# Analysis of differential exposure of socio-demographic groups to situations of environmental risk in São Paulo, Brazil


## Abstract:

This article attempts to make operational the concept of *environmental inequality* through the use of geoprocessing methodologies. The objective is to pinpoint and measure the association between disadvantaged socioeconomic conditions and greater exposure to environmental risks. In other words, this work is an analysis of situations of environmental inequality in São Paulo city based on the level of risk exposure of different social groups.
The methodology is based on the construction of a Geographical Information System through which the digital layers of environmental risk areas are overlapped with the digital meshes of the census sectors of the 1991 and 2000 IBGE demographic censuses.
The results show that people living in risky areas are in a much worse socioeconomic condition than those living outside them. Moreover, the results clearly show that in recent years there has been an increase in the level of environmental inequality in the city of São Paulo.



**Key-words:** environmental inequality; environmental risk; social groups; São Paulo city; populations at risk; geoprocessing.


## Introduction

In this paper, *environmental inequality* is defined as the differential exposure of social groups to situations of environmental risk. This empirical work attempts to make this concept operational by employing indicators and geoprocessing methodologies which were applied to São Paulo city in order to better identify and characterize these said circumstances.

The argument of environmental inequality emerges from the hypothesis that a number of social groups such as some minorities and low income groups are more prone to certain types of environmental risks (floods, landslides, etc). The environmental risk areas (close to landfills or subjected to floods and collapses) are very often the only places accessible to low income populations. In turn, they end up building their dwellings in hazardous conditions while simultaneously tackling other environmental, sanitation and health problems (TORRES, 1997; 2000).

According to the hypothesis tested, there exists a positive correlation between disadvantaged socioeconomic conditions and greater exposure to environmental risk, which sets the stage for situations of environmental inequality. Environmental risks are unevenly distributed across social groups, income level and availability of public services.

Thus, social inequality would be at the origin of environmental inequality because individuals and social groups have different access to property and environmental benefits (or to environmental quality).

The general objective of this work is to make operational the concept of *environmental inequality* to identify and characterize situations of environmental inequality in the metropolis of São Paulo at the present time. To achieve this, indicators and geoprocessing methodologies were utilized to pinpoint and measure the existence of a link between disadvantaged socioeconomic conditions and greater exposure to environmental risk. Further, an attempt was made to verify if the current trend of environmental inequality is increasing in São Paulo city.

To achieve this objective we analyzed the exposure level of different social groups to situations of environmental risk in São Paulo city, doing a comparative study of the demographic and socioeconomic dynamic between the populations living in areas of environmental risk and those living elsewhere. As proposed by Marques (2005), the typology of the spatial distribution of São Paulo´s population was divided into three large social groups: poor, middle and high class.

Thus, by gathering the analyses, it is possible to put forth some geoprocessing methodologies to make operational the concept of environmental inequality. It is believed that the development of empirical analyses, in particular the quantitative and spatial ones, is an important part of the endeavor to advance the research on the thematic of environmental inequality and environmental justice in the Brazilian scientific and academic milieu (ACSELRAD; HERCULANO; PÁDUA, 2004).

## Brief discussion about the concept of environmental inequality

*Environmental inequality* can be defined as the differential exposure of individuals and social groups to environmental pleasantness and risks. Which means individuals are not equal from the perspective of the access to environmental benefits and pleasantness (such as pure air, green areas and clean water), as well as regarding their exposure to environmental risks, such as floods, landslides and pollution. In this way, factors as residence location, dwelling quality and transport means availability can limit the access to environmental benefits and increase the exposure to environmental risks (TORRES, 1997).

To elucidate this concept further, we can compare it to the social inequalities existing between races, genders, groups of income, etc. In all of these cases, individuals face environmental disparity *because* they are different in respect to certain key factors. Therefore, the idea of environmental inequality implies a superimposition or simultaneous exposure to more than one form of inequality coupled with environmental disparity in residence, level of income, social identity, race, etc. (TORRES, 1997). Taking all this into account, environmental inequality brings additional tribulations. For instance, a low income family living in a shanty town suffering due to dire conditions of lodging, the lack of resources and so on, can be *additionally* bare to environmental risks such as floods, collapses and so on (HOGAN, 1993; JACOBI, 1995; TASCHNER, 2000).

An important topic of environmental inequality is the origin of the phenomenon, with two main ways of explaining its genesis. The first one entails that environmental inequality originates in the land market. According to it, minorities and low income families settle "voluntarily" in areas where *previous* problems occurred and environmental risks *already* exist, due to low real estate prices (NAPTON; DAY, 1992).

The second explanation points to the institutional mechanism that is responsible for generating situations of environmental inequality. In these cases, the actions of the State are influential and wealthy economic and social groups prompt the installation of enterprises that create environmental risk and degradation (landfills, incineration, polluting industries) in areas already inhabited by minorities and low income communities; despondently, these communities are powerless to challenge the encroachment of these types of deleterious industries (BULLARD, 1990; PULIDO, 2000).

Lastly, this debate concerns the causality of the phenomenon: i.e. "what came first", the minorities/low income communities or the sources of risk and environmental degradation? In reality, both scenarios of environmental inequality can occur. There are situations in which the environmental risk already exist and the families "choose" to live in those areas and there are those in which a previously settled community is left powerless to stop the vehement infiltration of undertakings that cause risk, pollution and environmental degradation and whose installation was sanctioned by the governing body (PASTOR; SADD; HIPP, 2001; KRIEG, 1998).

Often, the expressions "*environmental inequality*" and "*environmental (in)justice*" are used interchangeably, this clearly propounds the closeness of these two concepts. *Environmental injustice* can be defined, in a very ample way, as an iniquity apparent or real resultant of the uneven distribution of environmental externalities that attach in a disproportionate way to communities of minorities and low income groups. Consequently, *environmental justice* (or environmental equity) can be defined as the reduction or release of environmental injustices (MOST; SENGUPTA; BURGENER, 2004; HOLIFIELD, 2001).

The concept of environmental justice emerged at the end of the 1970's in the United States with the social movement prompted by Blacks, Natives, Latinos and low income populations living close to landfills, radioactive dumps and highly polluting industries. In that country, the scope of research concerning environmental justice is very extensive and has shown increasing scrutiny in the past 30 years. This has had the effect of positively influencing current environmental policies in North America (CUTTER, 1995; BUZZELI et al., 2003).

In Brazil the research agenda focusing on the thematic of environmental justice is still relatively incipient, choosing to solely highlight the actions of the Brazilian Net of Environmental Justice (ACSELRAD; HERCULANO; PÁDUA, 2004). Hence, the inception of studies in the Brazilian scientific and academic milieu based on the concept of environmental inequality and the empirical operational definition of environmental justice should be of foremost importance in future studies in order to ensure research advancement.

## Methodology

The methodology is based on the construction of a Geographical Information System (GIS), through which the digital cartographies (layers) of the environmental risk areas (near to watercourses and with high declivities) are overlapped with a digital mesh of the census sectors and weighting areas of the 1991 and 2000 IBGE (Brazilian Institute of Statistics and Geography) demographic censuses of São Paulo city.[1]

At the onset of this study, areas of environmental risk were selected based on their proximity to watercourses (less than 50 meters) and/or because they have high slopes (more than 30%) which predispose the area to floods and mudflows. Afterward, digital cartographies of environmental risk areas were superimposed onto the digital mesh of the 1991 and 2000 census sectors. The population size, the demographic growth and the socioeconomic characteristics of the residents *inside* and *outside* of the environmental risk areas were assessed, for both census dates. These estimates were done for the city as a whole and for each region delimited by the spatial distribution of the social groups of São Paulo city (poor, middle class and high class).

To achieve these estimates, a geoprocessing method, known as "*overlayer*" was used. An estimate of the resident population in 1991 and 2000 living in areas of environmental risk can be attained by superimposing the demographic and socioeconomic data of the census sectors which are proportionate to the participation of the territories in risky areas.[1]

The regions corresponding to the three large social groups in the metropolis of São Paulo were defined by Marques (2005), based on factorial and cluster multivariate analyses and a broad set of socioeconomic and demographic variables of the 2000 census sample. By the end of the factorial analysis, only two variables were retained: average family income and demographic growth rate of the weighting area between 1991 and 2000. These were utilized in the analysis of groups to define the three social groups. This way, the set of 456 weighting areas of São Paulo city were stratified according to three main groups of regions, corresponding to the three social groups: "poor regions", with a predominant low income population; "middle class regions", with a predominant middle class population; and "high class regions", with a predominance of high income population (MARQUES, 2005; MARQUES; TORRES, 2005).[2]

## Increase in environmental inequality for São Paulo: differential population growth of the social groups exposed to situations of environmental risk

Initially, the evolution of the population living in areas of environmental risk between 1991 and 2000 will be analyzed to verify if environmental inequality is increasing in recent times within São Paulo city. To do that, the population living in areas of environmental risk, i.e., very close to watercourses (less than 50 meters) and/or with high slope (more than 30%), in 1991 and 2000, was assessed, using the "*overlayer*" approach.

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[1] It is of note that such methodology can also be utilized to study other modalities of environmental risk, such as populations living in contaminated areas, close to landfills, areas of environmental preservation and so on.

[1] Therefore, more than just a tool to visualize the cartographic overlapping, *overlayer* is an instrument that helps to estimate for the environmental risk areas (in this case, those near to watercourses and/or with high slope) information such as the population and the number of residences that [before] were accounted for by the census sectors. When using the *overlayer*, we assume that the distribution of the population is homogeneous along the area concerning the population information, in this case the census sector.

The estimates obtained for 1991 by the *overlayer* method reveal a population of 1.6 million living in areas of environmental risk in São Paulo. Because the total population of the city corresponded to 9.6 million people that year, 16.5% million inhabitants occupied environmental risk areas.

In 2000, the number of people living in areas of environmental risk was barely 2 million, while the population of the city was 10.4 million. Thus, the presence of residents in areas of risk accounted for 19.1% of the inhabitants of the capital that year. The increase in the proportion of people in areas of environmental risk within the total population results from the fact that while these areas of risk have a population growth rate of 2.5% a year, in the remaining areas it barely attained 0.5% a year, between 1991 and 2000.

Therefore, the results reveal that 1 out of 5 inhabitants of São Paulo city (equivalent to almost 2 million people) lives in areas of environmental risk, that is, in localities in close proximity to watercourses (risk of floods and exposure to illnesses transmitted through the water) and/or in those with high slope (risk of mudflow).

However, despite being meaningful, these results are distorted because the greatest environmental risk areas are concentrated in the poor and peripheral regions of the city. Therefore, by observing the population growth in the set of risky areas, it is not possible to discern if it is a direct result of the environmental characteristics of the areas or from the fact that this type of area is concentrated in poor and peripheral regions of the city.

Taking this into consideration and in order to prevent the affect of peripheral population growth on population increase data in areas of environmental risk [aggregated for the city as a whole], comparative analyses between areas of risk and non-risk were performed for each of the three groups of regions: "poor regions", with a predominant low income population; "middle class regions", with a predominant middle class population; and "high class regions", with a predominant high income population (MARQUES, 2005).

For each region, population size estimates within the areas of risk and non-risk in both census dates (1991 and 2000) were assessed. Afterward, the population growth rates for 1991 and 2000 were measured (Tables 1 and 2). Map 1 shows the spatial distribution of the environmental risk areas (near to watercourses and with high declivities) and of the three groups of regions (poor, middle class and high class) for São Paulo city.

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[2] For further details about the concepts and methodologies employed for the demarcation of the social groups in the metropolis of São Paulo, see Marques (2005) and Marques and Torres (2005).

**TABLE 1**
**Size and relative participation of the population, by regions, in relation to areas of environmental risk and non-risk**
**City of São Paulo – 1991-2000**

| Areas | 1991 | | | | 2000 | | | |
|---|---|---|---|---|---|---|---|---|
| | Total of the city | Poor regions | Middle class regions | High class regions | Total of the city | Poor regions | Middle class regions | High class regions |
| **Population** | | | | | | | | |
| **Total** | **9,644,122** | **2,799,606** | **5,198,973** | **1,644,240** | **10,434,252** | **3,873,362** | **5,074,262** | **1,486,628** |
| Areas of risk | 1,593,591 | 717,645 | 712,089 | 163,855 | 1,991,716 | 1,095,621 | 749,052 | 147,043 |
| Non-risk areas | 8,050,531 | 2,081,961 | 4,486,884 | 1,480,385 | 8,442,536 | 2,777,741 | 4,325,210 | 1,339,585 |
| **Participation (%)** | | | | | | | | |
| **Total** | **100.00** | **100.00** | **100.00** | **100.00** | **100.00** | **100.00** | **100.00** | **100.00** |
| Areas of risk | 16.52 | 25.63 | 13.70 | 9.97 | 19.09 | 28.29 | 14.76 | 9.89 |
| Non-risk areas | 83.48 | 74.37 | 86.30 | 90.03 | 80.91 | 71.71 | 85.24 | 90.11 |

**Source:** IBGE**.** Demographic censuses of 1991 and 2000; CEM-Cebrap, cartographies of environmental risk areas; Marques (2005).

**TABLE 2**
**Geometrical rates of annual population growth, by regions, in relation to areas of environmental risk and non-risk.**
**City of São Paulo – 1991/2000**

In percentage

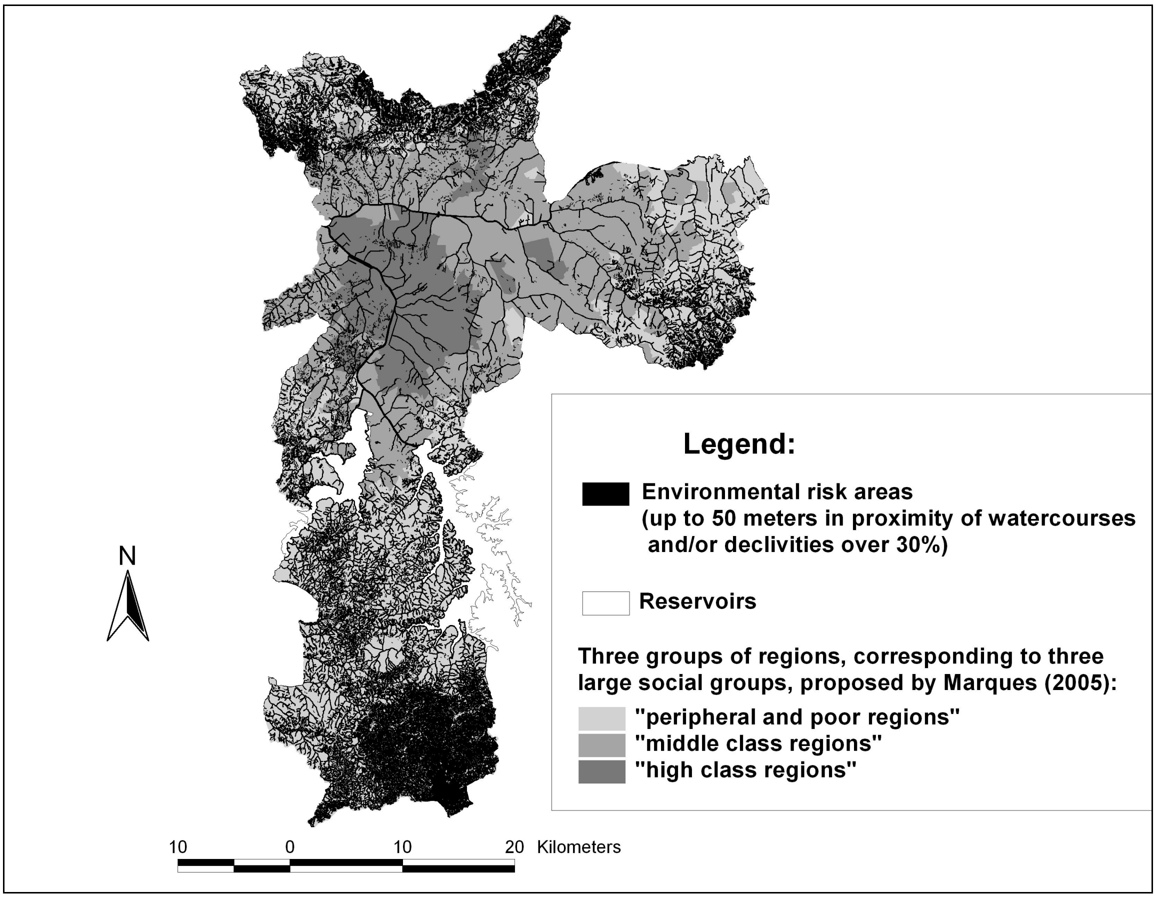
| Areas | Total of the city | Poor regions | Middle class regions | High class regions |
|---|---|---|---|---|
| Areas of environmental risk | 2.51 | 4.81 | 0.56 | -1.20 |
| Areas of environmental non-risk | 0.53 | 3.26 | -0.41 | -1.10 |
| **Total** | **0.88** | **3.67** | **-0.27** | **-1.11** |

**Source:** IBGE. Spring: IBGE. Demographic censuses of 1991 and 2000; CEM-Cebrap, cartographies of environmental risk areas; Marques (2005).

In the set of "poor regions" (where low income population predominates), the proportion of people living in environmental risk areas reaches an impressive 28.3% for 2000, which represents a population contingent of 1.1 million people living in areas with cumulative overlapping of poverty and environmental risk. As for the "middle class regions" and "high class regions", the proportions of population living in environmental risk areas is much lower with 14.8% and 9.9% respectively(Table 1).

Moreover, the results also show that in all the three groups of regions, the population grew more rapidly in the areas of environmental risk (near to watercourses and/or with high declivities), between 1991 and 2000. Likewise, in the peripheral and poor regions, the population in areas of risk grew 4.8% a year, while regions outside these areas recorded a much lower rate (3.3% a year). In the middle class regions, the number of residents in areas of environmental risk increased 0.6% a year, while in the non-risk areas the population decreased 0.4% a year in the period 1991-2000. In the high class regions, the population diminished at very similar rates in the areas of risk and non-risk (Table 2).

**MAP 1**
**Spatial Distribution of the environmental risk areas (near to watercourses and with high slopes) and of the three groups of regions (poor, middle class and high class) in the city of São Paulo**




**Sources:** CEM-CEBRAP, environmental risk areas cartographies; Marques (2005).

As the high class regions (risk areas included) had negative population growth and the environmental risk areas in the middle class regions increased nearly 0.6% a year, the largest part of the population rise in the environmental risk areas of São Paulo occurred in peripheral and poor regions.

Therefore, while the population of the poor and peripheral regions grows at a moderate to high pace, the numbers in suburbs of environmental risk areas raised extremely rapidly. What's more, the environmental risk areas in the suburbs are, in general, less urbanized than the areas of risk located in central and wealthy regions. In other words, the peripheral localities close to watercourses and/or with high slopes very often situated in less urbanized areas (and consequently more prone to environmental risks) presented explosive growth rates in the 1990's.

In summary, the results show that the areas where the population of São Paulo is growing most notably are the peripheral and poor areas with *compounded* environmental risks. This phenomenon stimulates a significant increase in environmental inequality for the city during the recent time period.

## Association between disadvantaged socioeconomic condition and environmental risk in São Paulo

Now that we have established the rise in environmental inequality for São Paulo city[3], we can continue to explore the hypothesis that there exists a positive association between disadvantaged socioeconomic conditions and greater exposure to environmental risk. As previously mentioned, one of the hypotheses on environmental inequality infers that environmental risks are unevenly distributed as are income and access to public services.

To test the hypothesis of the existence of positive association between disadvantage socioeconomic conditions and larger exposure to environmental risk, we present the subsequent comparative analysis of the socioeconomic and demographic indicators between the areas of environmental risk and non-risk for both the city of São Paulo as a whole and for each of its three regions.

Initially, we compared the basic sanitation in the areas of environmental risk and non-risk for the city as a whole, in 2000. With regard to the coverage of the water supply network and of garbage collection we show, in Table 3, that the differences of coverage

[3] As observed, the increase in environmental inequality was demonstrated by verifying that the areas where the population of São Paulo is growing more significantly are simultaneously areas of environmental risk, as well as, peripheral and poor areas.

between the areas of environmental risk (near to watercourses and/or with high declivities) and those of non-risk (distant from watercourses and with low declivities) are small.[4]

However, the same cannot be said in regard to the sewer coverage which reveals huge inequalities between the two types of area. In the non-risk areas (distant from watercourses and with low declivities) 90.6% of the domiciles were connected to the sewer system while those in environmental risk areas (near to watercourses and/or with high declivities) the proportion was close to 71.9%, indicating minute sewer coverage in many areas next to watercourses and/or with high slope (Table 3).[5]

The indicators of income are also very inconsistent between the areas of environmental risk and non-risk in the city as a whole. In Table 3, one can substantiate that the monthly average income for the heads of household living in environmental risk areas corresponds to 888 reais (5.9 minimum wage) in 2000, compared with those located in areas of non-risk which reached 1,421 reais (9.4 minimum wage). Also, the proportion of heads of household with a low income (lower than three minimum wages, including the ones without incomes) was around 37.5% for the group in the non-risk areas, compared with 51.8% for those in environmental risk areas.

Levels of education can also be seen in Table 3. In 2000, the proportion of heads of household with low schooling (includes those with 3 years of schooling or less) reached 24.1% in the areas of environmental risk (up to 50 meters from watercourses and/or over 30% slope) versus 16.4% for those living in environmental non-risk areas. By the same token, the heads of household with college degrees corresponded to 19.3% in non-risk areas (distant from watercourses and with low declivities) versus 10% in the environmental risk area. In light of this, the average number of completed school years by the heads of household varied from 6.4 years to 7.9 years, for risk and non-risk areas respectively.

Concerning the age structure of the population, one sees that the areas of environmental risk (near to watercourses and/or with high declivities) had, in 2000, a significantly superior concentration of children and youths than those of non-risk areas. Thus, while the non-risk areas barely recorded an 8% proportion of 0-4 year-olds, the

[4] These small differences between the areas of environmental risk and non-risk are due to the fact that the water supply and garbage collection coverage are practically universalized in the city of São Paulo, which is not the case in respect to sewage.

[5] In reality, the sewer coverage percentage is lower in the areas close to watercourses than in those with high declivities, with 70.7% and 73.1% respectively.

areas of environmental risk achieved 10.3%.[6] The 0-14 year-old group corresponded to 23.8% and 29.2% in non-risk and risk areas respectively. The proportion of elders (65 years old or more) also varied significantly between the areas of environmental risk (4.1%) and non-risk (7.0%).

**TABLE 3**
**Comparison of the socioeconomic and demographic indicators, by area of environmental risk and non-risk**
**City of São Paulo – 2000**

| Indicators | Areas of environmental risk | Areas of environmental non-risk | Total of the city |
|---|---|---|---|
| Water network coverage (%) | 96.90 | 99.00 | 98.62 |
| Sewage network coverage (%) | 71.94 | 90.58 | 87.23 |
| Garbage collection (%) | 97.76 | 99.51 | 99.20 |
| Illeterate heads of household (%) | 8.95 | 5.19 | 5.86 |
| Low schooling heads of household (until 3 years in school, including the ones without) (%) | 24.09 | 16.41 | 17.78 |
| Heads of household with college degree (%) | 10.03 | 19.25 | 17.60 |
| Average number of years of schooling of the heads of household | 6.44 | 7.94 | 7.67 |
| 0-3 minimum wages heads of household income (%) | 51.84 | 37.48 | 40.06 |
| More than 5 minimum wages heads of household income (%) | 17.08 | 21.80 | 20.95 |
| Average income of heads of household (in reais) | 888.24 | 1421.05 | 1325.43 |
| Average income of heads of household (in minimum wages) | 5.88 | 9.41 | 8.78 |
| 0-4 year-old population (%) | 10.31 | 7.98 | 8.43 |
| 0-14 year-old population (%) | 29.23 | 23.81 | 24.84 |
| More than 65 year-old population (%) | 4.10 | 6.97 | 6.42 |
| Population living in subnormal sectors (%) | 21.60 | 5.68 | 8.72 |

**Source**: IBGE. Demographic census of 2000; CEM-Cebrap, cartographies of the areas of environmental risk.

The literature on the subject clearly reveals a link between shanty towns and areas of environmental risk (TASCHNER, 2000). By comparing the percentage of inhabitants living in subnormal sectors (shanty town areas, according IBGE definition), across the entire city one can see that the areas of non-risk accounted for only 5.7% of the population residing in subnormal sectors; in the environmental risk areas (near to watercourses and/or with high declivities) the percentage reached a whopping 21.6% (Table 3).

In brief, the results for São Paulo city reveal that the residents in areas of environmental risk possess inferior socioeconomic conditions and a greater concentration

[6] It is known that 0-14 year-old children are the most prone to hydro transmissible diseases, which reinforces the state of vulnerability and environmental inequality in areas on the edge of watercourses.

of children and youths. Therefore, these results validate the hypothesis that there exists a positive connection between disadvantaged socioeconomic conditions and greater exposure to environmental risk.

## Discussion and final considerations

In this article, we attempted to build an empirically operational concept of environmental inequality by means of geoprocessing methodologies for identification and characterization of environmental inequality situations in the city of São Paulo. The hypothesis was that environmental risks are unevenly distributed among different social groups. Hence, the objective was to test for the existence of an association between disadvantaged socioeconomic conditions and greater exposure to environmental risks. Moreover, it was the goal of this paper to assess if an increase in environmental inequality was present within the city during the recent time period.

The results show that the areas where the population of São Paulo grew significantly, between 1991 and 2000, were also areas of environmental risk (near to watercourses and with high declivities) and peripheral and poor areas. This phenomenon reveals an increase on the environmental inequality in the city in the recent period.

Subsequently, we reflect on some decisive factors that could explain the elevated growth rate of the population living in areas of environmental risk (near to watercourses and/or with high declivities) in São Paulo, in particular, for peripheral and poor regions.

The first factor that could explain the growth of the city and the metropolitan region continues to be horizontal expansion and peripheral sprawl (TORRES, 2005). The suburbs of the city and Metropolitan Region of São Paulo, especially in south, east and north extremes, encompass a very dense watercourse network due to the topographical and hydrological emplacement of its river basins. Furthermore, the peripheral areas also cover inhospitable mountainous regions, such as the Cantareira Mountain Range. This basically means that the higher population growth rates in these areas translate into a larger population increase in areas of environmental risk (TORRES; ALVES; OLIVEIRA, 2007).

The second aspect has to do with the dynamics of urban land occupation. As the urban mesh of the city, including the more consolidated peripheral regions is already occupied to a great extent, it is reasonable to assume that the continuity of the horizontal growth implies the occupation of less appropriate areas for human settlement, such as the ones near to watercourses and those with high declivities. These areas of environmental risk, very frequently, are the only ones accessible to the low income population, because they are public and/or preserved (invaded) or devaluated in the market, due to the risk and lack of urban infrastructure (ALVES, 2006).[7]

A third factor is related to the significant growth of the population in shanty towns. The association between shanty towns and areas of environmental risk, especially those on the edge of watercourses, but also the ones with high declivities, is very apparent in the literature concerning the subject (TASCHNER, 2000).

In a few words, the natural conditions of the areas where population growth has occurred, the exhaustion of the available areas for horizontal urban growth and the increase in shanty town populations are some decisive factors that explain the meaningful population rise in areas of environmental risk, seen recently, in the city of São Paulo.

The results also reveal that the population living in areas of environmental risk (near to watercourses and with high declivities) presents socioeconomic conditions significantly disadvantaged when compared with areas in non-risk areas. All the indicators considered point to the existence of disadvantaged socioeconomic conditions in areas of environmental risk. Amongst these indicators, there exists a significant different when it comes to access to public sanitation and for the percentage of people inhabiting subnormal sectors (shanty towns). Therefore, the results of the analyses confirm the hypothesis that there exists a positive correlation between greater exposure to environmental risk and disadvantaged socioeconomic conditions.

Beyond the validation of this hypothesis, the analysis made here allows us to evaluate the environmental inequality phenomenon in São Paulo in quantitative and spatial terms, identifying the most exposed social groups (to environmental risk), their location and the number of people involved.

The identification and the characterization of some specific patterns of spatial superposition of poverty and environmental risk situations existing in the city of São Paulo demand the development of detailed analyses such as those allowed by the geographical information systems which utilizes extremely disaggregated spatial units of analysis such as census sectors and the weighting areas of the demographic censuses. Therefore, this work could possibly provide insight into situations of environmental inequality in the city,

[7] In São Paulo city, a great portion of the land available for eventual horizontal expansion is formed by public and/or preserved areas, or pieces of land less appropriate for occupation, due to its natural features – in close proximity to watercourses, with high declivities, subjected to mudflows and the like. This means that, in the absence of housing policies to make denser the occupied

hence yielding prominent subsidies for the planning of social and environmental public policies such as housing and sanitation.

## References and Bibliography

ACSELRAD, H.; HERCULANO, S.; PÁDUA, J. A. (Orgs.). **Justiça ambiental e cidadania**. Rio de Janeiro: Ed. Relume-Dumará, 2004.

ALVES, H. P. F. Vulnerabilidade socioambiental na metrópole paulistana: uma análise sociodemográfica das situações de sobreposição espacial de problemas e riscos sociais e ambientais. **Revista Brasileira de Estudos de População**, São Paulo, v. 23, n. 1, p. 43-59, jan./jun. 2006.

BULLARD, R. **Dumping in Dixie:** race, class, and environmental quality. San Francisco: Westview Press, 1990.

BUZZELLI, M.; JERRETT, M.; BURNETT, R.; FINKLESTEIN, N. Spatiotemporal perspectives on air pollution and environmental justice. In: ASSOCIATION OF AMERICAN GEOGRAPHERS. **Annals…** 93(3), 2003, p. 557–573.

CUTTER, S. Race, class, and environmental justice. **Progress in Human Geography**, 19, p. 107–18, 1995.

HERCULANO, S. Riscos e desigualdade social: a temática da Justiça Ambiental e sua construção no Brasil. In: ENCONTRO DA ASSOCIAÇÃO NACIONAL DE PÓS-GRADUAÇÃO E PESQUISA EM AMBIENTE E SOCIEDADE, 1, Indaiatuba, 2002. **Anais...** Campinas: Anppas, 2002.

HOGAN, D. J. População, pobreza e poluição em Cubatão. In: MARTINE, G. (Org.). **População, meio ambiente e desenvolvimento**: verdades e contradições. Campinas: Abep/Editora da Unicamp, 1993, p. 101-131.

HOLIFIELD, R. Defining environmental justice and environmental racism. **Urban Geography**, 22 (1), p. 78–90, 2001.

JACOBI, P. R. **Moradores e meio ambiente na cidade de São Paulo**. Cadernos CEDEC, São Paulo, n. 43, 1995.

KRIEG, E. The two faces of toxic waste: trends in the spread of environmental hazards. **Sociological Forum**, 13, p. 3–20, 1998.

MARQUES, E. Espaço e grupos sociais na virada do século XXI. In: MARQUES, E.; TORRES, H. (Orgs.). **São Paulo:** segregação, pobreza e desigualdades sociais. São Paulo: Editora Senac, 2005, p. 57-80.

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areas, the population growth, mainly in the peripheral regions, will cause environmental risk area occupation.

MARQUES, E.; TORRES, H. (Orgs.). **São Paulo:** segregação, pobreza e desigualdades sociais. São Paulo: Editora Senac, 2005, 329 p.

MOST, M.; SENGUPTA, R.; BURGENER, M. Spatial scale and population assignment choices in environmental justice analyses. **The Professional Geographer**, 56(4), p. 574–586, 2004.

NAPTON, M. L.; DAY, F. A. Polluted neighborhoods in Texas: who lives there. **Environment and Behavior**, 24, p. 508-526, 1992.

PASTOR, M.; SADD, J; HIPP, J. Which came first? Toxic facilities, minority move-in, and environmental justice. **Journal of Urban Affairs**, 23, p. 1–21, 2001.

PULIDO, L. Rethinking environmental racism: white privilege and urban development in southern California. In: ASSOCIATION OF AMERICAN GEOGRAPHERS, 90. **Annals...** 2000, p. 12–40.

TASCHNER, S. P. Degradação ambiental em favelas de São Paulo. In: TORRES, H.; COSTA, H. (Orgs.). **População e meio ambiente**: debates e desafios. São Paulo: Editora Senac, 2000, p. 271-297.

TORRES, H. A fronteira paulistana. In: MARQUES, E.; TORRES, H. (Orgs.). **São Paulo**: segregação, pobreza e desigualdades sociais. São Paulo: Editora Senac, 2005, p. 101-119.

_________. A demografia do risco ambiental. In: TORRES, H.; COSTA, H. (Orgs.). **População e meio ambiente**: debates e desafios. São Paulo: Editora Senac, 2000, p. 53-73.

_________. **Desigualdade ambiental em São Paulo**. Tese (Doutorado em Ciências Sociais). Campinas: IFCH-Unicamp, 1997. 255 p.

TORRES, H. G., ALVES, H. P. F.; OLIVEIRA, M. A. São Paulo peri-urban dynamics: some social causes and environmental consequences. *Environment & Urbanization Journal,* London, Vol. 19, No. 1, April 2007.