According to the PRIMAHD (2005), in Santos, São Vicente and Cubatão there are more than 8.000 families living in illegal and inadequate settlements. Praia Grande has a smaller amount with 4.300 families, but in Guarujá the situation is worst, exceeding 19.000 families.

Although this kind of data may not precisely establish the connections between population growth and deforestation, it is clear that most of the deforestation occurs in areas with significant growth rate. The poor people live in a significant part of wetland, restingas and landslides areas.

A recent green coverage study using satellite images¹ indicated that the Baixada Santista Metropolitan Region has 987 km² of forest. The greatest part of the problem, in terms of deforestation, was concentrated in Cubatão. All located in the poor suburbs (slums or illegal settlements), with a significant rate of population growth.

In other words, the urban sprawl resulted in a significant destruction of the remaining forests in the metropolitan region, with little respect for the restrictive environmental

¹ It was produced a survey using satellite image - Landsat 5 TM (12/03/1990) e Landsat 7 ETM + (30/04/2000 e 20/04/2005) - orbital point 219.076 e 219.077, resolution 30x30m. This material was produced in pos-doctorate research with FAPESP financial resource.

legislation that forbids any deforestation of the Atlantic Forest of the Serra do Mar State Park (by decree N°10.251/1977).

Those green areas are part of so-called the Atlantic Forest Biosphere Reserve and key for different ecological dynamics, since they serve as ecological corridors, routes for migratory species and reproduction areas (in the wetlands). They also play a fundamental role in the conservation of water sources.

Not surprisingly, the region has an important deficit of public spaces and green areas. The vegetation coverage into the urban areas of the cities is restricted only trees plantations along the road network and of municipal parks or squares (PMS, 2007).

Although such deforestation in the region could not be considered very high when compared with the rates of deforestation in other Brazilian areas, such as the Amazon (PRODES-INPE, 2004), it is not possible to neglect the importance of these areas in terms of ecosystem services such as protection of water sources, climate regulation, and reduction of the air pollution. Moreover these areas are highly biodiversity.

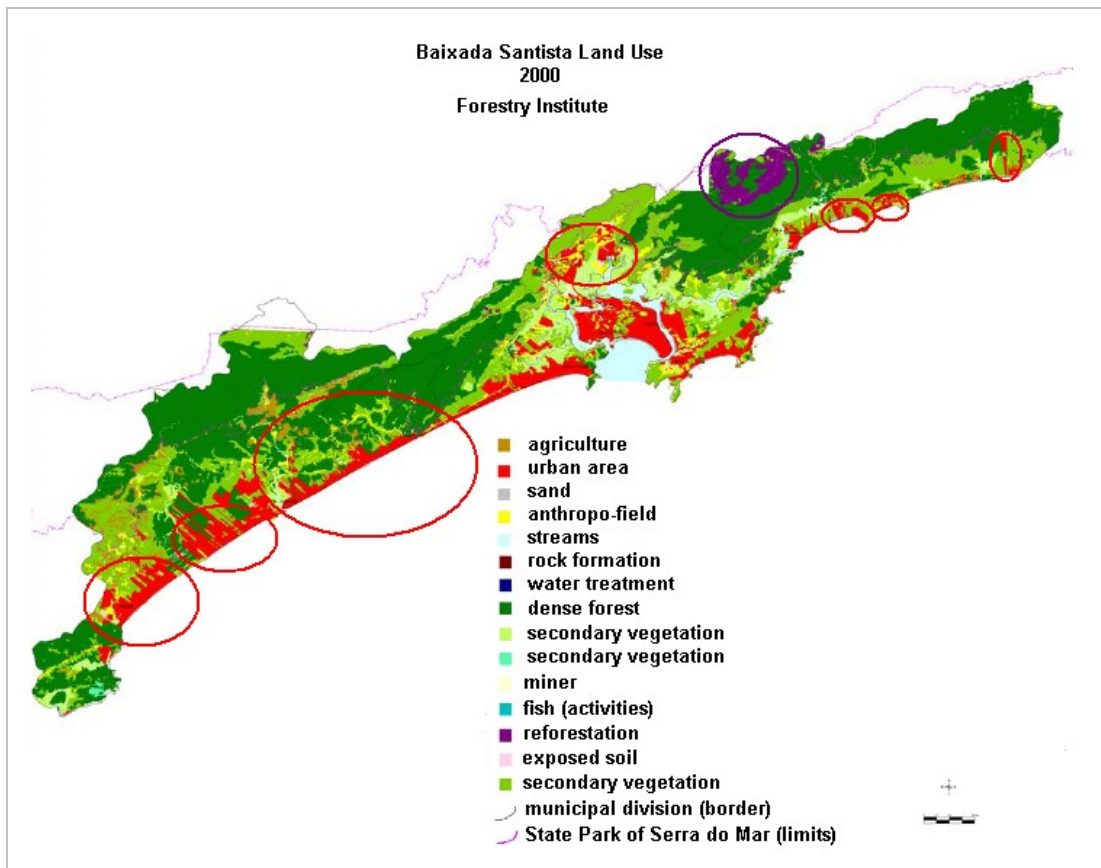
In Figure 4 it is possible to verify the areas of remain forest in Baixada Santista in 2000, highlighting the reforestation areas (in violet color) during the 90's (almost 1.5% of its area within the decade). In geographic terms, most of the deforestation is associated with urban sprawl process (some urban areas in red mainly in south and west and less in north direction).

It is possible to verify that the centre of the region and coast are almost completely deforested. On the other hand, large parts far from the ocean are still covered with their original vegetation. There are some areas of agriculture, secondary vegetation and reforestation.

Figure 4 shows that there are very few situations in which urban growth occurs in some areas of centre of the region (like Santos and São Vicente), and that probably almost all deforestation has happened in the peri-urban areas in south (like Praia Grande – Mongaguá – Itanhaém – Peruíbe, and west direction - in Cubatão).

However, it is also important to consider that not all peri-urban areas present high rates of deforestation, with some of them even showing forest regeneration (west direction). In this context, public intervention have been considered as a target to the western portion of the region (the polygon in violet color).

Figure 4: Land Use of Baixada Santista in 2000



The Table 2, it is possible to identify the percentage of vegetation present in each city of the region.

Table 2: Area of vegetation in each city of the metropolitan region

City	Area of the city (Km ²)	Area of vegetation in each city (Km ²)	%
Bertioga	482	378,21	78,5
Cubatão	148	90,18	60,9
Guarujá	137	78,04	57,0
Itanhém	581	470,31	80,9
Mongaguá	135	108,26	80,2
Peruibe	328	216,98	66,2
Praia Grande	145	97,56	67,3
Santos	221	187,19	84,7
São Vicente	146	89,91	61,6
Total	2373	1716,64	72,3

Source: DEPRN, 2000

Despite the fact that the urban sprawl are occurring in south direction of the metropolitan region (mainly in Mongaguá, Praia Grande, Itanhaém), there still exist many areas with a reasonable degree of natural vegetation which represents an average of 80% of the municipal area.

Therefore, in 2000, almost 70% of the metropolitan region were still forested. Furthermore, a significant part of all vegetal coverage of Baixada Santista is located in peri-urban areas, with more than one thousand square kilometers.

According to DEPRN (2000), between 1991 and 2000, the peri-urban areas presented a loss of almost 50 km² of forest coverage, which represent a reduction of 2,9% of the original 1991 coverage. In other parts of the region (as Cubatão) such loss was less significant; with an important growth in the forest (area of reforestation).

The whole thing is almost 2,9% of the forest coverage that existed in 1991 was destroyed along the decade. So, every indicate that a trend will most likely continue in the near future, despite of some government actions to reforest.

Most of these awful trends are related to the logic of the land markets. As it was mentioned before, the important question here is: how to achieve intensive and sustainable utilization of land through transforming modes of economic development, adjusting urban land-use structure and upgrading spatial structures? Urban sprawl leads to the shift from a natural steady state of abundant and well-connected natural land to a second steady state of greatly reduced and highly fragmented natural land.

It was referred that the sprawl state is characterized by a low density urban pattern, highly fragmented landscape, increasing substitution of ecological functions with human functions and highly reduced capacity of ecological functions to support human functions. But, the land markets are just worried with economical returns. How to deal with?

5. Urban sprawl and land markets

In the last five years, there was a significant residential real state investment in Baixada Santista, with private and public companies lunching more than 3 thousand residential projects, including nearly 500 residential units of CDHU (public company) and 2.500 units from private investments.

However, the connections between the private companies' production of housing and the strong dynamic of population growth in the far suburbs is still limited. The housing built by private companies was offered almost exclusively for high and medium income families. And the public offers are not enough for existing demands.

The prices of residential units are variable, from US\$ 43 thousand to US\$ 86 thousand. Only 16% of such projects referred to houses or apartments of less than 50 square meters of residential area, which could be considered more cost effective for low- income families.

Even in this case, many small apartment projects were located in rich areas (near of coast or central areas), and sold as hotel- flats, not affordable for the poor.

Overall, the projects by private companies were never intended to be sold to poor dwellers, since their lack of income made them unaffordable for both acquisition and rental purposes.

In fact, the rich areas (those that are losing population) receive the largest amount of private investment (70%). with poorest receiving less than 6% of the total investment.

In other words, almost there is no private investment in poor areas, especially considering the size of the population and its growth rate. These trends also indicate an increasing of the already high level of residential segregation.

In the 90s the public housing projects were almost insignificant, which means that most of the new housing has been built by families and individuals in very far away suburbs.

This indicates that the pattern described in the 70s - of poor urban dwellers living in self-constructed houses in the so-called “peripheries” of the region - is still true for Baixada Santista from 1990 to 2000 (PMS, 2007).

In other words, in the case of Baixada Santista it seems quite clear that the urban sprawl shows a stronger relation to land market dynamics (and the role of the government) than with the demographic dynamics *per se*.

5. The participation of the informal markets

Informal settlements are yet another important dimension of this process. Due to the lack of affordable housing, the poor population ends up living in different types of informal settlements, such as slums, irregular developments and shantytowns.

It was estimated that at least 12,35% of the population are either in shantytowns or in illegal settlements (AGEM, 2005). Despite, illegality or informality in Baixada Santista should be even higher since it also refers to a more complex arrangement of land use regulations: building norms, environmental constrains for land occupation, infrastructure regulation on neighborhood development, zoning, and property rights.

As a consequence, only a small part of the region - which has also been called “the legal city” can be to some extent comparable to a region of a developed country (Grostein, 1987).

Private investments usually happen in such legal city. It explains why the bulk of private investments have happened in central areas of metropolitan region. Most shantytowns

and illegal settlements are located in poor suburbs and in peri-urban areas. It is possible to verify that shantytowns are much more frequent in the peri-urban areas (12,35% of the local population) than in the central (negative growth) areas (approximately 0,96% in tenements).

In a few words, illegal occupation of the poor peri-urban areas seems to be part of the same process that induces the rate of population growth and deforestation. Although these arguments are based in ecological data (Figura 4), there is a strong reason to support them.

In the case of Baixada Santista, there are diverse institutional barriers for the provision of proper infrastructure and social services in irregular and/or invaded areas. This high level of irregularity “justifies” the non-provision of social services, or to limit their potential availability. Even when the State decides to invest in irregular settlements, it is more difficult to find proper site location for social equipment in irregular or illegal land.

Moreover, the State must follow complex legal procedures in order to appropriate private land. It takes more time to find proper land for public equipment close to illegal developments and shantytowns.

Sometimes the State decides not to invest in these areas due to the risk of losing public investments made in such places – which may be later appropriated by their private owners. Lawsuits against public administrators that do not follow the complex set of standard procedures may also happen in regard to land use regulations (Maricato, 1996; Torres, 2002b).

Different authors have argued that informal land use is a major issue for developing countries. Some defend the regularization of land property and the simplification of norms and regulation as important preconditions for further social and economic development in this kind of urban area (World Bank, 1999).

However, the links between land use and social policies need to be addressed more extensively because public services must be present even when land regularization is not in force. In the case of Brazil, some of these services are even considered to be constitutional rights.

6. Conclusion

The general argument presented here was developed as follows. We have first shown that the demographic growth of the city is very uneven. While the center of the region is losing population, some municipalities around are growing. Associated to this observation, it was possible to note that those areas are the poorest and with less infrastructure of the region.

These areas present high levels of deforestation and informality in terms of land use. The high concentration of social, environmental and legal problems in the far suburbs makes them a very ill-suited area for population growth, which ironically insists to live on there.

Secondly, it is important to notice that it is not the case to blame the poor people (migrants) that move to these suburbs without adequate infrastructure. They are the first to be affected by the environmental degradation, not only due to their exposure to environmental hazards and vectors of vulnerability, but also because their places of residence are less protected in terms of equipment and patterns of construction that if were good and secure could avoid such hazards.

The logic that produces the urban sprawl in metropolitan regions such as Baixada Santista is quite complex, and related to the role of different branches of the government (the system of taxing, regulation, infrastructure, housing policy, etc.) and to the role of private companies (industrial, tourism and construction business). Therefore, the most significant issue here would be *“how to change such undesirable trends?”* The idea that land use regulation could cope with such problems is quite naive, since it has not been able to regulate illegal settlements in the Baixada Santista region and to prevent a high level of local vulnerability.

Urban environmental legislation, for instance, is many times victim of such logic. The “law for areas of protection” in avoiding land occupation is just one tragic example of the failure of a series of attempts to enforce land regulation.

Under these circumstances, is necessary to promote the development of new regional infrastructure and practices associated with more efficient natural resources use. It is necessary to concern about the fact that urban form (from urban sprawl) is changing the environment provoking different levels of vulnerability (for people and places). These connections result in an increasingly uneven and inequitable distribution of population and consequently of hazard exposure and disaster risk.

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