INTEGRATED FLOOD MANAGEMENT

CONCEPT PAPER

The Associated Programme on Flood Management

World Meteorological Organization
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The Associated Programme on Flood Management (APFM) is a joint initiative of the World Meteorological Organization and the Global Water Partnership. It promotes the concept of Integrated Flood Management (IFM) as a new approach to flood management. The programme is financially supported by the governments of Japan and the Netherlands.

The World Meteorological Organization is a Specialized Agency of the United Nations. It co-ordinates the meteorological and hydrological services of 185 countries and territories and as such is the centre of knowledge about weather, climate and water.

The Global Water Partnership is an international network open to all organizations involved in water resources management. It was created in 1996 to foster Integrated Water Resources Management (IWRM).

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CONTENTS

SUMMARY

Settling on flood plains has enormous advantages, as is evident from the very high densities of human settlement in, for example, the Netherlands and Bangladesh. Disaster mitigation by restricting the occupation of flood plains and wetlands limits the potential of these lands for socio-economic development.

Integrated Flood Management (IFM) integrates land and water resources development in a river basin, within the context of Integrated Water Resources Management (IWRM), with a view to maximizing the efficient use of flood plains and minimizing loss to life. Thus, occasional flood losses can be accepted in favour of a long-term increase in the efficient use of flood plains.

Integrated Water Resources Management, which, as defined by the Global Water Partnership (GWP), is "a process which promotes the co-ordinated management and development of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems", is based on the recognition that a single intervention has implications for the system as a whole. More positively, integrating management means multiple benefits may be achieved from a single intervention.

For flood management to be carried out within the context of IWRM, river basins should be considered as integrated systems. Socio-economic activities, land-use patterns, hydro-morphological processes, etc., need to be recognized as constituent parts of these systems. A consistent approach needs to be applied to all forms of possible intervention. The entire hydrological cycle is considered rather than differentiating between floods and droughts when planning water resources development.

The aim of IFM is to put in place well-functioning integrated measures for flood management. For this, the linkages between various relevant sectors become very important. Thus, the most important key will be co-operation and co-ordination across institutional boundaries, noting that the mandates of many institutions will either cover only part of the river basin or extend well beyond the basin boundary. At the core of integration is effective communication across institutional and disciplinary boundaries, which can take place only if there is a perception of common interest. Emphasis should be on the adoption of flexible strategies tailored to each flood-prone region (characterized by their various physical, social, cultural and economic aspects) – recognizing the importance of evaluating differing options and their relative advantages and disadvantages.

A participatory and transparent approach which includes a representative range of stakeholders in the decision making process is another key component of IFM. The degree of public participation can differ from region to region. However, it should not be assumed that such stakeholder involvement will necessarily result in a consensus. Therefore, a methodology for managing conflicts, possibly a formal system of conflict resolution, needs to be developed. In this context, a major challenge will be how to develop a consensus on the question of funding of overall activities when flood management is one of the main objectives, and to do this through dialogue among stakeholders – particularly in places where such practices are not commonplace.

1. INTRODUCTION

The recurrence of extreme precipitation anomalies, leading to the availability of too much or too little water – resulting in floods or droughts respectively – is a normal component of natural climate variability and often has far-reaching socio-economic and environmental implications. The adverse impacts of floods and droughts include loss of life and property; mass migration of people and animals; environmental degradation; and shortage of food, energy, water and other basic needs. The degree of vulnerability to such natural disasters has been highest in developing countries, where, often it is the poor who suffer the most as sheer necessity forces them to occupy the most vulnerable areas.

The Plan of Implementation of the World Summit on Sustainable Development (WSSD), held in Johannesburg in August/September 2002, highlights the need to "... mitigate the effects of drought and floods through such measures as improved use of climate and weather information and forecasts, early warning systems, land and natural resource management, agricultural practices and ecosystem conservation in order to reverse current trends and minimize degradation of land and water resources …" The international community has therefore committed itself to an integrated and inclusive approach to addressing vulnerability and risk management that includes prevention, mitigation, preparedness, response and recovery.

Sustainable development through Integrated Water Resources Management (IWRM) aims at the sustained improvement in the living conditions of all citizens in an environment characterized by equity, security and freedom of choice. It necessitates the integration of natural and human systems as well as land and water management. The available literature on IWRM, however, generally does not address the issues related to flood management aspects of water resources. There is clearly a need to develop understanding on dealing with this aspect.

This paper conceptualizes IFM as a subset of IWRM and describes the interplay between floods and the development process. It takes a look at traditional flood management options from the IFM angle and identifies the major challenges encountered by flood plain managers and decision makers before describing the basic tenets and requirements of IFM. The concept paper is to be followed by a series of supplementary papers going into further detail about different aspects of IFM to help flood managers and decision makers implement the concept. This series of papers requires familiarity with flood management issues and the concept of IWRM.

The application, and sometimes the basic philosophy, of IFM and how flood issues are addressed depend largely on the nature of the flooding problem, socio-economic conditions and the level of risk a society is forced or prepared to take in order to achieve its development objectives. As such, the practical application of IFM is not universal and needs to be adapted to specific situations.

2. FLOODS AND THE DEVELOPMENT PROCESS

Societies, communities and households seek to make the best use of the natural resources and assets available to them in order to improve their quality of life. However, they are subject to a variety of natural and man-made disturbances such as floods and droughts, economic recessions and civil strife. These disturbances adversely impact their assets or the multipliers that build their capacity to increase their incomes. Since not all sections of society have equal opportunities to improve their quality of life – with respect to access to resources, information and power to participate in the planning process and implementation of development policies – these disturbances have varying effects on different social groups.

Natural disasters cause much misery, especially in developing countries where low-income economies are greatly stressed by their recurrence. Statistics show that around 70 per cent of all global disasters are linked to hydro-meteorological events. Flooding is one of the greatest natural disasters known to humankind. Flood losses reduce the asset base of households, communities and societies by destroying standing crops, dwellings, infrastructure, machinery and buildings. In some cases, the effect of flooding is dramatic, not only at the individual household level but on the nation as a whole. The 1982 floods in Bolivia are reported to have resulted in a loss equivalent to 19.8 per cent of the country's GDP. It may, however, be argued that looking at the impact of floods on a piecemeal basis, rather than making holistic appraisals, has too narrowly assessed their impact.

Although living on a flood plain exposes its occupants to one set of disturbance – i.e. flooding – it also offers enormous advantages. The deep, fertile alluvial soil of flood plains – the result of aeons of flooding – is ideal for higher crop yields and helps reduce vulnerability of the flood plain occupant to a wide range of other disturbances. In turn, flood plains typically support very high densities of human settlement. It is not entirely coincidental that the population densities of the Netherlands and Bangladesh are so high, and that the gross domestic product (GDP) per square kilometre is high in countries whose territories are comprised mostly of flood plains, such as in the Netherlands – which has the highest GDP per square kilometre in Europe.

It is vital to understand the interplay between floods, the development process and poverty in order to ascertain the way in which current and future development planning and implementation leads to, or has the potential to, increase vulnerability and risk. A population might be poor because it is exposed to flooding or it might be exposed to flooding because it is poor and occupies the most vulnerable land. The appropriate

method of intervention will differ according to which diagnosis is correct. Further, a community with a weak asset base and few multipliers is exposed to many different disturbances, some of which may have a greater impact than floods. Decision makers and development planners at all levels need to be sensitive to this aspect.

The "vulnerability" of potential victims of flood losses is a function of their ability to mobilize the assets available to them to meet the challenge posed by the flood risk versus the extent of the challenge. More generally, the capacity of the society to maintain or improve its quality of life in the face of such external disturbances may be enhanced either by reducing the extent of the challenge presented by the disturbance or by enhancing their capacity to cope with the disturbance.

3. TRADITIONAL FLOOD MANAGEMENT OPTIONS

Traditionally, flood management has essentially been problem driven: usually after a severe flood a project would be quickly implemented; the problem and its solution seeming self-evident without giving any thought to the impact such solutions would have on upstream and downstream areas. Thus, flood management practices have largely focused on reducing flooding and reducing the susceptibility to flood damage through a variety of interventions. There are a number of different ways to categorize such flood management interventions. They can be structural and non-structural; physical and institutional; implemented before, during and after the flood; etc., and these categorizations overlap.

The flood management interventions listed below are not discussed in detail. Only the relevant measures that strengthen the case for adopting an integrated approach to flood management have been elaborated.

- Source control to reduce runoff (e.g. permeable pavements, afforestation);
- Storing runoff (e.g. detention basins, wetlands, reservoirs);
- Increasing the capacity of the river (e.g. bypass channels, channel deepening or widening);
- Separating the river and the population (e.g. land use control, dikes, flood-proofing, house raising);
- Emergency management during the flood (e.g. flood warnings, emergency works to raise or strengthen dikes, flood-proofing, evacuation);
- Flood recovery (counselling, compensation or insurance).

Source control takes the form of storage in the soil or via the soil and involves intervention in the process of the formation of runoff from rainfall. It is normally considered with its consequential impact on the erosion process, the time of concentration and evapo-transpiration. In assessing the likely effectiveness of source control, pre-flood conditions (e.g. frozen or saturated ground) need to be considered. Thus, a potential drawback with some forms of source control, and other forms of land use modification such as afforestation, is that their capacity to absorb or store rainfall depends on the antecedent conditions of the catchment.

In the traditional approach to decreasing the challenge presented by the flood, an attempt is made to modify the flood to make it easier to cope with: slow rising, with a long time to peak, and with a low peak level. Surface water storage, by way of dams and detention basins, is usually adopted to attenuate flood peaks. More often than not, such storage serves multiple purposes and the exclusive flood storage can be the first casualty in any conflict situation. Moreover, by completely eliminating the

low floods such measures give a false sense of security. Storage has to be used in an appropriate combination with other structural and non-structural measures.

Dikes or flood embankments are most likely to be appropriate for flood plains that are already intensely used. Increasing the carrying capacity of the rivers, while disturbing its natural morphological regimes, has impacts on other river uses and has a tendency to shift the problem spatially and temporally. Deepening of channels may also affect the groundwater regime in the region.

Land use control is generally adopted where intensified development on a particular flood plain is undesirable. Providing incentives for development to be undertaken elsewhere can probably work better than simply trying to stop development on the flood plain. However, where land is under development pressure, especially from informal development, such planning constraints are unlikely to be effective. Flood-proofing or house raising are most likely to be appropriate where development intensities are low and properties are scattered or where the warning times are short. In frequently flood prone areas flood-proofing of the infrastructure and communication links can reduce the debilitating impacts of floods on the economy.

Flood warnings and timely emergency action are complementary to all forms of intervention. A combination of clear and accurate warning messages with a high level of community awareness gives the best level of preparedness for self-reliant action during floods. It is important to put in place public education programmes for hazard warnings to be successful in achieving the desired objective of not allowing the hazard to turn into a disaster. Flash floods present the greatest risk to life. However, in flash flood prone catchments it is unwise to rely upon a formal flood warning system as dissemination takes time.

Evacuation is an essential constituent of emergency planning. Depending upon circumstances, evacuation may be upward (e.g. into a flood refuge to a higher elevation) or outward. Outward evacuation is generally necessary where the depths of water are significant, flood velocities are high and buildings are flimsy (e.g. not masonry or concrete framed). For outward evacuation to be successful it must be planned in advance and the population concerned must know what to do in a flood emergency. To be effective evacuations require active participation of the communities right from the planning stage.

4. THE CHALLENGES OF FLOOD MANAGEMENT

Securing Livelihoods

Both population and economic growth exert considerable pressure on the natural resources of a system. Enhanced economic activities in flood plains, due to increased population pressure and the construction of infrastructure, further increase the risk of flooding. Flood plains provide excellent, technically easy livelihood opportunities in many cases. In developing countries with primarily agricultural economies, food security is synonymous with livelihood security. Flood plains contribute substantially to food production and provide nutrition for the people of these countries. While it can be argued that virtual water trade – and by inference reduced dependence on flood prone and water scarce areas – could address the issue of food security, it would not address the issue of livelihood security. In the competition for access to limited land resources, it needs to be ensured that the weaker sections of the population who largely occupy the flood plains do not suffer further by the application of policy measures and have their livelihood opportunities reduced.

Population growth and the migration of large populations in developing countries towards unplanned urban settlements in flood plains increase the vulnerability of the poorest sectors of society to flooding. It is these sectors of society that also suffer from a lack of health and sanitation facilities and are thus most vulnerable to disasters and post disaster consequences. Emphasis needs to be placed on addressing the needs of these societies.

The Need for a Basin Approach

A river basin is a dynamic system in which there is a series of interactions between the land and water environment (Figure 1). These interactions involve not only water but also soil/sediment and pollutants/nutrients. The system is dynamic over both time and space. The functioning of the river basin as a whole is governed by the nature and extent of these interchanges.

An increase in economic activities, such as mining, farming and urbanization, has been responsible for large-scale deforestation, resulting in larger sediment yields from water catchments. Landslides induced by natural or human activities in hilly areas increase sediment concentration in the rivers. The increased sediment concentration disturbs natural river regimes. While most of the sediment is carried to the sea, a large portion gets deposited in river channels thus reducing the discharge capacity of the conveyance system. Over a period of years this sometimes results in parts of the river becoming raised above the surrounding flood plains.

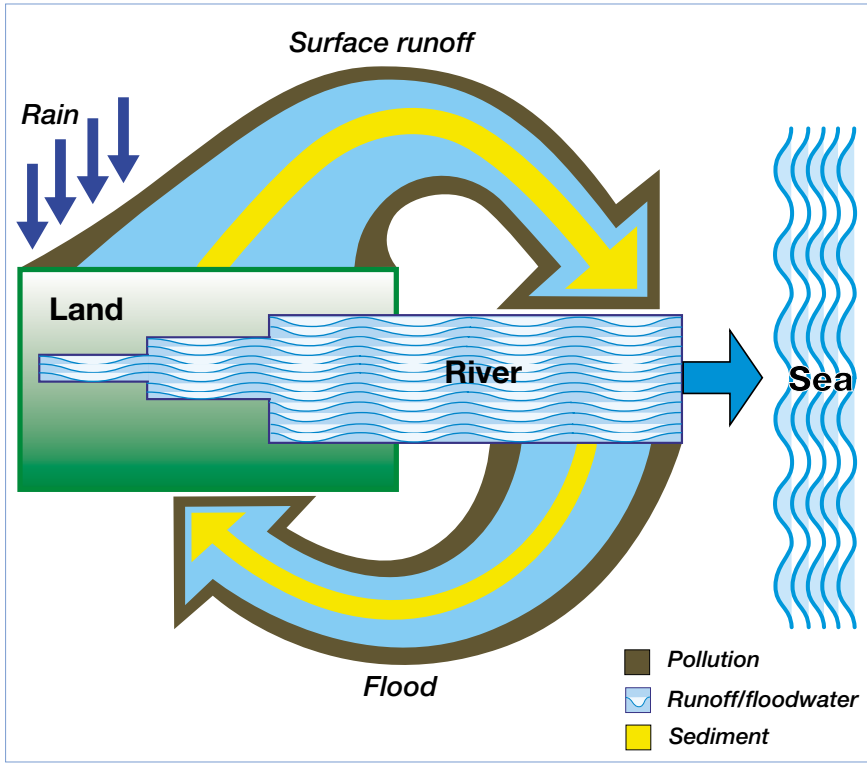

Figure 1. Interaction between land and water

Large-scale urbanization in comparatively small catchments accentuates flood peaks and reduces the time of concentration. This is because land use surfaces in urbanized basins – made up of roofs, paved streets and other impervious surfaces – increase overland flow volume and decrease groundwater recharge and evapo-transpiration. Urban drainage design is, unfortunately, most often based on the principle of draining water from urban surfaces as quickly as possible through pipe and channel networks that increase the peak flow, and reduce the time available for flood response, in downstream areas. In lowlands and coastal areas, road and rail embankments and similar infrastructure can obstruct flood flows and accentuate flood conditions upstream. Similarly, measures to improve navigation can have drastic impacts on biodiversity as well as affecting the risk of flooding. These and other competing requirements on flood managers call for an integrated basin wide approach to flood management.

Absolute Safety from Flooding is a Myth

Absolute protection from flooding is neither technically feasible nor economically or environmentally viable. Thinking in terms of setting a design standard of protection is both a trap and a delusion: such a standard conflicts with the principle of managing all floods and not just some.

It is also a delusion because estimates of the magnitude of extreme floods are very inaccurate and, due to climate change, likely to get modified over time.

A dilemma of sorts exists regarding whether to design interventions to provide protection from large floods or not. By reducing the losses from high frequency floods, there could be greater risk of disastrous consequences when more extreme events take place. It is also necessary to consider the likelihood of failure in the case of floods below the notional design standard. Some structural measures such as dikes and bypass channels, due to long-term disuse or lack of finances, may not be adequately maintained and can be susceptible to failure in the event of floods of magnitude lower than the design standard. In addition to estimating the likelihood of such failures, how they might fail and how such events are to be managed should also be considered.

Emergency response to a flood event, like any other disaster, depends on the frequency of the event. Generally, losses from a large flood that occurs a few years after a major flood are lower than in the first flood as both institutions and the public are more prepared and apply the lessons they learnt from the earlier flood.

Ecosystem Approach

Riverine aquatic ecosystems – including rivers, wetlands and estuaries – provide many benefits to people such as clean drinking water, food, materials, water purification, flood mitigation and recreational opportunities. Variability in flow quantity, quality, timing and duration are often critical for the maintenance of river ecosystems. For example, flooding events serve to maintain fish spawning areas, help fish migration and flush debris, sediment and salt. This is particularly so for regions with dry climates that experience seasonal flooding followed by a period of drought. Different flood management measures have varying impacts on the ecosystem and at the same time changes in the ecosystem have consequential impacts on the flood situation, flood characteristics and river behaviour.

Some flood management interventions adversely impact riverine ecosystems by reducing the frequency of flooding of wetlands that develop around flood plains, which are subject to frequent flooding and owe the large variety of flaura and fauna to this phenomenon. In these situations it is desirable to avoid changes in high frequency floods since to do so would damage the ecosystems that have developed around the existing flood regime. What is desirable is to reduce extreme floods. Thus a trade-off between competing interests in the river basin is required to determine the magnitude and variability of the flow regime needed within a basin in order to maximize the benefits to society and maintain a healthy riverine ecosystem.

The ecosystem approach is a strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way. The Integrated Flood Management approach encompasses the main principles of the ecosystem approach by considering the entire basin ecosystem as a unit and accounting for the impacts of economic interventions in the basin as a whole. It also supports the decentralization of the management process to the lowest appropriate level. Environmental sustainability of the flood management options is one of the prerequisites in IFM.

Climate Variability and Change

General circulation models predict that changes to monsoon patterns with respect to both intensity and duration are likely to occur as a result of climate change. This could mean increased flash floods and seasonal floods, but not necessarily uniformly. The effect this would have on the design standard flood regarding infrastructure depends on the economic principles that are followed. Increases in the number of storm surges hitting the land are also likely. Sea levels may rise effecting flooding in estuarine areas as well as further inland due to re-grading of riverbeds.

Flood warnings are an obvious example of a variability based approach: the problem is to predict what will happen in the future in a certain place on the basis of what has happened higher up the system. Again, the probability of a flood frequently changes. Changes in land use across the basin affect runoff and hence the probability of a flood of a given magnitude. This effect is most acute in small, urbanized catchments.

Changes in the Decision Making Process

In tandem with the above, there are a number of shifts taking place in the decision making process. From being one-dimensional and focused on economic efficiency, decision making is increasingly becoming multi-dimensional and concerned with resolving multiple, often conflicting, objectives. The involvement of different stakeholders is considered as central to making better decisions.

Conventionally, risk of flooding is expressed in terms of the exceedence probability of a flood of a given magnitude on a particular stretch of river. In current thinking, emphasis is placed on analyzing the sequence of events and associated probabilities that result in a flood – based on the meteorological event itself and the antecedent conditions. For example, the impact of a rainstorm of a given intensity on a basin may depend on in which part of the basin it occurs. Equally, the shape of the outflow hydrograph from a basin can depend on the direction in which the rain front moves. In this approach, the consequences of one event depend

not simply on its magnitude but also on what happened before. For example, if the soil is already saturated as a result of previous rainfall, then the proportion of rainfall that runs off the land and goes to swell the flow in the river is higher than if the soil was only moist. The risk management approach is increasingly being adopted in the decision making process.

Risk Management

Modern society is termed a "risk society". Uncertainty and risk management are recognized as defining characteristics of choice rather than being inconveniences. It is recognized that "risk" is a social construct resulting from the accumulated or short-term effects of social and economic processes and defined as the conditions that societies perceive as troublesome. Thus, risk management is a necessary component of the development process, essential for achieving sustainable development. Flood risks are related to hydrological uncertainties. Our knowledge of the present is incomplete and generally we have only a partial understanding of the nature of the causal processes in operation. The extent of future changes cannot be predicted with certainty, as these changes may be random (e.g. climatic variability), systemic (e.g. climate change) or cyclical (e.g. El Niño). However, hydrological uncertainty is perhaps subordinate to social, economic and political uncertainties. For example, the biggest and unpredictable changes are expected to result from population growth and economic activity.

Balancing development needs and risks is essential. The evidence worldwide is that people will not, and in certain circumstances cannot, abandon flood-prone areas – whether they are in the sparsely populated flood plains of the Mississippi, the mountains of Honduras or in the densely populated deltaic regions of Bangladesh. There is a need, therefore, to find ways of making life sustainable in the flood plains – even if there is considerable risk to life and property. This can be approached through the integrated management of floods.

5. INTEGRATED FLOOD MANAGEMENT – THE CONCEPT

Integrated Water Resources Management

The principle of Integrated Water Resources Management has been the accepted rationale since the Dublin Conference (1992). Subsequent meetings (e.g. the Ministerial Declaration of The Hague on Water Security in the 21st Century, 2001) have re-emphasized that IWRM is a necessary criterion for sustainable development.

According to the Global Water Partnership (GWP): "Integrated Water Resources Management is a process which promotes the co-ordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems." Sustainable and effective management of water resources demands a holistic approach, linking social and economic development with the protection of natural ecosystems and appropriate management links between land and water uses. Therefore, water related disasters such as floods and droughts, that play an important part in determining sustainable development, also need to be integrated within water resources management.

Defining Integrated Flood Management

Integrated Flood Management is a process promoting an integrated – rather than fragmented – approach to flood management. It integrates land and water resources development in a river basin, within the context of IWRM, and aims at maximizing the net benefits from flood plains and minimizing loss to life from flooding.

Globally, both land, particularly arable land, and water resources are scarce. Most productive arable land is located on flood plains. When implementing policies to maximize the efficient use of the resources of the river basin as a whole, efforts should be made to maintain or augment the productivity of flood plains. On the other hand, economic and human life losses due to flooding cannot be ignored. Treating floods as problems in isolation almost necessarily results in a piecemeal, localized approach. Integrated Flood Management calls for a paradigm shift from the traditional fragmented approach of flood management.

Integrated Flood Management recognizes the river basin as a dynamic system in which there are many interactions and fluxes between land and water bodies. In IFM the starting point is a vision of what the river basin should be. Incorporating a sustainable livelihood perspective means

looking for ways of working towards identifying opportunities to enhance the performance of the system as a whole. The flows of water, sediment and pollutants from the river into the coastal zone – often taken to extend dozens of kilometres inland and to cover much of the river basin – can have significant consequences. As estuaries overlap the river basin and coastal zone it is important to integrate coastal zone management into IFM. Figure 2 depicts an IFM model.

The attempt is, therefore, to try to improve the functioning of the river basin as a whole while recognizing that gains and losses arise from changes in interactions between the water and land environment and that there is a need to balance development requirements and flood losses. It has to be recognized that the objective in IFM is not only to reduce the losses from floods but also to maximize the efficient use of flood plains – particularly where land resources are limited. However, while reducing loss of life should remain the top priority, the objective of flood loss reduction should be secondary to the overall goal of optimum use of flood plains. In turn, increases in flood losses can be consistent with an increase in the efficient use of flood plains in particular and the basin in general.

Elements of Integrated Flood Management

The defining characteristic of IFM is integration, expressed simultaneously in different forms: an appropriate mix of strategies, points of interventions, types of interventions (i.e. structural or non-structural),

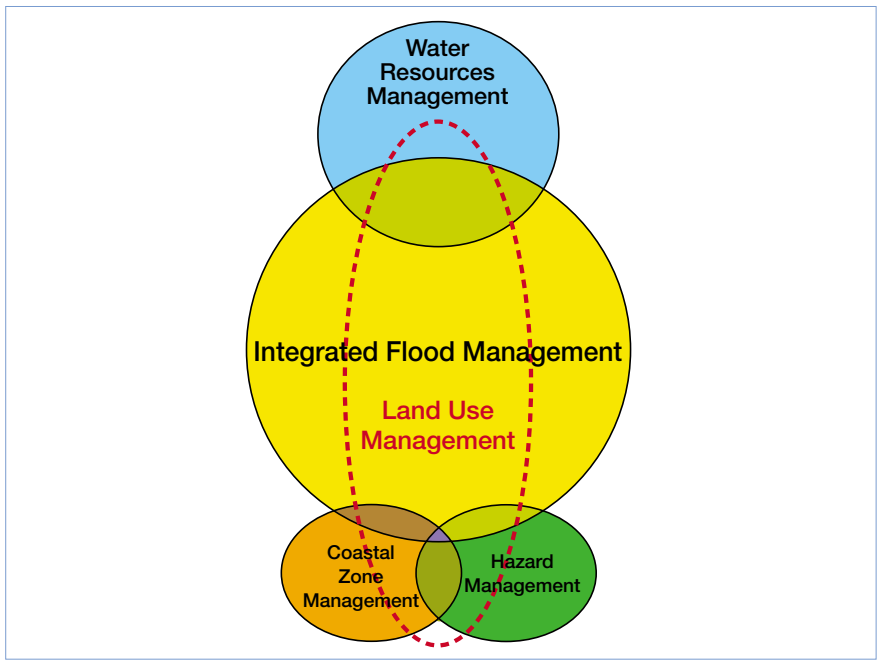

Figure 2. Integrated flood management model

short or long-term, and a participatory and transparent approach to decision making – particularly in terms of institutional integration and how decisions are made and implemented within the given institutional structure.

Therefore, an integrated flood management plan should address the following five key elements that would seem to follow logically for managing floods in the context of an IWRM approach:

- Manage the water cycle as a whole;
- Integrate land and water management;
- Adopt a best mix of strategies;
- Ensure a participatory approach;
- Adopt integrated hazard management approaches.

Manage the Water Cycle as a Whole

Recognizing that water is a finite and vulnerable resource, differentiation between water resources management, flood management and drought management needs to be circumvented. Flood management plans need to be intertwined with drought management through the effective use of floodwater and/or by maximizing the "positive" aspects of floods. In arid and semi-arid climates in particular, floods are essentially the water resource. Whilst for most of the time runoff is essentially the water resource, it is only at the times of extremes that runoff is a problem. The positive effects of floodwater should be recognized in national/local water management plans. Groundwater and floodwater should be treated as linked resources and the role of flood plain retention capacities for groundwater recharge should be considered. Alluvial flood plains, particularly provide opportunities for groundwater storage of the floodwaters. Possibilities of accelerated artificial recharge, under given geological conditions need to be explored and utilized. The possibility of retaining part of the flood flows, as green water should be explored. However, in considering interventions that will change the runoff regime, one needs to consider the effects holistically. For example, taking measures to reduce runoff during the rainy season could be counter-productive if it also reduces runoff at other times of the year.

Further, there is a need to manage all floods and not just some – e.g. not just those floods up to some design standard of protection, and in turn to design for failure. What happens when a flood more extreme than the design standard flood occurs and how such a flood will be managed need to be addressed. One needs to clearly identify areas that will have to be sacrificed for flood storage in such an extreme flood event in order to protect critical areas.

More positively, integrating management across functions means that we may achieve multiple benefits. It would mean no more flood alleviation

schemes per se, but only interventions, one purpose of which – and perhaps the primary purpose – would be to change the risk of flooding and/or its consequences. It would also mean that interventions that serve several different purposes simultaneously (e.g. to improve water quality as well as to improve the management of flow variations in the river) would be favoured. Integrated flood management, therefore, envisages both economies of scope (e.g. from integration across functions) and economies of scale (e.g. throughout the river basin). Conflicts of interests, however, need to be addressed in such multi-options interventions.

Integrate Land and Water Management

Land use planning and water management have to be combined in one synthesized plan through co-ordination between land management and water management authorities to achieve consistency in planning. The rationale for this integration is that the use of land has impacts upon both water quantity and quality. The three main elements of river basin management – water quantity, water quality, and the processes of erosion and deposition – are inherently linked and are the primary reasons for adopting a river basin-based approach to IFM.

Upstream changes in land use can drastically change the characteristics of a flood and associated water quality and sediment transport characteristics. Upstream urbanization can cause an accentuation of flood peaks and their early occurrence in downstream reaches. Using low lying depressions that play an important role in flood attenuation for dumping solid waste may worsen hygienic conditions and increase flood peaks in downstream reaches during floods. Ignoring these linkages in the past has lead to failures. These linkages need to be recognized, understood and accounted for to lead to synergies in improving river basin performance in several different ways simultaneously. Taking advantage of these potential synergies will, however, require a wider perspective of the issues of development of the river basin in its entirety, rather than attempting to resolve local problems in an isolated manner.

By adopting a functional approach to flood management, a problem orientation is an almost inevitable consequence. Taking a wider perspective can allow the situation to be viewed as one of opportunities, of looking for ways in which the performance of the basin as a whole can be enhanced.

Adopt a Best Mix of Strategies

Strategies and options generally used in any flood management approach are given in Table 1. Adoption of a strategy depends critically on the hydrological and hydraulic characteristics of the river system and the region. Three linked factors determining which strategy or combination of

Strategy	*Options*
Reducing Flooding	Dams and reservoirs Dikes, levees, and flood embankments High flow diversions Catchment management Channel improvements
Reducing Susceptibility to Damage	Flood plain regulation Development and redevelopment policies Design and location of facilities Housing and building codes Flood-proofing Flood forecasting and warning
Mitigating the Impacts of Flooding	Information and education Disaster preparedness Post flood recovery Flood insurance
Preserving the Natural Resources of Flood Plains	Flood plain zoning and regulation

Table 1. Strategies and Options for Flood Management

strategies is likely to be appropriate in a particular river basin are the climate, the basin characteristics and the socio-economic conditions in the region. Taken together, they determine the nature of the floods that are experienced and their consequential effects.

Quite different strategies are likely to be appropriate in different situations and in different countries. However, the strategies often involve a combination of complementary options – a layered approach that includes intervention at several points in the process of flooding. The differences in the performance of the different options also suggest that adopting a layered flood management strategy will often be the best strategy.

Further, if we know that we are necessarily uncertain about the future then it is not logical to seek for optimal solutions since optimality depends upon knowledge that is complete, precise and accurate. Instead, we should seek a resilient response that is flexible and can be adapted to changing conditions. Such a strategy would be multi-faceted with a mix of options being used to create a layered strategy, appropriate to the given conditions.

It is important to avoid isolated perspectives and the trap of assuming that some forms of intervention are necessarily always appropriate and others are always necessarily bad. Instead, it is necessary to look at the situation as a whole, compare the available options and select a strategy

or a combination of strategies that is most appropriate to a particular situation. While recognizing the merits and demerits of various structural and non-structural measures, a good combination of both kinds of measures needs to be evaluated, adopted and implemented. Measures that create new hazards or shift the problem in time and space, sometimes merely temporarily, need to be guarded against.

Evidence suggests that a strategy to decrease risks aimed at a reduction of flooding – through structural measures and flood embankments or non-structural measures including afforestation – can confer only partial safety for people inhabiting flood plains. When protection fails, damage can be manifold due to increased investments made by flood plain users. For many societies and situations throughout the world, the cost of reducing the risk – most often through the adoption of high-cost structural measures or through policies aimed at relocating "at-risk" land use – is simply too high to be affordable or the side effects of such measures are too damaging to the environment or in contravention of the development goals of the society. In such cases the strategy could then be to reduce vulnerability through disaster preparedness and flood emergency responses.

Loss of life and property can be avoided if appropriate disaster response plans supported by reasonably accurate and reliable forecasts are put in place and are well rehearsed. Floodplain zoning regulation maps, which show the areas at risk of flooding within a given probability, provide the most advanced warnings of likely hazard and help people to make their decisions on investment in these areas. Floodplain zoning, however, has its limitations – particularly in developing economies with population pressures and unplanned developments.

One area that needs to be guarded against, especially after extreme flood events, is to adopt only long-term interventions. It is important for the strategy to be successful that the stakeholders, especially those who are directly affected by the floods, get an immediate reassurance of safety through short-term measures. Therefore, the need is to include both the long-term as well as short-term interventions in the overall plan.

Ensure a Participatory Approach

The definition of sustainable development agreed at the Rio Conference specifies two defining conditions: the involvement of the public at all levels of decision making and recognition of the role of women.

Identification and Participation of Stakeholders: IFM, like IWRM, should be based on a participatory approach, involving users, planners and policy makers at all levels. For the approach to be participatory it needs to be open, transparent, inclusive and communicative and requires decentralization of decision making with full public consultation and

involvement of stakeholders in planning and implementation. All the upstream and downstream stakeholders representing different parts of the river basin need to be involved. The core of the debate in the stakeholder consultation process is frequently not what the objectives are but what they ought to be. Two aspects of this argument are: who has standing in the decision, what is the legitimacy of their standing, and by what right are they entitled to be heard; and, secondly, how to ensure that the powerful do not dominate the debate.

It is essential that a good representative range of stakeholders is involved in the dialogue/decision making process leading to IFM. The impacts of flooding and of interventions are often differentially distributed between members of households and sections of a community. Women are usually the primary child and health care providers and so commonly experience a disproportionate share of the burdens of recovering from floods. They also play a central part in the provision, management and safeguarding of water, and their special requirements in dealing with flood situations need to be reflected in the institutional arrangements. Integrated Flood Management has to keep gender based, religious and cultural differences in perspective. The participation of minorities/indigenous people and weaker sections of society needs to be ensured. The interests of other vulnerable sections of society, such as children and the elderly need to be specifically addressed while planning and executing interventions to reduce risks from flooding in the future, during a flood and its aftermath. The form of participation could vary, depending upon the social, political and cultural setup of the society. The participation can also take place through democratically elected representatives and spokespersons or through the various user groups such as water users associations, forest user groups etc. As IWRM and the IFM are not isolated issues, and usually mirror society's general characteristics and problems, the adopted model for stakeholder participation will vary with the specific circumstances.

Bottom-up and Top-down: An extreme "bottom-up" approach risks fragmentation rather than integration. On the other hand, the lessons from past attempts at "top-down" approaches clearly indicate that local institutions and groups tend to spend a great deal of effort subverting the intentions of the institution supposedly responsible for overall management of the basin. It is important to make use of the strengths of both the approaches using an appropriate mix.

Integration of Institutional Synergy: All institutions necessarily have geographical and functional boundaries. It is necessary to bring all the sectoral views and interests to the decision making process. All the activities of local, regional and national development agencies, departments and ministries working in the field of agriculture, urban development, watershed development, industries and mines, transport, drinking water and sanitation, poverty alleviation, health, environment, forestry, fisheries and all other related fields should be co-ordinated at the highest level.

The challenge is to promote co-ordination and co-operation across functional and administrative boundaries. River basin organizations can provide an appropriate forum for such co-ordination and integration. The best examples of such practice are likely to lie in those conditions under which there has been no choice but to seek to build such coordination and cooperation between existing institutions.

Adopt Integrated Hazard Management Approaches

Communities are exposed to various natural and man-made hazards and risks. A wide range of activities and agencies are involved in the successful implementation of disaster management strategies. They involve individuals, families and communities along with a cross-section of civil society such as research institutions, governments and voluntary organizations. All these institutions play vital roles in transforming warnings into preventive action. Members from all sectors, involving different disciplines must be involved in the process and carry out activities to ensure the implementation of disaster management plans.

The success of disaster mitigation will be measured from the public understanding of the adoption of appropriate strategies and their implementation and preparedness. Integrated natural hazard impact mitigation to address all hazards holistically ("all hazard" emergency planning and management) is preferable to hazard specific approaches and hence IFM should be integrated into a wider risk management system. This helps in structured information exchange and the formation of effective organizational relationships. The approach has the benefit of improved treatment of common risks to life, efficient use of resources and personnel and includes development concerns along with emergency planning, prevention, recovery and mitigation schemes. It consequently ensures consistency in approaches to natural hazard management in all relevant national or local plans.

Early warnings and forecasts are key links to the series of steps required to reduce the social and economic impact of all natural hazards including floods. However, to be effective, early warnings of all forms of natural hazards must emanate from a single officially designated authority with a legally assigned responsibility.

6. PUTTING INTEGRATED FLOOD MANAGEMENT INTO PRACTICE

As IFM is essentially a subset of IWRM it faces similar challenges, though perhaps greater since the desire and pressure to bring short-term benefits following a disastrous flood can overwhelm attempts at a longer-term integrated approach. Integrated Flood Management requires certain basic inputs and a conducive environment for its effective implementation. These requirements are a function of the specific hydro-meteorological and physical conditions of the basin coupled with cultural and socio-economic interactions and existing development plans for the location.

Clear and Objective Policies Supported with Legislation and Regulations

The nature of the flood problem creates a situation of competing claims and sometimes the need for immediate action in order to fulfil people's aspirations, particularly just after a major flood. In such circumstances integration is the first casualty. Thus, political commitment to IFM principles and practice is critical. The strategies developed for IFM need to be translated into specific policies for planning, allocation and management of resources. Linking flood management with IWRM and thus social and economic development, providing inter-sectoral linkages and the basis for stakeholder participation call for a substantial overhaul of policies, laws and management institutions. Clear and objective policies for the declared goals of the government, supported with appropriate legislation and regulations to enable the process of integration, are a prerequisite for IFM.

Integrated Flood Management seeks both to modify the system and interactions in order to enhance economic and social welfare while recognizing that the system is subject to influences both natural, such as climate variability, and artificial, such as land use. What one expects to see as a result are approaches that are appropriate to local conditions within the wider vision of the river basin, matching policies within the overall framework of national economic, social and environmental priorities. There is a need to develop and adopt policies that respond to the long-term needs and address themselves to both extreme and normal flood events, providing for stakeholder participation in the process. These policy stipulations have to be supported through an appropriate legislative framework such as flood plain zoning regulations, disaster response regulations, etc. Apart from these, to fulfil the basic enabling environment for IWRM, the principles of water and land use, water rights and the legitimacy of stakeholders also need to be defined.

The flood management sector has seen very few flood related laws legislated, and more importantly, implemented, especially in developing countries. In certain countries the indivisibility of river water and riverbed does not exist. How it affects the flood plain regulation mechanism needs to be addressed. Flood plain zoning and regulation, flood disaster management legislation, flood plain infrastructure development regulation need be put in place and require a political commitment for their effective implementation.

Institutional Structure through Appropriate Linkage

Fragmentation and sharing of responsibilities in a society are inevitable. Further, an institution has formal and informal rules which govern both what it can do and, by inference, what it cannot do. These prescriptions commonly define both the geographical space across which the institution can operate and also the functions or objectives it can pursue. Unfortunately, the geographical boundaries of a river basin rarely coincide with those of the institutions that are involved in the management of that basin. In the past, rivers have been important barriers so that the centre line of a river has commonly come to be an important boundary between political entities. Again, the differences in size between catchments around the world mean that a river basin is usually unlikely to be the appropriate size for, say, a water supply company. As a consequence, the problem in IFM is usually to deliver comprehensive, co-ordinated management through the co-operation of fragmented institutions.

It is important to attain a mutually beneficial synergy between national interests, regional prosperity and the people's well-being through the best possible use of regions' natural resources – both land and water – and human capacity. River basin management is a long-term strategy to combat the threat of flooding and erosion with the need to preserve ecosystems. However, care must be taken that integration at a basin level does not lead to sub-optimization at a wider level. Not only is it necessary to consider the functioning of river basins, and the livelihood strategies of households and communities, but also to treat flood management within the development strategy of the nation or region as a whole. It is, therefore, vital that there be both upward integration into national policies and lateral integration between different national and regional policies. At the same time, the role of local, regional and national authorities in identifying and addressing development issues and in implementing development programmes and activities must be explicitly spelled out.

Community Based Institutions

Integration and co-ordination across sectors calls for trade-offs. Furthermore, the requirement for stakeholder involvement needs institutions that are community based. The challenge is to find ways of

co-ordinating and co-operating across institutional boundaries, to achieve IFM through decisions at the basin level with the complete involvement of local level institutions and implementation through these institutions.

To incorporate the "bottom-up" approach in the decision making process existing institutions need to be modified to facilitate community involvement. The critical issue in IFM is to resolve relationships between stakeholders, and so a common platform for stakeholders needs to be developed.

An obvious but dangerous approach to IFM would be to establish new institutions that would implement flood management by instructing all of the existing institutions (performing the functions that need to be integrated if IFM is to be adopted) operating within its geographical area. Such a simplistic approach to management of water resources is unlikely to succeed. Given the wide interaction between land use, hydrological and hydraulic characteristics of the drainage system; a river basin organization approach to flood management is preferable. This can ensure that local institutions do not ignore the effect of their actions on the downstream stakeholders. Existing institutional and community capacity needs to be enhanced to adjust to the requirements of IFM.

Multi-purpose interventions call for resolving conflicts between various user groups or stakeholders since it does not necessarily follow that consensus would always emerge as the best course of action. Given the uncertainties in the various elements and options constituting a strategy, solutions can scarcely be optimal. Consensus building and conflict management mechanisms have to be built in to the system.

Information Management and Exchange

In order to build consensus the capacities of all stakeholders and institutions to appreciate and adopt a holistic approach and look beyond their narrow short-term interests has to be built on their capabilities to understand and appreciate differing viewpoints in a rationale and objective manner. If stakeholder involvement is to be real and effective not only their capacities and capabilities have to be built up, they must be supported by expert advice and a knowledge base. The community has to be fully involved in data and information collection and in formulating and implementing emergency plans and post disaster responses. The sharing and exchange of data, information, knowledge and experience among experts and the general public, policy makers and managers, researchers and voluntary organizations, upstream and downstream users, all co-basin states and various institutions, in a most transparent manner is an essential ingredient for consensus building and conflict management and for the implementation of a chosen strategy. Transboundary sharing and exchange of flood information is essential for implementation of flood preparedness plans in downstream regions.

Appropriate Economic Instruments

Living on flood plains involves risk, and for this there is a price to pay. The cost of living on flood plains is borne by flood plain occupiers, by way of economic losses and reduced opportunities, and taxpayers, through government funded protection measures and relief and rehabilitation activities. To what extent this split is acceptable depends on the social and economic construct of the society. Ideally, the share in the risk should be commensurate with the gains to the common taxpayer from the economic activities of the flood plains occupier. To what extent a government should fund flood mitigation activities and subsidies to flood insurance can be debated and will largely depend on the socio-economic policies of the government. The success of the IFM approach will depend on how these economic instruments are used.

7. END-NOTE

Integrated Flood Management is founded on a broad concept that uses a combination of policy, regulatory, financial and physical measures which focus on coping with floods within a framework of IWRM while recognizing that floods indeed have beneficial impacts and can never be fully controlled. It may be noted that the paper does not go into detail on the various building blocks of IWRM including enabling environment, the cross-sectoral and upstream downstream dialogue, co-operation within international river basins, institutional and community capacity building, etc., which are equally important for IFM.

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Associated Programme on Flood Management
c/o Hydrology and Water Resources Department
World Meteorological Organization
7 bis, avenue de la Paix
Case postale 2300
CH-1211 Geneva 2
Switzerland
E-mail: apfm@wmo.int
Website: www.apfm.info
Tel: 41 22 730 8479
Fax: 41 22 730 8043