FLOODINGS AND SOCIAL VULNERABILITY: THEIR SPACIAL EQUIVALENCE IN THE CITY OF CURITIBA, BRAZIL

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ABSTRACT
This is a theoretical discussion on social vulnerability and on the construction of vulnerability indexes. Empirical exercise takes place in the city of Curitiba, Southern Brazil. Article is based on both conceptual approaches revealing complexity of such topic as well as on empirical demands to establish priorities in terms of risk reduction action facing natural adverse events and distribution of resources in post-disaster recovery. Urban context is that of Brazilian cities, revealing spatial inequalities in the way inhabitants build, use, and transform urban compartments. Research presented here can be contextualized in a scenario where adverse phenomena increasingly influence the elaboration of urban public policies; its main target is to contribute to the identification of parameters to channel public resources in preparedness actions facing adverse situations.

KEY WORDS
Social Vulnerability; Natural Hazards; Vulnerability Index; City of Curitiba.

1. FOREWORD

Natural hazards represent an increasing threat to populations in all parts of the world. Historical statistics show that, since the 1950s, the number of these hazards has increased significantly (EMDAT, 2011; SWISS RE, 2011). Natural hazards may occur regardless of social stratification, and their impacts affect differently among these very same specificities, enabling to increase or diminish damages and their temporalities. Empirical and scientific observations confirm that lower income levels of the population often are repeatedly affected by the recurrent hazards, which leads to the necessary addition of social and economic parameters on the vulnerability concept. It means that similar exposures to natural hazards may generate different consequences according to social parameters. Again, we juxtapose Hewitt´s (1997) more restricted view of social vulnerability to that of sustainability restricted view of Blaikie et al (1994). By adding the complex social layers to an already wide concept such as Beck's (1992, 2006) risk society, vulnerability acts as a result of contemporary social development and discrepancies in the distribution of the outputs of this very same development. This article is based on such conceptual bias, stressing a close relation between impacts caused by natural accidents and social characteristics of those who are submitted to

them. Because of the fact that social vulnerability may be understood as a “dormant phenomenon in suspended animation till a calamity occurs,” it is more easily related to risk management situations and hardly taken as a pre-existing condition that shapes suffering and recovery ability. Case study presented here is carried out by the authors in the city of Curitiba, located in the southern region of Brazil, with 2 million people and known because of its urban management experiences and a better quality of urban life if compared with country´s average but still with deep social discrepancies. Methodology adopted in this case study overlays the most affected areas by natural hazards to the spatialization of social-economic indicators of the entire population. This methodology is pragmatically and necessarily simple to be developed based on the data available and to pedagogically and clearly distinguish a city´s district regarding their vulnerability index. It also stresses the importance of spatializing public policies, an approach rarely seen even in cities marked by social and environmental compartmental discrepancies. Longer periods of analysis would certainly provide more solid results; however, the intended time frame of 10 years had to be shortened because of data unavailability and different methodologies used to collect them. Thus, the time frame considered was limited to 2003-2008. Otherwise, this period provides rich information on the topic discussed here because it may be particularized by the occurrence of intense adverse natural phenomena in the city. Geographical scope of the research refers to the entire territory of the city (430, 9 sq. km) according to its 75 districts that represent not only administrative units but also specific territories with social and economic specificities.

2. THE CONTEXT OF ADVERSITIES

In the last 100 years, an increase in the number of natural hazard events has been noticed throughout the world. According to The International Emergency Disasters Database, the number of natural hazards in the last decades increased faster if compared with the first decades of the 1900s (EM-DAT, 2009). Other studies, developed according to different methodologies, also have stressed similar concerns. Data showing and highlighting the increase of disasters is, in fact, recurrent in the scientific production that discusses contemporary social and urban problems. The United Nations Development Programme (UNDP) states that, in the last 25 years, not only the number of reported natural disasters but also their impacts on human and economic development worldwide have increased, reducing gains obtained during a period of relatively economic success. “It is troubling that disaster risk and impacts have been increasing during a period of global economic growth” (UNDP, 2004, p.11). Similarly, Munich Re Group (2003) data show that the economic losses related to disasters also have increased since the 1950s.

Rampant impacts of natural disasters on human and economic indicators call for a combined and complex action in terms of prevention, risk reduction, emergency procedures, and reconstruction practices. They also call for a solid proposal of financial and economic sustainability for the communities involved. Globalization and regional intricacy have certainly multiplied solidarity action but, reversely, also have caused impact on communities and countries that were not primarily submitted to the natural phenomenon.

According to Nunes and Kobiyama (2006), the increase of reported disasters is caused by a number of factors, such as the population growth, social and territorial segregation, accumulated resources in danger areas, progress in communication media, and global changes. This phenomenon also can be related to the global warming process and climatic changes (IPCC, 2007). If causes are to be detected in a myriad of typologies, current scientific production seems to focus its main concern on the social factor, which is considered decisive to understand natural hazard impacts.

Yet considering the complexity involving the increasing number of accidents and the increasing impacts they impose, this paper concerns the ability of local power or cities to adopt reduction risk procedures. Indeed, some authors quote the cities' occupation dynamics and urban growth as important facts to understand the social systems and the social and environmental vulnerability related to natural hazards (Santos, 1996; Rolnik, 1997; Giddens, 2000; Hogan et al 2000; Kasperson & Dow, 2001; Mattedi & Butzke, 2001; Carvalho, 2006; Maricato, 2006; and Marandola Jr. & Hogan, 2006).

In poor countries, the intense and fast occupation of the urban territory, especially in the 1970s – 1990s, was caused by many facts such as a) mechanization of rural production procedures resulting in migration of countryside populations to cities and b) generalized crisis in the production and consumption systems with impressive layoffs and no generation of new compensatory job posts.

In fact, the expansion of Brazilian cities is basically characterized by both an impressive official division of rural areas into urban lots, reserved to those who can afford this product, an even more impressive production of irregular or illegal division of land properties or a complex process of squatting environmentally fragile urban compartments. All this forms what Milton Santos (1993) calls spread urbanization: an intricate way of building and transforming cities with fragmentation, peripherization, and dispersion.

The large number of unqualified workers available in urban centers made salaries even cheaper, working conditions precarious, and informal jobs recurrent. Generalized impoverishment pushed low-income families to distant and never ending suburbs. Despite low urban quality of these areas—in most cases, with no basic infrastructure, new comers were not able to afford the cost of the formality desired by the urban technique and imposed by municipal and federal legislations. Resulting settlements mostly characterize the entire city with an inappropriate way of occupying the territory such as riverside strips, with the reduction of essential riparian woods, environmentally protected or fragile areas, and highly descending slope areas with no proper soil engineering correction, among others. At the same time, territory in impoverished cities is improperly occupied; an almost generalized lack of basic services and infrastructures also aggravates urban dwellers´ vulnerability: if occupation occurs in improper ways, municipalities hardly consider the possibility to correct resulting risk situations. In fact, lack of basic services and infrastructure imposes an additional burden to a population already overexposed to natural and social contingencies: nonpaved road system or the lack of rain water drainage network causes or aggravates floods, lack of garbage collection services obliterates existing water and sewage pipes and natural hydrological

flows, and poor sanitary habits in high urban densities lead to alarming public health problems.

Despite recent positive changes in the Brazilian and other countries in Latin America, cities of this continent are still featured by a fast and impoverished urbanization process: "while 136 million poor people lived in LA/C countries in 1980, this number rose to 204 million in 1997. One third of all people in LA/C live in poverty, and 15 percent (90 million people) live in extreme poverty" (Duncan, 2005, p 5). The same author stresses the fact that, according to the International Labour Organization, the unemployment rate in this continent in 1999 was at 9.5 percent, higher than it was even during the worst period of the 1980´s generalized debt crisis.

Two concurrent and connected impacts in the consolidation of the contemporary Brazilian cities can still be identified: those resulting from economic crises and those resulting from a fast urbanization that certainly shaped urban settlements with hard-to-solve problems. Current urban policies in the country recognize social and financial limitations to transform entire cities and have channeled efforts to more pragmatic solutions comprehending acupunctural interventions, legalization of squatted areas, and maintenance of original people in their occupied lots (Ultramari, 2006). If this approach may be considered appropriate mostly because of the grant of legal property rights, it does not fully eliminate the submission of large groups of Brazilian urban population to the immediate impacts of natural accidents.

This occupation dynamics is largely known in large poor compartments of impoverished Brazilian cities. However, if that generalization is still valid, new economic scenarios in regional emerging markets announce new phenomena still left to be understood. Brazil, in the last five years, has embarked in a non-precedent economic recovery with immediate transformation in the way its cities are occupied. Legal land market has, in fact, boomed in Brazilian cities, following the decision of federal and local governments to launch massive low-income housing programs: lower income levels of Brazilian population, who were marginalized, are now part of the consumption market. It certainly increases pressure on the limited stock of land made available by planning guidelines. At the same time, this lack of proper urban land for occupation is now a real problem if we consider the fact that in the case of governmental programs considering the necessary removal of families from risky areas, new houses must be located not far from original areas, services, and job posts: a demand not easily to be accomplished. For the first time in recent Brazilian urban history, limitations for implementing social housing programs concern not only financial restrictions and speculative behaviors but also physical unavailability of proper land. This new situation indicates a problem that has unexpectedly forced national urban planning and management to be more "flexible" in their parameters of proper and safe land. Irony now takes place in the construction and transformation of our cities: if, in the past, they experienced risks being concretized by illegal or informal occupation, at present, this phenomenon may take place because of official determination and technical orientation.

3. NATURAL HAZARDS AND VULNERABILITY

Situation previously described confirms the idea of a wider concept of vulnerability resulting from natural accidents. Certainly, social, community, political, cultural, and economic aspects play decisive roles in its definition side by side to natural phenomena. This is, in fact, a conceptual approach already largely adopted by the scientific milieu and that has been clearly defined by the distinction between the Theory of Disasters and the Theory of Hazards. These theories attest two traditional analytical formats. The first one is mostly aware of geographic aspects, such as dimension, causes, and typologies of natural phenomena. The second one conducts its investigations mostly referring to more socially elaborated analysis to understand adverse natural phenomena. From a limited mono-disciplinary approach, the concept of vulnerability has been driven to a wider understanding, with several sciences playing a distinctive and collaborative role (Thouret & D'Ercole, 1996).

The research presented in this article is related to the Hazards Theory, considering it as its main reference and understanding urban occupation dynamics (presented above) as a fundamental factor to consider lower income levels of the population as the most vulnerable to natural disasters' effects. These populations, usually living in environmentally risk areas and relying on their low incomes, present a limited "response capacity," forcing them to depend on external agents to cope with adversities. Deschamps´ empirical research reinforces the idea that "there's a strict relation between the placement of the lower levels of the population and the areas that have adverse risk factors. The socially vulnerable populations are placed in socially vulnerable areas" (2004, p.104). This is an example of a series of studies that this present research takes part in, all insisting on the assumption that disasters are no longer acts to be understood through the lens of the natural sciences alone or even nature's will.

At this point, we should go back to the dialectics announced by Hewitt´s (1997) and Blaikie et al (1994) and the construction of the concept of social vulnerability. The origins of the concept of vulnerability may, in fact, blur the idea we have of it today. Introduced as a scientific field of research connected to the hazards and disasters phenomena, it still shifts from a more natural to a more social approach. Back in the 1970s, O´Keefe, Westgate et al. (1976) radically proposed to *take the naturalness out of natural disasters, advocating that* socioeconomic factors were the causes for natural disasters; a conclusion taken from an empirical study proving that the larger amount of human losses because of natural accidents is confirmed in the poor countries. Chambers (1989), despite agreeing with the fact that people present specific abilities to cope with exposure to natural adverse phenomena, argues that vulnerability results from both natural and social risk, opening the opportunity to accept that social vulnerability has, in fact, multiple origins in terms of scientific fields, either in social or natural sciences, and so is expected to be presented according to different approaches.

Social factors have a partial implication in the construction of the social vulnerability concept and also depend on an institutional - civil and governmental - framework and its ability to respond to emergency situations. The case study presented here describes a

city with different urban compartments according to their social indicators, with specificities in terms of community ability to react when facing adverse phenomena but with a homogeneous paid attention in terms of governmental public policy in preventive actions. If this combination of factors confirms the complexity of the social vulnerability concept, it allows a more simplified analysis of concentration of low social indicators and the number of natural accidents per district. Case study confirms too that social indicators certainly have a close relation with the compulsory choice lower income classes (have to) take for their settlements. The city of Curitiba, and other capitals in the country, suffered from huge rural-urban migration in the 1970s and 1980s; to the newcomers, improper parcels of urban land were left, both those cheaply and legally traded and those simply squatted. This situation is recognized recurrently among authors who discuss vulnerability in the context of Brazilian cities. Rolnik (2011) perhaps synthesizes these ideas by recalling that

There are ways of intervening in order to improve terrain stability, drain water, slope reinforcements, that are ways of intervening in order to improve safety and management of a certain urban so that even at risk situation deaths are avoided. But the main question is that nobody chooses to live in a risk area because he is dump. People live in a risk area because there is no other option to their income. We are talking about workers whose salary does not allow to buy neither to rent a place to live in a proper area. … There is no point in palliative measures here and there if we do not take decisive action: what are the proper areas, or what are the areas that will be designated to the poorest people? (Translated from the Portuguese).

At this point, we can refer to the pressure and release model as announced by Blaikie et al (1994) as a reformulation of that previously proposed by Turner et al (2003). The model proposed by Turner et al (risk hazard model) understands impact of hazards as a result of the exposure to a hazardous phenomenon and of the sensitivity of a community exposed; however, authors do not make clear what or how impacts of the hazard are amplified or attenuated. The model by Blaikie et al stresses the progression of vulnerability according to the relation between the four main component - three socially constructed and one naturally built: root causes, dynamic pressures, unsafe conditions, and the natural hazard itself. In the case of the city of Curitiba, these four components can be understood as follows. Root causes can be translated into the economic and demographic features of the boroughs in the city, each of them presenting specificities in their average income, unemployment rate, and demographic performance implied in the number of people per family and house density. Dynamic pressures may indicate the migration process observed in the city confirming at least three main inhabitant groups: those who arrived in the turn of the 19^{th} - 20^{th} centuries; those who arrived in the rural urban migration flux of the 1970s and 1980s and still able to afford safe but distant areas of the city or of its metropolitan region; and finally, those who still arrive, with low income, and occupying off-adequate limits of an already large agglomeration. As a rule, these two social components—root causes and dynamic pressures—present a close

relation with the distance we take from central areas: the further we go, the worst social conditions are. This is, in fact, a pattern to be taken as a rule for Brazilian cities, where central areas differ in terms of historical occupation, provision of infrastructure, urbanistic quality, and income from that occupied in the most recent decades, more precisely after the 1970s, when urbanization process boomed. Third, Blaikie et al´s component—unsafe situations—is to be observed mostly in summer time during the rainy season and the resulting floods: illegal settlements along rivers or in areas already considered improper by planning guidelines but still an affordable choice for lower income classes are among the most submitted areas to such adversity. Finally, in terms of the natural hazard itself—the four component, it is important to recall that impermeabilization of urban land in the city resulting from a demographic rate of 1.3% per year and a never seem civil construction sector boom have imposed the elimination of so far large areas of natural permeability.

It seems that models to establish components of a comprehensive concept of vulnerability and indicators to geographically measure impacts of adverse phenomena are under constant criticism and, paradoxically, an object of recurrent practice, both at public policy agencies and scientific production levels. Undoubtedly, despite conceptual limitations of these methodological tools, they remain, or should remain, a reference for public managements concerning the most sensitive groups in emergency situations. In the case study presented here, pragmatism imposed submission to data available: number of occurrences (floods) per district per year and social indicators gathered to summarize a hierarchy of income levels' emergency response ability per district. By adopting such approach, we avoid common criticism to the construction of the concept of vulnerability by adding probably more adequate indicators but with difficulty in their measurements. Besides, the approach adopted here considers the fact that statistics concerning geographical and social concentration of floods in the city of Curitiba are taken as a result of 1. Social structures and processes (either by the lack of necessary infrastructure or by the occupation of environmentally fragile areas), 2. Different responses to recovery according to different socioeconomic profiles (poorest people rely more on immediate public action than those who can afford individualized solutions), and 3. Physical features of the municipal terrain (some areas are more subject to floods than others). As a matter of fact, the case of the city of Curitiba, which could be taken as a parameter for other Brazilian cities, overlaps these three levels of comprehension: unsafe lands are primarily occupied by lower income people, both for historical reasons but mostly because of impositions of segregating practices concerning real estate values. The effort to establish a relation between these levels of comprehension is aligned to what Villágran de León (2006) considers one of the main current topics in the formulation of social vulnerability: use of models to explain it and the creation of indicators to express it over time and across spaces.

Another conceptual reference adopted in the case study presented below concerns the limited number of indicators used to determine the most and the least affected districts by adverse natural phenomena and the most and the least prepared districts to respond positively to their impacts. It contradicts other analyses such as that developed by

Yeletaysi, Sarp et al (2009), among many other authors, who works with a broader set of indicators to identify poverty. In our case, there is an assumption, based on empirical experience, where it is possible to work with combined indicators such as that used by the municipality of Curitiba to express a social condition or, what interests the most here, a hierarchy among districts of social fragility facing disasters. By proceeding this way, we avoid criticism as that recalled by Villégran de Léon (2006) who attests an intrinsic difficulty in quantifying vulnerability.

What is important for the construction of a socially sensitive public policy is the recognition that certain areas of a city are more likely to suffer from the very same adverse event than others. This results not only from different physical features but also from differences concerning its population groups. By doing so, this discussion enlarges the comprehension of Beck´s (1992) idea of risk society or even his own concept of risk: society is not only part of the "world's uncontrollability" but also capable of disaster preparedness, mitigation, reconstruction and, most important, understanding who deserves priority in actions depending on limited financial resources.

The case of the city of Curitiba reinforces these ideas and confirms the hypothesis that the higher impacts of disasters and the lowest social and economic features are expectedly and almost precisely overlaid. This article focuses on the determination of compartments that are socially and spatially vulnerable. The first compartment stresses the identification of human settlements with lower social and economic indicators. The second one focuses on where natural disasters are more likely to take place, according to physical and natural aspects. The combination of social and physical aspects reveals a conceptual concern that disasters are hard to be named either natural or human but certainly carries a combination of both (Baker, 1976; Tobin and Montz, 1997).

The understanding that natural hazards cannot be described as consequences of independent natural or human factors but, most likely, as a result of their complex and constant interaction is on the basis of what is described below.

4. ANALYSIS AND RESULTS

The method used in the case study is primarily based on the analysis of official data produced by public agencies. According to Brazilian legislation and local institutional practices, incidence of accidents must be reported, properly classified, and publicized. Despite this organizational process of collecting and making information available, as well as an increase in the number of accidents and in the number of impacted areas and people, they are not yet easily spatially understood. It means that civil defense agencies or urban management processes still resent planning tools to establish priorities in terms of city compartments and their vulnerability specificities. This absence of spatial comprehension is implied not only in a blurred and generalized view of possible adverse phenomena and their real impacts but also in difficulties to later determine the kind of action needed to each one of the urban compartments of the city. In fact, most of the Brazilian municipalities still lack spatialization of accidents data in their territories; the city of Curitiba made progress in presenting these data according to its districts; however, microspatialization is still in demand.

In terms of the variables used in the research, two are more representative: a) natural disasters (number of registered disasters between 2004 and 2008), collected by the City´s Civil Defence Agency, classified by year and type of occurrence and gathered by the city´s districts; and b) population's quality of life index (PQLI) given in percentage and synthesizing a series of education, health, housing, safety, and transport indicators. This variable was collected at the Institute of Research and Urban Planning of Curitiba (IPPUC) and refers to the year 2003.

In both cases, data used were the most updated at the moment of the research. Complementary and updated analysis made for selected compartments of the city confirm positive changes in terms of the quality of life index. However, it also confirms the persistence of spatial patterns differentiating districts and confirming a discrepancy between those with high PQLI from those with generalized critical socioeconomic indicators.

Data concerning accidents are normally classified in natural, anthropic, and combined. Despite the fact that such distinction is very subtle in urban areas and more and more difficult to be established, official data are still organized according to these three typologies. In the case of the present research, the combination of anthropic factors such as the location of urban settlements, techniques of civil construction, density categories, provision of infrastructures, and impermeabilization patterns intensely shape and graduate impacts imposed by the most recurrent natural adverse phenomenon observed in the city: intermittent floods in selected areas during the three months' summer time. Discussion presented here is limited to this kind of accident (floods) and confirms the inaccuracy in classifying accidents according to independent causes.

To make a joint analysis of the variables (recurrence of natural accidents and PQLI), they were both classified in four categories and were given numerical values. In both cases, the category with the lowest value (1) represents the worst situation; the category with the highest value (4) represents the best situation.

Table 1: Classification and Numerical Value of the Variables

Numerical Value given to the Registered number of Disasters and to the PQLI	PQLI Classification	No. of accidents Classification
1	Very Bad	Highly above average
2	Bad	Above average
3	Good	Below average
4	Very Good	Highly below average

Additionally, the analysis of the areas were floods are more recurrently observed reveals that relation between these phenomena and the density of water bodies is not equivalent; in fact, their spatial differences stress the idea that natural events may constitute a risk but not necessarily an accident: a paradoxical discrepancy that confirms conceptual differences between risks, accidents, and vulnerability.

Considering the fact that Curitiba's territory is fully occupied, although with different densities, spatial differences between indicators used in the present research reinforce the well-known idea that not all adverse natural events necessarily turn into accidents: the two North-South corridors (along the two main rivers crossing the city of Curitiba), for example, that concentrate the largest areas under historical risk of floods, do not correspond to the main areas of accidents: districts in the north, around downtown area, and those in the very south.

By analyzing the information of the two variables simultaneously according to the same scale of 1 to 4, it was possible to create another scale, now with a combined meaning but again from 1 to 4. As a result, the highest number (8) represents the best situation in both (lowest number of accidents and the best socioeconomic situation), and the lowest number (2) represents the worst situation in both variables (similarly, the highest number of accidents and the lowest PQLI). This combination made possible the creation of the so-called Vulnerability Index to be used in analytical spacialization.

After this classification, it was possible to visualize a spacialization that gathers both variables simultaneously (registered number of disasters and quality of life index) and then to establish the vulnerability index per boroughs. Such spacialization confirms that a) neighboring boroughs perform similar results, and b) distinction between central and peripheral boroughs is clearly observed.

Districts presenting a score of 8 are concentrated in the central regions (downtown areas); districts with a score of 7 are not as spatially concentrated as those with score 8 but are generally located in the surroundings of downtown area. These factors can be explained by the history of this part of the city territory, which has been occupied mainly by higher socioeconomic level populations. Safer areas were first occupied, leaving those considered under risk to migrants arriving in the 1970´s demographic boom or simply to those who could not afford overpriced urban land. It is important to stress that areas in the core territory of the city were not "made" safe by infrastructure interventions; quite the contrary, they present almost no limitations in terms of unstable terrains, slopes, or high concentration of river channels. Mostly recent occupied areas either depend on such infrastructure implemented by local government or are simply left to be occupied under risk.

Districts with scores of 3, 4, 5, and 6 or classified as "Vulnerable" and "Most Vulnerable" do not have an occupation pattern in the municipal territory.

Despite the already mentioned facts, by drawing an east-west line along the center of the municipal territory, it would be possible to observe a concentration of the higher scored districts ("least vulnerable" ones) in the upper part of the map, whereas the lower numbered ones ("vulnerable" and "most vulnerable") are concentrated in the southern areas of the city. Again, this fact may be related to the history of the territory's occupation: selection of safer and infrastructured areas by those who first settled (a long and slow process of urbanization till late 1960s) among an occupation that would sprawl to distant, improper, and metropolitan terrains (an appalling process starting in the early 1970s).

Final analysis reveals that 29 districts or 40% of the total (least vulnerable ones or adding the ones with results 7 and 8) have the best situation in both variables. Eleven districts, or 15% of the total (most vulnerable ones or adding the ones with results 3 and 4), have the worst situation in both variables.

All this facts allow the conclusion that in a great number of cases, the districts classified as having higher PQLI levels (good and very good) are related to lower registered numbers of disasters (below average and highly below average). On the other hand, the districts classified as having lower PQLI levels (very bad and bad) are related to higher registered number of disasters (highly above average and above average).

Considering these observations, it is possible to understand that the populations performing lower PQLI are more vulnerable to natural hazards than those performing higher PQLI. This information allows the return to the working hypothesis announced earlier in this article. This being confirmed was so reiterated in the final results of the research that authors now believe it would be only named assumption And, at the same time, scientific approach recurrently observed in terms of validating the priority given to social concerns in the discussion of adverse phenomena.

5. FINAL REMARKS

A conceptual review on social vulnerability and efforts to measure it are discussed in this paper; the case study presented here submits itself to explicit methodological limitations for apprehending social realities in abstract representations such as numerical indicators and maps. Despite the confirmed possibility to rely on the vulnerability index as a parameter for the development of public policies in the city of Curitiba, it leaves room for controversies concerning variables to be considered and the way they are overlaid and finally analyzed. Despite its significance for a specific urban planning, it reinforces unavoidable generalizations of specific situations (in this case, made at the district level), recalls the multitude of variables influencing final results, demonstrates recurrent ideological approaches in the selection of parameters to be taken into consideration, and confirms a submission of the researcher or policy maker to data availability. If this complex situation leads to reconsider the search of precise hierarchical definitions of spatial compartments in terms of risks, the extreme situations, those that interest us most (both very good and most critical) are believed to be detected in a more accurate way. Such contribution, made possible by the definition of a vulnerability index, also may serve as an instrument of public policies concerning different needed governmental or community actions facing risk reduction plans or emergency procedures. Despite generalizations because of the geographic scale adopted (boroughs), it may constitute a primary planning tool. Otherwise, much room is left to the investigation of particularities at a more intra-urban scale, considering existing differences inside the same district.

Results presented in this research were not expected to point out other important facts related to the concept of vulnerability, such as different capacities of the population´s territories to reduce risks and to respond to disasters according to their institutional and local organizations. Therefore, there is an assumption that it is implicit in socioeconomic

profiles described in the synthesis brought by the population´s quality of life indicator (PQLI). Constraints and distinguished abilities to establish either formal or informal civil organizations to present demands are to be differently detected in territories classified either as the most or as the least vulnerable ones. Social scenario worked in this research certainly indicates the existence of an overlay of unequal access to urban services and infrastructure (education, health, housing, safety, and transport), unequal conditions to respond to emergency situations, and unequal conditions to postulate for structural changes. If this triple overlay is somewhat a synthesis of different vulnerabilities, it still recognizes the existence of a city far from the dual visualization proposed by Castells (1989) or Mollenkopf & Castells (1991) but closer to a more encompassing one, such as that formulated by Marcuse´s quarters (1993). From a dual city of rich and poor, overlays worked in this research indicate an urban occupation characterized much more by a profusion of situations, agents, and abilities to cope with adverse natural phenomena.

If the assumption that different socioeconomic levels are affected differently by natural hazards is largely taken into consideration at conceptual discussion, urban management practices are hardly familiarized with this particularities in their own territories. It draws the attention to the fact that preventive actions are not only needed but also must adopt a profound fractal vision of the city.

6. REFERENCES

Alexander, D. 2003. Terrorism, Disasters, and Security. University of Wisconsin. Journal of Prehospital and Disaster Medicine. 2003;18 (3):165–169.

Beck, U. 1992. **Risk Society** – Towards a New Modernity. London, Sage Publications.

_____, *Ulrich.* 2006. Living In the World Risk Society. **British Journal of Sociology Centennial Professor**. London School of Economics and Political Science: A Hobhouse Memorial Public Lecture given on Wednesday 15th February 2006, London.

Blaikie, P., T. Cannon, I. Davis & B. Wisner. 1994. At Risk: Natural hazards, People's vulnerability, and disasters. London, Routledge.

Carvalho, I. M. de. Globalização, Metrópole e Crise Social no Brasil.2006. **Revista Eure**. Vol. XXXII, n. 95. p.5-20, Santiago do Chile, maio de 2006.

Castells, M. 1989. The Informational City, Oxford: Basil Blackwell.

Curitiba. Agência Curitiba de Desenvolvimento S.A. 2007. Available in: <http://www.agencia.curitiba.pr.gov.br/publico/conteudo.aspx?codigo=41>. 03/10/2009. [Accessed 23 March 2011]

Deschamps, M. 2004. **Vulnerabilidade Socioambiental na Região Metropolitana de Curitiba**. Phd Thesis: Programa de Doutorado em Meio Ambiente e Desenvolvimento da UFPR, Curitiba.

Duncan, Jennifer. 2011. Causes of Inadequate Housing in Latin America and the Caribbean. Published by Habitat for Humanity Latin America & the Caribbean. Available at <http://www.habitat.org/lac_eng/pdf/causes.pdf>. 09/05/2011 [Accessed October 2011]

EM-DAT, Emergency Events Database. 2011. **The OFDA/CRED International DisasterDatabase**. Available at <http://www.emdat.be/natural-disasters-trends>. [Accessed 23 March 2012].

Giddens, Anthony. 2000. **Sociologia.** 2. ed. Lisboa: Fundação Calouste Gulbenkian.

Hewitt, K. 1997. Regions of Risk: A Geographical Introduction to Disasters. Essex, Longman.

IPCC – Intergovernmental Panel on Climate Change. Summary for Policymakers. 2007. / **Climate Change 2007**: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

IPPUC. Curitiba em dados. 2007. Available at: <http://ippucnet.ippuc.org.br/Banco dedados/Curitibaemdados/Curitiba_em_dados_Pesquisa.asp>. [Accessed 22 October, 2009].

Kasperson, R. E.; Kasperson, J. X; Dow, K. 2001. Vulnerability, equity, and global environment change. In: Kasperson, R. E; K., Jeanne X. (Ed.). **Global Environmental Risk**. Londres: United Nations University Press, p.247-272.

Marandola Jr., E.; Hogan, D. J. 2008. **As dimensões da vulnerabilidade**. São Paulo em Perspectiva, São Paulo, Fundação Seade, v. 20, n. 1, p. 33-43, jan./mar. 2006. Available at <http://www.scielo.br>. [Accessed 3 August, 2010].

_____. *2004.* Natural Hazards: o estudo geográfico dos riscos e perigos. **Revista Ambiente & Sociedade.** v. 7, n. 2, jul/dez, 2004.

Marcelino, E. V. N.; Lucí H.; Kobiyama, M. 2006. **Banco de Dados de Desastres Naturais:** Análise de Dados Globais e Regionais. Caminhos de Geografia Uberlândia v. 6, n. 19 p. 130-149. Out/2006.

Marcuse, P. 1993. What's So New About Divided Cities? International Journal of Urban and Regional Research. Volume 17, Issue 3, pages 355–365, September 1993.

Maricato, E. 1996. **Metrópole na periferia do capitalismo:** desigualdade, ilegalidade e violência. São Paulo: Hucitec.

Mattedi, M. A.; Butzke I. C. 2001. **A relação entre o social e o natural nas abordagens de hazards e de desastres**. Revista Ambiente & sociedade, n.9 Campinas Jul. / Dez. 2001.

Mattedi, M. A. 2009. Causas e conseqüências do fenômeno no território. In: **Seminário de Estratégia Habitacional de Blumenau e Região**. Blumenau, 09 mar 2009. 19 slides. Power-point presentation.

Mollenkopf, J. and Castells, M. (eds). 1991. Dual City: Restructuring New York, New York: Russell Sage, 1991.

MUNICH RE GROUP – Munich Reinsurance Group. 2003. **Annual Review**: Natural Catastrophes 2002. Munique. Available at <http://www.munichre.com/en/publications/default.aspx> [Accessed 04 February, 2010].

O´Keefe, K. Westgate, et al. 1976. Taking the naturalness out of natural disasters. Nature, Volume 260, Issue 5552, pp. 566-567.

*PNUD. 2008. Programa das Nações Unidas para o Desenvolvimento. **Relatório de Desenvolvimento Humano**, 2005. Available at http://www.pnud.org.br/* [Accesed 5 November, 2011].

*Rolnik, R. 1997. **A cidade e a lei:** legislação, política urbana e territórios na cidade de São Paulo. São Paulo: Nobel/Fapesp, 1997.*

_____. 2011. Niguém vai morar em área de risco porque quer ou porque é burro. Jornal Brasil de Fato, Jan., 14th, 2011. Available at < http://www.brasildefato.com.br/node/5475 >. [Accesed 5 November, 2011].

Santos, M. 1996. **A urbanização brasileira.** 3 ed. São Paulo: Hucitec.

Swiss Re, 2011. Sigma Journal. Natural catastrophes and man-made disasters in 2010: a year of devastating and costly events. *Available at: <http://www.swissre.com/sigma/>*. [Accesed 5 November, 2011].

*Thouret, J-C. & D'ercole, R.*1996. Vulnérabilité aux risques naturels en milieu urbain : effets, facteurs et réponses sociales. Cahiers Sciences Humaines. 32 (2) 96: 407-422. Available at <http://horizon.documentation.ird.fr/exl-doc/pleins_textes/pleins_textes_4/sci_hum/010006241.pdf>. [Accesed 5 November, 2011]

Tobin, G. A; Montz, B.E. 1997. **Natural Hazards**: Explanation and Integration. 2 ed. New York: The Guilford Press.

UN/ISDR, Inter-Agency Secretariat of the International Strategy for Disaster Reduction. 2004. **Living at Risk**: a global review of disaster reduction initiatives. Genebra. Available at <http://www.unisdr.org/eng/about_isdr/bd-lwr-2004-eng.htm>. [Accesed 5 November, 2011]..

Ultramari, C; Rezende, D. 2006. Mudanças e Continuidades na Gestão Urbana Brasileira. Revista Paranaense de Desenvolvimento, n.111, p.19-28, jul./dez. 2006. Ipardes: Curitiba, 2006.

UNDP, United Nations Development Programme. 2004. **Reducing Disaster Risk**: A Challenge for Development. Nova York. Available at <http://www.undp.org/.cpr/disred/documents/publications/rdr/english/rdr_english.pdf>. [Accesed 5 November, 2011].

Villegrán de Leon, Juan Carlos. 2006. Vulnerability: a conceptual and methodological review. UNU Institute for Environment and Human Security, Bonn, Available at <http://www.ehs.unu.edu/file/get/3904>. [Accesed 8 November, 2011].

Yeletaysi. Sarp. 2009. A Framework to Integrate Social Vulnerability into Catastrophic Natural Disaster Preparedness Planning. Proceedings of TIEMS 2009 Annual Conference. Istanbul, june 9th – 11th. Available at <http://www.gwu.edu/~icdrm/publications/PDF/Yeletaysi_et_al_TIEMS2009.pdf>. [Accesed 15 December, 2011].