María Augusta Fernández
Compiler

Urban Risk and Disaster

Environmental Degradation

CITIES AT RISK

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Environmental Degradation, Urban Risks and Disaster in Latin America

María Augusta Fernández
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PREFACE

The issue of disasters and the actions taken accordingly is a field with a long history of research, bibliography, theoretical and methodological approaches, and experiences in management. National and international organizations have worked extensively to face the problem, provide assistance and support the local attempts to improve the preparedness and response to disasters. Several actions have also been taken regarding the prevention and mitigation of disasters considering that the most effective approach to reduce their long term impacts is the availability of activities the evaluate the threats and the mitigation within the planning and investment processes for development.

On the other hand, urban management has been supported at all levels by encouraging the local and national governments, and the private sector of national and international contexts, to improve and increase the policies that keep the environment in stable conditions in the long run. Since the processes that affect the environment are well known, non-threatening technologies have been developed in order to provide potable water, sewerage, waste collection, and control of contaminants in the air and in industrial processes, among others. Although, the main problems remain to be solved, a significant step has been taken towards the creation of organizations with enough credibility to confront the governing political groups and struggle against those interests than threaten the environment.

The vast experience in each one of the two issues has been acquired independently. Even though, both areas are usually studied separately, it is relevant to underline the complex relationships between urban environmental degradation and urban vulnerabilities – as risk magnifiers and disaster originators - in regards to natural or man-made hazards. It is necessary to have a complete vision of the two issues in order to lay out the foundations of future research and provide the appropriate support to those involved in the issue. Little has been done to develop a framework that explains these relationships.

On May 1995, in Quito, Ecuador, the Network for Social Studies on Disaster Prevention in Latin America in conjunction with the Housing and Urban Development Office for South America from the United States Agency tirelessly worked to gather Latin American institutions and researchers that would be able to provide new elements towards the quest for relationships among disasters, environmental degradation and urban management. This first workshop, named "Environmental Degradation: The Impact of Environmental Management on Hazards and Vulnerabilities," was followed by another workshop held in Joao Pessoa, Brazil, in December1995, which evaluated the hypothesis that environmental degradation increases the vulnerability to disasters.

Research and regional exchange programs have produced this book that is hereby presented to those concerned with the topic. Part One presents some theoretical discussions of the different approaches for creating a purely Latin American framework. Part Two presents the supporting selected documents regarding the interpretations of the relationship between transformation processes of the *natural* and *social* environment that interact in gathering the conditions for risks and potential disasters.

This first publication about environmental degradation, urban risks and disasters is intended to raise the concern about the issue. Be welcomed to consider the content of the chapters as an incentive to motivate discussions on the topic. Hopefully, the new contributions generated by this book may be shared with the Latin American community.

PART ONE

Towards a Conceptual Framework from the Latin American Perspective

CHAPTER 1 WHAT IS THE PROBLEM?

María Augusta Fernández
Lyvia Rodríguez

It is not unusual to speak not only about the increasing number of disasters, especially in areas inhabited by marginal groups, but also about the weakness of civil defense organizations, or their equivalents, to provide assistance that meets the growing demand. In fact, statistics show that while the number of disasters has increased, the number of physical-natural events remains the same. This is a fact that we have to accept. This acceptance will lead us towards the causes of disasters, rather than conveying our approach to relieve. We know that disasters are social events, not physical phenomena; therefore the intensifying and deepening search for answers within the analysis of human behavior and its relationship with nature is the path we must take to find feasible solutions.

Why do people say that nowadays we have disasters that did not use to affect their territory in the past? The metropolitan area of Buenos Aires floods more frequently now because of the inadequate drainage and sanitary infrastructures (Herzer, 1996). In the past, landslides were known as spectacular natural events in Quito, a city in the mountains of Ecuador. Today small and frequent landslides that kill people are not uncommon. The cities in the northeast of Brazil are dramatic examples of the results of rural-to-urban migration that promotes an internal social dysfunction and it is due to the high occurrence of droughts in rural as well as in urban areas. Do urban resources demands contribute to the increase of droughts?

Although Latin America is a region highly exposed to geo-dynamic phenomena, volcanoes, earthquakes, and hurricanes are not alone in the generation of destruction. The lack of adequate solid waste collection

causes the pile-up of waste in the drainage ditches, clogging them, repressing the flow of water, and causing floods. In certain moments, sudden ruptures cause alluviums or «huaicos» which result in considerable human and material losses. All of us pay attention to disasters; we are surprised by them, and look at them as exceptional events. But we do not realize that we did not notice that they were growing slowly in front of us. For example, in the case of alluviums, the absence of an effective system of rainwater collection and drainage triggers floods and landslides without exceptionally heavy rains

The shores of the rivers flood in accordance with the hydro-climate system of their basins. When the water was clean, floods were expected because they brought the benefits of cleaning and soil enrichment. House built on piles (palafitos) survived. Nowadays the landscape is the same --with houses being built on the shores of the rivers -- but now the shores have become ecologically fragile. Now when we approach to the shore, the smell bothers us. The floods now contain black (polluted) waters from urban areas, and the volume of the river, diminished by dams, is not enough to process and clean this waters. Often the level of the water surpasses the «traditional» flood levels and invades areas that were not historically vulnerable. The filling of the riverbed with erosion products usually causes this.

It is estimated that in 25 years, 85% of the Latin American population will reside in urban areas (World Bank, 1992). A significant percentage of urban residents live in poverty, without access to adequate infrastructure or housing. Spontaneous settlements are the most significant form of growth in the region's urban centers, with precarious economic conditions that impede the provision of basic services. The fate of urban spaces lies in the hands of many agents, so it's difficult to identify which one to blame. The local government is a leading actor whose role is to provide services though this is often a neglected role, especially in poor areas. In both cases there is general disagreement about «how» the job should be done. The same may be said about the private sector and the communities themselves. Due to needs, interests or ignorance, the various social groups gradually damage our surrounding environment, increasing our vulnerabilities and creating new threats, either anthropologic or natural. The actions that we take towards our environment, the use and waste of our natural resources, are guided by an inter-

est in satisfying our immediate needs. This type of *management* is causing an accumulation of degradation with the result being a «surprise» to us all - a disaster called *natural* which no one expected but built by everyone, day after day and year after year.

According to the researchers of this subject, both those involved in the practical and in the theoretical aspects, there is a non-defined relationship between urban environmental degradation and vulnerability of a city to natural disasters[1]. Although these two topics have been widely studied, we do not have a theoretical framework that relates them to each other. In 1992, the World Bank organized a conference on Environmental Management and Urban Vulnerability. The conclusions of the conference underscored the need for an integrated framework that expedites the analysis of urban vulnerability in order to allow us to take preventive measures.

Does urban environmental degradation increase the degree of vulnerability and risk of disasters? For example, should the contamination of a river be considered a disaster? If so, how do we distinguish between a disaster and gradual environmental degradation? In what way does the degree of contamination of natural resources affect the degree of vulnerability in the region? Is environmental degradation the triggering agent that causes or enhances the effects of natural disasters? Let's briefly discuss these subjects one by one.

In underdeveloped countries, the feeling of impotence when facing a *natural* disaster increases. The lack of sufficient economic resources, as well as internal and external structural problems, impedes the management of the crisis Possible disasters are not a concern in people's everyday lives since problems such as extreme poverty, hunger, high infant mortality rates, among others, are more pressing than a potential disaster. Although technical advances allow us to predict with certainty a natural event, such as hurricanes, there are others that are completely unpredictable. The common aspect to all geo-dynamic events is that they are unavoidable: we cannot control nature.

However, since human activity is precisely the cause of environmental degradation, it might be prevented and avoided once the necessary measures have been taken. The sustainability of social and economic structures depends on the availability of natural resources. Ironically, it is precisely in the name of supporting a society and promoting the devel-

opment that human activity becomes the main source of environmental degradation. The contamination and exploitation of natural resources is most often the result of a slow and cumulative process of human activity. For example, although an automobile is constantly producing smog, it is only in the long-term that the contamination becomes evident. In order to reach a critical point, a long period of time must pass and thousands of cars contribute to the contamination of the environment. However, since this process takes time, society have developed mechanisms that increase its ability to cope with environmental degradation.

Urban areas are made up of complex micro-systems that intersect at several points. Neighborhoods, financial networks, basic services, and migration patterns are some of these systems. Environmental degradation slowly unbalances these systems, until the elasticity limit is reached and the equilibrium is broken. It is then that disasters occur in one or more points of the micro systems.

Is it possible to consider environmental degradation as a slow disaster? Water and air contamination, deforestation, river and ocean bed alterations, and landscape modifications affect social systems daily. Eventually, these practices impact society and may in some cases cause an event that could be qualified as a sudden *natural* disaster or, in other cases, this practice may worsen the effects of true natural disaster. For example, deforestation may transform into landslides during rainy seasons. It is not easy to categorize a *disaster* when daily pressure inflicted by a hostile environment becomes a crisis.[2]

Resources and natural phenomena become threats when their potential to generate an imbalance in the social system increases. Water, air, soil, volcanoes and rain generate disasters in the form of flood, storms, landslides, eruptions and earthquakes. When a natural system produces an event necessary for the maintenance of its balance, but affects the normal functioning of the social system, such event is considered dangerous and its consequences a disaster. On the other hand, if it is the social system that unbalance the ecosystem through contamination, deforestation and other activities, the daily consequences are not usually identified as micro-disasters until these small, but permanent forces accumulate and show themselves in a catastrophic event. This is when the disaster is finally recognized.

We have established that natural events may turn into disasters if they negatively affect human populations. These same events might become essential to keep the balance of the social system. The flood of a river benefits the agricultural activities of the affected region, providing important nutrients for the soil. However, if the same flood happens in a highly populated area, the balance of the social system is broken causing a disaster that results in population displacement and other human, infrastructure and material losses. Now, what happens if, in the first scenario, the river whose floods were beneficial for local agriculture is contaminated with heavy metals? It might be logical to conclude that the soils will be contaminated. A number of problems will result: the health of the consumers of the products grown in that area will be affected, or simply the soil will lose its fertility. In this case, the environmental degradation causes a disaster where none previously existed.

When there is a substantial increase in the disaster vulnerability of the region, risks also increase. Unfortunately, limited research has been conducted towards measuring the degree to which contaminants become triggering agents of vulnerability or threats that generate disasters.

The situation worsens if we consider the effect of urban contaminants on the ecosystems of border cities and rural areas. The multiplying effects of a disaster might reach devastating proportions. However, it is impossible to establish conclusions due to the lack of investigations in this area.

NOTAS

1 For example, Roberto Eibenschutz, professor for the Autonomous University of Mexico, mentions environment as one of the factors that contribute to the increase of the urban vulnerability.

2 Clark Guarnizo, Caroline «Living with Hazards Communities: Adjustment Mechanisms in Developing Countries.» Environmental Management and urban Vulnerability. Ed. Alcira Kreimer and Mohan Munasighe.

THE PROBLEM AND THE CONTEXT

The Urbanization Process

Human settlements - villages, small and medium size cities, metropolis and megalopolis - are constructed and shaped through the modification or transformation of nature: the land, air, flora and fauna support these transformations and are in turn transformed by them. The product is a new constructed environment, a new *natural* environment that combines social and natural elements under patterns of high centralism and density. That is to say an urban environment. This environment constitutes the concrete and dynamic expression of the physical-spatial and eco-demographic units better known as *cities*.

From a demographic, economic, and social/cultural perspective, the city increasingly dominates the immediate setting of human existence. The urbanization process seems to be irreversible. In developing countries, today's urban economies generate between sixty and eighty percent of Gross National Product (Dossier, 1992). And, "whilst the rural population will tend to level off over the next twenty years, for the first time in human history the majority of the poor will live in the cities of developing countries" (Mougeot, 1993: 190; based on UNDP, 1991: 9, 19). In Latin America this trend will be even more evident. The urban population will reach 76.6% of the total population by the year 2000, and 84% by the year 2025 (UNCHS, 1995).

City, Risks, and Disasters

Globally, it is evident that the city is a scenario of risk and disaster, particularly in Latin America. The foundations of the colossal insurance industry were shook by the devastating human and economic impacts suffered over the past ten years as the result of the earthquakes in Northridge, California and in Kobe, Japan (over US$100,000 million in economic losses); the impact of Hurricane Andrew in South Florida; the great floods of the Mississippi River; and the storms that devastated southern England and northern Europe towards the end of the past decade. At a regional scale, the urban seismic disasters of Huaraz, Perú (1970), Managua (1972), Guatemala (1976), Popayán (1983), México (1985), and San Salvador (1986); the alluvion that buried Armero (1985); the

great floods that affected Buenos Aires (1985); and the landslides in Rio de Janeiro (1988) inflicted high costs in terms of human life and of economy. These events remind us that an important number of the world's largest cities - without forgetting the smaller ones - are located in zones prone to a wide range of physical-natural hazards, whose impacts are amplified due to the dense concentration of population and infrastructure, and the prevailing levels of social vulnerability. Additionally, the urbanization process itself and the changes that it generates in surrounding regions, increasingly modify and transform the existing physical-natural elements, creating new hazards or amplifying the intensity and frequency of the existing ones.

But hazards of a physical-natural origin constitute only one component of the risk factors that prevail in urban (and rural) settings. The spatial concentration of population and economic infrastructure, the complexity and interconnection of the elements of the urban structure, the synergic effects produced by the city, and the prevalent lack of control and legislation referring to citizen safety, create new risk factors. As in the case of physical-natural hazards, numerous examples of urban explosions and fires, technological accidents, spills of toxic material, accumulation of solid waste, collapse of buildings, pollution of air, water, and soil, drought, and *urban* epidemics, among others, are well documented. The hazards associated with terrorism or urban violence are far from being eradicated from societies where extreme social conflicts or contradictions still prevail (the World Trade Center in New York, the Federal Building in Oklahoma City, the toxic gases in Tokyo, the civil disturbances in Los Angeles, and the bombings in Paris and in London).

The "traditional" hazards are well known and, whether sufficient or not, a certain level of understanding has been reached with respect to their causes and possible activities for preventing them. However, the dynamics of society, particularly urban society, constantly poses challenges, creating new or modified hazards and vulnerabilities and new urban disaster scenarios that defy existing precedents, levels of knowledge, and prevailing management measures. James Mitchell, one of the most sharp and imaginative researchers of the problem, has argued that, "few explanations give sufficient attention to unprecedented impelling actions, related to contemporary changes in society and the environment. It is probable that such changes are essentially modifying the nature of

mental Management and Urban Vulnerability," a compendium edited by Alcira Kreimer and Mohan Munasinghe, and the result of a conference sponsored by the World Bank. This edition surprised the institution that promoted it by introducing an almost forgotten issue into the international agenda. Throughout the 1980s, the World Bank had been the target of growing criticism because of its *anti-environmental* policies and the promotion of investments that radically modified the natural habitat.

Despite its impact and, undoubtedly, its positive aspects and elements, the World Bank document is essentially conservative and technocratic in its approach reflecting the dominant disaster paradigm that ten years previously, Hewitt (1983) had nimbly and eloquently unmasked. Varley (1994) points out the technocratic nature of an important part of the publication. She concludes that the solutions there proposed essentially aim to promote technology transfer, institutional modernization, and a reduction of the physical vulnerability of the city. An essential similarity between the old and the new preoccupations and priorities of the World Bank could be perceived. The concept of vulnerability was greatly restricted to the physical environment and buildings, ignoring the more global, comprehensive and social contributions on the topic made by authors such as Hewitt (1983), Anderson and Woodrow (1989), Wilches Chaux (1989) and Cannon (1994). As Varley argues, the risk faced by the population is considered to be a problem of ignorance or of being outside of the "information circuit." Essentially, the multiple components of social vulnerability were evaded as explanatory components. The Marxist "origins" of the concept of vulnerability, combined with the uncomfortable recognition that vulnerability is a product of the models of development promoted (and therefore, a political problem), could help explain its absence as a fundamental component of the analysis in the World Bank sponsored document (Varley, op.cit.).

Varley's arguments are validated by an IDRC-Canada, publication edited by Mougeot and Massé in 1993. This publication, "Urban Environmental Management: Developing a Global Research Agenda," was the result of an exhaustive review of the existing literature and prevailing perspectives on the issue. And also, the product of exhaustive interviews with Latin American, African, and Asian specialists.

From our perspective the document, which offers a distinct perspective to that included in the World Bank publication, presents important

parameters for research and practice in the field of Urban Environmental Management. It is worthy of being extensively cited, not only because of its content but also due to the relevance of the conclusions it draws, based on a comprehensive review of the existing literature. In the base line document of Mougeot's publication (1993:22-24, Spanish version in Lavell, 1994), the following principle is established: "Donor agencies, research institutions and publishing houses have been slow in financing, implementing and disseminating research on the environmental problems faced by Third World cities. During the 1980s, the volume of urban research decreased abruptly, 'just when many questions regarding urban policies gained importance' (COHEN, 1991:12)" (Mougeot, 1993:22)

It further establishes that "few donors' agendas face the issue of prevention and mitigation of urban environmental degradation, and those which do usually direct their attention towards improving governmental capabilities through technology transfers" (op.cit. 25, Lavell's emphasis). Referring to the World Bank, UNDP and OECD, the document concludes that technological solutions are channeled through governments, and are mainly concerned with mechanisms of economic instrumentation and legal regulations. According to the author, these measures "will probably not be sufficient to mobilize the public and introduce significant changes in their behavior" (op.cit.26).

Regarding Urban Environmental Management and the research on the topic, the main problems identified in the IDRC document include water management, disaster prevention and mitigation, solid waste management, and urban agriculture, all of which are of significant conjunctural and future importance. However, the final version of the research agenda that would be financed by the IDRC during future years, left out disaster prevention and mitigation as a discrete topic. From our perspective this was a mistake of unforeseeable consequences made by the institutional "decision-makers." It mirrored, on the one hand, a partial conceptualization of urban reality and of the different components of urban environmental risk. On the other hand, it reflected a mistaken conceptualization of the components and process of disaster itself. This issue will be addressed further on.

Establishing a clear difference with some existing perspectives (including those of the World Bank and, unfortunately, to a certain extent,

ety itself, of the social conditioning of human impacts on the natural world, and of the impact of modified nature on society.

Such a vision of urban (or rural) environmental degradation explicitly brings to the forefront the problem of sustainable development and the sustainability of the city. Additionally, as is examined further on, it suggests a conceptualization of degradation, risks, and disasters formulated from a human-ecological standpoint, thus establishing significant differences with the existing, and as yet dominant, "physicist," "social" or "sociological" currents of thought (see Hewitt, 1997). Degradation is equivalent to an increase in society's vulnerability and, it affects the physical, ecological, and social components discussed by Wilches Chaux (1993) in a classic Latin American formulation of the idea of global vulnerability. The degraded environment is the "expression that summarizes environmental vulnerability to disasters" (see Herzer and Guverich, in the present volume).

Despite the apparently clear understanding of the meaning of degradation, it is in fact not easy to find operational parameters, criteria and policies regarding "acceptable" levels of degradation.

From a purist or absolute perspective, if we look at the natural environment, any modification or transformation of the elements of nature could be interpreted as degradation. Nowadays, it would be difficult to identify many ecosystems that have not been affected directly or indirectly by human activity. In view of the imperative need to achieve human welfare, it is obvious that the transformation and degradation of nature is unavoidable. The decision of how much transformation should be allowed requires the establishment of criteria with which we can identify which type of degradation is convenient or not. Issues such as the transformation of highly productive agricultural land into urban property have already been object of extended debates in various contexts. A similar situation occurs with the damming of rivers to generate electricity, the underground channeling of *urban* rivers, the transformation of the tropics into cattle raising "prairies," or the more difficult issue of the use of endangered flora for medical purposes (for cancer treatment, for example).

In regards to the natural environment, several criteria may be used in the decision making process:

i) that the transformation does not endanger a community's economy or lifestyle surpassing the benefits received from the transformation itself; ii) that it does not significantly change the functioning of a highly productive natural ecosystem; iii) that it leads to a sustainable and highly productive activity in the long run; iv) that it does not affect or reduce the prevailing biodiversity and ecological complexity; v) and, that short term in situ degradation of natural resources (i.e. tree logging for the construction industry) is compensated by their medium and long term reproduction. Obviously, in a context dominated by short term economic or survival interests, the most important challenge for Urban Environmental Management is to make effective these "rational" criteria.

Other questions exist, however, regarding the transformation (degradation) of the urban environment seen as a socially and constructed reality. Thus, it is fairly easy to establish with certain precision the idea that already existing collective goods and new ones should not suffer a reduction in quality and coverage. However, it is not that easy to introduce criteria that provides guidelines for new patterns of urban development (i.e., housing, the location of industrial zones and transformations or changes in urban land use patterns). The complex interaction between the functional and spatial elements of the city suggests that urban expansion and changes in, or densification of land use, etc., can generate harmful impacts in settlements and areas different from those where transformation (or degradation) takes place. Examples include proliferation of housing on hillsides to satisfy existing urban demands, with its unavoidable repercussions in terms of pluvial runoff and urban river regimes. Other example is the decentralization of the middle class housing towards urban periphery, which produces negative impacts on the levels of atmospheric pollution as the number of vehicles increases; and finally, the "forced" construction of housing units in marginal areas or close to hazardous infrastructure (chemical factories, petrochemical plants, etc.).

Risk

The concept of risk, in its simpler definition, refers to the probability that something harmful or injurious will occur to a settlement (population, physical structures, productive systems, etc.) or to a segment of them.

and available controls. They are easily interpreted as acts of nature or acts of God, thus notably reducing the possibilities to promote adequate, preventive management schemes. A lack of understanding of causalities and responsibilities may result in the absence of adequate schemes for reducing the hazard, and a concentration on the mitigation of their effects (that is, the reduction of existing vulnerability), which is far from being an easy and lasting "solution" in present social and political contexts.

Socio-natural hazards are commonly materialized as floods, landslides, sinkholes, droughts (and desertification), coastal erosion, rural fires, and the exhaustion of aquifers. In these cases, deforestation and degradation of river basins, the destabilization of slopes through mining operations, underground mining, the disposal of industrial, agricultural and domestic solid waste in river channels, the overexploitation of the land, the destruction of mangroves, among others, constitute explicative variables for some of these phenomena.

Floods, landslides, sinkholes, and droughts (resulting from aquifer exhaustion, the lack of economic options for exploiting more distant water sources and losses due to damage in the distribution channels) are undoubtedly serious and growing problems within the Latin American urban context. Besides, the most important causes of urban floods today are the impact of factors such as deforestation, the very process of urbanization, the location of buildings and asphalt in areas of natural pluvial infiltration, and the lack of sufficient and adequate pluvial drainage systems (see Herzer and Guverich, in the present volume).

It is foreseeable that in the future, existing socio-natural hazards will possibly be intensified and new ones will appear related to the climatic changes induced by atmospheric pollution, the depletion of the ozone layer, and the deepening of the *greenhouse effect*. Scientists repeatedly predict phenomena such as changes in sea level, noteworthy increases in the intensity and recurrence of hurricanes, rainfall increases and droughts.

From the perspective of Urban Environmental Management (or Risk and Disaster Management), the existence of socio-natural hazards automatically leads us to a series of conceptual considerations, issues and research questions.

Firstly, socio-natural hazards clearly illustrate that *hazards* and *vulnerabilities* are not simply categories on two sides of an equation that, when combined in an unstable way (as in the case of natural hazards and vulnerabilities), may result in disaster or catastrophe. Socio-natural hazards result from the impact of determined social practices. Some of these derive from the search for economic gain (commercial deforestation, changes of agricultural patterns in zones of ecological fragility, urban commercial construction on marginal lands, etc.). Others derive from survival strategies among the poor (i.e. the cutting of mangroves or forests for firewood); from the fiscal crisis of the State or municipal governments (i.e. the inability to create or maintain pluvial drainage infrastructure where rapid processes of urban growth and land use densification are occurring); and, from harmful practices sometimes associated with the lack of adequate public services (garbage disposal in river courses causing artificial dams, or on the streets, blocking the drainage inlets). All of these practices constitute expressions of vulnerability (ecological, social, economic, institutional, or cultural; see Wilches Chaux, 1994). As a consequence, Urban Environmental Management is not limited to the management of natural components, but also consists of the management of social and socio-natural components.

Secondly, socio-natural hazards imply the need to consider and assign responsibilities to determined social agents (not to God or to Nature). As Herzer and Guverich point out, the social agents at fault are not necessarily those who suffer the hazard impacts. From this perspective, Urban Environmental Management is essentially an economic and political issue. Meanwhile, the combination of hazard with vulnerability reaffirms Metzger's argument (in the present volume) that environmental degradation constitutes a "hidden" or "insidious" risk.

Thirdly, socio-natural hazards clearly indicate the role that should be played by education and consciousness raising in establishing the fundamental pillars of Environmental Management. In the social construction of a problem (see Stallings, 1991) there is an important difference between assigning the responsibility to an untouchable God or innocent Nature on the one hand, and on the other, assigning the responsibility to concrete social agents. Raising of awareness constitutes the first step in empowering communities, and is also the first step in transforming the *environmental* problem into a scenario of social and political struggle. It

represents the difference between resignation and conscious action. Moreover, it highlights the fundamental importance that should be given to the *perceptions* and *social representations* of hazards and risks, as objects of research and action.

Fourth and lastly, although in many cases there may be an important correlation between what can be called the *territory of causality* of socio-natural hazards and the *territory of impact*, in other cases this is not so. For example, the deforestation of upstream basins may increase pluvial runoff and contribute to the generation of floods. Deforestation may occur at a great distance from the area impacted by the floods. A similar situation occurs with the exhaustion of aquifers in zones surrounding cities, and with impacts in terms of urban droughts. These scenarios create two problems, or are useful in identifying two challenges for Urban Environmental Management.

In the first place, the problem of the perceptions or knowledge that the population or the authorities might have with respect to causalities is seen to be extremely relevant. The relationship between certain construction patterns within the city and an increase in the frequency and violence of floods may be fairly easy to perceive due to geographical proximity to the problem and its causal factors. This may not be the case, however, when the causal elements are distant from the zones and populations affected by flooding, as is the case with some deforestation processes and dam failures. In the second place, the notion of an Urban Environmental Management system or institutional organization that is territorially bounded to the city is itself challenged. Both from the investigative and the political-administrative and organizational perspectives, an adequate approach demands the incorporation of the urban region as a unit of analysis, planning, and action (see Herzer and Guverich), with complex methods of interaction and inter-institutional coordination. It requires a governmental approach to the urban region and not only to the city itself. The tendency to fragment and particularize solutions is contradictory to the integral and complex processes that characterize urban development and risk (see Lungo and Baires, in the present volume).

The issue of the *territory of causality* and the *territory of impact* has long been recognized when discussing problems related to shared resources and fluid environmental systems (i.e. the transportation of pollutant material through rivers affect downstream communities). This is-

sue, which will be examined further in the following sections, constitutes a very important Management consideration when dealing with socio-natural hazards. The issues related to socio-natural hazards constitute one of the central elements of Urban Environmental Management, capturing the essence of the dynamic relationship between hazards and vulnerabilities, and consequently, risks and potential urban disasters.

Anthropogenic Pollutant Hazards

Accepting the risks implied in the use of any typological system, we will identify a third group of hazards: the anthropogenic-pollutant. These, despite the similarities with socio-natural and technological hazards (given the presence of human intervention in their materialization), differ from them in an essential way. Here, we refer to a series of hazards that are materialized in the form of "transformed" elements of nature (air, water and land). These hazards are founded and constructed on elements of nature, but are not part of nature itself. However, because of the importance of natural resources for human existence, their transformation presents an important challenge for the survival and daily livelihood of important sectors of the local, regional, national and even international population.

In regards to Environmental Management, these hazards mainly relate to pollution processes derived from spills, leakage, or emissions of toxic substances into the air, earth and water. This is the case with oil, pesticides, toxic gases derived from combustion, chlorofluorocarbons and nuclear waste. In general terms, these hazards are either the product of negligence, the lack of legal controls or of diverse types of "accidents." They result from the lack of control over modern production, distribution and consumption processes.

Another subgroup of anthropogenic-pollutant hazards is that related to the disposal of untreated domestic, liquid or solid waste. The result, in terms of the biotic pollution of air and water, presents serious health problems to the population, leading at times to epidemics. These hazards are generally the product of poverty, lack of adequate disposal options as a result of unsatisfactory infrastructure and urban services, or from negligence.

Natural and socio-natural hazards present an "external" danger to the population, whilst anthropogenic-pollutant hazards have internal

physiological impacts that destroy the backbone of the biological existence and health of the population. Additionally, in terms of their relationship with interconnected diffuse and fluid mediums, potential impacts are not restricted to limited areas (although at times, large) or places, but are, rather, widely spread throughout the local, regional, national or international ambits. This characteristic provides them with a specific peculiarity and presents an extraordinary challenge for Environmental Management and for its organizational and institutional schemes. As in the case of socio-natural and anthropogenic-technological hazards, man-made-pollutant hazards encompass a dynamic relationship between hazards and vulnerabilities and, consequently, the demand planning and coordination at an inter-institutional, inter-sectorial, territorial and community level (see Herzer and Guverich).

Anthropogenic-Technological Hazards

Modern processes of industrial production and distribution, mainly concentrated in urban centers or close to them, and the provision of urban infrastructure, especially for energy distribution and consumption, imply the use of an important number of potentially dangerous processes. These present a problem for public safety. Due to negligence or to the lack of proper controls and foresight of science, possible failures of these processes generate a series of hazards whose materialization (even when affecting limited territorial extensions) may affect large numbers of settlers due to the population density in areas surrounding the source of the hazard.

In terms of a potential disaster, the importance of these hazards derives from the human settlements that surround them. In many cases this is the result of poverty (lack of options for alternative location of housing) and the lack of implementation of land use zoning controls (urban planning). The majority of these hazards are materialized through "accidents" that, depending on their impact, could become real disasters. Many of these give rise to "secondary" hazards, of a pollutant nature (see above).

Among the better known examples of this type of events are the cases of Chernobyl and Three Mile Islands (nuclear plants); Bhopal (chemical plant); and the explosion and fires in the PEMEX Mexico City gas plant in 1984 and in Guadalajara, Mexico, in 1992. Many other smaller scale cases occur annually in different cities of the world, including urban

conflagrations that result in many cases from failures in electrical systems.

The management of man-made technological hazards (and of other accidents) is obviously not distinct from that employed in facing natural events. The causes are found entirely within the social realm and require foresight, controls, and regulations to modify the practices of the social agents involved in the creation of these hazards. However, man-made technological hazards may materialize as the result of the occurrence or impact of natural or socio-natural events. This highlights the importance of "complex" or "concatenated" hazards, an aspect reflected in the idea of "primary," "secondary" and "concatenated" impacts of determined hazards.

These complex hazard categories help us to understand that although the typology we suggest is useful for heuristic and classificatory purposes, as it denotes different social actors and challenges according to the type of hazard, reality is much more complex than the schemes that attempt to systematize it. The eventual impact of concatenated hazards makes it indispensable to resort to complex and permanent monitoring and observation schemes, constant anticipation, and integral planning mechanisms. The incidence of this type of situation is probably greater in urban areas than in rural ones. Examples include the case of a tsunami that destroys a warehouse of chemical-toxic material, scattering the contents into the sea, land, and potable water systems. And, the case of an earthquake that prompts explosions and fire in a petrochemical plant, causing the leakage of toxic materials into the environment.

Vulnerabilities

Discussion, classification, and typologies of *social vulnerabilities* and their relationship with risk and disaster have been widely disseminated in academic and research circles. This is the product of a growing body of literature on the topic, developed over the last fifteen years. Numerous theoretical and empirical documents on this topic (i.e. Hewitt, 1997; Blakie et al., 1994; Cannon, 1994; Kreimer and Munasinghe, 1992; Lavell, 1994; Maskrey, 1993 and 1993(a); Varley et al., 1994; Wijkman and Timberlake, 1985; Wilchez Chaux, 1989; Anderson and Woodrow, 1989) appeared after the pioneer works of Hewitt (1983 essay collec-

tion), and after the innovative perspective included in *Desastres naturales y sociedad* (Natural Disasters and Society), edited by Caputo, Hardoy, and Herzer in 1985 and published by the Latin American Commission for the Social Sciences.

These efforts are a categorical response of the social sciences to the need to "socialize" the problem of risk and disaster, and reduce the influence of the dominant physicist or technocratic paradigm so elegantly debunked by Hewitt and his collaborators 15 years ago (Hewitt, 1983). This involves an erosion of the technocratic conception of disasters, which places the emphasis on the physical triggering events and promotes technical and technological solutions that mirror a conception of *vulnerability*, that is essentially limited to a consideration of physical structures (buildings, infrastructure, housing, etc.).

The arguments developed by these authors have increasingly been reflected in the discussions of many national and international disaster management organizations committed to the issue. However, the scenario changes when we consider the levels of implementation of the lessons derived from comprehensive analyses on vulnerability. Such analyses clearly show the relationships between vulnerability and the prevailing characteristics of many of the *development* models promoted, poverty levels, income distribution, among others. Facing the "discomfort" that these analyses cause, the trend has been to revert to nature the physical vulnerability, the lack of information, human irrationality, and the lack of education in order to justify a good part of the national and international initiatives taken in the field of Disaster Management (scientific and technological research, prediction, forecasting, and monitoring, early alert systems, technology transfers, the modernization of the State, geographic information systems, organized relief systems, etc.).

These emphases can be clearly perceived in the programs promoted by, and the composition of many National IDNDR Committees, the high level IDNDR Technical Committee, and the original propositions included in the Decade's work plan (see Mitchell, 1994; Varley, 1994; Blaikie et al, 1994; and Hewitt, 1997).

Prevention and mitigation are essential components of future and more effective Risk, Disaster and Environmental Management practices, as well as indispensable for reducing disasters. However, they continue to be left aside in the decade. Their role is postponed, given the impera-

tive need for effective and efficient preparedness and response to disasters, a never-ending task given the current trends.

The support of prevention and mitigation activities is the reduction of society's vulnerabilities derived from, and is intimately related to, the contents of development projects and plans. They are essential in conceptualizing and implementing Sustainable Development schemes. They are the essence of the efforts in favor of reducing environmental degradation. However, despite the growing attention received in academic circles, and recent activities prompted by international agencies and organizations, disaster prevention and mitigation have yet to surpass a very low threshold of concern in most Latin American (or African and Asian) countries.

It is clear that any significant reduction of historically accumulated vulnerability can be extremely costly, in both economic and political terms. The mobilization of key social and political actors in favor of risk reduction has yet to be achieved. Disaster Management continues to be dominated by actors linked to the traditional activities of preparedness and response, scientific forecasting and monitoring, and structural engineering. Relevant social actors associated with economic, urban and spatial development planning and the assigning of financial and budgetary priorities have yet to become thoroughly acquainted with the topic. It is likely that these social actors will continue to use anachronistic concepts of disaster. Naturalist conceptions that characterize disasters as *unavoidable* and *unmanageable* (see Hewitt, 1983) continue to dominate the scene. These conceptions are of interest of those sectors responsible for the immediate response; that is, humanitarian aid, logistic and mobilization sectors.

The "anachronism" of many of the institutions involved and the maintenance of the existing status quo do not help to alleviate this situation. Response activities are slowly improved (at times with international assistance). However, each disaster scenario breaks the rules in many ways, presenting new and unknown challenges. Institutions do not change rapidly enough to face existing and future social and environmental transformations. On the other hand, looking to the future, it is clear that a scheme of environmental management that favors disaster reduction has not been able to convincingly introduce disaster reduction and sustainable development into the discourse and practice of development plan-

ning. Professionals and politicians associated with these activities, the environmental movement, and other political "caucuses" that are fundamental for prevention and mitigation, have not grasped nor taken the message to heart. Disasters are still someone else's business (that of emergency technicians), and that someone else has neither the knowledge nor the methods, the resources, or the political understanding needed to reduce *vulnerabilities*.

As discussed in the previous section, hazards have eventually become more socially conditioned. Although hazards are still mainly the target of natural and basic sciences, they receive little recognition in relation to the fact that they are the product of diverse types of human *vulnerability* and of determined hazardous social practices (for a more comprehensive elaboration of these ideas, see Lavell 1996 and 1996a; Maskrey, 1996).

The previous arguments have been presented in certain detail, distracting us from the central point of our analysis. This is, the understanding that the scientific and academic community has a tremendous responsibility in changing conceptions, in "marketing" ideas, in instilling pragmatism and persuasion in their arguments, in being timely and political in order to promote a more adequate and current state of knowledge and action in society as regards risk reduction. And this has yet to be achieved. The messages are diffuse; the arguments are presented in unattractive attire and rarely made in the right place, fall on deaf ears, or are preached to the converted. Scientific production and cultural dissemination mechanisms must be more incisive and direct, offering feasible alternatives for change, and ways of influencing fundamental political decisions. Research must help translate the problem of risk and disaster into a significant social and political problem.

Returning to the central point under consideration, it is not our intention to extensively discuss the concept of *vulnerability* or to closely examine the typologies proposed by different authors. The existing literature offers sufficient elements on these issues, and it is relatively readily accessible to the reader. (See Blaikie et al, 1994 and Hewitt, 1997 for recent comprehensive treatments of vulnerability). However, it is important to conclude this section by pointing out the need for a continuously more comprehensive vision with respect to vulnerability and its relation-

ship with disasters. This relationship has been popularly expressed by the widely used lineal equation

Hazard + Vulnerability = Risk or Risk of Disaster. This idea has well served its educational purpose during past years.

Our earlier analysis of hazards shows however that the formula should perhaps be widened to include the following options:

1. Hazard + Vulnerability = Risk/Risk of Disaster

and/or

2. Natural Hazard + Vulnerability = Socio-natural Hazard or
Antropogenic Hazard ® Vulnerability = Risk / Risk of Disaster

It is established that the analysis derived from social sciences is as relevant to the study of hazards as it is to the study of vulnerabilities. Both studies have been conceived in relation to disasters, as we have previously stated, and it goes beyond the traditional perception of hazards.

Such an affirmation adds a further argument to the multidisciplinary work, and induces a greater degree of collaboration between the social and the basic and natural sciences, both in research and in the search for feasible solutions. It also introduces an interesting complexity in the analysis of hazards. The materialization of hazards via human intervention may result in the reduction of social vulnerability for those groups that promote them, in regards to either their general lifestyle vulnerability or hazards in particular.

How to Interpret Disasters

The definition and conceptualization of disaster has absorbed much research time and many pages in books and journals. It is not our intention to summarize this debate, much less to propose a solution of the conflicting opinions that can be found. Probably, this is an impossible task. Rather, our objective is to develop a series of ideas that are fundamental for correctly placing the research problem in context. This unavoidably requires some synthesis of the "state of the art."

The disagreement in terms of the definition or conception of disaster refers to its particular object of study. Disasters are seen, on the one

hand, as a product, fact or consummated reality (this is, materialized, evident, visible, and measurable disasters). On the other hand, disasters are seen as a "process" in which the emphasis is mainly placed on the objective, historically constructed conditions that allow the eventual appearance of an occurrence defined as *disaster* (or catastrophe, emergency, accident, etc.).

The conception of *disaster* as a concrete and consummate object of study typifies the operational definitions of national Disaster Management organizations (reflected in the declarations of a State of Emergency, Disaster or Public Calamity); of many international organizations dedicated to the problem; and of natural and basic sciences (the International Federation of Red Cross and the Red Crescent Moon Societies, OFDA-USAID, PAHO, and DHA, for example). It, also, typifies the conceptions of the main proponents of the Sociology of Disasters from the United States, Europe, Australia, and of some geographers, sociologists and scholars of Public Administration.

The definitions of international and national response organization will not be examined here, as their logic is obvious. They are the products of the need to define clear quantitative or operational parameters for deciding about their intervention in specific cases. The weight of these organizations and their presence in disaster scenarios makes them enormously influential. Sometimes, their definitions have had a harmful impact in terms of the development and complexity of Disaster Management in the modern context (i.e. their over-concentration and presence in the humanitarian stages of disaster relief, their concern for *large scale disasters* rather than for the *process of disaster*; their limitations in mobilizing fundamental social actors in a disaster scenario - communities, different sectors of the population, etc.).

Among the better known literature on this subject, the definitions derived from American Sociology and authors such as Fritz, Quarantelli, Kreps, Wenger, Miletti, Drabek, and Dynes have been the most widely disseminated. These contributions have mainly circulated through the international journal of *Mass Emergencies and Disasters*, published by the Disaster Research Committee of the International Sociology Association. "Obsessed" with definition, taxonomy, and classification of disaster, these authors have promoted and contributed to an important and stimulating debate on the topic.

However, their devotion in pursuit a disciplinary rigor has left their debates incomplete and with reduced options for further development. The definition of disaster should not allude in any way to *hazards* or to *nature*, we insist. It should, rather, be formulated in purely social terms, they promote a view of disasters limited to the "product," in which the essence of the research promoted has been on the analysis of social responses (organizational, individual, community-based) displayed in the period immediately prior to or following the event. Their contributions in this area have been meaningful, and have helped to correct mistaken conceptualizations about social and institutional behavior under disaster conditions. In addition, it has made an important contribution to the establishment of the principle of Integral or Comprehensive Disaster Management Systems, based on the idea that impacts or responses to physical events might be considered in generic terms rather than as specific events.

A syncretism of the classic contributions of Fritz (1961), Kreps (1984) and Quarentelli (1987) leads us to the following sociological definition of disaster:

Moments of crisis or social stress, observable in time and space, in which societies or their components (communities, regions, etc.) suffer physical damages or losses and alterations in their daily functioning to a degree that exceeds their own capacity for self-recovery, thus requiring external intervention or cooperation. Both the causes and the consequences of disasters are the result of the social processes that operate within the affected society.

This is a valuable definition in terms of the emphasis placed on the alteration of daily life functions, on the difficulty of self-recovery, and on disasters as the product of existing social processes. However, the practice of sociological research has almost completely left out a consideration of the processes behind the social construction of risk and disaster. As introduction to this type of research, arguments such as those of Pelanda (1981:1), in the sense that "an understanding of what goes on at the intersection between an extreme physical phenomenon and the social system, require examining the relationship between the context of 'normality' and the process of disaster." Another argument to be considered is that of Clausen et al. (1978), in the sense that "disasters are a normal (and usually highly relevant) component of the social system," serve as

an introduction to this type of research. However, the dominant line of research continues to emphasize the response phase (or preparedness). Prevention and mitigation are relegated to the interest of very few (see Tierney, 1989, Alesch and Petak, 1986, Olson, 1985, for some exceptions to this rule).

Vulnerability and the social construction of hazards receive ephemeral attention. The "Sociology of Development" applied to disasters does not find many adepts, maybe because of the emphasis placed on research on the developed societies of the North. Or, because of some hidden supposition that the American society does not experience differential social vulnerabilities in or between regions and cities. In some way it reflects a continuum from the origin of disaster sociology. That is to say, the analysis of the possible responses to a nuclear war on society. Whatever the reason maybe, nobody has persistently suggested that in the context of the United States, disasters are a "non-resolved development problem."[2]

The Latin American context requires a different starting point. One that puts the complex nature of the phenomenon of *disaster*, its historic and social nature, its relationship with hazards, vulnerability, and risks, and the imperative need for support for prevention and mitigation in perspective. One that encourages and demands multidisciplinary researches and facilitates the communication among disciplines. Such a starting point will not come from physicist definitions (i.e., earthquake = disaster), nor from purely sociological definitions (without denying the right to propose definitions that are useful in delimiting disciplinary areas of research on the topic).

In our opinion, only a definition derived from a human-ecological perspective can satisfy the needs of research on disaster, risk, hazard and vulnerability, and of their relationships with the process of environmental degradation. A definition that withdraws from the restrictive idea of disaster seen as a "product" (see Hewitt, 1997) is required.

What do we propose?

Firstly, although a disaster can be seen as "product" (described in terms of disruption, destruction, or death at community, zonal, city, regional, or national levels), its real significance in terms of process is that it represents a progressive rupture, lack of equilibrium, and instability in

the "normal" relationships between human beings, their economic, and social structures (housing, infrastructure, institutions, etc.) and the environment that supports their existence. Disasters are the "culminating point of risk, its revelation, its materialization" (see Metzger, in the present volume). In other terms, it represents a consummation of the degree of risk that prevails in a given society. It is the manifestation of a false equilibrium between society and its environment. Thus, the lack of a real equilibrium, expressed in the continuity of daily life apparently "adjusted" to its medium, is uncovered by the disaster. This is triggered by an external, physical, disturbing agent, but determined finally by the conditions of human existence, population location, structure, and organization. Thus, we do not face an optimal or balanced condition of society, but rather an institutionalized condition of existence marked by multiple social contradictions and inequalities, and that is perceived as "normal." In this sense, a disaster constitutes an "abnormal" condition in which its characteristics are determined by an existing "normalcy."

Secondly, as a consequence of the previous argument, a disaster is both a process and a product. The process can be seen in the historical creation of risk, which is in itself, the result of the dynamics of hazards and social vulnerabilities. Therefore, the condition of disaster is neither unforeseeable nor uncontrollable, at least in theory. Whether sudden or slow and continuous, the materialization of the existing risk in the form of a disaster has normally been proceeded by smaller ruptures or lack of equilibrium. That is to say, small and medium scale disasters, which are, in general, given little attention by the authorities and elicit limited response from the population. Low impact seismic activity, highly frequent floods, minor landslides, controlled epidemics, small-scale pollution episodes, etc., form part of the every day life of many communities, and are in many cases preambles to larger *disasters* events.

Thirdly, disasters are the most evident expression of what Wilches Chaux (1993) calls Ecological Vulnerability. They represent the most radical expression of our distancing from the laws of nature. They are the most conclusive expression of a process of environmental expropriation that has led society to exceed the capacity of natural resources, to the breakdown of our balanced relations with the environment (whether natural or constructed). Disasters are the antithesis of Sustainable De-

velopment, and at the same time, they are one of the possible pitfalls to achieving future patterns of Sustainability.

What are the implications of a human-ecological vision of disasters for research on the issue of Degradation, Risks, and Urban (or rural) Disaster in Latin America? Four are very clear.

Firstly, research cannot prioritize disaster as a product. This does not mean that the study of disasters as products and the study of the problems of response, rehabilitation and reconstruction do not deserve attention, but rather, that they should be studied within a dynamic perspective that considers process. Priority should be placed on researching the processes, on generating risk conditions, hazards and vulnerabilities. This must be undertaken from a historic perspective, and at the same time a profoundly prospective one.

Secondly, we must reiterate once more that disaster research should be preferably multidisciplinary, attracting practitioners from disciplines that have generally not been involved in the study of disaster in Latin America. Among these, ecology, cybernetics, law, political science, urban planning, crisis management, etc.

Thirdly, research must be as integral as possible given the complex nature of hazards and vulnerability. Synergy and complexity are attributes inherent to "modern" risk.

Fourthly, disaster research must consider the postulates of conflict theory and the idea of the existence of fundamental social contradictions in society. Risk is the result of contradictions between the interests of individuals or particular groups and the safety of others or of the collectivity as a whole. Solutions will come as the result of social mobilization and political struggle, the empowerment of disadvantaged, affected groups. Although a certain level of social consensus may be reached as regards disaster response, the generation of risk is the product of a failure of consensus and the result of a conflict of interest between groups in society (private vs. private, private vs. public, or public vs. public). Raising awareness and the creation of political 'caucuses' are essential elements in the proposition of social research on the topic. It is clear that disasters are an optimum indicator of *environmental degradation*, and "*degradation* is the result of the materialization of private interests, but it may affect the city as a whole, or particular groups within it" (see Herzer and Guverich in this volume).

INTERMEDIATE CATEGORIES: ACCEPTABLE RISK, COMMON AND COLLECTIVE GOODS AND THE CITY AS A PUBLIC GOOD

There are series of intermediate categories that must be taken into consideration when researching the relationship between Environmental Degradation, Risks and Urban Disasters. Herzer and Guverich refer to these in the present volume. These concepts have been extensively studied in the context of natural resource management (perception and common goods) and of urban development (collective goods and the city as a public good). Undoubtedly, they are relevant to our discussion. Their content and importance for research will be further explored in this section.

The Perception of Risks (and of Hazards)

During the 1960s and the 1970s, studies on the perception of hazards gained impulse as a result of the work of North American social geographers such as Gilbert White, R. Burton and Robert Kates. Subsequently, sociologists, anthropologists, and some economists further developed their research. The results of these studies are headed towards the diverse ways in which individuals, families, communities or organizations rationalize, organize, and systematize, both objectively and subjectively, their knowledge of hazards and risks, in a way that influences their decisions on location, production diversification, and self protection techniques (structures, behavior, safety, etc.).

These studies are intimately related to the issue of the *social representation* of diverse problems (in this case, hazards, risks and disasters). On the one hand, their main objective is to explain behavior and, on the other, to identify the factors that hinder processes of self-protection and social (political) organization in favor of changing public policy.[3]

From this point of view, these studies are an important element in the identification of educational or training challenges directed towards changing the false parameters (ideology, ignorance, etc.) that condition some of these perceptions. Secondly, the study of social organizations and their perceptions is important in identifying the factors that hinder the "social construction of a problem" and, consequently, the decision to

intervene in the problem (see Stallings, 1991). (For an excellent review of perception studies, see Tobin and Montz, 1997)

The factors that may influence perceptions are varied, including those related to class, ethnic groups, race, gender, age, educational levels, religious beliefs, previous experience and organizational participation, among others.

Several lines of questioning seem to be important in terms of our central line of enquiry. These derive from a consideration of previously discussed ideas with respect to hazards and risks and include:

* The perceptions of settlers, local organizations, etc. on hazards and complex hazards, and particularly regarding causal factors such as human intervention in the construction of hazards and the issue of the distinction between *causal* and *impact* territories.
* Perceptions of settlers as to their own vulnerability and their ability to dealing with problems, the role of local, regional or national governments, non-governmental organizations, etc.
* Perceptions of governmental authorities, the private sector, and other decision making groups on the issue of hazard, risks and disasters, their relevance, determining factors and possible solutions; and, perceptions on legislation, institutional organization and feasibility of intervention.

Acceptable Risk

Cardona (1993:93) defines *acceptable risk* as "a probability measure of social, economic or environmental consequences that, according to the authorities that regulate this type of decisions, is considered to be low enough as to permit its use in planning, in formulating the quality requirements of the elements exposed, or in establishing complementary social, economic and environmental public policy."

This definition, which emphasizes the subjects of "authority," assumes a fundamental importance in the scope of action of public and private organizations. It becomes the harbinger of deciding whether to prevent or mitigate, considering the costs implied and the degree of *acceptable risk*. The aspects derived from this concept refer, for example, to decisions as to the levels of protection to be established in seismic codes, the degree of tolerable environmental pollution and the levels of protection against flooding, considering probable intensities and frequencies.

Although it encompasses only a part of the universe to which the idea of *acceptable risk* could be applied, the emphasis on "authorities" and on organizations illustrates one essential aspect of the problem. Thus, studies made in the United States (see Tierney, 1989; Clarke, 1985; 1988; 1989) show that many decisions, taken with respect to risks, are made by organizations. "A great number of the risks imposed on others are those defined as acceptable for organizations, based on organizational priorities" (Tierney op.cit). Drabek (1986) observes "whether households in high seismic risk areas obtain or not earthquake insurance, probably depends more on the decisions that are taken within the insurance industry and the governmental sector than on the decisions made by the household" (Tierney, op.cit: 383). A conclusion from this is that there is a need to study "the way in which hierarchies assign resources in favor or against risks" (Clarke, 1988: 25).

The ability of individuals or local organizations to mitigate levels of *unacceptable risk* is still quite limited. In Third World countries, large segments of poor population do not have real options to mitigate risks, even when they are conscious of the existing levels of risk. The problem of the lack of options available to large sectors of the population requires assuming the concept of *acceptable risk* as relative. Thus, there are multiple cases (if not the majority) in which the risks could be *unacceptable* in absolute terms, but *acceptable* in relative terms. For example, those settlers who, after receiving the option of resettlement (through governmental programs, etc.) refuse or reject such possibility since it may produce a rupture in their daily living, cultural ties, or sources of employment. This case illustrates the problem of the way settlers "read" risk scenarios within the context of their daily life needs. (see Maskrey, 1994).

One problem with the concept of *acceptable risk* is that it can generally be applied only in the case of decision on new development and infrastructures. Particularly, those promoted by financially private and public sector interests. In those cases where risks already exist and a decision has to be taken as to the introduction of prevention and mitigation procedures it is highly probable that the concept of *unacceptable risk* is far more important as criteria for decision making.

When does a certain level of existing risk become unacceptable so that it elicits public or private intervention? Where are the probable eco-

nomic, social and political consequences of future loss unsustainable or unacceptable? These are significant questions, which may inspire decision-makers to take remedial action. The lack of remedial action of existing risk scenarios in developing countries is certainly no indicator of acceptable or accepted risk. Rather it is an indication that given a prevailing economic, social and political constraint, there is no real incentive to take remedial action. Risk levels have not reached, in terms of policies, a socially and politically unacceptable level.

Finally, it is necessary to recognize that even in large organizations, the mitigation of *unacceptable risks* is not simply a question of perceptions, of possible economic or political implications of not mitigating, or traditional cost-benefit calculations. The option of mitigating is usually seen in the light of the cost of opportunity of the required investment (what other use of investment could be made that would bring greater short term economic and social benefits?). This option could also be seen in the context of the political conflicts or pressures that could arise with the introduction of mitigation rules or measures (Lavell, 1994). In a context in which risks are the result of private and public interests and actions, but in themselves affect a wide collectivity, risks will always be the object of conflicting interests (see Herzer and Guverich).

Common Goods, Collective Goods, and the City as a Public Good

The concept of common goods refers to natural resources (air, water, earth, landscape and others) that exist without a process of social production, that are indispensable for human existence, and that in principle do not have an owner - although society appropriates them for its own use. This concept has been widely discussed in relation to Resource and Environmental Management.

Today, due to existing levels of degradation or destruction of common goods (the result of economic and social processes associated with modern, industrial, urban and rural societies), and because of the increasing emphasis on Sustainable Development, the environmental issue has become increasingly critical. The degradation of common goods has a substantial impact on the productivity and the living standards of the population. Effective controls, regulations and legislation on their use

(consumption) and on their degradation have become imperative. However, this implies new policies that challenge private interests, many of which are economically and politically powerful. The concept of "green accounting" has been introduced together with the idea of a price that must be paid for the use and degradation of common goods (see Wilches Chaux, 1993).

In the urban context, the issue of the appropriation and use of water, air, and soil leading to degradation and, consequently, to risk, comprise three spatial levels of analysis: *rural* processes and their impact on the urban area (i.e. use of fertilizers, pesticides, etc., and river and aquifer pollution); urban processes and their impact on the neighboring regions (atmospheric pollution and acid rain, use of polluted water for agriculture, etc.); and, urban processes that have an impact on urban areas (atmospheric pollution, blocking of urban river channels, hillside destabilization, etc.).

As opposed to the concept of common goods, *collective goods* refer to a set of urban infrastructures whose production cannot in general be individualized but provided by the State. Some examples include urban roads, sewerage systems, street lighting, low-income housing, public urban parks, and storm water drainage systems. The production and maintenance of these goods require State (local, regional and national) investment, which depends on the fiscal solvency, and policy orientations of the organizations involved.

As these goods comprise the material or infrastructure pillars of the city, on which production, circulation, and consumption are based, their degradation has a deep implication for public welfare and the creation of *risks*. The lack of maintenance, the inadequate supply of infrastructure with respect to the demands of the city, and, nowadays, the processes in favor of the privatization of collective goods, may originate a series of hazards for public health and safety.

The city, conceived and constructed as a public good (see Herzer and Guverich), faces a tendency towards privatization, the implementation of partial solutions to its growing problems and a growing lack of governability. This is partially the result of the financial crisis that most large cities of Latin America face today.

The management of common and collective goods is the principal concern in urban environmental and risk management Globalization.

Privatization, financial crisis, and lack of governability of the city constitute conditions that probably favor the increase of urban risk.

TOWARDS A PRIORITY RESEARCH AGENDA.

The analysis, conceptual debate, and discussion of the environmental issue, as presented in previous pages, *reveal* significant topics for research. Particularly, research that contributes in transforming reality through a raising process of awareness and the production of knowledge, both among the so-called guardians of the *public welfare*, as well as the affected population itself.

Three main subjects/objects of research are obvious from the outset.

First, the set of social actors, private and public, individual and organizational, that promotes or contributes to urban environmental degradation and the construction of risk. The research on this set of actors (or subset or sectors of it) should elucidate responsibilities, changes, trends, conflicts, and consensus, among social groups. The *space of risk causation* should be clarified, whether local, urban, regional, etc., and equally, *the space of the impacts*. Based on concrete experiences, successful changes in *policy* and the practice of actors with respect to degradation, motivation, conjunctures, and precise contexts should be documented. The relationships of specific agents with governmental authorities and the ways of evading the existing rules and regulations should be examined and corrected.

Second, the set of public actors, authorities, norms and legislation that deals with the issues of hazards, vulnerability and risks; in other words, those in charge of assuring that the city is a secure *public good*. This includes a wide range of institutions and legislation. A characteristic of risk or disaster management is that it should intersect multiple areas of institutional activity. At one time or another, it relates to the management of natural resources, to urban, regional, and sector planning, to citizen safety, and to sustainable development, among others. It is precisely this diversity of *specialized* entities that gives a highly complicated hue to risk management. The achievement of consensual harmony, coordination, compatibility and inter-sector integration, is one of the key aspects for successful management implementation. This is a

complex task that involves the economic, political, social and cultural spheres. Within this context, research must favor:

- Inter-sector analyses, the study of mechanisms which bring together the actors involved in the decisionmaking process on mitigation, the contexts by which risks are proscribed as unacceptable and prompt a response from the State and, on the other hand, the contexts in which risks are *accepted.*
- The relationship between urban public management and risks, including decisions on land use, on the densification of land plots, and on investments, modernization and maintenance of infrastructure.

From our perspective, research on public policy and management should be developed in a framework that considers:

- The process of globalization / internationalization of the economy;
- The financial crisis of the city and the impact of privatization processes; and,
- The role of local authorities.

Third, the set of social sectors (settlers, communities, economic sectors, etc.) affected by degradation and risk. Here, research must privilege action, which, following the parameters established by the IDRC in its document "Urban Environmental Management," (Mougeot and Massé, 1993) searches to:

- Actively incorporate those social groups that endure risks and seek their reduction (settlers, communities, etc.).
- Share and disseminate information among these groups; and,
- Profile and discriminate participatory solutions, adjusted to the economic, social, and cultural realities of the human collectivities affected.

The establishment of these three subjects of research does not mean that research be circumscribed to one of them, excluding considerations with respect to the others. Holistic research that attempts to discern the relationships among leading agents of degradation, public policy, and management, and those affected by a particular problem, or set of problems, would clearly yield interesting results. On the other hand, research must consider diverse scales and time frames. Metropolitan areas, large, medium and small cities should be incorporated. Diachronic and synchronic, conjectural and historic studies would offer different lessons. In short, there is much to be done. The lack of systematic research on the topic provides a multidimensional challenge for researchers in Latin America.

NOTAS

1 Two points related to the loss of productivity must be stressed. Firstly, this refers to the system as a whole, accepting that as a result of degradation, some individual actors, activities, sectors, etc. might increase their productivity, defined as economic performance. Secondly, the productivity that is referred to must be conceived in global and not only in economic terms. That is to say, the conceptualization must include a notion of social, cultural, and environmental productivity. Translating into practice, this constitutes a challenge that must be faced sooner or later.

2 parent contradiction, given that risk is also seen to be a product of prevailing develpment models, and their consequences in terms of poverty, inequality, social exclusion, income distribution etc. (see Blaike et al, 1994). The contradiction is resolved if i) we take the position that most so-called development models are primarily economic growth models; or ii) we do not assume that is using the term nonresolved development problems we are referring to forgotten components of prevailing models, but rather, to some more general idea of aspects, should be considered in development planning.

3 By saying this, we are not suggesting that we have solved the problem by changing perceptions. Clearly structural problems (poverty, inequality, etc.) exist and impede communities or individuals from solving risk problems even though they are fully cognizant of its objective characteristics.

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CHAPTER 3 URBAN ENVIRONMENT AND RISKS: ELEMENTS FOR DISCUSSION

Pascale Metzger

INTRODUCTION

The purpose of this article is to initiate a discussion about the relationships that exist between the urban environment and risks or disasters. Case studies support the empirical notion that urban environmental degradation and natural disasters are related topics.The present discussion provides several points from which to formulate theoretical ties between both topics.

However, this work does not present a conclusive analysis of the theoretical relationship between these concepts.Instead, it merely presents points from which a debate may be initiated as to how the formulation of both the central problem and its conceptual framework can be improved.

The theoretical discussion presented in this document elaborates much more on the concept of *urban environment* than on the concepts of *risk* and *disaster*. Therefore, the arguments relative to the urban environment are more comprehensive than those addressing risk. However, a direct relationship arises between the conceptualization proposed for the urban environment[1] and that proposed for risks.

It is common knowledge that a disaster causes more victims and economic losses each time it occurs.In such a context, disasters are specifically circumscribed to the urban space, as the probabilities of occurrence and the impacts are concurrently higher.However, this aspect of the relationship between both topics refers more frequently to the ties between city and risk than to those that exist between the transformation of the

environment and disasters.

The present text presents several ideas on the definition of the urban environment, and addresses the issue and conflicting elements of risk. The discussion concludes with the examination of the points of intersection between both topics identified throughout the analysis.

THE URBAN ENVIRONMENT

The notion of *urban environment* alludes to a multiplicity of phenomena that are perceived as the causes of problems within cities: air pollution, water quality, sanitation, transportation, noise, landscape deterioration, the preservation of green areas and the decline in the quality of life.Of course, an articulation between the urban environment and risk is perceived as the degradation of the environment denotes risks that are yet to be clearly identified.

The Urban Environment in the Scientific Field

The first question that should be raised refers to the definition of urban environment.What is urban environment?What new contributions to the knowledge about the city does this approach make?

An initial characterization of *urban environment* can be made through an inventory of the research that is spontaneously related to the topic of urban environment or urban ecology, whether by explicit preference to this notion or by thematic classification of the studies found under these topics.

The studies gathered in this inventory are not intended to define urban environment but rather they engage the topic simply by observing and analyzing several aspects of the urban reality and identifying a direct relationship between them and the urban environment.

The numerous works that deal with the urban environment may be grouped according to three different approaches:

Nature within the city
City Management
Risk in the city

Nature within the City

This category includes those studies applied to objects associated with the modern conception of nature. They intend to describe these objects or to explain the biological, physical, or natural phenomena that are also found in the cities and that until now had not been studied, except in a natural setting.

- Biological nature within the city refers to all the research that analyzes the biological aspects of the city from the perspective of the specificity or the differentiation of the biological elements found within an urban setting as opposed to those found in a natural setting.Examples include the analysis of the flora or fauna population, behavior, density, reproduction and adaptation to the urban environment (birds, roaches) (Rivault, 1992).
- Pieces of "nature" within the city are orchards, green areas, and their role in the urban space, be it physical, economic, social, cultural (Legrand and Randureau, 1992).
- The physical-natural elements within the city is the water in the city (the characteristics of run-off, water quality, the state and evolution of ground water), the studies of urban hydrology (Bouvier, 1990)), urban edaphology (soil composition, formation, and evolution), urban air, and climatology (microclimates, air circulation, renovation).

City Management

In these studies, the environment is analyzed as a component of a new dimension of the municipal management, which intervenes in the delimitation of urban growth and in the social representation that supports and demands action.It also intervenes as political, institutional and administrative rhetoric.For city managers, the urban environment involves a series of sectors of intervention in physical elements that pose problems in terms of production, preservation, evacuation, or circulation: water, air, transportation, green areas, etc.

- Water supply, sanitation, wastewater sewers, and urban waste treatment are analyzed from different perspectives: service management strategies; the adaptation of applied technologies; the birth of the so-called alternative technologies; and their impact on the environment (Dourlens and Vidal-Naquet, 1993; Knaebel et al., 1986).

- Urban planning and land use planning, transportation, and urban growth are also research topics related to city management.We refer to studies related to those management elements and methods that are favorable to the environment.That is, factors that contribute to reduce the risk to which the population and urban activities are exposed, to improve the environment or to protect nature (green areas and the like, and urban landscapes), to exert less pressure over the site, and to generally make urban development feasible over time.
- The design of public policy presents multiple political, economic, social and physical challenges. This is another question addressed by the city management studies, which includes an analysis of the actors of city management, the democratization of their methods, and the role of environmental issues on public policy (Sachs-Jeantet, 1992).

The Risk of/within the City

Risk itself constitutes a perspective directly associated with urban environment studies.

The general methodology of the research included in this category is the identification and analysis of risk in the city, or more precisely, of the risk factors that the urban environment imposes on life, health, and human activities.In the majority of the cases, such risks are analyzed, not only from a physical or physiological perspective, but also in their social components, simultaneously in the grounds of cause and effect (Chaline and Dubois, 1994).

- The health of the urban population and the urban environment, as risk factor for the health of its inhabitants, occupy a preponderant place in urban environmental studies.This refers to studies on demographics, epidemiology, the consequences of urban noise, the spatial distribution of endemic illnesses, and urban stress (Lapoix, 1992; Dorier and April, 1993).
- Biological risks are the proliferation of bacteria, disease vector insects and the sanitary hazards they pose.
- Physical-chemical risks are air and water pollution and their consequences on human health or urban activities (Bouvet, 1991).
- Technological risks are industrial pollution, technical failure, vulnerability of the networks, dependence of the urban functioning in regards to the increasingly complex networks (Dourlens, 1988, Lavigne, 1988).
- Morpho-climatic risks, especially those associated with urban growth, land

tenure, and the management or lack of management of the urban site such as floods or alluviums (Peltre, 1992).

- Natural risks, earthquakes, volcanic eruptions, and their social and institutional implications (d'Ercole, 1991).
- Violence and safety in the city include the city as producer of violence, delinquency, and other types of social deviations, following the Chicago school of thought on urban ecology studies.[2]

A NEW APPROACH?

This synopsis leads to the perception that the studies on nature, risk, and management aim to lay the foundations for a general, all-encompassing understanding of the city that, unlike previous urban studies, introduces physical, chemical, and biological considerations on the one hand, and time considerations on the other.

Such an approach coincides with a process that makes the vision of the city more complex and comprehensive, as different disciplines introduce new objects traditionally analyzed by other sciences.This process leads in two directions.On the one hand, the social sciences attempt to integrate objects that were traditionally exclusive of the natural, physical, and biological sciences (in the wider sense).On the other, the natural sciences move toward a totally man-made setting, the city, which until now had almost been forgotten.

Hence, the question arises regarding the contribution of the social sciences to the knowledge of the natural world, on the one hand; and on the other, regarding the capability of the natural sciences to take into consideration social factors. As a logical inference, it requires the application of a multiple-disciplinary approach.

Explicit contributions to the construction of the scientific *urban environment* are few and relatively vague.Given the recent nature of the topic and the state of development of the arguments, these studies have the advantage of clearly illustrating the need to conscientiously and scientifically elaborate further on the problem.

The proposal includes constituting a scientific problem that is not necessarily associated with the expression *urban environment*.This term involves a manifest conflict with *urban ecology*, which has a much more

elaborated conceptual background.Thus, there is a generalized confusion between the terms ecology and environment and a usage without scientific rigor of the concepts ecosystem, human or urban ecology, etc., which are not suitable for scientific research.

The following arguments attempt to clarify these terms.Inspired directly or indirectly by the Chicago school, theoretical papers point out the existence of an urban ecosystem or of an urban eco-socio-system, a concept that would lay its foundations for the renovation of urban studies by centering the analysis in the "eco-socio-systemic" functioning of the city. The relevance of transferring concepts extracted from the natural sciences to analyze phenomena with social dimensions is yet a debated subject.

For example, the concept of an urban ecology is vindicated but, paradoxically, it is affirmed that we cannot refer to an urban ecosystem since the city has never had functional natural autonomy.An ecological framework of the urban phenomena is non-existent (Labeyrie, 1991). Some believe that, "with the risk of disappearing, the ecological analysis must focus on the physical characteristics of the urban system."

Research related to urban ecological development has also revisited the notion of the urban ecosystem (Sachs, 1992).

The ecosystem of an urban region has been defined as city and as territory in need of a mandatory zone of solidarity. Concurrently, the simplification of the notion of urbanization is denounced, and the urban-rural approach is questioned (Delavigne, 1992). Numerous works that proclaim a new interpretation of the territory (Regazzola, 1992; Rocayolo, 1990) question the urban-rural relationship, overcoming the so-called anachronistic dichotomy in geographical analysis.

Density

It can be argued that the criticism made on the fundamental geographic distinction of urban-rural radically opposes the interpretation of the urban environment based on an essential factor: density (of population, of activities).For many, density represents the basic characteristic of the urban environment.

The notion that density is a problem must be as old as the city itself. This notion originated the hygienist obsessions that appeared from the

eighteenth century on, and later, the policies of lowering urban density, which were theorized in the Athens Charter and implemented by progressive city planners of the turn of the century (Choay, 1965).

In the same manner, the notion of the rupture of equilibrium, of surpassing a threshold (not necessarily demographic) would lay out the foundations for the urban crisis.It is quite revealing that a "threshold" was sought to explain and scrutinize the urban environment. The procedure fits perfectly in the notion of rupture of one or several equilibrium.

Aspects in common among the Different Research Studies

Numerous investigations on the subject of urban environment reveal a certain number of aspects in common that may constitute the first points of reference of a new scientific issue:

- The city produces its own environment, whose main characteristic is that it is fully constructed (usually overseen, this aspect fundamentally differentiates the city from the natural environment studied by ecology).
- The city modifies the global environment and, thus, increases risk.
- Like the notion of natural risks in an urban setting, the urban environment is at the interface of the human and earth sciences, and of the physical sciences and engineering.
- The urban environment is embedded in an evolutionary relationship among man/nature/society or, more precisely, man/nature/city.
- The urban environment becomes evident with the phenomenon of"globalization" of urban society. This phenomenon is also implicit in the term "pendulum," making reference to an inverse relationship between the relative weight of the urban and the rural with respect to the world population.
- Social representations play an important role in the urban environment studied by the social sciences.

Is there a new scientific hypothesis for the city?

The environmental issue as object of investigation requires certain theoretical clarification since in its origin it was highly influenced by an ideological, scientific and social context and in view of the risk entailed by confining the research to purely ideological dimensions.

First, it is necessary to differentiate accurately the issue *urban environment* from previous urban studies, and to identify without ambiguity

the contributions made by the research on the urban environment with respect to the research that makes reference to this perspective.

The Reference to Global Change

In almost all instances, a key element is the scientific literature on the urban environment, which implicitly or explicitly refers to an urban crisis that results from the rupture of certain "equilibrium."Contrary to previous urban studies, each equilibrium is simultaneously integrated--whether directly or indirectly -- into the issues of global change and sustainable development.In other words, locally identified problems remit to phenomena that affect the planetary environment.Thus, urban change itself is the first manifestation of the global changes.

In regards to the hygienist issues that during the 19th and the beginning of the 20th century characterized the interpretation of the city and of the "urban," the main differences are found precisely in the reference to global change and to durability, to time, and also to the search for managerial solutions.In the nineteenth century, research was oriented mostly towards the elaboration of technical solutions.However, there are certain aspects in common with the current approach.Phenomena that used to describe the living conditions of urban societies, such as the presence of risk and safety, the reference to an urban order, and the appeal to the general or collective interest, are now characterized as determinant elements of human society as a whole.

It is no coincidence that a significant portion of the arguments made about the urban environment were introduced through a panorama characterized by the evolution of the global urbanization and the rapid increase in the number of cities inhabited by millions of people.The notion of an inverse urban-rural demographic relationship is present in the discussion.

Materiality

In the urban studies of the 1960s and 1980s, the crisis of the cities was associated with urban explosion, a real challenge evidenced by the accelerated growth of shantytowns, sub-urbanization and misery. These research studies are closely related to the essential elements of urban knowledge derived from the mid-nineteenth century social statistics. The

scientific contribution of the work of Doctor Vilerm is not questioned. As a matter of fact, the notion of urban explosion is always present in urban environment research studies and frequently constitutes an introductory justification of the research topic.

During the 1970s, geographical studies identified habitat as the predominant manifestation of urbanization, and housing policies as the essence of urban policies.Urban services and infrastructure characterized habitat in one way or another. The attempt of urbanism to address the challenges posed by rapid urbanization through a proposed urban order was disrupted by the illegal production of the city and the poor solvency of the population.In developing countries, urban research was aimed at the objects and processes of that city.Efforts were mainly geared towards understanding the mode of production and the functioning of the city as an expression of the development model adopted by society, or of the adaptation of society to that model.The interpretation was entirely centered on the social, economics, and politics, that is, the "materialization" was observed from totally "immaterial" dimensions.

Therefore, the city was a completely socialized space, in which *nature*, or at least the set of purely physical dimensions (water, air, soil, displacement), posed issues that were labeled as purely technical, thus requiring technical solutions. A mode of production and functioning of the city that is widely withdrawn from environmental limitations has contributed to the elaboration of a scientific production of the city that is almost totally separated from physical hazards.

Inversely, it can be said that to identify their causes and consequences, urban environmental objects are first identified from the perspective of the materiality, or physical angle, reversing the heuristic procedure. The inventory of studies on the urban environment presented so far is an unquestionable demonstration of this.Such studies make it possible for non-human elements, the physical and the material, to be considered as scientific subject matters, integrating nature and physical-chemical phenomena into the field of the social sciences (Kalaora, 1993; Peltre, 1992).

Durability

On the other hand, the concept of sustainable development introduces the dimension of time.The question of the urban environment en-

ters the discussion on whether the city is feasible in its current mode of production and functioning. This is a new way of responding to urban development and production mechanisms, as it is not based on social inequalities, but rather on the feasibility of the physical conditions of the urban system.

It then becomes apparent that centrality and density, which are the essence of the city, are also elements that contribute to generate or amplify urban environmental problems.In other words, the basic elements of the city themselves are the ones attacked by the issue of the urban environment.

The research studies analyzed enable us to identify arguments capable of sustaining a new perspective on the city. They allow for an expansion on the knowledge about the urban environment, its mode of production, and its functioning, from which the parameters that support a new vision of urban environmental conflicts could be traced.

Towards a hypothesis on the urban environment

It is possible to organize the ideas that exist in the research on the urban environment and to raise the scientific hypothesis through the procedure described below.

Let us depart from the idea that the production and functioning of the city require the generation and consumption of "things."With the evolution of the social representations and practices, such "things" enter the sphere of what can be called *common goods* or goods of common legacy. These "things" refer to water, air, health, soil, but also to silence, the architectural setting and safety.

It is the way in which the production and functioning of the city, on the one hand, manufacture and mobilize, and on the other, consume, transform, and deteriorate these common goods that create what could be termed as urban environment.This "way" of transforming or consuming involves actors, technical instruments, and a juridical and financial framework.Thus, strategies, conflicts, social representations, techniques, and modes of management necessarily intervene.It will also depend on the economic and/or social value of the consumed goods, of their availability, of their accessibility.Undoubtedly, it is an historic product.

There is a different way in which the city functions, in terms of the production and consumption of common goods and according to the different spaces and territories that make it up. The actors, strategies, conflicts, social representations, techniques, prevailing management models, and also the collective goods available are spatially heterogeneous. Thus, the urban environment is historically, spatially, and socially differentiated.

We are not far from the notion of building a "set of theories on how to manage nature" (Ferras and Volle, 1991), but we are not dealing with nature nevertheless. Instead, we are dealing with the sum of"common things" that could come from a "reinvented nature" that has been constructed by the city.

Thus, on the one hand, the question of the urban environment could be applied to the processes by which the production and functioning of the city are articulated; and on the other, to the production and the consumption of the common goods that it needs.Perhaps what determines the nature of urban crisis is the uncontrolled growth in the amount and in the quality of collective goods that the city needs in order to grow and function. This crisis is not about the relationship with nature, but rather about the regulation of the production and consumption of collective goods. The problems are organized around elements that are also goods consumed by the city and around the management intentions of the public authorities.

Stated differently, the question of the urban environment should provide information on the mechanisms that govern the way in which the city produces and consumes the goods and resources of the community. This continuously evolving field necessarily redirects us to social representations that allow the appearance or disappearance of the different elements that belong to this set of goods, according to the collective characteristics of their management, uses and perception.

DEBATABLE ELEMENTS OF DISCUSSION AND DEFINITIONS OF RISK

Insurance companies define risk as the probability of the occurrence of a perturbing event, multiplied by the cost of such an event if it occurred (Dourlens, 1988).

Other elements are extracted from the definitions available in the scientific literature, especially those pertaining to the social sciences. Risk is commonly conceived as the product of the probability of occurrence of a given "uncertainty" and the value of its consequences.[3] Thus, risk would be a function of a probability and its potential consequences; that is, it does not have an absolute meaning and is not justified by the interaction of two inseparable elements: the physical and the social. Also, risk are always hidden; they are *potential*, a characteristic that differentiates them from accidents or disasters (Lavigne, 1988).

An aspect in common between a hidden, potential and not clearly identified risk and environmental degradation is perceived.

Risk and the City

The terms *risk* and *city* are frequently associated with each other.For example, the city has always been perceived as having a dangerous nature, beyond the place of risk. This problem may be alleviated through distance, spacing or low density (Lavigne, 1988).

There is another common point in the urban environment: population density is usually identified as one of the primaries causes of environmental degradation and particularly of urban environmental degradation. This phenomenon is usually blamed for the increase of risks and the impact of disasters.

In the city, risk is perceived as the possibility of interrupting the metabolic process by blocking the exchanges, either by the excess or the lack of flows in the urban space (Lavigne, 1988).As a matter of fact, some authors associate environmental degradation with gradual risk.

The Evolution of the Perception of Risk

It is also known that risk awareness is one of the traits of our current environment.Such risk is perceived as imputable; that is, the causes and

responsibilities may be identified (Fabiani and Theys, 1987). There is also a relationship between risk and environmental issues from the perspective of raising awareness and the search for accountability.

Since the 1950s, the perception of risk has been modified. According to some authors, risk has become unacceptable or unbearable, even in developing countries (d'Ercole, 1991). Once again, the relationship with environmental issues becomes clearly apparent when the degradation of the landscape or the pollution of rivers, for example, become socially unacceptable.

The modification of the perception of risk is interpreted by some as resulting from an excess of security. Protection systems are perfected while a profound aversion towards less familiar risks increases (d'Ercole, 1991). Environmental problems raise new questions on poorly known or uncontrollable phenomena.

On the other hand, other risk specialists demonstrate that there is a clear evolution of the perception of risk and of its corollary, security, since there is a certain degree of social acceptance of risk. At the beginning of the century, city planners sought the total eradication of risks within the city; their elimination was the maximum security objective to be reached.Nowadays, however, efforts move towards an approach based on acknowledging the irreducible nature of risk and the need to integrate it with city management.Under such conditions, the issue of *risk management* (Dourlens and Vidal-Naquet, 1992, p.127) replaces the "conquest of security". Such an evolution allows uncovering the social dimension of security parameters of acceptable risk that were previously concealed.

Risk and City Management

In the same way that the objective of diminishing urban risks is to manage them, the objective of city management is to reduce environmental degradation.

The socio-political dimension of risk appears. Specialists demonstrate how the risk of disaster, as well as urban environmental degradation, tend to become a political challenge (d'Ercole, 1991).

Some authors conceive risk policies as the management of the unforeseen (Fabiani and Theys, 1987). The environmental question also remits to an uncertain future.

Vulnerability

There is one concept that systematically appears in risk analysis, especially in the context of the urban environment: vulnerability. It questions the reliability of the urban system in its complexity and growing interdependence (Lavigne, 1998). The environment is also analyzed in these terms.

Vulnerability frequently appears as an articulated system around a large number of variables. It can be defined as the propensity of a given society to experience damages in case of a disaster.

The qualitative approach of vulnerability is based on the identification and analysis of the factors that have an influence on it. The most common ones are: demographic and urban growth, land use modes, socioeconomic factors, psycho-sociologic factors, culture, and the history of the cities exposed, including also technical, functional, institutional and political-administrative factors (d'Ercole, 1994).

There is also a semi-quantitative approach to vulnerability analysis, which is supported by the same foundations, but leads to the creation of the social and/or spatial hierarchy of the elements exposed.Maps of vulnerable zones are generated from this type of studies.

The determinist perspective implies the adaptation of mankind to disasters, thus returning to the notion of the man/nature relationship and to the idea of man's adaptation to a specific characteristic of the environment, its limitations, and hazards (d'Ercole, 1991). This is definitely an environmental issue.

Although the case studies on urban risks are increasingly more numerous, the relationship between risk and environmental degradation is not established. Rather, risks are associated with the process of urbanization. Urbanization effects are analyzed in terms of how they worsen or amplify disasters.

URBAN ENVIRONMENT AND RISKS

Which conception of the environment will allow us to identify the factual and theoretical relationship between the urban environment and risks?Would it be possible to articulate the environmental issue, as previously defined, with the issue of risks and disasters?How may risks be incorporated into such a definition?

Using the theoretical framework proposed, risk could mean the virtual but "legitimate" affectation of collective goods. For example, pollution is a slow risk that affects the population, as it transforms a common good (water, air, and soil) in such a way that it generates a real or virtual hazard.

In order to identify the relationships between environmental transformation and risk, we would have to investigate how modifications of the mode of production and consumption and the transformations of the common goods constitute a risk. These modifications affect common goods when they generate some sort of hazard upon the population, health, urban economy and collective safety. A possibility would be to consider the collective safety as a collective good or resource. Risk would then threaten this collective good, as a questionable management or an unequal distribution of safety in space or in time. Disasters would then be the turning point, the revelation, or the materialization of risks.

By introducing the concept of risk into the discussion we propose the definition of environmental degradation as the transformation of the modes of production or of consumption of goods that generates risks. The proposed concept of the urban environment did not allow for a scientific definition of environmental degradation. By introducing the notion of risk we fill this space considering the importance of social representations in environmental degradation.

NOTAS

1 For detailed analysis on environmental problems see Metzger 1994.

2 See mainly the Annales de la Recherche Urbaine Magazine, No 40, 1988.

3 See D'Ercole, 1991, p.22 and next, who cites other authors.

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CHAPTER 4 ENVIRONMENTAL MANAGEMENT AND DISASTER PREVENTION: TWO RELATED TOPICS

Omar Darío Cardona A.

INTRODUCTION

In the international arena, it is widely accepted that during the upcoming decades and due to the inertia in the bio-geo-chemical and the socioeconomic systems, some environmental trends will not change, unless unexpected events with the necessary intensity to modify them occur. Such trends include an increase in global warming as a result of the greenhouse effect; endemic water pollution; a relative increase in agricultural production and in energy consumption as a consequence of population growth (although the per capita increase is smaller); greater environmental degradation in developing countries (Biswas et al., 1987); and, an increase in the occurrence of disasters of both natural and man-made origin.

As a result, worldwide interest for the environment and its accelerated degradation has intensified during the past decades. The exhaustion of renewable and non-renewable natural resources, population growth and its spatial concentration, the demand for species required to satisfy urgent needs, and the escalating increase in the occurrence of disasters are worrisome situations whose accelerated growth surpasses the available scope of its solutions.

The United Nations Environment Program (UNEP) has adopted the postulates of Sustainable Development proposed by the International Union for the Conservation of Nature (IUCN). These postulates establish the interrelationship among several factors that imply restating po-

litical, economic, social, productive, technological and administrative systems, as well as a new world order for international relations (Blanco-Alarcón et al., 1989). On the other hand, and as a result of a situation that has affected developing countries with greater severity, the UN General Assembly proclaimed the 1990s as the International Decade for Natural Disaster Reduction (IDNDR). The objective is to promote risk mitigation through the incorporation of disaster prevention in the social and economic development policies of all the nations of the world.

Crisis scenarios

The environment can be understood as a system whose elements are in permanent interaction, or as a network of active relationships among such elements, which determines the conditions of their existence and the totality of the system. A crisis emerges when changes, transformations, or alterations that cannot be absorbed by the system - because of the lack of flexibility or adaptation capabilities - occur within the dynamics or process of interaction (Wilches-Chaux, 1989). This crisis, which might result from a chain reaction of influences, is known as *disaster.* This designation depends on the social value that the community assigns to it, and in all cases, it refers to a negative environmental impact.

Except in the case of short-term approximations, the evolution of complex social and bio-geo-chemical systems cannot be adequately depicted neither by linear functions nor by soft and continuous curves. Usually, the real evolution of these systems contains positive feedback and shows non-linear and even discontinuous behavior, which is difficult to predict, although in retrospect it can be easily explained (Merkhofer, 1987). The concepts of *vulnerability*, or the predisposition to be affected, and *resiliency*, or the capability to recover, play fundamental roles due to their significant relationship with the possible occurrence of discontinuities. When altered by a sufficiently strong disturbance, a system may change from an almost constant state to another. Such a change depends not only on the magnitude of the event, but also on the presence of system instabilities that are difficult to perceive.

Crisis scenarios are the manifestation of existing conditions of risk, which consequently depend not only on the action of an external disturbing or trigger agent such as an accumulative degrading event or process, but also on the conditions of vulnerability. The conditions of vulnerability are agents that facilitate the development of a crisis scenario once the trigger event occurs, or the critical point of degradation processes is surpassed. The social and environmental conditions that characterize the vulnerability or frailty of a human settlement, for example, usually result from the models of development adopted and the debt that has been generated with nature, which yield to a process of incubation. In other words, crisis scenarios and even disasters are non-resolved problems of development that must be analyzed not only from a technocratic viewpoint, but also from the perspective of political economics. Vulnerability in its diverse manifestations is nothing but a deficit of development. It represents a negative green account towards which preventative management efforts with planning perspective must be guided in order to reduce or avoid negative social, economic and environmental consequences.

Cardona (1995) argues that, methodologically, the potential presence of a crisis scenario during the development process can be expressed as:

$$Cp = Ta \cdot Vc$$

Cp (Potential crisis) represents the possibility of the occurrence of a crisis. Ta represents the probability of occurrence of an external trigger agent, which might be a disturbing event or the surpassing of a critical point in the process of continuous degradation. Vc represents the conditions of vulnerability or *instability of the system* exposed to the trigger event.

The conditions of vulnerability are weaknesses or deficiencies that may be, among others, of environmental, ecological, demographic, social, economic institutional, political, cultural and/or ideological character. These characteristics are related to the fragility or susceptibility of the elements and the activities or relationships that contribute to the generation of a crisis when an event or process difficult to absorb occurs.

ENVIRONMENTAL PHENOMENA

" It would seem that, like the ancient Roman god Janus, nature has two faces: the smiling face, which must be protected, and the threatening face, against which we must protect ourselves... both faces belong to the same entity, and the rituals performed for any of the two faces will have repercussions on the other..." Michel Hermelin.

Environmental phenomena may be classified into three types: those that have never occurred and whose occurrence is very remote, such as the appearance of a "hole" in the ozone layer over Antarctica; those that have never occurred but whose occurrence is probable, as the global warming due to the greenhouse effect; and, those that can be anticipated due to their historic analogy or to a reasonable understanding of them. Among the latter are natural and/or man-made events such as earthquakes, volcanic eruptions, hurricanes, the degradation of hydrographic basins and the subsequent events, such as floods, avalanches or landslides, pollution and technological events.

In the first case, preventative actions have not been carried out due to the lack of historic precedents and information about the generating processes. Although in the second case it is possible to take preventative measures, these have not been implemented with determination since the degree of uncertainty regarding the generating factors is significant. The phenomena grouped in the third case are characterized by the increasing body of knowledge that has been gathered with respect to them and in many cases, by the possibility of forecasting them. Their effects can be mitigated through the implementation of preventative measures. Non-modifiable natural hazards refer to the intervention of conditions of vulnerability and resiliency of the elements exposed. Socio-natural and technological hazards refer to the prevention of their generation by modifying the processes of environmental degradation and by improving the safety of hazardous technologies.

A conceptualization of the environment is limited and unreal if it restricts its management to aspects such as protection and preservation, and if considers human beings as threatening external agents (Hermelin, 1991-92). Such a theoretical trend has led to an incomplete definition of what is understood as environmental impact, as it excludes those natural

and man-made events that may affect intensely not only human beings but also renewable and non-renewable resources.

Hazards, Risks and Disasters

The term *hazard* is frequently used to describe the latent danger that characterizes a wide variety of phenomena. Its range goes from those whose occurrence is considered to be exclusively of natural origin, such as earthquakes, hurricanes and volcanic eruptions, to those whose origin is considered to be exclusively human, such as wars and technological accidents. In between both extremes lies a wide spectrum of phenomena such as famine, floods, and landslides that result from a combination of natural and human factors.

Disasters are social processes that unchain as the result of two concomitant and mutually influenced factors: hazard and vulnerability. The hazard is characterized by the imminent or actual manifestation of a trigger agent. Vulnerability is the weakness of the elements exposed to that trigger agent, that is, those conditions that facilitate the severe effects - once materialized- that the hazard will have over the urban, environmental and social context. Considering urban and social factors as components of the ecosystems, a crisis is always a disaster in itself more than merely the generator of one. Therefore risk evaluation or the estimate of the possible occurrence of future crisis or disasters whether of natural, social or socio-natural origin, must be an integral part of development planning.

In other words (Cardona, 1986), risk (Rie) can be determined once the *hazard* (Ai) - the probability of occurrence of an event of equal or higher intensity than (I) during a period of exposure (t) - and *vulnerability* (Ve) - the intrinsic predisposition of an element (e) to be affected or susceptible to suffer a loss when exposed to an event of intensity (i) - are identified. Thus, risk can be understood as the probability of the occurrence of a loss in the element (e) as a consequence of the occurrence of an event with an intensity equal or higher than I,

$$Rie = f(Ai, Ve)$$

That is, the probability to exceed determined social, economic or environmental consequences during a given period of time t.

Several countries are located in zones of tectonic complexity and high levels of seismic and volcanic activity, as evidenced by a historic record of destructive earthquakes, *tsunamis* and the recent activation of volcanoes. In addition, the slopes of the mountainous regions are affected by the action of man-made, biological and meteorological agents such as the rain, the winds, temperature changes characteristic of extreme climatic conditions. A significant number of countries are highly prone to the effects of severe events such as erosion, landslides, avalanches and floods (Colciencias, 1990)

In those countries where the population is concentrated in large cities located in areas with high exposure to hazards, the potential for the occurrence of a natural disaster is significantly high.

Environmental Degradation and the Generation of Risks

Even when from the urban perspective it has been common to recognize that the process of environmental degradation may become a trigger of supposedly natural events that affect the habitat of human settlements, disaster prevention and mitigation have not been explicitly associated with environmental degradation. Environmental experts have paid little attention to the topic of disasters, perhaps because of the bias towards the emergency response that during years has characterized the discussion of disasters. Some researchers limit their definition of habitat to artificial aspects of the environment, for instance, they do not include human settlements into their conceptualization of the ecosystems. Human settlements could be understood in a holistic way as social-ecosystems, allowing a synthesis and a more integral vision of the urban and environmental question. Unfortunately, a similar position is taken by risk reduction and disaster prevention experts, who support an incomplete perspective on the question of risks and the urban habitat since they do not incorporate into their models and conceptual frameworks those aspects related to environmental management and protection.

It could be argued that besides technological risks, there are the usually incorrectly named *natural disasters*. Many of the so-called natural disasters have a man-made origin, whether because environmental degradation may stimulate or induce natural hazards, or because the increase

of vulnerability of human settlements notoriously influences the occurrence of disasters.

In South America, for example, the Andean region is highly exposed to the processes of soil instability or landslides. Because of its complex geomorphology, it also presents a high number of rivers of torrential behavior that continuously present flash floods and avalanches, which result from the damming in the upper basins. In most cases, these types of events result from the environmental unbalance that leads to the degradation of nature and also affects human settlements. Hydrographic basins deteriorate, and consequently the hydro cycle is interrupted. Water is exhausted, the soil dries up, and crops lose their irrigation source. Both deforestation and fires destroy the vegetation that protects soils and stabilizes the climate, causing erosion and instability in the mountainsides; agricultural soils are vertiginously drained by the unstoppable passing of water runoff, generating the sedimentation of valleys, watercourses, dams, and cities where the sewerage systems have surpassed their capacities. The sources of water are reduced due to the destruction of the vegetation, which also strips the fauna from its niches and habitats; the disappearance of mangroves from the coastal areas, which facilitates flooding and diminishes fishing; and the annihilation of the vegetation of the highlands called «paramo.» Lakes, marshes, and downstream watercourses are being dried up and embanked to prepare land for inhabitation and agriculture. Mining has sterilized the land and contributed to the sedimentation of watercourses and the destabilization of mountainsides. In the inter-Andean region, these processes originate intense hydrodynamic events, such as landslides, floods, and avalanches that destroy housing units and infrastructure works and generate loss of life. Industrial and farming activities carried out in poorly chosen sites pollute cities, valleys, water, vegetation, and the atmosphere, as well as it can potentially become serious technological hazards for neighboring human settlements. Urban sprawl has been polluting the best agricultural, pasture and forest soils, while generating subnormal human settlements in degraded areas as a result of social maladjustment in the land tenure structures (Blanco-Alarcón et al., 1989).

Vulnerability: Deficit of Development

The *vulnerability* of ecosystems, of human settlements or of the urban environment depends on the population concentration. It is intimately linked to the social processes developed in the cities and is usually related to the frailty, susceptibility or lack of resiliency of those elements exposed to different types of hazards. The convulsion of these two circumstances determines the degree on the conditions of risk of the exposed elements. Consequently, risks are intimately linked not only to the degradation of the urban environment, but also to the degradation of the natural environment that has been intervened or is in the process of being transformed. In conclusion, environmental degradation, impoverishment and crisis situations are nothing but environmental events, and their manifestation is the result of the social construction of risks, that is, the incubation of vulnerability and/or hazards.

Little has been done to create an adequate theoretical framework that relates environmental degradation with the generation of risks and crisis, perhaps because such a relationship is widely accepted or is simply considered being evident. The current parameters for the transformation of society and the environment indicate that it is progressively harder to separate the so-called natural hazards from other human and environmental trigger agents. Consequently, it is widely accepted that environmental degradation generates risks since it represents a reduction in the (natural, physical and social) productivity of nature and society. To review the origin of crisis or disasters and to admit that they represent the materialization of the conditions of risk that arise from the action of hazards and the exposure of vulnerable elements may facilitate finding the relationship among these macro concepts. For example, the acceptance that, in many instances, hazards may be classified other than strictly natural, as socio-natural, man-made pollutant or man-made technological, conducts us to the idea that hazards arise from the interactive processes between human beings and nature. It also leads us to think that environmental degradation generates conditions of risk, as it contributes to an *increase of the vulnerability* of human settlements or ecosystems and of hazards themselves (Lavell, in the present volume).

DISASTER: SEVERE ENVIRONMENTAL IMPACT

In accordance with the previous arguments, a disaster is then the materialization of risk. It represents an environmental impact with a variable dimension in terms of volume, time and space. Some disasters cause few deaths; others affect millions of people. Some are short-lived; others are slow and may last years. Some physically affect a few square kilometers; others cover several countries.

Although scientifically environmental impact could be considered as disaster, most people interpret as disasters only those manifestations that significantly modify the volume or distribution of the human population. This explains why those events that occur in "empty" regions, where no human settlements exist, are rarely perceived as disasters. A highly populated settlement might be more affected than a smaller settlement in absolute terms, but less affected in relative terms (Clarke, 1989).

Although widely accepted, the degree of a disaster depends not only on the number of people affected but also on the ecological, economic and social characteristics of a settlement. An event that does not affect people directly but damages other renewable and non-renewable natural elements, would be classified as a disaster.

From a time perspective, disasters are commonly interpreted as the serious consequences of a "sudden" event, a quality whose perception varies according to the context in which it is used. "Sudden" acquires a different connotation when its point of referral is a lifetime, than when it is related to the timeframe of the history of humanity. As an analogy, when related to public health, there is a trend to use the term *disaster* to refer to emergencies and even to epidemics, rather than to endemic diseases that has persistently been part of humanity.

Defining the duration of a disaster presents a real difficulty although, as previously mentioned, many relate it with its demographic effects. On the one end of the time scale are those disasters of instant impact caused by events such as earthquakes, volcanic eruptions and airplane crashes. On the other end are those disasters of long-term impact caused by phenomena such as drought, famine and wars, events that usually have the worst demographic impact. Sudden and unpredictable disasters whose causes are historically well known generally produce greater fear and

are perceived as catastrophic, precisely because they are unexpected and cause sensationalism.

Another aspect related to time is the frequency of the phenomena. For example, some societies are adapted to an environment highly prone to disasters, where the occurrence of events is almost part of their lifestyle. On the other hand, those societies that are settled in an environment where the occurrence of events is sporadic consider them to be fortuitous contingencies.

The spatial impact of hazards is particularly varied. Therefore, some disasters are isolated and affect a very specific region, while others are scattered and widespread. Some disasters are the result of the effects over one settlement, while others sufficiently extensive affect several settlements.

The area of influence of an airplane crash or of a volcanic eruption is generally considered to be small and discrete, while that of a drought, famine, or epidemics can reach great proportions, even of continental scale, usually trespassing political borderlines.

In conclusion, the concept of environmental impact or disaster is relative to the way in which it is described (time, spatial and volumetric dimensions), and depends on the social value that the community assigns to it. I have elaborated during the past years a list of definitions that seeks to associate the concepts used in disaster prevention with those used in environmental management. It takes into account some of the definitions used by international agencies. Its objective is to contribute to a coherent and unified use of terms. This glossary is in the accompanying appendix.

THE APPROACH OF THE NATURAL AND SOCIAL SCIENCES

Despite pioneer efforts of social scientists during the mid 20th century, risk evaluation and disaster prevention have been addressed internationally only during the past few years. Researchers of the natural sciences practically have taken upon themselves the task of systematically conceptualizing and analyzing them. They elaborated studies about geological (i.e. earthquakes, volcanic eruptions), hydro-meteorological

(i.e.hurricanes, floods) and technological (industrial accidents) events. That is, during most of the time and particularly recently, the emphasis was directed towards the knowledge about *hazards*, precisely because of the academic and investigative bias of those who generated the most recent theories on this topic.

It is important to mention that such emphasis still prevails particularly in developed countries, where because of the level of technological development, research seeks to learn with greater detail about the phenomena that generate hazards. This marked trend became evident during the first years of the "International Decade for Natural Disaster Reduction," declared by the United Nations as closure for the last years of the present millennium.

If the intention is to estimate risk, undoubtedly hazard research and evaluation is a step of fundamental importance. However, to reach such an objective it is equally important to study and analyze vulnerability. This is why more recently several specialists started to raise the need to study *physical vulnerability*, which was basically associated with the degree of exposure and the fragility or capacity of the elements exposed to the action of phenomena.

This last aspect permitted the opening of the field to a multidisciplinary arrangement because of the need to involve other professionals, such as engineers, architects, economists and planners. Eventually, these professionals have found it particularly important to consider both hazards and vulnerability as fundamental variables for physical planning and for generating housing and infrastructure construction codes.

Despite this step forward, the technocratic approach still prevails, as it continues to emphasize the trigger event of the disaster. It pays little attention to the conditions that make possible the occurrence of the crisis, which include not only the conditions of physical vulnerability, but also those related to *social vulnerability*. In most cases in developing countries, social vulnerability generates the conditions for technical vulnerability. Different from a hazard that acts as the trigger event social vulnerability is a condition that prevails through time, and is intimately linked to cultural aspects and to the level of development of the communities.

It has only been in the past few years that a greater number of social scientists have become interested once again in the topic. Thus, there are still theoretical vacuums that prevent us from understanding completely the problem of risk and the real possibilities for its mitigation. The interpretation of vulnerability and risk given by geophysicists, hydrologists, engineers and planners can be extremely different from that of the people and communities exposed. Therefore, it is necessary to study further the individual and the collective perception of risk, and to investigate the social, developmental, and organizational characteristics of the societies that either favor or hinder prevention and mitigation. These are two aspects of fundamental importance in finding efficient and effective methods to reduce the impact of disasters in the world.

PREVENTION AND SUSTAINABLE DEVELOPMENT

The concept of *development* intends to communicate that the environment can somehow be more productive or "better," depending on ecological, political, cultural and technological factors. *Sustainable* refers to the endurance or prolongation of a process or activity over time. The term *development* and *sustainable* seem to be contradictory; however, it does not take too much optimism to believe that development can be sustainable through technological innovations and the implementation of management strategies such as *prevention*.

An advantage derived from improving the living conditions of human beings is to obtain a greater degree of safety and survival with respect to the actions and reactions of the environment. And this may be achieved by understanding the interaction between them (Duque, 1990). Thus, it may be inferred that *prevention is a fundamental strategy for sustainable development*. It allows the natural ecosystem and the society that inhabits and exploits it to coexist harmoniously by regulating and directing human action upon the environment and vice versa.

The challenge that sustainable development currently faces is to change the approach of environmental management from reaction to prevention. This implies reducing eventually the need to correct problems on the run and to recommend attenuating measures, as well as consolidating the implementation of previously evaluated alternatives whose

advantages, disadvantages, and interaction scenarios have been foreseen (Wathern, 1988). For planning purposes, both risk and environmental impact analyses share great similarities and relate to each other. Both analyses seek to determine the consequences of environmental change (Clarke and Herington, 1989).

In general terms, considering the knowledge, use, conservation, preservation, and promotion of natural resources as activities inherent to environmental management, the concept of prevention is linked to each and all of them. In other words, prevention can be clearly defined as a strategy of environmental management.

The Planning Perspective

In a significant number of countries, phenomena of natural and man-made origins continuously and severely affect human settlements. Such effects fundamentally result not only from the occurrence of phenomena, but also from the high levels of vulnerability that characterize these settlements as a result of disorderly urban growth and the type of technologies utilized.

Risks may be reduced if they are understood as the result of relating hazard, or the probability of occurrence of an event, with vulnerability, or the susceptibility of the elements exposed. Protective measures, such as the use of non-vulnerable appropriate technologies, land use regulation, and environmental protection, are the foundation to reduce the consequences of natural and technological hazards (Cardona, 1990).

Population increase and densification in large urban centers, the development of vulnerable technologies, and environmental degradation worsen the effects of natural phenomena such as earthquakes, volcanic eruptions, floods, and landslides, on the people, their goods, and infrastructure. The losses can severely affect the economic and social development of regions or countries whose recuperation can take several years (Cardona, 1991).

Therefore, *the reduction of vulnerability must become an explicit goal of development*, understanding development as the improvement of not only the living conditions but also of the quality of life and social welfare. Beyond ideological arguments, the objective of development must be to meet the needs of mankind and its environment, as well as

growth with quality. In general terms, safety is a fundamental component of a human sustainable development. Thus, *prevention* is a *fundamental strategy* towards achieving equilibrium between human settlements and nature. Conventional development indicators - i.e. economic growth, the accumulation of wealth and generation of income - usually promote short-term actions with consumption/production purposes that impel the degradation of natural resources and do not consider prevention and mitigation. On the other hand, indicators such as the Human Development Index (HDI, proposed by the UNDP) present further elaborated criteria by which development can be elaborated.

The natural environment may be characterized by the existence of extreme trigger events, which may be of a sudden and intense nature or advanced degradation processes that frequently surpass the critical thresholds. In such cases, identifying the vulnerabilities of the elements exposed and analyzing their origin and social and territorial accumulation across time would allow for the establishment of priorities regarding which physical, environmental, and social measures to be taken to neutralize or reduce vulnerabilities. The identification and analysis of physical, environmental, social, economic, and cultural vulnerabilities, among others, is a tool of diagnosis that facilitates the classification of the problems and deficiencies of development. It leads to establish priorities as to which political, economic, social, and environmental actions must be implemented to achieve a balanced development.

It is necessary to elaborate techniques to monitor, on the territorial, the social accumulation of vulnerabilities. The early identification of the development of trigger processes would facilitate the dynamic application of realistic planning techniques. This type of preventative and prospective approach may be promising due to the degree of uncertainty and instability that currently characterizes the processes of change. It is due to the new postmodern conditions of the world and the inability to propose medium and long-term plans that techniques can be implemented without major traumatic effects.

Despite the fact that many societies in developing countries live in pre-modern conditions, modern and postmodern elements influence their dynamics of growth and development. In view of those characteristics of change, fragmentation and ephemeral images, it is necessary to propose flexible planning models that allow for a more adequate incorporation of

uncertainty, instability and surprises. These models imply dynamic planning with early alert techniques that anticipate the conditions of the social environment and the disturbing agents; that is a preventative and prospective vision of development.

Risks and the Urban Habitat

The elements of the urban habitat that are exposed to risks are resources and services that can be affected by the occurrence of an event; that is, human activities and systems such as buildings, infrastructure, production centers, services, and the people who use them.

Generally, high-risk zones coincide with those areas that present subnormal or marginal conditions. The family income of the settlers precludes them from having access to institutional housing credit, when it is available. The costs of relocating the inhabitants, the lack of technical and financial resources in the municipalities, and the limited economic capacity of the potential beneficiaries convey the need to resort to the assistance of provincial, and national governmental entities and non governmental organizations (Ramírez, 1991).

Thus, the development of new housing projects, the relocation of human settlements and the improvements to housing and to the environment require financial support and technical assistance from governmental agencies and non-governmental organizations. Adequate construction techniques should be promoted as to guarantee the protection of the investment and the patrimony of the families that participate from such programs. Not only would their use contribute to the reduction of risks, but it would also improve the quality of life of the population that is exposed to hazards, who usually live in poverty as a result of the prevailing land ownership patterns.

From the human ecology perspective, it is important to mention that risks arise from the inadequate development of human settlements. It is not only in terms of their location in areas prone to natural or industrial/technological hazards, but also because of urban disorder, the loss of public spaces and low levels of environmental sanitation (CNUAH-HABITAT-JNV, 1988).

According to the World Bank projections, in the next 30 years a considerable number of developing countries will duplicate their urban popu-

lation. As a result of this urban disorder, growing difficulties in the provision of public services and in the industrialization processes will appear. Vulnerability will probably increase dramatically. The only way to make possible a balanced process that could be interpreted as sustainable development is to incorporate preventative criteria in physical (urban and/or territorial), sectarian and socioeconomic planning, and to formulate indicators geared towards the early detection of crisis.

Institutional Organization

It is unavoidable to conclude that in developing countries there is a lack of coherent organizational institutions that carry out those activities inherent to environmental management. On the contrary, dispersed entities from different sectors and at different hierarchical levels have been performing one or several functions related to the administration of renewable natural resources or the control of environmental degradation factors (Departamento Nacional de Planeación, 1991).

Consequently, an adequate coordination among the national, provincial and municipal levels, and among those sectors involved in environmental management, is required for the formulation of policies and their implementation. The objective of this approach is to avoid the contradictions, disagreements, and vacuums that usually end up harming not only the resources, but also their users.

On the other hand, and usually as a result of a large-scale disaster, Latin American countries have created organisms whose principal objective is emergency preparedness and response planning. Under this institutional figure, civil defense or protection organizations usually administered by active or retired military officials have been created. With some exceptions, these types of organizations are of national scope, have little local presence, and have not included actions related to prevention and mitigation within their activities. Therefore, those activities inherent to risk reduction and management of the environment and the urban habitat have not been carried out coherently. In the best of cases, they have been carried out in a scattered manner by entities from diverse sectors. These entities do not have links with the localities and do not present proper orientation and coordination.

The inter-institutional organizations recently created in some countries were conceived considering the need to coordinate properly the formulation of policies and their execution among the national, provincial and municipal levels, and among sectors involved in prevention and mitigation as well as emergency response. These types of structures have been named *systems*. Contrary to the centralized models based on a single directing entity, the systems rely on a network of institutions coordinated by focal entities in each territorial level (national, provincial-departmental-state, municipal) that orchestrate disaster prevention and response activities in accordance with the expertise, jurisdiction and autonomy of each institution.

The National System for Disaster Prevention and Response of Colombia is an example of this type of institutional model, as it was established with governmental entities and existing non-governmental organizations at all levels. These institutional systems were conceived to allow the decentralization of actions and the support of both the central government and international technical cooperation agencies in the areas of environmental management for risk mitigation and the rehabilitation of affected areas. Disaster prevention and response activities are being developed under a national plan that defines for each field of action the national objectives to be promoted and developed during the International Decade for Natural Disaster Reduction. Among these objectives are: the elaboration of maps depicting hazards and high risk zones; the instrumentation and monitoring of natural phenomena; institutional and financial strengthening; the stock provision and furnishing of emergency storage centers and the elaboration of contingency plans; education and training; incorporation of prevention in regional and municipal development plans; vulnerability analysis and relocation of settlements in high risk areas; post-disaster rehabilitation; and, the recovery of degraded hydrographic basins. These objectives are promoted at the local, provincial, and national levels through the inter-institutional coordination of governmental entities and non-governmental organizations.

An inter-institutional organization is a *system* only when its structure corresponds to that of a model of entities that are interdependent for purposes of environmental management; that is, prevention, response and rehabilitation, while conserving their autonomy with respect to their individual sectarian and territorial jurisdiction and responsibilities. The

activities and results of the system are synergic, as the actions of the whole exceed the sum of the separate actions taken by each entity. Provincial, departmental, or municipal organizational schemes are replicas or versions of the national model. The different levels act as a whole, guaranteeing the coherent flow of information and the implementation of programs and projects, vertically among territorial levels and horizontally among the components of each level, which are organizations from the State, the private sector and civil society.

The development of the type of organization depends on the historic circumstances and democratic tradition of each country. Nevertheless, currently it is recommended to promote systems that have the participation of concerned entities from the public and private sectors in accordance with their jurisdiction, to carry out management activities of operative, technical, scientific and planning character, in an organized and decentralized manner and through regional and local committees. In an inter-institutional system for environmental management and disaster prevention and response, each institution must define its functions and responsibilities at the national, provincial and local levels. One of the fundamental aspects of such a system is the clear function of national and provincial institutions as coordinating and advising agents of the local levels. The national planning systems of each country play a key role as structures that make policies coherent, while the municipalities act as implementing entities.

As a consequence of administrative centralism, local levels have ignored their role as environmental managers, a fact that could explain the indifference toward degradation. It is clear that when external forces prevent local levels from conditioning their environment, everything loses the sense of ownership. When an absorbing centralism assumes powers to control natural resources, these end up belonging to nobody and losing interest for everybody.

Local governments can assume the responsibility of managing the environment and the habitat, emergency preparedness, and disaster prevention and mitigation implementation. The fundamental argument is the necessity to recuperate a consciousness about the region and the locality, which also represents the beginning of a new concept about the level of acceptable risk and the value attached to environmental impact.

Such an appraisal comes from the citizenry and is developed from the bottom up, in accordance with democratic rights and responsibilities.

CONCLUSIONS

Disasters are environmental impacts that vary greatly in spatial, time and volumetric terms; reasons why their qualification is relative and depends on the social value assigned by the community. There is tendency to relate the magnitude of disasters with those events that affect demographic distribution. However, from the scientific perspective any severe environmental impact is a disaster, even when there is no direct effects over the population, goods and services, the effects can be of ecological nature, resulting from natural or man-made actions. In such situations it is valid to apply the concept that fighting nature is fighting oneself.

The only way to make possible a balanced process that could be interpreted as sustainable development is to incorporate prevention criteria into physical (urban and/or territorial), sectarian and social-economic planning, and to formulate prospective models of indicators to detect through early warnings any future crises. Therefore, any policy that incorporates the principles of ecological, social, cultural, and economic sustainability must include the following elements: an explicit planning of the use of the environment and its resources as an instrument of *prevention and regulation*; the technological response to instrument efficiency and as a complementary resource for the proper transformation and modeling of nature; education and information to generate a sense of responsibility in the population and to incorporate prevention in the culture; community organizing and participation as an instrument of adaptation of the social system with a democratic foundation; and, legal and juridical action to instrument the legalization and control of the rights, responsibilities and actions of mankind over the environment.

The reduction of vulnerability must be an explicit objective of development, as it represents a deficit in the conditions and quality of life of the population. Consequently, prevention and mitigation are a fundamental and unavoidable strategy towards sustainable development.

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APPENDIX: GLOSSARY OF TERMS AND CONCEPTS

Acceptable risk: Probability value of social, economic or environmental consequences. According to the judgment of the regulating authorities, it is considered to be sufficiently low as to allow its use in planning, the formulation of the quality requirements of the elements exposed, or to create compatible social, economic and environmental policies.

Damage: Economic, social or environmental loss, or degree of destruction caused by an event.

Development: Process constituted by activities that lead to the use, improvement, and/or conservation of the system of goods and services. It takes into consideration the prevention and mitigation of hazardous events that could generate negative environmental impacts, with the purpose of maintaining and improving the safety and quality of human life.

Direct effects: Those effects that have a direct causal relationship with the occurrence of an event, usually represented by the physical damage on the persons, goods, services and environment, or by the immediate impact on social and economic activities.

Disaster: Situation caused by a phenomenon of natural, technological or man-made origin that signifies intense alterations in the people, goods, services and/or the environment. It is the effective occurrence of an event that, as a consequence of the vulnerability of the elements exposed, causes adverse effects upon them.

Ecology: The study of the structure and function of the ecosystems. Discipline that studies the requirements that economic activity must fulfill and the external limits that it must respect as to prevent effects contrary to its objectives.

Ecosystem: Spatial unit defined by a complex of physical and biotic components and processes that interact in an interdependent manner and create particular flows of energy and cycles or movement of materials.

Elements exposed (at risk): The social, material, and environmental contexts represented by the persons, resources, and services that may be affected by the occurrence of an event. Human activities include all the systems made and operated by man, such as buildings, vital lines,

or infrastructure, production centers, services, the people that use them and the environment.

Environment (Human Environment): Set of conditions or influences that affect human behavior, either as individuals or as a society. It is the shape and function of the ecosystems that surround and support human life.

Environmental impact: (Negative) The result of any developmental activity or of a hazardous event that disables, deteriorates, or destroys goods and services that could be or are used to improve the quality of life of human beings.

Environmental management (Gestión Ambiental): Integral management of the environment that incorporates the criterion of equity to obtain the welfare and harmonic development of human beings, as to improve the quality of life and maintain the availability of resources, without exhausting or deteriorating renewable resources nor squandering those that are non-renewable. The welfare of both present and future generations is considered.

Environmental management (Manejo Ambiental): Planning and implementation of actions geared towards improving the quality of life of human beings. Mobilization of resources, employment of measures to control the use, improvement, or conservation of resources and natural and economic services, as to allow the minimization of the conflicts originated by the use, improvement or conservation.

Environmental quality: Relative capacity of an environment to satisfy the needs or desires of an individual or society.

Environmental science: The study of the natural processes that make up the air, land, water, energy, and life systems, their interaction among themselves and with human beings.

Event: Description of a natural, technological, or man-made phenomenon in terms of its characteristics, severity, location and area of influence. It is the registry in time and space of a phenomenon that characterizes a hazard.

Forecast: Determination of the probability of occurrence of phenomena based on the study of its generating mechanism, the monitoring of the perturbing system, and/or the registry of events through time. A forecast might be short term, usually based in the search and interpretation of signs or premonitory events. It might be medium term,

based on the probabilistic data; or it might be long term, based on the determination of the maximum probable event that can occur in a given period of time and that can be used as a planning tool for the potentially affected area.

Goods and services: Specific components and processes of the structure and function of ecosystems that are relevant or valuable for the population.

Hazard: Latent danger associated with a physical phenomena of natural, technological, or man-made origin that can materialize in a specific place and a determined period of time, producing adverse effects on the people, goods, services and/or the environment. Technically, it refers to the probability of occurrence of an event of certain intensity in a specific place and in a determined period of time.

Hazard evaluation: The process through which the probability of occurrence and the severity of an event are determined for a specific period of time and a determined area. Represents the estimated recurrence period and geographical location of probable events.

Hazard management: Mitigation measures related to the intervention of phenomena associated with a hazard. Whenever feasible, hazard management refers to the control or channeling of physical phenomena through technical and scientific methods, protective public works, or security measures that prevent the occurrence of hazardous events.

Indirect effects: Those effects that have a causal relationship with direct effects, and are usually represented by a series of concatenate or subsequent impacts over the population, its economic and social activities, or over the environment.

Intensity: Quantitative or qualitative measurement of the severity of a phenomenon in a specific place.

Intervention: Intentional modification of the characteristics of a phenomenon with the objective of reducing a hazard or of the intrinsic characteristics of an element with the objective of reducing its vulnerability. The intervention seeks to modify risk factors. Both to control or channel the physical course of an event, or to reduce the magnitude and frequency of a phenomenon, are measures related to the intervention of the hazard. Minimizing to the extent possible any material damage through the modification of the resistance to impact of the exposed elements are structural measures related with the in-

tervention of the physical vulnerability. Those aspects related to physical planning, land use regulation, insurance, emergency measures, and public education are non-structural measures related with the intervention of the physical and functional vulnerability.

Lifelines: Basic infrastructure of networks, pipelines, or connected or continuous elements that allow the distribution of electricity, water, fuels, information, and transportation of people and products, necessary for society to carry out activities with efficiency and quality. Energy: dams, substations, electrical lines, fuel storage plants, oil and gas pipelines. Transportation: Road networks, bridges, transportation terminals, airports, ports. Water: Treatment plants, potable water and sewerage systems, irrigation channels, and conduction. Communications: Telephone plants and networks, radio and television stations, post offices, and public information agencies.

Loss: Any negative value of economic, social, or environmental nature reached by a variable during a specific period of exposure.

Man-made: Of human origin or from human activity.

Mitigation: Those intervention measures taken to reduce or diminish risk. Mitigation is the result of the political decision of setting a level of acceptable risk, which is obtained through an extensive analysis of the risk and the understanding that it cannot be totally reduced.

Pollution: Entropy process caused by human activity against the trends that determine the proper equilibrium among living beings. It is one of the indexes that characterize the antagonism that can occur between development and the quality of life.

Prevention: Set of measures and actions taken in advance with the purpose of avoiding the occurrence of an event or reducing its consequences over the population, goods, services and the environment.

Resiliency: Capability of an ecosystem to recuperate once affected by an event.

Risk: The probability of occurrence of economic, social, or environmental consequences in a particular place and during a determined time of exposure. It is calculated by relating the hazard with the vulnerability of the elements exposed.

Risk evaluation: In its simplest form, it presents risk as the result of the relationship among hazard, vulnerability, and the elements exposed, with the purpose of determining the possible social, economic, and

environmental consequences associated with one or more events. Changes in one or more of those parameters modify risk in itself, or the total of expected losses in a determined area by a specific event.

Risk management: Integral activities taken to avoid or reduce the adverse effects on the people, goods, services, and the environment, through preventative planning and the preparedness for the response of the potentially affected population.

Subject: Component of an ecosystem that may be understood as a group of elements that represent the persons, goods and services, economic activities and/or the environment.

Sustainable development: Process of natural, socioeconomic, cultural, and institutional transformations whose objective is to insure the improvement of the living conditions of human beings and of its production, without degrading the natural environment or compromising the foundations of a similar development for future generations.

Vulnerability: Internal risk factor of a subject or system exposed to a hazard that corresponds to its intrinsic predisposition to being affected or to being susceptible to suffering a loss. The different degree of vulnerability of the elements exposed to an event determines the selective character of the severity of the consequences of such an event on them.

Vulnerability analysis: The process through which the level of exposure and the predisposition to loss of an element or group of elements that face a specific hazard are determined.

Part two

Reality of / Whithin Cities

CHAPTER 5 ENVIRONMENTAL DEGRADATION AND DISASTERS: SIMILAR BUT DIFFERENT. THREE ARGENTINEAN CASE STUDIES TO CONSIDER AND SOME DOUBTS TO FORMULATE

Hilda Herzer
Raquel Gurevich

INTRODUCTION

In this article we will outline several conceptual and empirical approaches to explain the relationship between the urban environment and disasters. Most studies investigate disasters in the urban context, but few of them examine the theoretical, conceptual and methodological mediations established between both topics.

Diverse examples and case studies in Latin America allude to the broader articulation between the environment and disasters, emphasizing in each case, one particular dimension of the analysis, whether ecological, political, social, economic, technological or cultural. It would be helpful to have a perspective that illuminates - in a global and integrated manner - the relationship between the urban environment and disasters, in order to understand the reaction in Latin American societies every time a risk approaches and to find out the best way to prevent or mitigate this risk. Since we are dealing with socially constructed phenomena, we believe they can be changed.

Both the literature and the research trends are useful for our discussion since they analyze disasters from a socio-historic perspective and

conceive the urban environment as a social construction, a historical product, with specific physical-natural and socio-economic regimes.

In the present study we will attempt to define the concepts of urban environmental degradation and disaster, as well as the relationship between them. Additionally, we will present the different scales at which this relationship manifests itself, and the manner in which the regional scale is promoted because of its influence over the generation of disasters at a local level. This is clearly illustrated by the case study of the system of the Encadenadas, in the province of Buenos Aires. The objective is to reach an understanding of the behavior of environmental variables at a regional level as a mean for explaining the materialization of disasters at a local level. Among these variables, we will address degradation, defined here as the product of an inadequate management of resources, which affects the environment and makes it vulnerable to the action of natural phenomena such as precipitation. An example of this is the case of the city of Resistencia in the province of El Chaco). In this way, the degraded environment may be characterized as a concept that summarizes environmental vulnerability to disasters.

More questions than answers

Some trigger questions open the field for discussion on the topic:

What is urban environmental degradation? What scale must be used to analyze the degradation processes that manifest themselves in the city? Is the urban territory a proper spatial unit of analysis? Is it indispensable to incorporate the region?

What is the relationship between disaster and urban environmental degradation? Are disasters a manifestation of degradation? To what extent is degradation generated by disasters?

Which social actors participate in the processes that lead to degradation and disaster? Are they the same for both cases or different? How do the relationships between the urban environment and disasters in central and peripheral zones of the city become evident? What relationships appear between the processes of spatial urban segregation and the population living in disaster prone areas?

To Better Understand

Generally speaking, we understand the urban environment as the set of relationships established between society and the physical medium, constructed or artificial, that takes place in a demarcated territorial space: the city. Simultaneously, this definition implies the consideration of juxtaposed land use, the multiplicity of processes and actors that produce and reproduce this medium, and a variety of cultural definitions and symbols.

We also understand degradation - following a semantic approach - as a reduction in degree or to a lower rank (Blakie and Brookfield, 1986). Degradation can be also defined as a set of changes in homeostasis of a system: when each new state of equilibrium entails a reduction in the productive capabilities of the system, or a reduction in its productivity that can subsequently cause other types of changes.

We are fundamentally concerned about the urban environmental degradation, and as a consequence, the alterations or the decline in the quality of the daily life of the population. Such degradation may become evident in housing, infrastructure, network services, air, public spaces, landscape, etc., and in all collective goods whether they have a price or not.

This definition of degradation will be interpreted in many ways according to the social, economic or political subject involved. Thus, there will be different interpretations of the existence and the magnitude of degradation. For example, in a case of pursue for urban land use (commercial facilities and green areas), the owners of urban land, the businesspeople, the scientists, the governmental levels involved, and the representatives of political power usually share different visions about the extent of urban degradation that such undertakings may represent. This argument does not imply a relativist or subjective position. It rather establishes that a definition of degradation is subject to ecological, political, social, economic, cultural, and technical factors that must be carefully analyzed.

The physical changes and the effects of the degradation must be evaluated according to social, economical and political conditions since climatic variations, soil transformations, and chemical alteration of air and water modify the quality of life of the population and their environment.

It is important to emphasize the social nature of the problem and to stress that degradation is a social and historic concept, comparable in this aspect to the concept of disaster. While degradation and disasters are related to one another, the social and environmental effects of both phenomena do not keep a strict proportion with their objective magnitude. A catastrophe does not occur only due to the trigger event, that is, the natural phenomena or hazard that originates it (i.e., rain or earthquake). But it is mainly originated by the socio-economic, cultural, and political framework that determine the final effect (i.e., construction codes, and/ or existing urban legislation that favor a certain construction type - whether retrofitted buildings or not - in areas with different levels of vulnerability, that may cause the collapse of buildings and will determine the number of dead and injured).

Degradation is also defined as an eminently social problem. Disasters and degradation could not be conceptualized as such if they did not produce victims nor had repercussions over people, the economy and society.

In urban settings, degradation causes problems to inhabitants, their daily life and the surrounding areas. When the city is degraded, its overall productivity decreases. Traffic jams, environmental pollution and floods - as in the case of the city of Buenos Aires - are the most eloquent examples.

Disasters are the best indicators of degradation. This statement is valid not only in a strictly urban environment, but also in a regional setting - a question of scale that we will address later on.

The City, Degradation and Disasters

The city appears as a fragmented space that is simultaneously articulated, in the sense that each of its parts relates with the others through flows of people, objects, information, etc. (Lobato Correa, 1989). "The city is the sum of different products destined to satisfy collective and individual needs, and in this sense, it is a public object" (Pírez, 1994). The conception of the city as a public good implies that its characterization, its problems, its government, and its management must be faced as such. Simultaneously, however, the urban environment is valued, appro-

priated, transformed, utilized, and abused by specific social sectors, economic groups, and governmental levels that usually have incompatible rationality, interests and beliefs. These remarks tend to enhance the idea that the degradation that is caused by private interests affects the city as a whole and, on the same token, it usually provokes the most direct consequences over private agents that are different from the ones that originated the degradation. The underlying question is how to reconcile these *degrading* private interests with a public interest that should supposedly satisfy the common good.

Scales of Analysis

In order to continue the research, it is essential to adequately identify setting of the problem. Several authors mention different geographical scales of analysis for approaching the research of the urban environment. They imply the identification of agents and processes that vary for each case. The proposed levels of investigation are the internal environment, that is, housing and its immediate surroundings, including the neighborhood or settlement, and the environment of the city and the extended region (Hardoy and Satterthwaite, 1987, Di Pace et al., 1992).

We will present a chain of events and social actors that construct a set of relationships that constitute an approximation of the links between environmental degradation and disasters at different scales of analysis. As an example we will consider the specific case of floods but other disasters could also be considered.

In the southeast of the province of Buenos Aires (districts of Adolfo Alsina and Guaminí), a particular management of the water and soil resources, associated with climatic variations and changes in the productive profile of the region, affected the interests of the dominant social actors. Successively over a period of approximately 10 years, changes made in the environmental management of the region led to the generation of degradation processes. The immediate consequence was the flooding of a populated area, the City of Lago Epecuén, which had a defined productive profile. Since tourism activities were no longer performed in that area, it can be described as disaster.

It is clear that the actions and authority of the social actors and processes involved in each of these analytical scales are different but at the

same time they complement each other. Therefore, it is important to emphasize the conceptual and methodological ties among the different levels of the appraised natural resources, the economic agents involved, the levels of the State that are present, the cultural and technological rationality, as well as the intentions and behavior of the communities involved. As an example, the reconstruction of housing units that have been exposed to disasters, the maintenance of land ownership irregularities after a relocation, the applicability of procedures for an imposed moratorium, or the financial and professional support for the construction of public works, imply decisionmaking and action strategies that cannot be understood without acknowledging the links among the different scales of analysis.

In the search for an optimum scale of analysis that understands this type of phenomena, it is necessary to include economic and extra-economic variables without restricting them to a determined geographical area, but rather considering the interplay among scales when evaluating the impact of natural disasters. It is also important to consider the relationship between the urban scale and that of the surrounding region, or even the global scale. Some factors such as demographics and changes in migration trends cannot be explained solely by an analysis confined to the city limits.

There are interesting connections between housing levels and the level of the city as a whole, as the sum of internal environments is not equal to the whole city. As an example, there are usually differences between flooded houses and affected houses (due to water or power cuts, for example). The number of residents in the flooded area is not equal to the number of people actually affected. Thus, there are differences among the affected population, the residents of the flooded area and those who receive aid during the emergency (Vaccarezza, 1990). These problems make it difficult to quantify damages and cause a high margin of error in the risk evaluation methods.

What Comes First, Degradation or Disaster?

Evidence shows that disasters have differential impacts, which vary according to the degree of fragmentation and articulation of the social sectors involved and to their location in the different zones of the urban

territory. The political, social, economic, and environmental manifestations of disasters seem to mirror society. The implications go both ways: from a logical perspective, the statement "the greater the urban environmental degradation, the worst the conditions of vulnerability, and the higher the propensity to disasters" is as valid as "the greater the occurrence of disasters, the greater the resulting urban degradation."

The signs of urban degradation usually originate, provoke or expedite disasters, which, in the absence of preventative measures, consequently contribute towards the degradation of the urban environment. With regards to this topic, it is essential to note that concrete social agents, who may or may not be the same as those affected, socially produce urban spatial forms. Thus, the owners of the urban soil, the real-estate agents, the State, and other social groups are responsible at different degrees for disasters.

Both the fundamental point of the conflict and the contents of emerging policies seem to rest upon the identification of two issues: (1) how to reconcile private interests with social needs; and, (2) how to relate short and long-term decisionmaking and implementation.

A Typology of Actors and Scales

The social actors involved differ not only in their political, economic and social means and capabilities, but also in the different scales of geographical analysis where their actions take place. This implies that the social actors involved in disasters are not necessarily the same as those involved in the processes of degradation. The way in which they perceive these processes as well as the level of critical thinking that they develop may also vary. As an example, we present a typology that relates social actors with geographical scales, using the variables *disaster* and *urban environmental degradation*:

(1) Social actors that degrade at the regional level and whose actions can impact the urban space, but that are different from the urban actors who receive the impact.
(2) Social actors that degrade at the regional level and whose actions can impact the urban space. They also receive the impact at the urban level since they live in the city;
(3) Social actors that degrade the urban space and differ from those who receive the impact; and,

(4) The same social actors degrade the urban environment and also receive the impact.

Public Policy and Disasters

When dealing with the categories "market" and "government," one must consider the mutual re-adaptation and conditioning that both establish with respect to each other; similarly one cannot deal independently with economics and politics. The land tenure regulations on flood prone settlements of the metropolitan area of Buenos Aires (i.e., Municipalities of Florencio, Varela, San Fernando and Berisso) are a clear example of such conditionings and also of how public policy reinforces what it is intended to avoid. This type of governmental intervention is also recorded in the flood plains at Resistencia (province of Chaco). It is also recorded in the working class neighborhoods built by FONAVI (National Housing Fund), in the flood prone shores of the Epecuén Lagoon (province of Buenos Aires) and in the flood plain of the Paraná River.

Also, the design of policies and implementation strategies would be improved by taking into account a socio-historic perspective of disasters. It becomes possible to adequately state the issue by denaturalizing the problem and removing its degree of fatalism and its characterization as an anomalous event. To these regards, it is important to note that natural phenomena are statistically foreseeable, and therefore, their risks and damages are not fatally unavoidable (Rodríguez, 1990).

Associating disasters with the natural and neglecting the character of collective construction of the city eliminate the real possibility of preventing risks. This naturalistic and non-historic conceptualization of disasters usually prevails in the political, technical, and at times, even in the academic arena. It creates the imagery that human beings are being submitted to nature's will, even though there are other social, economic, and political variables that must be considered in the analysis (i.e., real state, neo-liberal economics, citizen participation, the role of the State). The level of corruption of public officials and/or politicians in connivance with the ties established with economic groups that influence the definition and objectives of public policy, warrant their inclusion among the political variables. This situation is fully exemplified by the exceptions allowed to the building code of the city of Buenos Aires, which

have led to an increase in the density of the constructed space and consequently, in an increase in the frequency and severity of floods.

The main principles behind the recommendations, made with regard to urban environmental management and disaster management, seem to coincide, as both are based on inter-sector, inter-jurisdictional and inter-organizational analyses, and entail institutional continuity.

A multidisciplinary approach is the key to formulating and mitigating the problems related to disasters within the urban context. To achieve an integrated management of the relationship between nature and society, the presence of the State (political level), the labor sector (economic level), the science and technology (scientific-professional level), and the affected population (social level) is indispensable. Being that virtually all of the components of the State are involved, it is not futile to insist once again in the necessary complementation and coordination among them.

Urban Environment and Disaster in Argentina

In the Republic of Argentina, floods constitute the most serious disasters recorded during the past decades, although last year drought and fires captured public attention. The environmental, political, social, and economic problems that result from these particular types of disasters are observed in the negative consequences, whether direct or indirect, that they have over the quality of life of present and future generations.

Even though the effects are significant for both the rural and the urban areas, it is in the latter where the more acute aspects become evident. Two main reasons explain this behavior: the amount of people affected directly or indirectly and the seriousness of the effects on the population and the economic activities.

Returning to the topic of the geographic scales involved in the study of the urban environment, it is important to note that the city as a whole is the appropriate scale for the analysis of the type of disasters we are concerned with. We recognize that although sometimes floods affect a particular zone or a particular neighborhood of the city, it constitutes a problem that concerns the urban context as a whole.

We pose a paradigmatic example: the flooding of the city of Buenos Aires between May 31 and June 1, 1985, when 308 mm. of rainfall affected the metropolitan area. "It rained almost non-stop for 25 hours, paralyzing the area for more than a day. As a consequence, more than 100,000 people were evacuated. 2,500 housing units and 14,000 automobiles were damaged. 100,000 houses remained without potable water, telephone and electric power. Private and public companies suffered multimillion dollar losses. The total cost of the damages caused by the flooding of numerous neighborhoods was estimated in US$246,087,500, most of which was accounted for in damage to housing. Additional losses include US$12.5 million in public health expenditures, US$9.3 million in capital goods, US$4.5 million in losses for the electrical power companies, plus lost workdays, and an interruption in the generation of profits for the transportation sector, sales taxes, and others."(Herzer and Federovisky, 1994)

Disasters may be interpreted as a valid indicator of degradation. Their effects provoke a reduction in productivity, which can be evaluated in economic terms. Technological and capital investments are significantly eroded, so that it becomes necessary to invest heavily in reestablishing productivity at pre-disaster levels.

In Argentina, the floods of greatest impact and highest frequency are those that occur in the northeast (provinces of El Chaco, Formosa, Santiago del Estero and coastal provinces) and in the Pampas region (basin of the Salado and Quinto rivers, the Encadenadas Lagoon system, and the metropolitan area of Buenos Aires). These floods significantly gravitate around the urban sectors involved, such as Buenos Aires and to the important cities located along the Paraná and Paraguay Rivers (Resistencia, Formosa, Goya, Corrientes, Rosario, and Santa Fe).

The urban environment, where almost 86% of Argentineans live, is greatly deteriorated. The main problems that affect Argentinean cities and that slowly construct a degraded habitat are: disorderly spatial growth; lack of appropriate housing; atmospheric, water, soil and noise pollution; drainage infrastructure; lack of green areas; high densities; lack of sanitation; inadequate waste collection and disposal; and, insufficient waste treatment and recycling plants. These conditions have direct repercussions on the increase of the population's vulnerability to disasters.

An analysis of the rationale behind the occupation of flood prone areas suggests that the unplanned and uncontrolled occupation of these areas is a constant in the Argentinean case. Therefore, the processes that characterize land appropriation govern the unequal production of the environmental supply for human settlements. The phenomena of spatial segregation and social exclusion bow to public and private interests of territorial organization, in accordance with the political, economic, social, and natural roles that prevail within profoundly fragmented cities.

It is timely to recall that some authors define *city* as an entity, as a simultaneously social and physical or territorial structure (Douglas, Ian 1983). Therefore, the natural framework - decisive in terms of the conditions of risk - and the social framework - in terms of the conditions of vulnerability - converge to classify the nature and materialization of disasters.

Three Examples on which to Reflect

We will present three case studies of floods in Argentina that illustrate the significance of the relationship between urban environmental degradation and disasters. Their presentation is interesting as each case corresponds to a different urban scale and socio-economic importance: the Metropolitan Area of Buenos Aires, the cities in the northeast of the country in the provinces of Chaco and Formosa, and the village of Epecuén / Carhué lake, in the province of Buenos Aires.

The Metropolitan Area of Buenos Aires

Although floods constitute the only significant disaster that affects the Metropolitan Area of Buenos Aires, their growing impact on the population, and the lack of solutions to reduce their effects, make them a significant problem for the citizenry. Floods are products of the combination of rainfall and an inadequate sewerage and pluvial drainage infrastructure - whose expansion is lagging behind the process of densification of the city and the growing expansion of an impermeable area as the land is covered by a tapestry of pavement and buildings.

The most serious consequences are localized in the marginal neighborhoods of the Buenos Aires conurbation, where low-income sectors of

the population live. The fringes with the lower sanitation and schooling indexes are superposed over the fringes where the population mostly affected by the floods lives (Di Pace, 1992). This verifies the relationship between urban poverty and vulnerability to disasters.

The consulted bibliography highlights the high degree of precariousness to which an important subset of the urban population of the Buenos Aires conurbation lives. The main indicators of the conditions of urban poverty are directly related to the degradation of the inhabited environment. It refers to: unfavorable housing conditions (location, construction materials, availability of pluvial drainage, lack of garbage collection services); the degradation of water resources; deficient drainage systems for evacuating pluvial water; and, in the case of coastal settlements, the lack of protection to face river swellings.

It is reasonable to point out that if the impacts of the "sudestada"[1] are included, the scale of analysis of the floods that affect the city of Buenos Aires must be enlarged. The scale may even reach that of the La Plata River Basin, since the dynamics of the hydrological resources that shape it are involved and since the variables of environmental degradation of the Basin would come into play in this case.

Cities of the northeast of the country, in the provinces of Chaco and Formosa

The severe effects of the floods that affected Gran Resistencia (capital city of the province of Chaco) resulted from the combination of a zone with a high degree of exposure to physical-natural risks with a highly vulnerable population. During the flood that occurred from the end of 1982 until the end of 1983, it was estimated that 40,000 persons were evacuated, 225 schools were closed, and 23,000 students remained without classes (CLACSO, 1984). The water covered seventy percent of Gran Resistencia, the flood lasted thirteen months, and the economic losses were estimated to reach US$10 million (Caputo et al., 1985).

During the period from May to July in 1992, the situation repeated itself with practically the same scale of disaster, as if it were something new and unpredictable. This time, more than 16,000 people from the riverside cities of Misiones, Corrientes, Entre Ríos, Chaco and Santa Fe remained homeless, while 50,000 were evacuated in Formosa. An ex-

treme case was that of the city of Clorinda (Formosa), which disappeared underwater in May 1992, when the water level reached 28.5 ft. It is worthwhile to remember that Clorinda had previously been submerged when the waters reached 26 ft. in 1983, and that the historic record was established in 1985, when the waters reached 35 ft. Meanwhile, the provinces of Entre Ríos, Chaco, Misiones, Corrientes, Santa Fe and Formosa lost US$280 million during the May-to- July 1992 floods (Source: Diario Clarín, August 1992).

The Argentinean northeast is one of the flood prone areas in the country that receives the highest impact, as over one million people live in the valleys of the Picomayo, Paraguay, Paraná and Uruguay Rivers. As a matter of fact, the capital cities of six Argentinean provinces are settled in this zone (Viladrich, 1985). According to the 1991 census data, in Formosa, the riverside departments contain 47% of the province's total population. The Department of San Fernando in Chaco, where Gran Resistencia is located, has 35% of the population.

With respect to the occupation of the flood plains, it is confirmed that the population settles in those places that offer better labor expectations or where the land value is lower. Therefore, the equation "the poorer one is, the closer to the river one lives" becomes true. Such spontaneous and non-controlled occupation of the flood plains of the country's main rivers is associated with the dynamics of real-estate market speculation and worsens the conditions of vulnerability of the settlers.

The type of investment in public works and the orientation of the growth and occupation of urban lands became clear during the emergencies, showing that the conditions of environmental degradation in urban areas and in the surrounding region existed prior to the disaster, and in turn, were worsened by it.

Any alternatives for the development of the Gran Resistencia area require interventions that come from the local level. Territorial, political, environmental, and economic strategies must be implemented at the local and regional levels. Pertinent legal and administrative elements must be modified or created. These include land use legislation, generalizing the updating and implementation of the metropolitan area urban codes and water management legislation, issuing laws on the use and reserves of public land, expropriations and others. "The laws in force establish certain conditions for an area to be declared appropriate for urban use.

Therefore, the regularization requires the prior approval of affected parties (i.e. this occurs with the land located below the flood line). If this makes them subject to flood, any building, regardless of how precarious it is, interferes even more with the water drainage. And being that usually there is no pluvial sewer infrastructure to compensate for the water runoff lost because of the construction, the impact is significantly amplified. There are land tenure programs in lands occupied by low-income sectors of the population. There are also urban intervention policies by which the State intervenes, modifying the free market. These include expropriations, voluntary purchases, land banks, sites-and-services schemes, and housing projects." (Clichevsky et al., 1991).

The original city of Resistencia was located in high grounds. As it grew, the city expanded over zones subject to flooding; these lands were occupied by those sectors of the population with fewer resources, a process that expresses the situation of differentiated access to the land market that characterizes urban social segregation. This process is not exclusive to the city of Resistencia, but rather repeats itself in almost all Argentinean cities.

In the governmental model that explained the disaster situation in the Argentinean northeast, urban-regional poverty was not linked with the flood. The relationship "the greater the poverty, the worse the degradation, the higher the vulnerability, the larger the disaster" did not organize the official conceptual framework when reaching an understanding about the process of flooding. However, the coincidence of the flood line with poverty stricken areas is evident. The non-consideration of the political and economic dimensions of this type of disaster is symptomatic, as those groups whose situation is especially vulnerable become "*the flooded.*"

The System of the Encadenadas Lagoons

The third example is the Encadenadas Lagoons, southwest from the province of Buenos Aires. The seriousness of the situation in this zone became evident with the overflowing of the lagoons, particularly that of Epecuén, posing a threat to the urban area of Carhué. In 1993 the situation was as follows: out of the total surface of the Municipality of Adolfo Alsina (1,451,736 acres), 80% presented signs of hydro and aeolian erosion, and around 49,421 acres were flooded. Traffic was interrupted by

flooded routes and broken sewers. Carhué's 10,000 inhabitants were at the mercy of the decisions taken by the provincial government with respect to the management of the excess water in the other lagoons of the basin.

The affected area is significant because of its size and mostly because of its economic importance. In addition to the main economic activities of the region -- which are cattle raising and agriculture for foraging - it is important to mention the permanent disappearance of the Lago Epecuén village, the main tourist hub in the zone. Hotel infrastructure and recreation and health services were overcome by the mineral characteristics of the lake's water.

This small city, with 1,200 inhabitants, had a beginning and an end: 1920-1985. On November 10, 1985, the waters of the Epecuén lake invaded Lago Epecuén village, sinking it forever under 23 ft. of water. The possibilities were lost for tourism that was attracted by the thermal waters, an industry that constituted the main income source of the urban economy of the region. Even today, the effects of the loss of the village are felt in neighboring settlements, and especially in Carhué. In addition to the reconstruction of the deteriorated elements of its own urban structure and finishing the relocation of the flooded cemetery, Carhué is currently trying to invigorate its economy by becoming the heir of the submerged city, but it has yet to reach the tourist profile the village once had.

As a result of the 1985 and 1992 floods, the residents of Carhué suffered from the lack of demand for their agricultural products, machinery and related services, and the loss of roads to transport products and obtain basic goods. The urban workers found themselves subject to under-employment and unemployment.

The most serious problems occurred in the residential zones: loss of housing and property, thousands evacuated, re-location to shelters, modification of their lifestyles and generalized uncertainty. Even those who did not lose their homes suffered from the lack of potable water, sanitary services, electricity, gas, telephone, and the semi-immobilization of their daily activities.

Since 1947, different engineering works to modify the hydraulic equilibrium of the region have been undertaken. An example is the Ameghino

Canal, the most important hydraulic public work of the Buenos Aires southwest. To a great extent, this and other infrastructure works grew out of pressure exerted by rural landowners and those involved in the tourism activity of the zone. Such works have been built anarchically. This factor, together with the presence of a humid cycle that led to the saturation of the soil because of the heavy rainfall, underscored the inadequacy of the measures taken. The present situation is the result of a decisionmaking process led by rural landowners and railway companies and of the public and private investments in infrastructure that did not consider the levels of risk and vulnerability that prevailed in the area. It is evident, then, how the processes of degradation - clearly caused by deliberate human interventions - established the preconditions for the occurrence of disaster.

The infrastructure proposals that are being currently studied are varied. It is important to note that it is impossible to limit the problem to the local level, and that a comprehensive perspective must be considered. In 1992, the provincial government and a group of Danish technicians agreed to formalize a loan of water exhaustion pumps and the implementation of a regional master plan, with activities in Encadenadas as the first step toward larger works.

The projects that constitute the master plan include the zone of Vallimarca and Encadenadas. Once the works proposed for Encadenadas are built, the plan foresees a series of activities for the basin of the Salado River. It is important to mention that the agreement for the plan's implementation deals not only with the lagoons but also with the whole basin (6,177,600 acres). The design of the plan - whose budget is of US$4,800,000 - was completed by June 1994. It was to be implemented by a partnership of Argentinean and Danish companies. By February 1995, a total of ten Danish pumps had been installed and another two were rented from the United States, in order to drain the water towards the open watersheds.

It is too early to evaluate the results of a better understanding of the problems, which are related to disasters and to the conservation of the public, natural and constructed patrimony. Until now, the landscape and the stock of natural resources, architecture and archaeology have not been adequately incorporated in the search for solutions and the elaboration of environmental public policy. This statement is valid for short-

term emergency management as well as for the search for long-term strategic structural responses with a global territorial planning approach.

As a Way of Concluding

The analysis of the three examples presented leads to the first conclusion that there are different potential interpretations of the concepts of vulnerability and urban policy for each of the flooding processes. Although present in the three examples and closely related, the fundamental incidence of socio-economic vulnerability of the population in the flooding process - that is, the relationship between poverty and inundation - is evident in both the Metropolitan Area of Buenos Aires and Gran Resistencia. In the case of the Encadenadas, the decisive variable is the absence of an urban policy and the anarchy exemplified by the hydraulic policies and infrastructure works, which facilitated the flooding process and consequently demonstrated the relationship between a poor infrastructure and flooding.

For the three cases, it valid to state that alleviating poverty (the poverty "in" as well as "of" the city, the latter associated with the state of the infrastructure of the city) is an essential prerequisite to reach environmental sustainability. The poor are simultaneously victims and agents of urban environmental degradation. As an example, it is sufficient to think about the situation of the poor illegally settled in densely populated areas of the Great Buenos Aires. On the one hand, they frequently endure inadequate potable water supplies and sanitation, and are victims of floods, landslides, industrial emissions and accidents, air pollution.

On the other hand, as they are in the edge of subsistence, they are busy with the constant struggle for survival. This implies that they are agents of environmental degradation when they pollute, destroy, or misuse resources. In this sense, poverty and degradation go together. In other words, poverty and environmental degradation are reciprocal and intrinsically related, whether environmental degradation provokes and worsens poverty, or whether social and economic poverty is responsible for the misuse of natural resources and the consequent degradation of the physical and human environment.

Urban development policies must combine corrective, preventative, and mitigation measures when addressing risks. The three cases show that the first two types of intervention fail (for example, great infrastructure works), even though they may be technically advisable, when they are not implemented with risk mitigation measures. The case of the rupture of the dam located in Río Negro in Resistencia, province of El Chaco, in November 1983, 4 years after its inauguration is highly illustrative. The problem is worst for the case of the Encadenadas, as the efficiency and effectiveness of the hydraulic infrastructure is questionable. Land use regulations or the relocation of vulnerable and/or transitory settlements would have attenuated the effects of the overflowing of the lagoon. In the three cases we have observed the lack of policies to organize the regional urban territory. Therefore, it is worthwhile to insist that the efforts must converge on the application of mitigation measures at the regional scale.

The prevalent strain between the social and the private interests is at stake in the three cases. It is important to differentiate the individual action from the collective action. The first one implies a perception of the natural risk and environmental degradation that may be intuitive or not, expert or casuistic, but that in every case is always singular, particular, unique. On the other hand, the public behavior must be defined by integrating different sectors, bodies of knowledge, and experiences, while trying to reconcile interests, technical rationales, political will, and social and environmental equity. It entails much more than the sum of individual actions, regardless of their expertise.

To improve disaster management, institutional and jurisdictional relationships around the urban-regional environment must be strengthened. The three examples show the level of mutual dependency among the scales of analysis of the urban environment. Therefore, the relationship among technical and administrative organisms, the concerned society, and the decisionmaking political levels in and among each of these levels must be improved.

The difficulties in evaluating the damages caused by floods and in the methodologies for the empirical treatment of the degradation (that is, how to state it, measure it, etc.) have yet to be addressed. Answers on how to assess environmental damage and how to classify and quantify the degradation of the quality of life not only in the immediate period but

also in the long run, still must be found. Thus, tangible losses or damages and evident proof of degradation (related to the means of production) can potentially be expressed in monetary terms, while the intangible (for society or the environment) is questionably conceptualized and valued.

This problem shows the relevance of constructing an encompassing time-space framework that presents an inclusive perspective of the general interest of society, and extending its value to future generations.

NOTAS

[1] Rainy southeast winds that bring the waters of the La Plata River to the Argentinian coast interrupting the natural drainage of the city.

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CHAPTER 6 DISASTERS, DEVELOPMENT AND REGIONAL POLICIES IN NORTHEASTERN BRAZIL

Jurandir Antonio Xavier

Brazil and its northeastern region are a forceful image of the dramatic trends pointed out in the Cartagena's Statement, Colombia (March 1994), in the Yokohama's Message (May 1994) and the San Jose's Conclusions, Costa Rica (January 1993). In these areas disasters are increasing, those triggered by natural hazards as well as those social-economic related. And the rhythm is so quick that tragedies are minimized. In this scenario, tragedies no longer raise indignation that might lead to corrective solutions aimed to their mitigation. On the contrary, when turned into «normal» for development, disasters are accumulated, transforming daily life in a barbarian stage of a population socially exhausted. And this happens under the perverse indifference of those responsible for the social performance of the nation. Today, more than yesterday, the ethical and professional approach of avoiding the transformation of disasters in *natural* events is imposed to the scientific community in charge of explaining such evolution.

This evolution is even more dramatic in northeastern Brazil, where the economical development, turning into «typical» underdevelopment, transforms itself into a calamity: the Northeast is an illustration of the modern tendency to minimize tragedies that reign in the countryside. On one side, the natural phenomena (rain but mainly droughts) have been enhanced in their devastating actions. In addition to the destruction of the soil (underdeveloped and inadequate preventive infrastructures), victims are found also in the city (chaotic urban system, migration, dense population and barbarian conditions of reproduction). On the other side, besides the enhancement of the destructive potential of natural phenom-

ena in the countryside and the city, the development of capitalism have also brought its own source of (threats) specific tragedies. Cyclic crisis of super production turn into recession, stagnation and economic-social regression, which produce in turn new social sources of disasters (over-population, unemployment, misery, hunger, violence, epidemics, etc).

With the same economic development process, public policies have proven that in its *natural* course, they are unable to reduce the incidence of catastrophes or diminish social vulnerability to hazards, without building adequate infrastructure. The social variable of vulnerability was never considered in their plans, programs or projects. An example of this is the northeastern region, where these policies were transformed in countless plans, programs and development projects, even forming pioneer institutions, paradigmatic in the matter of economic development, such as the «Northeastern Bank of Brazil,» BNB, or the «Northeastern Superintendence of Development,» SUDENE. Even, recently, SUDENE promoted an «International Seminar on the Development of Northeastern Brazil,» to commemorate its 35th anniversary. In this event the past was evaluated again and the future defined; however, in the new development plan for the region, the social vulnerability of the «Disaster Region,» dramatically increasing, was not included.

Signs of underdevelopment

It is mandatory to recognize that neither capitalist development, within its *natural* course, nor public policies have been able to slow down the curve of disasters in their plans. On the contrary, economic development as well as private sector initiatives and public policies coming from the State, have contributed to enhance the disasters instead of diminishing them. Natural phenomena originate disasters, which produce more victims inside of the cities than outside. Disasters are also produced by social - economic actions, such as periodic economic crisis, whose recession, stagnation and evolution towards social regression, ends in the degradation of social reproduction relations. In fact, we have to consider that underdeveloped conditions are the consequence of underdeveloped economic-social structures, both in the countryside (extensive or under invested activities) and in the cities (precarious or under invested urban-

social). The droughts, especially in the Northeast, disarticulate social-economic reproduction of the countryside, intensifying migration to the cities and driving agricultural workers to the barbarian urban joints. Rain, floods and storms continue to produce deaths and epidemic outbreaks, and destroy shelter and social-economic activities in the countryside; as well as material damages and disasters in the urban conglomerates.

Even more dramatic is the increase of those tragedies whose primary source lie within the degeneration of the capitalist social relationship. It causes economic crises that are not only periodic and cyclic but also permanent. Crises do not yield to recovery, development and prosperity but to recession, depression and economic-social regression. The evolution of the crises toward social regression, that started in the 1980s, led to the waste of the scarce infrastructure services, causing the dilapidation of the few public services of social content that where built in the prior decade. The crises also added new contingent unemployed people to the critical mass in our nation. The increase of hunger, misery and indigence, desperation, illness and endemic outbreaks, as well as hatred and violence in social relations, in a daily fashion, led to the spread of social vulnerability and disasters that have been the most visible social signs of the current process of for development, specially in the Northeast.

Social vulnerability of the tragedies caused by the present state of diminished social relationships due to the capitalist reproduction may be illustrative. In fact, in their meeting of November 1994, the World's Health Organization stated that every 24 hours, six thousand people in the world are infected by AIDS. Today, approximately 17 millions are infected and, with such speed, by the end of the millennium the number will reach the 40 millions (25% of these people will be young adults). And the worst part is that thirteen years have elapsed since the discovery of the virus and there is nothing efficient to cure it yet.

In Brazil, violence, in its different manifestations, produce an increasing number of victims every day. Regarding traffic, there is a victim every 3 minutes. In the urban conglomerates of Sao Paulo, nearly 15 murders are perpetrated daily. In the last 3 months of 1994, 7 slaughters were registered. Something similar happens in the city of Rio de Janeiro. It is horrifying to verify that 60% or 6 out of each 10 teenagers' deaths, between the ages of 15 and 18 years, in 1993-1994, were murders; actu-

ally, more than traffic accidents, murders are the most common cause of violent deaths in the urban centers of the nation. Today in Brazil, infant mortality rate is not under the 700 children (around 5 years of age) that die daily due to poverty related illnesses. This relationship may be even bigger if other multiple social indicators are considered. What we are showing here is the extreme social vulnerability to catastrophes throughout the nation; the social reproduction of a land parcel endangers an important segment of the working population. Capitalist development is deepening social vulnerability, without public policies trying to stop this evolution, and even worse, instead of banning them, while anticipating social neutralizer actions, the policies have strengthen vulnerability.

We have to bear in mind the double nature of capitalist development. It expressed its nature by investing in low productive activity, and through unemployment, underemployment or low occupation of labor forces, both in the countryside as well as in the city. This meant that in the countryside economic-productive activities were able to develop in a privileged fashion due to the permanent expansion of the agricultural boundaries and not because of the intensification of agricultural methods; economic productivity was not obtained and, in consequence, infrastructure, investment or social capital density remained as underlying elements. And, in the city, economic-productive underdevelopment or underinvestment also meant a fragile infrastructure, low investment density and social underinvestment, both in the productive (industry, commerce and finance) as well as in the social environment (assistance, education or housing). On the other side, underdevelopment in the form of massive under employment or scarce labor force occupation meant low acquisition power, misery and indigence, lack of market forces and of incentives to produce. Such conditions triggered new economic activities of urbanization, self-building of infrastructure services trying to improve life conditions of the workers beyond the barbarian conditions found in the cities.

It is true that partial industrialization of underdevelopment economies as well as urbanization of their population, made economic-social activities and industrial development, independent from economy, food supply and social reproduction of high risks and uncertainty that even now continue to reign in the rural activities. Thus, industrial development transformed economy, social reproduction and made society less vulnerable to crisis of under production of food, usually unchained by

the hazard of natural scourges, devastation and disasters, especially in economies strongly dependent on agriculture. In this case, and maybe only where the development of capitalism became significantly industrialized, social vulnerability of the economy, periodic crisis of underproduction, permanent devastation, hunger and disasters in the agricultural economies might be related. However, such reduction of social vulnerability to natural hazards was not attained without increasing socially built disasters, which found in the periodic super production crisis their source of power. Simultaneously, highly concentrated population, misery and endemic outbreaks, as well as exploitation, assistance and wars were empowered.

When displacing the economic activities from the countryside to the cities, without building a social infrastructure against natural hazards in neither one of the two contexts (the growing urbanization gathered precariously the working population), capitalist development transformed significantly into industrialization, instead of reducing enhanced the destructive capability of natural hazards. Droughts, rains or tempests, for example, continued destroying plantations, breaking social reproduction and damaging social relations in the countryside. It is true that such natural hazards did not lead the whole economy to underproduction of food. However, such disasters, due to the precarious conditions of the economic-social environment are associated with landslides, crumbling, floods, traffic accidents; even endemic outbreaks in the cities and natural hazards triggered by landuse mismanagement, are multiplied. The development of capitalism is barely related to a destructive enhancement of natural hazards in urban areas, based on the amplification of social vulnerability and the precarious conditions of the economic-social activities within which the social reproduction process of the working class is carried on. It has also meant new sources of social disasters, even more powerful than nature: periodic crisis of overproduction, source of intermittent confrontation, war and economic destruction, underemployment, misery, hunger and degradation of social relations within capitalist reproduction.

Capitalist development, industrialization and urbanization that come together were not performed simultaneously, but unevenly, polarizing the nations in developed versus industrially underdeveloped. In the United States of America, 20% of the inhabitants with high income make 11

times more than the 20% of lower income; in Japan 4 times. In underdeveloped countries such as Brazil, this relation is approximately 32 times (in the Northeast, 50 times). This difference implies that the developed group has solid infrastructure against economic-social or natural hazards (to protect social reproduction, rural or urban properties). For the underdeveloped nations, on the contrary, development meant economic-social underdevelopment, predominance of extortionist economical activities, improvisation, inadequate infrastructure services and economic-social under investment both in agricultural and industrial areas. In consequence, extreme private enrichment versus social impoverishment is generated. Short periods of economic expansion were followed by long periods of economic-social depression, regression and stagnation that transform periodic crises into permanent ones. It is the increase of social vulnerability to catastrophes.

Signs of Public Policies

It is significant that in developed countries, investment took care of its own re-investment, valorization and reproduction, generating an actual economic development, taking its own risk. The State and its public policies had the freedom to adopt «anti- hazard» policies, such as social compensations that built a vast network of infrastructure services, increased investment and social richness. These policies became barriers of social vulnerability to disasters. Obvious examples of these policies are the so-called anti crises that originated the building of the «State of Social Welfare» and, regarding the natural aspect, the anti-seismic, anti-hurricane or even anti-drought buildings. In underdeveloped countries, however, the State takes care of the economic-productive and industrial actions. While the countries sank in a daily barbarian condition, the State took care of the economic development, productive infrastructure and the value of the private capitalist richness.

Public policies were neither preponderant social developers nor social compensatory, but incomplete capital developers, because they did not take care of the economic aspects that might build social-economic anti-hazard instruments nor social compensations that might reduce social vulnerability to disasters. The private fortunes of the capitalists al-

ways presented solemnly as national-social developers. The «development of the underdevelopment» did not build a significant infrastructure anti-hazards neither in the countryside nor in the cities. On the contrary, the development model adopted has mainly transformed the densely populated areas into mortal traps; public policies do not constitute anti hazard, anti cycle or social compensations to neutralize the devastating social effects of the long periods of economic stagnation. In this way, the social relations of the capitalist reproduction, degrading in barbaric systems, turned into sources of permanent catastrophes for the nation. Economic crisis and its recurrence, enlargement and mutation towards social regression, increased dramatically social vulnerability to disasters in the country and especially in the northeast, where daily brutality and violence are the means of social reproduction, in such a dimension that they accumulate more victims than conventional wars.

Development plans deserve special considerations; they were forms of excellence or idealization by which public policies were presented in underdeveloped countries. Different from developed countries where capital took care of its own actions; in underdeveloped countries the State, initially, took care of the markets and their expansive reconstitution through public capital-reproductive policies, and developed an almost absolute monopoly of the oligarchies. Reconstruction market policies (income and consuming capability) or social compensatory policies in multiple presentations, were never significant here. That is the reason why the State and all the precedent capital-productive cycle was not able to distribute but extremely concentrated the income.

The accumulation of the capital, reproduction and valorization as well as the private capital interest were never presented as such, as income, richness or capitalist private issues. On the contrary, they were shown as causes pertaining to the State and to the public, and national, social and development causes. These causes were always portrayed as representatives of the national or State security interests. They proposed development plans that were finally taken by the nation as their own, as if they were the «nation's redeemers» from all natural or social problems accumulated in the past centuries. In a predominant agricultural and industrially underdeveloped society, it was considered that if droughts triggered a production crisis, they would also interrupt social reproduction. Economic development over the entire industrial segment will displace

the core of the activities from agriculture to the cities, reducing the vulnerability of social reproduction to natural events. With this idea, instead of building anti-hazard means to diminish the social vulnerability of agriculture to climate variations, regional development plans produced a complete industrial urban expansion. In this way, it was believed that the country would be free from the high risks always present in agriculture and under development.

Signs of Regional Policies

Few regions in the world have been exposed so exhaustively to public development policies as northeastern Brazil. However, the terrifying aspect of such plans is the confirmation of their relative economic failures (industrialization was not extended significantly in the region nor its remained core gained economic meaning) and their social failures (their indexes are among the worst in the world). Moreover, they also failed in providing the region with a minimal anti-hazard infrastructure that diminishes social vulnerability to disasters, especially droughts. Starting in the 1950s, a large series of plans took place in Brazil: Federal Anti Droughts Works Institute (IFOCS), latter National Anti Droughts Works Department (DNOCS); the Company of the San Francisco Valley (CVSF); in 1952, in the middle of the big drought of 1951 - 1953, emerged the Northeastern Bank of Brazil (BNB); as a reaction to another big drought in the Region, in 1959 the Superintendence of Northeastern Development (SUDENE) was formed and launched the document «A Policy for the Development of the Northeast» - GTDN.

The strategies for development managed by the Directors of SUDENE, contained in the GTDN document, spread the «development culture» in the region, and also in the SUDENE. In essence, the GTDN recommend, firstly, the intensification of industrial investment in the region in order to generate autonomous expansion centers of industrial manufacture. Secondly, the transformation of the humid regional zone by producing an adequate supply of food for the urban centers that will support its industrialization. Thirdly, the progressive transformation of the economy of the semi arid region, in such a way that will both raise its productivity and its resistance to droughts. And lastly, the GTDN rec-

ommended the displacement of the agricultural boundaries of the region to the humid areas of the Marañon River, in the northeastern border of the Amazonas, preparing the area for the reception of excessive population produced by the growth of the experimental northeastern economy. These recommendations were assumed as absolute truth, in such a way that the regional problems were referred as deviations that the SUDENE had experienced in the execution of these recommendations, particularly those of the military period.

GTDN-SUDENE started the *industrial cycle* of the regional development policies in the country, closing the *hydraulic cycle* when it was presumed that the region was going to be liberated from its secular dilemma by the expansion of the water dam. Cycle in which the planning of the economic-industrial development of the region and its expansion were taken as the absolute agents of restructure, modernization and economic freedom of the region. Cycle that was present only after five decades of non interrupted industrial expansion in southeast Brazil, in a period in which, while the northeastern economy was torn by economic regression, industrial southeast expansion, as it is know, yield to the recessive, regressive and anti-development policies. Maybe this is the reason why few years after its birth, and after producing several successive financial constrains of a highly centralized and militarized federation. SUDENE also experienced the failure of its industrial development plans. And in the northeast of Brazil there were plenty.

An immediate consequence of such development conception or of its identification with the state actions was the erection of the productive-industrial infrastructure, which should have made possible the installation of possible southern industries that did not showed their dimension as expected. It was also the weak infrastructure that served only to the few branches of southern industries that overflowed the production of the regional market. It did not serve to the northeastern economy nor to the multiplication of productive activities of the region, which surely needed other equipment and economic-social infrastructure. As a relevant example, beside all the commerce, service, transportation or communication services, it is enough to look at the waters of the San Francisco River, the only permanent river that washes 50% of the semi arid territory of the Northeast. The waters of this river are used for electric generation and not in the regulation of the supply of water in the region,

situation that might be changed with the transposition of the waters of the river to the hydrographic zones of the area. But such a project will need to break not only the source of opposition with the Southeast, but also with its own regional «technology culture,» which considers the energetic use of the waters as a «noble cause» for the river.

The years immediately following the implementation of SUDENE, the 1960s, were the country's transition. While state industrialization was observed, crisis, ethnic and class confrontations were growing and creating frameworks by which the State left the productive-development sphere into the financial-speculative one. Without a doubt, at that time, SUDENE, which pretended to industrialize the region while the State left it aside, was arbitrary abandoned. It was only remembered again in the 1970s, after the drought of 1970 (famous because it caused that Military Dictator Medici burst into tears), when the industrialization efforts wished to join the rural development, through integrated plans, so called PDRIs. The PDRIs were sponsored not only by the State, but also by the international banks, mainly the World Bank.

Thus, at the beginning of the 1970s, the «National Program for Integration- PIN» emerged and «Proterra (Policies for the earth)» looking for irrigation, as well as migration from the Northeast (semi arid) region of Brazil to the Amazonic (humid) region. In this period, the construction of the «Transamazonic» as a link with the main micro regions and the northeastern cities with the Amazonic region, in a new tentative to evacuate the Northeast (1/3 of the national population) and its exceeding population, especially from the semi arid to the Amazonas. After the failure of both, in 1975, the first «Integrated Rural Development Program» appeared in order to fight the rural poverty in the region, the «Northeastern Pole», branched in all the northeastern states. It was financed with resources form the federal budget, the World Bank and the Inter American Bank for Development, BID.

Regardless of their variety, the programs were not enough to change the face of the region in a significant way. Thus, in 1983, after another big drought, a new region development program appeared, the «Northeast Project.» This was the result of a critical evaluation of all the preceding programs, since former programs did not obtain a significant surpass of the economic under development and neither the indigence of the population nor the reduction of the social vulnerability of the region to

simple climate modifications. 500 technicians including consultants, government and civil society representatives formulated the plan.

The «Northeast Project,» as others, confirmed industrialization as a global strategy for development of the Northeast, and the concept of integrated development in the rural environment. It recognized the difficulties of a regional implementation, due to the large number of components and the need of a well-defined coordination, originated in the optimization of the resources. In fact, the «Northeast Project» substituted all other existing programs, presenting a strategy of integrated rural development, the «Support Program for the Small Producer - PAPP,» exclusively oriented toward small agricultural production. Other programs followed "PAPP": «Support Program for Non Agriculture Rural Business,» «Irrigation Program,» «Basic Program for Rural Education,» «Basic Program for Rural Environmental Health» and «Basic Rural Sanitary Program.»

The «Support Program for the Small Producer» was probably the broadest and best planned among the rural development programs carried out in the Region. It was divided into ten plans, one for each state of the Northeast, every one with its essential components: access to the land (Development Program for Northeastern Rural Properties - PDFN), access to water, credit, appropriate technology, rural extension, commerce and local associations. Its resources come from the federal budget and the World Bank. However, before the «PAPP» and the other programs were executed, the Federal Government created other programs, for example: the «Father Cicero Program,» aimed to the financing of community projects.

Other divisions of the «Northeast Project» were not concluded nor did they obtain independent life with the weakening of regionally coordinated planning. The «Program for Irrigation» turned into the «Ministry of Irrigation» and latter in the «Secretary of Irrigation.» The programs for education and health turned into local and they are still being provided in same states. The «Basic Sanitary Program,» although the great expectation involved in the planning did not became a reality. The «Small Agriculture Business» never left the paper. And the PAPP after two reformulations (1992 and 1993) survives quietly, although without its initial strategy of integrated rural development form, but in the form of different sub projects, harassed by the lack of resources, due to difficul-

ties of implementation or coordination and, over all, because of the lack of results.

The «Northeast Project» with the «PAPP» were the last rural integrated development plans for the Northeast, although not the last that the region had from their planning organisms. In 1993, while SUDENE conducted a new review process of former plans, based on the new development proposal, the Northeastern Bank of Brazil had a meeting with the World Bank and representatives of the northeastern states for the elaboration of a new proposal «Aridas Project,» which adapted the concept of sustained development to the northeast. As if the not implemented plans were not enough, SUDENE, proposed its original regional project, whose results were expressed in a new proposal for regional development of the zone, which, as tradition orders, was filled away by the new government.

EPILOGUE

The Northeastern Bank and SUDENE have commemorated their 40th anniversary. The Northeast continues without any change. There, more than half of the population live under absolute misery (just bear in mind that medical salaries here are only 50% of the national media, which in turn are among the lowest of the world). Under such circumstances, to speak about a successful development of the region is being a Pharisee, hypocrite and cynical. The international, national and regional capitalist elite was responsible for the calamitous situation of the region. It is terrifying to verify the failure of public policies, which were unable to develop or adapt infrastructure that might reduce the social vulnerability to the natural phenomena, to droughts that persist. On the contrary, the public policies implemented contributed to the increase of the social vulnerability to catastrophes. These are derived from natural phenomena, such as droughts (it not only has a devastating effect in the economy of rural zone, but also in the urban area) or from social phenomena, such as the barbaric property, production and income relationship, as well as the social conditions in which reproduction of working population is carried on.

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CHAPTER 7 URBAN AREAS, ENVIRONMENTAL DEGRADATION AND DISASTERS: A POLEMIC ISSUE

Marx Prestes Barbosa
Thomas Booth

INTRODUCTION

The issue of this article will lead to several discussions. In order to define correctly what urban environmental degradation and disasters should mean, it is necessary to discuss what the terms *urban* and *rural* mean. The word *urban* is derived from the Latin word «urbe» which means *city*. In the New Dictionary of the Portuguese Language,[1] the word *city* is defined generically as follows:

> *Demographic complex formed socially and economically by a significant concentration of people not working in agriculture, but rather in mercantile, industrial, financial and cultural activities.»*

Quoting the same author, the word *city* in Brazil has another meaning:

> *Municipal cite, independent of the number of inhabitants."*

Therefore, based on this definition, we may conclude that, in the Brazilian context, cities are classified as such independently from their economic activity, even if they are agricultural.

The same dictionary defines *rural* as related to the country. This definition does not require further explanation.

In order to define the urban and rural dichotomy as it relates to envi-

ronmental degradation and disasters, we will present a number of case studies from the state of Paraiba, in the northeastern region of Brazil. One case may be considered urban and the others urban-rural. Northeastern Brazil covers approximately 18% of Brazil's territory; 70% of its surface area is located in the semi-arid zone called the «Drought Polygon» and contains 63% of its population. The state of Paraiba (Figure 1) is approximately 34,797 miles in size. It has 97% of its lands within the semi-arid zone. Two of its 171 cities are considered large: the city of Joao Pessoa, the state capital, with 650.000 inhabitants and the city of Campiña Grande with 450.000 inhabitants. Ten are considered medium-sized (from 50.000 to 150.000 inhabitants) and 159 are small, with an average of 15.000 inhabitants -- several of these cities have from 1.000 to 2.500 inhabitants.

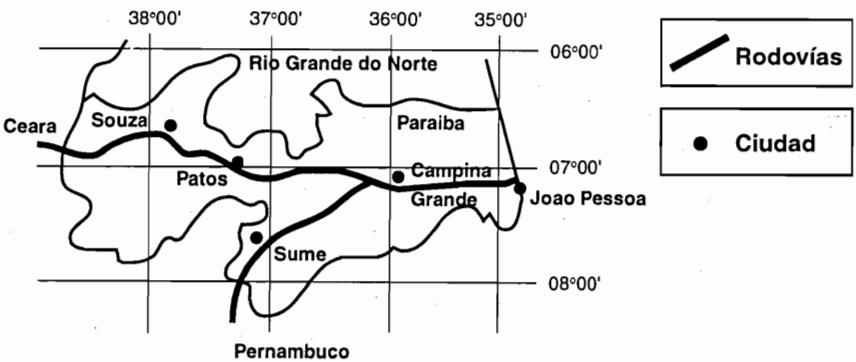

Figure 1: Schematic map of the State of Paraíba, Brazil.

CASE STUDIES

Case 1: Coastal Erosion

This case study is beginning with the participation of the Canadian Remote Perception Center (CCRS). Since their objective was to study the urban area, the cities of Recife (with 2 million inhabitants), Olinda (Pernambuco's State capital with 600,000 inhabitants), and Joao Pessoa (Paraiba's State capital with 650,000 inhabitants) were selected.

In the city of Recife, the effects of the ocean are felt all along the coast. In the «favela"[2] of Pina's Beach, ocean waters have broken the protection dam and the flood tide is destroying the homes and the main avenue along the beach. A similar case is the city of Olinda, where the streets were completely «swallowed» by the sea, with the consequent destruction of many homes. In areas where the situation is even more critical, cities and municipalities have created barriers by piling rocks along the beach in order to delay the action of the water. Dams placed perpendicular to the beaches have been built with some more than 164 ft. long. Additionally, in some places the local population has tried to stop the action of the sea by burying palm tree logs along the beaches.

In the city of Joao Pessoa, the phenomenon is not so extreme, but the destructive power of the ocean is destroying the coast of the most eastern Brazilian and South American point, Cabo Blanco. In Manaira Beach, the municipality has built a few rock dams in order to stop the water.

Case 2: Drought in rural and urban areas

For the study of environmental degradation resulting from droughts, we selected three cities: a large city and two middle-sized ones (according to the state of Paraiba's definition of city size).

Large City:

An example of a large city water supply problem in Campiña Grande and the subsequent migration during drought periods is presented.

The city of Campiña Grande, with 450.000 inhabitants, has only one source of water, the Boqueirao Dam, which is located 28 miles from the city and provides water for irrigation both upstream and downstream. The main degradation factor of the dam is related to the chemical contamination of the waters due to the agricultural toxins used upstream. This chemical contamination is a constant risk for the population of Campiña Grande, which makes it extremely vulnerable to a water supply-related disaster. Also, this unplanned irrigation is a danger to the dam itself due to moor formation. The drought, over the last several years, has prevented the overflow of the dam causing an increase in the water salinity. This endangers the low-income population, especially the informal urban population, who does not have the resources to purchase

high quality water. It is not only a classic rural-urban conflict, but also an environmental management problem.

At first glance, we should consider migration from rural areas to the cities as a natural mitigation action during drought periods. However, it has been verified that «drought immigrants» are subject to new vulnerabilities because, upon their arrival to the city, they increase the informal urban population, already affected by poor quality of water.

Rural drought immigrants are not prepared for urban activities because they are not qualified for specialized labor. This produces underemployment and consequently in more impoverishment of this segment of the population.

Immigrants in miserable conditions have no other alternative but to live in non-hygienic conditions where they become vulnerable to diseases. This results in an increased risk for the urban population as a whole with regard to epidemic outbreaks such as cholera and dengue. Both cholera and dengue are diseases that the government is unable to eliminate or control, as it is children's syphilis with a growth rate of 400%.

Smaller cities: cities

The city of Sumé is located 81 miles southeast of Campiña Grande. It has a population estimated in 15.000 people, and for the last 7 years it has suffered a real disaster situation. After a long drought the dam that supplied water for irrigation to the urban and rural zone dried up to levels less than 5% of its capacity.

The city of Soledade, located 37 miles from Campiña Grande, has an estimated population of 10,000 inhabitants and has the same problems as Sumé. For the last 6 years, the water from the public supply does not reach the houses. Water measuring devices have become decorative, rather than functional.

These two cities are typical examples from the region of Cariris Velhos of the state of Paraiba. As a consequence of the prolonged drought seasons, rural migration becomes informal urban population. Thus, scenes that were typical of large urban centers are now found in smaller centers. The proliferation of boys and girls in the street (photo 1) and the increased number of urban street beggars and delinquents (photo 1). 1 is a typical example of education vulnerability and cultural vulnerability.

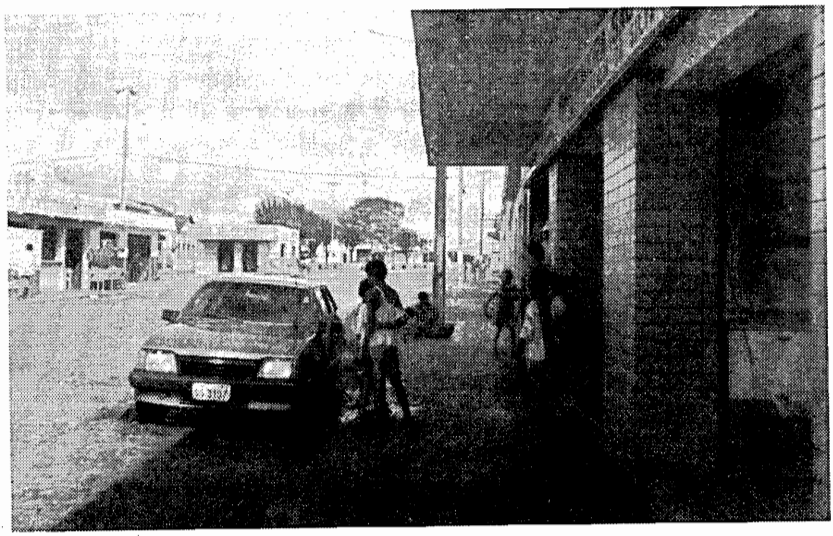

Photo 1: In Soledade, the children wash cars or ask for money in order to help their parents.

These children live in the street without schooling and grow up to become the next generation of the marginalized urban population.

Our studies have confirmed facts identified by other authors: small cities have problems and issues similar to large cities -- only at a smaller scale. Degradation of the rural environment has a direct influence on urban disasters (mainly social-economic), as well as a direct influence on vulnerability. Photograph 2 is a good example of what we just stated. In this photo, we see some men with their donkeys in the supply area, collecting water from a small dam. There donkeys defecate and urinate and the remains get into the dam. The men get in the water with dirty feet, so the dam supplying the city gets more and more contaminated, endangering the health of the whole population.

Environmental degradation amplifies social-economic impacts from a drought. It increases the vulnerability of the individual, as well as of the whole population, to hunger, beggars, under- employment (photo 2),

Photo 2: During long periods of drought, the rural population migrate to urban zones, where they are under-employed in tasks that do not require specialized work.

malnutrition, unemployment, etc. This is why urban centers continue to grow rapidly regardless of their ability to absorb this growth.

State and federal governments have adopted demagogic mitigation policies through «emergency» programs. Theoretically, the policies should support small and middle-sized rural landowners during long drought periods. The current situation is not good; here are two testimonies of the people covered by the «emergency» program:

> "I am giving profit to the patron because he doesn't pay and has his land prepared by us" (comment of a small 5 acres landowner).
>
> "Big owners have the means to obtain all the loans they need because they have bank credit. We are small farmers. We don't have the means for getting anything. Everything is more difficult. Right now, with the drought, EMATER [the disaster response program] suddenly meets with the big owners to organize

the emergency response. The small owners depend on the big ones; it is their will that prevails" (comment of a 36 acres land-owner).

The government pays these two small farmers, with money from the public budget, to work in the big farms owned by rich people. The federal salary is half the minimum Brazilian wage that amounts to US$50. Thus, by the end of the drought period, big owners have profits and small owners have losses.

The emergency phase of the crisis is characterized very frequently by local migration to the big urban centers and also to the coastal zones, such as Paraiba. Another aspect of the «emergency» is that conflicts arise from the water and land management policies while at the same time other social vulnerabilities deepen the crisis. In turn, such conflicts promote inadequate development activities and result in further environmental degradation, human vulnerabilities and demographic growth linked with poverty. As the emergency continues, migration increases with a succession of decomposition effects promoted by disorganized societies or antagonistic social segments. Such social degradation and dysfunction result in serious disasters, mainly droughts.

In Paraiba, specifically in the capital Joao Pessoa, the results of migration and the concomitant social dysfunction are obvious. The urban population depends on neighboring areas for its protein supply (mangroves for example), the volume of garbage dumped in the city dump, which is located in a wood near the mangroves area of the rivers Sanhaua and Paraiba, is four to five times greater than it was in 1974 and the covered area is seven times bigger. From 1974 to 1994, Joao Pessoa's population has quadruplicated. The solid waste has economic value because it is collected for recycling. There even are rural houses built on top of the trash. Since immigrants come to the city from the interior of the state, they often build their houses in high-risk areas, including the city waste area.

Frequently, there are conflicts that result from the use of the garbage resources. When migration increases, there is an increase in the number of people that need to collect and sell the garbage. At the same time, local environmental authorities try to relocate the inhabitants of the waste area who resist the loss of their only means of survival. This is one of the

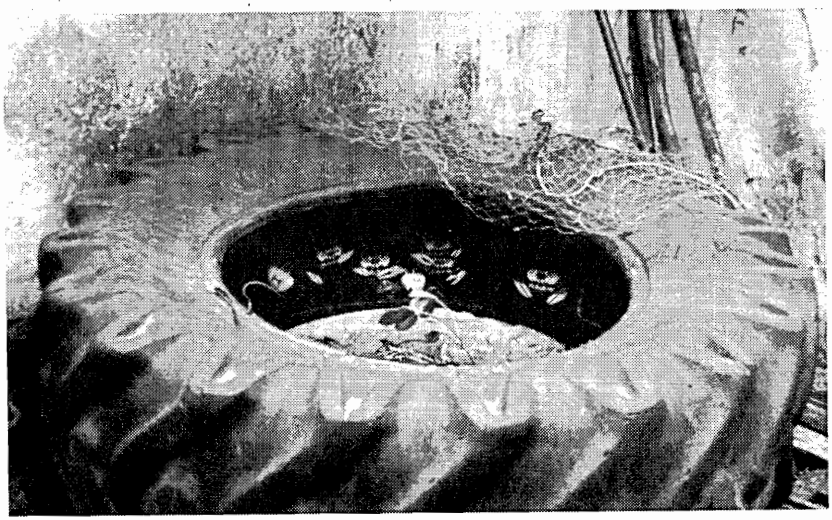

Photo 3: Crabs culture in tires found in garbage dumps.

reasons of conflicts among individuals and social segments as a result of environmental management policies.

The waste area of Joao Pessoa pollutes the mangroves. With the degradation of the mangrove, a source of protein has been eliminated from the cities food sources since the survival of the people depends on obtaining shellfish as the main (and often the only) source of proteins. Heavy metals and other contamination agents that accumulate in fauna that grows in the mangrove affect the health of the inhabitants of the garbage dumps. Because of the reduction of fish and edible crabs supply near the city, it has increased the capture of fish and shellfish in the coastal region.

The coastal communities, such as those associated with the Mamanguape estuary, who depend on crabs as both a source of food and an economic resource, are threatened by the intense crab fishing undertaken to supply the city. In the mangrove, protected by the Federal Environmental Agency, crab fishing is not carried out in the traditional manner. A type of net, made out of the plastic from seed sacks, is placed over

the ditch's caves, it is left for a day or two, and is then pulled out with the captured crabs. This method results not only in an excessive number of captured crabs, but also in loss of proteins due to the death of other animals captured by the screen. An interesting response to the lowered supply of crabs comes from the traditional catchers: they are now growing crabs in captivity using waste materials (photo 3).

Migration resulting from droughts has promoted social dysfunction, urban environmental degradation, destruction of food supplies and related income. This results in rivalry among individuals, social groups, and in some cases even among societies. This excessive competition for resources results in serious conflict if demographic and environmental issues are not addressed and managed. It is certain that the reasons for crises, disasters and conflicts should be considered synonymous.

Notas

[1] Written by Aurelio Buarque de Holanda Ferreira, a member of the Brazilian Philology Academy.

CHATER 8 SAN SALVADOR: URBAN GROWTH, ENVIRONMENTAL RISK AND DISASTERS

Mario Lungo
Sonia Baires

SAN SALVADOR: A LONG HISTORY OF DISASTERS

At the beginning of the last decade of the 16th century, San Salvador was a grand and beautiful city; a city of much commerce, with a ublic square, market, and a stone masonry arish church... Every asect of the city soke of the roserity and consolidation of the colonial city, caital of the rovince. However, in Aril 1594, a catastrohe once again disturbed the foundations and the heart of San Salvador, entirely destroying the flourishing city. This time the reconstruction was much more ainful and slow. By 1601 most of the city was still in ruins and the city council begged the metroolis for the concession of hel to alleviate the situation..." (Salazar, 1995)

Such descritions are reeatedly found throughout the history of a city that was founded 450 years ago. Whenever an earthquake strikes, it modifies the hysiognomy of the city, while the social and urban develoment attern continues to accentuate environmental risks. Damages are assessed and the reconstruction is lanned, in a rocess in which the main attention is given to the hysical factors.

For examle, most of the research conducted on the earthquake of October 1986 did not consider two fundamental issues: the consequences of the disaster on the social sectors that were mostly affected and its imact on the future satial growth of the city (Lungo, 1987). A artial and segmented vision revailed not only in the analyses, but also in the reconfor

future constructions, ignoring all reviously constructed buildings. But above all, they ignored the fact that the majority of the city was constructed illegally and without regard to the existing regulations.

It is imortant to note that these hysical structuralism reventative actions, although valid and necessary, are far from comrehensive. They do not address the increase in social and economic vulnerability, which in the case of the Salvadorian caital, is a factor as imortant as the long history of the increase of environmental risks.

ENVIRONMENTAL RISKS AND URBAN GROWTH

Although resent for some time, the relationshi among urban growth, degradation, and environmental risks has become evident only recently, to the extent that it is now the object of investigation for several Latin American researchers. The rocesses of territorial occuation and urban roduction, land use atterns, the lack of regulation of construction, and the severe deficits and obsolete infrastructure and basic services, combined with oulation growth and urban overty, increase the ressure exerted on environmental resources. Thus, an increasing urban oulation is exosed to enormous environmental risks.

For the uroses of the resent article, urban environmental risk is defined as the risk that is generated because of the interaction among a) natural hazards (storms, floods, landslides, etc.), b) man-made hazards (urbanization atterns, construction atterns, lack of waste treatment, etc.) and c) an increase of social and economic vulnerability. This idea can be reresented as follows:

Urban Environmental Risk = Hazard x Vulnerability
(natural/man-made)

It is often difficult to establish the causal relationshi of man-made hazards. Thus, the risk of landslides, for examle, frequently results from the settlement atterns of the oor, who build their homes in hillsides that are not aroriate for urbanization. The situation worsens with the subsequent deforestation and inaroriate management of luvial and wastewater. However, the cause of such landslides is not necessarily the result of human settlements in hazardous laces, but rather the lack of other alter-

natives from which to select since access to safe urban lands is limited.

The most imortant issue is that humans bear a great amount of resonsibility in the generation of risks. Such reasoning makes revention ossible. Risk can be avoided in so much as the relationshi between human beings and nature is modified and urban olicies that incororate environmental risk revention are formulated.

Different from the situation in a rural setting, urban environmental risk has articular characteristics, among which are the following:

(a) Its eriod of develoment is long and cumulative, and it is intimately related with the characteristics of urban develoment models. In the San Salvador Metroolitan Area (AMSS), a good examle is the current attern, which began in the 1970s, of rogressive and uncontrolled occuation of vacant lands with the otential of being used for agriculture. One of the worst examles of urban environmental risk was the Montebello landslide in 1982, which caused many deaths and significant hysical damage.

(b) Its consequences and effects are constant and generally of small scale. As oosed to large-scale disasters such as earthquakes, which usually occur suddenly and without warning, urban environmental risks materialize at a smaller scale and in a quotidian manner. In the medium and long-term, they cause similar or greater economic and social losses than those resulting from large catastrohes.

(c) Their causes and effects are regional, surassing the urban sace where small and medium-scale events continuously take lace. For examle, in the San Salvador metroolitan area, the imact on the otable water suly is beyond the scoe of the city, affecting other regions of the country.

Because of these characteristics, urban environmental risks are not erceived in their whole dimension. The eole and the governmental entities do not consider them life-threatening risks. It may seem that they accet them as art of their habitat and daily life.

These characteristics have led to a debate about the levels of accetance of urban environmental risks. Do the minor flooding of a neighborhood, accumulation of trash in the street, or living in the riverbanks of the Acelhuate River - main wastewater drainage of the city - constitute accetable urban environmental risks? It is our oinion that the fundamental question should be: accetable for whom? For the eole who have no other alternative? For governmental entities that do not face these tyes of risks and thus imlicitly accet that they do not reresent an immediate haz-

ard for human life?

Finally, another idea on this issue refers to the limitations of the concetions that limit the urban environment to natural asects (green areas, etc.), leaving aside fundamental asects such as obsolete or inadequate infrastructure and basic services. Due to the technology used in construction, inadequate infrastructure and services also constitute a generator of urban environmental risks. In general terms, construction technology used in the formal sector lays a fundamental role in risk generation, and generally it is not considered in the case of recarious settlements construction.

The ath towards a sustainable future in San Salvador is to incororate urban environmental risks into the city develoment lans. Not doing so will contribute to the generation of more and greater risks, exacerbating the living conditions of its inhabitants and its environment, reducing the urban roductivity of the caital city, and, above all, making this rocess irreversible in the medium and in the long term.

Risk factors in the recent growth of the city: an increase in the social vulnerability and environmental degradation

Analyzing the growth of the San Salvador Metroolitan Area (AMSS) in the last years, four rocesses can be identified:

(a) The transformation of the urban economy and the accelerated growth of overty while ockets of modernity emerge.
(b) Social fragmentation and exclusion develo a arallel increase.
(c) The city government structure is exeriencing a rofound crisis.
(d) Urban environmental degradation is reaching its uermost limits.

These rocesses consire against the sustainability of urban develoment and generate environmental risks. In our oinion, and contrary to general ercetions, demograhic growth is not an urban environmental degradation factor in itself, but rather in its relationshi with the reviously mentioned rocesses. This is true even when the territorial occuation atterns within the city have characteristics that increase environmental risks, as we will further demonstrate.

Although the AMSS holds 20% of the country's total oulation, its reonderance in the national urban network began to decrease in 1971. An indicator is the demograhic suremacy index, which increased from 1.68 in 1950 to 1.87 in 1961, but started to decrease to 1.73 in 1971 and 1.19 in 1992. Thus, the Municiality of San Salvador started losing its rank as the most highly oulated community. In 1950, 64.9% of the AMSS total oulation lived in this Municiality, while in 1992, this ercentage decreased to 34.7% (Lungo and Oorto, 1994).

Changes in the Economy of the City

The current economic reform movement involves two rocesses that articularly influence the economy of the city and thus they become relevant objects of our analysis: financial reform and the deregulation of land use and of basic service rovision.

The financial reforms undertaken by Cristiani's administration had a raid growth effect on the GN, esecially in the commerce, manufacture and construction sectors. The high volume of foreign currency remittance sent by migrants contributed to the stabilization of the economy, substantially modified consumtion atterns, and stimulated investment in new sectors such as commerce and services.

The rocess of deregulating the use of urban land began later, esecially through the elimination of restrictions and the modification of construction codes. However, it was not until recently that ublic investment in infrastructure modernization took lace, mainly in resonse to the demand of those firms that rovided services to exort-oriented comanies and industries (telecommunications, energy, transortation, etc.). The rivatization of urban services is also recent.

On the other hand, the trend towards an informal urban economy, which is common in other cities of the continent, becomes evident. The number of workers in the informal sector increased at a higher rate than the number of those who work in the formal sector. In 1986, there were 80,028 informally emloyed workers and 219,222 formally emloyed workers. By 1992, the number increased to 146,047 and 269,587 resectively (Encuesta de Hogares [census data], 1986 and 1992).

An increase in urban overty accomanied these changes in the economy, and at the same time the social vulnerability of low-income sectors of the

oulation also increased. The data demonstrate not only an increase in overty, but also changes in the internal comosition of these sectors. For all the cities in the country relative overty remains stable, whereas extreme overty grows.

Table 1
Poor urban families 1976/1990 (%)

	1976 / 1977		1990	
Families	Metroolitan Area	National Urb. Total	Metroolitan Area	National Urb. Total
Poor oulation	30.0	50.0	49.5	61.4
a) Extreme overty	10.0	20.0	17.0	29.6
b) Relative overty	20.0	30.0	32.5	31.8

Source: Briones, Carlos, 1992. La obreza urbana en El Salvador. San Salvador: UCA Editores.

Several factors lay out the foundations for growing social fragmentation and exclusion in the AMSS, such as the transformation of the economy, limited social articiation in city government and socio-satial segregation. Unfortunately, this has yet to be studied.

The City Government Crisis

A quick overview facilitates the conclusion that the management of the AMSS is fragmented in terms of urban lanning, regulation, administration and ublic investment. Entities of different hierarchical levels, which act without coordination within the governmental aaratus, are resonsible for these strategies.

Created in 1988, the lanning Office of the San Salvador Metroolitan Area (OAMSS), which constitutes the greatest effort ever made to have a single develoment agency for the AMSS, has serious limitations. Meanwhile, the Metroolitan Area Land Use Law, aroved by the legislature on December 8, 1993 through Decree 732, has yet to be imlemented.

Within such a gloomy framework, there aears the ossibility to modify the style of urban management that revails in the country. It imlies taking advantage of the State reform rocess, whose magnitude is only comarable to the revious reform cycle that took lace in the 1950s.

Four rocesses within the current reform that the Salvadorian State is undergoing may be identified: institutional modernization, reduction in the size of the state, decentralization, and rivatization. They are develoed in coordination with and through a dense network of interventions, usually suerimosed and contradictory. In general terms, rivatization is the dominant reform, while decentralization is fundamentally geared towards assigning new rogram imlementation functions to munici governments.

With resect to urban develoment, it is evident that the rocesses of state reform that would tend to be the most influential on its future develoment are rivatization and decentralization. The roosals resented and the measures adoted during the first few months of the Calderon Sol's administration oint in this direction. The rivatization of electrical ower, telecommunications, and even otable water rovision has been widely debated. However, in many cases, the trend to rivatize is contradictory with resect to the decentralization process.

Because of the central role and dimension of the AMSS with resect to the country's urban network, rivatization revails over decentralization in its urban management. In that sense, the rivatization of the city management and of urban services could be said to be the main illars of the constitution of a neo-liberal urban management (Lungo, 1992). It is imortant to kee in mind that in the case of the AMSS several municialities are resonsible for urban management. San Salvador has a clearly redominant role among them.

Among the comonents of urban management that can be identified, investment seems to be the key element that guides current develoment of the AMSS. Within this framework, the role of ublic investment could lay a fundamental role in the search for a new tye of urban develoment, even when the rovision of urban services is rivatized. For this to haen, it is necessary to foster a modern urban lanning rocess that above all rovides an instrument for coordination and agreement, rather than for the design of the ideal city. This would make ossible to establish different new regulatory and urban management systems. Not doing so would jeoardize the near future of the AMSS, making it imossible to reach the resently nonexistent goal of sustainable develoment.

The exhaustion of the current city government aroach, which does not allow for much social articiation, becomes a key factor for environ-

mental degradation and for an increase in environmental risks. It fosters irrational land use, a situation that is worsened by the revailing deregulatory trends.

The Limits of Environmental Degradation

Although there are no secific studies on this matter, we can argue that the "oints of environmental strain" (Stein, 1992) generated by the growth attern of San Salvador which are about to reach the critical thresholds are otable water suly, waste treatment and the availability of urban land.

With resect to otable water, it is well known that from the 1970s forward, underground sources have been insufficient, making it necessary to dig wells in laces relatively distant from the AMSS. The roject, known as "Zona Norte" and located 15.5 miles away from the AMSS, became oerational in 1984. However, towards the end of the 1980s, this aquifer was already exhausted. ANDA, the National Aqueduct and Sewerage Administration, was forced to use suerficial sources such as the Lema River to guarantee water rovision for the AMSS. This alternative, which had a rofound ecological imact of national dimensions, became the last otion. The country is undergoing a recarious situation in terms of underground or suerficial water availability, and it is close to reach the critical threshold of this "oint of environmental strain."

Liquid and solid waste treatment and environmental sanitation in general make u another of the most critical "oints of environmental strain" in the AMSS. The Office of the Mayor of San Salvador revealed that in 1993 around 1,076 metric tons of solid waste was roduced in the 13 municialities that make u the AMSS, 43% of which was generated in the municiality of San Salvador, and 57% among the rest. Of the total roduced, only half was being collected; the rest of it was disosed of in the ravines and rivers of the AMSS. The situation has not imroved substantially. A USAID reort estimated that during the last decade, 70% of the solid waste roduced in the municiality of San Salvador was collected (AID, 1991). The lack of treatment of the trash collected constitutes yet another factor to consider.

The drainage of untreated wastewater into ravines and rivers such as the Acelhuate River reresents an even worse situation. The 1992 House-

hold Survey reorted that 54,510 out of the 258,612 housing units in the AMSS did not have a sanitary sewerage infrastructure. A survey in low-income communities showed that more than half of the housing units did not have access to either otable water or sewerage infrastructure. Another imortant source of ollution has yet to be added: liquid waste generated by the manufacturing industries in the AMSS, which also constitute some of the worst generators of atmosheric ollutants. Out of 91 water intensive comanies located in the AMSS, 30 disosed of their liquid waste in ravines and rivers (ons et al., 1993). Both water suly and solid and liquid waste treatment are roblems that go beyond the territorial limits of the AMSS.

This last issue is somewhat easier to deal with than the first one, although it is directly related to another "oint of environmental strain": the decreasing availability of urban land.

The rate of land occuation may surass any calculations based only on an increase in housing construction. According to estimates, the current area of the AMSS, slightly higher than 22,239 acres, would reach 24,710 acres by the year 2000.

Because of the scarcity of urban land in the AMSS, it is interesting to look at the rocess of occuation of those lands better suited for agriculture. During the 1970s, the northern and northeastern zones received the highest urban growth. These lands were used at the time for sharecroing and sugar cane cultivation. During the 1980s, although the occuation of these areas continued to haen, the residential uses increased in the southern and southeastern zones, which had reviously been used to grow coffee in large and mid-size farms. Both changes imlied a significant rate of deforestation.

The roortion of urban/rural oulation in each of the AMSS municialities is a relative indicator of the conversion of agricultural lands into urban lands, esecially in the municialities of the erihery. Since 1961, the roortion 85% urban and 15% rural, has remained stable for the AMSS as a whole. However, in Soyaango, the municiality with the highest demograhic growth rate, rural oulation made u 57.28% of the total in 1950, and was reduced to 8.17% by 1992 (Lungo and Oorto, 1994).

Concurrently with this rocess of agricultural-to-urban land conversion, the continuous land occuation to build illegal settlements or

shantytowns is clear. These settlements are located in ronounced sloes, ravine banks, and the right of way of roads, streets, and railways, thus increasing environmental risk.

Table 2
Amss: informal settlements and shantytowns evolution

	1968	1974	1992
Informal Settlements	-	380	498
Shantytowns	31	-	293

Source: Zschaebitz et al., 1994. «Estadísticas básicas de los asentamientos oulares urbanos del AMSS», Documentos de estudio # 15, v. .I y II. San Salvador: FUNDASAL.

Table 3
Amss: shantytowns location

	#	%
Road reserve zones	42	14.3
Rivers and ravines banks	89	30.4
Others	162	55.3
Total	293	100%

Source: Zschaebitz et al., 1994. «Estadísticas basicas de los asentamientos oulares urbanos del AMSS», Documentos de estudio # 15, vol. I y II. San Salvador: FUNDASAL.

Limitations in urban land suly are evidenced by the accelerated increase in the rice of urban land for residential use. Official reorts confirm that the low-income sectors of the oulation lack access to the land that meet the minimum conditions of habitability (BCR, 1994).

The actors and their resonsibilities

Who are the urban actors and what is their osition with resect to the generation of environmental risk? They and their ositions can be established by analyzing the role they lay in the growth of the AMSS. The following table rovides an examle.

Table 4
Amss: environmental risks, actions and social actors

SOCIAL ACTORS	ACTIONS	RELANTIONSHI TO RISKS
Government		
OPAMSS	- Technical assistance to mayors - Urban develoment plan elaboration - Building approval	Direct
Local Government	- Garbage collection - Natural resources protection	Direct Indirect
Autonomous Institutions	- Service roviders	Direct
Vice-ministry of Housing and Urban Develoment	- Urban develoment and shelter	Direct
SEMA	- Environmental develoment and control	Direct
National Emergency Commission	- Emergency response - Prevention activities promotion	Direct
Non Government		
- Enterrises	- Project management	Direct
- Self-builders	- Shelter building	Direct
- Professional associations	- Technical advice	Indirect
- Grassroots organizations	- Management and implementation project for	Indirect
- International Agencies	- Develoment projects support	Indirect

Source: Lungo

It becomes necessary to erform a detailed analysis of the actions of the different agents and the osition they have with resect to environmental risks, esecially considering their level of awareness of the consequences of their ractices and their role with regards to risks. We can reliminarily state that the revailing level of deregulation in the construction of the city (infrastructure, services, housing, etc.), the lack of coordination among the various governmental agencies, and the roliferation of self-construction of housing units that do not meet the minimum security

requirements (obviously exlained by the revailing overty levels), among other causes, create a setting of growing environmental risk.

This trend must be reverted in the short term, before another disaster (such as an earthquake) once again triggers the well-known damages that the city has exerienced throughout its history. Unfortunately, another urban develoment lan for the AMSS is currently being develoed without serious regard to the issue of environmental risks, as the characteristics of the recent growth of the city would require.

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CHAPTER 9 URBAN ENVIRONMENTAL DEGRADATION IN A HIGHLAND CITY LOCATED ON THE SLOPES OF A VOLCANO: QUITO, ECUADOR CASE

Othón Zevallos Moreno

Quito is located at a tectonic step of the Pichincha Volcano massif, in the occidental mountain range of the Andes, at an altitude of between 9,184 and 10,496 ft. above sea level. The volcano represents a hazard for the city because of the probability of an eruption, landslides and floods. In addition, seismic risk is very high in the city.

Approximately 85 ravines proceeding from the volcano reach out the city. In a short distance that varies from 0.6 to 6.2 miles, the altitude ranges from 15,177 ft. above sea level at the Rucu Pichincha peak to 8,856 ft. above sea level in the lower parts of the city. Thus, there are steep slopes of about 30% and 60%. Intense rainfall produce torrential flows that, because of the high erosion rate on the mountainside, have caved in trenches 33 to 98 ft. deep.

In regards to the geological composition of the area, the rocky foundation of the so-called «Pichincha volcanic» (andesite lava, agglomerates and tuff) is covered by thick layers of volcanic ashes, sand, muddy materials, lapillis, etc., all of them are easily erodible materials.

The annual mean of rainfall varies from 1,200 mm in the urban plains to 1,500 mm in the high areas. There is an average of 177 rainy days per year. The rainy season goes from January to May, and 20% of all the rainfall is reported in April, the month with the highest precipitation of rain. The highest intensity registered is between 40 to 45 mm per hour. The mean temperature ranges from 57°F to 49°F at 11,152 ft. above sea

level, with low temperatures of 32°F and 39°F, and high temperatures of 75°F and 79°F. Winds are moderate, with a mean velocity of 10 and 13 miles per second, and predominantly they are headed to the north (Empresa Municipal de Agua Potable y Alcantarillado de Quito - EMAAP - Q, 1995).

URBAN GROWTH AND LAND USE MANAGEMENT

The population of Quito has quadrupled over the last 30 years. In 1960, the city had 330,000 inhabitants while today there are nearly 1,400,000 inhabitants. From 1988 to 1995, the city expanded its surface area 40 times (Peltre, 1989). According to the data presented in the «Quito Plan,» at the beginning of the century the urban area of Quito was of 356 acres, increasing to 3,299 acres by 1950, 15,568 acres by 1974 and 29,059 acres by 1980. Thus, the urban territory underwent an exponential growth.

According to official data, around 55,000 people live on the mountainside[1] although the actual number is probably higher. The combination of an explosive urban growth in this area, which has reached an impressive yearly rate of 17.5%, and an inappropriate environmental management represents a serious hazard for the city.

Quito, the capital of Ecuador, has traditionally been a city for the elite population associated with political power and governmental bureaucracy. The city has been characterized by its good local government administrations and planned urban growth. From the 1970s on, the territorial organization of the city, which consisted of three main activity centers, changed to a disperse organization. The 1964 Agrarian Reform Law led to the subdivision of the old haciendas that surrounded the city into small plots of land. As a result of this process, which was carried out without regard to municipal regulations, the local government lost control over urban expansion (Barreto, 1994).

The growth experienced during the 1980s, when the external debt crisis emerged, accelerated the illegal and unplanned occupation of the mountainside, mainly in the state-owned forests.

Political parties represented by city government councilors favored land invasions.

CURRENT LAND USE

The land use pattern of the mountainside is rapidly changing. Currently, it may be described as follows (EMAAP-Q, 1995):

The high barren plateau or *paramo* (between 13,776 ft. and 10,496 ft. above sea level) occupies 26.6% of the surface and is extensively used for cattle raising in the 24 local haciendas. Natural secondary forests, altogether with pasture and thicket, occupy 9.7% of the total area and are in poor condition as a result of grazing. Forest plantations occupy 21,6% of the surface, mainly with eucalyptus, and are also used as grazing land for ovine, bovine and caprine animals that eradicate the vegetation of the inferior strata. Despite the fact that agricultural lands barely occupy 2.1% of the mountainside surface, they contribute significantly to erosion since no conservation methods are utilized. Artificial pasturelands occupy 12.1% of the area, and are associated with trailing leguminous in mild slope surfaces. Urban areas occupy 27.9% from the total. They present different levels of consolidation and constitute the main land use in the watersheds.

HUMAN INTERVENTION AND ENVIRONMENTAL DEGRADATION

Although the Municipality of the Metropolitan District of Quito (DMQ) declared the mountainside as protected area, it continues to be legally or illegally occupied. To date, the DMQ has identified 22 communities in the area, eight of which are traditional settlements 20 or 30 years old, and the rest have been there for approximately ten years. Six of these communities are inhabited by low-income sectors of the population, three are middle class residential areas, and five are inhabited by high-income sectors of the population.

Up to date, *unplanned urbanization* continues. In July 1995, the author witnessed the removal of over 80 truckloads of soil and tree trunks that were deposited in the San Lorenzo Ravine for the lying out of the San Vicente Ferrer housing program, which clogged the drainage. Just by visiting some of these communities, anyone can corroborate the spread

of the construction fever that takes place in the area, mainly by the owners themselves.

The difficult topographic characteristics of unplanned communities result in a *lack of services* and makes it difficult and expensive to provide potable water, sewerage, pavement, electricity, waste collection, erosion control, accessibility, health care and other services. The cycle of deforestation, eviction, road building, construction, and occupation presents serious environmental consequences.

Urbanization and the demand for wood, firewood, fuel, and construction material have led to *deforestation*. The rate of deforestation for urban occupation has been estimated to reach 247 acres per year or more. If this rate is sustained, the mountainside forest will disappear in 15 years

Waste and debris disposed of in the ravines not only create sanitation problems, but also result in high operational and maintenance costs. According to EMAAP-Q (1995), only 36.8% of the waste generated in the mountainside is properly disposed of. Approximately 3,200 tons per year are disposed of in ravines, obstructing the water collectors, and thus increasing the risk of floods and alluviums in the city.

Artisan bricks are manufactured in 152 locations in the northern mountainside. Around 143,500 units are produced daily, generating an income of US$ 12,000 yearly, which supports 456 persons (EMAAP-Q, 1995). This industry uses 9,676,219 cubic ft. of land and 2,224,824 cubic ft. of wood for fuel each year, which is equivalent to the destruction of 116.79 acres of forest each year.

Numerous *access* roads are the result of the main activities of the zone. They are not paved nor has protection works. The following example illustrates the degree of irresponsibility and chaos that prevails in the mountainside land use. Last year, a landowner of the upper basin of the Rumiurco Ravine built a road 14.3 miles long that reached 14,104 ft. above sea level. The road was built on fragile volcanic materials, with 60 - 70% lateral slopes, in a zone characterized by the presence of high geomorphologic hazards (Costales, 1995). Besides the fact that the road quickly became useless, it became an enormous source of sediments and a mountainside destabilization hazard.

In addition to public health problems, the *lack of storm water* and wastewater sewerage systems in some neighborhoods causes serious ero-

sion problems and floods. Thirty-nine significant floods have been recorded during the last six years.

Every year *fires* are reported during the dry stage of the «summer»[2] season (July to September). They mainly result from either the negligence of visitors to the area or the intentional burning that cattle breeders initiate to renovate grazing lands.

Among the *other uses* that exist in the zone is the installation of over 30 radio and television station antennas and of a high voltage cable, for which a 98 ft. wide and 8 miles long strip of land was felled. Old open-air mines used to exploit construction materials constitute yet another severe hazard. Fortunately, this activity has been prohibited.

IMPACTS AND CONSEQUENCES

Increase in runoff and erosion

Applying the SWRRB (Storm Water Runoff for Rural Basins) Model to the Rumiurco Ravine basin, Fleming (1995) estimated that if the urban area in the high zones is doubled, the erosion rate would increase from 20,000 to almost 40,000 T/Ha/year during the next 10 to 20 years. Test results obtained after applying the hydrological model HIDRO1 indicate that the maximum water discharge and runoff volume would increase by 50%.

Erosion and mountainside instability

Although the impact has yet to be quantified, the formation of ditches several feet deep generate a significant amount of sediments that go into the ravines and further destabilize the mountainside, thus increasing the probability and magnitude of the occurrence of landslides.

Degradation of the water quality in the ravines

Fleming (1995) performed preliminary measurements of various water quality parameters in two monitoring stations of the Rumiurco Ravine. The first station is located at 10,824 ft. above sea level, and basically has no activity going on above it. The second one is located at 9,514 ft. above sea level, right before the water enters the collector at the edge of the city, which is demarcated by the Occidental Avenue.

Table #1
Water quality Data Collected at
Two Monitoring Stations in the Rumiurco Ravine

	Turbidity	Total solid	Phosphates	Nitrates	Bio-diversity Index
	[NTU]	[mg/l]	[mg/l]	[mg/l]	[-]
10,826 ft. above sea level	5.6	30.0	1.2	3.7	35
9,514 ft. above sea level	65	260	1.8	7.6	0

The large difference between the level of turbidity and the amount of dissolved solids is an indicator of how soil erosion resulting from human intervention negatively impacts on water quality. The degradation of this basin is evidenced by the changes in the physical water quality in stations only 1,640 ft. away, one of them at the edge of the urban area. Indeed, it is possible to look at the sources of sediment production located next to the river. The total disappearance of aquatic life in the lower location results from both sedimentation and the direct wastewater discharge into the river.

One of the greatest assets of the city, and a source of enchantment for its inhabitants and visitors, is the landscape. Despite this chaotic and discouraging panorama, it is still possible to find peaceful places, humid forest smells, and clear waters in the upper basins. It is still possible to close one's eyes and remember the sound of birds.

MORPHODYNAMIC HAZARDS

Responding to growing concerns, different organizations have conducted hazard analysis in the mountainside. These studies identify several types of hazards: superficial erosion, movement of unstable material, landslides and fluvial erosion; that is, mud and debris flows and floods. Although these phenomena are created in the mountainside, the lower more consolidated city would be the most affected.

Floods

Floods constitute the most frequent disaster that affects Quito. Although their incidence is limited to damages of little or medium impact in some neighborhoods, the accumulative damages are important. This problem is related to the sewerage system capacity; its solution being the improvement of the drainage networks.

Erosion

Superficial and fluvial erosion are the main causes of sediment generation and of the maintenance problems in the water collector system in the lower city. Inappropriate management of the mountainside increases the loss of soil and increases runoff and risk to slope stability.

Using the Modified Soil Loss Equation and volumetric estimates based on the amount of sediment that is removed from the collectors annually, the average sediment production rate is estimated to reach 8 tons/Ha/year, with maximum rates of up to 100 tons/Ha/year. The average soil loss is of 0.6 mm/year, with a sediment annual production of 1,271,328 cubic ft. During a single rainfall event with a recurrence period of 50 years, a maximum of 1,589,160 cubic ft. sediments may be produced (Zevallos, 1995).

Landslides

Because of their characteristics and magnitude, landslides, and mud and debris flows constitute an important hazard for the city. Thus they are analyzed in detail.

Basabe (1993) directed a regional research project on the hazards posed by unstable soils in Quito, summarizing the results in a map of 1:50,000 scale. In addition, he conducted both a pilot study in a 1:10,000 scale for the most hazardous ravines, such as the Rumipamba and Rumiurco, and a geotechnical analysis of slope stability using the Morogensten/Price method. From the stability analysis performed for 15 active landslide sites, he determined that even in dry conditions, 33% of the slopes are below the critical level and have a security factor lower than 1.0. If the water table rises, this percentage reaches 60%, and if soils are saturated, 87% of these slopes would be in critical condition. These disasters have not occurred yet because of the favorable effects of veg-

etative roots. In rainy years, the risk of disasters is very high and becomes unavoidable with the ongoing deforestation.

Costales (1995) agrees with Basabe in the hazard that these two ravines present, and identifies volumes from 3,531,467 to 88,286,675 cubic ft. of landslide prone material.

Mud and debris flows

Better known as alluviums, mud or debris flows are viscous flows made up of a mixture of water, soil, stones, blocks, trunks, etc. They originate at the upper basin and move torrentially through the steep slope riverbed, destroying everything in their path. Once they reach the zone with softer slopes, alluvium deposits form potentially destructive alluvial fans. The difference between mud and debris flows is the size of the materials in the mixture and the concentration of sediments. Debris flows contain a high percentage of thick material, while at least 50% of the mudflows is made up of sand, mud and clay. In Peru and Bolivia, these flows are called by the Quechua word «huaycos.» When the flows result from volcanic eruptions, as in the case of the Nevado del Ruiz, they are called «lahares.»

These phenomena may be caused by landslides, slope erosion, temporary dams and dam ruptures, and even by superficial erosion in the mountainside. Among the mechanisms that trigger these events are intense or continuous rainfall, earthquakes, eruptions, anthropogenic factors or a combination of them. In the Pichincha mountainside, all of these factors and mechanisms are present.

The author conducted a preliminary study of the characteristics, magnitude, and frequency of the mud and debris flows that are of hydrometeorological origin for each of the 33 ravines of the northern sector of the city (Zevallos, 1995). Using the procedure presented by Ishikawa (1989) and Bagnold's equation, the initial slope, volume, and concentration of the mud and debris flows are determined.

Based on the interpretation of historic events and the comparison of the I-D-F curves at the La Chorrera station with the equations of Caine and Cannon-Ellen (Keefer et al., 1987), the author estimated that 50 to 100 year storms may trigger the mud and debris flows.

Table #2
main characteristics of the probable mud
and debris flows with a return period of Tr=100 years

Ravine	Area	Maximum Hydrological	Sediment Concentration	Mud factor	Maximum Equivalent	Total Volume
	[km²]	[m³/s]	[%]	[-]	[m³/s]	m³x1000
Singuna	7.9	52.2	40.5	1.7	88.7	308.1
Rumiurco	11.5	71.4	37.4	1.6	114.2	436.5
Atucucho	2.2	15.6	53.7	2.2	34.3	75.5
San Carlos	2.5	20.8	47.7	1.9	39.5	85.0
Habas Corral	3.4	22.0	46.1	1.9	41.8	97.1
Rumipamba	7.1	45.2	62.9	2.7	122.0	305.0
El Tejado	1.2	7.2	77.6	4.5	32.4	52.2

Source: Elaborated by Zevallos O.

Table #2 presents the main characteristics of the probable mud and debris flows with a return period of Tr=100 years, for some of the selected ravines. According to the degree of the damage and the size of the basins, the northern sector of the city presents the highest risks.

Peltre conducted an approximate analysis of the secondary lahars that resulted from the ashes that fell after an eruption of the Pichincha Volcano. For the extreme scenario of a uniform 7.87 inches layer of ashes falling over the basin, he estimated that there would be alluvium volumes of up to 44,849,631 cubic ft. for the Rumiurco Ravine, 27,262,925 cubic ft. for the Rumipamba Ravine, and 12,642,652 cubic ft. for the Atucucho Ravine, that is, an average of between 2.7 to 4 times more than those of hydro-meteorological origin.

Risk analysis

Although they can be of significant magnitude, volcanic originated lahars have a smaller occurrence probability (p=0.003) than those of hydro-meteorological origin (p=0.01). The magnitude of flows and landslides of seismic origin, combined with rain, could be even more dangerous, but with a smaller probability that the rest.

The author studied the main areas to be impacted by mudflows using a simplified mathematical model to qualify the transit and deposit of water, mud, and debris in those urban zones that can be affected by the 33 ravines (Zevallos, 1995a). The route of the flows was determined topographically in a 1:2,000 scale map. The degree of the risk for these zones was determined by calculating the depth of the routed flows and the sediment deposits in each affected stretch. Risk sites are localized and have a relatively small size. However, there are significant direct and indirect impacts that will generate serious problems for the city.

Approximately 1,315 urban acres could potentially be affected with mud and debris, and an additional 1,483 acres could be affected with water. Hundreds of high to medium income individual housing units would be seriously damaged. Several miles of road stretches would be interrupted. The most important north-south transportation routes are highly vulnerable. The most important avenue, 10 de Agosto, would be interrupted for a day or two. The city traffic, which is usually chaotic, would be completely altered, as only two north-south routes would remain available. Four of the most important hospitals in the city, at least three high schools, and several elementary schools are in the area prone to receive mud and debris flows. Air traffic at the International Airport would be paralyzed as the result of the flooding of passenger waiting areas and of the landing field itself, a similar situation to the ones that occurred on April 31, 1983 and in May, 1995. The already flawed telephone system would collapse in the affected areas. Electrical lines and the sewerage system would become useless.

CONTROL AND MITIGATION PROPOSALS

Financed by the Inter American Development Bank, the EMAAP-Q is implementing the Pichincha Mountainside Stabilization Project, which has several structural and non-structural components and covers the 33 ravines located in the north of the city. Around US$17 million are being used to build a complex of 15 regulatory reservoirs, 18 collector entrances, and 4 road crossings that could function as reservoirs, 5 by-pass and deviation tunnels, 6 mud contention ditches, etc. The purpose of these works is flood regulation and sediment trapping.

Approximately US$2.5 million will be used to implement runoff and erosion control works in the mountainsides, among which are gutters, drainage, crossings, ditches, etc. Additional funds will be used to stabilize the ravine beds and to gather data on runoff and sedimentation and erosion rates. Over one million dollars will be invested in buying the equipment necessary for a mud and debris flow monitoring and alert system.

Although it received the smaller assignment of US$250,000, the mountainside management and control program is a very important component. The proposal is the creation of the Pichincha Mountainside Management Unit, which would consist of specialized trainers, ranges and guards.

Conclusion

This perspective of the problem provides an opportunity to demonstrate the relationship between urban environmental degradation, risks and disasters.

The mountainside of Quito is the typical case of an increase in the risk of disasters as the result of the mismanagement of the urban environment. The degradation of the so-called common goods, such as soil, water, landscape, security, etc. (see P. Metzger in the present volume), lead to the generation of risk scenarios and the occurrence of disasters.

An initially natural hazard (geodynamic, hydro-meteorological), has been transformed into a socio-natural and even anthropogenic hazard (water pollution, waste, etc.), as a consequence of the lack of planning by the local government, the lack of services and ultimately, the socio-economic conditions that prevail in the country (see A. Lavell in the present volume).

Risk becomes evident not only in the increase of the probability and magnitude of the occurrence of landslides and alluviums that affect the population of the lower zone, but also in the conditions of physical, social, economic and environmental vulnerability in which the population of the mountainside lives.

The fact that low-income sectors of the population have settled in the high areas implies a sort of an unconscious and unwilling revenge on the

high-income sectors living in the lower areas. The solutions presented are fundamentally structural engineering works geared towards reducing the physical risk to which the inhabitants of the lower areas are exposed to, leaving the low-income sectors of the population on their own. As stated by Herzer and Guverich in the present volume, risk is always the result of opposite interests. According to Barreto (1994) the mountainside is still a zone under dispute.

The mountainside protection project is focused on avoiding the «big disaster» (return period of 100 or 500 years) and does not pay attention to the «process in which disasters are generated.» Thus it does not mitigate socially constructed hazards and vulnerabilities (poverty, education, basic services, jobs, environmental management).

The project evidences the vision of international organizations. Hazards are seen as purely natural problems, vulnerability as a problem of the exposure of infrastructure to damages, and risks as essentially economic problems (cost-benefit analysis).

Municipalities tend to believe that the solution is an issue of economic resources and construction of public works. This trend must be reverted so that environmental management becomes the main mechanism to prevent and mitigate disasters. Municipal management must incorporate community participation so that the citizenry becomes part of the solutions rather than being mere spectators or generators of the problem.

It becomes necessary for the authorities and society to readjust their social policies and vision of development. If real solutions are to be found, sustainable development and equity issues cannot be ignored.

Although certain sectors of the population are exposed to a high level of risks, the hazardous zone does not exceed 7% of the total urban area of the city. Indeed, the result of a severe earthquake would be much more catastrophic. Therefore, it is necessary for the city to establish risk reduction as one of its priorities if Quito is to continue to be not only a beautiful city, but also a livable and safe one.

NOTAS

[1] From this point on, *mountainside* shall refer to the zone over 9,843 ft. above sea level that has been intervened, constituting a hazard for the lower parts of the city.

[2] Although Ecuador does not present clearly marked seasons, the period from July to September is considered summer since showers are not present and the temperature raises in few degrees higher than the normal (Translator's note).

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CHAPTER 10 A DEGRADED LAKE IS BORN FROM A DISASTER: THE LAKE WAS FORMED BY A MACRO LANDSLIDE IN CUENCA, ECUADOR

Alfonso Neira
Lucía Cáceres Parreño

INTRODUCTION

On March 29, 1993, in the southern zone of Ecuador, a landslide of approximately 706 million cubic feet occurred, damming the Paute and the Jadán Rivers. The rising waters flooded natural vegetation and farmland, homes, industrial zones, communication systems, roads and a thermoelectric station.

The evaluation of the damages, prepared by the Civil Defense (Cruz, 1993), officially reported 35 people dead and 6,400 people directly affected. Regarding material losses, the evaluation reported the destruction of two irrigation canals, eight bridges, 25 miles of roads and access roads, 716 homes and 4,448 acres of farming land. Besides, many agro-industrial factories were severely affected, as well as a significant portion of the communication and education infrastructure, and many community works and emergency systems. For Ecuador, the total of the damages was equivalent to approximately 146.9 million dollars[1] (CREA and University of Cuenca, 1993), not including the cost of rebuilding affected areas.

After 33 days of flooding, the dam on the Paute River drained and a lake of approximately 240 million cubic feet remained between the zones of El Descanso and La Josefina in the old riverbed. This new lake is fed by the waters of the Cuenca and the Burgay Rivers, which contain wastewater from approximately 447,000 people and from 270 different kinds

of industries located within the hydrographic margins of the Cuenca and the Burgay Rivers.

Before this tragedy, water for irrigation and for other uses were obtained from two irrigation canals located half a mile downstream from the La Josefina dam. Water was mainly used for agricultural activities, cattle-raising and domestic uses (where no potable water was available).

The zone where the landslide occurred consisted mainly of agricultural land, which depended on the water from the rivers for its survival. Thus, it is necessary to analyze the quality of the water in the La Josefina Lake if we want to predict the downstream effects and avoid the transformation of this water into a source of contamination and problems for the inhabitants of the area.

As a request of the President of Ecuador, ETAPA, the Municipal Public Company of Telephones, Potable Water and Sewerage for Cuenca, has started a study on the water quality and the results obtained will be analyzed in this document. It is desirable to continue constant monitoring of the different variables that impact on the quality of the rivers that feed the lake.

LOCATION

La Josefina Lake occupies the old Cuenca riverbed prior to the damming of the waters. It is located at the confluence of the Cuenca and the Burgay Rivers and the Cuenca and the Jadán Rivers. The total area of the riverbed covers approximately 832 mi2. The geographic position of the La Josefina Lake and its altitude are as follows: Longitude of 2°50'30" South; Latitude of 78°51'40" West; and Altitude of 7,626 ft. above sea level. The latitude of the lake, which is near the equatorial line, in addition to its altitude, determines its behavior with regard to temperature and thermal stratification of the water mass.

Annual precipitation in the lake's tributary area is 985 mm. The months with the highest precipitation are March and April, with an average monthly rainfall of 100 to 200 mm, while the months with drought conditions are July and August, with average monthly rainfall of 50 to 60 mm.

The constant intake into the lake is approximately 1,187 cubic ft./s, on average. Higher volumes are found between the months of March and May, which is the rainy period of the southern region, with values greater than 1,236 cubic ft. per second. Lower volumes are found in December, January and August, with values lower than 1,059 cubic ft. per second, which qualifies as a drought period.

The total annual intake level from the tributary area is approximately 35,773 million cubic ft., which constitutes the main source in comparison to the insignificant volume of direct rain supply from the area directly over the dam. Surface evaporation is approximately 13.7 million cubic ft. annually, which is not significant in comparison to the total volume. The hydrologic influence of underground waters on the lake has not been determined, but it may be assumed that the income and outcome are similar. From this perspective, the lake behaves like a river since it does not receive a significant level of effluents within the parameters of this study.

Use of the soil in the tributaries area

The beds of the Yanuncay, Tomebamba and Machángara Rivers have high percentages areas covered by "paramo." The bed of the Tarqui river has a significant-sized grass and bush-covered area in comparison with the other sub-beds where large-scale destruction of the bushes has occurred. In every sub-bed there is minimal forest coverage, which is always less than 5% of the total area. The beds of the Burgay and the Cuenca Rivers have the largest area of agricultural lands. Erosion is not significant in any of the nearby valleys; the area directly beside the Cuenca river is the most affected.

Identification of direct and indirect sources of contamination.

Direct sewerage discharge is the most significant source of contamination of the rivers that feed La Josefina Lake. A total of 205 types of contaminants have been identified including sewerage, solid waste, polluted rainwater, and industrial and domestic waste.

Approximately 447,000 people contribute to the pollution of these rivers and lakes, both in urban and rural areas. Additionally, there are 270 industries located within the tributary area of the lake, mainly in the city of Cuenca and its satellite areas. The range of polluting industries

includes food, clothing, leather, wood, paper, chemical products, rubber, plastic and non-metallic minerals, among others. This is equivalent to a wide variety of contaminants, such as organic charges, suspended solids, biological contaminants, phosphorus and nitrogenous nutrients, heavy metals and organic compounds.

Approximately five and a half million cubic ft. of residual waters are discharged daily in the tributaries of the lake. The large amount of solids coming from direct sources into the bodies of water is one of the main problems of the dam. An index of the large volume of solids that comes from the hydrographic beds is set at the amount accumulated in the first year of damming. According to DOSNI/INECEL, between May 1993-1994, more than 19 million cubic ft. of sediments were deposited.

This phenomenon is easily detected if we observe how the initial segment of the lake in the zone of El Descanso now contains large sand-banks. Since the sediments are reducing the volume of water in the lake, the hydraulic time of retention is diminishing which is affecting the quality of the water.

Among the contaminants coming from indirect sources are solids and nutrients from superficial erosion. It is important to point out that due to the natural self-purification that takes place in the rivers themselves, only a fraction of the contaminant charge reaches the lake in its original form. This is why we choose to measure the concentration of certain contaminants in the rivers at the entrance of the lake.

Studies of the lake

Although the main reasons for eutrofization usually depend of external factors located in the tributary area, the characteristics of the lake may change significantly the impact of these factors. Different lakes, even with the same charge of nutrients, may respond in a different way. These differences depend of the internal cycle of the nutrients and the specific properties of the lacustral vase, as well as the morphology and hydro-dinamic of the lake.

In order to establish parameters, we first determined the weather conditions of the lake, performing a batimetric surveying of the dam vase. Then, we estimated the flow rates and retention times and, finally, we measured the variations that were present within these parameters with regard to the quality of the water.

Vase morphology

In order to determine the morphology of the vase of the lake, we performed a settlement of the perpendicular profiles in the direction of the flow.

At the end of 1994, the lake had a volume of 196,134,000 cubic ft. It is presumed that its volume is quickly diminishing due to the large amount of sediments that are being deposited into the lake. The approximate length is 11,152 ft. and the width ranges from 141 to 1,312 ft.

The long shape determines its hydraulic system, making the flow similar to a «piston» rather than a «complete mix.» This condition must be considered when modeling the hydraulics and the quality of the water, since this system impacts on the dispersion and distribution of the concentration of compounds present in the water.

The depth profile of the bottom of the lake presents a variation that goes from few feet at the head up to 66 ft. by the drainage point. This configuration allows good mixing conditions at the head, while a stratification of the water mass is produced at the drainage point.

Flow rates and retention time

Based upon the data related to water supply and volume, we determined that its retention time, which is estimation based on the average annual caudal, is only 1.9 days. Because it was such a low number, an estimation of monthly time of retention was performed.

Studies of thermal stratification

Regarding temperature, in order to determinate the behavior of the water mass of the lake, we evaluated the depth at three selected points: the entrance, the middle and the exit of the lake. This work was performed under different weather conditions, in the months of June, July, and September of 1994 and in January of 1995.

From the samples, we observed that at the entrance to the lake there is no thermal stratification and there is a good mixing of the water mass. At the middle points and at the exit, there is always a temperature gradient of up to 36°F/m, near the mirror of the water, and a slight thermal variation is produced on the surface and bottom of the lake. As a consequence, there is not a good mixing of the water mass, and there are a

variety of concentrations of other parameters related to the water quality at each depth.

Water quality parameters

On site measurements and water sampling were performed monthly during 1994. Each time, nine samples were taken from three points of the lake, located at the head, middle and exit. In each of the three points, three samples were taken: surface, half depth and near the bottom. Laboratory analyses were performed using a standard methodology (American Public Health Association, 1992). The parameters studied were temperature; muddiness; pH; dissolved oxygen; chemical and biochemical demands of oxygen; nitrogen; phosphorus; and fecal coliforms and solids.

The comments about the results are presented below, with special emphasis on those parameters associated with the criteria for water quality established by the «Rules for the Prevention and Control of Environmental Contamination Regarding Water Sources» (Official Registration N. 204, 1989).

Dissolved Oxygen and Biochemical Oxygen Demand

Dissolved oxygen is present in acceptable conditions, that is, above 4 mg/l at the entrance of the lake. However, at other points, oxygen concentration declines gradually as water mass depth increases, until it reaches unoxygenated conditions in the middle of the lake for the sample taken in September. This condition is considered normal due to the superficial re-aeration that is produced in all bodies of water that are in contact with the atmosphere and to the lack of the mixture of the water mass as a result of thermal stratification.

The maximum value of Biochemical Oxygen Demand was approximately 8.3 mg/l, in December's sample, which was taken at the entrance. There is an elimination of DBO5 along the lake, because it acts as a lake of aerobic stabilization.

Nitrogenous and Phosphorus

Regarding the different forms of nitrogen, the concentration of Kjeldahl nitrogen, ammonium, organic nitrates and nitrites, were deter-

mined. High concentration of nitrogen was found in every sample. Total nitrogen read over 0.20 mg/l.

Phosphorus concentration in general did not surpass the value of 1.5 mg/l.

Nitrogen and phosphorus did not come only from the discharge of the sewerage of the cities, but also from agricultural activities that used nitrogen and phosphorus fertilizers in the affluent shores.

Solids

The presence of floating solids is the first thing to be noticed about La Josefina Lake. This is a consequence of a deficient waste collection in the cities of Cuenca and Azogues. This severely damages the scenic beauty of the lake. There is a higher concentration of total solids in the entrance of the lake and due to the process of sedimentation, they are gradually reduced.

Coliforms

There is a very high concentration of fecal and total coliforms. Their values are well above the quality limits stated for human use and irrigation (Official Register N 204, 1989).

A phenomenon that deserves to be pointed out is the bacterium mortality that is found in the lake. The high concentrations of 3.5E+05 and 1.6E+05 (NMP/100ml), determined by fecal and total coliforms in the head of the lake, are significantly reduced to 1.7E+04 and 1.1E+04 (NMP/100ml) at the exit of the lake; this is because the lake acts as a water body of primary oxidation.

Oils and fats

A maximum value of 627 mg/l, registered in the month of April 1994, shows that traces of spilled hydrocarbons - a consequence of the landslide and the industrial activity that discharges its black waters in the effluents - are still in the lake.

Aquatic species

Teachers and students from the School of Biology from the Azuay University have paid four visits to the lake in order to take measurements

and samples for lab analysis. These visits took place in June, July and September of 1994 and in January of 1995 (Turcotte et al 1995).

From their report, we may conclude that zooplankton is almost non-existent in La Josefina Lake. In a study made in January 1995, two Oligochaeta were found, a smaller number than in the prior sample. The reason is that the caudal that flows through the lake is smaller and the turbulence is not strong enough to cause this bottom-living organism living to rise to the surface.

In the phitoplankton studies, a predominant alga family of Chroococcaceae was found in all the samples. A family of Diatomaceae was also found. During the entire study period, a variation in the numbers was observed, most probably caused by the instability of the recently formed system.

Of the groups of living creatures at the bottom of the center of the lake, there is a predominance of Oligochaeta over Chironomidae. On the shores of the middle of the lake, we found the bivalve Phylum Mollusca. At the head of the lake, we found mainly Chironomidae. The large Oligoqueta, Gastropoda, and Bivalved vertebrates are characteristic of organically contaminated ecosystems.

There were no amphibious creatures found on the shores of the river, due mainly to the characteristics of the terrain and to the accumulation of solid waste that has impeded the colonization of these areas by this type of animal.

A group of wild ducks spotted at the drainage of the lake was observed only once. It happened while a group of floating macrofits was also observed.

No fish were found. The small population of algae and the absence of zooplankton, which are the primary source of food for fish, make it impossible for fish to survive in this lake. The region's typical species, rainbow trout, is absent in this ecosystem due to the high concentration of solids and the chemical contamination of nitrites, phosphorus and ammonium.

Trophic status

The trophic status is one of the main factors to be considered in a lake in order to determine the quality of the water. We found models that allowed us to establish the trophic status of the dam, but most of them

had been developed for cool temperatures, so we could not use them in this case.

A model that might have been applicable was developed by the Panamerican Center of Sanitary and Environmental Engineering (CEPIS, 1990). This model was developed for tropical lakes. Those with a minimum water temperature of 50°F, in normal conditions, and a minimum annual average of 59°F are classified as tropical lakes. From this perspective, La Josefina Lake may be classified as a tropical warm lake. However, due to the low chlorophyll concentration (0.8-1.6 mg/m3), the short retention time that impedes the presence of phitoplankton, and the high concentration of suspended solids that blocks sun light, it was impossible to use any of the existing mathematical models developed to predict the future trophic status of the lake.

SUMMARY

A register of those that benefit from the water of the Paute River is not available. The sole information available indicated that prior to the formation of the dam, water was taken from two irrigation canals which begin approximately half mile downstream from La Josefina dam.

According with the water quality criteria, established for the different identified uses and for the range of values measured for every parameter in the sample extraction points, we may conclude the following:

- La Josefina Lake is a young, recently formed lake. As a consequence of the large amount of organic material in the lake, the decomposition process is presently affecting the quality of the water.
- The water coming from the dam into the Paute River is not adequate for human consumption, agricultural uses, or fishing because of high concentration of coliforms, both fecal and total and because of the presence of floating materials such as fats and oils. This is of such high concern that a rehabilitation plan for both mentioned irrigation canals is underway so that water for human use can be taken from these canals.

Trees and bushes cover only 16% of the land surrounding the lake and its tributaries; the rest is devoted to agriculture and fishing activities. This has resulted in large deposits of nutrients and contaminants into the lake, which is promoting the degradation of the lake water quality. The

sediments carried by the tributary rivers are settling in the lake, gradually reducing its volume, hydraulic retention time and affecting the quality of the water.

- The high concentration of nitrogen and phosphorus in the water may seem to suggest high productivity of the lake (algae proliferation); however, this is not true due to the short retention periods.
- The only way of minimizing the effects of the contaminants of the lake is through the management of the whole bed, including controlling discharges of domestic and industrial black waters from the tributaries.
- In order to take advantage of the desire of the inhabitants of the region to develop a tourist industry, the lake is initially going to be turned into a recreation area. However, the study of the waters showed that they are inadequate even for this purpose.

CONCLUSION

The lake exists. But, beyond confirming the concept that adequate management of the whole bed is the only solution for improving the present conditions, we want to emphasize that the lake has turned into a disaster due to the degradation of the Paute River. If the cities of Cuenca and Azogues, their surrounding urban areas, the industrial parks and neighboring towns had maintained minimum quality standards for the discharge of water into the rivers, the dam would not be the disaster it is. Rivers and lakes harmful for human use, with awful smells, covered by algae, that are being tapped for domestic use and, downstream, for consumption and irrigation are the consequences of the careless management of the water. The technical information presented here is justification enough to attack the cause of the problem: environmental degradation upstream.

NOTAS

[1] According to the Central Bank bulletins, the dollar exchange rate at the moment of the disaster was 2.000 sucres.

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