Popul Environ (2006) 28:83–112
DOI 10.1007/s11111-007-0036-7

ORIGINAL PAPER

Vulnerabilities and risks in population and environment studies

Eduardo Marandola Jr · Daniel Joseph Hogan

Received: 15 May 2006 / Accepted: 16 January 2007 / Published online: 6 February 2007

Abstract In the study of *risks*, different sciences use the same category in different ways, each related to its own ontological assumptions. But many of these fields communicate very little with one another. This article seeks to approximate two of these areas of study that have shown similar concerns and that can mutually strengthen one another, namely, geography and demography. Geography was one of the first disciplines to include risk in its environmental dimension and has had broad experience in simultaneously focusing on social and natural dynamics. Demography, on the other hand, faces greater difficulties because only recently has it incorporated the environmental dimension into its scientific scope. Both have brought the concept of vulnerability into their conceptual framework as complementary to that of risk. Geographers understand vulnerability as a more symbiotic form of the relationship between society and nature, whereas demographers give it a

An earlier version of this article was presented at the 14th National Meeting of Population Studies, sponsored by the Brazilian Association of Population Studies (ABEP) held in Caxambú, MG, Brazil, 20–24 September 2004. That version was subsequently published in the Revista Brasileira de Estudos de População 22, 1, 29–53, 2005. The present text has been considerably revised and expanded, and translated from the Portuguese version.

E. Marandola Jr (✉)
Institute of Geosciences (IG), State University of Campinas (UNICAMP), Campinas, SP, 13084-970, Brazil
e-mail: eduardom@ige.unicamp.br

D. J. Hogan · E. Marandola Jr
Population Studies Center (NEPO), State University of Campinas (UNICAMP), Campinas, Brazil
e-mail: hogan@nepo.unicamp.br

D. J. Hogan
Institute of Philosophy and Human Sciences (IFCH), State University of Campinas (UNICAMP), Campinas, Brazil

strong socioeconomic component. In this regard, the conceptual discussion on risks and vulnerabilities, in its attempt at approximating these two fields, is a way of conceptually advancing and strengthening the different approaches to empirical work, especially in population–environment studies which is the common ground for the dialogue between the two disciplines.

Keywords Natural hazards · Socio-demographic vulnerability · Population and environment · Space · Scale

Introduction

This article on the approximation of the disciplines of Geography and Demography in the use of the concept of vulnerability is part of a systematic effort we have pursued in the context of a project that involves researchers at the Population Studies Center (NEPO) of the State University of Campinas (UNICAMP). The project has the objective of studying the socio-demographic vulnerabilities found in two large metropolitan areas in the State of São Paulo, Brazil (Campinas and Santos). When taking the term vulnerability as its central theme, the project based itself, *a priori*, on the bibliography developed mainly by Latin-American researchers who have focused on the social and demographic dimensions of vulnerability.

Our specific interest here, however, will go beyond these questions and establish our priority as the *environmental dimension of vulnerability*, on the basis of the population–environment relationship. It is in this respect that the conceptual effort of mapping and understanding the forms and meanings that various researchers give this concept is inserted, focusing on different dimensions of vulnerability on the basis of their theoretical–methodological and ontological frameworks.

To locate and understand the term vulnerability in different scientific approaches is an enterprise that cannot be carried out without considering, at the same time, the concept of *risk*. This is because vulnerability appears in the context of studies on risk, first in its environmental dimension and only later in its socioeconomic context.

The first scientific studies involving the concept of risk had a strong objectivist orientation, based on the assumption that the understanding of reality is a given, that is, it can be measured. This notion of risk also has significant echoes in other academic traditions. However, with time, not only did contrary positions arise (such as subjectivism, which held that risk exists only on the basis of language), but also others that attempted to blend these two extremes.

A milestone in the development of these studies was the discussion of Risk Society, a term first used in sociology in the mid-1980s. These scholars took the discussion from a place circumscribed in time and space to the sphere of macro-social transformations. But there is still a gap between this contem-

porary analysis and earlier studies, with some important exceptions and preliminary efforts at outlining a common approach.

This text, then, is part of a continuing effort to map tendencies and approaches in the study of risks and vulnerabilities, with the objective of developing a theoretical-methodological framework to support our empirical research; in other words, although this effort has a clear theoretical purpose, its end result is meant to provide a methodological basis for our ongoing project. In view of this, themes like geographers' research on natural hazards (among the first work on these concepts) (Marandola Jr. & Hogan, 2004a), the different approaches used in the study of risk (risk perception, risk and culture, risk analysis, environmental events and systems), together with the recent discussions of Risk Society have been analyzed (Marandola Jr. & Hogan, 2004b). Furthermore, the two principal axes of the study of vulnerability (poverty and inequality, on the one hand, and the environmental dimension in its various scales, on the other) were examined from a theoretical and conceptual point of view, with a focus on their epistemological and ontological meaning, as well as the most significant aspects of the different approaches (Hogan & Marandola Jr., 2005).

On the other hand, the study of risk has other traditions in the context of the Social Sciences, such as the work of Niklas Luhmann, Mary Douglas, Deborah Lupton and Caroline Moser, which have not yet been treated in our theoretical-methodological efforts (nor will they be in this article, considering its more specific objectives). (Douglas, 1966, 1985; Douglas & Wildavsky, 1982; Luhmann, 1993; Lupton, 1999; Moser, 1998, 2004). These studies will be fundamental in widening the scope of analysis of Geography and Demography and are, indeed, important referents of this dialogue. However, since we have chosen the environmental axis for this text, we will leave for a later article a more careful evaluation of the contributions and perspectives raised by these authors.

We will concentrate here, therefore, on the reciprocal relations of Geography and Demography for the study of risks and vulnerabilities in the environmental field. The geographers were the first to bring vulnerability into the environmental debate in the context of studies on risks. They have, as mentioned earlier, emphasized these categories in the context of studies of natural hazards (Marandola Jr. & Hogan, 2004a).

The interests of geographers and demographers have converged, especially with more recent concerns of demographers regarding *populations in risk situations*. Unlike other population phenomena, the locality-specific nature of environmental risks—which do not limit their effects to age-sex categories nor to the entire population of standard units like towns or census blocks—has led to creating ad hoc units which circumscribe groups exposed to risk (Taschner, 2000; Torres, 2000). Also, scholars in both fields have begun studying floods, landslides and other situations where the environment, in conjunction with socioeconomic factors, exposes populations to risks, especially in cities.

In this regard, one can see the relevance of proposing a conceptual approximation of these two fields, geography and demography. Geography was among the pioneers in dealing with risks and vulnerabilities in their environmental

dimension, with a solid conceptual body and a long tradition of empirical studies. In contrast, only recently has demography included the environmental dimension in its concerns, but it has contributed with empirical studies in a theoretical universe different from that of geographers. Both are aligned with approaches based on strong empirical orientations, with direct concerns about specific space-times and problematics related to planning and management.

The convergence identified here is manifested more strongly in studies of population and environment, an area more developed within Demography than Geography, but which has evolved through close interdisciplinary contact with researchers from other areas. In the studies produced in this field, space has taken on an increasingly central role, a third axis which orients and aggregates interests and has contributed to a more systematic outline of this new sub-field (Martine, 2001). Over the last 20 years of the development of this work we have seen the debate move from the demystification of Neo-Malthusianism, going beyond the discussion of the pressure of numbers on resources, incorporating questions which led population studies to other areas of interest, such as the social and environmental conflicts involved in urbanization, planning and public policy, land use and the carrying capacity of regional ecosystems. These studies have concentrated on two scales of analysis—the regional and the urban—and two cross-cutting themes—risks and vulnerabilities, on the one hand, and population mobility (in its various moments and stages), on the other (Marandola Jr. & Hogan 2005). All of these interests have a common base in the spatial distribution of population, signaling the importance of interdisciplinary dialogue, especially with areas such as Geography, which has a long tradition of the study of the spatial dimension of social phenomena.

Geography, therefore, has a fundamental contribution to the development of this field, not always clearly discernible in the theoretical-methodological framework employed. In view of this, the present article seeks to contribute to strengthening this dialogue in studies of population and environment, from the perspective of risks and vulnerabilities (one of the most important thematic emphases of these studies), in the direction of the explicit incorporation of the spatial dimension to the scope of concern.

We will present a brief review of how the debate on risks and vulnerabilities developed and evolved among geographers, and then among demographers. This approach will refer to studies on natural hazards, which constitute the main line of investigation of geographers who have dealt with concepts of risk and vulnerability. This restriction is both circumstantial, due to the dimension of this text, and methodological, since the area of natural hazards has been the arena of the most important contact between geography and demography, and is also the theoretical-methodological basis, which many demographers have used to orient their academic work.[1] We have chosen three approaches from

[1] This strategy seeks to develop a frame of reference for the different perspectives as well as to allow a better understanding of the evolution of the concepts. However, there are currently other geographers, not directly associated with studies on natural hazards, who have advanced in their discussion of vulnerability, especially in the context of Global Environmental Change Science and of Sustainability Science. This discussion has been developed in Hogan and Marandola Jr. (2005).

Demography which have contributed significantly to studies of risks and vulnerabilities, as well as to the development of a conceptual and thematic framework for population–environment studies; these approaches are presented in chronological order. At the end of this article we will relate these two fields in an attempt to establish a common framework for discussion of concepts, and in order to operationalize our research, not with the objective of uniting them in a new field, but in order to bring them closer together, a process of mutual enrichment in a field of studies which is essentially interdisciplinary, the population–environment relationship. We believe the field is at a moment of transformation, ready for an epistemological leap in its trajectory. Increasingly, the field is constituted by a specific theoretical and methodological framework, constructed on the basis of a dialogue between a significant demographic foundation and developments in allied disciplines. In view of this, the present effort seeks to contribute to this construction in population–environment studies, bringing from Geography some fundamental elements for the construction of these bases, which are clearly still in development.

Natural hazards: a geographical tradition

Geographical studies of risk have received special treatment from researchers concerned with natural phenomena that, in extreme situations, have caused damage and exposed populations to hazard. Natural hazards have required great effort and been a source of considerable concern for researchers involved in planning and management and interested in the relationship between human beings and their environment.

Among these hazards are floods, landslides, tornados, volcanic eruptions, hurricanes, windstorms, hailstorms, frosts, snowstorms, desertification, earthquakes and others. They are considered hazards when they cause *damage* to the populations affected (Aneas de Castro, 2000; Burton, Kates, & White, 1978).

Since the study of these hazards has always been in the context of planning, where specific areas were in focus, as well as imminent human, material and economic losses, such studies have always been permeated with the concern to understand the extent and damage that hazards cause to these populations. Predicting the *probability* of these phenomena was also basic to that context. In this regard, geographers developed what they called risk assessment: *the assessment of the risk of a certain hazard occurring in a given place*.

It is clear that assessing risks was not an exclusive activity of geographers. However, they developed specific methods, which encompassed both environmental variables and the collective and individual responses of the populations facing hazards. In this respect, of special importance are the books of Robert W. Kates, *Risk assessment of environmental hazards* (Kates, 1978) and of Anne White and Ian Burton, *Environmental risk assessment* (White & Burton, 1980), both published in the context of the *Scientific Committee on*

Problems of the Environment (SCOPE), an important scientific organization that has contributed greatly to studies on the relationships between human beings and their environment, especially during the 1970s and 1980s. These methods oriented a large body of research that analyzed risks in many parts of the world.

In these seminal works, the main concepts treated were *risk* and *hazard*. Hazard was the phenomenon studied, whereas risk was the perspective in which the approach to the problem was placed. Instead of using an impact approach, there was a concern for prediction that sought to minimize uncertainty. In other words, it was considered essential to be able to measure the probability of occurrence of certain hazards, in order to reduce the frequency and intensity of such events.

In these early studies, vulnerability did not appear as a concept, but as an idea underlying the notion of *capacity to respond*. This notion is central to the methods proposed, and is therefore an integral part of the studies to date.

In their important evaluation of this line of investigation, Ian Burton, Robert W. Kates and Gilbert F. White give central emphasis to this question. For them, the response to hazards is the ability to reduce losses and save lives. ''Response to hazards is related both to perception of the phenomena themselves and to awareness of opportunities to make adjustments.'' (Burton et al., 1978, 35) The authors thus stress the importance of perception of risk as basic to the response that a population will give to a hazard. These responses may be in the short, medium or long term. Therefore, among the possible responses the authors mention emergency measures, evacuation of areas and sending aid to those affected, as well as biological and cultural adaptation and the capacity to absorb both hazards and adjustments.

This focus emphasizes medium and long-term measures and, among them, those that are intentional, that is, that result from planning and decision (choices). Biological and cultural adaptations are on a prior temporal scale, where human societies, throughout history, have adapted to various natural hazards. These take place today on a reduced scale, although cultural adaptation may be related to changes in behavior and values brought about especially by new risks experienced in cities. However, adjustments constitute the most interesting factor because they involve collective and individual actions and choices, the consequence of which is a reduction in the lack of adjustment that exists between populations and these events of nature (Burton et al., 1978).

Such events may be either incidental (attitudes that do not have hazard in perspective but, as a consequence, produce a reduction in the damage or risk involved) or the result of conscious decision, either individual or collective. ''Adjustments may be separated into those that are purposefully adopted and other activities and characteristics of individual behavior that sometimes are not primarily hazard-related but have the effect of reducing potential losses.'' (Burton et al., 1978, 40) It is in this context that the broad range of proposals for intervention, public policies and proposals for planning and management

can be found, all of which have the objective of reducing losses (both material and human) and increasing security. Also important here are collective and individual measures taken by communities, families and other non-governmental entities, which also increase adjustment to hazard and thus reduce risks and vulnerability.

Another important concept in this respect is *absorptive capacity*. According to the authors, since hazards are natural events that directly affect systems of human use, responses to them must involve aspects of both economic and social life and of natural systems. The primary focus is on adjustments that have been decided upon. However, the authors also underscore the role of incidental adjustments and of cultural adaptation that create a level of capacity of individuals and social systems to absorb the effects of extreme fluctuations in the environment. This absorptive capacity is therefore directly related to the adjustments made, and it is indispensable that, even when sustaining losses, society, people and the environmental system be able to absorb the impacts and to recover.[2]

Therefore, although vulnerability already had a place in these early studies,[3] it received even greater attention in the late 1980s and the 1990s. This happened when research ceased being concerned only with natural hazards and began focusing on *social* and *technological* hazards as well. ''Natural'' hazards began to be seen as *environmental*, which implied that hazards can only be understood if one takes into account the natural context and the forms that society has appropriated from nature, thus *producing hazards* (Jones, 1993).

Although geographers have always focused on the human dimension simultaneously with the physical dimension (hazards only existed as of the moment when populations were affected), these new concerns gave more direct attention to socioeconomic processes and eminently social problems. Vulnerability thus appeared in these three contexts (social, technological and environmental), and its importance grew increasingly.

In view of the above, one important discussion regarding the debate on vulnerability is its nature, in other words, its causes and constitutive components. As long as its focus remained on biophysical phenomena, vulnerability could be easily related to ecosystems or environments. However, with

[2] This is, in fact, the idea of resilience, a concept originally developed in physics, which has been taken over by ecology and today is present in a vast bibliography on environmental issues. The authors mention this fact in passing but they do not deal directly with the concept. A more direct association of this concept with studies on vulnerability is a promising perspective.

[3] In the book by Burton, Kates and White, although vulnerability appears in a diffuse way in the text, it is stressed in the summary of ideas, indicating the importance it would take on in the years to come: ''Nature, technology, and society interact to generate *vulnerability* and resilience vis-à-vis disaster. In the short run the global toll in *damage* will continue to rise, while *loss of life* will be reduced substantially. The long-term thrust of development in nations is toward reducing the social cost of hazard to society—but in periods of rapid transition societies become peculiarly *vulnerable to hazard*. A central task for international cooperation should be to ease these transitions. *Hazard vulnerability* varies among nations, emphasizing loss of life in the developing, and catastrophic damage in the highly industrialized.'' (Burton et al. 1978, 223, *our bold face*)

increased perspectives for research, the following question arose: Is vulnerability an attribute defined by an environmental determinant (biophysical or natural) or by socioeconomic resources that provide greater ability to respond to hazards?

According to Susan Cutter, an important author in the systematization of the different approaches to vulnerability,[4] this variety of perspectives exists because of the diversity of themes approached, the different spaces studied (countries in different situations of development) and even the specific researcher's epistemological orientation (political ecology, human ecology, physical science and spatial analysis) and consequent methodological practices. According to this author, these differences result in three main postures (Cutter, 1996, 530):

1. One that is focused on the probability of exposure (be it bio-physical or technological);
2. Another that focuses on the probability of adverse consequences (social vulnerability);
3. And a third that combines the first two.

These three positions are represented by three trends that Cutter calls: (1) Vulnerability as a pre-existing condition, (2) Vulnerability as tempered response, and (3) Vulnerability as hazard of place.

Cutter says that studies in the first category are characterized by their focus on the distribution of a hazardous condition, of human occupation in hazardous zones (coastal areas, seismic zones, flood plains) and the degree of loss (of life and property) associated with the occurrence of a specific event (flood, hurricane, earthquake, etc). When verifying vulnerability in these studies, the magnitude, duration, impact, frequency and general biophysical characteristics and exposure to the phenomenon are taken into consideration.

Many of the initial studies on vulnerability and natural hazards, such as that by Hewitt and Burton (1971) and the articles and papers brought together in the seminal collection by Gilbert F. White (one of the most outstanding and well-known pioneers in this line of investigation), were centered on this perspective. Much of this production was the result of the work by the Committee on Man and the Environment, of the International Geographical Union (IGU), with collaboration of researchers from a number of different countries (White, 1974).

The second group of studies dealing with vulnerability, states Cutter, is concerned with the responses of society, including social resistance and resilience in the face of hazards. ''The nature of a hazardous event or condition is considered a given, or at the very least, viewed as a social construct, not a biophysical condition.'' (Cutter, 1996, 532–533) This trend is therefore

[4] This geographer, a researcher at the *Hazards Research Lab*, of the University of South Carolina, U.S.A., has made important conceptual and retrospective assessments on what she calls *Vulnerability Science*, in the perspective of studies on *environmental risks and hazards* (Cutter, 1994, 1996, 2003).

addressed to the social construction of vulnerability and its cultural, economic, political and social factors, which determine individual and collective responses.

As shall be seen below, this trend is the closest to the most productive work by demographers. But some geographers interested in social hazards have also worked within this perspective (Oppong, 1998; Watts and Bohle, 1993). Several Latin-American researchers also have dealt with vulnerability, especially in its social dimension (Garcia, 2003; Padlog & Márquez-Azúa, 2003).

Finally, Cutter emphasizes her preferred trend, which is currently predominant, namely, vulnerability as hazard of place. This is a more conjunctive perspective. That is, in the author's evaluation, it is more geographically centered. From this point of view:

> [V]ulnerability is conceived as both a biophysical risk as well as social response, but within a specific area or geographical domain. This can be geographic space, where vulnerable people and places are located, or social space, who in those places are most vulnerable. (Cutter, 1996, 533)

The measurement of biophysical (environmental) risk, the social production of risk and the capacity to respond are also part of the same discussion by both society (social groups) and individuals. In this approach, we find many geographers dealing with different types of hazards.

Keith Smith, for example, in his book entitled *Environmental hazards: assessing risk and reducing disaster*, defines, based on Timmerman (1981), his concept of vulnerability:

> The learning benefits of experience for future hazard reduction strategy will be nullified if the level of human vulnerability to disaster continues to rise faster than the degree of protection which can be offered. The concept of *vulnerability* implies a measure of risk combined with the level of social and economic ability to cope with the resulting event in order to resist major disruption or loss (Timmerman, 1981). In other words, vulnerability is the liability of a community to suffer stress, or the consequence of the failure of any protective devices, and may be defined as 'the degree to which a system, or part of a system, may react adversely to the occurrence of a hazardous event'. (Smith, 1992, 22)

The author makes it clear that vulnerability, seen from this point of view, cannot be calculated only through assessments of the natural dynamics of the hazards in evidence, much less only through the study of the social resources available to cope with the hazard. It is first essential to understand the relationship existing between these determinants, in order to avoid two opposing mistakes: overestimating either the environmental factors or the social dynamics.

Harold Brookfield expressed this concern. According to him, whereas it is easy to identify the causes of some phenomena (such as atomic bombs—originating from human action), others are more complex, and in these cases, both natural and human causes may bear equal weight. Brookfield (1999) also

says that causes are often calculated hurriedly, with cause-and-effect relationships being asserted simplistically and environmental factors often being underrated.

The author understands vulnerability as related to both the geography where the community under study is located and its economic and political situation. For him, ''[T]here are both geophysical and human forces at work in the production of vulnerability to damage and of damage itself.'' (Brookfield, 1999, 7) The author thus proposes that the study of vulnerability be focused on the resistance and sensitivity of the environment and not on the basis of the social causes of vulnerability because, in his opinion, such an approach may end up masking the natural causes involved in the process. All of this author's efforts are bent on relocating the importance of studies on the biophysical causes of hazards. He asserts that there are many more physical causes in many more cases than one might imagine.

This concern is more than legitimate, to the extent that, involved in a system with a very controlling mode of production, with direct and indirect implications on all facets of our life, the social sciences in general (and he includes geography among them) are experiencing a trend toward minimizing any factor that is neither socioeconomic nor political. Although we do not intend to reduce the importance of the political aspects of the discussion on vulnerability by placing it in discussions of its environmental determinants, it cannot be reduced to social factors.

Brookfield's warning becomes all the more relevant in an inter-disciplinary scenario and in an effort, such as this, of establishing a dialogue between geography and demography. However, the terms of this dialogue are, in large part, the terms of the third trend indicated by Cutter, who attempts not to stress either pole in detriment to the other. Many examples of empirical studies that have used this orientation could be mentioned. Such studies seek both to consider the social implications and determinants in the response to hazards and to stress the nature and relevance of these phenomena in the ability of the different social groups to respond (Ayoade 1983; Gardner 2002; Kolars 1982; Liverman 1990; Naughton-Treves 1997; Paulson 1993; Palm and Hodgson 1992).

Cutter (1996) describes this approach by using a figure where the study of vulnerability is based on a conjunctive perspective centered on place (Fig. 1). This model shows the relationships that exist among risk, measures for mitigation (responses and adjustments) and vulnerability of place, with these elements defined in terms of the relationships established among them. That is, an increase in mitigating measures may mean a reduction in risk and, consequently, may imply a reduction in the vulnerability of place. But risk can also increase if there are changes in the geographical context or in social production, and this could mean increased biophysical or social vulnerability, respectively, and greater vulnerability of place. This process may also begin through an increase in a potential hazard, which may be either the result or the determinant of increased or reduced vulnerability.

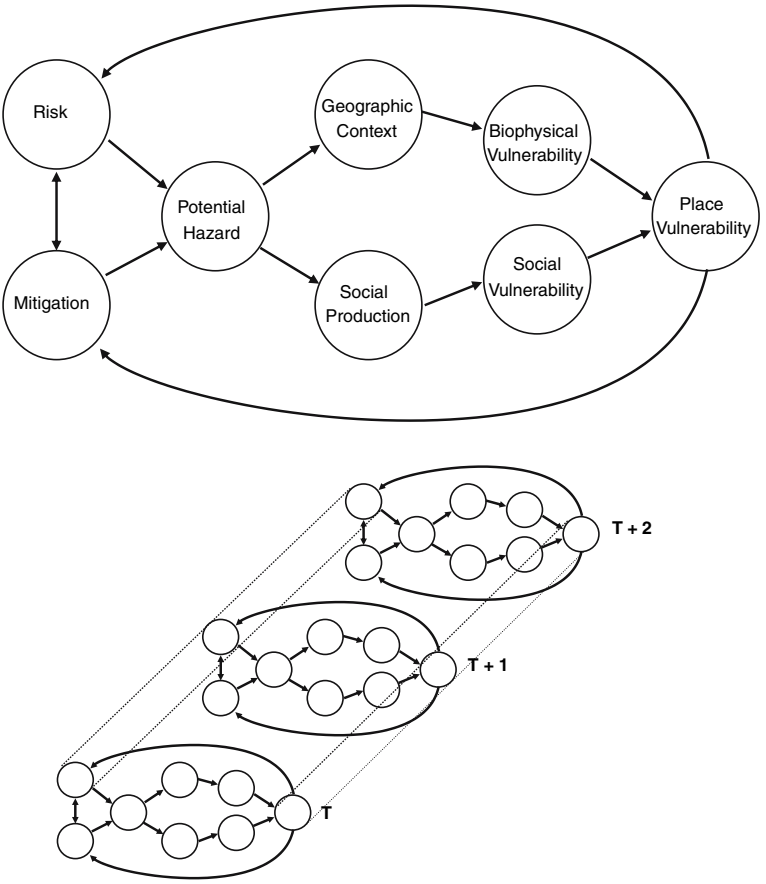

Fig. 1 Hazards of place model of vulnerability. The various components that constitute vulnerability interact to produce vulnerability of specific places and of the inhabitants in these places (upper part). This vulnerability can change with time (lower part) with changes in risk, mitigation, and contexts within which environmental hazards occur. Source: Cutter (1996, 536)

In the lower part of the figure Cutter makes it clear that she proposes to limit studies on vulnerability to circumscribed places in space, but without disregarding the temporal evolution that brings about changes in the components in this scheme. Therefore, a change in the terms of the relationship among components should be weighted on a satisfactory temporal scale so that the changes can be assessed and put into perspective. The situation should not be considered static, or frozen in time. Spatial and social interactions are continuous and only increase the complexity of our job as researchers of trying to understand them and provide answers to the uncertainties faced by society.

In fact, the search for these solutions includes the application of more conjunctive models that bring together knowledge of both social and natural dynamics. Vulnerability, as these geographers understand it, is an intrinsic characteristic of places, defined by this set of environmental and social

determinants, which should be studied case by case, in order to calculate where one or another element has greater importance and where both act simultaneously and with the same intensity in the exposure of populations to risks and hazards, and to the consequent vulnerability.

One crucial aspect in this regard is the notion of *capacity to respond,* so closely associated with vulnerability, as well as *adjustments* and *absorptive capacity*. All these concepts are dealt with, in greater or lesser degree, by demographers, not only those concerned with the environmental dimension, but those interested in socio-demographic vulnerability as well.

We will now seek to trace the evolution of the use and understanding of the concepts of risk and vulnerability in demography in an attempt to demonstrate the specific aspects of the use that demographers make of these concepts, as well as the points of contact with the line of study used by geographers.

Risks and vulnerabilities in demographic studies

Risk in traditional demographic analysis

Traditionally, demography uses the notion of risk associated with the *probabilities* that certain events in demographic dynamics will occur. This risk is the result of a mathematical calculation, whose elements are defined according to the nature of this phenomenon. Especially, the risk of death and the risk of contracting a given disease are calculated.

George W. Barclay, in his classic work *Techniques of population analysis*, explains this traditional use of risk in demographic analysis:

> Both expressions [proportions dying and probability of dying] refer to the notion of the 'risk' of death, which is a way of saying that people live continually exposed to some chance of dying, a chance that is precisely measurable. Everyone of course dies some time, but the prospect is uncertain at any given moment. The *risk* is the *degree* of uncertainty. The 'proportion dying' and the 'probability of death' both indicate how great the risk of dying is. The numerical value measuring this degree is also called a 'mortality rate'. (Barclay, 1958, 100)

Risk, therefore, is a mathematical fraction expressed by an index that varies from 0.0 (impossibility of occurring) to 1.0 (absolute certainty of occurring). This difference, or gradation, refers to the degree of certainty that one is able to infer that a given person (or population group), under certain circumstances, will contract a certain disease or show certain fertility/mortality behavior. Barclay underscores that some of the steps in the delimitation of these calculations include the definition of the universe, the age bracket and the total number of persons that have the possibility of dying during the interval. Therefore, the universe is defined in order to identify the highest possible number of deaths, considering the factors relevant to that dynamic and the set of opportunities that may result in death during a specific time interval.

However, the author shows that there are other uses of the notion of risk, such as the risk of getting married, the risk of having children, the risk of going into some professional field, the risk of acquiring some type of mental disease. However, emphasizing especially the demographic character, Barclay stresses that the universe for calculating risk of any occurrence should be well delimited because the risk of having a child, for example, may be very different from one demographic group to another, such as those below age ten, those between 20 and 40, and those over age 60.

From this point of view, risk is a strictly neutral, probabilistic factor and contains no negative connotation in itself, as in studies by geographers, and in the way risk has generally been treated since the beginning of modernity (Giddens, 1990).

Therefore, taking into account *risk factors* is essential to this tradition, particularly important in studies related to health. Studies dedicated to understanding the relationship of demographic dynamics and behavior in regard to certain diseases have used this approach to identify *demographic risk groups*. Greater importance is also given today to *risk behavior groups*, in an attempt to expand the discussion and overcome a certain determinism. Greater attention is also being paid to the different *perceptions* of groups regarding risk, and their cultural, material and symbolic insertion in society, which directly influence behavior and the adoption (or not) of preventive measures (Connors, 1992; Monteiro, 2002; Paicheler 1999).

However, some correlations are quite clear and have been supported by various studies. These studies take on greater legitimacy to the extent that they incorporate not only aspects such as fertility, gender or family, but also parents' socioeconomic conditions and education, among other factors and situations which are not specifically demographic (Barbosa & Andrade, 2000; Cruz & Leite, 2002; Saad & Potter, 1994).

The authors of these studies are therefore seeking correlations among these different factors, through different statistical techniques, in order to determine which of them constitute risk factors and which can be discarded as irrelevant. To be a risk factor therefore means to directly influence the probability of occurrence of a given phenomenon. That is, there is a positive correlation.

Many of these studies hold to a notion of strictly objectivistic reality, where reality is understood as given, subject not only to measurement but also to the identification of causal relationships, even when they are multifocal and multivariate. These studies have not always fully incorporated the capacity that persons and demographic groups had or could have to minimize the risk to which they were exposed, nor did they consider chances of ''escaping'' the likelihood imposed by the coefficient of the risk factors.

In this regard, epidemiology, allied to demography, brought new factors into the discussion on health, incorporating the concept of vulnerability. Even if imprecisely, this is a step forward in relation to the concept of risk behavior, as Ayres, França Júnior, Calazans, and Saletti filho (1999) show. With the specific case of Aids in mind, but broadening the discussion to epidemiology in general, these authors, monitoring international movements, attempted to

trace the possibilities and improvements in the concept, and pointed out that one of the greatest challenges is to go beyond the behavioral dimension and move into the social dimension, which takes social and demographic aspects into account.

> The concept of vulnerability is not aimed at distinguishing the *probability* that a *given individual* will be exposed to Aids, but at providing elements for objectively appraising the different chances that *each specific individual or population group* has of contamination, given the set of certain individual and social characteristics of their everyday life *deemed as relevant* for greater exposure or lesser chance of protection in regard to the problem. (Ayres et al., 1999, 65)

Ayres et al., then, present the concept of objective, quantitative and behavioral risk for a ''quanti-quali'' analysis that will incorporate objective quantitative aspects into socio-demographic and programmatic situations. One of the main conceptual aids here is the view that vulnerability and empowerment are two aspects of the same process, which interact in the equation of risk and health. Another essential point is emphasis on collective, social and demographic processes and on the political aspects of the disease and of risk, influencing the capacity of persons and groups to protect themselves and/or obtain treatment. However, the conceptualization of vulnerability is still under construction, widely used but insufficiently precise in most of these studies.

Regarding the broader range of these studies, vulnerability has not yet become the key concept, although great strides have been taken in this direction. And despite criticisms of the persistence of the use of concepts such as risk factors or even risk groups and risk behavior,[5] it continues as a significant line of investigation, and is closely related to epidemiology. It has advanced in statistical refinement and broadened its theoretical-methodological bases to strengthen the instruments it has proposed for analyzing the data and the problematics under discussion.

''Populations in risk situations'': a conceptual advance

These may have been the first attempts, within demographic studies, which oriented the questions raised by the Working Group on Population and Environment, of the *Brazilian Association of Population Studies* (ABEP), especially in the 1990s. This group has played an active role in the conceptual and methodological advances made in the context of demography in studies of risk.

One of the central concepts discussed by these researchers was that of *populations in risk situations*. After several years of discussions and research, the ABEP group published a collection of articles where the results of this

[5] Ayres et al. (1999) point out the limitations of these concepts for studies related to health.

debate may be seen, especially the means used by the group in general to operationalize and analyze this concept.[6]

Daniel J. Hogan, in a broad appraisal of the Population and Environment field, identifies the topic of populations in risk situations as one of the research perspectives in this area of demography. According to the author, this is a promising approach because

> Since the consequences of environmental deterioration are not felt in the same way by different social groups, nor even uniformly throughout a territory, the usual categories for demographic analysis are not always able to show these consequences. (Hogan, 2000, 41) (our translation from the original Portuguese)

The author then reviews articles and books that have contributed to greater understanding of this approach, which takes into consideration the biophysical factors of environments and their inter-relationships with demographic dynamics. Examples of this are populations that occupy marshes along rivers and other areas subject to floods in shantytowns, as well as populations subject to natural disasters. This approach seeks to link the physical aspects of environments where populations live, with their socioeconomic situation.

Haroldo da G. Torres, in ''*The demography of environmental risk*,'' raised the questions that were on the group's agenda: What are environmental risks? What types of population live in areas of risk? How do we measure and study risk? This is an important addition to the traditional concerns of demographers, namely, the *environmental* aspect. That is, one latent concern of the group was to go beyond the limitation that the components of demographic dynamics establish for understanding certain phenomena strongly influenced by the physical environment, such as ''risk factors.''

Torres (2000) discusses the concept of environmental risk theoretically, as well as in terms of implementation. He seeks to go beyond commonplace discussions of risk to draw up a logical plan for studying it. He mentions four difficulties and five steps in this plan. The difficulties can be summarized as follows:

1. There are known and unknown substances that may have exposed or may be exposing populations to known and unknown risks. There are risks that will only be known when their negative effects have already affected many people, sometimes with irreversible processes;
2. The notion of what is risky is defined historically, and may change with time;
3. The perception of individuals and families regarding a risk may be very different, due to different factors, even if the risk is relatively well-known;
4. The capacity of individuals or social groups to protect themselves is affected by income level.

[6] This book, organized by Haroldo Torres and Heloisa Costa, selected texts produced by the Working Group during the 1990s, as a representation of its conceptual and thematic history (Torres & Costa, 2000).

According to the author, these points have strong spatial influences. That is, the scale of analysis, spatial delimitations and spatial distribution of the phenomena have direct influence on how they can be dealt with and how their relationship with society can be better understood.

In addition, perhaps the greatest difficulty of all, according to Torres (2000, 64), is the ''[I]dentification of the social groups most affected by a given environmental phenomenon that one intends to study.'' (our translation from the original Portuguese) Aware of this inherent difficulty, the author proposes the main logical steps involved in defining populations subject to environmental risks:

1. The identification of a potentially generating source/factor of environmental risks;
2. The construction of a real or imaginary risk curve;
3. The definition of a standard of acceptability of the risk;
4. The identification of the population subject to risks; and
5. The identification of degrees of vulnerability.

A central intrinsic aspect of these steps is the concentration on a specific area, generally more limited than standard demographic units, and Torres specifically mentions census tracts and intra-urban analysis. These researchers took a major step in relation to traditional studies on risk, even though this initial debate employed a wide-ranging use of the term ''risk,'' sometimes using it to refer to ''hazard'' or to ''vulnerability,'' as well as to ''risk'' itself. Nevertheless, when observing these five stages, demography, in its traditional meaning, was mindful only of the first, and perhaps referring to the fourth, but due only to the demographic results of the application of its models. Traditionally, demography took into account only two of these steps: the identification of risk factors and of the population subject to risks.

Torres (2000, 67) recognizes in these five stages (and especially the first three) the need for inter-disciplinary activity where the presence of specialists from other areas would be essential. The work of the demographers associated with the Working Group has shown that they have accepted this challenge, as can be seen in the other contributions in the book (Porto and Freitas, 2000; Taschner, 2000), as well as in other more recent writings (Hogan, Cunha, Carmo, & Oliveira 2001; Hogan & Carmo, 2001; Torres & Marques, 2001).

Finally, Torres (2000, 69) draws attention to ''[S]ocioeconomic characteristics of the populations in the areas of risk.'' (our translation of the original Portuguese) Factors such as income, education, ethnicity, occupation, among others, should receive attention together with classic demographic variables. This is important for identifying environmental inequalities, which show a high correlation between areas of environmental risk, lower-income groups, and those with higher levels of social disadvantage.

This is a basic question that emerges both from the concerns of this group and from other sectors of demography more closely related to sociology. Both

Hogan and Torres raise the issue of vulnerability, although at the time they had not yet sufficiently developed the notion. However, in both cases, it appears as related to the socioeconomic situation and to the capacity to respond to environmental risks. However, it was more broadly developed in another context and with several constitutive aspects that were somewhat distinct from the approach focused on here. We will dwell a little more closely on this approach below.

Socio-demographic vulnerability: a Latin-American concept

This other trend is found especially among researchers at the Latin American & Caribbean Demographic Centre (CELADE), a division of the United Nations' Economic Commission for Latin America (ECLAC), with broad international repercussion and a large number of comparative works.

Although they also use the term vulnerability, the theoretical-methodological context of these researchers is quite different, and this results in a different, although related, perspective of vulnerability and risks. The following paragraphs synthesize the origin of this debate and the treatment these researchers have given the concept.

First vulnerability is considered ''[M]ore an analytical approach than a conceptual category'' (ECLAC, 2002a, 1). But what analytic perspective?

Most Celade studies on vulnerability center on discussions of socio-demographic inequalities related to *poverty* and *social exclusion***.** In a document drawn up to systematize knowledge about the notion as it has been employed by its researchers, Eclac ''[A]ims to apply a vulnerability-oriented approach to the analysis of the relations between population and development at the community, household and personal levels.'' (ECLAC, 2002a, 1)

This orientation makes explicit what the authors understand as vulnerability and its theoretical-methodological application. Emphasis is given to the study and identification of *vulnerable groups,* which are those that present specific characteristics, which make them susceptible to risks. The delimitation of these groups is based on the components of both demographic and social dynamics.

> The use of the notion vulnerability to refer to specific groups of the population has a long history in social analysis and social policies. It is used, firstly, to identify groups which are in situations of 'social risk': i.e., groups made up of individuals who, because of factors typical to their domestic or community environment, are more likely to display anomic forms of conduct (aggressiveness, delinquency, drug addiction), to suffer different forms of harm by the action or omission of others (intra-family violence, attacks in the street, malnutrition), or to display inadequate levels of performance in key areas for social inclusion (such as schooling, work or interpersonal relations) (ECLAC, 2002a, 2).

Poverty and social mobility (especially toward the bottom of the social pyramid) are, in fact, the main themes that motivate these researchers.

> Thus, lack of assets, their loss value or inability to manage them properly form the distinctive sign of vulnerability to two social risks of capital importance: poverty, and downward economic and social mobility. (ECLAC, 2002a, 3)

In this regard, there is a trend toward understanding vulnerability as the susceptibility to sustain socioeconomic losses, such as in buying power, in the capacity for social inclusion or even in employment. The poverty line has sometimes been seen as one of those limits between more or less vulnerability (CELADE, 1999; ECLAC 2002b; Torres et al., 2003).

Vulnerability is understood, therefore, on the basis of three components: (1) the existence of a potentially adverse endogenous or exogenous event (risk); (2) the incapacity to respond to the situation, either because of the inefficiency of their defenses or lack of resources that give it support; (3) the inability to adapt to the situation generated by the materialization of the risk (ECLAC, 2002a, 1).

These components place the dynamic in three distinct stages: (1) there is a *potential* event, which may cause damage; (2) when faced with this *risk*, people seek ways of protecting themselves and they perceive that they are *incapable* of doing so because there are no resources or means to defend them; (3) when the event occurs, or *materializes,* people face the *hazard* and suffer from the lack of *ability* to *adapt* to it, thus sustaining *losses* and *damages*.

This perspective understands vulnerability in an essentially negative way, in an *inescapable* and *inevitable* sense.

In a convergence with this work at Eclac, Ruben Kaztman has been one of the main researchers to treat social vulnerability in conjunction with a group of researchers in Montevideo, Uruguay, and in Cordoba, Argentina. The most significant contribution of these authors has been to link a framework of *assets* and the *structure of opportunities* to vulnerability, in the same perspective as that taken by ECLAC.

In a comparative study of Argentina and Uruguay, Kaztman, Beccaria, Filgueira, Golbert, and Kessler (1999) show to what context the concepts of vulnerability and assets apply:

> [These concepts] are constituted or could constitute middle-range theories, not because of their pretension to take a subgroup from a macro phenomenon and explain it, but because they aim at approximating us to the explanation of the phenomenon of poverty in general, contributing with a type of efficient cause. It definitely seeks to provide a systematic body of concepts and relationships that explain part of the variation in poverty and well-being. This model finds its explanatory axis in the resources which households have to face outside situations. (Kaztman et al., 1999, 2) (our translation from the original Spanish)

It is this concern with poverty that leads the authors to propose what they call assets, which consist of a broad structure of resources (human, social and physical capital) distributed unequally in a society in different places. The

distribution of these assets, the strategies of using them and the exchanges that determine the production of the assets, as well as the distinct types of access to them, constitute the analytic basis for studying poverty.

The authors understand vulnerability as less availability, access or capacity to manage these assets, which are aspects of a given opportunity structure (where the assets are found), where one can investigate the social inequalities at hand more deeply, as they often condition criminality and exclusion.

According to the authors, as with the concept of populations in risk situations, vulnerability in this perspective requires a micro-social analysis at the community level. Through this approximation, the second greatest virtue of an approximation of vulnerability to assets can be seen, which is the possibility of ''[E]ntering into a key aspect, usually omitted, of intentional social action.'' (Kaztman et al., 1999, 4) (our translation from the original Spanish) This is a key point because it is the perspective of seeing a society respond to an adverse situation.

Obviously, there are other ways of contextualizing the discussion on socio-demographic vulnerability. Many authors discuss vulnerability in the context of citizenship and of identities (Hopenhayn, 2002), of civil rights and of citizenship as opposed to social exclusion (Kowarick, 2002) or even of social vulnerabilities to different diseases related to symbolic constructions and social representations (Monteiro, 2002). Without a doubt there is a broad range of issues that will also deserve more detailed evaluation and discussion.

However, due to its focus (poverty and exclusion), this socio-demographic understanding of vulnerability has a sense of a *condition* and not a direct correspondence to aspects that cause risks. Vulnerability is seen as more permanent, understood as a result of greater social interaction; the concept does not establish more direct causal relationships, as in its use by demographers (and geographers, as was seen above) occupied with vulnerability in its environmental dimension, as to be discussed below.

Population and environment: between geography and demography

As mentioned above, researchers from the population and environment relationship had been considering vulnerability since the early 90s, and more formal treatment followed the elaboration of the concept of populations in risk situations. This advance had two main matrices: the study of environmental hazards by geographers and studies of social vulnerability by demographers.

The geographical literature contains the earliest references to the environmental dimension of vulnerability. This confluence did not take place by mere coincidence but by the overlapping of problems of study. Like geographers, demographers were studying problems such as floods, landslides and other risks that exposed many populations to hazards (Hogan et al., 2001; Martine & Guzman, 1999).

In other contexts, the discussion on the dynamics of metropolitanization and environmental degeneration in densely urbanized areas also led demographers to study in greater detail the environmental (biophysical) factors to which certain populations are subject, sometimes demographically located and sometimes spatially delimited. This situation also brought to the surface concepts dealt with by geographers who follow a similar orientation, due to the origin of the problems studied (Hogan & Carmo, 2001).

But this confluence is not exclusive to the Brazilian literature. The international bibliography also refers to books and articles written from this perspective, where the interests of demographers and geographers come together under the heading of natural hazards (Blaikie, Cannon, Davis, & Wisner, 1994; EZRA, 2002; Hunter 2004; Satterthwaite, 1998).

In addition, socio-demographic vulnerability was also present in both cases, because, like geographers, the demographers involved understood vulnerability not only from an environmental perspective (biophysical aspects), but also because it is related to the socioeconomic capacity (assets and opportunity structure) of the respective populations to respond to the hazard. Some studies have gone further, seeking to identify post-disaster impacts in components of demographic change, which in turn affect the structure of populations' vulnerability (Martine & Guzman, 1999).

The notion of opportunity structure has an even greater contribution to be explored in these studies, since it broadens the range, and does not limit such assets to socioeconomic situations. In a risk situation, aspects of social capital, related neither to buying power nor to income, may be found among the assets that a given population uses to reduce its vulnerability. These are the networks of solidarity, systems of community and family protection, and other alternatives not directly related to a population's socioeconomic situation.

This discussion has become a central one in international fora. The *Global Science Panel on Population and Environment* (GSP), in a recent publication aimed at an appraisal of the role of population in strategies for sustainable development, included considerations on vulnerable populations. The focus given by the GSP is on vulnerable demographic segments and how they are related in the spatial (environmental) and social spheres. The text treated topics such as poverty and health, as well as low educational levels, gender differences, privation from access to resources and services, and unfavorable geographical location.

> Populations that are socially disadvantaged or lack political voice are also at greater risk. Particularly vulnerable populations include the poorest, least empowered segments, especially women and children. Vulnerable populations have limited capacity to protect themselves from current and future environmental hazards, such as polluted air and water, catastrophes, and the adverse consequences of large-scale environmental changes, such as land degeneration, loss of biodiversity, and climactic changes. (GSP, 2002, 3)

In this respect, reduced vulnerability is seen as essential for increasing sustainability. By equipping populations with the capacity to respond to adverse situations (whether social or environmental hazards) to which they are exposed, an improvement in their quality of life and social inclusion will result.

International institutions such as the International Human Dimensions Programme on Global Environmental Change (IHDP) or the International Union for the Scientific Study of Population (IUSSP) have promoted meetings and publications, as well as integrated research programs which have contributed to the elaboration of a broad dimension of vulnerability, linked to its environmental dimension. As examples we may cite the program ''Population, Land Use and Health in Frontier Regions, 2004–2006,'' connected to the IHDP and coordinated by Ronald Rindfuss of the Carolina Population Center. This project, after a decade of parallel studies on land use and land cover change seeks to establish an exchange among researchers of various world regions who study agricultural frontier areas. The themes of greatest interest to this project are changes in land cover, from environmental, health and demographic perspectives, as well as global environmental change. These studies have helped to direct interests of an evolving field and to systematize research results, as several books of collected articles have also done (Bilsborrow & Hogan, 1999; Lutz, Prskawetz, & Sanderson, 2002; Potrykowska & Clarke, 1995; Zaba & Clarke, 1994)

Regarding migration, Lori M. Hunter has made important contributions to the study of the relation of natural and technological hazards to migration motives. In an earlier study, she found that American counties with environmental hazards did not ''push'' migrants to other counties, though they did not ''pull'' them as much as counties without such hazards (Hunter, 1998). In a more recent article, she revisits traditional migration theory, incorporating vulnerability and risk to hazards as fundamental for understanding the migratory phenomenon in contemporary society. The author analyzes a considerable research literature of both geographical studies of environmental hazards and demographic research on migration.

> Migration as a demographic process can be associated with environmental hazards in several ways. On the one hand, proximate environmental hazards might influence residential decision-making by shaping the desirability of particular locales. In this case, we might consider environmental hazards as factors shaping migration. On the other hand, migration can represent an exacerbating force with regard to environmental hazards as a result of increasing population density in vulnerable locales. (Hunter, 2004, 4)

The idea of vulnerability in this paper, considering its emphasis on the geographic literature, is centered on places, that is, people in risk are people living in places vulnerable to hazards. This is not a simplistic position, however. Hunter brings into a common perspective the dynamics of extreme events (natural and technological), of family structure (demographic and social) and

of risk perception (by individuals), in order to understand the migratory phenomenon. In doing so, she is able to integrate social processes (who can or cannot choose how and where to migrate), environmental processes (physical phenomena and damages which affect individuals and families) and individual processes (perceptive and particular elements which influence vulnerability and decision making).

It is a significant contribution which seeks a conjunctive perspective of the multidimensionality of reality, suggesting possible paths for a fruitful dialogue between geography and demography. These paths have been trodden earlier by authors like Markos Ezra, in his studies on environmental vulnerability and migration in Africa (EZRA, 2002), or even earlier studies such as those by Hogan (1992, 1995) on the migration/environment/health relation, revealing facets and components of this dynamic in connection with environmental degradation, principally pollution, together with its social consequences. Although the concepts of risk, hazard and vulnerability were not yet incorporated in these analyses, the research concerns which would guide subsequent demographic research on population and environment were already present.

Demography, then, started off with a strictly objectivist notion centered on aspects of demographic dynamics, and evolved to a more global perspective that incorporated socioeconomic and environmental factors. This path represents a continuous approximation to geography, from which demographers can extract important notions and conceptual bases. The main meeting point is the concern that orients the work of these geographers and demographers: the relationships between humans and their milieu (geographers) and between populations and their spatial distribution (demographers). These relationships are in many senses different ways of expressing the same problematic, which converges in the interdisciplinary field of population–environment studies. This field joins both concerns, with some overlapping and mutual borrowing of concepts, which does not eliminate the difficulties and confrontations inherent in any interdisciplinary dialogue. Nevertheless, the advantages and mutual contributions are more important than the difficulties, considering the common goal of research centered on the spatial dimension, having as a basis the human and environmental elements. In the following section we evaluate the implications of this dialogue, in terms of the consequences and future challenges for geographers and demographers in the population–environment field.

Directions and challenges for research and practice

The concern with the environmental situation of populations in their diverse geographical contexts is a common focus for these researchers. The interest of geographers is based on space, which in a holistic perspective includes people, in their social dimension. For demographers the concern was based on the populations themselves and extended to the environment as an essential

factor for delimiting the living conditions of these groups. Therefore, both academic fields are interested and occupied with the same problems, even though their histories, as seen above, have been quite different.

In view of this, what directions, conjunctive if possible, can we expect from these two sciences? We traced a broad panorama of research which has occasional points of contact. But is there really any promising dialogue?

First, we should reinforce the multidimensional and polysemic character of the categories of risk, hazard and vulnerability. The different approaches and perspectives of study, much broader and varied than those we approached here, deal with the terms in specific theoretical-methodological contexts and from an analytic point of view. There is no common conceptual basis which different fields have used as a matrix. But there are undoubtedly certain confluent postures, especially when similar concerns exist, as is the case of geography and demography in the field of environmental studies.

This confluence can be seen in several aspects. For example, the description of the problem of populations in situation of risk (Hogan, 2000) brings up the same questions that moved research and discussion on natural hazards. The author holds that there is need for a focus that can account for the range of hazards and risks, in both their environmental and socioeconomic dimensions. This also occurs because demographers are studying these same hazards, based on an area of research specific to geographers, although not directly related to it.

There is a clear geographic problematic in the questions raised by Torres (2000), especially in regard to his concern with spatial limits, the scale of analysis, and the spatial distribution of phenomena.

Therefore, if, on the one hand, demographers have an important reference in the spatial treatment that geographers give to environmental dynamics, they have also produced a broad range of socio-demographic discussions that deserve the attention of geographers. Such studies can strengthen the vulnerability approach already present in their studies. We are thinking especially of studies on assets and opportunity structure, concepts that have much to contribute to a context of a broad understanding of vulnerability, beyond its socio-demographic dimension.

In this regard, elements of the physical environment can be incorporated to the list of assets, as they also have a place in the opportunity structure that people use to cope with risks, reducing their vulnerability. In addition, risks and vulnerabilities are also aspects that influence a population's spatial mobility. Fleeing risks (search for safety) and high vulnerability (search for protection) are among the most important motives in people's decisions to move from one place to another, especially for those sectors of the population that are able to do so. In a certain sense, these moves are part of the opportunity structure of these individuals, (but not of the majority), who seek housing in places where social and environmental factors are of higher quality.

These examples show that we need a more conjunctive understanding that can bring both socio-demographic and environmental aspects into the same

conceptual perspective. Cutter's proposal (Fig. 1) would seem to address this demand, as it seeks to establish some reciprocity between social and spatial spheres.

An issue that deserves greater attention is the methodological focus on analysis according to areas (risk/vulnerability of places/areas) and on analysis according to persons (risk/vulnerability of persons/families). More than expressing different paths of study of the two disciplines, these two foci are not, today, synonyms of geography and demography, respectively. Geographers have for some time worked with cultural and humanist approaches, which focus on the relationships of involvement, belonging and identity of persons and collectivities, using qualitative approaches and methodologies somewhat similar to anthropology (principally of phenomenological inspiration). On the other hand, demographers, especially those involved with environmental questions, have emphasized analysis according to specific areas, including spatial analysis, geostatistics and GIS.

In this sense, we see no mutually exclusive positions in these different approaches. Indeed, this may be another promising facet of the dialogue between the disciplines. Seeking to join these approaches increases analytical capacity and the dimensions of vulnerability under study. Evidently, adopting the ''vulnerability of place'' approach, as proposed by Cutter, is more appropriate for verticalized, in-depth studies in specific places. And it is precisely in these approaches that the approach on persons/families may become useful and revealing, by permitting greater detail of the reality as it is experienced by those who inhabit a specific place. On the other hand, the focus on persons in a wider perspective permits treatment of a greater number of spatially localized realities, but which have significant demographic (and also spatial) differences. This focus presents us with better delineated general views (a horizontal view), losing as a result the perspective of the verticalized place. In the same way, it is possible to join the two approaches, bringing information on persons/families related to the spaces they inhabit, as well as the relation existing between them in the socio-spatial macro-organization, whether of the city, the metropolis or of a larger region.

In view of this, we are moving toward a wide-ranging perspective of vulnerabilities and risks, which does not privilege only the focus on areas (the place) nor on persons (families). The larger ambition is to give risks/vulnerabilities a multidimensional and trans-scalar sense (Marandola Jr., 2004) which would permit us to work with the two approaches in an integrated way. We intend to work in this way with the social, environmental and demographic aspects at the same time we focus on the perspective of experience—related to sociocultural construction and to risk perception (Marandola Jr., 2005)—and global environmental change, seeking a link which connects such apparently distinct processes, but which in their genesis or in the final analysis, have clear links which point to the general sense of the future of society (Hogan & Marandola Jr., 2005).

Our tendency, then, is anthropocentric in the sense that we focus on the risk/vulnerability of persons/families, understanding, however, that for this

distinction the factors of different dimensions are fundamental; among them, the place, or the space (and all its implications) in which that person/family live. This does not mean defining risk or vulnerability *a priori*, as a condition of nature. Risk is the result of the hazard-vulnerability relation, and each of them arises from other equations which involve the different dimensions involved in the generation, in confronting and in the impact of the phenomenon. In this sense, it is not possible, in a wide-ranging perspective, to treat isolated aspects such as, for example, environmental factors *stricto sensu*. The geographic context and the social production of hazards, as well as systems of protection and insecurity which are the basis of the configuration of vulnerability, are varied and present us with a complex set of variables, conditions and indeterminations which lead us to seek ways of including socio-demographic determinants together with spatial-environmental aspects, in a historical and geographic perspective which is sufficiently broad to encompass the variety of the processes involved.

We still face, however, various difficulties to accomplish this conjunction. In view of this, we continue with an open-ended reflection, seeking better conditions for accomplishing this dialogue, to the extend that we deal with the difficulties inherent to the process.

To conclude, we list the main points of confluence and of mutual enhancement that we believe could constitute an agenda of dialogue between these two disciplines, with the objective of constructing this conceptual basis.

- In both disciplines *risk* is understood as a probabilistic notion that warns of a hazard and calls for action. In demography, risk began as a neutral concept, but it acquired essentially negative connotations in environmental and social studies, whereas it has always had a negative meaning for geographers;
- *Hazard* is an event that causes damage. It is intimately related to risk and vulnerability but is not a part of the vocabulary of demographers. It is commonly confused with risk, and a clear definition would improve the conceptual and explanatory framework;
- Demographers stress three constitutive components of *vulnerability:* (1) the existence of a risk; (2) incapacity to respond to the risk; (3) inability to adapt to the hazard. This position of demographers establishes vulnerability as essentially negative. That is, it places it as *in*capacity and as *in*ability. Although geographers deal with these three components, they see the concept as characteristic of places (not only of persons), and tend to see vulnerability as the *degree* of capacity to respond and of ability to adapt (adjustment). Demographers tend to see vulnerability as characteristic of less favored populations (fewer socioeconomic resources), whereas geographers tend to have a more marginal perspective, as they focus on vulnerabilities of places;
- *Resilience and capacity for absorption* are concepts that appear in the literature of both geographers and demographers. These are also promising concepts that show excellent analytic possibilities that can be better explored and delineated for use in research. The aim is to identify mech-

anisms that foster interconnectivity and flexibility, stimulating stronger resilience against impacts from outside. This approach will allow analyses to be made in terms of individuals, families, communities or the State;

- *Assets and opportunity structure* are also notions to be explored and expanded by putting them in the context of broader discussions beyond their socio-demographic dimension. The inclusion of elements from the biophysical environment seems promising for use by both geographers and demographers;
- Discussions on *citizenship, social exclusion* and *poverty* should also be included in this discussion of environmental vulnerability, because many socio-demographically vulnerable groups live in areas of high environmental vulnerability. This fact reinforces the idea of more conjunctive and broader concepts for focusing on problems related to environmental inequality, side-by-side with social inequality;
- The study of *sociocultural perceptions* and *constructions* concerning risk are also themes that have not yet been adequately explored by demographers. There are indications in this direction, but the issue has still not been faced by these researchers. This lacuna is important to the extent that it directly influences the results of public policies and efforts at prevention, protection and construction of structures of opportunities. In geography, although there is a broad tradition of studies on the perception of risk and of human experiences in their environments, greater efforts are still needed to bring together these approaches to biophysical and socio-demographic problematics. This is clearly a major challenge for both areas;
- There has been no systematic effort by either field to relate the factors studied (environments and demographic groups) to the dynamics of a *risk society*. Torres (2000) recognizes this failing and the difficulty of making the connection. But the effort could be mutually enriching and may increase the explanatory universe of the phenomena studied, as it builds a bridge between phenomena circumscribed in space with broader dynamics that operate in the sphere of the macro-social production of contemporary society. This is an important agenda for both fields that may provide a theoretical link for the classification of the different perspectives in the study of vulnerability;
- It will be important to specifically include *man-made hazards* in this discussion, as well as the social aspects of ''natural hazards''. The widespread use of pesticides, areas with soil contaminated by earlier industrial products, the proximity of transmission lines or gas and oil pipelines, etc., are spatially located hazards whose consequences are filtered by different vulnerabilities. If the greater objective of research is to consider quality of life and sustainability, it will be of no use to base one's positions on a rigid distinction between natural and man-made hazards. Studies on natural hazards have produced an important conceptual framework, but today they will have to be integrated into academic work that relativizes the notion of ''natural'';
- At the same time that these efforts are made, it will be necessary to look for *''synthesis'' indicators* of hazards and vulnerabilities. The harm caused

to the quality of life (of a population, an individual, a domestic group or a place) and to sustainability cannot be estimated by a simple sum total of hazards of floods, hazards of landslides, hazards of exposure to chemical products, etc. One major methodological challenge is to develop indicators that refer to hazards, risks and vulnerability (Cutter, 2003). This effort will not rule out the usefulness of sectoral studies, which will continue to orient policies that are also sectoral. But here, as in environmental planning in general, integrated perspectives are indispensable, even when the necessary interventions are sectoral;

- However, the consequences of this approach for *public policy* deserve special attention. Prevention, mitigation and recuperation activities which recognize that effective action requires an integrated, multi-level approach will meet with greater success in limiting the suffering of those populations facing risk and those for whom the risk materializes.

The advantages of these lines of research include the fact that they draw our attention to factors other than poverty, *stricto sensu*, and to the adoption of perspectives that are clearly inter- and multi-disciplinary and that can enhance analytical frameworks and the understanding of these phenomena that are so latent and so excruciating in our cities.

In addition to this, the present questions which go beyond several contemporary fields of research, in different sciences, require greater attention and study on the part not only of geographers and demographers, but of others concerned with social and environmental questions in general.

Population–environment studies have much to gain from intensifying this dialogue. The spatial dimension is at the heart of these discussions, and its theoretical-methodological incorporation requires more refined and precise epistemological foundations. Although we do not yet have all the necessary elements for this incorporation, the path begun here may contribute to this joint construction of the field of population and environment.

These are only a few of the preliminary questions and considerations that will require refinement during the exercise of this dialogue between geography and demography, ours in particular, and that of the study group as a whole. This is one of the challenges that we hope will contribute to the study of the environmental situation of populations for whom risk is a dark shadow hovering over their lives and homes. Awareness of the different vulnerabilities of these populations can contribute to the identification of the assets they need to be able to respond more adequately to such hazards and thus improve their perspectives and quality of life.

References

Aneas de Castro, S. D. (2000). Riesgos y peligros: una visión desde lá Geografía. *Scripta Nova: Revista Electrónica de Geografía y Ciencias Sociales*. Barcelona, n.60, 15 de mar. 2000. See: <http://www.ub.es/geocrit/sn-60.htm>.

Ayoade , J. O. (1983). *Introduction to climatology for the tropics*. New York: John Wiley & Sons.
Ayres, J. R. de C., França Júnior, I., Calazans, G. J., & Saletti filho, H. C. (1999). Vulnerabilidade e prevenção em tempos de aids. In: R. M. Barbosa, & R. Parker, *Sexualidades pelo avesso*: *direitos, identidades e poder*. São Paulo: Ed. 34, pp. 49–72.
Barbosa, L. de M., & Andrade, F. C. D. (2000). Aplicação das técnicas dos riscos competitivos à mortalidade do Brasil e macrorregiões, 1991. In: Encontro nacional de estudos populacionais, 12. See: <www.abep.org.br>.
Barclay, G. W. (1958). *Techniques of population analysis*. New York: John Wiley & Sons, 311 p.
Bilsborrow, R. E., & Hogan, D. J. (Eds.) (1999). *Population and deforestation in the humid tropics*. Liège: IUSSP.
Blaikie, P. M., Cannon, T., Davis, I., & Wisner, B. (1994). *At risk: Natural hazards, people's vulnerability, and disasters*. London: Routledge, 284 p.
Brookfield, H. (1999). Environmental damage: distinguishing human from geophysical causes. *Environmental Hazards: Human and Policy Dimensions, 1*(1).
Burton, I., Kates, R. W., & White, G. F. (1978). *The environmental as hazard*. New York: Oxford University, 240 p.
Celade - Latin American & Caribbean Demographic Centre (1999). *Vulnerabilidad demográfica y desventajas sociales*: el caso del Chile. Santiago del Chile: LC/DM/R. [Área de Población y Desarrollo].
Connors, M. (1992) Risk perception, risk taking and risk management among intravenous drug users: implications for Aids prevention. *Social Science and Medicine, 34*(6), 591–601.
Cruz, M. C. C. da, & Leite, I. da C. (2002). Fatores de risco para déficits estaturais no segundo ano de vida: Brasil, PNDS, 1996. *Revista Brasileira de Estudos de População,* ABEP, *19(1)*, 131–140.
Cutter, S. L. (Ed.) (1994). *Environmental risks and hazards*. London: Prentice-Hall, 413 p.
Cutter, S. L. (1996). Vulnerability to environmental hazards. *Progress in Human Geography, 20*(4), 529–539.
Cutter, S. L. (2003). The vulnerability of science and the science of vulnerability. *Annals of the Association of American Geographers, 93*(1), 1–12.
Douglas, M. (1966). *Purity and danger: an analysis of concepts of pollution and taboo*. London: Routledge & Kegan Paul, 188 p.
Douglas, M. (1985). *Risk, acceptability according to the social sciences*. New York: Russell Sage Foundation, 115 p.
Douglas, M., & Wildavsky, A. (1982). *Risk and culture: an essay on the selection of technological and environmental dangers*. Berkeley: University of California, 221 p.
Eclac – Economic Commission For Latin America. (2002a). *Socio-demographic vulnerability: old and new risks for communities, households and individuals. Summary and conclusions*. Brasilia: UNA, 34 p.
Eclac – Economic Commission For Latin America. (2002b). *Proposal on indicators for follow-up to the goals of the International Conference on Population and Development in Latin America and the Caribbean*. Santiago del Chile: United Nations, 74 p. [Serie Población y Desarrollo].
Ezra, M. (2002). Environmental vulnerability, rural poverty, and migration in Ethiopia: a contextual analysis. *Genus Lix, 2*, 63–91.
García, C. C. (2003). Construcción social del riesgo. Vulnerabilidad y habitabilidad de la vivienda de interés social en la Ciudad de México. 1985–2000. In: Encuentro de geógrafos de América Latina, 9, Mérida, México, 2003. *Programa general y resúmenes*. Mérida: Instituto de Geografia, UNAM.
Gardner, J. S. (2002). Natural hazards risk in the Kullu District, Himachal Pradesch, India. *The Geographical Review, 92*(2), 282–206.
Giddens, A.. (1990). *The consequences of modernity*. Stanford: Stanford University Press.
Global Science Panel On Population and Environment – GSP. (2002). *Analyses, goals, actions, realities*. IUSSP: UNU, 10 p.
Hewitt, K., & Burton, I. (1971). *The hazardousness of a place: a regional ecology of damaging events*. Toronto: University of Toronto Press, 154 p.
Hogan, D. J. (1992). Migração, ambiente e saúde nas cidades brasileiras. In D. J. Hogan, & P. F. Vieira (Eds.), *Dilemas socioambientais e desenvolvimento sustentável*. Campinas: Ed. da Unicamp, pp. 149–170.

Hogan, D. J. (1995). Population, poverty and pollution in Cubatão, São Paulo. *Geographia Polonica 64*, 201–224.
Hogan, D. J. (2000). A relação entre população e ambiente: desafios para a demografia. In H. da G. Torres, & H. Costa (Eds.), *População e meio ambiente: debates e desafios*. São Paulo: Senac, pp. 21–52.
Hogan, D. J., & Carmo, R. L. do. (2001). Distribuição espacial da população e sustentabilidade: alternativas de urbanização no Estado de São Paulo, Brasil. *Idéias,* Campinas, *8*(2), 151–190.
Hogan, D. J., Cunha, J. M. P. da., Carmo, R. L. Do., & Oliveira, A. A. B. de. (2001). Urbanização e vulnerabilidade sócio-ambiental: o caso de Campinas. In: D. J. Hogan, R. Baeninger, J. M. P. Da. Cunha, & R. L. do. Carmo (Eds.), *Migração e ambiente nas aglomerações urbanas*. Campinas: NEPO/UNICAMP, 395–418.
Hogan, D. J., & Marandola Jr., E. (2005). Toward an interdisciplinary conceptualization of vulnerability. *Population, Space and Place, 11*, 455–471.
Hopenhayn, M. (2002). A cidadania vulnerabilizada na América Latina. *Revista Brasileira de Estudos de População, 19*(2), 05–18, jul./dez. 2002. See: <http://www.abep.org.br>.
Hunter, L. M. (1998) The association between environmental risk and internal migration flows. *Population and Environment, 19*(3), 247–277.
Hunter, L. M. (2004). *Migration and environmental hazards*. Boulder: Institute of Behavioral Science (IBS), 2004. 39p. [Working Paper].
Jones, D. (1993) Environmental hazards in the 1990s: Problems, paradigms and prospects. *Geography, 78*(2), 161–165.
Kates, R. W. (1978). *Risk assessment of environmental hazard.* London: John Wiley & Sons, 1978. 112 p. [SCOPE Report 8].
Kaztman, R., Beccaria, L., Filgueira, F., Golbert, L., & Kessler, G. (1999). *Vulnerabilidad, activos y exclusión social en Argentina y Uruguay*. Santiago de Chile: OIT, 22 p. [Documento de Trabajo, 107].
Kolars, J. (1982). Earthquake-vulnerable populations in modern Turkey. *The Geographical Review, 72*(1), 20–35.
Kowarick, L. (2002). Viver em risco: sobre a vulnerabilidade no Brasil urbano. *Novos Estudos CEBRAP, 63*, 9–30.
Liverman, D. M. (1990) Drought impacts in Mexico: Climate, agriculture, technology, and land tenure in Sonora and Puebla. *Annals of the Association of American Geographers, 80*(1), 49–72.
Luhmann, N. (1993) ***Risk****: a sociological theory. (trad. Rhodes Barrett)*. New York: Aldine de Gruyter, 236 p.
Lupton, D. (1999) *Risk*. London: Routledge, 184 p.
Lutz, W., Prskawetz, A., & Sanderson, W. C. (Eds.) (2002). *Population and environment*: *Methods of analysis*. Population and Development Review, 251 p.
Marandola Jr., E. (2004). Uma ontologia geográfica dos riscos: duas escalas, três dimensões. *Geografia, 29*(3), 315–338.
Marandola Jr., E. (2005). Vulnerabilidades e riscos na metrópole: a perspectiva da experiência. In: Encontro Nacional da Associação Nacional de Pós-Graduação E Pesquisa em Planejamento Urbano e Regional – ANPUR, 14, 2005, Salvador. Anais. Salvador: Anpur, 2005. [CD-ROM] See: <http://www.xienanpur.ufba.br>.
Marandola Jr. E., & Hogan, D J. (2004a). Natural hazards: o estudo geográfico dos riscos e perigos. *Ambiente & Sociedade, 7*(2), 95–109.
Marandola Jr. E., & Hogan, D. J. (2004b). O risco em perspectiva: tendências e abordagens. *Geosul, 19*(38), 25–58.
Marandola Jr. E., & Hogan, D. J. (2005). Avaliação preliminar do desenvolvimento dos estudos de população e ambiente no Brasil: métodos, temáticas e perspectivas. Paper presented at Workshop ''Population and Environment: approach metodologies''. Campinas: Work Group Population and Environment (ABEP); NEPO/UNICAMP. 10 nov. 2005.
Martine, G. (2001). The sustainable use of space: advancing the population/environment agenda. *Population-Environment Research Network*. Jan. 2001. In: <http://www.populationenvironmentresearch.org/papers/Martine_paper.pdf>.
Martine, G., & Guzman, J. M. (1999). Population, poverty and vulnerability: Mitigating the effects of natural disasters. *SDdimensions,* SD/FAO, dec. 1999. In: <http://www.fao.org/sd/wpdirect/wpan0042.htm>.

Monteiro, S. (2002). Gênero, saúde e proteção entre jovens: um perfil tradicional. In: R. M. Barbosa et al. *Interfaces*: gênero, sexualidade e saúde reprodutiva. Campinas: Ed. da UNICAMP, pp. 23–48.

Moser, C. (1998). *The Asset Vulnerability Framework:* Reassessing Urban Poverty Reduction Strategies. World Development.

Moser, C. (2004). Rights, power and poverty reduction. In: R. Alsop (Ed.), *Power, rights and poverty*: *Concepts and connections*. Washington: World Bank.

Naughton-Treves, L. (1997). Farming the forest edge: vulnerable places and people around Kibale National Park, Uganda. *The Geographical Review, 87*(1), 27–46.

Oppong, J. R. (1998) A vulnerability interpretation of the Geography of HIV/AIDS in Ghana, 1986–1995. *Professional Geographer, 50*(4), 437–448.

Padlog, M., & Márquez-Azúa, B. (2003). Vulnerabilidad y resistencia: expertos y pobladores frente al riesgo de erupción volcánica. In: Encuentro de Geógrafos de América Latina, 9, Mérida, México, 2003. *Programa general y resúmenes*. Mérida: Instituto de Geografia, UNAM.

Paicheler, G. (1999). General population and HIV prevention strategies: from risk to action. *Cadernos de Saúde Pública, 15*, 93–105, [Suplemento 2].

Palm, R., & Hodgson, M E. (1992). Earthquake insurance: mandated disclosure and homeowner response in California. *Annals of the Association of American Geographers, 82*(2), 207–222.

Paulson, D. D. (1993) Hurricane hazard in Western Samoa. *The Geographical Review, 83*(1), 43–53.

Porto, M. F. de S., & Freitas, C. M. de. (2000). Indústria química brasileira, acidentes químicos ampliados e vulnerabilidade social. In: H. Da G. Torres, & Costa, H. (orgs.), *População e meio ambiente: debates e desafios*. São Paulo: Senac, pp. 301–326.

Potrykowska, A., & Clarke, J. I. (Eds.) (1995). *Population and environment in industrialized regions. Geographia Polonica*. *Polish Academy of Sciences, 64*, 225–256.

Saad, P. M., & Potter, J. E. (1994). Uma análise de riscos competitivos sobre o uso de métodos anticonceptivos no Nordeste. In: Encontro nacional de estudos populacionais, 9. See: <http://www.abep.org.br>.

Satterthwaite, D. (1998). Rapid urbanization and the environment. In: M. Livi-Bacci, & G. de. Santis (Eds.), *Population and poverty in the developing world*. Oxford: Claredon, pp.189–291.

Smith, K. (1992). *Environmental hazards: assessing risk and reducing disaster*. London: Routledge, 324 p.

Taschner, S. P. (2000). Degradação ambiental em favelas de São Paulo. In: H. da G. Torres, & H. Costa (Eds.) (orgs.), *População e meio ambiente: debates e desafios*. São Paulo: Senac, pp. 271–297.

Timmerman, P. (1981). *Vulnerability, resilience and the collapse of society*. Toronto: Institute for Environmental Studies, University of Toronto, 1981. [Environmental Monograph n.1].

Torres, H. da G. (2000). A demografia do risco ambiental. In: H. da G. Torres, & H. Costa (Eds.) (orgs.), *População e meio ambiente: debates e desafios*. São Paulo: Senac, pp. 53–73.

Torres, H. da G., & Costa, H. (2000). *(orgs.) População e meio ambiente: debates e desafios*. São Paulo: Senac, 351 p.

Torres, H. da G., & Marques, E. (2001). Reflexões sobre a hiperperiferia: novas e velhas faces da pobreza no entorno municipal. *Revista Brasileira de Estudos Urbanos e Regionais, 1* (4), 49–70.

Torres, H. da G., Marques, E., Ferreira, M. P., & Bitar, S. (2003). Pobreza e espaço: padrões de segregação em São Paulo. *Estudos Avançados, IEA, 17*(47), 97–128.

Watts, M. J., & Bohle, H. G. (1993). The space of vulnerability: the causal structure of hunger and famine. *Progress in Human Geography London, 17*(1).

White, A. V., & Burton, I. (1980) *Environmental risk assessment*. London: John Wiley & Sons, 157 p. [SCOPE 15].

White, G. F. (Ed.) (1974). *Natural hazards: local, national, global*. New York: Oxford University Press, 288 p.

Zaba, B., & Clarke, J. I. (1994) *Environment and population change*. Liège: Ordina Éditions.