

DEMOGRAPHIC DYNAMICS AND ENVIRONMENTAL CHANGE IN BRAZIL*

DANIEL JOSEPH HOGAN**

INTRODUCTION

As one of the world's largest countries, in terms of both territory and population, Brazil has been an inevitable focus of attention for population-environment concerns. In the last quarter of the 20th century, as both issues moved to center stage on international policy agendas, the realities behind these concerns, and political response to them, were polemical issues. At the level of international diplomacy, Brazil was an active participant in UN conferences on population and on environment. At the level of scientific inquiry, demographic studies sought to avoid the oversimplifications often present in such political debate, while seeking to contribute to an understanding of the relationships between these two orders of phenomena. Research agendas were defined, to a considerable extent, by Brazil's specific socio-economic realities and their political context.

What has Brazilian demography had to say about population and environment? The first challenge was to develop approaches which did not simply extend run-of-the-mill neo-Malthusianism; i.e., the issue was not reducible to the pressure of numbers on resources, but the two dynamics – demographic and ecological – had important interactions which (1) were new, inasmuch as the environmental situation had changed so radically over the 20th century and (2) had been largely unrecognized or ignored by demographers. This process occurred at a moment when Brazil's demographic transition was entering a new phase and population stability was visible. This fact had two important implications for the development of this field. On the one hand, it was now possible to separate consequences of rapid growth and identify environmental determinants and consequences of demographic phenomena. On the other hand, Brazilian (and in general, Latin American) demography, relaxing a decades-long resistance to the *controlista* view of the relations between population and development (given the waning of this view within the demographic establishment), was able to consider, as legitimate fields of research, themes which earlier had been regarded as mere apologies of such a view.² This discussion has been developed in several papers (HOGAN, 1991; 1992; 2000) and will not be repeated in this text.

The second challenge was to identify these interactions and search for concepts and methodologies capable of analyzing and explaining them. Much of the 1990s was given over to this task, mirroring developments at the international level. This work will be examined in the second part of this text and constitutes its central focus of attention.

Finally, this work has led some demographers to view the population and environment issue as not merely adding one more variable to population analysis, but as requiring an entirely new approach to the field of population and development. A new “environmental demography” has been proposed (HOGAN, 2001). This idea will be briefly discussed in the third section.

Among world nations, Brazil has one of the greatest ecological and cultural diversities. Such diversity provides greater resilience to Brazilian development, with more degrees of freedom than most countries enjoy. The final section of this text represents an initial attempt at characterizing population and environment relationships in the major biomes of Brazil, with a view to identifying the distinct roles each area has in answering the competing needs of economic development and environmental preservation.

ENVIRONMENTAL FACTORS IN BRAZILIAN POPULATION STUDIES, 1982-2001¹

Systematic work in this field can be traced to the initial activities of the Population Studies Center (Nepo) of the State University of Campinas in 1982, when *population and environment* was defined as one of Nepo’s research areas. Two reference dates are worth recalling. The first event organized specifically on these issues took place at Nepo in 1986. The *Workshop on Demographic Dynamics and Environmental Pollution (Workshop Sobre Dinâmica Demográfica e Poluição Ambiental)* (July 2-3, 1986) brought together sociologists, geographers, ecologists, physicians, political scientists and architects to discuss, from an interdisciplinary perspective, demographic aspects of urban environmental problems (HOGAN, 1987). This initial attention to the “brown agenda” contrasts with events at the international level, where early considerations were directed to such issues as deforestation, biodiversity and soil loss. The focus on health and population distribution reflected both the intention to avoid a simplistic “pressure of numbers on resources” perspective and a conviction that in a country already urbanized, the greatest impact on population would come from **urban** environmental issues.

A second important date was the creation of the Population and Environment Working Group of the Brazilian Population Studies Association (Abep) in 1991. Coordinated by George Martine, and with the support of the MacArthur Foundation, this group was fundamental in defining a consistent scientific agenda and in promoting opportunities for furthering this new field. In this regard, the decade of the nineties was marked by two books which brought together earlier work by Working Group members (MARTINE, 1993) and representative work produced in the context of the working group itself (TORRES & COSTA, 2000).

Precursors of these developments include analyses of Amazonian settlement and of certain health aspects of environmental factors. In these cases,

however, environment entered into the analysis either as an extension of migration or morbidity research, or as incidental to the basic issues under study.

Migration and colonization in the Brazilian Amazon

Concern with the Amazon was reflected early in the work of Abep. At its first meeting in 1978, George Martine (1978) discussed internal migration and the colonization experiences of the National Institute for Colonization and Agrarian Reform (INCRA). Martine summarized research on three main avenues of Amazon settlement: (1) the Belém-Brasília highway, where he considered earlier colonization efforts up to the 1970s, before the highway construction; (2) the Transamazon highway, beginning in the 1970s; and (what was then) more recent experiences along the BR 364 highway (Porto Velho-Cuiabá) in Rondônia. He concluded that these programs failed to settle small farmers, to the benefit of large, capitalized landowners – a result of official incentives for the latter and the lack thereof for the former. Jorge Jatobá reached similar conclusions for a case study of the colonization of Alto Turi in the “pre-Amazon” region of Maranhão (Souza, 1978). This Sudene project, begun in 1962, also failed to provide family farmers with the necessary support; again, large agribusiness interests were found to prevail.

In the first article of the first issue of Abep’s journal, *Revista Brasileira de Estudos Populacionais*, Donald Sawyer published a theoretical essay on a structural and spatial interpretation of these frontier movements, an essay which continues to be an important reference in the discussion of Amazonian settlement. Sawyer (1984)² analyzed the Center West region as well as the Amazon, and related frontier movements to capitalist expansion of agriculture. With urbanization and industrialization, when population and economic activities were concentrated in cities, part of the excess population moved to new frontiers, farther into the “interior”. Here, conditions were found for market-oriented agriculture and for the expansion of peasant production. Although capitalist in nature, these pioneer fronts lost out to modern agriculture, integrated to agro-industry, considering the requirements of the latter for spatial concentration. Empirical case studies had provided the necessary evidence for such considerations. (See, for example, ALMEIDA & ALBUQUERQUE, 1982a, 1982b; COSTA & OLIVEIRA, 1982; PINTO, 1982; TURCHI, 1982). The early 1980s also saw other contributions to a general understanding of these processes (ANDRADE, 1982; GRAZIANO DA SILVA & KAGEYAMA, 1982; MARTINE, 1982).

Several studies followed, with similar conclusions, on Rondônia (TURCHI, 1980) and Acre (OLIVEIRA, 1980). Oliveira analyzes what would become a major theme of Amazon settlement – the precocious urbanization of the frontier (MARTINE & TURCHI, 1988; TORRES, 1988, 1990). Adopting a historical perspective, Oliveira examines the rubber boom (1880-1910); the period marked by mercantile and subsistence production (1910-1960); and the opening of the agricultural frontier beginning in the 1960s. This period is marked by the end of the predominance of small farms and large scale migration to Acre’s capital, Rio Branco. This article

anticipates studies of the rapid urbanization of the frontier, a phenomenon which will be found in both Center West and Amazon regions (RIBEIRO, 1994).

In an early paper on natural resources in the Amazon, ecologist Mário Menezes (1980) analyzes soil conditions, potential for lumbering and other factors, in addition to economic and institutional features of the Amazon, identifying environmental degradation as a permanent element of the intensive agricultural occupation of frontier lands in Brazil. The author, in an effort demographers would only pursue much later, sought to define areas where human settlement was viable, considering the distribution of natural resources. Two decades later, it is remarkable how much data on the natural potential of the Amazon were available to orient population settlement – an unrealized goal. At about this time, Fearnside (1986, 1999) would elaborate on the connection between the lack of success in settling small farmers and environmental degradation. Fearnside distinguished two stages in the migration/deforestation/soil impoverishment cycle. Observing the intense deforestation in Rondônia in the 1980-85 period, recorded in Landsat images, it was obvious that original settlers provoked rapid deforestation to begin their activities. What satellite images did not reveal, however, was that these first settlers, unable to sustain their farms, soon abandoned their lots to others in a process of land concentration:

The *greater financial resources and different cultural backgrounds of second owners* mean that they clear a larger area per year than do the original colonists (FEARNSIDE, 1986: 7481 [my emphasis])

This is similar to Sawyer's conclusion that small lots are predatory because they are precarious. If they had had conditions to remain on their lots, first settlers would not have been replaced by entrepreneurs with a different logic of exploitation of natural resources (SAWYER, 1987).

Similar studies of land use change and patterns of migration and population settlement include those on Paraná (BASTOS, 1982), Paraíba (GUERTECHIN, 1982), São Paulo (MÜLLER, 1982), Mato Grosso (GORDIN, 1982), Bahia (MACHADO, 1990) and on the North and Center-West regions as a whole (SAWYER & PINHEIRO, 1984). Indeed, the rapid transformation of Brazilian agriculture motivated other analyses of the relations between population dynamics and agricultural modernization (GRAZIANO DA SILVA, 1980; GRAZIANO DA SILVA & KAGEYAMA, 1982; MARTINE, 1982; MÜLLER, 1982; IVO, 1984). Motta's analysis of migration and the development of alcohol production in the State of São Paulo (spurred by the oil crises of the 1970s) is typical of work at this time: economic and population aspects are examined without a central role for the environmental impacts which this program would have, an impact felt in both cities (lower air pollution) and in rural areas (loss of biodiversity, intensive use of agrochemicals, etc.). Other work which dealt with themes which would later be seen as environmental issues include Martine & Garcia (1984) on food production and Worms (1982) on health aspects of colonization projects.

With the notable exception of the earlier work of Sawyer (1986, 1987) and Monte-Mor (1986), the first decades of contemporary frontier expansion concentrated demographers' attention on migration and colonization issues, without

identifying an environmental link. This concern with agricultural expansion, especially in the Amazon region, would lead to more explicit incorporation of environmental concern in the 1990s. The continuing analysis of population movements in the Amazon would increasingly deal with deforestation and loss of fertile soils. While this coincides with society's growing concern about deforestation at both national and international levels (BILSBORROW & HOGAN, 1999), it was not exactly an inability to recognize or prioritize this question (as the invitation to ecologist Menezes to participate in Abep's 1980 meeting attests), but the difficulties of interdisciplinary research and the lack of any tradition of environmental research in demography which delayed linking demographic and environmental concerns.

One of the major sources of Brazilian demography's concern with environmental issues was the research discussed above. Several key figures in field developed their environmental emphasis in this context (MARTINE, 1993; SAWYER, 1992; TORRES, 1993; SYDENSTRICKER NETO, 1992; MONTE-MOR, 1986). But this was only one side of the development of population-environment studies in Brazil. To bring the issue closer to home, away from the exotic Amazon, it would be necessary to deal with questions which both academics and the general population confronted on a daily basis. Environmental change could not be understood as a sectoral problem, unconnected to all aspects of development.

Population and the "brown agenda"

The first specifically environmental papers presented at Abep meetings dealt with health consequences of air pollution (HOGAN, 1988) and the role of internal migration and commuting in maintaining the degraded environmental situation of the steel and petrochemical center of Cubatão (HOGAN, 1990). It was this urban emphasis which was to focus the attention of Abep's new Working Group on Environment. In part, this was a reaction to the exclusive focus of international groups on deforestation and biodiversity (where the "population explosion" was invoked as the major threat to the environment), and in part due to a perception that Brazil's greatest environmental problems were in cities. Air pollution and respiratory illness; the lack of sewage treatment and consequent water pollution; urban sprawl and a horizontal urbanization process; extremely rapid urban growth and the difficulties this presented for urban management and the provision of environmental amenities: these were the issues which structured the agenda of the Abep group in the early 1990s. These urban issues had appeared earlier in a "pre-ecologized" context of the analysis of health and urban growth. Thus, for example, Ferreira (1992) analyzed the decline of infant mortality in São Paulo in the light of investments in basic sanitary infrastructure since the 1970s, and Oya-Sawyer et al., (1987) examined the impacts of urbanization and industrialization on mortality.

But what motivated the group's work was the view that man's interference in – and alteration of – the natural world had reached a crucial point by the late 20th century. The conditions in which we and future generations will live had changed

fundamentally. It was no longer possible to treat environmental factors as epiphenomena of the capitalist mode of production (a view very much present in Brazilian social sciences) nor as incidental noise in a system whose technological orientation would be capable of overcoming such obstacles. Neither were environmental concerns of importance only to counter-cultural “greens” whose alternative value system eschewed contemporary materialist society in favor of simple lifestyles in harmony with nature. Environmental constraints, it was increasingly clear, required rethinking “business as usual.” The ideology of abundance and unlimited resources, so much present in Brazilian life, was based on false premises. While the country’s continental proportions and rich resources had sustained this ideology for centuries, the reality of **limits** began to be absorbed.

For the group’s work, it was especially important to bring this discussion to bear on issues which affected the majority of the population. It was not that the earlier work on the Amazon had no implications for population-environment studies, but that urban problems were more present in people’s lives. And the question did not arise from abstract values concerning forests, sea turtles or the natural landscape. Very concrete features of environmental degradation affected the well-being of Brazil’s urban population – nearly 80% in 1990.

Thus, the work on Cubatão (HOGAN, 1988, 1990, 1993, 1994, 1995) was part of a preliminary consensus on the role of urban problems in environmental studies. Environmental pollution was also analyzed in the petrochemical complex of Camaçari (Salvador) (Noronha et al, 1985; Franco, 1993), drawing attention to the relations between industrial organization and the victims of pollution. More generally, Torres examined the growing importance of “dirty industry” in Brazil’s industrial structure. Smolka (1993), Costa (1992, 1998), Ferreira and Siviero (1994), Lago (1998), Nahas et al. (1996) and Cardoso (1998) also focused on the city in studies of environment, intra-urban structure and sustainability. As representative of the discipline’s view of population-environment interactions, the Martine collection also included an analysis of environmental policy in Brazil (FERREIRA, 1993) and a chapter on involuntary population movements related to large construction projects (VAINER, 1993). The single reminder of the earlier phase of Amazon studies was Sawyer’s review of population and environment in the Brazilian Amazon (SAWYER, 1993).

The initial emphasis on urban environmental problems reflected two concerns which were important starting points for this work. In the first place, the role of nature in society/nature relations is both as a *source* of natural resources used in productive processes and as a *sink* which receives the detritus of these processes. Brazil’s abundant resources placed the source function on a lower order of priority. The importance of biological diversity, while a basic ecological principle, was recognized as urgent by biological sciences, but not yet by social scientists nor by society at large.

Even the environmental problems produced by urbanization, however, were not immediately accorded the necessary priority in policy agendas. Brazil’s rapid urbanization process, with its accompanying social inequality, resulted, among other things, in individual solutions to meeting needs. Those social classes with resources,

for example, to build septic tanks could dispense with municipal waste collection and treatment. Much of the urbanization of this period was horizontal in nature and urban sprawl meant that a very considerable part of the middle and upper classes lived on tree-lined streets where septic tanks were viable. The same horizontal pattern of urban growth reinforced a transportation system which was heavily dependent on the automobile: again an individual solution which produced air pollution and noise, as well as traffic congestion for those segments of society able to afford private cars. This meant low priority for efficient public transportation, which, with few exceptions, was based on pollution-producing buses.

In the second place, the environment is conceived not as limited to the natural world but as including the human species, with its specific social organization and institutions. In this context, environmental deterioration – filtered by this organization and these institutions – not only diminished urban green spaces and polluted air and water, but contributed to the burden of social inequality borne by less-favored segments of society. Pollution is not a democratic plague, affecting all of society equally. While some problems, such as biodiversity loss, thinning of the ozone layer and climate change, alter the very biosphere and affect all humans, *local* environmental problems are differentially felt by different social segments. The same social structure which distributes, in an unequal way, the benefits of society, also distributes the ills unequally.

These ideas informed early demographic work on population-environment interactions in Brazil. In particular, health and morbidity analysis identified who pays the price of pollution (HOGAN, 1988, 1992, 1995; FERREIRA, 1987; FRANCO, 1997; MARQUES, 1996; MARQUES & TORRES, 2000; FIRPO, 2000; TORRES, 1998, 2000; MONTELEONE NETO, 1986; MONTELEONE NETO et al., 1985, 1986; DUCHIADE & BELTRÃO, 1992). On the one hand, environmental factors operate through their spatial character, concentrating poorer populations in closer proximity to sources of pollution or in areas not served by environmental amenities. On the other hand, less healthy individuals (from malnutrition or from more limited access to health care) offer less resistance to the assaults of environmental degradation. Ferreira & Sawyer (1986), Monte-Mor, (1986) and Barbieri et al. (2000) discuss these interrelations in frontier regions, in the case of malaria which affects migrant populations. More such work will be necessary to overcome the urban/frontier divide in population-environment analysis. This is one of the challenges researchers will face in the immediate future.

In this regard, recent studies of health and environmental factors have opened new avenues of research. It has always been difficult to assess the aggregate effects of environmental stress on health – and to identify how these factors operate in the context of contemporary societies. Water-borne and respiratory diseases, for example, afflict the poor differentially, through social-structural filters. Until recently, though, research in this area was limited to a mass of case studies, many of which were produced in the context of control of industrial pollution – both within the workplace and in the ambient environment. New work has developed measures of equivalence

which permit rough comparisons of health consequences in different settings and countries. The World Health Organization, which has pioneered in this field, has estimated the burden of disease from poor household environments in developing countries (WORLD BANK, 1993), identifying eight principal diseases:

1. tuberculosis (related to crowding);
2. diarrhea (related to sanitation, water supply and hygiene);
3. trachoma (related to water supply and hygiene);
4. tropical cluster³ (related to sanitation, garbage disposal, vector breeding around the home);
5. intestinal worms (related to sanitation, water supply and hygiene);
6. respiratory infections (related to indoor air pollution and crowding);
7. chronic respiratory diseases (related to indoor air pollution); and
8. respiratory tract cancers (related to indoor air pollution).

According to the index of health burden developed by the WHO/World Bank team, 29% of this burden is due to diarrhea and 35% to respiratory infections; when chronic respiratory diseases are added to infections, this share reaches 47%.

A major obstacle to assessing the dimensions of this aspect of population-environment interactions is lack of data. This problem motivated the WHO study and similar research is underway in Brazil. The fields of epidemiology and occupational health have produced a considerable research literature on health in the workplace, in homes and in the ambient environment. Much work is to be done, however, to reinterpret this body of literature from an environmental perspective, with the objective of assessing the aggregate consequences for morbidity and mortality patterns.⁴

The other component of demographic dynamics which has been seen to be relevant in environmental terms is population distribution processes. In the long run, even when demographic pressure may no longer be an issue and if environmental threats to health were to be controlled, *where* populations **live, work and play** will be crucial aspects of sustainability.

Population distribution processes, and their environmental determinants and consequences, have been examined in many different settings over the last decade:

- In the São Paulo Metropolitan Area – SPMA – daily population exchanges between the center and the periphery are a mechanism for the distribution of good jobs: not only in the center, but even on the periphery (with its deficient environmental infra-structure) residents from the center, who enjoy greater environmental quality at home, have the better jobs. Commuting permits a double standard for environmental amenities to persist (HOGAN, 1992a).

- In the petrochemical center of Cubatão, a combination of commuting, migrant selectivity, greater turnover and residential segregation means that the population which suffers the consequences of pollution is an economically disfavored segment; the truncated social pyramid (a result of differential migration patterns) also means that Cubatão does not have social groups with a culture of political organization sufficient to provoke corrective action on the part of the State (GUILHERME, 1987; HOGAN, 1993).

- In the SPMA, the reversal of long-term growth tendencies in the eighties was welcomed as a sign of hope for improving urban quality of life. But the decline in growth rates was very unequal in different municipalities, some of which grew at rates of 8 or 9% annually – precisely those which contained watershed protection areas. The contamination of local rivers and reservoirs has not been corrected and water rationing persists (MARCONDES, 1996; CARMO, 2001).

- In the environmentally degraded Steel Valley of Minas Gerais, fragmented, peripheral urbanization provoked by flexibilization in the location of production factors, condemns workers in the steel and paper industries to live in bits of urbanized territory, isolated from the industries and from cities, with minimal environmental infra-structure (COSTA, 1995, 1996, 1999, 2000; COSTA & COSTA, 2000).

- In the East Zone of São Paulo and in the squatter settlements of São Paulo and Campinas, the perverse dialectic between socioeconomic condition and population distribution has reserved flood zones for the poorest segments of the population (TORRES, 1997; TORRES & CUNHA, 1994; TASCHNER, 2000).

- In Natal, tourist development of its pristine beaches brought an insertion in globalized culture at the costs of socio-environmental degradation (LOPES, 1997, 2000).

- Accelerated tourist development on the North Coast of São Paulo opposes tourists, migrants who moved there to meet the service demands of these tourists, and the native population. Everybody loses: the natives – their traditional way of life; the migrants – the tranquility and proximity to nature they thought they had found; and the environment – a natural patrimony of incomparable beauty (LUCHIARI, 1992, 1999).

- Agricultural modernization, in provoking environmental degradation, also contributes to the rural exodus; more labor-intensive, environmentally friendly alternatives to modern agriculture are an opportunity for the survival of small farmers on the land (AZEVEDO, 2000).

- Agricultural populations who live in conservation units and in the buffer zones surrounding them, move freely to exploit natural resources, with consequences which are still unpredictable for the environmental integrity of these areas (RODRIGUES, 1995).

The emphasis on population mobility includes other forms of movement which have distinct consequences for environmental change. Forms of concentrating population in space are produced not only by permanent moves (a classical aspect of the definition of migration), but by seasonal migration, which may permit the maintenance of precarious population-environment balance in the Jequitinhonha Valley (RIBEIRO & GALIZONI, 1998, 2000; RIBEIRO et al., 2000), commuting (HOGAN, 1992, 1993), tourism (LUCHIARI, 1999, LOPES JÚNIOR, 1997) and involuntary displacement of populations due to large public works projects (VAINER, 1993; SCOTT, 1996).

Methodological challenges to population-environment research

Several conceptual and methodological issues have been identified and, if not solved, better understood and dealt with today than a decade ago. One major problem – common to the social sciences in general – is that the dynamics of natural systems can rarely be captured in the framework of analyses which use traditional political-administrative boundaries to define units of analysis. Demography, in particular, considering the centrality of census and vital statistics data in demographic analysis – generally organized and available at the level of municipalities – faces the obstacle of considering the dynamics of natural and social systems in inappropriate geographical units. The multiplication of municipalities in Brazil (currently 5,500), permits a relatively fine gradient; in the State of São Paulo, however, there are 645 municipalities, with 248 808 km², while in the State of Amazonas, with 1 577 820 km², there are 62 municipalities. The possibility of correlating socio-demographic and natural phenomena is much greater in the first situation.

Furthermore, much of demographic analysis is carried out for purposes of public administration and uses administrative groupings of municipalities (Government Regions, Administrative Regions), groupings which do not necessarily correspond to the organization of nature. Regional population dynamics are generally analyzed according to official divisions of North, Northeast, Central-West, Southeast and South. Several recent studies have departed from this territorial division, defining, for example, an “amplified Center-West,” which adds Tocantins and Rondônia to the usual group of states of Mato Grosso, Mato Grosso do Sul, Goiás and the Federal District (HOGAN et al., 2001). Both economic and ecological considerations justified this approach. In general, however, although a region’s **resource base** may enter the development equation, environmental change as a dynamic process related to population change is not considered.

A promising solution is to reorganize groups of municipalities to approximate river basins (PAULA, 1997; HOGAN et al., 1998-99, 2000; NEGRI, 1992; RODRIGUES & CARMO, 1996; COSTA, 1996; BRAGA, 1996; VALLOTI, 1998; BRASIL, 2000; CHIARAVOLLOTI, 1998; RIBEIRO & GALIZONI, 1998; RIBEIRO ET AL., 2000), ecological reserves (LIMA-AYRES & ALENCAR, 1994; MOURA & PERES, 2000), coastal agglomerations (DECHAMPS et al., 2000) and colonization and agrarian reform settlements (ABELÉM & HÉBETTE, 1998; GUIMARÃES, 1998; SYDENSTRICKER, 1998; D’ANTONA, 2000; MOURA AND

PERES, 2000; TUBALDINI, 2000). Such analyses have allowed researchers to relate population movements and population densities to environmental change. There is increasing use of census block data to refine analyses and create new units of analysis according to the environmental problem at hand, using the powerful data management tools of geographic information systems. Torres (1997) has conducted the most systematic attempt to date to overlay population and environmental data with GIS procedures. Hogan et al. (2000) and Carmo (2001) have also used these techniques to examine the demographics of water resources.

Just as certain sub-areas of space, with their specific ecological characteristics, experience population movements differentially, so also do some population groups receive environmental impacts differentially. Assessing the effects of air pollution, emanating from industrial plants or in heavy traffic corridors, for example, requires careful identification of the *risk* populations. The concept of populations in situation of environmental risk was developed in the interior of Abep's working group on population and environment. Squatter settlements (*favelas*) (TASCHNER, 2000; TORRES & CUNHA, 1992) and industrial complexes (HOGAN, 1993; FRANCO, 1993; COSTA, 1992; COSTA, 1996) have been studied in terms of flood zones and exposure to acute air pollution, but other ways of identifying populations subject to specific environmental risks are also possible (populations living on unstable hillsides, in proximity to open air garbage dumps, around transformers of electric lines). Torres (2000) has further elaborated the concept of the demography of environmental risk, providing an analytic framework for these studies.

TOWARD AN ENVIRONMENTAL DEMOGRAPHY

Another concept which has gained currency in the nineties, and has helped organize discussion of population and environment is *sustainable development* or *sustainability*. Independently of semantic doubts and criticisms of such a polysemous notion, sustainability has clearly served to galvanize research on environment; to provide an over-arching concept which promotes interdisciplinary dialogue; to place environmental concern in the center of development policy; and to underline the question of solidarity with future generations, explicitly incorporating this ethical dimension into discussions of development.

For demography, this umbrella concept suggests that the innumerable consequences of environmental change on health and the equally innumerable consequences of population distribution patterns and processes on the environment require more than recognizing this factor as an additional *dimension* of population change. The question which arises is whether environmental effects on health can be controlled on a case by case basis. Has environmental change simply produced new hazards which medical research and new organizational arrangements may control? Are these challenges only new versions of those which disease and physiological defects represented in centuries of scientific progress? Or have we so altered the environments in which we live that a new framework is necessary for comprehending this new

situation? Are our patterns of production and consumption compatible with the standard of health and quality of life we desire? Or do these studies indicate certain limits which we have long ignored?

In terms of population distribution, two remarkable features must be recognized. In the first place, there is no more frontier. In the million years of man's existence, he has never before confronted a world completely settled and completely owned. Migration research is no longer a question of analyzing determinants and consequences of population movements. Sustainability considerations require us to identify those areas capable of absorbing more population and those which are not. All of society's values cannot be realized in all spaces. Careful fine-tuning will be necessary to maintain a balance between meeting today's needs and the preservation required to meet those of tomorrow.

In the second place, even in long-settled areas, it will be necessary to reconsider settlement patterns and processes to recuperate and manage vital natural resources. The issue of water resources is paradigmatic. Long thought to be a renewable resource, we have come to realize that, while this may be true on a geological time scale, water must be carefully managed to assure continuous supply. Management implies attention to balancing population distribution according to distribution of water. The new political awareness in terms of water resources means that the old engineering solutions to transporting water from one region to another meet increasing resistance. We cannot *engineer* our way out of the limits water represents to the ways we occupy the earth's surface. We have fewer degrees of freedom today than in the past and this raises important issues for sustainability.

The suggestion made here is that, far from being only another *dimension* of population change, environmental considerations require us to recast our thinking on population and development. We cannot simply incorporate these considerations into our current models. It is not a question of *greening* demography but of creating a *green demography*. An environmental demography would take the limits imposed by the natural world as a starting point for thinking of population and development. The world is no longer a *tabula rasa*, where men may write their history as they wish. If we are to write our own history at all, we will have to begin with the recognition that the world we desire can only be achieved from the world we have created. Science and politics – and demography as part of this – must place environmental concerns at the center of thinking about the future.

POPULATION AND ENVIRONMENT IN BRAZIL'S MAJOR BIOMES

While the studies cited in the previous sections suggest fruitful lines of research, especially for policies of urban and regional development, a country as diverse as Brazil must be seen in the overall context of the differential distribution of population and resources. As a first step in characterizing these differences, this section examines some population characteristics of Brazil's principal ecological formations. In assessing the prospects for sustainable development, it is clear that not all socially desirable

goals can be met in all points of the nation's territory. If we are to understand the possibilities and limits of economic activities (and the jobs and population movements inspired by these activities) in Brazil's remarkable ecological diversity, we must start by examining the present situation.

The following paragraphs discuss five of Brazil's major ecosystems: the Amazon Forest, the savanna-like *Cerrado*, the semi-arid *caatinga*, the Atlantic Rainforest and the savanna lands in Southern Brazil (*Campos do Sul*). According to the considerations above, the ideal strategy would be to form these areas by dismembering the municipalities⁵ according, not to state or regional boundaries, but to the ecosystems themselves.⁶ Considering this limitation, the population data do not precisely refer to these ecosystems, but may be considered to represent the level of pressure exerted on an ecosystem by its "area of influence." The states have been identified by their major ecosystem, a procedure which does not account for situations such as Mato Grosso, which in its Southern part is dominated by *cerrado* and in the North by the Amazon Forest. This limitation also ignores the Pantanal (one of the world's major wetlands), whose Brazilian portion is located in the states of Mato Grosso and Mato Grosso do Sul.

Ecosystem	1996		2000	
	Population	Percent urban	Population	Percent urban
<i>Amazon Rainforest</i>	14.233.009	58	16.025.287	66
<i>Cerrado</i>	10.959.183	79	12,101,365	81
Semi-arid (<i>caatinga</i>)	37.927.461	63	40.261.478	70
Atlantic Rainforest	64.209.020	89	66.880.948	94
<i>Campos do Sul (savanna)</i>	9.637.682	79	10.179.801	82

Ecosystem	Area (km ²)	Population Density (persons/km ²)
<i>Amazon Rainforest</i>	3.686.070	4.35
<i>Cerrado</i>	2.123.189	5.70
Semi-arid (<i>caatinga</i>)	607.556	66.27
Atlantic Rainforest	634.054	105.48
<i>Campos do Sul (savanna)</i>	282.062	36.09

The Amazon Rainforest, Brazil's largest formation, according to the definition used here (the states of Amazonas, Para, Acre, Amapá and Roraima) has an area of 3,686,070 km². It is Brazil's major forest formation, with a humid climate and a large variety of vegetation, from forest to savanna-like areas at low elevations. The principal environmental problem of the Amazon is deforestation, which occurs from fires provoked by the expansion of agricultural activities and by the exploitation of lumber. Data from the Environment Ministry register an increase in the pace of deforestation of 14.9% between 1999 and 2000. This situation has provoked much concern, first in Brazil and later internationally, and for much of world opinion represents Brazil's major environmental dilemma. Its population of 16 million in 2000, however, was concentrated in cities (66%), not in forest lands. And overall population density of 4.35 persons/km² is extremely low. It is difficult to conclude that "population pressure" is responsible for the environmental threats facing the Amazon, bearing in mind that interregional migration, including frontier migration, was on the wane by 2000. The driving forces of deforestation have been identified and well-documented over the last 20 years. It has not been the land-hungry poor and their large families who bear the greater responsibility, but economic interventions, in the name of financial gain or national security. The Amazon region, considering its important biological diversity, its numerous indigenous groups and generally poor soils, would not be a major focus of economic development from a sustainability perspective. Large population contingents are not supported by extensive agriculture. Indeed, in the state of Amazonas, half the population lives in the capital of Manaus, sustained by an enclave of duty-free production of electronics. This is an arrangement whose days are numbered, but reveals the limited possibilities for absorbing population in the extensive forested regions.

The population-environment equation in the Amazon is not now in a critical state, but neither can it be seen in the future as an important alternative for population settlement. The crucial factors are such large-scale economic development projects, such as those planned in the government's *Avança Brasil* project. The environmental consequences of this program of infra-structure development are predicted to be disastrous (LAURENCE, 2000). Sustainability, from the perspectives of the region's biodiversity and its limited capacity to support large populations, reserves this region as the low-density area which it is today. Not population policy, but economic-ecological policy must be tailored to this end.

The *cerrado* (whose area of impact is defined here as the states of Mato Grosso, Mato Grosso do Sul, Goiás and the Federal District) has an area of 2,123,189 km² and a 2000 population of 10,959,183. While international concern for its biodiversity is more recent, Brazil's second largest ecosystem is a valuable national resource. The region has undergone rapid development over the last three decades. In this period, the region has moved from (1) a sparsely populated area of subsistence agriculture to (2) a major migration destination for land-seeking migrants from other regions to (3) dynamic, export-oriented monoculture. This has been a rapid process, coinciding with the modernization of Brazilian agriculture; increasing mechanization

and government incentives have contributed to the transformation of vast extensions of land to the production of grains (especially soybeans, but also cotton, corn and rice) and cattle-raising. Great expectations have been placed on an expanding world market for soybeans and Brazil's comparative advantage in this field.

Considered as unproductive for farming until the use of modern methods since 1970, the *cerrado* has always been considered as not worth preserving. The *cerrado*, with an almost entirely tropical climate, is a complex of different forms of vegetation which have variable physiognomies and floristic compositions, forming an ecological mosaic. According to Goodland & Ferri (1979), the *cerrado* is "a mixture of low trees and a well developed herbaceous strata." (cited in SMA, 9)⁷

Since then, and especially since the seventies, when soil management methods were developed for the region⁸, the *cerrado* has been definitively incorporated into the national economy, and is now seen by planners, investors and farmers as unoccupied and available for agroforestry, cattle raising and large-scale grain production. The intensive use of machinery and agricultural equipment, fertilizers, pesticides, herbicides and selected species have transformed the natural landscape of the region, frequently leading to the depletion of natural resources (desertification) and the contamination of food, soils and water. The original vegetation has been greatly reduced, 37% having been converted to pasture, annual crops such as soybeans, corn and rice and perennial crops such as eucalyptus and pine plantings, as well as such urban-generated land uses as reservoirs, cities and garbage disposal. In many areas, environmental degradation has already produced decreasing productivity and greater costs. These agricultural activities were rarely introduced with any environmental concern. Local varieties of plants were ignored and instead of adapting farming to the characteristics of the region, especially to the soil, the region's characteristics were adopted to the products. (SHIGEO, 1999) The result has been compacting of soils, erosion and the genetic impoverishment of the native biota.⁹

Environmental concern is related to three major questions:

1. **biological diversity:** the *cerrado* is home to an estimated 420 species of trees, 10,000 different species of plants and 800 species of birds; 40% of its woody plants and 40% of its bees are endemic. It is the world's most biologically diverse savana, home to at least 5% of the planet's flora. One of the so-called biodiversity *hotspots* of the world, the *cerrado* is one of the most threatened biomes of the planet.

2. **carbon sequestration:** although it has not yet received much attention, the capacity of the *cerrado* to store carbon is immense. While it does not have dense forest, this is compensated by its enormous size and a vegetation with deep roots, forming an "underground forest," which makes a significant global contribution as a carbon sink. (Sawyer, forthcoming)

3. **watershed protection;** the sources of the three major Brazilian and South American river basins – the Amazon, the Rio de la Plata, and the Rio São Francisco – are located in this region. Large-scale transformation of land use will

have continental consequences in terms of water supply and quality. This biome also plays an important role in the support of biodiversity in general, inasmuch as its river network functions as a corridor for fauna and genetic exchange.

The *cerrado's* population density, like the Amazon's, is also remarkable low. Its precocious urbanization (81% in 2000) is testimony to the importance of capital-intensive monocultures of soybeans and cotton in its environmental transformation. In part, these urban populations represent centers of support, including agro-industry, for agricultural activities. But these cities are also reservoirs of unemployed and under-employed poor, who were unable to sustain their families on small farms, in the face of the region's monocultures.

The *cerrado* is a region whose biodiversity must be zealously defended. It is perhaps not so fragile as the Amazon, however, and greater proximity to major urban centers suggest that economic activities can be conciliated with environmental protection. Greater fine-tuning of the population-environment relation will be required to identify those regions and those economic activities which may be sustainably explored. Agro-industry has already begun to shift processing activities to the region, decentralizing job-creation but also decentralizing environmental pollution. From social, economic and demographic perspectives, this development makes sense. But these activities must be accompanied by pollution control and treatment of effluents, and must be carefully located within the region's territory. The population-environment balance is not critical and the *cerrado* may still absorb population, but much more ecological-economic planning is required to revert the pell-mell development activities of recent decades.

The *caatinga*, Brazil's semi-arid region, is its second most populous. Its vegetation is conditioned by its dry climate, which predominates during the winter and is renewed with summer rains. Its vegetation composes an aggressive landscape of species resistant to drought, with occasional islands of humidity, where higher vegetation and more fertile soils are found. The major environmental problem is desertification, aggravated by the intense use of irrigation with inappropriate technology, by the contamination of what water sources are available and by deforestation to obtain firewood and charcoal. The 2000 population of 40 million is an inheritance of the region's importance in the production of sugar cane, since colonial days. The more fertile coastal lands have not supported the region's population for a long time. Subsistence agriculture in the semi-arid backlands is precarious and the Northeast is Brazil's classic case of out-migration. Social concern and political pressure of the traditional oligarchy has produced an impressive array of water projects aimed at permitting a sustainable way of life for family farmers. In an area of 607,556 km², with a population density of 66.27 persons/km² in 2000, however, such projects have generated much environmental concern. It is not only that much of the investment in water projects has benefited only rich landowners, a scandalous remnant of traditional politics as yet unchecked. Such projects as deep wells which tap into non-replenishable *fossil* water and the reversion of the São Francisco River for irrigation of dry lands have

been questioned by environmentalists. The history of other nations has provided innumerable examples (McPHEE, 1990) of the futility of controlling nature. Only in man's omnipotent imagination is it possible to realize all goals and values in all regions.

Furthermore, the *caatinga's* biodiversity has its own, largely unrecognized, importance. Thousands of species have adapted to this apparently hostile environment and are not likely to survive transformation to irrigated farmland. The question which must be posed, as it was by economist Celso Furtado many years ago, is whether this large population can be sustainably supported in this region. Declining birth rates will stem secular out-migration, but will this be enough? From a sustainability perspective, it cannot be taken for granted that useful, productive employment can be found for such large numbers in this hostile environment. Continued investment is necessary to rectify centuries of neglect and impoverishment. But it cannot be taken for granted that nature can or should be "dominated" to these ends.

The *Atlantic Rainforest*, (considering in this text the states of Espírito Santo, Rio de Janeiro, São Paulo, Paraná and Santa Catarina, which account for 634,054 km²) has been reduced to 5% of its extent 500 years ago. In Rio de Janeiro, for example, 20% of the territory is covered by forest, compared to 97% originally; in Minas Gerais, forest extent has declined from 51.7% to 1.5%. This is the region in which Brazil's *crab civilization* (because it clung to the shore) has developed. With the exception of timid and short-lived colonization efforts in the Amazon, Brazilian development only began to reach beyond this coastal region in 1960, with the construction of Brasília. Home to 66.9 million people in 2000, this is the most urbanized (94% in 2000) and densely populated (105.48 persons/km²)¹⁰ region. It is also home to a rich biodiversity. Its vegetation is composed of dense forest closer to the ocean, less dense on the steep slopes and open fields on the tops of these slopes.

This is undoubtedly the region whose population-environment balance is most precarious. Both **source** and **sink** functions of nature have been acutely affected. The limited remnants of the Atlantic Rainforest were the first to generate protective measures, a movement which continues today. Nevertheless, the forest continues to shrink each year. Most remaining intact areas are in coastal regions, interior portions having been almost completely substituted by agriculture over the centuries. Today, both urban population growth and a growing consumer culture have generated large-scale tourist development on the coast. This development threatens to complete what isolation and lack of other economic options did not do, and the biodiversity of the Atlantic Rainforest is more threatened than that of the Amazon.

But ecosystem limits to absorbing waste have also been stretched, often beyond the breaking point. Two of the world's largest cities (São Paulo and Rio de Janeiro), along with a large number of smaller (but still large) cities, have sprawled over rich soils, deforested their hinterlands, degraded rivers, lakes, bays and estuaries, contaminated soils and groundwater and saturated local capacities for absorbing solid waste. Accelerated economic development and rapid population

growth in the second half of the 20th century created environmental liabilities which will require much time, planning and investment to overcome. In areas like the São Paulo Metropolitan Area, environmental degradation is so severe, pressure on resources so great and water supplies (for example) so limited, that simple remedial measures may never be adequate. The *interiorization* of development and population growth in São Paulo State since the 1970s is a reflection of such problems. Considering the vast social infrastructure in place (transportation, schools, universities and research centers, health care facilities), the region of influence of the Atlantic Rainforest must continue to meet the needs of a large part of Brazilian population. Smaller and middle-size cities, however (as in the São Paulo case), may provide greater possibilities of promoting the quality of life, including environmental quality, which is the goal of sustainable development. It must be remembered that earlier efforts to promote the growth of middle-size cities – a generally frustrated effort – were undertaken in the context of rapid population growth, especially urbanization. In today's different demographic context, such planning efforts may be more viable.

The impact region of the Atlantic Rainforest, then, must continue to be the home of most Brazilians. Internal redistribution of economic activity (and population), together with environmental remediation and enforced environmental protection may ameliorate environmental pressure in this region. For the reasons mentioned above, redistribution of population to other regions will play a minor role in bringing population and environment into more harmonious balance. Sustainable solutions must be found within the region itself.

Finally, the *Campos do Sul* savanna, a smaller (282,062 km²) but distinct ecosystem (in the division used here, covering the state of Rio Grande do Sul). This region has level or slightly hilly lands, with isolated areas of forest and grassy plains. This is a highly urbanized (82% in 2000) region, with a population of 10 million. One of Brazil's more developed, industrialized regions, its population density is relatively low (36.09 persons/km²). The small-scale agriculture which predominated for over a century (especially since European immigration in the 19th century) began to lose its viability in the last decades of the 20th century. The region's emigrants were important contributors to colonization efforts in the Center-West and Amazon regions. One of the local consequences of these developments is the regeneration of forest cover over the last decades. Considering the human resources in this area (one of the most educated and skilled populations in the country) and the diminished pressure on natural resources, this may be the region where population-environment balance may be more easily reached. It is not likely, however, to represent an important alternative to the highly urbanized and densely populated Northeast and Southeast.

This brief overview of the population/environment balance reveals the great diversity which characterizes the relations between man and nature in Brazil. This diversity is not homogeneously distributed over the national territory. Differential natural resource endowments and the history of economic and population growth which impacted different regions at different moments have produced a situation in which the major ecosystems are still clearly visible in demographic and environmental

terms. Synthesizing the major differences, which have important consequences for sustainable development, we can emphasize:

1. the Amazon region, still sparsely populated, concentrates most of its population in cities. In terms of national and planetary biological and cultural diversity, this is a region whose development must be carefully monitored. Environmental considerations should be paramount. In the long run, it will be recognized that Brazil was fortunate in that Amazon deforestation began in an era of environmental consciousness. There is still time to preserve, an option not open to many countries. Brazil will harbor, in the future, one of the only undisturbed tropical forests. The long-term advantages far outweigh the short-term gains intense development could bring. This favorable situation depends, for its realization, on maintaining low population densities.

2. the savanna-like *cerrado*, already intensively explored for grain production and cattle-raising, is also important in terms of biodiversity and potential carbon sequestration. Also a sparsely populated region, the *cerrado* offers more opportunities for environmentally sustainable development. Population growth has not reached a situation of limits, but much care must be taken in locating economic activities in space.

3. the Atlantic Rainforest is the most complex of these ecosystems. While intact remnants of primary vegetation must be carefully protected, most of this forest has been lost, and the region's economic-ecological vocation has long been determined. In this region, the major environmental challenge is the recuperation of degraded areas and the implementation of long-term environmental safeguards. For extreme cases, such as the São Paulo Metropolitan Area, recuperation will probably have to be accompanied by population deconcentration. This process, already underway, if accelerated, could contribute to the region's sustainability. Considering the limited possibilities in other regions, most of the deconcentration will be in the direction of smaller cities within the region itself. Most likely, this region will also continue to absorb population contingents from the semi-arid region. The greater natural resiliency of this region has permitted – and will continue to permit – greater population densities.

4. the semi-arid *caatinga* faces enormous difficulties – perhaps insurmountable – in the effort to balance population and environment. With its inheritance of poverty and high population density, the solutions proposed may not be environmentally sustainable. Sustainable development may require investments and job-creation for this population in environmentally more amenable areas.

5. the savannas of Southern Brazil offer limited possibilities for absorbing population. Considering its relatively well-educated population and higher levels of development, this region – if development is directed toward modern industrial and service sectors – should be able to retain its current population.

CONCLUSIONS

The present paper has tried to synthesize Brazilian demography's contribution to understanding the relations between natural and social systems. Given the history of the discipline's work on population and development, the starting point and directions of this contribution have not emphasized traditional environmentalist concern for the pressure of numbers on resources. Reviewing the emergence of this field, it is clear that while the *Amazon question* was important, it has not determined the greater part of the empirical work of the nineties. On the contrary, considerable efforts were dedicated to studies of the *brown agenda*, the determinants and consequences of urban pollution.

By the beginning of the new decade, a clearer view of the environmental limits of human activity has led to a more integrated vision of urban-industrial and rural-ecological problems. And the question of the pressure of numbers has been recast in less neo-Malthusian terms as the need to balance the requirements of today's populations with the environmental integrity of natural systems – a fundamental ingredient to guaranteeing quality of life to future generations. Ecological-economic zoning is one possible path to sustainability, and initial efforts in this direction are now underway (ACSELRAD, 2000; STEINBERGER & ROMERO, 2000).

The *environmental demography* suggested here recognizes that the problems described and analyzed by researchers of population and environment in Brazil reveal the need for new frames of reference. That this challenge can be enunciated is testimony to the considerable advance this field has seen.

Finally, the brief review of population-environment concerns in Brazil's major ecological formations reveals the great diversity of situations in the country, as well as the greater range of possibilities for achieving population-environment balance, compared to other countries. But it is time to begin to ask hard questions about centuries-long settlement patterns and their sustainability in the centuries ahead. Brazil has some room for maneuver. Optimizing quality of life suggests that the earlier consensus is reached on the "ecological-economic vocations" of different regions, the greater is the possibility of achieving this optimum.

BIBLIOGRAPHY

- ABELÉM, A. & HÉBETTE, J. Assentamentos da reforma agrária na fronteira Amazônica e meio ambiente. *Anais do XI Encontro Nacional da Abep*, Caxambu, 1998
- ACSELRAD, H. Zoneamento ecológico-econômico – entre ordem visual e mercado-mundo. *Anais do XII Encontro Nacional da Abep*, Caxambu, 2000.
- AGUIAR, T. C. ; MAGNANO, A. A. ; NÓBREGA, R.C.; BARRUCHO, H.; MATTOS, S. O entorno do Distrito Federal: no espaço e desordem ambiental. *Anais do IX Encontro Nacional da Abep*, Volume II, Caxambu, 1994

- ALMEIDA, A.L.O. & ALBUQUERQUE, M. B. Frente de penetração da pequena produção agrícola na Amazônia. *Anais do III Encontro Nacional da Abep*, Volume I, Vitória, 1982
- . Tipos de fronteiras e modelos de colonização na Amazônia - revisão da literatura e especificação de uma pesquisa de campo. *Anais do III Encontro Nacional da Abep*, Volume I, Vitória, 1982
- ANDRADE, M.C. Redistribuição da população e das atividades econômicas no espaço brasileiro. *Anais do III Encontro Nacional da Abep*, Volume I, Vitória, 1982
- AZEVEDO, A. M. M. A agricultura orgânica como forma sustentável de ocupação do solo e de fixação do homem no campo. *Anais do XII Encontro Nacional da Abep*, Caxambu, 2000
- BARBIERI, A. F.; FILHO, B.S.S.; COELHO, L.C. Uso da terra e malária : uma análise espacial para o norte de Mato Grosso , 1992 a 1995. *Anais do XII Encontro Nacional da Abep*, Caxambu, 2000.
- BASTOS, M.I. Estrutura agrária e movimentos populacionais: o caso do Paraná. *Anais do III Encontro Nacional da Abep*, Volume I, Vitória, 1982
- BILSBORROW, R. E., & HOGAN, D.J. (eds.). **Population and Deforestation in the Humid Tropics**. Liège, IUSSP, 1999.
- BRAGA, T. Risco, conflito e política ambiental sob o signo da (MONO) indústria: Um estudo sobre a bacia do Rio Piracicaba (MG). *Anais do X Encontro Nacional da Abep*, Volume II, Caxambu, 1996.
- BRASIL, M. “Estratégias de sobrevivência da população ribeirinha da Ilha de Marajó”. In: TORRES, H. & COSTA, H. (orgs) **População e Meio ambiente: debates e desafios**. São Paulo, Senac, 2000.
- CARDOSO, A. L. Meio ambiente e moradia: discutindo o déficit habitacional a partir do caso da Região Metropolitana do Rio de Janeiro. *Anais do XI Encontro Nacional da Abep* , Caxambu, 1998.
- CARMO, R.L. **A água é o limite? Redistribuição espacial da população e recursos hídricos no Estado de São Paulo**. Doctoral thesis, State University of Campinas, 2001..
- COLBURN, T.; DUMANOSKI, D.; MYERS, J. P. **Our Stolen Future – Are we threatening our fertility, intelligence and survival? — A scientific detective story**. New York, Penguin, 1996.
- COSTA, C. B. & OLIVEIRA, J. M. O processo de colonização no Mato Grosso - 1970-1980. *Anais do III Encontro Nacional da Abep*, Volume I, Vitória ,1982.
- COSTA, G. M. & COSTA, H. S. M. Novas e velhas diferenças: desafios à gestão metropolitana no Vale do Aço. *Anais do XII Encontro Nacional da Abep*, Caxambu, 2000
- COSTA, G. M. Impacto de grandes projetos industriais: desorganização/ reorganização espacial dos processos econômicos e populacionais. *Anais do VIII Encontro Nacional da Abep*, Volume III, Brasília, 1992.
- COSTA, H. S. M. Indústria, produção do espaço e custos sócio-ambientais: reflexões a partir do exemplo do Vale do Aço, Minas Gerais. *Anais do X Encontro Nacional da Abep*, Volume II, Caxambu, 1996.

- COSTA, H. S. M. Questão ambiental, população e espaço urbano: em busca de um novo paradigma? *Anais do VIII Encontro Nacional da Abep*, Volume III, Brasília, 1992.
- COSTA, H. S. M. Sustentabilidade urbana: um debate colocado em prática? Reflexões a partir de São Francisco/CA e sua área metropolitana. *Anais do XI Encontro Nacional da Abep*, Caxambu, 1998.
- COSTA, H.S.M. **Vale do Aço: da produção da cidade moderna sob a grande indústria à diversificação do meio-ambiente urbano.** Doctoral thesis, Universidade Federal de Minas Gerais, 1995..
- Costa, H.S.M. Indústria, produção do espaço e custos ambientais: reflexões a partir do exemplo do Vale do Aço, Minas Gerais. In: TORRES, H. & COSTA, H.M. (eds.), **População e Meio ambiente: debates e desafios.** São Paulo, Editora do Senac, 2000.
- D'ANTONA, A. O. Questões demográficas na definição, monitoramento e planejamento de reservas extrativistas da Amazônia Legal Brasileira. *Anais do XII Encontro Nacional da Abep*, Caxambu, 2000.
- DESCHAMPS, M. V.; KLEINKE, M. L. U.; MOURA, R.; WERNECK, D. Z. Afinal, o que induz o crescimento nas aglomerações litorâneas? *Anais do XII Encontro Nacional da Abep*, Caxambu, 2000.
- DUCHIADE, M.P. & BELTRÃO, K.I. Mortalidade infantil por causas na Região metropolitana do Rio de Janeiro, 1976-1986: associação com variáveis sócio econômicas, climáticas e ligadas à poluição do ar. *Revista Brasileira de Estudos de População*, São Paulo, V. 9, Nº2, jul.dez. 1992
- FEARNSIDE, P. M. Spatial Concentration of Deforestation in the Brazilian Amazon. *Ambio* 15,2, 1986.
- FEARNSIDE, P. M. Human Carrying Capacity Estimation in Brazil's Amazonian Settlements as a Guide to Development Policy. In: BILSBORROW, R. E., & HOGAN, D.J. (eds.). **Population and Deforestation in the Humid Tropics.** Liège, IUSSP, 1999.
- FERREIRA, A.F.B. & SAWYER, D. Estrutura produtiva, migrações e malária: notas sobre duas áreas amazônicas. *População e Saúde: Anais do Seminário Latino-Americano*, vol. 1. Campinas, Editora da Unicamp, 1986.
- FERREIRA, C.E.C.. Saneamento e Mortalidade Infantil. *São Paulo em Perspectiva* 6,4 (outubro/dezembro), 1992: 62-69.
- FERREIRA, L. C. & SIVIERO, S.O. Busca de alternativas de sustentabilidade nos novos padrões de urbanização. *Anais do IX Encontro Nacional da Abep*, Volume II, Caxambu, 1994
- FRANCO, T. (ed.) **Trabalho, Riscos Industriais e Meio ambiente: rumo ao desenvolvimento sustentável?** Salvador, EDUFBA, 1997.
- GORDIN, M.H.O. Transformação agrícola versus evolução demográfica na região de Dourados. *Anais do III Encontro Nacional da Abep*, Volume I, Vitória, 1982
- GRAZIANO DA SILVA, J. A estrutura fundiária e relações de produção no campo brasileiro. *Anais do II Encontro Nacional da Abep*, Volume 1 Águas de São Pedro, 1980.

- GRAZIANO DA SILVA, J. & KAGEYAMA, A. Emprego e relações de trabalho na agricultura paulista no período 1960-1975. *Anais do III Encontro Nacional da Abep*, Volume I, Vitória, 1982
- GUERTECHIN, T. L. “Expulsão” do homem do campo na Zona da Mata e Brejo paraibano. *Anais do III Encontro Nacional da Abep*, Volume I, Vitória, 1982.
- GUILHERME, M.T. Urbanização, Saúde e Meio ambiente: o caso da implantação do pólo industrial de Cubatão e os seus efeitos urbanos e regionais nos setores de saúde e poluição ambiental. *Espaço & Debates* 22, 1987, 42-53.
- GUIMARÃES, M.L.L. Assentamentos rurais sob políticas públicas com a empresa privada: assentamento Hipólito no município de Mossoró/RN. *Anais do XI Encontro Nacional da Abep*, Caxambu, 1998.
- HOGAN, D. J.; CUNHA, J.M.P.; CARMO, R.L.; OLIVEIRA, A.A.B. Urbanização e vulnerabilidades socioambientais diferenciadas: o caso de Campinas. *Anais do XII Encontro Nacional da Abep*, Caxambu, 2000.
- HOGAN, D. J. Quem paga o preço da poluição? Uma análise de residentes e migrantes pendulares em Cubatão. *Anais do VII Encontro Nacional da Abep*, Volume III, Caxambu, 1990.
- HOGAN, D. J.; CARMO, R.L.; RODRIGUES, I. Migração e Crescimento Populacional na Bacia do Piracicaba-Capivari. Caderno 1, **Qualidade Ambiental e Desenvolvimento Regional nas Bacias do Piracicaba e Capivari**. NEPAM, 1997.
- HOGAN, D. J.; RODRIGUES, I.; CARMO, R. L. 1997. O Novo Padrão Migratório e os Impactos Sobre os Recursos Hídricos – As Bacias dos Rios Piracicaba e Capivari. *Travessia*, Ano X, nº 28, Maio-Agosto, São Paulo, 1997: 27-33.
- HOGAN, D.J. & VIEIRA, P.F. (org.). **Dilemas Socioambientais e Desenvolvimento Sustentável**. Campinas, Editora da Unicamp, 1992.
- HOGAN, D.J.; CARMO, R.L.; RODRIGUES, I. A.; ALVES, H.P.F. Conflitos entre crescimento populacional e uso dos recursos ambientais em bacias hidrográficas do Estado de São Paulo. *Anais do XI Encontro Nacional da Abep*, Caxambu, 1998.
- HOGAN, D. J. População e Meio Ambiente. *Textos NEPO*, 16, 1989.
- HOGAN, D. J. The impact of population growth on the physical environment. *European Journal of Population* 8, 1992:109-123.
- HOGAN, D. J. Population, Poverty and Pollution in Cubatão, São Paulo. *Geographia Polonica* 64, 1995: 201-224.
- HOGAN, D. J. (ed.). Dinâmica Demográfica e Poluição Ambiental. *Textos Nepo* 12, Campinas, Núcleo de Estudos de População, 1987 (144 p.).
- HOGAN, D. J.; CARMO, R.L.; RODRIGUES, I.; ALVES, H. Conflitos entre crescimento populacional e uso dos recursos ambientais em bacias hidrográficas do Estado de São Paulo. In: TORRES, H. & COSTA, H.M. (eds.), **População e Meio ambiente: debates e desafios**. São Paulo, Editora do Senac, 2000.
- HOGAN, D. J. et al. Sustentabilidade no Vale do Ribeira (São Paulo): conservação ambiental e melhoria das condições de vida da população. *Ambiente & Sociedade* 2, 3-4, 1998/1999, pp. 151-175.

- HOGAN, D. J. et al. Conflitos entre crescimento populacional e uso dos recursos ambientais em bacias hidrográficas do Estado de São Paulo. In: TORRES, H. & COSTA, H.M. (eds.), **População e Meio ambiente: debates e desafios**. São Paulo, Editora do Senac, 2000, pp. 233-269.
- HOGAN, D. J. **Migração, Estrutura Social e Ambiente em Cubatão**. Paper presented to the XI Encontro Anual da Associação Nacional de Pesquisa e Pós-Graduação em Ciências Sociais. Águas de São Pedro, 1987.
- HOGAN, D. J. Condições de Vida e de Morte em Cubatão. *Anais do VI Encontro da Associação Brasileira de Estudos Populacionais*, Olinda, 1988.
- . Crescimento demográfico e meio ambiente. *Revista Brasileira de Estudos de População* 8, 1/2, 1991, pp. 61-71.
- . Migração, ambiente e saúde nas cidades brasileiras. In: HOGAN, D.J. & VIEIRA, P.F. (org.). **Dilemas Socioambientais e Desenvolvimento Sustentável**. Campinas, Editora da Unicamp, 1992a., pp. 149-170.
- . Crescimento Populacional e Desenvolvimento Sustentável. *Lua Nova* 31, 1993, pp. 57-77.
- HOGAN, D. J. População, Pobreza e Poluição em Cubatão, São Paulo. In: MARTINE, G. (ed.), **População, Meio Ambiente e Desenvolvimento: verdades e contradições**. Campinas, Editora da Unicamp, 1993, pp. 101-131.
- . La réponse à une catastrophe environnementale: résidents et migrants à Cubatão, Brésil. *Espaces et Sociétés* 77, 1994, pp. 79-96.
- . Population and Environment in Brazil: a changing agenda. In: CLARKE, J. & TABAH, L. (eds.), **Population - Environment - Development Interactions**. Paris: CICRED, 1995, pp. 245-252.
- . Mobilidade Populacional e Meio Ambiente. *Revista Brasileira de Estudos de População* 15, 2, 1998.
- . A relação entre população e meio ambiente: desafios para a demografia. In: TORRES, H. & COSTA, H.M. (eds.), **População e Meio ambiente: debates e desafios**. São Paulo, Editora do Senac, 2000, pp. 21-52.
- . Migraciones y salud en el complejo siderurgico-petroquimico de Cubatão, São Paulo. In: CANALES J. L. (ed.), **Efectos Demograficos de Grandes Proyectos de Desarrollo**. San José, Costa Rica, Celade, 1990.
- HOGAN, D. J. et al. Land Use and Land Cover Change in Brazil's CENTER West: demographic, social and environmental consequences. *Paper presented to the Annual Meeting of the Population Association of America*, Washington, 2001.
- HOGAN, D. J. Meio ambiente e saúde: um desafio para as Ciências Sociais. Ciências Sociais e Medicina: atualidades e perspectivas latino-americanas. *Anais do III Congresso Latino-Americano de Ciências Sociais e Medicina*. Atibaia, 1995, p. 227-260.
- IVO, A.B. L. A reespecialização da estrutura fundiária do Estado da Bahia (versão preliminar). *Anais do IV Encontro Nacional da Abep*, Volume III, Águas de São Pedro, 1984
- LAGO, L. C. Segregação socioespacial e condições urbanas de vida nos anos 80: a metrópole do Rio de Janeiro em Questão. *Anais do XI Encontro Nacional da Abep*, Caxambu, 1998

- LIMA, D.; ALENCAR, E. Histórico da ocupação humana e mobilidade geográfica de assentamentos na várzea do Médio Solimões. In: TORRES, H. & COSTA, H.M. (eds.), **População e Meio ambiente: debates e desafios**. São Paulo, Editora do Senac, 2000.
- LIMA-AYRES, D. ALENCAR, E.F. Histórico da ocupação humana e mobilidade geográfica de assentamentos na área da estação ecológica Mamirauá. *Anais do IX Encontro Nacional da Abep*, Volume II, Caxambu, 1994
- LOPES JÚNIOR, E.. **A Construção Social da Cidade do Prazer: urbanização turística, cultura e meio ambiente em Natal (RN)**. Doctoral thesis, State University of Campinas, 1997.
- LOPES JÚNIOR, E.. 2000. População e meio ambiente nas paisagens da urbanização turística do Nordeste: o caso de Natal. In: TORRES, H. & COSTA, H.M. (eds.), **População e Meio ambiente: debates e desafios**. São Paulo, Editora do Senac, 2000, pp. 213-231.
- LUCHIARI, M.T. **Caiçaras X Turismo em Maresias : Transformações Sócio-Ambientais no Litoral Norte Paulista (1969-1990)**. Tese de Mestrado, UNICAMP, 1992.
- . **O lugar no mundo contemporâneo: turismo e urbanização em Ubatuba-SP**. Doctoral thesis, State University of Campinas, 1999.
- MACHADO, E. As imagens da emigração fundiária na fronteira. *Anais do VII Encontro Nacional da Abep*, Volume I, Caxambu, 1990.
- MARCONDES, M.J.A. **Urbanização e Meio Ambiente: os mananciais da metrópole paulista**. Doctoral thesis, Universidade de São Paulo, 1996.
- MARQUES, E. C. As políticas de saneamento no Rio de Janeiro e seus aspectos espaciais: 1975 – 1996. *Anais do XI Encontro Nacional da Abep*, Caxambu, 1998
- MARQUES, E. C. & TORRES, H A.G. A recalcitrante relevância da periferia para o debate sobre as condições metropolitanas. *Anais do XII Encontro Nacional da Abep*, Caxambu, 2000
- MARQUETTE, C. M.; BILSBORROW, R. E. **Population and the Environment in Developing Countries: literature survey and research bibliography**. United Nations, ESA/P/WP. 1994, 123p.
- MARTINE, G. Migrações internas e alternativas de fixação produtiva: experiências recentes de colonização no Brasil. *Anais do I Encontro Nacional da Abep*, Volume I, Campos do Jordão, 1978
- MARTINE, G. & COUTINHO, R. G. Mudanças tecnológicas e sociais na agricultura: a panela do povo em tempo de crise. *Anais do IV Encontro Nacional da Abep*, Volume III, Águas de São Pedro, 1984
- MARTINE, G. & TURCHI, L. A urbanização da Amazônia: realidade e significado. *Anais do VI Encontro Nacional da Abep*, Volume II, Olinda, 1988
- MARTINE, G. Processos Recentes de Concentração e Desconcentração no Brasil. ISPN, n.11, *Série Documentos de Trabalho*, 1992.
- . Transformação na agricultura e êxodo rural. *Anais do III Encontro Nacional da Abep*, Volume I, Vitória, 1982

- . População, meio ambiente e desenvolvimento: o cenário global e nacional. In: MARTINE, G. (ed.), **População, Meio Ambiente e Desenvolvimento: verdades e contradições**. Campinas, Editora da Unicamp, 1993, pp. 21-41.
- . (ed.) **População, Meio Ambiente e Desenvolvimento: verdades e contradições**. Campinas, Editora da Unicamp, 1993, 207 p.
- . The relations between population and environment in the context of globalization: preliminary considerations, In: CLARKE, J. & TABAH, L. (eds.), **Population - Environment - Development Interactions**. Paris: CICRED, 1995, pp. 95-115.
- MENEZES, M. A. O atual estágio de conhecimento sobre os recursos naturais da Amazônia: pressuposto para definição de uma política de ocupação. *Anais do II Encontro Nacional da Abep*, Volume I, Águas de São Pedro, 1980
- MONTELEONE NETO, R.; ROGATKO, A.; CHIEN, Y.T. As perdas gestacionais em Cubatão. Pp. 12-23 *População e Saúde: Anais do Seminário Latino-Americano*, vol. 1. Campinas, Editora da Unicamp, 1986.
- . Birth defects and environmental pollution: the Cubatão example. In: **Prevention of Physical and Mental Congenital Defects: Proceedings of the International Conference of the Institut de la Vie held in Strasbourg, France, October 10-17, 1982**. New York, A.R. Liss, 1985, pp. 65-68.
- MONTELEONE NETO, R.. **As anomalias congênitas e as perdas gestacionais intermediárias e tardias no município de Cubatão**. Livre Docente thesis, Faculdade de Medicina de Ribeirão Preto/USP, 1986.
- MONTE-MOR, R.L. Malária e meio ambiente na Amazônia brasileira. *População e Saúde: Anais do Seminário Latino-Americano*, vol. 1. Campinas, Editora da Unicamp, 1986.
- MOTTA, A. C. C. Notas preliminares sobre o Proálcool e a migração no Estado de São Paulo: o caso de Ribeirão Preto. *Anais do III Encontro Nacional da Abep*, Volume I, Vitória, 1982
- MOURA, E.A. F. Laranjal sem laranjas: condições de vida após a implantação dos grandes projetos na Amazônia. *Anais do VII Encontro Nacional da Abep*, Volume III, Caxambu, 1990
- MOURA, E.A. F. & PERES, L. V. C. Aspectos demográficos, sócio-econômicos e de saúde da população ribeirinha durante a enchente de 1999 na reserva de desenvolvimento Sustentável Mamirauá (região do Médio Solimões- Amazonas). *Anais do XII Encontro Nacional da Abep*, Caxambu, 2000.
- MÜLLER, G. A modernização do campo e a questão agrária: tem gente sobrando no rumo das coisas. Dá para mudar? *Anais do IV Encontro Nacional da Abep*, Volume I, Águas de São Pedro, 1984
- . O trabalho na máquina agrária paulista nos anos 70. *Revista Brasileira de Estudos de População*, Nº 2, São Paulo, jul.dez. 1985
- . População, emprego e espaço - a dinâmica agrária paulista em 1950-1980. *Anais do III Encontro Nacional da Abep*, Volume I, Vitória, 1982

- NAHAS, M.I.P.; MARTINS, V. L.A.B.; ESTEVES, O. A.; GUERRA, L. P.; SIMÕES, R. F. O índice de qualidade de vida urbana de Belo Horizonte (IQVU/BH): Um instrumento de avaliação do lugar urbano. *Anais do X Encontro Nacional da Abep*, Volume II, Caxambu, 1996
- NEGRI, B. Urbanização e demanda de recursos hídricos na bacia do rio Piracicaba no Estado de São Paulo. *Anais do VIII Encontro Nacional da Abep*, Volume III, Brasília, 1992
- NORONHA, C. V.; CARVALHO, F. M. Camaçari: migração e investimentos em saúde sob a égide do capital monopolista. *Revista Baiana de Saúde Pública* 12, Jun/Jul, 1985.
- OLIVEIRA, L. A. Expansão da fronteira, migração e reprodução urbana: o caso do Acre. *Anais do II Encontro Nacional da Abep*, Volume 1 Águas de São Pedro, 1980
- OLIVEIRA, N. M. Rainha das águas, dona do mangue: um estudo do trabalho feminino no meio ambiente marinho. *Revista Brasileira de Estudos de População*, V.10, São Paulo, N°1-2, jan. dez. 1993
- OYA-SAWYER, D.; FERNANDEZ-CASTILLO, R.; MONTE-MOR, R. L. M. The impact of urbanization and industrialization on mortality in Brazil. *World Health Statistics Quarterly*. 40(1):84-95, 1987.
- PAULA, J.A (ed.). **Biodiversidade, População e Economia: uma região de Mata Atlântica**. Belo Horizonte: UFMG;CEDEPLAR/ECMVS, 1997.
- PINTO, M.G. O. Saúde, colonização e trabalho: análise das condições de reprodução da força de trabalho em Rondônia. *Anais do III Encontro Nacional da Abep*, Volume I, Vitória, 1982
- RIBEIRO, E. M. e GALIZONI, F. M. Sistemas agrários e reprodução familiar. O caso dos lavradores do Alto Jequitinhonha, Minas Gerais. *Anais do XI Encontro Nacional da Abep*, CAXAMBU, 1998
- RIBEIRO, E. M.; GALIZONI, F. M.; DANIEL, L. O.; AYRES, E.C.B.; ROCHA, L. C.; GOMES, G.A. Práticas, preceitos e problemas associados à escassez da água no Vale do Jequitinhonha, Minas Gerais. *Anais do XII Encontro Nacional da Abep*, Caxambu, 2000
- RIBEIRO, E. & GALIZONI, F. Sistemas agrários, recursos naturais e migrações no Alto Jequitinhonha, Minas Gerais. In: TORRES, H. & COSTA, H.M. (eds.), **População e Meio ambiente: debates e desafios**. São Paulo, Editora do Senac, 2000.
- RIBEIRO, M.A. C. A dimensão urbana da questão ambiental na Amazônia. *Anais do IX Encontro Nacional da Abep*, Volume II, Caxambu, 1994
- RODRIGUES, I. A. **Áreas Naturais Sob Proteção. Estabelecimento e Avanços nas Medidas de Conservação Ambiental. Um Estudo no Vale do Ribeira – SP**. Tese de Mestrado IFCH/UNICAMP, Campinas, 1995.
- RODRIGUES, I. A.; CARMO, R.L. Migração e processo de urbanização nas bacias dos rios Piracicaba e Capivari nos períodos 1970/80 e 1980/91. *Anais do X Encontro Nacional da Abep*, Volume II, Caxambu, 1996.
- SAWYER, D. População, Desenvolvimento e Meio ambiente na Amazônia. *Trabalho apresentado no XI Encontro Anual da ANPOCS*. Águas de São Pedro, 1987.

- SAWYER, D.; PINHEIRO, S.M. A dinâmica demográfica das regiões de fronteira. *Anais do IV Encontro Nacional da Abep*, Volume IV, Águas de São Pedro, 1984
- SAWYER, D. R. Industrialização da agricultura brasileira e debilitação da fronteira amazônica. *Anais do III Encontro Nacional da Abep*, Volume I, Vitória, 1982.
- . Fluxo e Refluxo da fronteira agrícola no Brasil: ensaio de interpretação estrutural e espacial. *Revista Brasileira de Estudos de População*, Nº 1, São Paulo, jan./dez. 1984.
- . **População, Meio ambiente e Desenvolvimento no Brasil**. Seminário Políticas Públicas, Agentes Sociais e Desenvolvimento Sustentável. Ministério de Relações Exteriores de Brasil. Belo-Horizonte, 14-15 de junho, 1993.
- . Deforestation and Malaria in Rondônia. In: BILSBORROW, R. E., & HOGAN, D.J. (eds.). **Population and Deforestation in the Humid Tropics**. Liège, IUSSP, 1999.
- . As Migrações e as Doenças. População e Saúde: *Anais do Seminário Latino-Americano*, vol. 1. Campinas, Editora da Unicamp, 1986.
- . População, Desenvolvimento e Meio ambiente na Amazônia. *Paper presented to the XI Encontro Anual da Associação Nacional de Pesquisa e Pós-Graduação em Ciências Sociais*, Águas de São Pedro, 1987.
- SCOTT, P. Remoção populacional e projetos de desenvolvimento urbano. *Anais do X Encontro Nacional da Abep*, Volume II, Caxambu, 1996.
- SOUZA, J. J. Dinâmica demográfica e econômica na pré-amazônia maranhense: a fronteira de recursos e o programa de colonização do Alto Turi. *Anais do I Encontro Nacional da Abep*, Volume I, Campos do Jordão, 1978.
- SPINDEL, C.R. Formação de um novo proletariado: as operárias do Distrito Industrial de Manaus. *Revista Brasileira de Estudos de População*, Nº 4, São Paulo, jul./dez. 1987
- STEINBERGER, M.; ROMERO, M.B. Reflexões preliminares sobre as dimensões demográficas e urbanas do zoneamento ecológico-econômico. *Anais do XII Encontro Nacional da Abep*, Caxambu, 2000
- SYDENSTICKER, J. M. Contraception in Frontier Regions: an unexpected picture. *Texto apresentado no Seminário Population and Deforestation in the Humid Tropics*, IUSSP/ABEP/NEPO, Campinas, 1992.
- . **Parceiros de Machadinho: história migratória e as interrelações entre a dinâmica demográfica e o ciclo agrícola em Rondônia**. Master's thesis, Universidade Estadual de Campinas, 1992.
- . Sustentabilidade ambiental nos trópicos: associações de linha e a formação de alianças locais. *Anais do XI Encontro Nacional da Abep*, Caxambu, 1998
- TASCHNER, S. P. Degradação ambiental em áreas de invasão no município de São Paulo. *Anais do VIII Encontro Nacional da Abep*, Volume III, Brasília, 1992
- . Degradação ambiental nas favelas em São Paulo. In: TORRES, H. & COSTA, H.M. (eds.), **População e Meio ambiente: debates e desafios**. São Paulo, Editora do Senac, 2000.
- TORRES, H. A. G. Migração e o migrante de origem urbana na Amazônia. *Anais do VI Encontro Nacional da Abep*, Volume II, Olinda, 1988.

- TORRES, H. G.; CUNHA, J.M.P. População sujeita a riscos de inundação: o caso de Campinas. *Anais do IX Encontro Nacional da Abep*, Volume II, Caxambu, 1994.
- TORRES, H. G. Migração e estrutura fundiária na fronteira. *Anais do VII Encontro Nacional da Abep*, Volume I, Caxambu, 1990.
- . Impacto ambiental em escala regional: a Amazônia. *IV Encontro Nacional da ANPUR*, Salvador, 1991.
- . A demografia do risco ambiental. In: TORRES, H. & COSTA, H.M. (eds.), **População e Meio ambiente: debates e desafios**. São Paulo, Editora do Senac, 2000.
- TORRES, H. & COSTA, H.M. (eds.), **População e Meio ambiente: debates e desafios**. São Paulo, Editora do Senac, 2000, 351 p.
- TORRES, H. G. **Desigualdade Ambiental na Cidade de São Paulo**. Doctoral thesis, State University of Campinas, 1997.
- . Pobreza e Degradação Ambiental na Periferia: uma aplicação de geoprocessamento para a Zona Leste da Cidade de São Paulo. In: NAJAR, A.L. & MARQUES, E.C. (eds.) **Saúde e Espaço**. Rio de Janeiro, Editora Fiocruz, 1998, pp.199-213.
- TUBALDINI, M. A.S. & RODRIGUES, E.F. Conflitos e interação rural-urbana nos nichos agrícolas da agricultura metropolitana de Ibirité –MG. *Anais do XII Encontro Nacional da Abep*, Caxambu, 2000.
- TURCHI, L. M. Estratégia de sobrevivência da pequena produção na fronteira agrícola: projetos de colonização Ouro Preto e Gy-Paraná. *Anais do III Encontro Nacional da Abep*, Volume I, Vitória, 1982.
- . A colonização dirigida no processo de expansão e ocupação da fronteira agrícola: Território Federal de Rondônia. *Anais do II Encontro Nacional da Abep*, Volume 1 Águas de São Pedro, 1980
- VALLOTI, V. B. C. Bacia hidrográfica do Guarapiranga: entre o poder público e as Ong's - breve panorama das intervenções nesta região. *Anais do XI Encontro Nacional da Abep*, Caxambu, 1998
- WORMS, M.A. A migração rural por unidade da federação no decênio 70-80 e sua relação com a modernização da agricultura. *Anais do III Encontro Nacional da Abep*, Volume I, Vitória, 1982.

NOTES

*This paper has benefited from a series of research projects on population and environment, most recently by the project "Population Redistribution and Environment: São Paulo and the Center West," supported by the Program for Centers of Excellence of the Ministry of Science and Technology. I would like to thank Adalberto Azevedo and Célio Delgado for their support in preparing this paper.

** Donald Sawyer's presentation (1993) at a preparatory meeting for the ICPD (Cairo 1994) questioned, perhaps for the first time, the discipline's conventional wisdom on population, development and environment. That this discussion did not provoke serious polemics among Brazilian demographers was a clear sign of changing times.

¹ Most of the references in this section are to the Proceedings (*Anais*) of the biannual meetings of the Brazilian Population Studies Association. The *Anais*, in their 12th edition in 2000, represent the most extensive library of Brazilian demography. Special attention is also accorded to Abep's two collections of articles on population and environment and to *abepianos'* publications in other forms.

² An earlier version of this paper was presented at the Abep meeting in 1982 (SAWYER, 1982).

³ The WHO considers that diseases within the tropical cluster most affected by domestic environments are schistosomiasis, South American trypanosomiasis and Bancroftian filariasis. (WORLD BANK, 1993: 90)

⁴ A model for such an effort may be found in Theo Colburn's work on consequences of endocrine disruption, provoked by exposition to a large number of chemical compounds (used in agriculture and in homes), on reproductive organs and processes. Convinced that there was a common thread in cases of congenital defects, altered sexual behavior, uncommon sex ratios, low sperm counts and other problems, Colburn read literally thousands of research articles (first on bird, fish and reptile populations, and later on human populations) to develop an explanation of how hormone-imitating substances – widely disseminated in the last fifty years – are responsible for a myriad of hitherto unconnected maladies.

⁵ This procedure is to be followed in research now underway, which will separate the Pantanal (one of the world's most important wetlands) and several sub-categories, as well as the major ecotones (areas of transition between major formations).

⁶ The degree of resolution can be improved by using census blocks, although not all ecosystems have boundaries so precisely defined by ecologists. In such densely occupied areas as the Atlantic Rainforest, however, this procedure is possible and necessary (see ALVES, 2001).

⁷ The core of the *cerrado*, considered the most characteristic and continuous portions, occupies 1,500,000 km² in the Central Brazilian Plateau, in the states of Goiás, Tocantins, Federal District, part of Minas Gerais, Bahia, Mato Grosso, Mato Grosso do Sul and part of Maranhão, Piauí, and Rondônia. Unconnected portions, forming islands of *cerrado*, are found in Amazonas, Amapá, Roraima, Alagoas, Bahia, Ceará, Paraíba, Pernambuco, São Paulo and Paraná. This fact, in addition to biological and political differences in defining *cerrado*, has led to a range of estimations of total area.

⁸ Government policy was fundamental to this process. Embrapa, a research arm of the Ministry of Agriculture, created in the early 1970s, soon developed varieties of soybeans adapted to the climate and soils of the *cerrado*.

⁹ An example of inadequate soil use is soybean production in the headwaters of the Taquari, in the North of Mato Grosso do Sul. "The plantations provoke erosion and silting of the river, which result in floods in the Pantanal. To avoid the floods on their properties, farmers dredge the river and end up blocking off its affluents. This then diminishes the oxygenation of the water and kills fish, leading to loss of biodiversity in the river." (WWF, 2001)

¹⁰ Densely populated in Brazilian terms. China's population density, in 2000, was 132 persons/km² and India's in 2001, 324 persons/km² (in its most densely populated state, West Bengal, density was 904 persons/km²).