# INTEGRATED FLOOD MANAGEMENT: IS THE NEXT STEP POSSIBLE?

BY CARLOS U. PAOLI

Latin America's financial losses due to flooding increase constantly. While the high frequency of extreme events gives a glimpse in the risk increase, it is the understanding of the increase in vulnerability which is most important. Integrated Flood Management is presented as a new vision in the effort to confront this challenge, but it also involves a series of difficulties, restrictions, and conditions for its efficient implementation. Different obstacles must be removed in order to advance towards implementation.

**Integrated Flood Management: a better vision to mitigate damages caused by flooding**

Floods account for approximately one third of the financial loss and one half of the loss of life caused by global natural disasters. Damages due to flooding have been extremely severe in recent decades and it is evident that their intensity and frequency are increasing. Economic losses have accounted for more than 250 billion US Dollars over the last ten years. Despite efforts to reduce losses, studies show that the extent of flooded areas is increasing with time and the magnitude of the associated financial losses increases similarly.
Integrated Flood Management (IFM) is "a process that promotes an integrated approach, not fragmented, in terms of flood management. It integrates the development of land and water resources of a river basin in the Integrated Water Resources Management (IWRM) context. Its objective is to maximize the net benefits of the floodplains and to reduce to a minimum the number of fatalities caused by floods" WMO (2004).

Creating an integrated flood management plan requires the following essential elements to be taken into consideration:

***Adoption of the Basin as a Planning Unit (Water Cycle Management as a whole, and Integrated Land Water Management):*** land and water management; local measures and at the basin level; top-down and bottom -up decision making; functional integration of institutions; and cross-border management.

***Adoption of an optimal combination of strategies:*** Adequate combination of non-structural works and measures, taking into consideration the technical, economic, social, environmental and legal dimensions.

***Guarantee of a participative approach:*** Ensure the implementation of integral flood management planning with full public support. Ensure the sustainability of associated planning and decisions. Build a consensus and public support for the management of selected floods. Build a commitment with those involved.

***Integrated Risk Management:*** Preparedness; response; recovery.

**Difficulties faced for the efficient implementation of the IFM policy**

There is a growing scientific, technical and political bibliography regarding this issue. We pose the question "Why is it so difficult to go one step further and move from theory to implementation when the theory and basic concepts are apparently widely known and accepted?"

**Serious difficulties to prevent or limit the improper occupation of flooding zones**

When valleys are frequently covered by flood water, public awareness is high that those valleys are flood zones and that occupation for permanent activities is not appropriate. However, when flooding is less frequent, public awareness of flooding is lessened, or is simply ignored, and land occupation and residential development in floodplains takes place, (Paoli, 2015).

As a consequence, large numbers of people (not only in big cities) live very close to rivers and streams and - as a result of urban development - the invasion of flooding valleys increases. Lack of studies for the delineation of risk areas, the absence of regulations in land use, and many times the irresponsibility of urban developers and municipal governments results in the occupation of flood-prone areas. Unfailingly, these zones are bound to be impacted by extraordinary floods.

**Misunderstanding of the functionality of defence projects and level of security**

Traditional solutions are part of the development of the defence against different types of floods that represent various problems. The defence mechanisms create an exaggerated sense of

Figure 1. Flooding areas around/environs Santa Fe city during year 2003

safety. Human settlements in protected zones increase and, therefore, damages are greater when the safety net fails. Maintenance and conservation of the projects is not properly implemented (highly expensive), which results in erosion problems and weaker protection. In the majority of these zones, the challenge of transporting, discharging and pumping of flood-waters has not been properly resolved.

All projects for control and protection against flooding are designed and built to withstand flooding of a certain magnitude associated with a probability of occurrence. No project can control or protect against the greatest possible flooding and, as a consequence, there is no zone absolutely safe or flood zone that "will never be flooded again". Pretending that some projects are designed to eliminate the flood risk in these zones does not make economic sense. The higher or lower level of acceptable safety depends on the expected consequences - in case the flood defence is exceeded - assumed by the project. Unfortunately, this issue is not properly understood by the public or, often-times, by the authorities. The result is pressure that constantly increases for more and better projects.

A well-developed project must have a sufficient margin of safety in order to avoid unforeseen situations. Unfortunately, many projects are neither well studied, nor well dimensioned and, therefore, their degree of vulnerability varies. In the majority of the cases, catastrophic impact assessments have not been performed for the scenario that the defence works are overtopped or destroyed. Often, the operational plan for the projects' system includes permanent monitoring. Maintenance of main and comple-mentary works and structures and an action plan for emergency situations is often non-existent and not in place.
The higher frequency of extreme flooding and exceptionally heavy rains are certainly concrete drivers in the increase of flooding. But, these factors in no way can be thought of as unpre-dictable.

### Resistance to the implementation of non- structural measures and the regulation of land use

Relocation, although difficult to implement, is in some cases the only option available and consists of relocating the activities developed in a high risk area and its occupants to a low risk area. Frequently, this option is rejected and opposed by the occupants to be relocated due to the fear of losing comparative advantages in the new location, or due to the cost they would incur directly or indirectly. Nevertheless, this measure must be considered along with the regulation of floodplain use.

The use of land regulations in urban zones refers to a series of actions whose objective is to guide the occupation of spaces in zones not yet urbanized, or re-orient those in the process of occupying floodplains. The following specific actions are mentioned in this context:

- The implementation of public policies that do not favour, or limit public services and infras-tructure development in floodplain zones such as: paving, energy supply, drinking water and sanitation, educational and health services, etc. The tendency of authorities seems to be in the opposite direction given that as land occupants' complaints arise, services are provided and settlements take place.
- The display of warning signs that identify flood prone areas and markings showing the historical range of floodplains. This measure is resisted by real estate interests.
- The utilization of differential real estate tax rates, very low for non-urbanized zones and very high for urbanized zones in floodplain areas. Urban planners and the Income Tax Office show resistance to this type of measures.
- The acquisition of land for parks, camping and other outdoor places. This action requires significant funds for acquisition and maintenance.

### Non integration of alert and prevention systems

An Alert and Prevention System takes into account not only the prediction of river flows and expected levels, but also the availability of Contingency Plans in case a flood occurs. Actions range from identifying the first signal of conditions that would produce an overflow and cause flooding to going through the warning of predicted levels and evacuation. Actions would also cover the location and maintenance of flood defences and the maintenance actions and repairs for emergency works, known as fight against flooding.

In order to provide effective Contingency Plans many issues of vital importance must be addressed the most relevant of which are:

- Developing and implementing the legal framework that establishes responsibilities, roles and institutional relationships of municipal, provincial and national organisa-tions, directly and indirectly related to the issue of flooding.
- Developing an adequate delimitation of risk areas and a current inventory of the flood-plains allowing the forecast of overflowing water levels and critical zoning in relation to such forecast.
- Developing emergency plans and evacuation with the participation of the affected people as the only way to ensure their effectiveness.

***Carlos Ubaldo Paoli*** **is Director of the Coastal Regional Center at the National Water Institute (INA) in Argentina. He is Faculty Professor for Graduates and Post-Doctorates in Hydrology and Faculty of Engineering and Water Science at the Universidad Nacional del Litoral. Dr. Paoli has participated and directed many projects and research focused on Planning and Management of Water Resources and Hydraulic Engineering. Since 2008, he participates as an instructor for Integrated Flood Management according to the APFM formats and sponsored by WMO. Recently, the European Commission has published a guide and a case study regarding Integrated Flood Management, which he authored.**

### Lack of knowledge and distrust in other adaptation measures

The concept of these measures is to modify the structures in risk areas, their surroundings or their layout in order to minimize water damage. Also, the purpose of daptation measures is to allow the continuation of normal activities in the area with the least possible disruption during flooding and to allow a quick recovery. Among other concrete actions that could be mentioned are the following:

- Raising the level of buildings by raising the ground elevation or by using construction on pillars.
- Waterproofing of retaining walls.
- Enclosing low-lying doors and windows with protective masonry.
- Placing critical elements of structures, such as lighting, gas, other facilities, etc., well over the foreseen flooding level.
- Construction with a floating capability in the flood zone.

These measures require professional planning and must not be improvised, as improper use

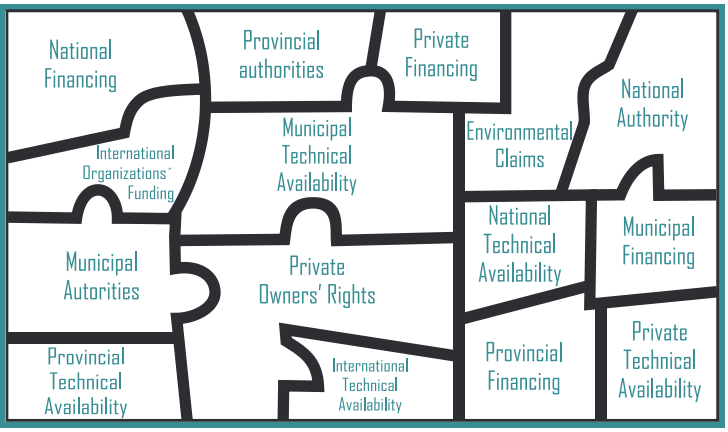


Figure 2. Solving the "puzzle" challenge to coordinate interests, responsibilities and resources at inter-jurisdictional, inter-sectorial, inter-functional levels

could cause more severe damage, or affect other neighbouring occupants. These measures are only recommended for the flooding areas with low currents, outside the flood evacuation channel.

### Lack of Inter-jurisdictional, Institutional and Sectorial co-ordination

Several major issues are at play relative to the compatibility of all territorial interests at stake. For instance, questions like how are the responsibilities shared for flood zone planning? Who is responsible for decision making? How is funding sourced and distributed? As shown next, solving the current problems of flooding could be compared to the process of solving a puzzle.

## THE CASE OF SANTA FE, ARGENTINA

Santa Fe has a population of 500,000 people and is located in the central zone of Argentina at the confluence of two important river systems. Santa Fe is on the right margin of the Parana River (mean flow of 17,000 $m^3/s$ and a maximum overflow of 62,000$m^3/s$) and on the left margin of the Salado River (mean flow of 180 $m^3/s$ and a maximum overflow of 4,000 $m^3/s$). In 1983, 1992 and 1998 the River Parana overflowed. The Salado River experienced heavy rainfall in 2003 and in 2007. The floods had catastrophic consequences in all cases: fatalities, massive evacuations and huge economic losses, with a strong social and psychological impact.

The main causes for the catastrophic effect of the floods were: deficiencies and limitations of existing works, lack of knowledge and foresight, and climate change as an important contributing factor. Furthermore, the vulnerability of Santa Fe increases because of critical risk factors, such as the absence of an alert system and the lack of a contingency plan.

After the experience of these critical situations, a paradigm change occurred and a movement towards Integrated Flood Management started. With its ups and downs, the performance and response to other situations presented subsequently have improved significantly. In summary, the most important non-structural actions put in place during the implementation of the Integrated Flood Management process are:

### *The response of academia*

For the first time a group was formed by the region's universities and organisations of Science and Technology named Programa de Cooperación Interinstitucional Frente a la Emergencia (PROCIFE), (Inter-institutional Collaborative Program in Response to the Emergency). As a starting point, diverse assessments were made in the aftermath of the floods. Conferences and seminars referencing the subject matter with wide participation from the science and technology communities were organized and action plans were developed. The discussion allowed the elaboration of a common agenda establishing and prioritizing the research and development needed, which allowed more efficient use and management of available funding.

### *Change in management structure and government agenda*

A Ministerio de Asuntos Hídricos (MAH) (Ministry of Water Affairs) has been created at the provincial level. Currently, the Ministry of Infrastructure is where the Secretaría de Recursos Hídricos (Water Resources Agency) is located. At the municipal level, a Dirección de Gestión de Riesgos (Risk Management Agency) has been formed as an independent entity from the office of the mayor. Creating these new organizations was an essential action that brought attention to the issue and facilitated its treatment as the main cross-cutting issue involving agencies from multiple levels of local government.

### *Implementation of a real-time hydrologic alert system*

Rio Salado's Red Alert Flood was implemented and is currently functional using 14 pluviographic/meteorologic stations and 14 hydrometric stations.

### *Land use regulation for riverbanks and bodies of water*

Law 11.730 is in place to zone and regulate the occupancy of valleys flooded by rivers and streams in the region.

Figure 3. Location of Santa Fe city

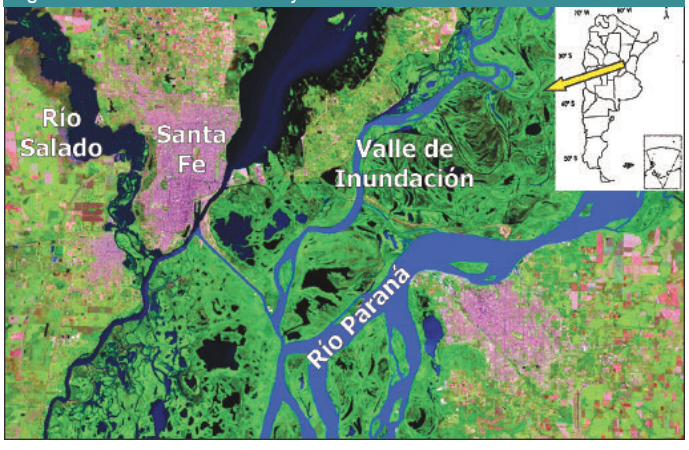



Figure 4. Preparation of contingency plans with communities' participation.

***Stormwater surplus regulation system in urban zones***

Regulatory mechanisms for buildings and streets as well as municipal laws were introduced to regulate the development of impermeable surfaces due to urbanization and mandate the retention of flood surplus waters.

***Availability of an appropriate legal and institutional framework and a contingency plan elaborated with community's participation***

A risk management municipal system was created and the development of a **Contingency Plan** was one of its first actions. Each district's vulnerability conditions were widely discussed as well as the potential damages that could be caused by different types of events. Strategies were implemented for, among other things, evacuation routes and meeting places during critical situations and methods to solve different types of conflict (Aguirre Madariaga et al, 2014).

***Risk management, education and communication***

A **risk communication program** was created in which sixty organizations from forty-five neighborhoods in the city participated. The program offers training seminars for teachers and community designated agents, and develops educational materials for teachers' support and flood risk management manuals. A web page has been developed where the Contingency Plan and other relevant publications, timely weather forecast, and river flow forecasts are available.

***Recovering and maintenance of live memory***

It is important to save images from the past that help prevent a possible future catastrophe. Photographic samples and documentaries and posting "water marks" of past floods are extremely important. A "Memorial" regarding past flooding is under development.

***Recovery and set up of environmental value in marginalized zones***

The degraded border area in the west of the Capital of Santa Fe is being transformed by turning it into a natural urban reserve. The transformation has been done with the support of the French Fund for Global Environment (FFEM). Multiple uses are being contemplated for the green space, reducing the ecological and social vulnerabilities while improving the quality of life in the neighbouring areas.

***Recognition of the efforts expressing the pride of the authorities and communities.***

Santa Fe was the first city in Argentina to join the Global Campaign of the United Nations Office, the United Nations International Strategy for Disaster Reduction (UNISDR). UNISDR's mission is "Developing Resilient Cities" to promote the implementation of the "Hyogo Framework for Action". The proactive engagement of Santa Fe has resulted in it being named "an exemplary Model City" and, in 2011, it was awarded the Sasakawa Prize. ■

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*Translated from Spanish by Maria S. Horta*