INTEGRATED FLOOD MANAGEMENT CONCEPT PAPER

World Meteorological Organization
Weather • Climate • Water

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ASSOCIATED PROGRAMME ON FLOOD MANAGEMENT

CONTENTS

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 coordinates the meteorological and hydrological services of 189 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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FOREWORD

The livelihood of a vast share of the world's population depends, whether directly or indirectly, on a number of key natural resources that are generally provided by floodplains, as well as on the income generated thereby. Several global issues, including increasing population pressure, continuous degradation of ecosystem services and, of course, climate variability and change, can contribute to a further increase in flood risks worldwide, a concern which in many parts of the world is further exacerbated by inadequate flood planning and management practices. Accordingly, an Integrated Flood Management (IFM) approach, which is an essential component of Integrated Water Resources Management, can help to balance flood risk management and development needs.

Ever since the first publication of the *Integrated Flood Management Concept Paper* in 2003, it has been the baseline reference document outlining IFM as a viable development policy option. Since IFM is essentially a dynamic notion, the perception presented in this third revised edition also includes a number of emerging issues, such as risk management, urban floods, climate variability and change, and adaptive management. Through this new edition, WMO hopes that the concept paper will continue to play a key outreach role to flood managers, policymakers and development planners, as well as to those responsible for formulating flood management strategies and policies.

The draft for this revised concept paper was prepared by the Associated Programme on Flood Management (APFM) Technical Support Unit, and it was subsequently reviewed by leading experts in the field of flood management and endorsed by the APFM Management Committee in June 2009. It is a pleasure to express the gratitude of WMO to all those actively involved in its preparation.

(M.Jarraud)
Secretary-General

SUMMARY

Integrated Water Resources Management (IWRM), as defined by the Global Water Partnership, is "a process which promotes the coordinated 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". This approach recognizes that a single intervention has implications for the system as a whole, and that the integration of development and flood management can yield multiple benefits from a single intervention.

Integrated Flood Management (IFM) integrates land and water resources development in a river basin, within the context of Integrated Water Resources Management, with a view to maximizing the efficient use of floodplains and to minimizing loss of life and property. Integrated Flood Management, like Integrated Water Resources Management, should encourage the participation of users, planners and policymakers at all levels. The approach should be open, transparent, inclusive and communicative; should require the decentralization of decision-making; and should include public consultation and the involvement of stakeholders in planning and implementation.

The management of 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, and encourages the efficient use of the resources of the river basin as a whole, employing strategies to maintain or augment the productivity of floodplains, while at the same time providing protective measures against the losses due to flooding. Sustainable development through Integrated Water Resources Management aims at the sustained improvement in the living conditions of all citizens in an environment characterized by equity, security and freedom of choice. Integrated Water Resources Management necessitates the integration both of natural and human systems and of land and water management.

Both population growth and economic growth exert considerable pressure on the natural resources of a system. Increased population pressure and enhanced economic activities in floodplains, such as the construction of buildings and infrastructure, further increase the risk of flooding. Floodplains provide excellent, technically easy livelihood opportunities in many cases. In developing countries with primarily agricultural economies, food security is synonymous with livelihood security.

The ecosystem approach is a strategy for the integrated management of land, water and living resources, a strategy that promotes conservation and sustainable use in an equitable manner. Both Integrated Water Resources Management and Integrated Flood Management encompass the main principles of the ecosystem approach by considering the entire basin ecosystem as a unit and by accounting for the effects of economic interventions in the basin as a whole. Environmental sustainability of the flood management options is one of the prerequisites in IFM.

Sustainable and effective management of water resources demands a holistic approach, linking social and economic development with the protection of natural ecosystems and providing appropriate management links between land and water uses. Therefore, water related disasters, such as floods and droughts, because they play an important part in determining sustainable development, need to be integrated into water resources management.

A holistic approach to emergency planning and management is preferable to a hazard-specific approach, and IFM should be part of a wider risk management system. This approach fosters structured information exchange and the formation of effective organizational relationships. In integrated flood management planning, achieving the common goal of sustainable development requires that the decision-making processes of any number of separate development authorities be coordinated. Every decision that influences the hydrological response of the basin must take into account every other similar decision.

Adaptive management offers a robust but flexible approach to dealing with scientific uncertainties,

an approach wherein decisions are made as part of an ongoing science-based process. It involves planning, acting, monitoring and evaluating applied strategies, and modifying management policies, strategies and practices as new knowledge becomes available. Adaptive management explicitly defines the expected outcomes; specifies the methods to measure performance; collects and analyses information so as to compare expectations with actual outcomes; learns from the comparisons; and changes actions and plans accordingly.

Water will be the primary medium through which the expected effects of climate change will materialize. Climate change and increased climate variability will affect flood processes in several ways simultaneously. Sea level rise will place coastal communities at higher flood risk. And changing precipitation patterns will lead to an increased occurrence of flash floods and, in some regions, riverine floods. Integrated Flood Management takes account of those expected effects, and is therefore an autonomous adaptation strategy to climate variability and change.

1. INTRODUCTION

The recurrence of the extreme precipitation anomalies that result in floods or droughts is a normal component of natural climate variability. The adverse effects of floods and droughts often entail far-reaching socio-economic and environmental implications, and may include loss of life and property; mass migration of people and animals; environmental degradation; and shortages of food, energy, water and other basic needs. The degree of vulnerability to such natural hazards is high in developing countries where necessity tends to force the poor to occupy the most vulnerable areas. The vulnerability of developed countries increases with economic growth and the accumulation of property in flood-prone areas and in highly urbanized settings.

The Plan of Implementation of the World Summit on Sustainable Development, held in Johannesburg, South Africa, 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 …" (United Nations Department of Economic and Social Affairs, 2002). Through this declaration, 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.

The strategic goals of the Hyogo Framework for Action (HFA) call for more effective integration of disaster risk considerations into sustainable development policies, planning and programming at all levels, with an emphasis on disaster prevention, mitigation, preparedness and vulnerability reduction; and for the development and strengthening of institutions, mechanisms, and capacities at all levels (United Nations International Strategy for Disaster Reduction, 2005). The HFA thus supports Integrated Flood Management as environmental and natural resource management that incorporates disaster risk reduction into its approach. The Hyogo Framework for Action also supports decentralizing the management process to the lowest appropriate level. Climate change is expected to exacerbate flooding in most regions. In light of this expectation, adaptation planning under the United Nations Framework on Climate Change and other frameworks for climate change adaptation assign flood management as a priority.

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. Integrated Water Resources Management necessitates the integration both of natural and human systems and of land and water management. The literature on IWRM, however, rarely considers the flood management issues associated with water resources management, and the need to develop a better understanding of how to incorporate flood management into IWRM remains.

This paper presents Integrated Flood Management (IFM) as an integral part of IWRM, and describes the interplay between floods and the development process. It takes a look at traditional flood management practices; identifies the major challenges for flood managers and decision-makers dealing with sustainable development; and describes the basic tenets and requirements of IFM. This concept paper is the "flagship" publication of the "Flood Management Policy Series". Subsequent papers go into further detail to help flood managers and decision-makers implement the concept. An understanding of this series of papers requires familiarity with flood management issues and with the concept of IWRM.

Integrated Flood Management is not universally applicable, but rather requires adaptation to specific situations, varying according to the nature of the floods, the flooding problem, the socio-economic conditions and the level of risk a society is prepared to take (or is forced to take) in order to achieve its development objectives. Similarly, the application of IFM at different administrative levels or geographic scales (national or transnational basins, for example) implies differentiated approaches to the process and to policy design.

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. They are all subject, however, to a variety of natural and man-made disturbances such as floods, droughts and other natural hazards, economic recessions and civil strife. These disturbances adversely affect personal assets and the multipliers of community well-being, such as job availability, the natural resource base and social networks, all of which contribute to the capacity to increase personal incomes. Unequal opportunities with respect to access to resources and information, and unequal power to participate in the planning and implementation of development policies mean that these disturbances have varying effects on different societies and on different groups within societies.

Natural disasters cause much misery, especially in developing countries where they cause great stress among low-income economies. Approximately 70 per cent of all global disasters are linked to hydrometeorological events. Flooding poses one of the greatest natural risks to sustainable development. Flood losses reduce the asset base of households, communities and societies through the destruction of standing crops, dwellings, infrastructure, machinery and buildings, quite apart from the tragic loss of life. In some cases, the effect of extreme flooding is dramatic, not only at the individual household level, but in the country as a whole. While the 2005 floods in Switzerland, representing the worst single loss event in the country since systematic records began, amounted to less than 1 per cent of gross domestic product (GDP), this figure regularly rises above 10% in developing economies, especially when floods occur as part of tropical cyclones (Federal Office for the Environment of Switzerland, 2007). In addition, the assessment of floods on a piecemeal basis, rather than holistically, may limit the usefulness of the effort.

Although living on a floodplain exposes its occupants to flooding, it also offers enormous advantages. The deep, fertile alluvial soil of floodplains – the result of aeons of flooding – is ideal for higher crop yields and the location provides good market access. Floodplains typically support high population densities, such as in the Netherlands and Bangladesh, and the GDP per square kilometre is high in countries constituted mostly of floodplains: the Netherlands boasts the highest GDP per square kilometre in Europe. Floods sustain ecosystems and the services that ecosystems provide. In Cambodia, the annual floods occurring on the floodplains of the Tonle Sap Lake are of prime importance in keeping the lake one of the most productive freshwater ecosystems (in terms fish catch) worldwide. This high productivity contributes strongly to regional food security (Van Zalinge, 2003).

The balancing of 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 floodplains of the Mississippi, in 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 floodplains – even if there is considerable risk to life and property. The best approach is the integrated management of floods.

An understanding of the interplay between floods, the development process and poverty is vital in order to ascertain the way in which current and future development processes can and do increase flood 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 of community well-being 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 prospect.

Risk is a combination of the chance of a particular event, with the impact the event would cause if it occurred. Risk therefore has two components, the chance (or probability) of an event occurring and the impact (or consequence) associated with that event. The consequence of the event may be either desirable or undesirable.

Vulnerability is a function of the ability of a society, community or household to mobilize the assets available to meet the challenges posed by flooding. 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 flooding or by improving their capacity to cope with the disturbance.

3. TRADITIONAL FLOOD MANAGEMENT OPTIONS

The traditional management response to a severe flood was typically an ad hoc reaction – the quick implementation of a project that considered both the problem and its solution to be self-evident, and that gave no thought to the consequences for upstream and downstream flood risks. Thus, flood management practices have largely focused on reducing flooding and reducing the susceptibility to flood damage. Traditional flood management has employed structural and non-structural interventions, as well as physical and institutional interventions. These interventions have occurred before, during and after flooding, and have often overlapped.

This section briefly discusses the traditional flood management interventions listed below:

- Source control to reduce runoff (permeable pavements, afforestation, artificial recharge);
- Storage of runoff (wetlands, detention basins, reservoirs);
- Capacity enhancement of rivers (bypass channels, channel deepening or widening);
- Separation of rivers and populations (land-use control, dikes, flood proofing, zoning, house raising);
- Emergency management during floods (flood warnings, emergency works to raise or strengthen dikes, flood proofing, evacuation); and
- Flood recovery (counselling, compensation or insurance).

(Section 5 elaborates on those measures that strengthen the case for adopting an integrated approach to flood management.)

Source controls intervene in the process of the formation of runoff from rainfall or snowmelt, and take the form of storage in the soil or via the soil. The use of this strategy normally considers the consequential effects on the erosion process, the time of concentration in the soil and the dynamics of evapotranspiration. The assessment of the likely effectiveness of source control also considers pre-flood conditions such as the state of saturation of the soil, and whether or not the ground is frozen. Thus, a potential drawback with some forms of source control, and other forms of land-use modification such as afforestation, is that the capacity to absorb or store rainfall depends on the antecedent conditions of the catchment.

Surface water storage, through such as devices as dams, embankments and retention basins, is a traditional approach to attenuating flood peaks. Water storage modifies floods by slowing the rate of rising waters, by increasing the time it takes for the waters to peak and by lowering the peak level. More often than not, such storage serves multiple purposes, and flood storage can be the first casualty in any conflict among purposes. Moreover, by completely eliminating the low floods, such measures can give a false sense of security. Storage has to be used in an appropriate combination with other structural and non-structural measures. Seemingly self-evident, but regularly overlooked in practice, is the need to make flood management a part not only of the planning and design, but also of the operation of reservoirs. Releases from reservoirs can create risks, and the careful operation of reservoirs can minimize the loss of human life and property due to such releases. In this context transboundary cooperation is indispensable.

Increasing the carrying capacity of a river changes its natural morphological regimes and ecosystem, affects 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. Dikes or flood embankments are most likely to be appropriate for floodplains that are already intensely used, in the process of urbanization, or where the residual risks of intense floodplain use may be easier to handle than the risks in other areas (from landslides or other disturbances, for example).

Land-use control is generally adopted where intensive development on a particular floodplain is undesirable. Providing incentives for development to be undertaken elsewhere may be more effective than simply trying to stop development on the floodplain. Where land is under development pressure, however, especially from informal development, land-use control is less likely to be effective. Flood proofing or house raising are most appropriate where development intensities are low and properties are scattered, or where the warning times are short. In areas prone to frequent flooding, flood proofing of the infrastructure and the 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. Public education programmes are crucial to the success of warnings intended to preclude a hazard from turning into a disaster. Evacuation is an essential constituent of emergency planning, and evacuation routes may be upward into a flood refuge at a higher elevation or outward, depending upon the local circumstances. Outward evacuations are generally necessary where the depths of water are significant, where flood velocities are high and where the buildings are vulnerable. Successful evacuations require planning and an awareness among the population of what to do in a flood emergency. Active community participation in the planning stage, and regular exercises to assess the viability of the system help ensure that evacuations are effective. The provision of basic amenities such as water supply, sanitation and security in areas where refugees gather is particularly important in establishing a viable evacuation system.

4. THE CHALLENGES OF FLOOD MANAGEMENT

Securing Livelihoods

Both population growth and economic growth exert considerable pressure on the natural resources of a system. Increased population pressure and enhanced economic activities in floodplains, such as the construction of buildings and infrastructure, further increase the risk of flooding. Floodplains provide excellent, technically easy livelihood opportunities in many cases. In developing countries with primarily agricultural economies, food security is synonymous with livelihood security. Floodplains contribute substantially to the food production that provides nutrition for the people of these countries. While it can be argued that virtual water[1] 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. The competition for access to limited land resources can jeopardize the weaker sections of the population who largely occupy the floodplains. Resettlement programmes and other floodplain policy measures must be assessed for their overall effect on the livelihood opportunities of populations at risk.

Rapid Urbanization

When there are increases in population in rural areas, it is often difficult for the standard of living to improve beyond basic sustenance. Farm living is dependent on environmental conditions that are often difficult to predict, and in times of drought, flood or crop failure, survival becomes extremely problematic. Under these conditions, people move from rural environments into cities to seek economic opportunities and better access to basic services. Climate change is likely to accelerate the migration patterns into urban areas by altering the livelihood basis from both fishing and farming, and by increasing the occurrence and intensifying the effects of natural hazards.

The urban proportion of the global population rose from 13 per cent in 1900, to 49 per cent in 2005. This figure is likely to rise to 57 per cent by 2025, and to nearly 70 per cent in 2050 (United Nations Department of Economic and Social Affairs, 2007). Most of this urbanization will take place in developing countries where the growth is largely unplanned and organic, occurring primarily in Asia and Africa, and to a lesser extent in Latin America and the Caribbean. Urbanization causes changes in the hydrological response of watersheds, and affects landforms, water quality and habitat. Population growth and migration towards unplanned urban settlements in the floodplains of developing countries increase the vulnerability of the poorest sectors of society to flooding. The fact that a large proportion of urban growth occurs in coastal zones raises the spectre of greatly increased flood vulnerability among these populations, not least due to the expected increase in riverine and coastal flooding resulting from climate change. These sectors of society also suffer from a lack of health and sanitation facilities and are thus most vulnerable to disasters and post-disaster consequences. Flood management policies must consider the needs of these societies.

The Illusion of Absolute Safety from Flooding

Absolute protection from flooding is technically infeasible and economically and environmentally unviable. No design standard of protection can account for the inherent inaccuracies in the estimates of the magnitude of potential extreme floods, or for the modifications over time resulting from climate change.

The question of whether to design interventions that provide protection from large floods or that reduce the losses resulting from high frequency floods poses an analytical dilemma. Designing for high frequency floods entails a greater risk of disastrous consequences when more extreme events take place. Similarly, designing for large floods must account of the likelihood of failure in cases of floods of magnitude below the notional design standard. In these cases, failures can occur when some structural measures, such as dikes and bypass channels, are inadequately maintained due to long-term disuse or lack of finances, and may no longer function properly.

1 Virtual water (also known as embedded water, embodied water, or hidden water) refers, in the context of trade, to the water used in the production of a good or service.

Flood risk management should estimate the likelihood of such failures, identify how the failures might occur and provide for how such events are to be managed.

Ecosystem Approach

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

Some flood management interventions adversely affect riverine ecosystems by reducing the frequency of flooding of the wetlands that develop around floodplains. These areas are subject to frequent flooding and owe the large variety of flora and fauna to this phenomenon. In these situations, changes in high frequency (smaller) floods would damage the ecosystems that have developed around the existing flood regime. The reduction of extreme floods, on the other hand, offers protection to the ecosystem. Thus, the magnitude and variability of the flow regime needed within a basin in order to maximize the benefits to society and to maintain a healthy riverine ecosystem must strike a balance between competing interests in the river basin. New interventions, the retrofitting of current structures, and adjustments in the operating rules of existing measures may offer opportunities for improved management.

The ecosystem approach is a strategy for the integrated management of land, water and living resources, a strategy that promotes conservation and sustainable use in an equitable manner. Both Integrated Water Resources Management and Integrated Flood Management encompass the main principles of the ecosystem approach by considering the entire basin ecosystem as a unit and by accounting for the effects of economic interventions in the basin as a whole. Environmental sustainability of the flood management options is one of the prerequisites in IFM.

Climate Variability and Change

A variety of climate and non-climate parameters influence flood processes. Apart from the antecedent basin conditions, flood magnitudes depend on precipitation intensity, depth, timing, and spatial distribution and phase. Temperature and wind affect snowmelt, which in turn affects flood magnitudes. The projected effects of global warming include changes in atmospheric and oceanic circulation, and many subsystems of the global water cycle are likely to intensify, leading to altered patterns of precipitation and runoff. (Bates and others, 2008) Various climate model simulations show complex patterns of precipitation change, with some regions receiving less and others receiving more precipitation than they do now.

The likely increase in the intensity of tropical cyclones implies a corresponding increase in the intensity of precipitation events. Similar patterns are also likely in high latitude areas that are expected to experience an increase in mean precipitation. Most tropical and middle and high latitude areas are expected to experience a greater increase in extreme precipitation than in mean precipitation (Bates and others, 2008). These heavy precipitation events are likely to increase in magnitude and frequency, resulting in an increase in the frequency of major floods in many regions.

The Intergovernmental Panel on Climate Change found a tendency for an increase in heavy rainfall events in many regions, even in some regions in which the mean annual rainfall is projected to decrease (Intergovernmental Panel on Climate Change, 2007). In these cases, the decrease in rainfall is often attributed to a decrease in the number of rain days rather than to a decrease in precipitation intensity. This leads to the conclusion that more heavy and intense rainfall may be expected in future but in an overall fewer number of events, implying greater incidence of extreme floods and droughts (Trenberth and others, 2003). At the same time, global sea levels are projected to continue to rise as the world warms. This has the potential to result in lowland inundation; enhanced coastal erosion; altered tidal range in rivers and bays; more severe storm surge flooding; increased saltwater intrusion into estuaries and freshwater aquifers; and increased wind and rainfall damage in regions prone to tropical cyclones. The rise in sea level increases the risk of coastal flooding, particularly in relation to storm surges.

Climate change poses a major conceptual challenge as it shakes the foundation of the normal assumption that the long-term historical hydrological conditions will continue into the future. At the same time the future development path and the consequent impacts on climate change can at best be projected in terms of different development scenarios. Tackling climate change requires leadership, vision, capacity, and resources beyond our experiences to date. On a positive note, however, flood management practitioners have dealt with climate variability in terms of extremes for decades, trying to capture all forms of uncertainty, as, for example, in the freeboards in dike design.

Regional shifts in climate, such as in average annual rainfall, may happen at a much faster pace than global shifts. In light of these possibilities, the selection of a design flood should balance risks and benefits on the basis of scientific principles, the knowledge of preceding flood events and the public's perceptions of risk. Flood management policy has already shifted in various places towards an approach beyond the myth of "absolute safety from flooding" towards a more flexible and adaptive approach of "living with flood risk". Such an approach recognizes the value of flood protection measures, yet also recognizes such residual risks as levee failure. Flood management needs to provide strategies for such eventualities, further strengthening the need for a balanced combination of structural and non-structural approaches. Balancing and sequencing a mix of "soft" (institutional and capacity) and "hard" (infrastructure) investment responses is complex, and calls for skills in the art of adaptation in water management.

The Nairobi Statement on Land and Water Management for Adaptation to Climate Change suggests a set of guiding principles that cover sustainable development, resilience, governance, information and economics and financing (Dialogue on Climate Change Adaptation for Land and Water Management, 2009).

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 (Administrative Committee on Coordination and Inter-Secretariat Group for Water Resources, 1992) and the Earth Summit in Rio (United Nations, 1993). Subsequent meetings (most notably the World Summit on Sustainable Development in Johannesburg in 2002) have re-emphasized that IWRM is a necessary criterion for sustainable development.

According to the Global Water Partnership, "Integrated Water Resources Management is a process which promotes the coordinated 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" (Global Water Partnership Technical Advisory Committee, 2000). The Global Water Partnership interprets "management" as including both "development and management". Sustainable and effective management of water resources demands a holistic approach, linking social and economic development with the protection of natural ecosystems and providing appropriate management links between land and water uses. Therefore, water related disasters, such as floods and droughts, because they play an important part in determining sustainable development, need to be integrated into 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 the use of floodplains and minimizing loss of life from flooding.

Globally, both land – particularly arable land – and water resources are scarce. Most productive arable land is located on floodplains. 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 floodplains. On the other hand, economic losses and the loss of human life 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 flux 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 upper catchments of the river into the coastal zone (ridge to reef) – often taken to extend dozens of kilometres inland and to cover much of the river basin – can have significant consequences. As estuaries embrace both the river basin and the coastal zone, it is important to integrate coastal zone management into IFM. Figure 1 depicts an IFM model.

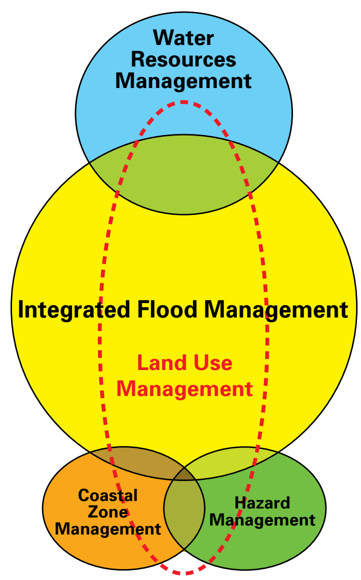

Figure 1. Integrated flood management model

The attempt is, therefore, 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 environments 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 with the awareness of flood risk – particularly where land resources are limited. In other words, 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 river basin in general.

Elements of Integrated Flood Management

Integrated Flood Management takes a participatory, cross-sectoral and transparent approach to decision-making. The defining characteristic of IFM is integration, expressed simultaneously in different forms: an appropriate mix of strategies, carefully selected points of interventions, and appropriate types of interventions (structural or non-structural, short- or long-term).

An Integrated Flood Management plan should address the following six key elements that follow logically for managing floods in the context of an IWRM approach:

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

Manage the Water Cycle as a Whole

Most of the time runoff constitutes an essential part of the available water resource and only poses a problem under extreme conditions. In arid and semi-arid climates in particular, floods represent a large part of the available water resource. Integrated Flood Management focuses on managing the land phase of the water cycle as a whole, taking into account the whole range of floods – small, medium and extreme. It recognizes the influence of floods on the recharge of groundwater, which forms an important source of water during dry periods, and takes account of the other extreme of the hydrologic cycle – drought.

Flood management plans should include drought management, and should take measures to maximize the positive aspects of floods such as by retaining part of flood flows for use in crop production. Alluvial floodplains, in particular, provide opportunities for groundwater storage of floodwaters. Integrated Flood Management should treat groundwater and surface water as linked resources, and should consider the role of floodplain retention capacities for groundwater recharge. Flood management plans should take a holistic approach to exploring the possibilities for accelerated artificial recharge under given geological conditions. Interventions that change the runoff regime, however, need to consider the potential adverse effects. Taking measures to reduce runoff during the rainy season, for example, could be counter-productive if those measures also reduce runoff at other times of the year.

Integrated Flood Management recognizes the need to manage all floods and not just those floods up to some design standard of protection. Flood plans must consider what will happen when a flood more extreme than the design standard flood occurs, and must foresee how such a flood will be managed. Plans must clearly identify areas to be sacrificed for flood storage in order to protect critical areas in an extreme flood event.

Urban flood management needs to deal explicitly with the three basic components of urban water management: drinking water supply; sewage and wastewater disposal; and surface runoff disposal. Urban flood plans must manage both stormwater quantity and the effects of stormwater on water quality. Polluted flood waters cause one of the most severe post-flood problems in urban areas. Traditionally, the municipal divisions responsible for flood management have focussed on the engineering aspects of drainage with the goal of channelling stormwater as fast and unobtrusively as possible out of town, often without consideration of the downstream effects. In many urban areas, however, the complete separation of stormwater management from the water supply systems is not feasible, and the draining of stormwater as fast as possible is not desirable. A growing number of "water sensitive" cities recognize these emerging ideas, and Integrated Flood Management provides strong support for their efforts .

Integrate Land and Water Management

Hydrological responses to rainfall strongly depend on the local characteristics of soil, such as water storage capacity, infiltration rates and preceding rainfall conditions. The type and density of vegetation cover and the land-use characteristics are also important in understanding a catchment's response to rainfall. Human alterations to catchments can play a significant role in increasing flood hazards if the runoff generation process is changed, especially when the infiltration capacity of the soil decreases or a change in soil cover occurs. Environmental degradation and uncontrolled urban development in high-risk zones, such as historical inundation plains and the bases of mountain ranges, lead to an increased vulnerability to catastrophic events for those communities on the floodplains. Changing pervious natural surfaces to less pervious or impervious artificial surfaces, leads to an increase on storm water runoff rates, and the total volume of runoff may also affect water quality. Changes in natural water storage as a consequence of urbanization also cause significant changes to the temporal characteristics of runoff from an urbanized area, such as shortening the runoff travel time, and can result in an increased incidence of flash flooding.

Land-use planning and water management should be combined in one synthesized plan with a certain common field, such as the mapping of flood hazards and risks, to enable the sharing of information between land-use planning and water management authorities. 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 an approach to IFM based on river basins.

Upstream changes in land use can drastically change the characteristics of a flood and the associated water quality and sediment transport characteristics, especially conversion of forested areas and wetlands into other landforms. Upstream urbanization as well as river training can cause an accentuation of flood peaks and their early occurrence in downstream reaches. Low-lying depressions can play an important role in flood attenuation, but the consequent deposition of solid wastes in depressions may worsen health conditions and increase flood peaks in downstream reaches. Ignoring these linkages in the past has often led to failure. Flood management needs to recognize, understand and account for these linkages in order to realize the synergies in improving river basin performance. Taking advantage of these potential synergies will, however, require the wider perspective of the development of the river basin in its entirety. Attempting to resolve local problems in an isolated manner is no longer a viable strategy, if it ever was.

Manage Risk and Uncertainty

Climate change exacerbates the risks to modern society. Living on a floodplain involves the risk of damage to property and the loss of life, yet also provides opportunities. Policy design should consider flood risk in the context of other prevailing risks to individuals, households and communities, in particular, the risks associated with poverty. Otherwise, policies for reducing flood risk may have the unintended consequences of reducing opportunities for livelihood through such measures as restrictive floodplain regulation or resettlement programmes based on an imperfect understanding of the socio-economic implications.

Flood risks are also related to hydrological uncertainties. Our knowledge of the present is incomplete and generally we have an imperfect understanding of the causal processes in operation. The extent of future changes cannot be predicted with certainty, as these changes may be random (climatic variability), systemic (climate change) or cyclical (El Niño). Hydrological uncertainty, however, is perhaps subordinate to social, economic and political uncertainties: the biggest and most unpredictable changes are expected to result from population growth and economic activity.

Uncertainty and risk management are defining characteristics of choice, and risk management is a necessary component of the development process, essential for achieving sustainable development. The application of a risk management approach provides measures for preventing a hazard from becoming a disaster. Flood risk management consists of systematic actions in a cycle of preparedness, response and recovery, and should form a part of IWRM. The actions taken depend on the conditions of risk within the social, economic and physical setting, with the major focus on reducing vulnerability.

Risk management calls for identification, assessment, and minimization of risk, or the elimination of unacceptable risks through appropriate policies and practices. Flood risk management also includes the efforts to reduce the residual risks through such measures as flood-sensitive land-use and spatial planning, early warning systems, evacuation plans, the preparations for disaster relief and flood proofing and, as a last resort, insurance and other risk sharing mechanisms.

Adopt a Best Mix of Strategies

Table 1 displays the strategies and options generally used in flood management. The adoption of a strategy depends critically on the hydrological and hydraulic characteristics of the subject river system and region. Three linked factors determine which strategy or combination of strategies is likely to be appropriate in a particular river basin: the climate, the basin characteristics and the socio-economic conditions in the region. The nature of the region's floods, and the consequences of those floods are functions of these linked factors.

Optimal solutions depend upon knowledge that is complete, precise and accurate. In light of the uncertainty about the future, flood management plans should adopt strategies that are flexible, resilient and adaptable to changing conditions. Such strategies would be multi-faceted with a mix of options.

Integrated Flood Management avoids isolated perspectives and the trap of assuming that some forms of intervention are always appropriate and that others are always bad. Successful IFM looks at the situation as a whole, compares the available options and selects a strategy or a combination of strategies that is most appropriate to a particular situation. Flood management plans should evaluate, adopt and implement those structural and non-structural measures appropriate to the region, and should guard against measures that create new hazards or shift the problem in time and space.

Strategy	Options
Reducing Flooding	Dams and reservoirs
	Dikes, levees and flood embankments
	High flow diversions
	Catchment management
	Channel improvements
Reducing Susceptibility to Damage	Floodplain 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	Floodplain zoning and regulation

Table 1. Strategies and Options for Flood Management

Evidence suggests that a strategy to decrease risks through the reduction of flood hazards – through structural measures such as flood embankments or non-structural measures including afforestation – can confer only partial safety for people inhabiting floodplains. Floodplain users who think they have total protection may increase their investments, and when the protection fails, experience heavier losses than they would have otherwise. For many societies, 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. The side effects of such measures may also be too damaging to the environment or in contravention of the development goals of the society. In such cases an appropriate strategy might be to reduce vulnerability through disaster preparedness and flood emergency responses. If, however, the analysis of the flood issue suggests that the main issue is a lack of investment in the agricultural sector because of too frequent flooding and the resulting agricultural damage, a more diversified approach might be necessary. Such an approach could provide a minimum safety level through agricultural levees, and provide incentives for agricultural use but not necessarily for residential or higher value uses.

Loss of life and property can be minimized if appropriate disaster response plans, supported by reasonably accurate and reliable forecasts, are put in place and are well rehearsed. Flood hazard 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, and inadequate institutional capacity for enforcement.

Flood management plans should guard against the inclination, especially after extreme flood events, to adopt only long-term interventions. The success of a strategy depends on the stakeholders, especially those who are directly affected by the floods, getting an immediate reassurance of safety through short-term measures. Therefore, flood management plans need to include both long-term and short-term interventions.

Ensure a Participatory Approach

The definition of sustainable development adopted at the 1992 Rio Earth Summit specifies the involvement of the public at all levels of decision-making and recognizes the role of women. On the subject of water, the definition stresses "management at the lowest appropriate level".

Identification and Participation of Stakeholders: Integrated Flood Management, like Integrated Water Resources Management, should encourage the participation of users, planners and policy-makers at all levels. The approach should be open, transparent, inclusive and communicative; should require the decentralization of decision-making; and should include public consultation and the involvement of stakeholders in planning and implementation. Representatives of all the upstream and downstream stakeholders 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. The stakeholder consultation process should be clear about who has standing in the decision, and should ensure that the powerful do not dominate the debate.

It is essential that a good representative range of stakeholders is involved in the IFM dialogue and decision-making process. The impacts of flooding and of interventions are often differentially distributed among households and sections of a community. Women are usually the primary providers of child and health care, 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, religious and cultural differences in perspective.

Stakeholder consultation should provide for the participation of minorities and indigenous people and the socially or economically weaker sections of society, and flood planning should account for the interests of other vulnerable sections of society, such as children and the elderly. Indigenous knowledge of coping with floods should inform the mix of measures evaluated. At the same time, the pace of human induced changes to the hydrological and climatic systems means that the adequacy of adopted and proposed measures need to be regularly reassessed. The form of participation may vary, depending upon the social, political and cultural makeup of the society. 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 and other interested parties. 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: 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 that support the implementation of disaster mitigation and management plans.

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 in determining the 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 should be coordinated at the appropriate level. These may include departments and ministries, as well as private enterprises working in the fields of agriculture, urban and watershed development, industry and mining, transport, drinking water and sanitation, poverty alleviation, health, environmental protection, forestry, fisheries and all other related fields. The challenge is to promote coordination and cooperation across functional and administrative boundaries. River basin committees or organizations, at basin or sub-basin levels, can provide appropriate forums for such coordination and integration. The best examples of such practice are likely to be found where circumstances required the coordination and cooperation of existing institutions.

Adopt Integrated Hazard Management Approaches

Certain hazards within the basin, such as landslides, have the potential to modify the flood risks downstream and, combined with floods, can generate mudflows. Storm surges associated with tropical cyclones greatly influence the flooding in estuarine areas and have the potential to travel tens of kilometres upstream thereby influencing riverine flooding. Such hazards call for a multi-hazard approach. A holistic approach to emergency planning and management is preferable to a hazard-specific approach, and IFM should be part of a wider risk management system. This approach fosters structured information exchange and the formation of effective organizational relationships.

The integrated hazard management approach includes development concerns along with emergency planning, prevention, recovery and mitigation schemes, and offers a better treatment of common risks to life, as well as more efficient use of resources and personnel. 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. To be effective, however, early warnings of all forms of natural hazards must emanate from officially designated authorities with a legally assigned responsibility.

6. PUTTING INTEGRATED FLOOD MANAGEMENT INTO PRACTICE

As an integral part of Integrated Water Resources Management, Integrated Flood Management faces similar challenges. The effective implementation of both IFM and IWRM requires an enabling environment in terms of policy, legislation and information; clear institutional roles and functions; and management instruments for effective regulation, monitoring and enforcement. These requirements are a function of the specific climatic, hydrological and physical conditions of the basin coupled with cultural, political 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 often 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 the planning, allocation and management of resources, not only in one sector such as transport or environment, but in all sectors having an influence on flood formation and management. Linking flood management with IWRM provides intersectoral linkages with social and economic development, and forms the basis for stakeholder participation. This approach may imply 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 prerequisites.

Integrated Flood Management seeks to develop and adopt policies that respond to long-term needs and that address themselves to both extreme and normal flood events, while providing for stakeholder participation in the process. These policy stipulations require an appropriate legislative framework defining the rights, powers and obligations of the concerned institutions and floodplain occupants. Regulations may cover such issues as floodplain zoning, the conduct of flood and severe weather forecasting and warning services, and disaster response, among others. In addition, the basic enabling environment for IWRM incorporates the principles of water and land use, requires a clear understanding of water rights and establishes the legitimacy of stakeholders. Flood-related legislation is rare, especially in developing countries, and the effective implementation of legislation requires a long-term political commitment.

The Need for a Basin Approach

River and lake basins are dynamic systems with complex interactions between the land and water environments (Figure 2). These interactions involve not only water but also soil, sediment, pollutants and nutrients. The system is dynamic over both time and space. The functioning of the basin as a whole is governed by the nature and extent of these interchanges.

An increase in economic activities, such as mining, farming or urbanization, may result in large-scale deforestation, leading to 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 sediment conveyance system. Over a period of years this sometimes results in some stretches of the river bed becoming raised above the surrounding floodplains, while erosion processes dominate downstream of reservoirs, as sediments are trapped by those reservoirs.

Large-scale urbanization in comparatively small catchments accentuates flood peaks and reduces the time of concentration. This is because land surfaces in urbanized basins – made up of roofs, paved streets and other impervious surfaces – increase overland flow volume and decrease groundwater recharge and evapotranspiration. In lowlands and coastal areas, road and rail embankments and similar infrastructure can obstruct flood flows and exacerbate flood conditions upstream. Similarly, measures to improve navigation can have drastic effects on biodiversity and increase the risk of flooding. These and other competing requirements call for an integrated, basin-wide approach to flood management.

While the basin is the fundamental unit for water resources planning and management, integration at a basin level can lead to sub-optimization at a wider (national or regional) level. Integrated Flood Management needs 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 the region as a whole. Both upward integration into national policies and lateral integration among different national and regional policies is vital. At the same time, the roles of local, regional and national authorities in identifying and addressing development issues and in implementing development programs and activities must be clear to all involved.

Institutional Structure through Appropriate Linkage

In Integrated Flood Management planning, achieving the common goal of sustainable development requires the coordination of the decision-making processes of any number of separate development authorities. Every decision that influences the hydrological response of the basin must take into account every other similar decision. 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. Some fragmentation and sharing of responsibilities are inevitable, and institutions have formal and informal rules which govern both what they can and cannot do. These rules commonly define both the geographical space across which the institutions can operate and also the functions or objectives they can pursue.

At the international basin scale, integration of IFM principles into wider frameworks for the utilization and protection of international watercourses is essential. Some 40 per cent of the world's population live in river and lake basins that comprise two or more countries, and perhaps more significantly, over 90 per cent live in countries that share basins internationally. National

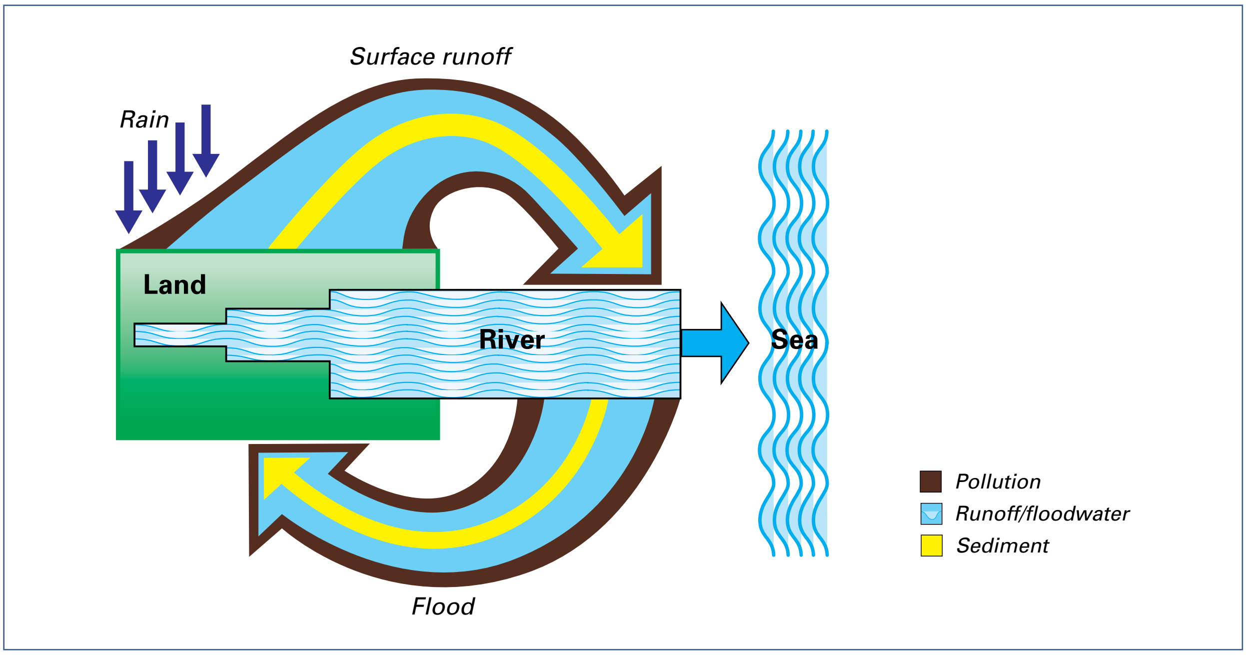

Figure 2. Interaction between land and water

legislation must take account of international obligations in transboundary watercourses, and communication between riparian states affected by floods should be as effective and efficient as possible. Similarly, existing rules of international law, especially those pertaining to "equitable and reasonable utilization" and "no significant harm" must be the foundation of conduct within internationally shared water courses. Integrated Flood Management seeks to attain a mutually beneficial synergy between national interests to promote regional prosperity and to improve the people's well-being through the best possible use of a region's natural resources. The same principle applies to federally organized countries where rivers are shared on the subnational level.

Community-Based Institutions

Integration and coordination across sectors calls for stakeholder participation that involves community-based institutions. Integrated Flood Management attempts to find ways of coordinating and cooperating across institutional boundaries to reach decisions at the basin level, and to involve local level institutions in both the decisions and their implementation. Some institutions may need to change their decision-making processes to facilitate community involvement in this "bottom-up" approach. The success of Integrated Flood Management depends on the relationships among stakeholders, and on a fair and transparent set of rules for stakeholder participation.

An obvious but dangerous approach to IFM would be to establish new institutions that would implement flood management by having authority over all of the existing institutions currently performing IFM functions within their respective geographical areas. Such a simplistic approach to the 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 approach can ensure that local institutions do not ignore the effect of their actions on downstream stakeholders. Existing institutional and community capacity may therefore need to be enhanced to meet the requirements of IFM.

Multi-purpose interventions often call for resolving conflicts between various user groups or stakeholders because of the difficulty of reaching consensus. The uncertainties inherent in the various elements and options constituting a strategy can exacerbate this difficulty, and render the defining of optimal solutions impossible. The stakeholder participation system must therefore include mechanisms for consensus-building and conflict management.

Multidisciplinary approach

Integrated Flood Management addresses itself to the interplay between the beneficial uses of floodwater and floodplains, on the one hand, and the risks posed by extreme events to the sustainable development in flood-prone areas on the other. Flood issues are influenced not only by the physical causes of flooding but by the overall social, economic and political setting of the area concerned. Further, flood impact assessment is an important and integral part of flood risk assessment and management. An understanding of the effects (environmental, economic and social) of an event is required for an assessment of the benefit–cost ratio of various options of risk management strategies.

The need to consider vulnerability in the management of risks requires a multidisciplinary approach with close collaboration and coordination among various development ministries, sectors and institutions at various levels of administration. Decision-making is no longer one-dimensional and focused on economic efficiency, but is increasingly becoming multi-dimensional and concerned with achieving multiple, often conflicting, objectives. The involvement of different stakeholders is central to making better decisions. The growing diversity in public values and opinions has made it difficult to evaluate and justify a project by one single method. Capturing these diverse values and opinions requires public participation in the planning process. A significant number of countries have passed regulations that require public involvement in the decision-making process, and IFM requires the involvement of all stakeholders including the civil society and communities that are directly affected.

Adaptive management

Scientific knowledge about future flood risks contains uncertainty due to both the uncertain natural inputs in terms of climate change and the human induced changes in the catchments. In such conditions the policies to address these uncertain risks has to be based on a robust but flexible approach. Adaptive management has been widely recognized as the approach to deal with such scientific uncertainties, wherein decisions are made as part of an ongoing science-based process. It involves planning, acting, monitoring and evaluating applied strategies, and incorporating new knowledge as it becomes available into management approaches. Monitoring and periodically evaluated results are used to modify management policies, strategies and practices. Adaptive management explicitly defines the expected outcomes, designs the methods to measure responses, collects and analyses information so as to compare expectations with actual outcomes, learns from the comparisons, and changes actions and plans accordingly.

Information Management and Exchange

Stakeholder involvement in Integrated Flood Management is most likely to build consensus where the stakeholders endorse the holistic IFM approach, look beyond their narrow short-term interests and regard differing viewpoints in a rationale and objective manner. Effective stakeholder involvement may require a capacity-building effort to ensure that stakeholders operate from a sound and relevant knowledge base and are supported by expert advice. 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 and experience among experts, the general public and all others involved are essential to consensus-building and conflict management, and to the implementation of a chosen strategy. This information exchange must be conducted in a transparent manner and should involve all parties. Transboundary sharing and exchange of flood information is essential for implementing flood preparedness plans in downstream regions. Information related to flood emergency preparedness and response should be shared as a public good.

Appropriate Economic Instruments

The cost of living on floodplains is borne in part by floodplain occupiers, through economic losses and reduced opportunities, and in part by taxpayers, through government funded protection measures and relief and rehabilitation activities. The extent to which this split is acceptable depends on the social and economic construct of the society. The costs of taking flood risk have to be distributed not only among those occupying the floodplains and drawing direct benefits but also among those who derive indirect benefits. Ideally, the public share in the risk should be commensurate with the gains to the common taxpayer from the economic activities of the occupied floodplains. The extent to which the government should fund flood management activities and pay subsidies to flood insurance should be debated locally within the context of the socio-economic policies of the government. The fair and equitable sharing of the costs of flood risks should be determined in a transparent manner. The success of the Integrated Flood Management approach depends to some extent on how the economic instruments (taxes, subsidies and insurance) for sharing flood risks are used.

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Integrated Flood Management recognizes that floods indeed have beneficial effects and can never be fully controlled. The IFM approach uses a combination of regulatory, financial, physical and policy measures that focus on coping with floods within a framework of Integrated Water Resources Management. This paper does not go into detail on the various building blocks of IWRM. The Flood Management Policy Series and the Flood Management Tools Series, published by the Associated Programme on Flood Management, provide further guidance on these and many other issues.

See: http://www.apfm.info/publications.htm#fm_policy or http://www.apfm.info/ifm_tools.htm for more information.

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