



World Meteorological Organization



FORMULATING A BASIN FLOOD MANAGEMENT PLAN



A Tool for Integrated Flood Management



ASSOCIATED PROGRAMME ON FLOOD MANAGEMENT

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The Associated Programme on Flood Management (APFM) is a joint initiative of the World Meteorological Organization (WMO) and the Global Water Partnership (GWP). 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.



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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).



Note for the reader

This publication is part of the “*Flood Management Tools Series*” being compiled by the Associated Programme on Flood Management. The contained Tool for “Formulating a Basin Flood Management Plan” is based on available literature, and draws findings from relevant works wherever possible. This Tool addresses the needs of practitioners and allows them to easily access relevant guidance materials. The Tool is considered as a resource guide/material for practitioners and not an academic paper. References used are mostly available on the Internet and hyperlinks are provided in the “References” section.

This Tool is a “*living document*” and will be updated based on sharing of experiences with its readers. The Associated Programme on Flood Management encourages flood managers and related experts engaged in formulating a basin flood management plan around the globe to participate in the enrichment of the Tool. *For the purpose comments and other inputs are cordially invited.* Authorship and contributions would be appropriately acknowledged. Please kindly submit your inputs to the following Email address: apfm@wmo.int under Subject: “Basin Flood Management Plan Tool”.

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FORMULATING A BASIN FLOOD MANAGEMENT PLAN

TABLE OF CONTENTS

1. INTRODUCTION	1
2. FLOOD MANAGEMENT POLICY	3
2.1 NATIONAL DEVELOPMENT POLICY	3
2.2 ROLE OF FLOOD PLAINS IN NATIONAL ECONOMY	3
2.3 NATIONAL FLOOD MANAGEMENT VISION AND POLICY	4
3. BASIN FLOOD MANAGEMENT PLAN.....	6
3.1 BASIN FLOOD MANAGEMENT VISION AND POLICY	6
3.2 THE PLANNING PROCESS	6
3.3 SURVEY AND ANALYSIS	9
3.4 FLOOD RISK ASSESSMENT	10
3.5 SETTING TARGET FOR BASIN FLOOD MANAGEMENT PLAN.....	11
3.6 IDENTIFICATION AND SELECTION OF OPTIONS TO REDUCE RISKS	12
3.7 IMPLEMENTATION PLAN AND MONITORING	14
REFERENCES	15
ANNEX I.....	17
ANNEX II.....	18
I) BASIN APPROACH	18
II) RISK MANAGEMENT	18
III) MULTI-DISCIPLINARITY	19
IV) ENGAGING ALL STAKEHOLDERS	19
V) TREATING FLOODS AS PART OF THE WATER CYCLE	19
VI) EQUITY AND FAIRNESS.....	19
FIGURES	
Figure 1. The Cycle for Developing and Adjusting an IWRM Plan	7
Figure 2. Step of Basin Flood Management Planning.....	8





1. INTRODUCTION

- 1 Historically, flood plains have been a preferred place for human settlement and socio-economic development because of their proximity to rivers, guaranteeing rich soils, abundant water supplies and means of transport. Floods play an important role in maintaining the natural function of river and flood plains and are source of fresh water and other natural resources, which bring the opportunity of livelihood. They replenish wetlands, recharge groundwater and support fisheries and agriculture systems thereby supporting livelihoods. At the same time, floods are also a source of risk when people and their activities are exposed to flooding without factoring their negative impacts. They can produce severe adverse impacts on the economy and people's safety. Given their beneficial location, people prefer to stay in flood plains even though they are aware of the flood risks. People in the flood plain have to adapt their life to these conditions.
- 2 The hydrological processes responsible for flood generation are continuous and interrelated across a river basin. There is a close relation between water resource management, river management, land use management, forest management, erosion control, agriculture, urban drainage and sewerage within a basin. Changes in the characteristics of the catchment have influence on the characteristic and magnitude of flood regime. Flood management measures may have impacts on the magnitude of floods downstream thereby transferring the flood risks. The flood management measures therefore should take account of entire basin from upstream to downstream. For example, restricting the solutions to the flood plains alone restricts the option of managing the run off where it is generated. Therefore the strategy for flood risk reduction should be realized through a basin flood management plan. Such a plan should take account of all the development activities undertaken in the basin that have the potential to affect the flood regime. Various organizations and institutions with mandates related to development activities that effect the hydrological processes in the basin should be counted as stakeholders in the process of formulating basin flood management plans. Basin flood management plans present clear picture of the causes and effects that promote Integrated Flood Management in a basin.
- 3 This tool is basically for the use of policy makers and flood practitioners to guide the contents and basic procedure of basin flood management planning. Several issues relate to the flood management planning is explained such as national development vision/policy and enabling mechanism of planning.
- 4 Integrated Flood Management (IFM) aims to harmonize human activities and flood risks through appropriate interventions to modify the water regime and adaptation of human behaviour thereby reducing such risks while maintaining the beneficial aspects of floods. The objectives of basin flood management plan are to protect life and property from flood risks and enhance the capability of socio economic development in the flood plains to realize the development vision in a basin through Integrated Flood Management (IFM). Evaluation of beneficial function of floods and negative consequences resulting from flood risks is the first step in developing a flood management plan.
- 5 Basin flood management planning should reflect the overall vision and policy of IWRM with special attention on the management of floods. Its formulation process should be incorporated in the planning process of IWRM. It has to be led by the designated authority or group of authorities that have responsibilities of flood management and basin planning. Since Integrated Flood Management (IFM) forms an integral part of Water Resources Management, it should be formulated in close coordination.
- 6 Establishment of an institutional framework and mechanism for transparent decision making involving all stakeholders is essential for ensuring ownership of all institutions and effected public. As such the plan should be formulated through active participation of all stakeholders concerned. If a basin wide institution exists, it should play the central role in the process. The institutions established for IWRM could lead or play a key role. In the case of an international river basin, it will require an international coordination mechanism such as international commission for coordination to exchange information,



develop policy and strategy, implement strategy and monitor the basin condition. Such a coordination mechanism can also support the cooperation during flood emergency situation.



2. FLOOD MANAGEMENT POLICY

- 7 In the past, in most of the countries, focus has been on control of floods in an ad-hoc manner with little or no attention to the long-term policies. Recent increasing trends in flood losses, threatening sustainability of development have, however, drawn wide attention of the policy makers. It is important to remember that floods are the only natural hazards that also provide freshwater resources and flooding has natural benefits to the society and the environment. As such the flood management policy has to be developed distinct from disaster management policies and have to be closely aligned to the water resources development and management.
- 8 The driving force behind establishing or modification of the flood management policy would be different in different physical and socio-economic contexts. These could be increasing damages, increasing casualties, migration of population from flood prone areas to cities or threat to food security. Whatever the driving force, the flood management policy has to be closely aligned with the national development vision and in certain cases the regional development goals.

2.1 NATIONAL DEVELOPMENT POLICY

- 9 National development vision/policy indicates the direction and goals of social, economic and cultural development of the nation, principles and strategies of the management of natural, land and human resources, financial mechanism to sustain development within the country. It indicates how national resources are deployed to achieve the national development goals. There are several issues that constitute the national development vision/policy that have relevance to flood management and need to be clearly identified. Below are some of such issues:
- Natural resources management (including water resources for domestic, agriculture, fishery, and industry)
 - Land use management (agriculture, industry, dwelling, urban development, etc)
 - Environmental management (conservation and modification)
 - Risk management policies, and
 - Social development issues (living conditions, level of poverty, equity and fairness principles)
- 10 For ensuring sustainable development in a country, the risks posed by various natural hazards that can hamper growth and development need to be managed. There are many kinds of risk that are rooted in both natural phenomena and human activities. National development policy should stipulate the basic policy of risk management and it should be embodied in the strategy for development in various sectors. Since the strategies for managing various risks have cross interactions an integrated approach such as multi-hazard management has the potential to enforce effectiveness and contribute to the rational utilization of national resources.
- 11 National development policy would generally provide the mechanism to formulate flood management strategy and action plan. National development policy would articulate public participation in decision making process and defining the role and responsibility of stakeholders in the decision making process. Basin flood management plan should be formulated drawing its inspiration from the national development policy.

2.2 ROLE OF FLOOD PLAINS IN NATIONAL ECONOMY

- 12 Flood plains provide the precious opportunities for farming, industry and urban development because of abundant water supplies, rich productive soils, and proximity to rivers. As such flood plains have been playing an important role in achieving various societal objectives such as food security, securing livelihood and enhance economic activities that contribute to the growth of Gross Domestic Product (GDP) of the country. National development vision, therefore, should reflect the current conditions



and issues in a basin and future prospect of improvement that can be realized through flood management measures in the basin.

- 13 As flood management attempts to realize national development goals by providing the enabling conditions in the flood plains, the elements of national development vision/policy should be examined for its relevance to the floods and flooding condition in the flood plains. Necessary arrangement are required for national development vision/policy if it is not appropriate from the flood management perspectives.
- 14 For developing basin flood management plans, identification of issues that are closely linked to floods and flooding is required. Analysis of benefits of flood waters and flooding vis-à-vis their negative socio economic impacts in form of flood risks become the starting inputs for the formulation of future vision, policy, strategy and action plan for flood management duly considering whether current condition should be maintained, improved or modified. Such an analysis should be undertaken in close cooperation of all stakeholders within a basin such as flood prone communities, public sector, local, district and national governments to comprehend the issues comprehensively and as such forms the starting point of identification and involvement of stakeholders. This is particularly important for the communities to have a chance to express their interests and concerns.

2.3 NATIONAL FLOOD MANAGEMENT VISION AND POLICY

- 15 A vision is a statement that describes a future state usually projecting for about 20 years. Visions, however, tend to be too vague and unachievable. Ideally they should be framed in the context of the national vision for development. The vision starts with the development of common view of the future and may include defined objectives, and policies, legislation and practice that would help translate them into realistic goals. The vision can be applied at a regional (inter-country) level, a shared watercourse level (internal river basin), a national level or a local level (sub-catchment). The vision can either take the shape of an overall statement of principle for the future of flood prone areas, or be developed in more detail combining clear statements on:
- Why flood management needs to be improved;
 - How risks due to floods are to be mitigated; and
 - When specific goals would be achieved.
- 16 Policies are more detailed than a vision. A national flood management policy provides a framework, gives direction for overall flood management in the country and facilitates coordination among various sectors and institutions involved/ related to flood issues. Therefore a written policy document, formally or informally adopted by government, is a valuable indication of government commitment to sustainable development. This is very relevant when considering a complex and cross cutting issue like water where many different interests have to be considered. In order to formulate flood management policy, it is necessary to delve into following pertinent questions:
- What are the rivers of the policy?
 - What role do the flood plains play in the economy of the country/region?
 - What issues in National development vision/policy have relevance to the condition of floods or flooding and its management?
 - How flood management can contribute to the national development?
 - How flood risks can be appropriately factored in national development planning?
 - How/Why the existing policies have/have not fulfilled their desired objectives?
 - How national development vision/policy should be aligned to the existing and future flood risks?
 - How flood risks mitigation costs are shared between federal, state, and local governments on one hand and the individual on the other?
 - What role do the different institutions play in flood management?



- 17 National flood management policy should be aligned with the other national development policies to achieve national development goals. National flood management policy should stipulate the basic tenet of flood management to contribute to the implementation of national development vision. It will guide stakeholders in practicing Integrated Flood Management. Such a policy would help build commitment of stakeholders.
- 18 National flood management policy should clearly adopt a basin approach to flood management planning. It should define as to how risks are proposed to be shared between Federal, State, and local governments on one hand and the individuals on the other. The relative emphasis that needs to be laid on risk reduction, and risk transfer has to be articulated. The need and means of bringing multi-disciplinary in the flood management in the country should be clearly defined. How the flood waters would be treated as asset and used as important element of the hydrologic cycle and augment the water and other national resources would be spelt out. Means of engaging all stakeholders in the planning and implementation of the policy so as to bring equity fairness in development would be identified.



3. BASIN FLOOD MANAGEMENT PLAN

3.1 BASIN FLOOD MANAGEMENT VISION AND POLICY

19 Based on the National vision and policy, a Basin Flood Management Vision and Policy should be developed at each river basin. Basin Flood Management Vision and Policy will show more specific images and ideas to be pursued and implemented in particular basin. It will reflect the characteristic of river basin with social and economic activities associated with the regime of the river. In the basin, impact of development activities on the flood risks can reflect themselves in changes in the flow regime and/or increased exposure of economic activities. Flow regime changes can be manifested in terms of changes in timing and volume, and quality of flood waters (due to water use, change of discharge conditions, increase of suspended material, inflow of driftwood, etc). Depending on the type and scale of development activities, the magnitude of influence could vary. Therefore overall review of various development policies on the flood risks is an essential first step. Following is a partial table that would help analyse these impacts. For a more detailed understanding the reader is referred to the Environmental Aspects of Integrated Flood Management [1]*.

National development policy	Likely changes in	
	Flow regime	Exposure to flooding
Agriculture		
Fishery		
Forest management		
Industry		
Urban development		
Environmental management		
Social condition improvement		
Others		

20 Basin Flood Management Vision and Policy will be reviewed to reflect the outcome of Flood Risk Assessment, which will be undertaken periodically with regard to the change in social, economical, environmental and hydro meteorological change in the basin.

3.2 THE PLANNING PROCESS

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

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

* [] indicate the reference listed at the end of the article

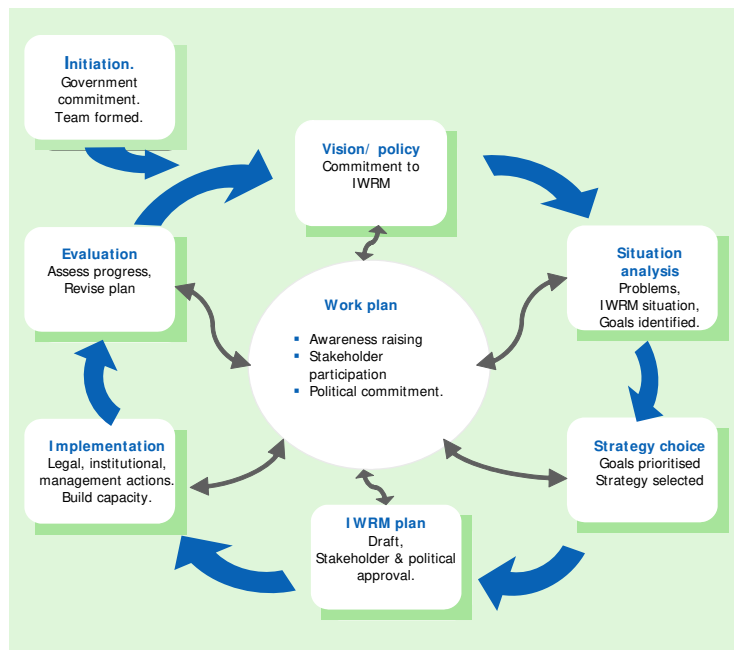


Figure 1. The Cycle for Developing and Adjusting an IWRM Plan

(“Integrated Water Resources Management Plans, Training Manual and Operational Guide”, CapNet, GWP and UNDP)[2]

- 22 Basin flood management planning should be essentially seen as a sub-set of an integrated water resources management plan. As such, the basin flood management planning should form part and parcel of IWRM plan development. However, more often than not this is not the case. Still in such cases also it would be useful to follow the basic cycle for developing an IWRM plan as given in Fig 1. In the absence of a river basin organisation, as a first step, it is essential to set up a core team consisting of representatives from key institutions that are mandated with flood management, water resources management, agriculture, disaster management and environment.
- 23 Like an IWRM plan the basin flood management plan requires identification of all relevant stakeholders. Apart from the general stakeholders in the water resources management, a basin flood management plan requires the disaster management institutions to actively participate in the process. The core team should set up a flood management committee or a steering group consisting of different key stakeholder ministries including financial ministry. It is important to draft a shared vision reflecting stakeholders’ needs, aspirations and concerns right at the beginning. Such a process begins with addressing certain key questions:
- Who are the stakeholders in the basin?
 - How they relate to the floods and flood plains?
 - How to proceed with the planning of their effective involvement?
 - What kind of arrangement is required for an international river basin?
- 24 There are certain prerequisites for ensuring the successful and sustainable involvement of stakeholders in a given situation. Role of each of the stakeholder, including the mechanism of their involvement, need to be specified so that they can be sustainable in the long term. Mechanism of engaging various stakeholder and their active participation in the proceeding of planning and decision making should be planned in advance and clearly articulated and clarified along with the launch of the process. The most important of all is to build trust through information sharing and repeated interactions. Social science expertise, outreach personnel and resources are needed to establish and sustain the participatory process. Commitment, accountability, transparency of action, the application of equality principles and tolerance towards dissent are factors that determine, encourage and promote public participation. A

public information campaign, started at the early stages, to share information and progress in the matter helps ensuring their participation at appropriate stages. A more detailed discussion on the subject is given in Social Aspects and Stakeholder Involvement in Integrated Flood Management [3].

- 25 Stakeholders' participation may require an enabling legal and institutional framework and continuous efforts to build capacity of different stakeholders. Some of these actions could be initiated right at this stage. In an international river basin the stakeholders, divided under different national government structures, involvement becomes more complex. However, aftermath of extreme flood events provide certain opportunities to explore the channels of communications if not already existing.

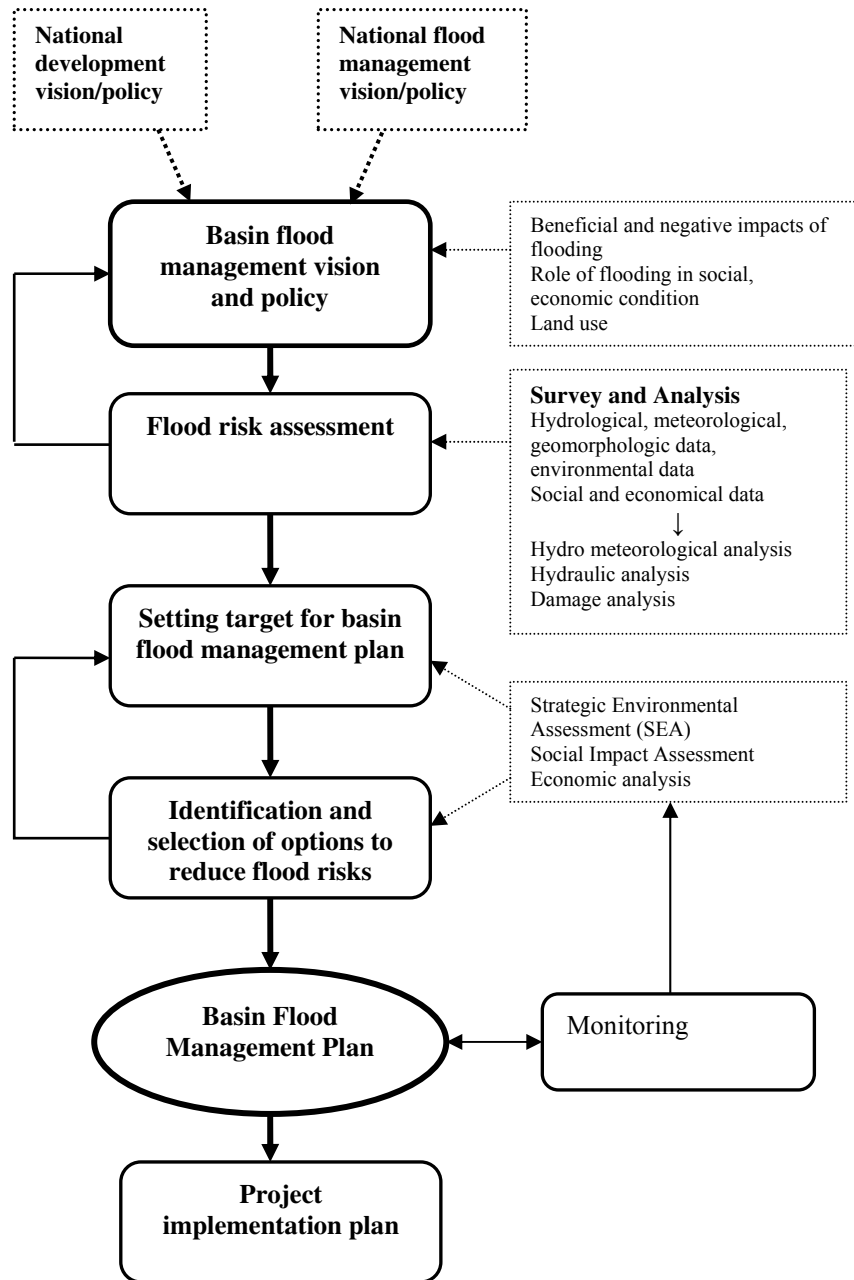


Figure 2. Step of Basin Flood Management Planning



3.3 SURVEY AND ANALYSIS

26 A variety of data, information and analysis are required to understand the flood issues, evaluate the current socio-economic conditions and the impacts of floods, project the future scenarios of development and climate change and the ecological consequences for the formulation of the basin flood management plan. The hydrological and meteorological data along with other physical characteristics of the basin are required for the analysis and simulation of physical characteristics of floods and flooding. Data of current social conditions, identification of beneficial aspects and negative socio economic impacts of floods, future economic development projections are required to decide the goals, target and activities to achieve the objectives. A quick analysis of the kind of data required for the basin flood management plan needs to be established right at the start. Following is the broad categories of data that may be required.

Basin condition

- Meteorological data
- Hydrological data
- Geomorphologic data
- Environmental data

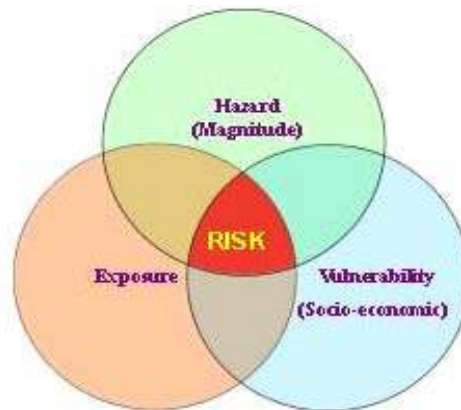
Social and economic condition

- Land use practices in the basin including flood plains
- Pattern of human settlements in and around flood plains
- Demographic profile of flood plain inhabitant
- Location of natural resources
- Livelihood sources in and around the flood plains
- Infrastructure and other assets in the flood plains
- Future development plan in the basin
- Social and economic damages in the past flood

27 Some of the information may not be readily available and may require special surveys. Particularly the information on the past floods and their beneficial and negative socio economic impacts may require to be assessed. Such surveys may require a clear understanding and evaluation of how people are utilize periodic floods for their activities and how floods contribute to the functioning and maintaining the natural ecosystem. The role of these ecosystems needs to be evaluated where possible in monetary terms.

28 Collection of data and information and its analysis may require inputs from experts outside the departments or institutions directly responsible and involved in the team created for the development of the plan. The kind of expertise required to analyse and evaluate the impact of floods may have to be called from outside the designated team. It is useful to draw upon the expertise of the specialist institutions within or outside the government. Requirement of such external expertise should be assessed very early in the process and such expertise services arranged to be available to the team throughout the planning process. Such an expert group may serve as the basis for continuous monitoring before, during and after implementation of the plan.

3.4 FLOOD RISK ASSESSMENT



- 29 A basin flood management plan has to start with assessing the present and future flood risks. Flood risks are a function of the magnitude of the hazard, the degree of exposure to the hazard and the vulnerability of society against damage due to the hazard.
- 30 Higher population pressures on natural resources are forcing people to carry their socio-economical activities in areas exposed to flooding, compelling them to take higher risks in search of livelihoods. Increase of economic infrastructure in flood-prone areas and development activities that have the potential to increase the magnitude of flood hazards, have considerably increased risk over the past decades. A risk culture that allows and enables us to assess, evaluate and reduce the prevailing risks and their escalation due to development activities is required.
- 31 Problem analysis starts with developing an understanding of the three constituents of flood risks.
- The magnitude of the flood **hazard** expressed in terms of frequency and severity (depth, extent and duration of inundation and relative velocities)
 - The **exposure** of human activities to flooding
 - The **vulnerability** of the elements at risk
- 32 Understanding of flood hazard and flooding may require hydro meteorological analysis; hydrologic and hydraulic simulation of surface runoffs, floods and inundations; and mechanism of flooding. It may also require a simulation and analysis projected conditions of land use change, future developments (e.g., urbanisation, infrastructure development etc) and the future trends of hydro-meteorological phenomenon due to climate variability or change. Flood inundation maps developed for different scenarios help understand and communicate with different stakeholders. Such flood maps would be the basis for developing flood risk scenarios based on various development alternatives, social and economic conditions. Based on the required uses, such flood maps should include other related and supplementary information to serve the desired purposes such as evacuation routes, raising risk awareness or regulatory. Other functions of flood maps could be (non-inclusive):
- **Planning:** Impacts of urbanisation, other land uses and climate change
 - **Regulatory:** Land use regulation and building codes
 - **Rescue Operations:** Building shelters and earmarking escape routes
 - **Flood Insurance**
 - **Informational/Educational:** record of flood magnitudes in an area
- 33 Analysis of exposure requires knowledge of the existing land use and the kind of activities that are undertaken in these areas. This analysis is useful in order to consider the regulatory mechanism as one



of the possible alternatives for risk reduction. It is also important to assess the exposures based on the planned future land uses contemplated.

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

3.5 SETTING TARGET FOR BASIN FLOOD MANAGEMENT PLAN

- 37 The scope of the basin flood management plan in terms of the geographical area covered should be clearly defined. A river basin (e.g., Yellow river in China, River Ganges in India) may be too big to have one set of basin flood management goals. In such cases, based on the regional characteristics, and issues it may be appropriate to develop separate plans for each of the sub-basins. On the other hand, a number of small basins, falling within a given administrative jurisdiction could be treated as a single unit for developing such a plan. Whatever the case, risk assessment shall be carried out for each basin distinctly.
- 38 Since most of the river basins around the world have certain flood control measures implemented, it is important that these are taken account through an analysis of their past performance and efficiency. It is useful to start with an enquiry into the principles that have been followed in the current flood management policies and practices and how successful they have been achieving the desired objectives.
- 39 The overall objective of a flood management plan is to prevent flood hazards turning into disasters while maintaining the benefit of floods.
- 40 Systematic actions in the cycle of preparedness, response and recovery based on the flood risk assessment carried out would help determine the distinct targets. These targets should clearly articulate as to how the flood risks would be reduced or managed. The targets would vary within a basin according to the natural conditions, state of socio economic activities and resultant damages. For example, the target for rural areas in a hypothetical basin could be:
- To reduce flood risks in rural agricultural areas by avoiding exposure to floods below 10 years frequency,
 - To deal with risks from all higher floods by reducing the exposure and vulnerability
- 41 The quantitative target mentioned in the first bullet will be implemented through structural measures by designing it to meet the requirement. As such, target of structural measure can be expressed in terms of quantitative evaluation of the effects of options, while non structural measure is usually not expressed its effects in terms of numerical terms. Since the structural measures require certain resources, the selection of target will subject to the analysis of its cost and effects to check the reasonability of choice, which will be explained in next section. Decision of the level of target also will subject to the availability of resources for the options in the basin. Optimization process in the



selection of options will sometime require reconsideration of initial setting of target. On the other hand, the target of non-structural measures will be the collective list of options applicable and effective in the place. The challenge in setting target and implementation of non-structural measures is how to activate knowledge and experiences to reduce flood risks and enhance the participatory action by stakeholders, even though some options such as forecasting system require certain resources.

42 Although the target level of structural measures would vary in a basin, certain common standards should be set up to show the level of safeties according to the condition of the basin, which is a commitment of government to guarantee the nation to protect people at certain level and maintain the equity in the national development. This also will be required for the future land use planning.

3.6 IDENTIFICATION AND SELECTION OF OPTIONS TO REDUCE RISKS

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

44 Hazards could be reduced adopting different approaches, say, by moderating the flood peaks, delaying flood peaks by retarding the surface run-off etc. Each one can be achieved in many ways. For example, the flood peaks could be moderated by retaining water it falls; by diverting and retaining the surface runoff in natural or artificial depressions; storing it in an on-stream reservoir; or a combination of them. Each one of the possible options of reducing flood hazard would have its functional efficiency, economic viability and environmental acceptability. Similarly flood risks could also be reduced by preventing exposure to flooding. Another approach would be increasing resilience of the society to withstand the adverse impacts. The last approach by reducing vulnerability plays key role in dealing with residual risks and the strategy to live with floods. A detailed discussion on the vulnerability characteristics and measures that may be useful in dealing with them is given in Social Aspects and Stakeholder Involvement in Integrated Flood Management [3].

45 Below is a list of options for reducing each constituent of flood risks. This is not an exhaustive list but pointers to the possible means.

Reduce hazard	Reduce Exposure	Reduce Vulnerability
<ul style="list-style-type: none"> • Retaining water where it falls (increasing infiltration, rooftop storing) • Retention basins (natural wet lands or depressions, man made e.g., school play grounds, household underground tanks) • Dams and reservoirs • Diversion channel • Land use management (e.g., house building codes in urban areas, infrastructure building practices, appropriate landscape planning) 	<ul style="list-style-type: none"> • Structural measures on the river (Dykes, river training work such as channelization, flood walls, raised infrastructures such as roads and railways) • Structural and non-structural measures/actions by individual (flood proofing) • Land regulation • Flood emergency measures (flood warning and evacuation) 	<ul style="list-style-type: none"> • Physical: by improving the infrastructure, well-being, occupational opportunities and living environment • Constitutional: by facilitating equal participation opportunities, education and awareness, providing adequate skills and social support system • Motivational: by building awareness and facilitating self organisation

46 A good guidance on the available options could be obtained by analysis of the past flood management practices actions and how they have mitigated the flood risks. Such an analysis would also provide



guidance on the improvements and modifications that may be required for adoption to the specific basin situation.

- 47 An exhaustive list of potential options for achieving the desired basin flood management targets could be derived in a variety of ways. First among them is the experience in the technical departments. However, care should be taken that the experts from other disciplines such as ecology, sociology, economics participate in brain storming mode of discussion and put forth their point of view and suggestion for achieving the targets. Public debate on various options and use of local knowledgebase can throw unexpected and un-conventional solutions. None of them should be discarded off hand.
- 48 The listed options should then undergo a multistage screening process from various perspectives: technical feasibility, economic efficiency, social acceptability and environmental viability. Technical standards or criterion should be adopted or developed to assess technical feasibility. This guarantees the consistency of designing and maintains the level of safety of structure.
- 49 Various tools such as Strategic Environmental Assessment, Social Impact Assessment, Cost Benefit Analysis and Multi-criteria Analysis are available to carry out each of these screening tests. However, in the preliminary stages it may not be feasible or necessary to carry out these tests vigorously and a qualitative assessment from technical, social, environmental and economic perspective may suffice. Such an analysis would best be carried out through an inter-disciplinary team of experts not only from the major stakeholder ministries and institutions but also specialise non-governmental organisations closely associated with flood issues. In the selection of options, multipurpose use of Dams/reservoirs should be taken into consideration to know the requirement of such facilities. In this regard, it is more cost effective and feasible to develop flood management plan as a subset of basin IWRM plan.
- 50 In the second stage of screening, which is generally more detailed an environmentally sensitive framework [1] is useful for decision making. Economic analysis provides efficiency and sustainability of the options. Strategic environmental assessment (SEA) examines the impact of intervention on the ecosystem in a basin to assess the environmental viability and sustainability, while, social impact assessment helps evaluate the social impacts such as equity. Multi Criteria Analysis is a method to identify best or best mix of options by comparing various assessment results and objectives. These analyses should be undertaken maintaining the transparency and accountability of the process and contents through stakeholders' participation. Disclosure of the information for wider public awareness of the process is crucial to gain the ownership of the process. Based on these analysis and evaluation, suit of options meeting the targets of basin flood management plan are chosen for inclusion in the basin plan. For a more detailed discussions the reader is referred to the Economic Aspects of Integrated Flood Management.
- 51 The basic template for basin flood management plan is attached as Annex II.
- 52 The decision of best options among available and practical choices is a challenge for decision maker because there may be conflicts between the stakeholders. Appropriate mechanism of decision-making should be sought and applied.

Stakeholder participation

- 53 Stakeholder participation brings individual and community ownership, commitment and concerted actions in flood risk mitigation, which in turn produces a wide range of appropriate, innovative and feasible mitigation solutions that are cost-effective and sustainable. It can also help take decisions on sharing the risks among various entities such as individual, communities, municipalities, state governments and the national government.
- 54 Stakeholder participation will start from the formulation of basin flood management vision and policy, the process of which will initiate the public motivation to be involved, and create the common base for



the discussion among various stakeholders. In many cases, the number and kind of stakeholders are so many to discuss together, delegate system is applied with employing public hearing or open forum as supplement measure to the process.

- 55 Flood risk assessment will be undertaken involving stakeholders. Even the assessment itself will require certain expertise, collecting and processing data in a participatory and transparently manner will create the trust and reliability of the contents. This is the essential part of capacity building of stakeholders to understand the necessity and requirement of flood management, which also facilitates the communication of risk management especially in the emergency situation. Understanding of risks helps create the national consensus on fund allocation to flood management.
- 56 As mentioned in the previous section, decision for setting target and selection of options is a crucial stage in basin flood management planning. Decision making process should be agreed and formalized in the beginning; otherwise people will deny entire process of planning if the decisions do not satisfy the person/organization's interest and concern. The process should state that who should make decision and how, while noting that best efforts will be made to solve conflicts. Different steps necessary in such a process are explained in the Social Aspects and Stakeholder Involvement in Integrated Flood Management.

3.7 IMPLEMENTATION PLAN AND MONITORING

- 57 There are several requirements for the implementation of basin flood management plan. Legal and institutional arrangements may be required to ensure the participatory process in the implementation of the plan. It may require clear assignment of the roles and responsibilities to implement and manage the implementation process and monitoring the plan implementation.
- 58 Some of the institutions may not have the capacity to undertake the responsibilities assigned to them. The plan should clearly define the capacity building requirements for all institutions and stakeholders at different levels in the basin. Some of these may relate to the capacity of the flood practitioners to implement the plan and monitor the whole process or the institutions that are required to build public awareness.
- 59 A plan of implementation for the options of basin flood management, providing clear timelines for meeting short- medium- and long-term target should be drawn. Such a plan should clearly assess the financial resources required and the way these resources are to be mobilised. This requires a clear assignment of tasks among organizations responsible and consultation with financial institutions to secure financial resource. The implementation plan should draw out alternative approaches to meet the targets if the required resources for taking up the plan as scheduled are not available. Identification of possible external resources for implementation of the plan should also be undertaken in consultation with the financial ministries in the country and the financial institutions. For this purpose, it is important to involve them from the beginning of the process of plan formulation.
- 60 At the implementation stage, detail design of various options would be carried out along with their Environmental Impact Assessment (EIA) [5] and economic analysis [6]. Final decision for implementing any component of the plan would be made based on the outcomes of these analyses.
- 61 Monitoring of basin condition before, during and after the implementation of the plan is essential to check its sustainability and help take corrective measures. Appropriate performance indicators, suitable for various level of management, have to be established and the threshold values assigned. If adverse affects beyond the specified threshold values are observed, modification and adjustment in the plan should be carried out.



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Further reading

Tools from GWP ToolBox <http://www.gwptoolbox.org>

- A1. POLICIES - Setting goals for water use, protection and conservation
- B1. CREATING AN ORGANISATIONAL FRAMEWORK - Forms and functions
- C1.3 Modelling in IWRM
- C2. PLANS FOR IWRM - Combining development options, resource use and human interaction



- C6.4 Land use planning controls and nature protection
- C8. INFORMATION EXCHANGE - Sharing knowledge for better water management

Other resources

Associated Programme on Flood Management, *Integrated flood management concept paper*, APFM Technical Document No.1, second edition (Geneva: Associated Programme on Flood Management, World Meteorological Organization, 2004).

http://www.apfm.info/pdf/concept_paper_e.pdf

Risk Management, 4th World Water Forum Thematic Document Framework Theme5 (2006).

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International Commission for the Protection of the Danube River, *Flood Action Programme: Action Programme for Sustainable Flood Protection in the Danube River Basin*, ICPDR Document IC/082 (2004).

<http://www.icpdr.org/wim07/search.php?tpl=icpdr-searchresult&siteid=2&q=Flood+Action+Programme>

International Commission for the Protection of the Danube River, *Development of the Danube River Basin District Management Plan*, (2005).

**Annex I****Basin Flood Management Plan: Contents**

1. Basin Flood Management Policy
 - 1.1 National flood management policy
 - 1.2 Basin flood management vision
 - Future plan of socio economic development in the basin
 - Basin flood management policy
 - 1.3 Legal and institutional setup
 - Role and responsibility of organizations at each level
(Institutional set up for flood emergency management, community based organization)
 - Available economic mechanisms
 - Environmental issues
 - Public participation
2. Outline of the basin
 - 2.1 The outline of natural condition
 - Geological, Meteorological, Hydrological, Geomorphologic and Environmental
 - 2.2 Administrative setup
 - Role and responsibility of existing institutions in the basin
 - 2.3 The outline of socio economic activities in the basin
 - Demographic conditions, Land use pattern, Livelihood sources and Asset distribution
 - 2.4 Beneficial aspects of floods
 - 2.5 Negative socio economic impacts of floods
 - Socio economic damage caused by past flooding
3. Flood risk management
 - 3.1 Risk assessment
 - 3.1.1 Hazard: Hydro meteorological and hydraulic analysis
 - 3.1.2 Exposure: Inundation area for given condition
 - 3.1.3 Vulnerability: Damages associated with flooding
 - 3.2 Risk mitigation
 - 3.2.1 Options for reduction of each constituent of flood risk (Hazard, Exposure and Vulnerability)
 - 3.2.2 Mechanisms for sharing risks
4. Basin flood management plan
 - 4.1 Identification and listing of options
 - 4.2 Evaluation of options
5. Implementation plan
 - 5.1 Short, medium and long term plan
 - 5.2 Role and responsibilities of organizations concerned
 - 5.3 Financial requirements
6. Recommendation
 - 6.1 Enabling requirements for the implementation of the plan
 - 6.1.1 Institutional changes required
 - 6.1.2 Public participation processes
 - 6.1.3 Financial mechanisms
 - 6.2 Monitoring
 - 6.2.1 Items of monitoring and method
 - 6.2.2 Evaluation mechanism



IFM Principles in National Flood Management Policies [7][8][9][10][11]

i) BASIN APPROACH

Key issues

- Downstream, upstream relationship
- Effect of land use change (land use management)
- Requirement of comprehensive measure
- Watershed management
- Ecosystem conservation

Australia: Floodplains will be developed and used in an ecologically, economically and socially sustainable fashion and in accord with the broader principles of sustainable natural resource and environment management and of integrated or total catchment management. Better and more efficient use of the nation's resources / Resource management considerations for floodplain areas, as addressed in floodplain management plans, need to be consistent with the objectives of broader resource management programmes; that is, sustainable management of the effect of flooding on the use of Australia's floodplains. Flooding needs to be considered from a catchment-wide perspective in order to manage effectively the result of existing development and the cumulative effects of future development on storm water and mainstream flooding. This perspective includes both the upstream and downstream implications of proposed land use development and floodplain management activities. Land use needs to be matched carefully to flood hazard to both maximize the benefits of using the floodplain and minimize the risks and consequences of flooding.

Switzerland: Land-use planning measures have the same priority as maintenance of river channels.

ii) RISK MANAGEMENT

Key issues

- Understanding of construct of flood risk (Hazard, exposure and vulnerability)
- Multi-hazard management approach (landslide, mudflows, storm surges, tsunamis, failure of river infrastructure, drought)
- Risk management principle (target level of safety of structural measures and residual risk, uncertainty related to the climate variability)
- Adapting risk management strategy (adaptive management, structural and non-structural measure)
- Flood emergency measures

Australia: All best practice principles are aimed at better management flood risk to optimize society's safe and sustainable use of Australia's floodplains in a cost-effective and ecologically responsible manner. Only flood emergency measures can be used to address the residual flood risk problem. / Care needs to be taken to ensure that strategies do not lead to public perception that flooding above selected standards will not occur. The use of the flood risk rather than some arbitrary flood recurrence interval or probability as the primary determinant for planning, development and building controls avoids much of the confusion and argument that can arise in a local community when flood levels "change".

Switzerland: Residual risks must be assessed and the planed measures supplemented by emergency planning and emergency organization.

UK: Extreme or unpredictable events can happen and it is not possible to protect everyone, everywhere against every flooding eventuality. So a necessary component of flood defense is a flood warning system, backed up by civil protection measures.



iii) MULTI-DISCIPLINARITY

Key issues

- Multiple concerns in the basin management calls for multi-disciplinarity in flood management
- Interactions between social, environmental and economic issues should be taken into account in the flood management

Australia: Comprehensive planning process to develop a flood plain management plan is the most effective and equitable way to realize the multiple objectives of floodplain management. Floodplain management is inevitably a compromise - trading off the social, economic and ecological costs and benefits of conducting certain activities on the floodplain against the risk, hazard and adverse consequences to these activities caused by flooding.

Switzerland: Flood protection concept has to be assessed in terms of technical, economic and ecological balance. Flood protection needs to show consideration for the numerous functions of the river.

UK: Take better account of environmental and social consequences as well as economic ones. Achieve a better balance between the social, environmental and economic pillars of sustainable development.

iv) ENGAGING ALL STAKEHOLDERS

Key issues

- Involvement of all stakeholders in the decision making process
- Conflict management
- Community participation
- Awareness rising

Australia: The local community needs to understand and appreciate the concept of flood risk and exposure to flood hazard - the local community needs to be flood aware.

Switzerland: Participation is required to realize sound projects and thus improve acceptance of measures.

UK: Implement the arrangement for stakeholder involvement at all levels of risk management.

v) TREATING FLOODS AS PART OF THE WATER CYCLE

Key issues

- Floods as a resource of water
- Floods as a important event for the floodplain ecosystem

Australia: Floods are a critical factor in the health of the floodplain itself, the rivers and coastal estuaries. Flood plain management can only occur on an objective and equitable basis if appropriate performance indicators are defined and used to evaluate the progress and success of floodplain management programs.

vi) EQUITY AND FAIRNESS

Key issues

- The target level of safeness by structural measures



- Who should pay for what (Role of government and responsibility of private – funding mechanism)
- Who will gain and who will lose (compensation mechanism)

Switzerland: Ensure access to the natural resource base and to public services under equitable conditions.