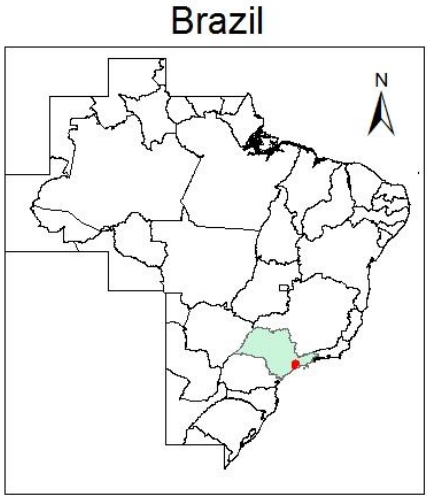
URBAN RISK ASSESSMENT

CITY OF SAO PAULO, BRAZIL

MAP

Geographical Cordinate System
UTM South American 1969
Scale
1:5.800.000



CITY PROFILE

The City is almost entirely urban (98.9% of the population). The population growth rate is decreasing (in 2010 it was only 0.76% compared to 1.16% in 1990). The difference between the numbers of people in the City between day and night could reach two million people. Nevertheless, the population rate in the periphery is

CITY SNAPSHOT

Total Population in 2010 (Source: IBGE)
11.253.530 (City)
Source: IBGE Census, 2010

Population Growth (% annual)
0,75% Source: SEADE, 2000/2010

Land Area (Km2), Source: SEADE
1,523.3 Km2
Source: IBGE Census, 2010

Population density (per Km2)
7,387.7 inh/Km2
Source: IBGE Census, 2010

Country's per capita GDP (US$) US$ 10,960
Source: Brazil Central Bank and IBGE, 2010.

% of country's pop
5.89% (SP City)
Source: IBGE Census, 2010

Total number of households 3,576,864
Source: IBGE Census, 2010

Dwelling density (per Km2) Slums: 1.6% Irregular lots: 6.32% Source: SEHAB/HABISP

Avg. household income (US$) US$891.37
Source: IBGE Census, 2000

% of Country's GDP
11.7%
Source: IBGE Census, 2008

Total Budget (US$)
US$ 17,220,088,415.00

Source: City Hall – Budget 2010

Date of last Urban Master Plan 2002

Exchange Rate: R$ 1= US$ 1.66

increasing (growing from 4.9-5.5 million from 1991-2000), representing 30% of the urban expansion. The periphery concentrates the majority of the poorer inhabitants (the average household income is half the average for the City and the per capita household income is up to three times lower than the City rate).

Graphic 1: Growth Rates for the city of São Paulo - 1950-2010 (Source: Habisp)

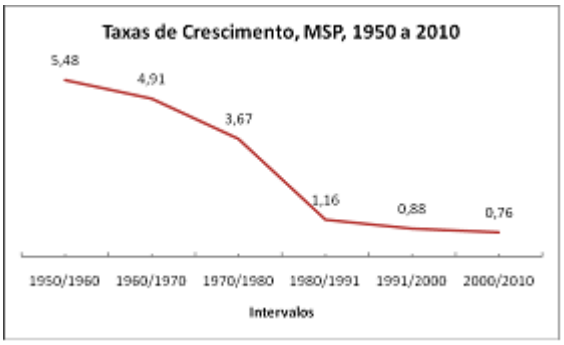
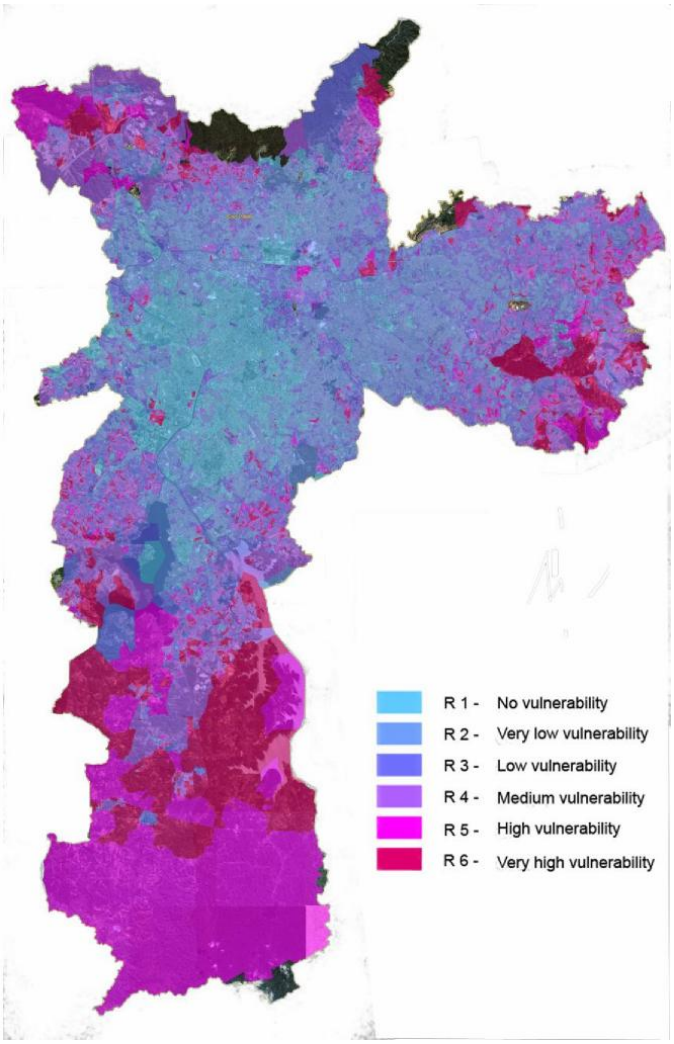


Image 2 indicates the City Social Vulnerability Index (IPVS). It is possible to see the concentration of social vulnerability in the periphery areas of São Paulo.

Image 2: São Paulo City Social Vulnerability Index - IPVS (Source: HABISP)



The life expectancy of the inhabitants of São Paulo is 71 years. The mortality rate is 6.53 for each thousand and the child mortality rate is 15.83 for each thousand. The City has 4.89% illiteracy among youth above 15 years old. Almost 47% of the population above 25 has less than eight years of formal education (primary education lasts nine years and secondary, three additional years).

The population is mainly made up of people 25-59, as shown in table 1:

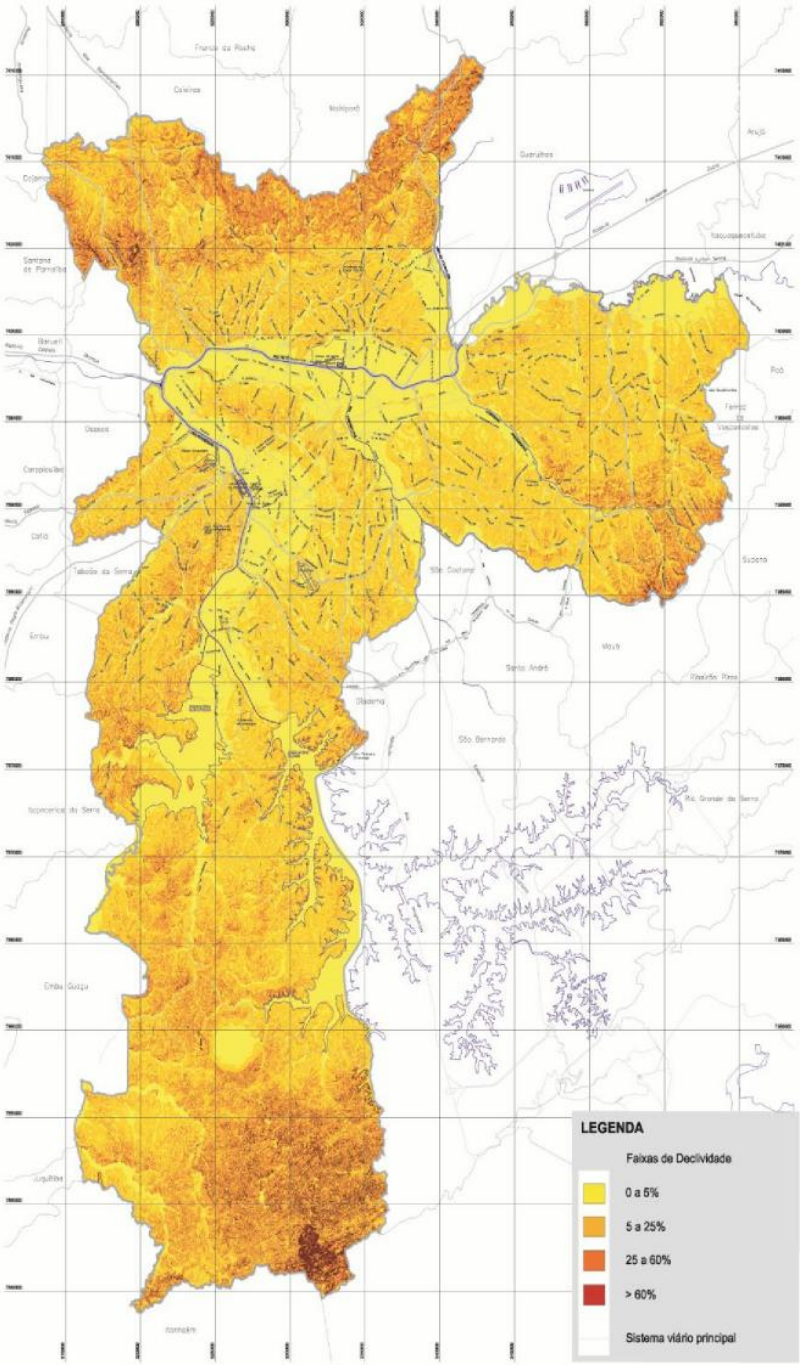
Table 1 (Source: SEADE 2009)

Population from 0 to 14 years old (in %)	24.1%
Population from 15 to 24 years old (in %)	14.8%
Population from 25 to 59 years old (in %)	49.6%
Population from 60 and more years old (in %)	11.5%

São Paulo City is located in the Atlantic Plateau, with hills between 718-720 meters above sea level. Regional hills climb from large floodplains through fluvial terraces into interfluvial areas. The following image shows the City´s declivity and main rivers.

There is no registered seismic activity.

Image 3: São Paulo´s topography and its main watercourses



Source: PMSP - São Paulo Environmental Atlas

Built Environment and Basic Service Provision

Adequate water supply is provided to 98.6% of the houses in the City (almost 65 cubic meters per inhabitant/year)1. Nevertheless, the increase in the number of consumers, scarcity of new water resources and decrease in basin water quality, increases future water supply concerns.

The City Hall reported 87.2% sewage collection for the City in 2006. From all the domestic sewage collected, 81% receives proper treatment. But in slums and irregular housing lots there are improper sanitation conditions and sewage is thrown directly into streams and rivers. Almost 48% of the inhabitants of the City's water basin wetlands live in slums and irregular settlements.

96.5% of the houses have solid waste collection, In spite of that, there are irregularities in site collection and inspection (more than 300 clandestine dumps), and the City suffers from improper waste disposal clogging and polluting culverts and watercourses: 2.6% is deposited in containers and removed by a City Hall contractor; 0.64% is discarded in the land or in waterways and another 0.16% is burned in yards or empty lands. City Hall data shows that, in 2010 the total amount of waste generated daily by the City was 17,000 tons—10,000 tons come from residential collection and almost 100% of the collected waste went to regulated landfills. Less than 1% of this waste was recycled2.

There is enough energy supply to meet City demands (99.99% of the houses possess energy), according to AES Eletropaulo Metropolitana S.A (energy utility). It is not unusual for the City to have localized blackouts, especially during heavy rains. Electricity theft is common in poor regions of the City. The industrial, residential and commercial sectors are more or less equal in their energy consumption (17% of the national consumption is equivalent to 35.3 million megawatt/hours).

Graphic 2: Greenhouse Gas emissions from electric energy use by sector in the City of SP (Source: São Paulo GHG´s inventory)

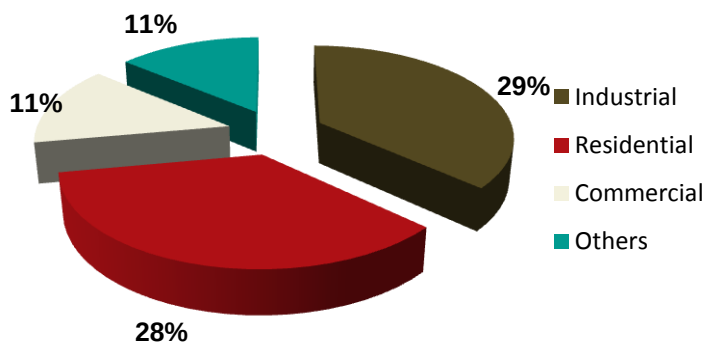
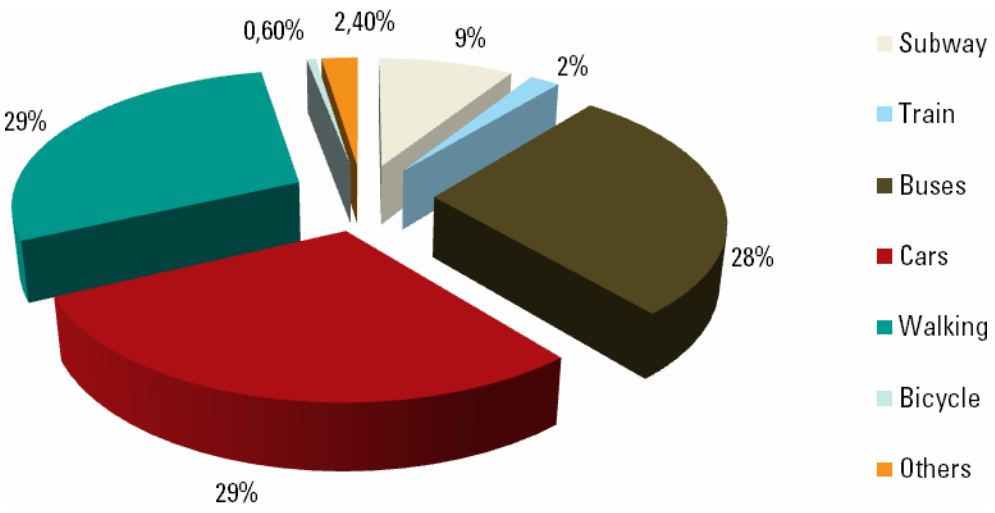


Figure 1 – Greenhouse gas **emissions from electric energy use for sector in the city of SP (Source: Sao Paulo** Greenhouse Gas (GHG) Inventory)

[1] Source: IBGE Census 2000 and City Hall website 2006
[2] Source: City Hall website 2006

The City's traffic is extremely intense with more than seven million vehicles. The subway system (managed by the State) is connected to the rail system (also managed by the state), through a CPTM (Train Management Agency). An average of 2.1 million passengers a day are transported through 89 stations, 260.8 kilometers (km), and 63.5 km of subway tracks. Approximately 15,000 buses circulate through 1,335 routes and 28 terminals. Every three years it is estimated that the number of bus trips increases by one million.[3] The design and number of routes is considered insufficient to adequately serve the entire population. The situation is even worse for the poor, since a great number of them live in the periphery areas but usually work in more centralized neighborhoods, because the job offer is better and the wages, higher. As a result, they spend hours in public transport going back and forth from their homes and their jobs.

Graphic 3: Transport use in São Paulo (Source: Research Origin and Destination – 2007)



In 2005 the City had 34 City parks (15 million cubic meters, (m_3). In 2008 the number increased by 48 parks (24 million m3) and 17 linear parks[4.] The SVMA plans for 100 parks by 2012 (50 million m_3), 20 linear parks and five natural parks. São Paulo had, in 2009, only 21% of its original forest coverage, according to the City Hall Site/Environment Section.

There are more than two million students in 7,103 schools. Elementary schools and medium (or secondary) education as per IBGE (Brazilian Institute of Geography and Statistics) shows 4107 schools in 2009[5]. Elementary schools are the focal point of basic education in Brazil. In São Paulo there is no shortage of elementary schools. The elementary schools are used in the fundamental education period that lasts nine years, and enrollment is obligatory for all children between 6 and 14 years old. The central inhabitants spent more time receiving education than those living in the periphery. Higher literacy rates are found in the central region. In 2000 19.1% of children 7-14 years old were not meeting the minimum school attendance-requirements (elementary school) and 61.5% of students 15-17 years old (secondary school).

[3] Source: CPTM, Metro and SPTrans, 2010.
[4] Linear Park is an area around an important reservoir or drinking water basin, where a structure is implemented to protect the environment and at the same time provide the nearby population with leisure or sports activities.
[5] Source: IBGE Cities, Education Ministry, National Institute of the Education Studies and Researches, Education Census, 2009

The City has an objectives program called “Agenda 2012”[6]. This measure was enacted into law in 2008 and prescribes the transparency of the actions and priorities managed by the City. This measure also permits that the population follow its development. Each region of the City has its targets which range from health, education, traffic, water quality, sewage piping, quality of parks and leisure areas as well as safety and transportation.

The City has challenges in several areas, such as:

- Housing—increase the regularization/improvement of slums and irregular allotments and remove families from risky areas;

- Health—Increase the number of people served in health services and increase its qualities;

- Transportation—Increase the coverage of bus, trains and subway routes, improve bus stops and terminals, renovate electric bus system and cars, enable public transport, decrease traffic rates, increase traffic safety.

- Education—Improve public system, decrease evasion rates – especially for the medium (or secondary) education; increase the number of public nurseries (insufficient to meet the growing demand).

- Water Supply—Increase the water quality and protect water basins.

- Sewage—system coverage and avoid illegal disposal of sewage into water courses.

- Waste management—Increase inspection of illegal dumping places, decrease waste generation and increase recycling.

- Cleaning—Improve cleaning coverage for culverts and streets.

- Drainage—clean and dredge the river bottoms, clean and increase the existing drainage underground channels, built more “pools” ("piscinões") around the City.

[6] http://www.agenda2012.com.br/oprograma

Agencies Involved in Disaster Risk Management and Climate Change Adaptation

The Emergency Management Agency acts on the federal, state and municipal levels. Its goal is to plan actions to prevent and minimize effects of disasters, either natural or human caused, assist people affected by them and to rehabilitate or recover the places destroyed by those events. In the City this responsibility rests with the **City Public Safety Secretariat,** through the City Emergency Management Agency **(COMDEC**). Nonetheless, its personnel are allocated to the 31 decentralized units or "sub-districts".

The City Emergency Management Agency acts on Prevention and Recovery, Assistance and Aid and also on Search and Rescue operations, and is assisted by the **Firefighter Department**. At the communities located in areas of risk there should be a Local Emergency Management Group, or **NUDEC**. They should be made up of volunteers trained by the **National Emergency Management Agency** to help during emergencies and risky situations.

Institutional Snapshot

Leading agency coordinating Disaster Risk Management efforts

Emergency Management Agency subordinated to City Public Urban Safety Secretariat

Non-governmental organizations involved in Disaster Risk Management

Rede Nossa São Paulo

The **Emergency Management Center** (CGE) is responsible for observing meteorological data (there are 180 monitoring stations) and for informing **COMDEC.** Then COMDEC alerts the Sub-districts and they monitor the volume of rainfall using pluviometers installed at 31 points in the City.

The "**Summer Rainfall Operation**" is a City plan that brings together the **Housing, Transport, Urban Infrastructure, Social Assistance and Sub- districts Coordination Secretariats,** led by the Emergency Management Agency, and targets disasters which occur during the summer (when heavy rainfall is common). Whenever necessary or from November-April, the City organizes initiatives to prevent disasters or to timely assist in case an emergency takes place, recovering the area after the flood or landslide and providing shelter for those in need.

When a heavy rainfall approaches, CGE issues an alarm to COMDEC, as well as to the traffic authorities (**CET**), the Health Secretariat (**SMS**), Green and Environment Secretariat **(SVMA)** and Housing Secretariat **(SEHAB)**. Each Sub-district must then activate the process using the Emergency Management Agency agents allocated to the region, following a **POP—**or Standard Operational Procedure. The initiatives include prevention (evacuating houses in at risk areas), search for and rescue people in floods or landslides and restoration of affected areas.

After the flood or landslide the firefighters rescue possible victims. Water and Sanitation authorities fix possible broken water pipes and energy

agents check the electricity posts. Social assistants verify housing conditions and if necessary, direct people to temporary shelters while SEHAB arranges for "rent allowance" or allocate housing for the needy. The City Health Secretariat , through its Health Vigilance Coordination (COVISA), trains its environmental agents to, before and after the heavy rains, informs the vulnerable communities about endemic diseases spread by water (such as leptospirosis), their symptoms and the need for medical treatment. The UBS (Basic Health Units) receive folders and posters to distribute to the population on how to avoid leptospirosis and the proper treatment. COVISA also alerts each region of the City about its specific risk of leptospirosis incidence, aiming to prepare the health professionals for the emergence and spread of the disease.

Examples of Disaster Related Program or Relevant Decrees

The **"Summer Rainfall Operation"** is an existing Plan from the City that brings together **the Housing, Transport, Urban Infrastructure, Social Assistance and Sub-districts Coordination Secretariats,** led by the **Emergency Management Agency.**

Decree 47.534/ 2006 – reorganizes the City system of the Emergency Management Agency. There are other laws at administrative levels that regulate the Emergency Management Agency and the Operation Procedures.[87]

The main program described above, the Summer Rainfall Operation, maintains the current emergency system: The Emergency Management Agency acts on Prevention and Restoration, Assistance and Aid and also on Search and Rescue operations, assisted by the Firefighter Department. The Emergency Management Center (CGE) is responsible for observing meteorological data (there are 180 monitoring stations) and informing the Emergency Management Network, traffic authorities, the Health Secretariat (SMS), SVMA and Housing Secretariat (SEHAB). Each "sub-district" must then enable the process using the Emergency Management agents allocated to the region, following a POP—or Standard Operational Procedure. The actions include prevention (evacuating houses in at risk places), search for and rescue people in floods or landslides and further restoration of the areas.

There is no information on the maintenance and testing of the procedures. From an ordinary citizen's point of view, those alarms are neither timely or efficient, since they require constant monitoring through the CGE´s website. In *at risk* areas this is even less likely to occur, since the rate of viewing the internet in general in the City in 2003was 25%. There is no data available on expenditures on disaster risk management or adaptation programs.

Shortcomings in Disaster Risk Management and Climate Change Adaptation Management

From the interviews and research it is possible to say that: The Emergency Management Agency has a shortage of agents in the *at risk* communities, distributing and teaching the use of the plastic pluviometers (PET) and water level rulers. CGE also needs resources to train Emergency Management Local agents about informing the population about the risks of heavy rain. The Health Secretariat has a shortage of medical personnel and adequate facilities to assist citizens with lepstospirosis or climate related diseases. A direct and efficient channel with the community in *at risk* areas must

[7] .http://www.prefeitura.sp.gov.br/cidade/secretarias/seguranca_urbana/defesa_civil/legislacao/pops__2009/index.php?p=7929

be created to alert in case of emergencies. The same needs to be done for the general population. Prevention measures in at risk communities must be strengthened, in order to avoid the need for emergency action.

Estimated Levels of Spending on Pro-Poor Services and Infrastructure

The City Emergency Management Agency works on disaster management activities. According to interviews made during the study, it lacks resources to carry out its projects, develop new initiatives, train and support communities based on units or groups, properly service the population in emergency cases and develop preventive maintenance processes.

The continuity of the existing measures, such as the ones described above, were the ones mentioned during the study.

At the beginning of 2011, the mayor of São Paulo and the governor of São Paulo jointly launched a US$ 5 million initiative to fight floods in the City. It included cleaning the Tietê River; acquisition of pumps to move water from the Pinheiros River to the Billings water reservoir; a system of underground channels to dredge the Tietê River; and the creation of the Varzeas Tietê River Linear Park (with plans to remove 5ooo families that should not be living at the margins of the River).

Table 2 - Institutional Mapping of Disaster Risk Management Functions

	Risk reduction		
Risk Assessment	*Technical (planning, management, maintenance)*	*Early Warning and response*	*Public Awareness*
• Civil Defense	Civil Defense • Agents and NUDECs	CGE • 18 meteorological stations	CGE • web site

Past Natural Disasters

Table 3 – Hazard, Effects and Losses

Hazards	Effects	Losses
Heavy rainfall- more than 30 mms /day	Landslides Floods Stream overflow River overflow Leptospirosis and water transmitted diseases	Lives Houses and Material Resident Property Cars Health Conditions
Extreme heavy rain (more than 100 mms / day)	Landslides Floods Stream overflow River overflow Leptospirosis and water transmitted diseases	Lives Houses and Material Resident Property Cars Health Conditions
Air dryness	Health problems: respiratory mainly	Health Conditions

Fonte: INPE (Institute of Research and Technology, 2009)

Natural Hazards Snapshot

	Y /N	*Date of last major event*
Earthquake	***NAp***	***NAp***
Wind Storm	***NAp***	***NAp***
River Flow	***Y***	***2009***
Floods, Inundations and waterlogs	***Y***	***2011***
Tsunami	***NAp***	***NAp***
Drought	***NAp***	***NAp***
Volcano	***NAp***	***NAp***
Landslide	***Y***	***2011***
Storm Surge	***Y***	***2010***
Extreme Temperature	***Need available data***	***Need available data***

There is no publicly available systematization of climate hazards and measurements of consequences and losses. This is a substantial gap in information which needs to be addressed by the City.

A prominent city newspaper created some records of rainfall events:

*November 2009-March2010. H*eavy rainfall accounted for 78 deaths and 20.000 homeless. Jardim Romano (a poor neighborhood) was flooded for more than two months.

Oct 2009. Tietê and Pinheiros´s rivers overflowed and there were 86 flooding points in the City.

February 2008. In one neighborhood in the east of the City (Mooca) the water height reached two meters. The firefighters were called 53 times to rescue stranded people. Train passengers were trapped in the railway car for more than six hours (due to lack of power caused by the rain).

November 2006. The City experienced 230 flooding points (doubling the number for the same month the previous year).

May 2004. The heaviest rainfall in years (140 mm in a single day) caused 120 flooding points in the City; small rivers flooded. One person disappeared in a flooded area.

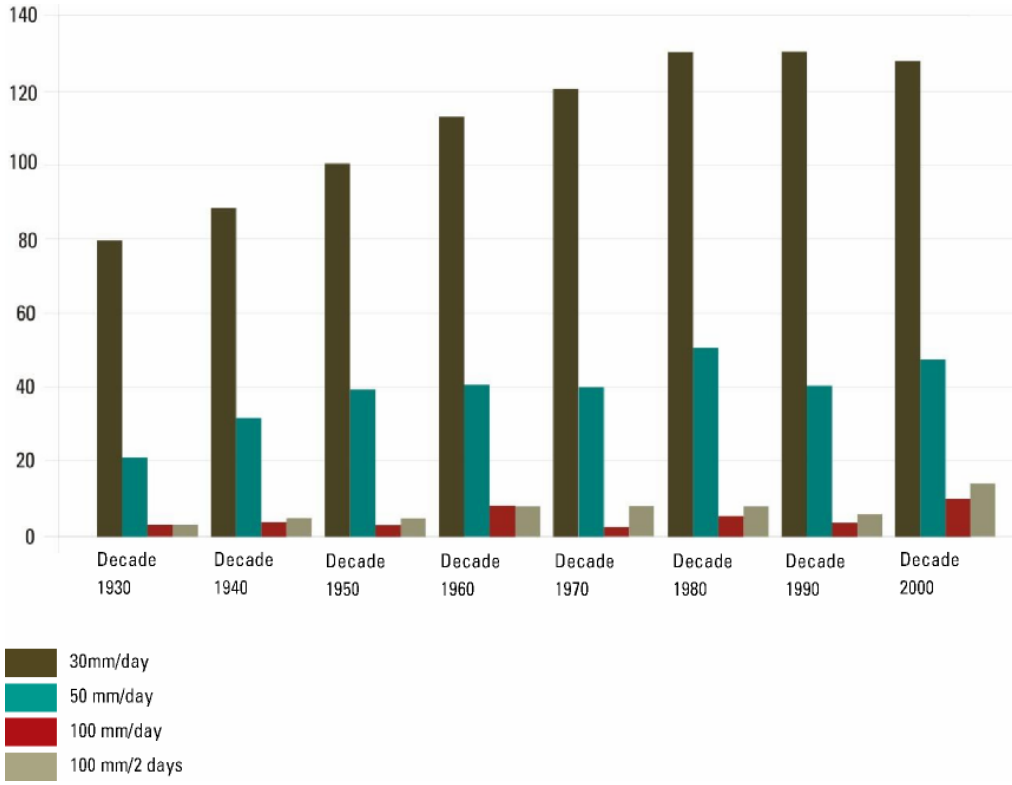
Main Climate Hazards

According to INPE (Institute of Research and Technology, 2009), São Paulo City is composed a variety of surfaces with different temperatures, forming a mosaic of urban climate. There are 'heat islands', specific thermal inversion areas, pollution bubbles and local differences in the wind patterns. Therefore it is impossible to plan a single initiative or define a precise level of climate event (quantity of rain or degree of heat) that could cause tragedies. Each area has its specific soil, drainage, occupation and permeability conditions and as a result, a different threshold to be met.

That said, INPE produced the chart below (graphic 4), that shows the amount of heavy rainfall in São Paulo per decade, from 1933-2000, which indicates an increase in the number of heavy rainfall days—with more than 100 mm of precipitation in just one or two days.

INPE confirms that rainfall above 10 mm per day is considered heavy, but is not potentially dangerous. More than 30 mm per day of rainfall can cause serious floods, and more than 50 mm can be even riskier for the City (before the 1950´s, rainfall above to 50 mm/per day was non-existent, but currently this occurs two to five times every year).

Graphic 4: Days with intense rainfall per decade



Source: IAG/USP, Analysis by INPE, 2010.

The chart below shows the number of flooding points registered by CGE in São Paulo City, per year.

Graphic 5 - : Number of flooding points registered by CGE in São Paulo City per year, 2004-2011 (Source: CGE and Mr. Mauricio Maia blog, 2011. Available at: http://alagamentos.topical.com.br/pontos.)

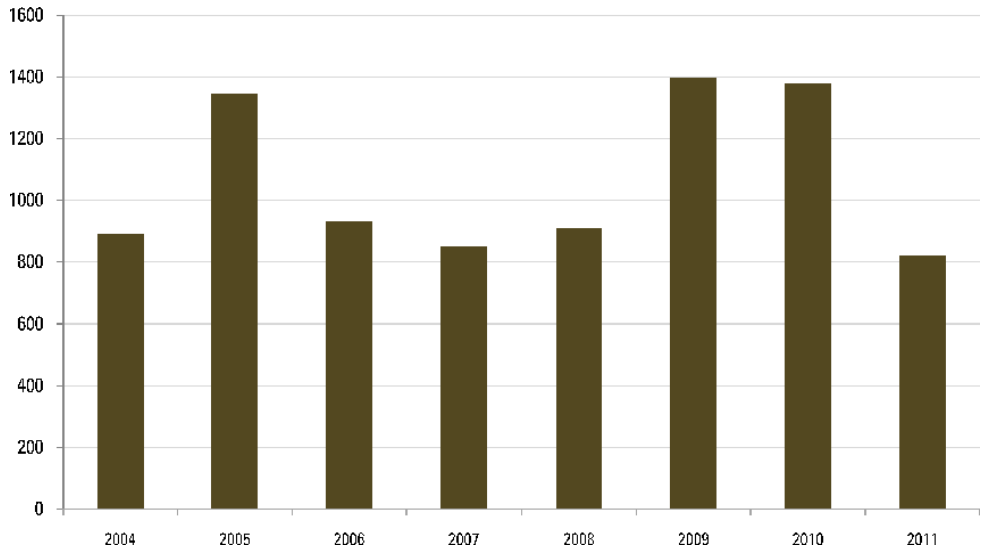


Table 4 - Climate projection for the metropolitan São Paulo City

	present observ	present simulated	2030-40	conf.	2050-60	conf.	2080-90	conf.
Temperature				High		High		High
warm nights				High		High		High
cold nights				High		High		High
warm days				High		High		High
cold days				Average		High		High
heat waves	Unobserved			Average		Average		High
total rain				High		High		High
intense precipitation				Average		Average		High
Precip. > 95th				Average		Average		High
precipitation > 10 mm				Average		Average		High
precipitation days > 20 mms				Average		Average		Average
consecutives dry days				Average		Average		High

Source: INPE/CEPTEC

SUMMARY OF CLIMATE PROJECTIONS FROM THE REGIONAL MODEL ETA/CPTEC MODEL FOR SÃO PAULO CITY

For INPE, the main climate risk scenarios for São Paulo City are:

Floods - This risk scenario is characterized by the overflow of river water onto the adjacent lowlands, when the plains along the main watercourses of the Alto Tietê Basin become flooded. Despite investments to increase flow capacity of the main watercourses, floods continue to occur due to urban growth and the natural dynamics of floods and previous major interventions in waterways.

Heavy Floods - Rugged conditions allow for the occurrence of heavy floods, that is, high water volume and speed. Flooding of this nature may cause destruction of buildings and other urban infrastructure works, material damage of various types and may also endanger the lives of riverine residents. Houses and occupations of people along watercourses subject to this kind of flooding can be seriously affected.

Flash floods with high potential for drag - Several public policies for channeling streams and construction of roads in valleys cause flash flood hazard scenarios along the streets, where there are concentrations of surface water (which also occurs in suburban areas, without paving). This process is characterized by the great power of accumulation of surface water and high destructive power of drag. Hydrological risk scenarios like these expose people and housing to high-risk conditions. The greatest probability of loss of life is found in the periphery regions, and loss of goods in consolidated central neighborhoods. Rainwater runoff concentrated along watercourses or on public roads is responsible for most deaths in hydrological events, when people are dragged and carried by the energy of the water.

Occasional Flooding - The processes of occasional flooding (accumulations of shallow water depths that rarely penetrate the interior of the buildings and affect most public roads) occur widely in various parts of the City, primarily by deficiencies in the drainage system. They are momentary inconveniences for pedestrians and vehicles.

Trash thrown into water courses - A total of 6000 households throw waste directly into waterways in the metropolitan region of São Paulo, a phenomenon that is repeated in the city of São Paulo. The garbage contributes to siltation and clogging of these waterways, and can be carried by runoff, captured by the river system and taken to lower slopes, where they are deposited. The detention reservoirs of Tietê River are located in these regions of lower slopes and can be damaged by the debris, in situations where devices that prevent the entry of bottom sediments and trash are not employed.

Land-slides on slopes - The slope regions are generally subject to informal settlements and prone to landslides, which can cause serious accidents and deaths of residents.

More severe rainfall - There is a clear correlation between more severe rainfall (greater than 100 mm), and more rugged terrains. The climate analysis by INPE indicates that severe rainfall will occur more in some areas of the City which have concentrations of *at risk* areas for landslides and flooding, increasing the vulnerability of the inhabitants of these places.

Exposure to Hazards

IPT (Technological Research Center) was commissioned by the City to map the geotechnical hazardous areas in São Paulo in order to identify sector vulnerabilities to landslides and stream washouts in areas of precarious urban settlements. In this study, a hazardous area is defined as one likely to be hit by natural or/and induced processes or phenomena that cause adverse effects. People living in such zones are exposed to physical harm and prone to material losses. Typically, in the context of Brazilian cities, these areas correspond to low- income housing units (precarious informal settlements).

The following factors found to be essential for hazard analysis have been assessed: type of process expected, prospect or likelihood of the process occurring; vulnerability of the urban settlements; and damage potential.

The analysis included morphological and morphometric features of the terrain; geological materials and profile of the alteration; geological structures; evidence of geological movements**;** ground coverage; and conditions associated with wastewater, rainwater and subsurface water. As a result, a landslide and stream washout hazard zone has been defined for vulernable urban settlement areas. The method used to map the zone included the following activities:

- Oblique low-height helicopter aerial photography ;
- Field work to examine features and limits of hazardous terrains in previously identified hazards zones;
- Assessment of the likelihood of destructive processes;
- Assessment of potential consequences due to dwelling vulnerability;
- Estimate of hazard level per sector;
- Recommendations for hazard-control initiatives; and;
- Data input into a geo-referenced database, integrated with the Housing Secretariat's (SEHAB) HABISP System.

Table 5 displays the incidence of hazardous areas mapped in the informal/vulnerable settlements. Slums have the highest incidence rate of landslide and washout hazard areas. About 20% of the land where slums are settled is subject to geo-technical hazard. As far as homogeneous distribution of households, slums in São Paulo represent roughly 76,000 households exposed to hazards. According to the mapping of the City, there are 407 highly hazardous areas located in 26 Sub-districts.

Table 5: Incidence of hazardous areas in precarious/informal settlements, in São Paulo City

	Urbanized Centers	Settlements/Allotments	Slums
Landslide Risk Percentage (IPT 2010)	10,43%	3,90%	14,79%
Washout Risk Percentage (IPT 2010)	2,44%	0,68%	5,38%

Source: HABISP - SEHAB; IPT – 2010

Image 4: Geo-technical Hazard Areas and Declivity Hazard Areas

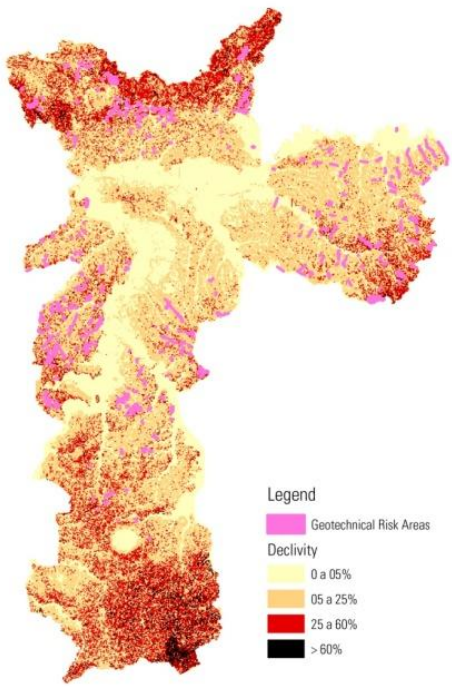


Image 4 displays geo-technical hazard areas overlapping data on steepness. As expected, critical areas are closely associated with high steepness. Such areas are more prone to be found in the peripheral zone of the City (northern, eastern and southern suburbs). The most critical areas are precisely those where the most precarious settlements are located. Lack of access to a formal land market by the poorest families generates the conditions for these combined factors of social and environmental vulnerability.

In addition to identifying hazardous areas, the IPT also ranked them in four levels of criticality. A qualitative hazard analysis has been made on the data obtained from field observation, integrating the analysis parameters into a hazard assessment record card, with the support of aerial imagery. The degree of hazard were those displayed in Table 6.

Table 6: Degrees of landslide hazard.

Class of hazard	Description of at Hazardous Situations
R1 - Low	Potentially low degree both of geological and geo-technical predisposing factors (steepness, type of terrain, etc.) and of intervention in the sector for the development of landslide and washout processes. There is no evidence of instability processes underway in slopes and drainage banks. It is the less critical condition. If the status remains unchanged, no destructive events are to be expected over one year.
R2 - Medium	Potentially medium degree of both geological and geo-technical predisposing factors (steepness, type of terrain, etc.) and of intervention in the sector for the development of landslide and washout processes. There is some evidence of instability processes underway (yet incipient) in slopes and drainage banks. If the status remains unchanged, there is little probability of destructive events occurring during long, strong rain episodes over one year.
R3 - High	Potentially high degree of both geological and geo-technical predisposing factors (steepness, type of terrain, etc.) and of intervention in the sector for the development of landslide and washout processes. There is significant evidence of instability (ground cracks, sag of embankments, etc.). If the status remains unchanged, destructive events may be expected to occur during long, strong rain episodes over one year.
R4 – Very High	Potentially very high degree of both geological and geo-technical predisposing factors (steepness, type of terrain, etc.) and of intervention in the sector for the development of landslide and washout processes. There is strong evidence of instability, supported by numerous accounts with regard to hazardous conditions (ground cracks, sag of embankments, , wall cracking in houses or retaining walls, tilted trees or poles, slide scars, erosion features, dwellings built near stream banks, etc.). It is the most critical condition. If the status remains unchanged, destructive events are highly probable to occur during long, strong rain episodes over one year.

A cross analysis of hazardous areas ranked by their critical level and precarious/informal settlements (Table 7) leads to that slums face the most hazardous conditions. In total, more than 5% of slum areas are highly or very highly exposed. This means that these areas are highly prone to be affected by destructive events in the next 12 months.

This conclusion only stresses the urgency of taking prevention measures. Furthermore, such hazards can be leveraged by prospective climate conditions, thus potentially increasing the degree of hazard level in areas currently ranked as low or medium risk.

Table 7: Cross referencing data: Areas ranked by their critical level and by types of settlements in São Paulo City.

	Low Hazard	Medium Hazard	High Hazard	Very High Hazard
Slums	2.92%	11.90%	4.11%	1.40%
Settlements/Allotments	0.65%	2.93%	0.97%	0.43%
Urbanized Centers	4.59%	7.62%	0.56%	0.09%

Source: HABISP – SEHAB; IPT - 2010

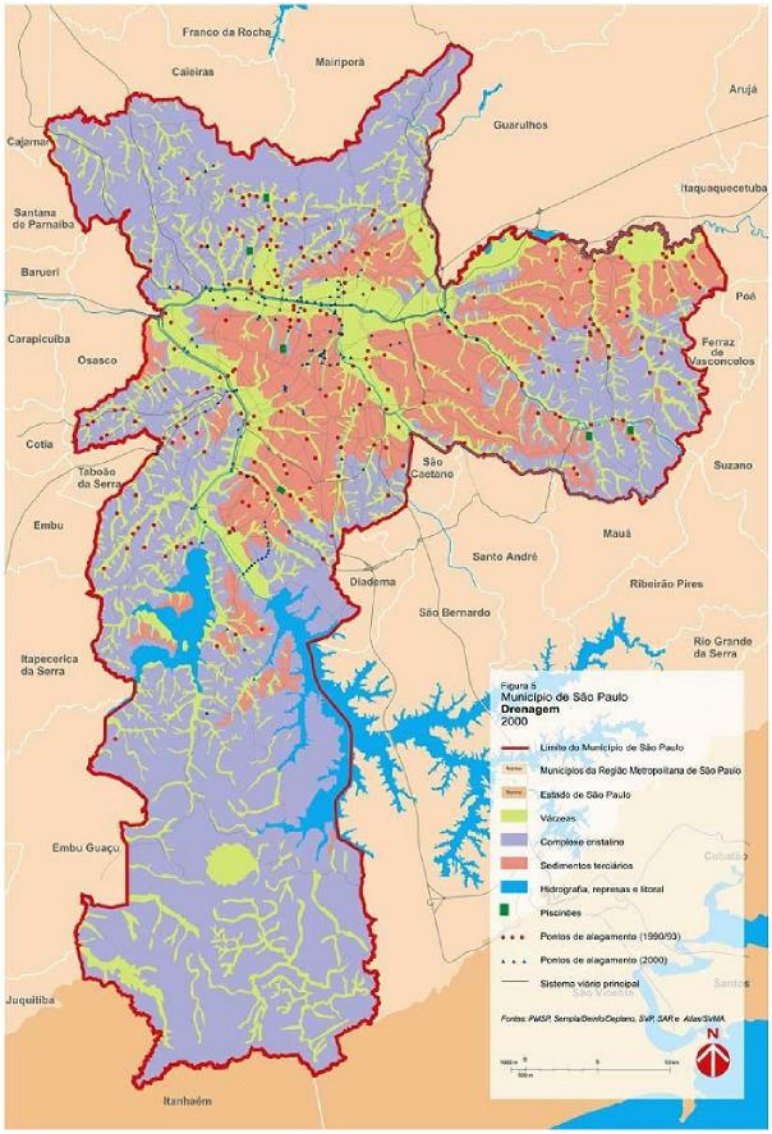
It is worth stressing that the map made by the IPT does not take into account flood and water logging hazards. While floods are not as lethal as mudslides and landslides, they represent the most frequent hazardous situations to which the population is exposed. These events result in great material damage and may have secondary effects on health by increasing the likelihood of spreading waterborne diseases such as *leptospirosis*. People living near streams or rivers, especially children and the elderly, the most vulnerable ones, are also exposed to direct risks such as drowning and physical injury in highly destructive landslides.

PILLAR #3 -SOCIECONOMIC ASSESSMENT

The most significant climate hazards for São Paulo City are related to floods and landslides. Flooding points have not been fully mapped by the City, only floodable points on streets, which are related to traffic problems (shown in image 5).

When dealing with landslides risks, the City commissioned IPT to map and rank the critical spots. A qualitative hazard analysis has been made on the data obtained from on field observation, integrating the analysis parameters into a hazard assessment report card, with the support of aerial imagery.

Image 5 - Main flooding points of streets.



Source: **SVMA, Environmental Atlas, 2000**

Social Assessment Snapshot

Percentage of city population below poverty line

5,6% in 2000. Atlas DH

Social inequality (Gini index)

0,543 Metropolitan Area. 2006. PNAD

Unemployment (% of total labor force)

12,3% in 2009. SEADE.

Areal size of informal settlements as a percent of city area

7,92% in 2010. HABISP.

Percentage of population living in slums (irregular houses)

0,48%

Percentage of households that exist without registered legal titles

7,9%

Percentage of children completing primary and secondary education: survival rate

Abandon rate for primary: 1,3% and for secondary: 5,4%.

Human Development Index

0,841 in 2000. Source: IBGE.

Predominant housing material

brickwork

During the study a map was producing overlapping the social vulnerability (mapped trough IPVS index mentioned before) and the climate vulnerability (using IPT and INPE data) was produced.

The followings layers were included in the database to produce the map:

- Informal/Precarious Settlements in São Paulo City (2010): obtained from HABISP- SEHAB (Housing Secretariat) containing the official demarcation of each settlement organized by: Slums, Urbanized Slums and Informal Settlements. Information about the quantity of houses, infrastructure and average income level available.

- Geotechnical Risk Areas (2010): Obtained from HABISP-SEHAB, a study from the Technological Research Institute (IPT) from the State of São Paulo, the data consists of the areas mapped by the IPT using *in loco* verification which presents geotechnical risk for landslide and undermining among water streams. The areas were characterized by four degrees of hazard level, varying from low risk to very high risk.

- Geotechnical Chart (1999): This chart was elaborated in analogical format and contains the mains geomorphologic areas of the City. The Planning Secretariat digitalized the map and the data could be integrated in the georeferenced dataset.

- Index of Social Vulnerability (IPVS) as per Census (2000). The São Paulo State was divided into six groups of Social Vulnerability. Based on multivariate statistical analysis technique, the IPVS uses the data from the last population census (2000). The calculation of the IPVS uses basically two different types of information: demographic characteristics and socioeconomic condition of the families;

- Declivity map: Based on the topographic chart of the City developed by EMPLASA, the declivity map is a raster dataset containing classes of declivity for each pixel. This dataset reveals the topography of the City indicating those areas with high declivity thus more inclined to landslide risk.

- Transportation infrastructure and public infrastructure: This data contains the localization of the public infrastructure of the City such as schools and health clinics. Obtained from the HABISP- SEHAB and SEMPLA, this dataset was used to infer the existence of public infrastructure under geotechnical risk as well as analyze the proximity of this equipment to the vulnerable areas.

- HAND model: This dataset was produced by the National Spatial Research Institute for the work on Brazilian megacities and climate change vulnerabilities. This data was calculated from the topographic chart of the City using spatial analysis. Based on a raster representation obtained from the declivity map, the dataset informs those areas with highest vulnerability to landslide and flooding occurrences;

- Water reservoir locations (piscinões or big pools): This data was collected from SEMPLA and corresponds to the locations of the 16 water reservoirs constructed in the City to control the floods.

- Hydrograph and Drainage System: Corresponds to the watercourses of the City and the natural drainage system.

- Flooding occurrences: This layer contains the points where flooding occurred . It was mapped by the Traffic Engineering Company (CET) responsible for the traffic control in the City.

The analytical approach used for the mapping task was based on spatial analysis techniques in the Geographical Information System (GIS). All the layers were compiled in an integrated geo referenced database. The calculations were based on overlays applied over the reference layers of Informal Settlements, Slums and

Urbanized Slums. Through this operation it was possible to calculate the relative incidence in terms of area of geotechnical risk of flooding. It was also possible to calculate the relative incidence of the Social Vulnerability Index in each of the reference layers.

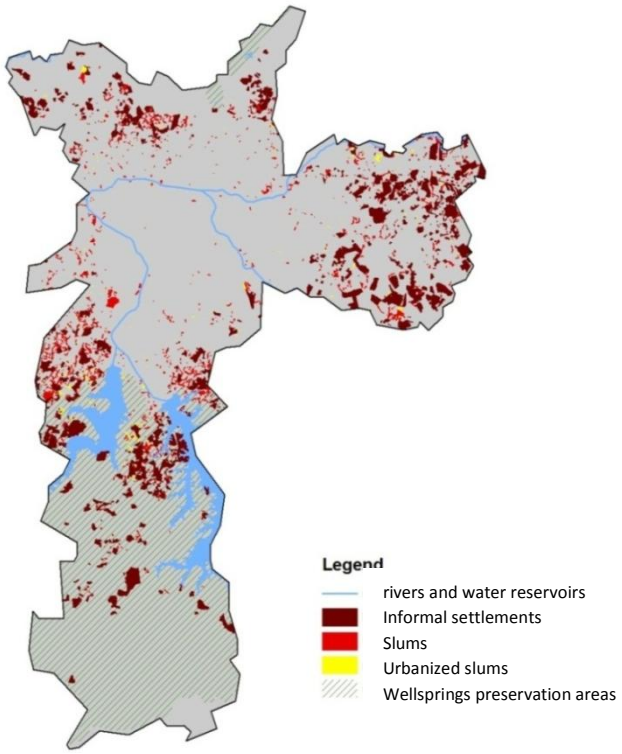
Having calculated both incidences, Social Vulnerability and Geotechnical Risk, it was then possible to establish a comparison between all the informal/precarious settlements in the City. The results of the geographical analysis operation were tabulated and organized by themes of vulnerability and hazards. The most vulnerable ones were those settlements which present the higher percentage of areas within highest geotechnical risk and social vulnerability. Finally, thematic maps were generated showing the layers included in the database allowing the visualization of the critical areas all over the City. The resulting analysis in images 6A and 6B.

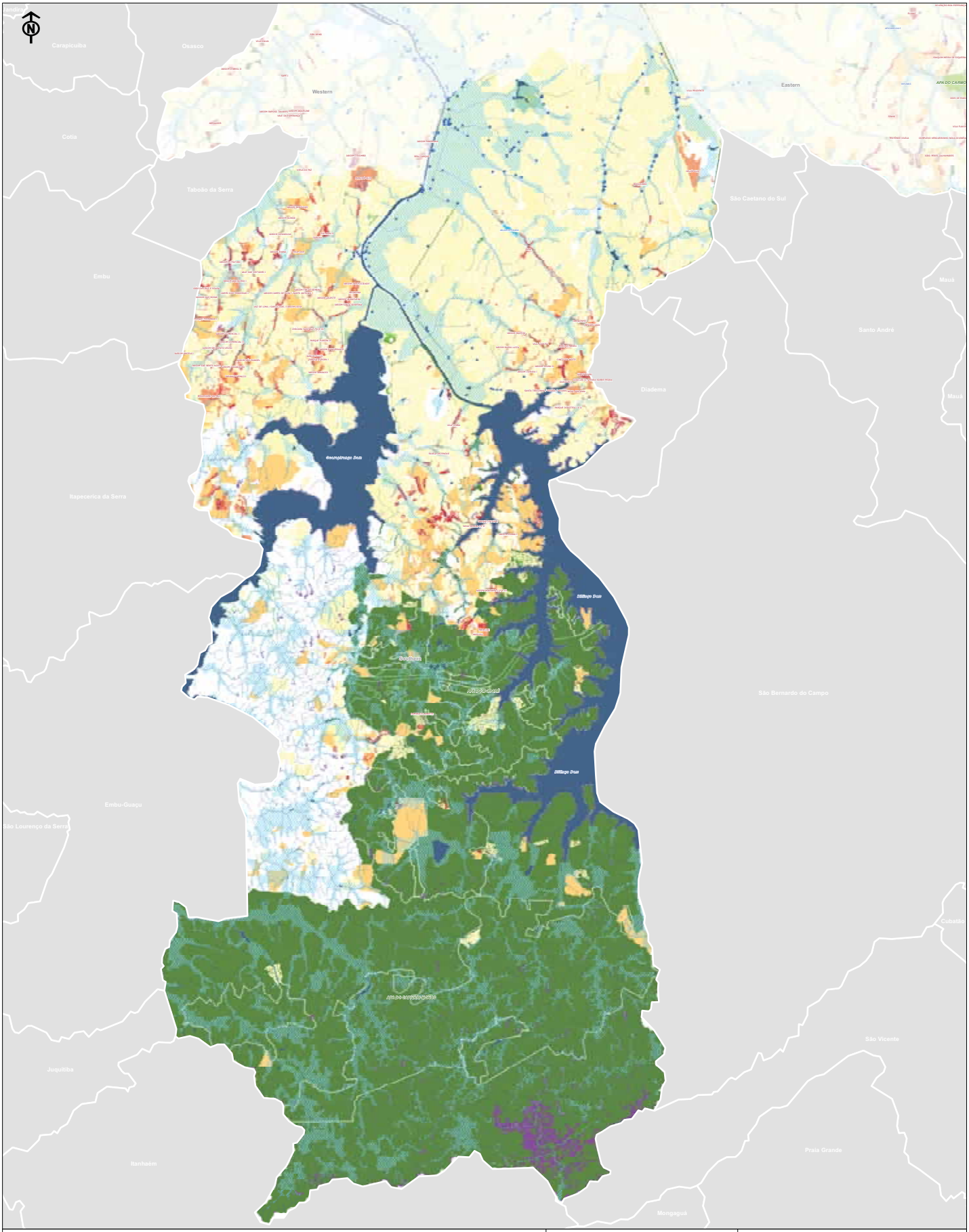
Location of the Urban Poor

Most precarious settlements are located in more peripheral areas of the City. Such areas concentrate a number of environmentally vulnerable situations and are the most poorly served with regard to basic services and urban infrastructure. The Study made for São Paulo indicated that through observing the relative locations between the risk areas and the informal settlements throughout the City it is possible to observe that there is a high degree of spatial coincidence between them.

The image presented in the previous question shows the location and exposure of the settlements to natural hazards. Image 7 indicates the location of precarious housing (slums, irregular lots and urbanized slums).

Image 7: Spatial distribution of the precarious settlements in the City (Source: HABISP – 2010)





Conventions

- Flooding occurrences - 2008 to 2010
- Risk area (Landslide and sapping) - 2010
- Landslide risk - 2003 and 2004
- Water reservoir
- Hydrography

HAND

- Landslide - HAND>15m and Declivity>30°
- Flooding risk - HAND<5.3m

- Slum
- Informal settlement
- Urban area
- Green areas

Park

- Planned
- Projected
- Under construction
- Post 2004
- Pre 2004

SOURCE:

-IBGE: Administrative limits;
-PMSP-SEHAB/HABISP: Slums, informal settlement, risk areas;
-PMSP-SVMA-*Parks*, environmental protection area;
-PMSP-SEMPLA-Hydrography, water reservoir;
-TPCL: Land use 2003;
-Emergency Management Center: Flooding occurrences
-INPE: HAND analysis.

UNIVERSAL TRANSVERSE MERCATOR PROJECTION
ZONE 23 S
DATUM WGS 84

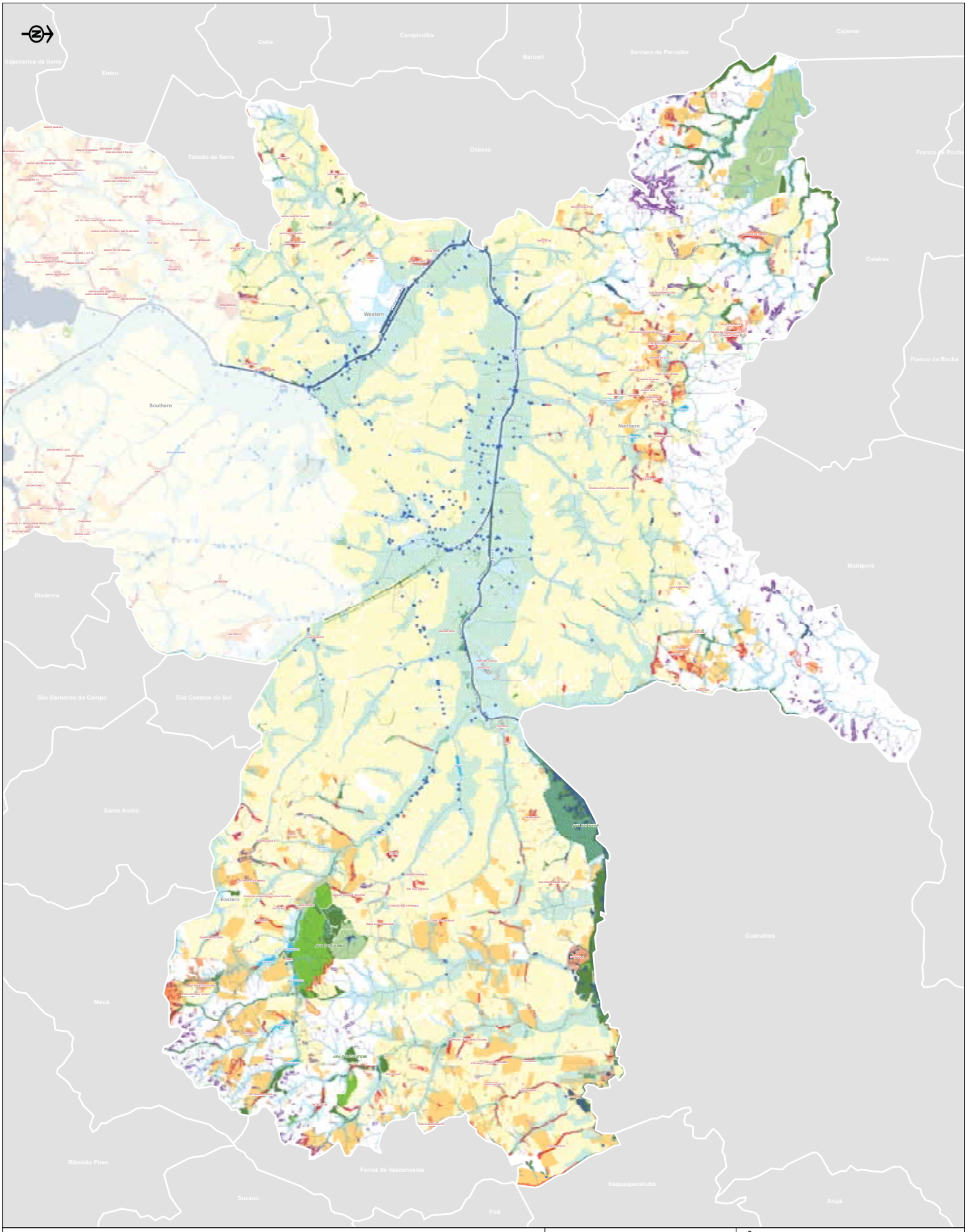
0 750 1.500 3.000 4.500 6.000 m

SÃO PAULO CASE STUDY
Climate changes,
Risk management and
Urban poverty

HAND ANALYSIS

Southern

PRODUCED BY	SCALE	DATE	REVIEW	
Tatiana Sayuri Jo	1:50.000	14/01/2011	0	01/02



CONVENTION

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UNIVERSAL TRANSVERSE MERCATOR PROJECTION
ZONE 23 S
DATUM WGS 84

0 750 1.500 3.000 4.500 6.000 m

SÃO PAULO CASE STUDY

Climate changes,
Risk management and
Urban poverty

HAND ANALYSIS

Northern, Eastern and Western

PRODUCED BY:	SCALE	DATE	REVIEW	
Tatiana Sayuri Jo	1:50.000	14/01/2011	0	01/02

Slum Characteristics

The distribution of the census in the City by groups of social vulnerability clearly discloses the socio-economic macro-segregation pattern that places the central area, and particularly the south-west quarter of the City, as the region with the lowest levels of social vulnerability, as opposed to the peripheral zone, where the highest levels of social vulnerability are recorded. These more critical situations can be found in the southern, northern and eastern periphery of the City. Not by accident, most of São Paulo's precarious settlements are set up in these peripheral areas.

According to the City, in 2010 there were approximately 890 000 precarious dwellings in the City. Over 85% of these households are located in slums and irregular settlements, spread across all regions of the City (Image 1). Table 8 displays the distribution of households per type and location in the large administrative regions of the City.

Table 8 - Houses by type of precarious settlements and administrative regions of the City Housing Secretariat

	Wellsprings1	North1	South1	Southeast1	East1	Center1	Diffuse2	Total
Slum1	54,886	65,696	117,793	64,980	67,072	10,724	0	381,151
informal settlement1	100,031	60,769	44,953	22,739	154,552	0	0	383,044
urbanized center1	11,193		1,973	1,051	2,640	262	0	24,522
Tenement (cortiços)(2) (3)						11,086	69,303	80,389
/ irregular housing complex(1)	669	7,403	4,657	2,533	3,056	1,659	0	20,702
Total	166,779	141,996	169,376	91,303	227,320	23,731	69,303	889,808

Source: Source: (1) HABISP - February 2010. (2) obtained from SEADE Foundation survey (3)the total amount of tenement houses is an estimation the SEADE Foundation

Slums record the highest proportion of children and youth up to 19 years old (41.7%), which is consistent with the presence of younger heads for households and a greater number of children. As for household income, most families earn less than three times the minimum wage[8]. Although many of them are employed in the formal labor market, low levels of education hinder access to better work opportunities. About two thirds of the heads of household have not completed primary education[9].

These areas still lack access to urban infrastructure and services supply (Table 9). There are significant deficits in public lighting, paving and urban drainage in slums, urbanized centers and allotments. Waste disposal and collection services are

[8] The minimum wage established by 2011 is around US$325.00
[9] SEADE 2008

not available to all households, often because collecting vehicles have no space to circulate. The most critical problem, however, concerns the sanitation network. The severity of this situation is mostly evident within the slums, where more than half of the households have no access to sewerage facilities, thus greatly exacerbating environmental problems and exposing inhabitants to disease and health hazards.

Table 9: Access to urban services and infrastructure in precarious settlements in São Paulo

	Urban Infrastructure			Waste Collection			Sanitation	
	Access to Public Lighting	Paving	Walkways and Culverts	Door to door Collection	Curb Container Collection	Other	No access	With access
Households in Slums	68,30%	67,10%	55,70%	64,90%	20,70%	14,40%	52,30%	47,70%
Households in Residence Centers	86,30%	91,10%	80,80%	67,90%	13,50%	18,60%	8,20%	91,80%
Households in Allotments	92,30%	81,50%	81,20%	91,50%	3,40%	5,10%	20,20%	79,80%
Total	**81,90%**	**75,70%**	**70,40%**	**79,50%**	**11,10%**	**9,50%**	**33,30%**	**66,70%**

Source: Fundação Seade; Secretaria Municipal de Habitação – SEHAB; Pesquisa Socioeconômica em Favelas e Loteamentos no Município de São Paulo, 2007.

A poverty ranking based on the World Bank's poverty threshold criteria[10] reveals the gravity of the situation for the families living in those settlements (Table 10). In the slums and urbanized centers, virtually all families live in poverty or extreme poverty. There is a slight improvement in housing settlements with regard to this indicator; yet about 80% of the families in that setting live in poverty or extreme poverty. This finding reinforces the importance of public services supply and policies for those whose ability to fulfill basic needs is extremely low, exposing them to even more critical levels of social vulnerability.

[10] As threshold for indigency and poverty, the value of R$ 280.40 updated in September 2007 was used, based on the – POF (Family Budget Study), undertaken by IBGE in 1987. Indigents are considered those with total family income per capita below R$ 140,20 and, poverty stricken, those who earn up to R$ 280,40.

Table 10: Number of precarious inhabitants per level of poverty

	Poverty		
	Indigent	Poor	
Families in Slums	31,90%	66,60%	98,50%
Families in Residence Centers	33,60%	66,40%	100,00%
Families in Settlements	26,10%	53,30%	79,40%
Total	**28,90%**	**59,40%**	**88,30%**

Source: SEADE Foundation; SEHAB/HABISP (São Paulo City Housing Information System) São Paulo Slum and Allotments Socioeconomic Research, 2007.

The situations of social vulnerability disclosed by the data are often associated with exposure to geo-technical and flooding hazards resulting from the occupation of land unsuitable for housing. Moreover, in most cases the dwellings are self-built over long periods. Thus, low technical quality of dwellings associated with occupation of areas unsuitable for housing brings about hazardous situations, often involving imminent risk. Characteristic of these areas are steep slopes and unstable land and flood zones during rainfall periods.

CLIMATE SMART PRACTICES

The Várzeas do Tietê Park , a project of the State Government, in partnership with São Paulo City, will be 75 km, the largest linear park in the world. There are about 7,000 households that will have to be removed. The resettlement will be done in the same region, with the construction of new housing units in a partnership between the City Housing Secretariat (SEHAB), Housing and Urban Development Agency (CDHU) and Metropolitan Housing Company of São Paulo (COHAB). The park will cover São Paulo City and seven Cities. Adding to the contingent of residents, there will be more than two million people benefitted. In addition to the 7,000 households removed in São Paulo City, 2,000 more will be removed in other Cities. Várzeas do Tietê Park will have total area of approximately 10,000 hectares, with significant environmental gains, because it is considered essential for preserving the river and the sanitation of the areas that affect the margins. The project should be completed in 2016. The project will restore and preserve the environmental function of wetlands, provide flood control, create options for leisure, tourism and culture. In the project, Via Parque (a track with a 23 km extension with car and bike paths and a lot of space for walking) will be built. The Tietê River, its tributaries, lakes and ponds will be restored as well as riparian and native vegetation. Special areas for leisure, courts, arenas, cafeterias and administrative spaces will also be built.

Key Lessons in Addressing Poverty in a Climate Smart Way

Some important constrains were found during the study, and a list of them is presented below:

- Lack of personnel from the Emergency Management Agency to be allocated at each vulnerable community, working as Local Emergency Management Group or NUDEC. They should be made up of volunteers trained by

the National Emergency Management Agency to help on emergencies and risky situations. This would allow preparation for emergencies and quicker and more effective response.. The same would apply to health agents.

- Extend mapping and systematization of the City's entire flooding areas—including all housing regions and use this data to prioritize initiatives;
- Improve measures to enable public transportation and the use of cleaner fuels;
- Implement an emergency transport plan for heavy rainfall (with use of buses with bi-articulated engines and special corridors for those vehicles to transit);
- Implement an efficient alert system for the entire population when there is heavy rainfall, with all government entities working rapidly through the risk situation with a direct channel of communication to the communities in the at risk areas (impacted by the event);
- Extend studies to analyze and enable change in the City's growth pattern and land use patterns to concentrate housing and job opportunities in necessary regions. Providing adequate social equipment such as hospitals, schools, leisure and sports facilities, would avoid long daily commutes and decrease the traffic and greenhouse gas emissions (such as São Francisco Global, described in "Opportunities"). Another approach is to promote the occupation of other degraded central places (such the one called Nova Luz in a degraded downtown location) which already has infrastructure, but is undervalued and contains dilapidated buildings;
- Promote an integrated policy to manage waste issues in the City. Not only should the policy take care of public cleaning, but also deal with waste reduction, inform the population about sustainable consumption and enable recycling;
- Extend measures for supervision and adequate disposal of waste as well as improve the periods between cleanings of streets and culverts.
- Extend enforcement of the Municipal Climate law obligating buildings with high concentrations or circulation of people (such as malls, large residential condos or commercial buildings) to install selective recycling facilities and recycling centers;
- Extend specific procedures related to environmental inspection, epidemiological and entomological control in selected locations, aiming at the quick discovery of biological effects caused by climate change and potential treatments;
- Extend initiatives to restore all permanent conservation areas, especially those located in floodplains, in order to avoid or minimize risks caused by extreme climate events;
- Extend the law which obligates the new corporate projects to maintain a permeable area in order to absorb water;
- Extend energy efficiency measures throughout the City.

- Find funding sources for public projects and specific NGO climate safety activities;
- Extend awareness of the Climate Law to public agents. The law must become part of the daily routine of planning and executing policies in all related government entities;
- Integrate and extend climate change policy, bringing together several organization and public players. The Climate Change Ecoeconomy Committee is the beginning of this movement, but its role needs to be reinforced;
- Promote increased citizen participation and planning on climate initiatives, incuding organized demands for new policies. In order to do that, society needs to be informed about the issue and their role in it.
- The climate policies must be incorporated into the City's management. The policies should be implemented regardless of changes in mayors in a new election or a change of Secretary in the middle of the term.

Constraints identified by the consulted communities:

- Communities lack an efficient public transport system which would improve accessibility to other parts of the City and reduce walking distances;
- The lack of quality and coverage of piped water and a sewer system, which currently could rupture during heavy rainfall and infiltrate houses and reach rivers or streams;
- Electricity theft through makeshift connections results in a high cost of energy, and becomes a risk during heavy rain;
- There is a lack of channeled streams, which could preventthe death of people who may fall during heavy rains;
- The lack of retaining walls on hillsides at risk;
- Poor quality of garbage collection and inspection of illegal dumps;
- The lack of adequate cleaning of streams and culverts.

OPPORTUNITIES

The City Housing Secretariat - SEHAB - provides the Housing Information System - HABISP: This information provides a comprehensive overview and update of planning and environmental conditions in the settlements of the City. The information allows people to define priorities for intervention, assist in the development of City policies and integrated plans with other agencies. These include: SABESP - São Paulo State Sanitation Utility, SVMA - City Green and Environment Secretariat, SME - City Education Secretariat, CDHU - Housing and Urban Development Agency, Caixa Econômica Federal (Federal Bank). The HABISP Information System is a tool that's easy to use, interactive and readily

accessible via the internet (www.habisp.inf.br). HABISP promotes increased citizen participation—it provides an opportunity for data disclosure and is an important resource for the population in general as a source of information about policies and plans under development..

Opportunities to promote adaptation strategies.

Existence of a comprehensive Legal Framework: The legal framework for the City to deal with climate change effects already exists. The Municipal Climate Law sets the foundation for the necessary measures related to energy, transport, land use, health, construction and waste management to be executed by the city, other government entities and private players.. A reduction target was established and the public disclosure of the results is expected. Nevertheless, future regulation is needed on some issues, such as payment for environmental services and inter subnational cooperation.

Mapping of landslides areas: The areas at risk for landslides are already identified and georeferenced by the municipality, allowing the prioritization of preventive action. The same must be done with all flooding spots beyond the current locations already mapped. This data must be produced and shared among Secretaries, in order to be included in their policy planning. If strong preventive projects are implemented, the risks will be lower and less will need to be spent on emergency action.

Existence of the beginning of a unified approach to climate issues and policies: The EcoEconomy and Climate Committee were created in an attempt to unite the city entities around the subject, and also bring together state and national players, citizen organizations and government agencies. The 2009 Decree 50.866/2009 inaugurated the Committee's works. The forum aims to propose, stimulate and follow the adoption of plans, programs and actions that help satisfy the city policy. It also intends to support actions to mitigate greenhouse gas emissions, promote adaptation strategies, create seminars and campaigns and suggests the adoption of social and environmental criteria in the city's product and service buying. Members of the Committee can help in the identification of technology trends linked to climate change and offer feedback on eventual amendments to the municipal climate law. The structure exists and meetings take place regularly; what is needed is to strengthen the Community capacity to propose and implement projects.

São Francisco Global Urban Plan, by SEHAB: creates guidelines to integrate the 50,000 inhabitants of the third largest slum on the east side of São Paulo into the formal city, by extending social housing, the construction of a hospital, school, community center and services center which will also serve as a commercial

center and income generator. it also includes the extension of the transport system and improvement of roadways. With paved streets and nearby trees, the ease of access to public transportation, town inhabitants will use a car less in everyday tasks. The objective is that the town will stop being a "bedroom-city" and will provide the products and

services essential for everyday day living in central city locations. New housing planning will maximize th conservation of the remaining green areas and water springs in the new town. Together with SVMA a park will be created, at an old dump, measuring 367,000 thousand square meters.

Ecofrota Program: At the beginning of 2011 the city initiated a program which provides for the use of 20% biodiesel in public transport throughout the city. The initiative aims to reduce the emissions of particulate matter by 22%, carbon monoxide by 13%, and hydrocarbons by 10%, and reaches the annual goal of reducing fossil fuels by 15%, as provided in the Climate Law. This states that the entire public transportation system in the city should operate on renewable fuels by 2018. The project will identify any public transport which is fueled with cleaner fuels including biodiesel, ethanol, hybrid or electric.

City Hall renewing transport fleet: SP Trans has been renewing its bus fleet which services the city, substituting the old vehicles with more advanced modern models.. Of the 15,000 buses in the city, 9,684 (65%) have already been replaced, lowering the average age of the vehicles in use to four and half years.. In addition, just by adding larger buses between 2006-2010, the fleet capacity increased 21% and the number of transported passengers grew by 11%.

Solar Systems to heat the water: The City Assembly approved the Law 14459/07 requiring that from that date forward all new residential or commercial buildings should be prepared to ultilize a solar-based system to heat the water used by its inhabitants. The new houses and buildings assembled with more than four bathrooms must adopt a solar panel heating system. Some commercial buildings, such as private clubs, gyms, hotels and motels, schools, hospitals, clinics and industrial Laundromats also need to install the solar panels. The system should meet at least 40% of the annual energy needs of the toilet water and water for pools that the building may require.

Sustainable Building Project: Developed by PMSP/SEHAB, this has been initiated in a part of Heliópolis, a large slum in the southeast of the City with almost 130,000 residents. . In the last number of years this area has been undergoing a process of urbanization and improvement: houses are now mainly made of bricks instead of scarce wood.

Carbon Credits: These are being used to develop social and environmental projects in areas near the plants, such as linear parks, public squares, eco points installation and the building of a center that holds wild animals and houses birds. For example, the Bamburral Slum (570 families living next to the Bandeirante waste site), is the first slum to be urbanized with funds from carbon credits. The community urbanization provides infrastructure, stream channeling and construction of four clusters of houses that will receive 260 families that live in at risk areas. The construction of a deck over the creek is also planned in order to facilitate the movement of residents, as well as a linear park with areas for sports and leisure.

Linear Parks: The Várzeas do Tietê Park, at 75 kilometers, will be the largest linear park in the world. There are about 7,000 households that will have to be removed. The resettlement will be done in the same region, with the construction of new housing units in a partnership between City Housing Secretariat (SEHAB), Housing and Urban Development Agency (CDHU) and Metropolitan Housing Company of São Paulo (COHAB). Várzeas do Tietê Park will have significant environmental gains, because it is considered essential for preserving the river and the sanitation of the areas that affect the margins, restoring and conserving the environmental function of wetlands, and providing flood control. Riparian and native vegetation will also be restored.

Operation Clean Stream: is a joint initiative with the state government of São Paulo to recover and treat streams throughout the City. The first phase was initiated in 2007 and ended in 2009. More than 800,000 people benefited from the cleaning of 42 streams and piping of 500 liters/per second of sewage. The program deals with the remediation of the water and improvement of the sanitation in informal homes, benefitting 1,637 inhabitants. The program will continue with the cleanup of 40 more streams up to 2012. During operations, the City is responsible for maintaining stream margins and layers, and removing houses which may prevent the passage of the sanitation piping system.

Headwaters Program by SEHAB: aims at servicing all vulnerable settlements located in protection areas such as G*uarapiranga* and *Billings* dams in order to restore drinkable water quality. It is a program that partners among the three parts of the government and focuses on the use of the sub-basin as an integrated planning unit of government initiatives. The City's Master Plan allows the construction of new vertical housing projects for 4,000 people at the margins of drinking water reservoirs of Guarapiranga and Billings (the first supplies water to 1,2 million and the second, to 3,8 million inhabitants). Billings currently has 12 square kilometers of its water mirror occupied by informal settlements and receives 400 tons of waste every day. Guarapiranga has 1,3 million illegal residents in its margins.

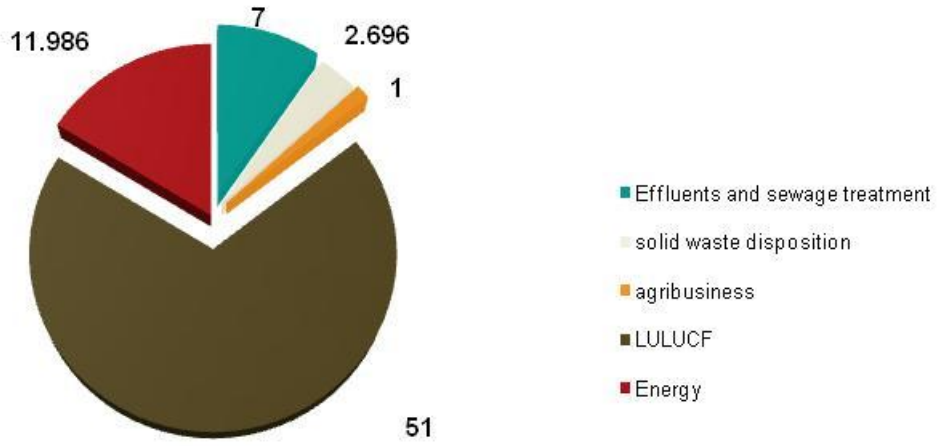
Social Partnership Program (City Housing, Social Welfare and Social Development of Public Policies in São Paulo), has the objective of providing access for low-income people to the formal rental allowance market. They are subsidized by the fixed monthly amount of $300.00 with no adjustments for a period of 30 months. Eligibility into the program requires income of 01 to 03 minimum wages, enabling access by vulnerable groups, including: the homeless in special social protection networks; families from areas expropriated by São Paulo City, displaced due to floods or fires, and residents in *at risk* areas. The social work is based on a development program, that carries out systematic monitoring of eligible families, providing social and economic development initiatives, that seek to restore social rights, especially with regard to decent housing.

URBAN CARBON FOOTPRINT

According to a 2005 study[11][11], the City's main source of emission comes from energy use, especially from transport (11,986 tons of carbon dioxide equivalent CO_2e).

Solid waste disposal is the second most important source (2,696 tons of CO_2e). Liquid effluents (seven tons of CO_2e), LLUCF – Land Use, Land Use Change and Forestry (51 tons of CO_2e) and agricultural activities (one ton of CO_2e) are not relevant sources in terms of city emissions.

Graphic 6: São Paulo GHS Study



Source: São Paulo GHG Study

In terms of energy, the use of fossil fuels in transport is the most critical issue for the City, since the fleet is made up of more than seven million vehicles (growing each year) and the traffic is heavy (the average peak in traffic varies between 80 and 111 kilometers in 2010 and the medium speed rate was of 1 6 km per hour—in 2008)[12].

Although most recent models of cars are "flex" – using both ethanol and gasoline – the majority of the private and public fleet runs on fossil fuel – especially gasoline and diesel (52% of the fossil fuel emissions come from gasoline, 45% from diesel and 3% from natural gas). A target of 30% reduction in the City´s greenhouse gas emissions was prescribed by law—in relation to emissions from 2005. Additional targets should be defined every two years.

Initiatives such as the use of more energy efficient street and traffic lighting and the establishment of infrastructure and incentives to promote the use of low-carbon vehicles are being offered, but specialists agree that the City needs to face the problem of planning land use in order to promote shorter commutes between home and work.

[11] São Paulo´s GHG´s inventory, available at: http://ww2.prefeitura.sp.gov.br/arquivos/secretarias/meio_ambiente/Sintesedoinventario.pdf

[12] São Paulo´s GHG´s inventory, available at: http://ww2.prefeitura.sp.gov.br/arquivos/secretarias/meio_ambiente/Sintesedoinventario.pdf

NOTES

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