

Economic Aspects of Floods: The Case of Argentina

Héctor Sejenovich and Guillermo Cock Mendoza

Floods, Catastrophes, and the Relationship between Society and Nature

Floods are catastrophic events that take place repeatedly in many countries, among them Argentina. Ample literature reveals the concern of our society to study these events and their different categories.

Concept of Catastrophe

The concept of catastrophe is often used to mean an unexpected, significantly harmful event affecting society in general and individuals. In this sense floods are natural catastrophes affecting people and their property. However, whether these are truly “natural” events is open for discussion. In general, a certain level of flood impacts can be anticipated when natural ecosystems are modified due to human activity. For example, modifying ecosystem properties for human settlements and the production of goods may result in certain indirect negative impacts on the environment, causing the impacts of a regular/normal flooding cycle to be catastrophic to humans.

The modification of ecosystems for development is similar to manufacturing goods in that it may entail a use-waste process. Along with production of goods comes deterioration of all the elements, which generally is not factored in: deterioration of raw materials, inputs, machinery, workforce, natural conditions for production, and of energy itself, which goes from use-

ful to dissipated energy. The elements involved and their environment can withstand part of this deterioration. Another part exceeds the load capacity of those elements and generates changes in the ecological system. If these changes take place gradually, they become part of a deteriorating environment. If the changes are abrupt, they become catastrophes. In the end, both scenarios adversely affect people’s quality of life.

Natural systems have extended “memories.” That is, major variations are not independent of small variations but have a unique relationship. In the case of rivers it means that the major flow variations causing what we know as floods are not independent of medium and small variations, nor of the frequency of occurrences. The records of the Nile River endorse this assertion.¹ Thus, the area for which the Buenos Aires floods need to be discussed is much larger than the area of the city itself.

Thus, in the case of floods, for example, the water occupies the river basin and the floodplain that belongs to it, if we expand the forecasting horizon. In this regard the economic and social impacts generated by a flood do not constitute a catastrophic element but are a natural part of the cycle. The time of a flood’s occurrence as well as its impact can be foreseen—with a certain level of randomness. Taking into account the timeframe needed to build infrastructure, there is no doubt that in that particular period a recurrent flood can be predicted. Historical analysis show us that even

a certain degree of vulnerability can be appraised, as shown below.

Every productive action implies a certain measure of destruction. In the case of Buenos Aires, however, the construction of settlements and infrastructure did not take into account the deterioration of the environment resulting from production. Substantial infrastructure, which in some cases benefits from being located close to the river, was located on the floodplain without considering the river's fluctuating water levels. Neither were structural measures built to deal with the runoff.

Such settlement becomes catastrophic, and the deteriorative aspects become visible only later, when the infrastructure has generated enough economic and social interest that a change of site cannot be considered seriously. Instead, the focus becomes "controlling" the river. As we can see, the river has not been smart enough to change its behavior and accept the intrusive actions of people that reduced or eliminated its floodplain.

At the same time, the economic push toward maximum cost reduction uses nature, but does not pay its sustainability costs. The sustainable use of the basin implies certain tasks for which the market does not take responsibility.

The concepts outlined above indicate that a different assessment process of natural resources is required for a city to achieve integrated basin management and to guide land development based on its sustainability and restrictions. To be sustainable, production should be maximized in a way that minimizes deterioration. We should use the floodplain differently, with other technologies and possibly also for other purposes. In this way adequate production could be achieved while minimizing or eliminating the problems caused by flood periods. Floods would no longer have catastrophic consequences.

Cost Minimization vs. Integrated Use of the Basin

In Buenos Aires settlement of the floodplains focused exclusively on the physical space, disregarding the

floodplains' function as part of the ecosystem. Multiple alternative solutions could have been chosen when constructing large buildings and infrastructure. Multiple uses of the coast would have set the foundation for substantial improvement of the quality of life of the population in a city that, within three decades, lost its beaches and its coastal area.

In general, commercial sectors use the natural resources and the habitat, but do not ensure sustainability of the habitat. Agricultural activity degrades the soil, and erosion exhausts it. Forests are not restored. Rivers and their beds are used for production, but the watershed is not managed appropriately.

In recent years some industries have begun a different process, not yet prevalent, of taking a closer look at higher energy efficiency, recycling of waste, and an ecologically more friendly management of their facilities.

Floods and the Cost of Integrated Use

No restrictions were applied in the construction of housing settlements on the floodplains. Despite the studies that were carried out to improve the conditions of some rivers, the environmental degradation could not be stopped because the whole basin became more and more populated. The urbanization of the floodplain increased the runoff of the water and caused catastrophes.

In light of this situation, when discussing the economic issues related to floods, the emphasis essentially is placed on the damages they cause. The importance of the efforts made—especially by international organizations—to improve the calculation and to integrate all the variables, is undisputed.

To improve the role of the economy in the context of the environment and flood prevention, we have to analyze the management of natural resources and habitat. To do so, we need an integrated vision of the basin that determines the cost of its management and detects the potentials and restrictions of the basin area. In this way some activities can be relocated, and others can be promoted.

Floods, Disasters, and the Concept of Society and Nature

Scientific Links to Understand Complex Systems

Most flood-related literature analyzes floods as natural disasters. In contrast the social sciences consider floods as a social category. Neither concept is broad enough to encompass the vast complexity of the issue. Floods are actually a link between society and nature, in the same way that natural resources and environmental problems are.

It is important to understand the interactions between social activities and nature. Investment planning is done on a short-term basis and defines the production scope. To put this into perspective, let us analyze the difference between the implicit schedules of ancient and contemporary societies concerning their task organization. The Nile floods, for instance, were not actually seen as dangerous events; instead, society was organized to anticipate their occurrence, aware of their positive aspects. The modern-day perception of floods as catastrophic events is undoubtedly related to the enormous push of economic development, which, as is well known, has a productive and a destructive aspect at the same time. Lester Brown points out that human output from the 1950s to the 1990s was roughly equivalent to what humankind produced from the beginning of time until 1950.

Consideration of Production and Destruction in Water Basin Use

Every economically productive action implies, in a different sense, a certain measure of destruction. The extent of the destruction may disturb the homeostatic capacity of the natural systems.

Use of space and water as raw materials for production. To use the self-cleansing capacity of a river or water stream and its tributaries implies contaminating the course to a certain extent and partly destroying the natural habitat. The extent of ecosystem deterioration will depend on the level of pollutants and the capacity of the river to cleanse itself. The same

process occurs with respect to fishing, depending on the technique used, or to navigation, depending on its intensity. Negative impacts either can be absorbed by the homeostatic capacity of the natural system or a change will occur in the system. When it can be absorbed, it can be called sustainable production.

Development and infrastructure construction (housing, industrial, and urban services). Either directly or indirectly, development of human habitat and infrastructure for living and production implies concurrent construction and destruction of the ecosystem. In most cases building human settlements does not integrate concerns for environmental degradation.

Frequently, infrastructure is sited in Buenos Aires without taking into account the river's flood area or flood recurrence. Occupation of this land "reclaimed" from the river leads to negative consequences. However, this need not be the case, as there are many examples of appropriate development of urban river courses. In those cases floods are expected from the river. There is also a rich experience with river destruction and construction and subsequent reviving of marine life, as in the case of the Thames and the Ruhr.

A common mistake is the assumption of productive criteria without analyzing their destructive aspects. For example, calculation of the gross national product (GNP) adds all production activities, without deducting the destruction they cause, a systemic miscalculation.² Flood damage reveals the deterioration caused by previous production of infrastructure and other human settlements.

When calculating agricultural production, land production is generally exposed in terms of tons of output per hectare without considering soil loss by erosion, nutrient balance (extraction/replacement), and/or water use indicators.

The oversimplification of considering production without taking into account the destruction and floods it causes prevents the evaluation of the appropriate and necessary changes to minimize the consequences. It also affects any cost-benefit analysis. Conservation of nature is not considered in the costs. The possibility of establishing the benefit of sustainable natural resource management is not considered. In a way

the establishment of insurance policies to at least plan the occurrence of these catastrophes is solving the problem.

Integrated Use and Wasteful Use of Natural Resources

Natural resources can be used either comprehensively or only to a limited extent. In general, the use of resources is limited, resulting in immense waste of trees, fish, fruits, harvests, and energy.

The river as a developed space also reveals large waste of potential uses. This waste is not only obvious when considering all the uses that could be possible in an agricultural area. Neither does the way the river is developed in the city take into account its many possible uses for recreation, landscape, transportation, and entertainment.

The River, Floods, and Quality of Life

Natural resources are used to improve the quality of human life. But quality of life cannot be defined without the active involvement of the population in solving its environmental problems. Quality of life is an historical and ever-changing concept embedded in the culture and in the specific goals of each social group. Summarized development indicators do not incorporate the effects of development on the social structure. Currently, human development indicators have begun a positive foray on a path awaiting deeper inroads.³

The comprehensive management of the river is embedded in popular culture. In Buenos Aires progressive development and effacing of the river is taking away all the positive aspects the river held in the social imagery. The river, especially the de la Plata River, had a coastline that allowed recreational uses for the whole population. Its beaches were popular spots for holidays and year-round recreational activities, especially for the poor. Recreational activities also took place in the rivers and streams of the basin of the city of Buenos Aires. These opportunities contributed to

quality of life. Currently, lands reclaimed from the river, even when they are part of the social endowment, are not available for popular use except to very high-income sectors. In comparison, the concept of flood is related to fear of loss: loss of workdays, of housing and furniture, or settlement instability.

Alternatives for an Ecological, Economic, and Social Concept of Floods

Social occupation of land is geared towards short-term productivity that, in the case of river and flooding areas, leads to deterioration and waste. This focus generates negative externalities that affect nature and quality of life, and it constitutes a core cause of environmental problems. In view of these problems the population has a certain perception that generates different reactions; thus, social and environmental movements are organized. Theoretical movements are constituted to interpret these new phenomena. The State usually intervenes, establishing various policies to influence the process.

Environmental policies mainly use incentives or restrictions to improve the management of natural resources. They make possible a better accommodation of the price structure based on sustainable development. The implementation of environmental regulations should operate in the same manner to guide land occupation. It is essential to generate and disseminate environmental awareness. What are required are work in the fields of formal and nonformal education, and the involvement of all social actors to come up with appropriate alternatives within the framework of sustainable development. With these policies, it is possible to generate change to maximize the sustainable use and productivity of natural resources, and minimize degradation, waste, and misuse.

To this end it is necessary that the economy adopt a more committed plan of action. Assessing the damages and the economic and social effects of economic production is very important. By assessing not only the damages caused directly but also the overall systemic impact of damage on the economy and society,

we can assess the real impact of these floods and consider the benefits of preventing them.

However, the necessary calculations should be supplemented with the comprehensive assessment of natural resources, providing a more comprehensive framework in which economics interacts with ecological and social issues to constitute a model of interaction enabling joint intervention in the management of a city's metabolism. The city constitutes a technical structure that interacts with the agricultural ecosystem and the broader natural ecosystem of which it is a part. Understanding their interactions can lead to a wide range of actions designed to handle more appropriately the physical, biotic, infrastructural, economic, social, and political factors in a city.

Patrimonial Accounts

The economic sectors in Buenos Aires use nature, but do not consider within their costs the costs to conserve nature. This is consistent with the traditional belief of the economic schools (partially changing) that assumed that nature was infinite and would reproduce itself.

We now realize that this is not so. Natural resources are finite. The capacity to absorb greenhouse gases has been largely exceeded, creating the basis for climate change. The economic sectors draw down resources and natural habitat, but do not develop activities to replenish these resources. Degradation and waste are severe. By this time reclamation of nature has become a necessity to set up a new economic sector. The objective is to create an *ecological systemic supply* to be used as sustainable raw material by the economic sectors.

To achieve this, a series of tasks need to be accomplished:

- Research natural resources and analyze their dynamics
- Research *ecological systemic relations of natural resources*
- Perform market studies to ensure product use
- Set up controls and participation of the population
- Develop activities that foster reclamation.

Expenditures on these tasks and their costs could constitute the preprimary sector aimed at the generation of such ecological systemic supply. This systemic supply would be made up of the following elements:

- Annual flow of renewable natural resources, consistent with both their quantitative and qualitative conservation
- Load capacity of water, soil, and air to absorb gaseous, solid, and liquid effluents
- Annual usage of nonrenewable resources in a proportion that can be replaced by establishing renewable resources
- Natural conditions for the placement of habitat for the population and productive activities.

How are sustainability costs calculated to achieve the development of ecological systemic supply? Through the following:

- Identification of reasonably homogeneous units (a forest, grasslands, a river) working as *natural mills*. These mills are designed to produce many products but carry a production cost. This production cost is the management cost. Considering all the natural resources that can be used, the comprehensive management cost is taken into account. The Input Product Matrix can be used as a methodological instrument, renamed by us as the Natural Resources Intersectoral Relations Matrix. For each resource the total cost of management is divided by the ecological systemic production expressed in the measurement unit corresponding to the type of resource. This will yield the unit management cost. On the basis of this unit cost and knowledge of the total physical inventory of each resource, we multiply by the unit cost to obtain the value of natural resources supplies measured against sustainability cost.

From there, we apply the patrimonial accounts scheme. As does any account, it has debits and credits. We quantify the value of the supplies of a single resource and of the overall resources on the debit side. We record all the increases leading to an increase of the initial wealth during one year. On the debit side we record all losses. The main increases refer to the growth of trees and plants. The main item in the debit side is the withdrawal. Applying the sustainable de-

velopment principles, the same rate of growth should be drawn. In that case the natural capital would be maintained. It would be as if an amount of money were deposited in the bank earning interest, and only the interest earnings were withdrawn. On the basis of the knowledge of how the ecological area operates, it is possible to draw alternative scenarios to evaluate the ecological, economic, and social impacts of different management alternatives. For that evaluation we require the use of *Regional Basins*.

- The economic regional accounts allow recording the evolution of the different productive sectors and also inferring the social impacts that eventually will be generated in light of the different natural resource management alternatives. Very frequently, to achieve the maximal benefit in the short term, a greater proportion than the capacity of regeneration is used, or industries exceed the load capacity of water, soil, and air, generating degrading processes. These approaches result in higher profits in the short term, but reduce the natural capital, jeopardizing future income. The sustainable management of natural resources makes it possible, in many cases even in the short term, for sustainable management to compete with squandering management.

Ecozones of the City

Ecological areas are reasonably homogeneous areas that can be seen as natural factories. Their operation requires quantitative and qualitative sustainability. The goal of these factories is to generate maximum sustainable supply. A city's goal is to operate the natural and infrastructural elements to provide an adequate quality of life for the population and adequate conditions for the productive activities.

Which is the ecological area of the city? What is its relationship with the area of its administrative jurisdiction? To analyze the city, we should ideally regard it as an area in which significant processes are trying to make the city ecologically sustainable. However, strict observance of this principle would cause many problems due to the spatial ambiguity and heterogeneity it encompasses. Productive activities of human

settlements in a city create multiple strong flows that often spill over into urban sprawl. In this regard the basins and sub-basins on which the urban sprawl has an impact should be reviewed frequently. Naturally, this decision depends on the type of natural space and the ecological system in question. But, in principle, the basin scheme can serve for the analysis of the city territory.

In special cases the first discriminatory criterion should be taken into account, since the main objective should be to focus on all major city processes. For example, if there were a factory outside the basin whose discharges reach the city and definitely pollute the watercourse, this facility should be taken into account. But in other cases, the difficulties of analysis and of action are much greater. For instance, emission of gases generated by a city, especially cities in which heavy industrial activity is concentrated, may necessitate the study of very broad territories. A similar broad study would be required to consider the place where the raw materials required by the city's industries are generated. These flows are of great interest, but specific studies should be undertaken in this regard.

Ecozones of the Autonomous City of Buenos Aires

An ecological "study area" to analyze, describe, and design actions and policies aimed at overcoming environmental degradation, particularly floods, brings to the fore once again the traditional issues between the land area of the water basins and the area covering the political and administrative jurisdiction. Studies of floods in the City of Buenos Aires seldom incorporate the city's tributary water basins. Thus, the analytical model excludes key aspects both in considering the problems and in their solution.

Similarly, problems are described in the environmental analysis of the city without systemic consideration of the existing ecological relations in the overall territory in which the city's significant problems are expressed. To understand all the phenomena, especially floods, the scope of such studies should include the entire ecological area.

The Autonomous City of Buenos Aires plus the 19 municipalities of the Buenos Aires Province form a functional unit known as the Buenos Aires Metropolitan Area (BAMA), to which 6 additional municipalities of the same province also contribute. The indiscriminate occupation of land and the changes of the runoff guidelines for the water basins and rainwater absorption have contributed to the growing problems. To analyze environmental problems in general, and flooding issues in particular, we need to include the land covered by the above units.

Water Basin Ecozone in the City of Buenos Aires

Characteristics. This area consists of the basins of the Matanza-Riachuelo Rivers, the Reconquista River basin, and the basins located in the City of Buenos Aires. According to the 1991 Census, the area comprises 4,110 km², and a population of 9,050,000. These are flat-land rivers with little gradient and are highly polluted due to the discharge of industrial effluents and wastewater, mainly untreated, in the upper part of the ecological area.

Overall ecological area output and flood-related output. The main output of this ecological area is to guarantee a habitat adequate for human life and for production. Given the characteristics of this work, the emphasis is placed on the floods caused by tributary rivers of the de la Plata River along the coastline of the City of Buenos Aires.

To reaffirm the comprehensive consideration of the phenomena occurring in all the major city areas and its tributary basins, it should be stressed that the simple study of water flows may show the need for a joint analysis of the basins as essential to include both the current operation as well as the proposals for change. It should also be recalled that in recent years, although with major difficulties, the systemic relations of other features of the city and its surroundings have been strengthened. Generally, the city is taking into account environmental issues, but as separate aspects. Global studies have yet to be consolidated.

The treatment of the interactions requires two correlated procedures: to delve further into aspects and specific functions taking place in certain sections of

the analyzed ecological area, and to maintain the interrelationships held by each of these areas. This requires constructing three subecological areas and indicating the differential outputs and externalities that each one grants or receives from others.

Floods and Environmental Problems of the Autonomous City of Buenos Aires

Floods in the City of Buenos Aires and its environmental problems have long been debated. However, economic evaluation and analysis of the interrelationships throughout the city have been very limited. We would like to stress the fact that "in the indiscriminate occupation of land and the changes of the runoff guidelines in the water basins and rainwater absorption," the rainfall, geomorphology, hydrology, and topography (with above sea level ranging from 4 to 24 meters) were not taken into account. This is a fact that "has given way to growing flood-generated problems," affecting extensive areas of the city. These problems are "aggravated by the pollution of waters originating from the Greater Buenos Aires municipalities" (due to the run-off of agricultural chemicals used in agricultural activities and to fluid effluents discharged by industrial plants) "and by the degradation of the coastlines and of de la Plata River waters, whose negative comprehensive impacts have not yet been studied."⁴

It should be noted that the areas recording greater frequency of floods, generally are very poor.

Albini and Costa (1988) developed an economic and social evaluation of great importance. They point out the unfavorable conditions created by the location of the city with respect to the surface runoff toward the de la Plata River. This runoff should have been subject to mitigation through an adequate drainage system. The current system was originated during the construction of the "450 km network constructed in the period 1925-1939," encompassing the city and part of the compound that operates as a tributary. The network was "planned under the assumption of an open structure city," with a significant density of permeable green spaces that would enable the infiltra-

tion of part of the rainfall. Since the inauguration of those works, the system has not been enlarged, despite the fact that since 1939 the population almost quadrupled from little more than 3 million to almost 11 million people.

The paving of natural drainage areas in the Municipalities constituting the Greater Buenos Aires also increased the frequency and the level of floods. The city became an impermeable unit with negligible or no capacity for infiltration of water, which concentrates in the lower and flood-prone areas. The "coastal landfills in the de la Plata River caused the disappearance of the reinforced coast, affecting the runoff of the emitting channels of the drainage network," which now end in trenches of nonconsolidated banks.

Federovisky (1985) states that

the degree of urbanization in the tributary areas of the city streams led to an important increase in the volumes to be drained during periods of major rainfalls, for which the original infrastructure was not ready. The cleaning and maintenance system of 27, 000 storm drains and an 8 km duct was privatized. State control on the companies' efficiency is very weak....

due to short supply of staff at the City Water Authority.

Hilda Herzer and Raquel Gurevich (1996) raised a series of questions that we consider appropriate for the purpose of the evaluation:

- What is urban environmental deterioration?
- What scale is required to analyze urban deterioration processes?
- Is the urban area enough as a unit of analysis?
- Is it necessary to incorporate the region affected by environmental degradation?
- How is disaster related to urban environmental deterioration?
- What social stakeholders are involved in the deterioration and disaster processes?
- How are relationships between urban environment and disaster in central and suburban areas of a city revealed?

In reflecting on the floods occurring in the Buenos Aires Metropolitan Area, those authors identify as triggers "the rains associated with the inadequate sanitary and sewerage infrastructure," and the expanding area waterproofed by paving and development. The shantytowns of Greater Buenos Aires yielded results of major importance for their work. These shantytowns have the lowest indexes of health and schooling, thus verifying the highly significant relation between urban poverty and vulnerability to disasters.

Albini and Costa (1988) analyze the problem of "floods in the Buenos Aires Metropolitan Area, assuming that it covers an area of some 7,000 km²." Until the second half of the 1980s a fourth of the area was occupied by the urban network. The technical, social, and urban approaches to these problems focused on reviewing the negative impacts caused by 308 mm (one foot) of rainfall that fell in just 25 hours between May 31 and June 1, 1985. That rain necessitated the evacuation of approximately 100,000 people, damaged 2,500 dwellings and 14,000 automobiles, and affected the supply of drinking water, electric energy, and other services, in addition to a tragic number of victims and of large losses caused to public and private companies. "Since 1939 the drainage network remained practically without change," Albini and Costa say. But the change of land uses (increased construction of dwellings, paving, establishment of industries), both in the city and of the tributary basin areas of the Buenos Aires Province have continued without interruption until today.

Federovisky and Albini and Costa emphasize that "the industrial and derived wastes discharged in the drains entailed disasters that caused water degradation and the elimination of plant and animal life."

The 1985 flood gave rise to the spontaneous organization of victims in Flood Victim Boards, or their active involvement in existing Neighborhood Councils and Development Societies. Numerous public meetings led to a protest march to the Government House, the National Congress, and the Buenos Aires Province Office. There the marchers submitted proposals for a final solution to river floods and rejected the palliative measures provided by the Government.

During the last two decades “a large number of stations were deactivated, instead of being modernized and incorporated to a systematic registry network.” These stations were responsible for the updated maintenance “of rainfall information.” This, however, does not justify the delay in the implementation of measures aimed at overcoming flood-related problems.

In the Greater Buenos Aires Area rainwater is discharged into the de la Plata River and in the Matanza, Riachuelo, and Reconquista Rivers. Given their water profiles, we can conclude that during flooding, they act as water lids to the discharge of network waters, the opposing masses of water that hinder the release of rainwater. Storm drains were extended through trenches and bays lacking consolidated banks, of limited depth, and insufficiently dredged.

On the other hand, the lack of maintenance of storm drains, which should be carried out by the city garbage collection concessionary companies, contributes to a “significant reduction of the absorption capacity and evacuation of the drainage network.” This is apparent upon observation of the patterns of the storm drains in the vicinity of major commercial centers. There is a high generation of garbage and no environmental education of the population (both from the operators of commercial booths and customers).

Gabriel Dupuy points out (1984) that “all the economic and social events of the city are absent in the dimensioning calculations” applicable to a network and to the overall urban infrastructure. He adds that “the economic dimension implies relating the cost of installing or expanding a network, with the social cost of not building it.”

Albini and Costa analyze the urban sprawl or area affected by the floods that occurred in 1967 and 1985 in the City of Buenos Aires. They point out that around 30 percent of the affected population are living marginally and concentrated in the topographically low areas. The authors assert that “there are no natural disasters, but social situations of high vulnerability” and that the floods of 1985 in the municipalities surrounding the city can be classified as “poverty floods.”

Albini and Costa conclude that water degradation results from the following:

- Industries discharge untreated effluents into rivers, streams, and drainage network.
- Shantytowns built on the flood-prone banks pollute the water sewage.
- Infrastructure to prevent floods does not exist.
- Installation of sewage ducts and drinking water supply in various municipalities of Greater Buenos Aires is deficient.
- Infrastructure, for example, massive highways, has expanded flood-prone areas.

The authors point out possible solutions:

- “Channeling all the river courses that directly or indirectly drain their waters in the de la Plata River.”
- “Developing a massive and intense environmental education campaign” aimed at minimizing solid and liquid waste in river courses; “supplementing that education with effective and efficient policies concerning the control” to avoid the degradation of water in those river courses.

It is noteworthy that Law No. 2,797 was passed in September 1891, through which industrial plants were forbidden to discharge untreated hazardous waste, but a jurisdictional dispute between the Municipality of the City of Buenos Aires and the National Executive Branch rendered it ineffective to remedy the problem.

- Develop “environmental land regulation,” that would relocate the dwellings in flood-prone or degradable areas, as well as reforest or enhance green areas.
- “Construct the necessary infrastructure to overcome the problems related to wastewater disposal, drinking water supply, sewerage pipes, and cost consolidation.”

Finally, Albini and Costa develop an economic evaluation of the damages generated by the flood of 1985 on the basis of the expenditures made to pay for the damages.

Conclusions and Recommendations

- The economic aspects of floods are of fundamental importance. When considering them, it is necessary to incorporate the damages generated within a comprehensive framework such as evaluating ways

to manage the city to reduce flood damage. From the analysis of the studies, it could be stated that the city and its surroundings could function as a “natural factory” that ensures sustainable natural and infrastructure conditions and social relations to generate a habitat appropriate to human life and to production.

- The literature reviewed suggests that to date few economic evaluations have been made in Argentina.
- The economic analyses that have been carried out are partial and excessively focused on the evaluation of damages. Actions taken to remedy the damage clearly are palliatives that do not attack the causes of the problem.
- We propose an economic evaluation that is closely integrated with an ecological and social analysis to demonstrate more clearly the interdependence of productive activities with one another and with the created bases.
- Evaluation of damages and permanent remedies can be achieved only when we consider the city not as a separate compartment but as an indivisible part of an ecological area. Comprehensive management of the ecological area is indispensable for a permanent solution.
- A more permanent solution to reduce floods requires that the City Government regulate new developments on the de la Plata River; that the current concessionaires carry out the necessary investments for the construction of works to consolidate the coast; and that adequate duct drainage, whose functions have been deteriorated by river development, will be reestablished.
- The riverbank should be structured as a recreation area with unrestricted access.
- The works underway to minimize flood damages should be part of an environmental management plan of the territory.
- The prior statement requires planning and actions agreed on by the political-administrative jurisdictions.
- The involvement of social sectors should not be considered as an additional requirement, but these sec-

tors should be involved from the beginning. Grassroots organization should be encouraged to carry out activities aimed at reducing environmental damages. National universities, research centers, and nongovernmental organizations, with the authorities of the city and the province and the social organizations, should form a partnership that enables real consensus in changing the environmental conditions of the population. Within this organization, the development of flood contingency plans should be proposed.

Notes

1. J. Hurst, an English geophysicist, studied the water level variations of the Nile and found this unique time pattern that served as a basis for the development of the illustration of 1/f systems in nature.
2. The gross national product is a macroeconomic measure resulting from the sum of all the productive activities of a country in one year. In the text, when we refer to the methodology assumed to compute GNP, we refer to the “core” of the accounts. The new version of the National Accounts methodology includes an environmental “satellite account.”
3. This area is formed by the continental surface that is part of the Greater Buenos Aires Metropolitan Area and by surfaces of islands and the water of the de la Plata River. The Greater Buenos Aires Metropolitan Area is made up of the city of Buenos Aires and 19 municipalities, comprising a total land area of 3,680 km², in addition to 6 other municipalities that have a portion of their areas in the metropolitan area.
4. Studies carried out in 1997 by Aguas Argentinas, OSBA, Instituto de Limnología R. Ringuelet, and Servicio de Hidrografía Naval determined that the water quality of the southern coastal strip of the river is standard and that the quality is not appropriate for direct contact up to 500 meters from the coastline.

References

Editors' note: Full data not available by print date.