Flood management tools

Panagiotis Anastasiadis† & George Metaxas‡

Technological Education Institute of Serres, Serres, Greece†
Technological Education Institute of Piraeus, Piraeus-Athens, Greece‡

ABSTRACT: The hydrological processes responsible for flood generation are continuous and interrelated across a river basin. There is a close relation between water resource management, river management, land use management, forest management, erosion control, agriculture, urban drainage and sewerage within a basin. Changes in the characteristics of the catchment influence the characteristic and magnitude of flood regime. Flood management measures may have impacts on the magnitude of floods downstream, thereby, transferring the flood risks. Flood management measures, therefore, should take account of the entire basin from upstream to downstream. Hence, the strategy for flood risk reduction should be realised through a basin flood management plan. Such a plan should take account of all the development activities undertaken in the basin that have the potential to affect the flood regime. Basin flood management plans present a clear picture of the causes and effects that promote integrated flood management in a basin.

INTRODUCTION

Historically, flood plains have been a preferred place for human settlement and socio-economic development because of their proximity to rivers, guaranteeing rich soils, abundant water supplies and means of transport. Floods play an important role in maintaining the natural function of river and flood plains are a source of fresh water and other natural resources, which bring the opportunity of livelihood. They replenish wetlands, recharge groundwater and support fisheries and agriculture systems; thereby, supporting livelihoods. At the same time, floods are also a source of risk when people and their activities are exposed to flooding without factoring their negative impacts. They can produce severe adverse impacts on the economy and people's safety. Given their beneficial location, people prefer to stay in flood plains even though they are aware of the flood risks. People in the flood plain have to adapt their life to these conditions.

Integrated flood management (IFM) aims to harmonise human activities and flood risks through appropriate interventions to modify the water regime and adaptation of human behaviour; thereby, reducing such risks while maintaining the beneficial aspects of floods. The objectives of basin flood management plan are to protect life and property from flood risks and enhance the capability of socio-economic development in the flood plains to realise the development vision in a basin through IFM. Evaluation of the beneficial function of floods and negative consequences resulting from flood risks is the first step in developing a flood management plan.

Basin flood management planning should reflect the overall vision and policy of integrated water resources management (IWRM), with special attention on the management of floods. Its formulation process should be incorporated in the planning process of IWRM. It has to be led by the designated authority or group of authorities that have responsibilities for flood management and basin planning. Since IFM forms an integral part of water resources management, it should be formulated in close coordination.

Establishment of an institutional framework and mechanism for transparent decision making involving all stakeholders is essential for ensuring ownership by all institutions and affected public. As such, the plan should be formulated through active participation by all stakeholders concerned. If a basin wide institution exists, it should play the central role in the process. The institutions established for IWRM could lead or play a key role. In the case of an international river basin, it will require an international coordination mechanism, such as international commission for coordination to exchange information, develop policy and strategy, implement strategy and monitor the basin condition. Such a coordination mechanism can also support the cooperation during flood emergency situation.

National development vision/policy indicates the direction and goals of social, economic and cultural development of the nation, principles and strategies of the management of natural, land and human resources, financial mechanism to

sustain development within the country. It indicates how national resources are deployed to achieve the national development goals. There are several issues that constitute the national development vision/policy that have relevance to flood management and need to be clearly identified. Some of such issues are:

- Natural resources management (including water resources for domestic, agriculture, fishery and industry;
- Land use management (agriculture, industry, dwelling, urban development, etc);
- Environmental management (conservation and modification);
- Risk management policies;
- Social development issues (living conditions, level of poverty, equity and fairness principles).

National development policy would generally provide the mechanism to formulate a flood management strategy and action plan. National development policy would articulate public participation in decision making processes and defining the role and responsibility of stakeholders in the decision making process. The basin flood management plan should be formulated by drawing its inspiration from the national development policy.

People need to respond to protect life and property in cases where water cannot be directed away from developed land or where flooding will exceed the design event. Community education is now being viewed as an important response modification mechanism to prepare people for flooding and recovery in these situations. Moreover, some researchers in emergency and flood plain management believe that improvement in community education is *the single most important action that could be taken to improve flood warning and associated response*.

Community flood education can include:

a) Public communications, information products and services, e.g. print publications;
b) Internet sites, displays, promotional products, media liaison, advertising/marketing, public education campaigns;
c) Training, development and industry-specific programmes, e.g. skills development courses, professional training, workplace induction programmes, field days;
d) Community development programmes, e.g. public participation programmes, awareness raising programmes, discussion groups, developing education networks;
e) Comprehensive personal education programmes, e.g. school curriculum, university curriculum, personal development courses, action research programmes, community education courses.

ROLE OF FLOOD PLAINS IN NATIONAL ECONOMY

Flood plains provide precious opportunities for farming, industry and urban development because of abundant water supplies, rich productive soils and proximity to rivers. As such, flood plains have been playing an important role in achieving various societal objectives, such as food security, securing livelihood and enhance economic activities that contribute to the growth of the gross domestic product of the country. National development vision, therefore, should reflect the current conditions and issues in a basin and future prospect of improvement that can be realised through flood management measures in the basin.

As flood management attempts to realise national development goals by providing the enabling conditions in the flood plains, the national development vision/policy should be examined for its relevance to the floods and flooding condition in the flood plains. Necessary arrangements are required for the national development vision/policy, if it is not appropriate from the flood management perspectives.

For developing basin flood management plans, identification of issues that are closely linked to floods and flooding is required. Analysis of benefits of flood waters and flooding *vis-à-vis* their negative socio-economic impacts in form of flood risks become the starting inputs for the formulation of future vision, policy, strategy and action plan for flood management duly considering whether current condition should be maintained, improved or modified.

Such an analysis should be undertaken with close cooperation of all stakeholders within a basin, such as flood prone communities, public sector, local, district and national governments to grasp the issues comprehensively and, such cooperation will be the starting point of identification and involvement of stakeholders. This is particularly important for the communities to have a chance to express their interests and concerns.

BASIN FLOOD MANAGEMENT PLAN

The process of development of a flood management plan is generally triggered by certain large flood events with extraordinary adverse consequences or a series of flood frequent events that have resulted in deprivation of the flood prone areas from the general development benefits in the region or country. Mostly, it is driven by internal public pressure, revised national development policy or external forces, such as pressure from basin co-sharing entities or aid and development agencies. For a meaningful and successful conclusion of the process, three key components are critical for initiating the process and for taking it to a satisfactory culmination:

- Political commitment;
- Public awareness;
- Suitable delivery team (steering committee, task team, coordinating body).

Resources management plan: as such, basin flood management planning should form part of the IWRM plan development. However, more often than not this is not the case. Still in such cases also, it would be useful to follow the basic cycle for developing an IWRM plan as given in Figure 1. In the absence of a river basin organisation, as a first step, it is essential to set up a core team consisting of representatives from key institutions that are mandated with flood management, water resources management, agriculture, disaster management and environment.

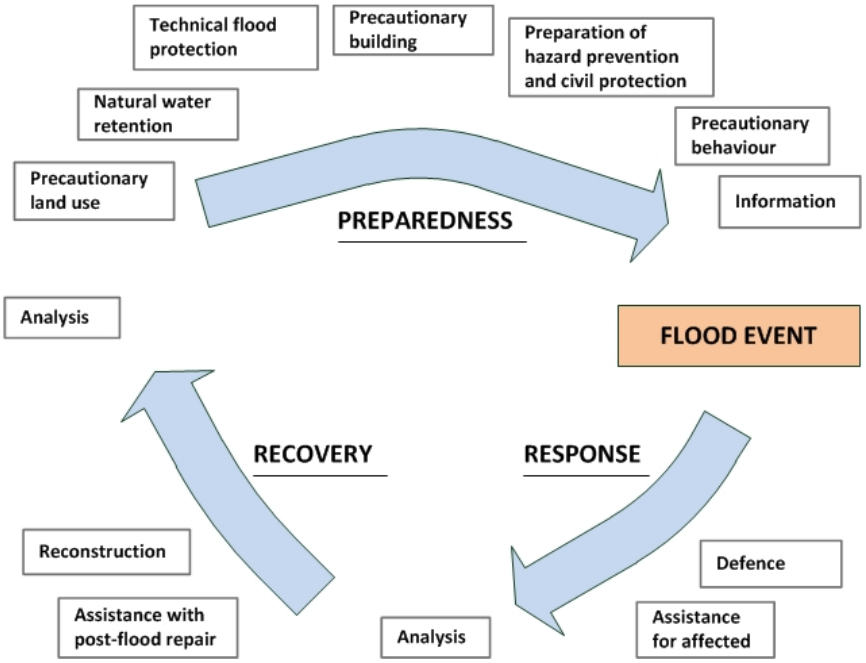

Figure 1:The flood management cycle.

Like an IWRM plan, the basin flood management plan requires identification of all relevant stakeholders. Apart from the general stakeholders in the water resources management, a basin flood management plan requires the disaster management institutions to actively participate in the process. The core team should set up a flood management committee or a steering group consisting of different key stakeholder ministries including financial ministry. It is important to draft a shared vision reflecting stakeholders' needs, aspirations and concerns right at the beginning. Such a process begins with addressing certain key questions:

- Who are the stakeholders in the basin?
- How they relate to the floods and flood plains?
- How to proceed with the planning of their effective involvement?
- What kind of arrangement is required for an international river basin?

There are certain prerequisites for ensuring the successful and sustainable involvement of stakeholders in a given situation. The role of each of the stakeholder, including the mechanism of their involvement, needs to be specified so that they can be sustainable in the long term. The mechanism of engaging various stakeholders and their active participation in the proceeding of planning and decision making should be planned in advance and clearly articulated and clarified along with the launch of the process.

The most important of all is to build trust through information sharing and repeated interactions. Social science expertise, outreach personnel and resources are needed to establish and sustain the participatory process. Commitment, accountability, transparency of action, the application of equality principles and tolerance towards dissent are critical factors that determine, encourage and promote public participation. A public information campaign, started at the early stages, to share information and progress in the matter helps ensuring their participation at appropriate stages. A more detailed discussion on the subject is given in social aspects and stakeholder involvement in integrated flood management [1-3].

Stakeholders' participation may require an enabling legal and institutional framework and continuous efforts to build the capacity of different stakeholders. Some of these actions could be initiated right at this stage. In an international river basin, stakeholder involvement becomes more complex, because it is divided between different national government structures. However, the aftermath of extreme flood events provides certain opportunities for exploring the channels of communication if not already existing.

A basin flood management plan has to start by assessing present and future flood risks. Flood risks are a function of the magnitude of the hazard, the degree of exposure to the hazard and the vulnerability of society to damage due to the hazard. Higher population pressures on natural resources are forcing people to carry their socio-economic activities in areas exposed to flooding, compelling them to take higher risks in the search for a livelihood. Increasing the economic infrastructure in flood-prone areas and development activities that have the potential to increase the magnitude of flood hazards have considerably increased risk over recent decades. A risk culture that allows and enables one to assess, evaluate and reduce the prevailing risks and their escalation due to development activities is required.

Problem analysis starts with developing an understanding of the three constituents of flood risks.

- The magnitude of the flood hazard expressed in terms of frequency and severity (depth, extent and duration of inundation and relative velocities);
- The exposure of human activities to flooding;
- The vulnerability of the elements at risk.

Understanding flood hazard and flooding may require hydro-meteorological analysis, hydrologic and hydraulic simulation of surface runoffs, floods and inundations, and mechanism of flooding. It may also require a simulation and analysis projected conditions of land use change, future developments (e.g. urbanisation, infrastructure development, etc) and the future trends of hydro-meteorological.

Problem analysis starts with the development of an understanding of the three constituents of flood risks.

- The magnitude of the phenomenon due to climate variability or change. Flood inundation maps developed for different scenarios help in understanding and communicating with different stakeholders. Such flood maps would be the basis for developing flood risk scenarios based on various development alternatives, social and economic conditions. Based on the required uses, such flood maps should include other related and supplementary information to serve the desired purposes, such as evacuation routes, raising risk awareness or regulatory. Other functions of flood maps could be (non-inclusive):

  - Planning: impacts of urbanisation, other land uses and climate change;
  - Regulatory: land use regulation and building codes;
  - Rescue operations: building shelters and earmarking escape routes;
  - Flood insurance;
  - Informational/educational: record of flood magnitudes in an area.

Analysis of the vulnerability of the section of the society exposed to flooding will show why, and to what extent, they are affected. It may be attributable to the social factors (poverty, livelihoods, gender, weaker social groups, and minority and ethnic groups) and the attributing vulnerability conditions (physical, constitutional, motivational) of the flood plain occupants (Figure 2). A demographic analysis based on surveys may be required for the purpose. A close involvement of the communities in these assessments along with the experts would give credence to such studies. Estimation of damage in monetary and non-monetary terms for a given condition is required for assessment of flood risk. This forms the basis for economic analysis of various options and deciding the priority of various basin flood management options. The Flood Loss Assessment Tool provides the basic methodology for assessing these options [4].

Figure 2: Flood risk management.

As flood risks are the construct of flood hazards, exposure of economic activities and the vulnerability of the society affected by floods, it is crucial that options to reduce each of the components are fully explored. Based on the target of flood management suitability of various options to meet that target should be examined.

IMPLEMENTATION PLAN AND MONITORING

There are several requirements for the implementation of a basin flood management plan. Legal and institutional arrangements may be required to ensure the participatory process in the implementation of the plan. It may require clear assignment of the roles and responsibilities to implement and manage the implementation process, and monitoring the plan implementation.

Some of the institutions may not have the capacity to undertake the responsibilities assigned to them. The plan should clearly define the capacity building requirements for all institutions and stakeholders at different levels in the basin. Some of these may relate to the capacity of the flood practitioners to implement the plan and monitor the whole process or the institutions that are required to build public awareness.

A plan of implementation for the options of basin flood management, providing clear timelines for meeting short-medium- and long-term target should be drawn. Such a plan should clearly assess the financial resources required and the way these resources are to be mobilised. This requires a clear assignment of tasks among organisations responsible and consultation with financial institutions to secure financial resource. The implementation plan should draw out alternative approaches to meet the targets, if the required resources for taking up the plan as scheduled are not available. Identification of possible external resources for implementation of the plan should also be undertaken in consultation with the financial ministries in the country and the financial institutions. For this purpose, it is important to involve them from the beginning of the process of plan formulation.

At the implementation stage, detailed design of various options would be carried out along with their environmental impact assessment (EIA) [5] and economic analysis [6]. The final decision for implementing any component of the plan would be made based on the outcomes of these analyses.

Monitoring of basin conditions before, during and after the implementation of the plan is essential for checking its sustainability and helping take corrective measures. Appropriate performance indicators, suitable for various level of management, have to be established and the threshold values assigned. If adverse effects beyond the specified threshold values are observed, modification and adjustment in the plan should be carried out.

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