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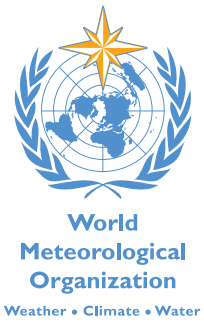

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To the reader

This publication is part of the *"Flood Management Tools Series"* being compiled by the Associated Programme on Flood Management. The *"Applying Environmental Assessment for Flood Management"* Tool 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 environmental assessment around the globe to participate in the enrichment of the Tool. For this 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: *"Applying Environmental Assessment for Flood Management"*.

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1 INTRODUCTION

1.1 Rationale and Objective of Tool

1 Integrated flood management calls for adopting the best mix of structural and non-structural measures. An isolated flood management option may achieve a limited objective, e.g. protection of a certain area, but may fail to address other objectives that may need to be addressed at the basin level.

Environmental assessment is an important input for project formulation as well as for strategic planning. It can be applied to plans and projects that are likely to cause adverse impacts on the environment and could help avoid, reduce or mitigate such impacts. In order to adequately assess and prevent environmental damage, a multi-stage process is called for.

2 Environmental assessment applications in basin flood management have been hampered due to inadequate guidance and readily available and acceptable methods. Thus the primary aim of this tool in this context is to provide practitioners a generic approach rather than prescriptive measures, designed for integrating environmental considerations into the decision-making processes in basin flood management from the earliest stage, and to document how this has been done.

3 This tool explains various aspects of environmental assessment both at the project and strategic level with special reference to flood management. It provides generic approach for conducting Strategic Environmental Assessments (SEA) at the basin flood management planning stage and Environmental Impact Assessments (EIA) at the project design and implementation stage. It helps document, identify, evaluate and mitigate environmental impacts of flood management measures from the early planning stages to the project implementation stage.

1.2 Environmental Assessment

4 As mentioned above and presented in **Figure 1**, environmental assessments are required to be applied at two main levels in flood management. These are the basin flood management planning stage and the project design and implementation stage. The environmental assessment at the planning stage is the SEA. EIA is applied at the time of transferring a basin flood management plan into specific projects. These are discussed briefly in the following sections.

1.2.1 Strategic Environmental Assessment (SEA)

5 SEA by definition is used to assess and predict the impact of Policies, Plans and Programmes (PPPs) on the state of the environment with a view to prevent environmental damage (Hayashi et al., 2003). It provides an opportunity to integrate environmental, social and economic considerations into strategic decision-making. SEA typically applies to regional development plans in the field of land use planning including basin plans, transport plans, waste management plans, tourism programmes, and energy plans among others.

It presents a more proactive approach than EIA and integrates environmental considerations into the strategic levels of decision-making process. Application of strategic environmental assessment from initial stages of decision-making prevents irreversible environmental damage that may be discovered at the later stage. It therefore provides early warning for environmental impacts during the decision-making process.

6 Often, physical developments and projects are the result of implementation of a policy or a plan. For example an extended highway network may be an outcome of a new transport policy. SEA focus is on long term actions such as new or amended laws, policies and plans and thereby on strategic issues that have long term impacts.

7 Major stakeholders involved in an SEA process are government officials, public agencies, policy-makers, technical experts from both academia and consulting institutions as well as funding agencies e.g. World Bank, Japan International Cooperation Agency (JICA), Asian Development Bank (ADB). In general, the public may be less inclined to participate in a PPP process compared to project, since the public is less able to foresee the likely impact of long-term policies. Therefore, essentially, representatives of general population e.g. mayors, government officials, community group leaders, and NGOs form part of the SEA.

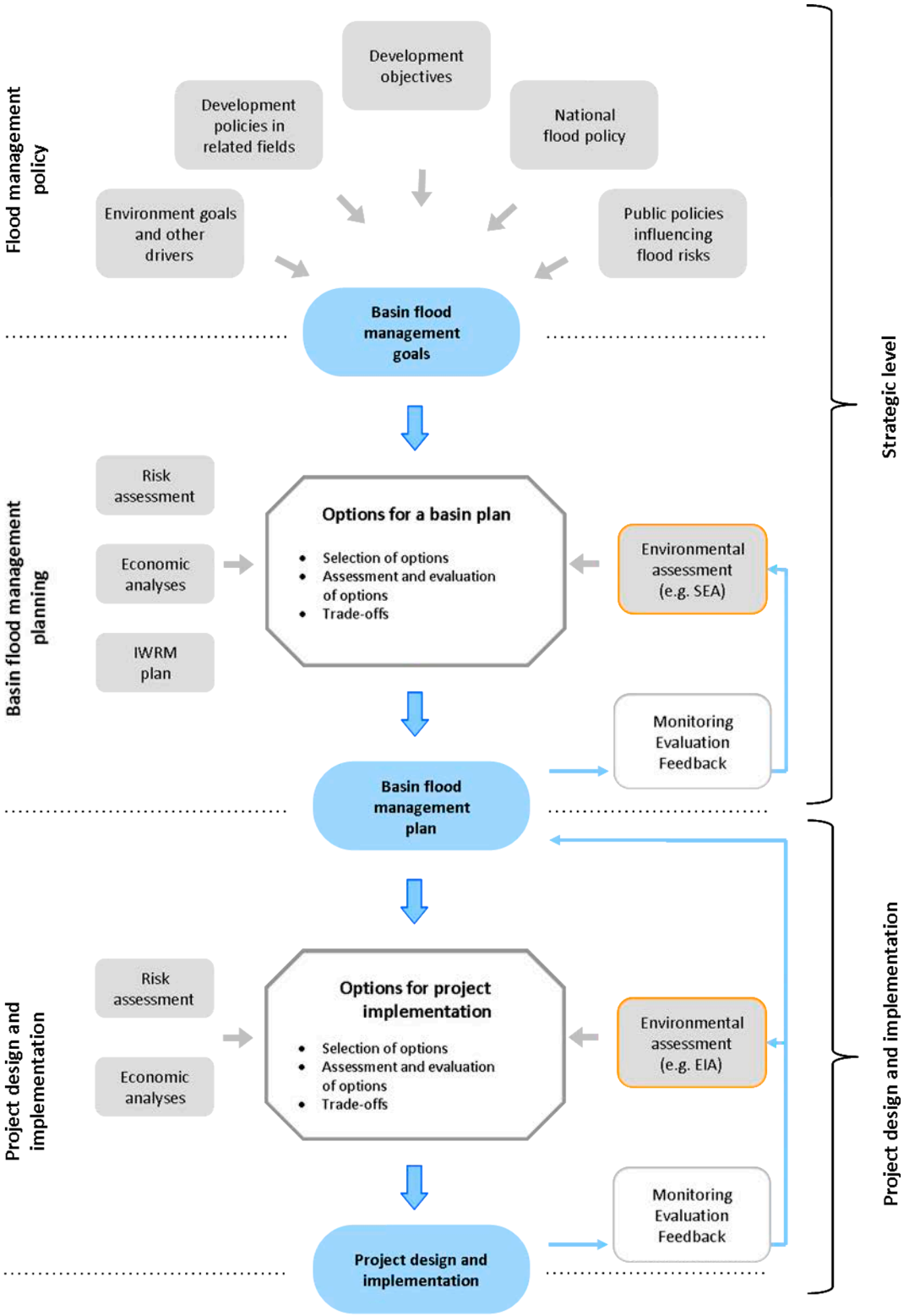

Figure 1 — Conceptual Framework for Integrating Environmental Assessments in Flood Management Approaches

1.2.2 Environmental Impact Assessment (EIA)

8 EIA assesses and predicts the impacts of a proposed project or action on human and ecosystems well-being. As such, EIA focuses on proposed development activities such as highways, power stations, large-scale industrial facilities, or embankment projects. Environmental impact, which may be caused by such activities, is assessed and examined from the earliest project planning stage possible. Alternative proposals or mitigation measures to prevent or reduce the likely adverse impacts must be examined and incorporated into the project plan (JBIC, 2002).

9 More widespread public consultation and participation is required and possible in EIA as compared to SEA. Usually, several rounds of consultations may be required to avoid, reduce or mitigate the adverse effects of a project implementation. Main stakeholders may include competent public authorities, civil society, technical experts and flood managers, academia and consulting groups, funding agencies and contracted parties.

1.3 Historical Background

10 It is important to note here that EIA has been in existence since 1970 (when it was introduced in the United States of America) and has been adopted since then in many countries around the world and virtually all countries have it as a legal or administrative requirement for the approval of projects. It is however still relatively new in some countries. SEA, on the other hand, is a more recent tool which emerged in the middle to late 1980s and its methodologies are still evolving (UNEP, 2002). Use of SEA and EIA has been formalized by the introduction of national laws and regulations, and in some cases policies, which establish systems of institutionalised procedures to ensure that all proposed development-related actions expected to have environmental consequences are assessed prior to authorisation and possible implementation of the projects (UNEP, 2002).

11 Some general exceptions do exist in the application of SEA and EIA such as in civil defence programmes. Others may include overriding public and economic interests, e.g. projects whose primary goals are to promote the protection or restoration of areas designated by law or ordinances as conservation areas.

1.4 Environmental Assessment and Capacity Building

12 Capacity building is a key process to achieve quality and reliable environmental assessments. This chapter summarises and explains some of the points that need to be addressed to build a sound capacity in the environmental assessment domain.

13 Institutionalisation is the main process to integrate environmental assessment (EA) in the national planning process. It is attained when expertise in EA application is sufficient and institutional structure with legal and financial basis is obtained. Some of the needs of capacity building for institutionalisation are listed and explained below:

- **Legal framework:** EA quality is completely dependent on the legal framework of its country: the objectives fixed for the assessment usually correspond to legal values. Policies and legislation should be adapted to the needs of EA. The increase of awareness of law-

draft experts helps them obtain a sound environmental legislative basis, for example by consulting legislation examples from other countries. Also, it is known from previous experience that community provides valuable inputs in this framework and should thus be involved in this process.

- **Continuity and commitment:** Institutionalisation of EA needs financial and temporal flexibility as well as long-term commitment. Time is needed to acquire experience at correctly using EA as a tool and usual strict budgets and outlines of EAs do not help with their exhaustive achievement.
- **Coordination:** Coordination among ministries, institutions and donors is essential to construct a structural basis on which implement a reliable institution of EAs. Roles and responsibilities must thus be clearly allocated from the earlier point. More information on roles and responsibilities can be found in (OECD, 2012).
- **Partnership and collaboration:** A network may be created with representatives of ministerial and institutional stakeholders. Community and involved NGOs should participate in the creation of this network as well as in the allocation of roles and responsibilities. EA legislation should be implemented with a participatory and informative approach. A sound network encourages donors to get interested in supporting sustainable governance and institutional capacity. These networks can then be institutionalised.
- **Skills and training:** The lack of skills is the major problem in the achievement of reliable EAs. To obtain a qualified society on EAs issues, capacity building needs to be carried out at all levels: from community to decision-makers. Training should be continuous, not a one-off event, in order to constantly adapt institutional framework to the evolution of necessities. Decision-makers could learn using EA as a tool. Training courses must be periodically organised, including training sessions for trainers. These courses focus on a "learning by doing" technique to gain experience with realistic cases that should be adapted to the conditions of the country. Guidance material is also often asked be available. Encouraging information exchange and knowledge transfer contributes to increasing awareness on beneficial impacts of EA. It should be avoided that EA capacity depends on a few persons, in which case the capacity would vanish when these persons leave.
- **Country-dependence:** EA framework needs to be built according to the local traditions and culture as well as institutions, resources and capacity conditions. There is no fixed recipe on how to implement a good institution on EA. It is however very useful to discuss with other countries from the same region that may have similar characteristics. The institutional model should gradually evolve with the experience of the country on EA.
- **Awareness and acceptance:** Increasing the general awareness of EA benefits improves acceptance of EA, which is fundamental to obtain political, financial and community support. For this, EA should be communicated in an understandable language for decision-makers. An increase in the number of EAs and/or pilot-models achievement contributes to the general acceptance and the improvement of the institutional set-up.

1.5 Elements of SEA and EIA

14 Basic requirements and conditions, under which the SEA and EIA could be applied, need to be clearly understood.

15 The common elements of SEA and EIA, and the sequence of action include (Kjorven et al., 2002):

- Adequate screening and scoping;

- Stakeholder involvement and transparency through information, consultation and dissemination;
- Description of policy/plan/project under consideration;
- Consideration of alternatives, including the no action option;
- Evaluation of impacts and proposed mitigation measures;
- Assessment of cumulative impacts of the considered measures;
- Communication of decisions, with explanations and justifications;
- Proposals for monitoring and evaluation.

16 First of all, it is important that the responsible agencies carry out an assessment of all strategic decisions with significant environmental consequences. If these consequences are significant, the policy, plan or project is analysed to identify alternative means to achieve the desired objectives. The adverse impacts are evaluated and means of mitigating them are examined. At each of these stages a transparent and continuous engagement of relevant stakeholders is ensured.

The differences between the two tools are compared below:

Table 1 — Comparing SEA & EIA (Hayashi et al., 2003)

	SEA	EIA
Stage of assessment in the proposals	Take place at earlier planning stages	Take place at late planning stages
	Pro-active approach to development proposals	Less pro-active approach to decision-making process
Scope of impacts	Identify environmental and sustainable development issues	Identify specific impacts on the environment
	Early warning of cumulative effects	Limited review of cumulative effects
Range of alternatives	Consider broader range of potential alternatives	Consider limited number of feasible alternatives
Characteristics of assessments	Emphasis on meeting environmental objectives	Emphasis on mitigating and minimising impacts
	Broad perspective, lower level of detail to provide vision and overall framework	Focussed perspective with high level of detail
	Multi-stage process overlapping components, policy level is continually iterative	Well defined process, clear beginning and end
	Focus on sustainability agenda, gets at sources of environmental deterioration	Focuses on standard agenda, treat symptoms of environmental deterioration

1.6 Environmental Assessment for Flood Management

17 For integrated water resources management, as well as integrated flood management, a river basin is considered as the most appropriate unit. Such a river basin may not essentially lie within one administrative jurisdiction. As one moves from an international level down to sub-regional level, a basin flood management plan may involve more than one administrative jurisdiction. **Table 2** represents the sequence of action of SEA and EIA in flood management.

Table 2 — Sequence of actions of SEA & EIA for Integrated Water Resource Management and Flood Management (Kjorven et al., 2002)

Level of government	Water-use and flood management plans (SEA)	SEA			EIA
		Policies	Plans	Programmes	Projects
International	Transboundary agreement on water resource and flood management	Multi country water and flood policy framework		Multi country water investment programme	Transboundary water and flood management projects
National/ Federal	National water-use and flood management plan	National water sector and flood management policy National economic policy		Long term water sector and flood management programme (e.g. 5-10 year)	Construction project (e.g. major dam, or embankment)
Regional/ State	Regional water-use and flood management plan		Basin Flood Management Plan		
Sub-regional	Sub-regional water-use and flood management plan			Sub-regional Investment Programme	
Local	Local water-use and flood management plan				Local infrastructure project

1.6.1 Environmental Impacts of Structural Measures

18 Various structural measures adopted to mitigate flood risks and optimise benefits from flood plains have impacts on natural hydrological and consequently ecological processes. Dams/ reservoirs, detention basins, embankments and bypass channels all have impacts on the natural hydrological and morphological regimes either in upstream, downstream or in the location of the measure. **Table 3** provides a comprehensive checklist of such likely impacts. Further **Table 4** provides the details of their related environmental issues.

Table 3 — Checklist of Environmental Impacts of Structural Flood Management Measures (Dixon et al., 1989; WMO, 2006)

Impacts		Dams and reservoirs			Detention/ retention basins			Embankments/ dikes			Bypass/ diversion channels			Channelization		
		Upstream	Impoundment area (on-site)	Downstream	Upstream	On-site	Downstream	Upstream	On-site	Downstream	Upstream	On-site	Downstream	Upstream	On-site	Downstream
(1)	Stream bed changes	○	○	○		○		○	○	○	○	○	○	○	○	○
(2)	Catchment run-offs and erosion			○			○									
(3)	Denudation e.g. flood plains and effect on traditional agriculture			○			○			○	○		○			
(4)	Inundation impacts e.g. farms, forest lands and mineral areas		○			○				○	○		○			○
(5)	Impacts on aesthetic, cultural, scenic or historical sites		○			○			○	○		○			○	
(6)	Pollution			○		○	○				○		○			
(7)	Inundation impacts e.g. loss of vegetation, wildlife habitat/species		○	○		○	○		○	○				○	○	○
(8)	Weeds proliferation/ riparian vegetation		○			○			○		○		○	○	○	○
(9)	Fisheries e.g. migration effects	○	○	○	○	○	○		○			○	○		○	
(10)	Water quality, salt intrusion		○	○		○							○			○
(11)	Seismicity		○													
(12)	Groundwater level/ recharge and salt intrusion		○	○					○			○	○		○	○
(13)	Health issues		○	○		○	○		○			○				
(14)	Impact on settlements - e.g. municipality	○	○	○	○	○	○		○	○		○			○	

Table 4 — Environmental Impacts of Structural Flood Management Measures (Dixon et al., 1989)

	Item	Environmental issues
(1)	Stream bed changes	Assess stream bed changes due to flow regime change as a result of structural measures
(2)	Catchments run-offs and erosion	Analyse watershed hydrology and sediment yields based on timing and magnitude of flood runoffs due to land use change, de-forestation etc. (e.g. population resettlement from inundated areas may increase cultivation, fuel collection and logging).
(3)	Inundation impacts e.g. farms, forest lands and potential mineral areas	Assess impact on species diversity and watersheds. Inundated vegetation may lead to loss of valuable timber and important or rare species.
(4)	Impacts on aesthetic, cultural, scenic or historical sites	Document implications on archaeological, historic, paleontological, religious and aesthetic or natural sites and unique values, which need to be conserved or salvaged.
(5)	Pollution impacts	Assess pollution from settlements and cultivation. This should be looked at in the context of potability, irrigation, fisheries, recreation (tourism) and perennial waterways and rivers.
(6)	Siting impacts e.g. loss of vegetation, wildlife habitat, endangered species	Analyse site implications. Siting may minimise extinctions and loss of important species, including birds. Discuss mitigation measures. Biotic rescue can assist.
(7)	Weeds proliferation	Make assessments for weeds proliferation, which can increase disease vectors, enhance transpiration and impair fish and water quality (e.g. Water Hyacinth (Eichhornia), Water lettuce (Pistia)). Clogging impairs navigation, recreation and irrigation.
(8)	Fisheries e.g. migration effects	Acquire information on migratory fish stocks (if any), which may be impacted without passage facilities or impaired by changes in water quality. Fish promotion in reservoirs can mitigate and produce more than prior to the project.
(9)	Salt intrusion	Analyse potential for salt intrusion into estuarine and lower river basin areas. This may result from sustained or seasonal reduction in river flow. For example in reservoirs, depending on what happens upstream and on the retention time within the reservoir, water quality may be affected by salt accumulation. Eutrophication from weed, biomass decay, turbidity, or pollution from sediments may result
(10)	Seismicity	Assess the situation for induced seismicity and tectonic movements may increase due to structural measures; monitoring is to be on routine basis.
(11)	Groundwater level/ recharge	Estimate groundwater levels. In reservoirs for example, there is often an increase of groundwater level on-site due to high water levels in the reservoir, whereas downstream, in old flood plain areas, the groundwater level may fall (except for irrigated areas, where it may rise).
(12)	Health issues	Assess project's implication in the increase of water-borne diseases (schistosomiasis, onchocerciasis, encephalitis, and malaria), which may augment without precautionary measures implemented (e.g. vector control, prevention).

Table 4 — Environmental Impacts of Structural Flood Management Measures *(continued)*

Item		Environmental issues
(13)	Impact on settlements e.g. municipality	Evaluate project's impact on surrounding infrastructures (houses, villages and farms), transmission lines and navigation induced problems. Involuntary resettlement imposes major social and economic costs. Projects should become regional development projects, which integrate social and rural development.
(14)	Productivity of riparian areas	Assess variation of vegetation productivity in riparian areas as a project direct or indirect consequence. Reduction of productivity can result from the decrease of floodplains' fertility, due to lower flooding sediment deposition. As a contrary, lowering flooding frequency and strength may sometimes also increase riparian productivity by avoiding periodical floodplain destruction.
(15)	Banks instability	Estimate banks' instability which is caused by many different reasons like the project construction phase, the inundation of certain geological layers or sediment deposition.
(16)	Sedimentation	Evaluate the change in sedimentation behaviour that will influence sediment quality, bank stability and ecosystem functioning. Sedimentation depends on the change of water velocity as well as the variation of water sediment load.
(17)	Sediment quality	Assess project consequences on sediment quality. In the reservoirs case for example, silts and clays sediment in the reservoir bottom, leading to a decrease in downstream sediment quality. This can have impacts on aquatic ecosystem and fishery.
(18)	Water quality (temperature, dissolved oxygen etc.)	Evaluate water quality change due to project implementation, which can have consequences on water potability, fishery, and ecosystem functions. Water quality includes temperature, dissolved oxygen, BOD, salt concentration, pesticides concentration and turbidity among other parameters.
(19)	Species diversity	Evaluate impacts on species diversity caused by physical obstacles (migration and spawning problems), water quality decrease, weakened riparian ecosystem, changes of light conditions, among others.
(20)	Greenhouse gas emissions	Analyse the increase of greenhouse gas emissions. Only emissions from ecosystem activity are accounted for. The emissions coming from the construction or maintenance of the structure are neglected for they depend on the chosen technique and not on a general structure type.

1.6.2 Environmental Impacts of Non-structural Measures

19 Non-structural measures serve as important complement to the structural measures and usually they may reduce not only the catastrophic consequences of flood risks, but also adverse impacts on the environment. However, there can be certain environmental impacts if they are not applied cautiously. These should be examined and investigated to a reasonable extent. As an example, the following two non-structural measures are examined: **Land use regulation** and **Living with floods**.

1.6.2.20 Land use regulation

21 Land use regulations play an important role in catchment management and in reducing the risk due to flooding. They may involve interventions that affect the hydrological processes and include the introduction of suitable soil-protecting vegetation and crops, forestation, better forest management, controlling of shifting cultivation in conjunction with minor engineering works, e.g. trenches, contour bunds etc. Such regulations through bylaws for instance, can help in preventing negative consequences due to urbanisation or restricting development in such a manner that the hydrological response characteristics of the catchments are not changed. For example, an appropriate land use management reduces the negative impacts of deforestation for agricultural purposes that would result in:

- Increase of runoff and sedimentation transport
- Reduction or alteration in biodiversity
- Impacts on scenic and landscape qualities
- Higher (or lower, depending on the crops) evapotranspiration
- Soil water retention

22 More information on this topic is available in the IFM Tool "The Role of Land Use Planning in Flood Management" (WMO, 2008).

1.6.2.23 Living with floods

24 The development of appropriate flood proofing measures and emergency response mechanisms allows people to settle in floodable areas, maximising the net benefits deriving from this choice. A residual risk of flooding however remains. Should flood happen, additional collateral effects can arise that result from anthropogenic activities in the floodplain. Those impacts are for example (Hayashi et al., 2003; WMO, 2006):

- Spread of pollutants and chemicals from households, industries and utilities (sanitation treatment plants, power stations, fuel deposits, etc.)
- Fertility of land may be impeded due to spread of sand or chemicals onto fertile lands
- Stagnant water may result in spreading of disease and weeds

25 These adverse impacts are to be avoided when non-structural measures are applied.

1.6.3 Environmental Assessment and Climate Change

26 Climate change is projected to influence water management in the next decades by altering the water level, varying the amount of precipitation, influencing frequency and magnitude of extreme events and modifying water resources and quality, among other consequences (IPCC, 2012). The impacts of those variations need to be assessed in all new policies, plans and programmes (PPPs) in order to evaluate the necessity of adaptation or mitigation measures. Both include structural and non-structural measures with the aim of providing a climate-proofed scenario. In this context, EA is a useful tool to assess environmental impacts of climate change and of the measures for protection against climate risks. EA encourages the inclusion of climate-related issues in governmental policies and plans and helps with the fixation of objectives.

27 For the particular case of flood management, EA deals with both adaptation and mitigation. The strategy of adaptation depends on the vulnerability of the area itself, relying on many political, economical, demographical and cultural parameters. The future values of these parameters cannot be certified and, as climatic models use those variables as inputs to create climatic scenarios, this explains the large uncertainty around climate evolution and impacts. The adaptation strategy must therefore rely on a large range of plausible outcomes and be based on flexible and adaptable solutions including structural, non-structural, regulative, economical, educational and awareness increasing measures. The priority is given to win-win and no-regret measures that will unconditionally bring socioeconomic benefits.

28 Vulnerability depends therefore on external factors as exposure to climate change as well as internal parameters like the sensitivity[1] of the area and its adaptive capacity. More information on integrating climatic issues in flood management is available in the IFM Tool "Flood Management in a Changing Climate" (WMO, 2009). **Figure 2** summarises the relevant components of climate issues for flood management.

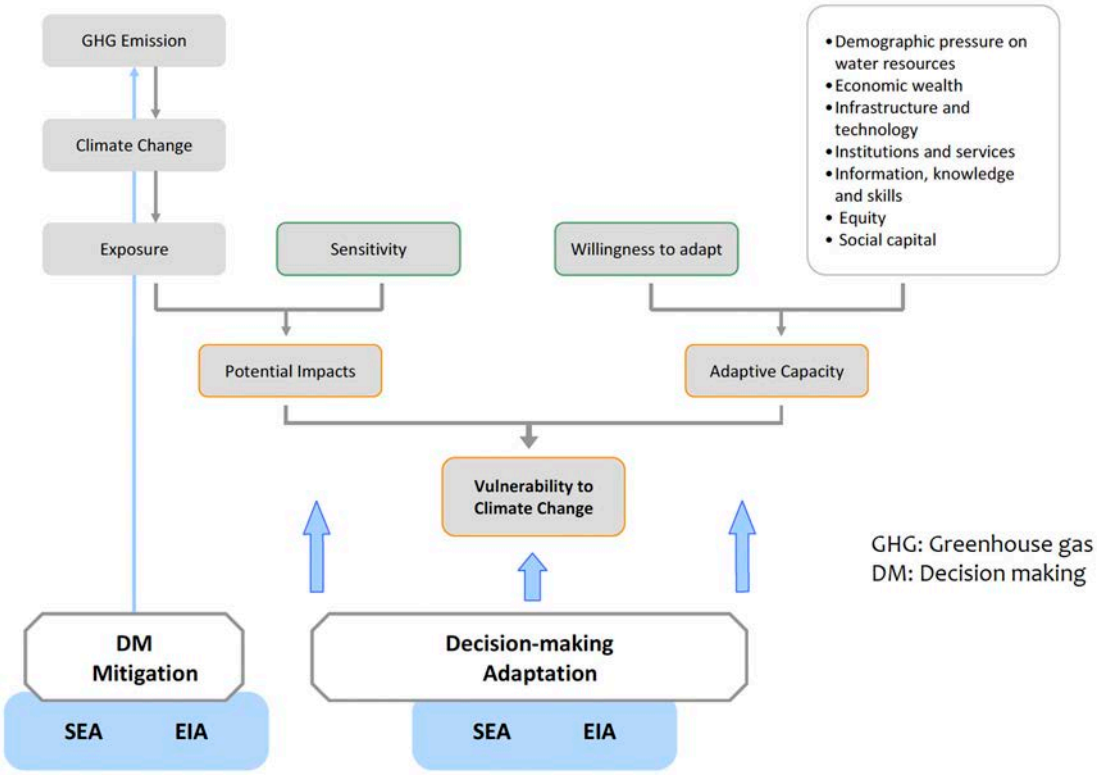

Figure 2 — Relevant Issues for Integrating Climate Change in Environmental Assessment for Flood Management (Kolhoff, 2011)

29 The following steps provide an approach to include climate issues in SEA. Each one should include stakeholder participation:

– **Objective setting:** Adaptation and mitigation goals depend on the governmental regulations and objectives. According to these, a plan needs to be implemented to establish quantitative

1 IPCC describes the sensitivity as follows: *"Physical predisposition of human beings, infrastructure, and environment to be affected by a dangerous phenomenon due to lack of resistance and predisposition of society and ecosystems to suffer harm as a consequence of intrinsic and context conditions making it plausible that such systems once impacted will collapse or experience major harm and damage due to the influence of a hazard event."* (IPCC, 2012)

objectives and standards, including a range of acceptability. The plan is also based on the adaptive capacity and the vulnerability of the region. An analysis of vulnerability needs therefore to be carried out based on the susceptibility of natural, social and economic systems to climate change at different levels. The aim is providing a climate-proofed scenario with long term perspective plan.

- **Climate change impacts identification:** A range of probable climatic outcomes are identified based on relevant socioeconomic factors in order to estimate climate change impacts on baseline environment. The analysis is carried out per sector and land use and must account for the uncertainty of assumptions. Maps of flooding and salt intrusion are then implemented with this data and include estimations of the climate risks for each community. This is the basis to establish a vulnerability map using Geographical Information Systems (GIS). These maps are often already achieved by many countries, in which case climate change issues are easily included in SEA.
- **Assessment and determination of adaptation options:** The objective of assessment is the identification of the proposal influence on climate risks. Adaptation scenarios are supposed to reduce climate change impacts and need to be compared to the non-adaptation option by implementing a Cost-Benefit analysis. The chosen alternatives provide the basis for future projects and should therefore encourage green measures at the earlier point of the SEA. The analysed measures can target different levels, from local to international.
- **Evaluation of each alternative:** The evaluation of the strategy has to take into account a variety of aspects including the strengthening of prevention, resistance, resilience and adaptation capacity. More generally, the evaluation analyses the risks of the climate change, the social costs and benefits, the livelihoods and the environmental quality.

30 EIA plays an important role when technical options are analysed in detail at the project scale. The considered mitigation measures and their cumulative effects have to reduce climate change impacts directly or indirectly. Greenhouse gas (GHG) emissions need to be assessed for each proposal phase by carrying out a Life Cycle Assessment and by analysing the strategy effects on carbon sinks. Green measures should therefore be encouraged when technical requirements permit it, accounting for the services provided by the ecosystems. They should contribute to the preservation of floodplain ecological functions and biodiversity. More information on this topic is available in the IFM Tool *"Conservation and Restoration of Rivers and Floodplains"* (WMO, 2012). Also, the IFM Tool on *"Reservoir Operations and Managed Flows"* (WMO, 2011b) provides valuable information on the management of structural measures in order to improve ecosystem conservation. An evaluation of the adaptation strategy should be included at each project phase: during implementation, just after the project and a few years after implementation. The evaluation assesses the relevance, efficiency and impacts of the project and analyses the failure causes, if there are. This will help identifying the necessary mid-term corrections.

2 STRATEGIC ENVIRONMENTAL ASSESSMENT FOR BASIN FLOOD MANAGEMENT PLAN

31 SEA for basin flood management planning provides a range of opportunities that help integrate environmental consideration – alongside social and economic – into strategic decision-making. To what details a basin flood management plan should be assessed, within a framework of SEA, is dependent on the planning objectives. If the scope of the plan is too broad to assess the environmental impact, general qualitative description of foreseeable cause-effect scenarios may be sufficient. In most cases, qualitative information on the basis of expert judgement may be sufficient at the strategic level. Quantitative assessment, however, is required where environmentally negative impacts have already been observed, or have reached a threshold, or where cumulative impacts are expected. Such an assessment should be documented with clear evidence, including details of the kind of analyses carried out, the data used for the analyses and the assumptions and hypotheses adopted.

32 Advantages of applying SEA in basin planning can be summarized as (JBIC, 2002):

- **Support to integrated decision-making:** SEA supports a decision-making process that can identify environmental impacts of proposed actions on other sectorial development objectives and vice-a-versa, consider different alternatives of meeting the desired objectives and specify appropriate mitigation measures.
- **Contribution to sustainable development:** SEA anticipates and prevents adverse environmental impacts at source by early warning and thereby prevents surprises at later stages. As such, it contributes to sustainable outputs from development actions.
- **Reinforcement of environmental assessment at project level (EIA):** SEA helps identify the scope of potential impacts to environment in advance and to inform the needs to address strategic issues that would require to be attended to at the project planning stage. This leads to reduced time and efforts required for EIA.

33 Strategic environmental assessment helps realise the importance of integration of environmental objectives into social and economic goals a society pursues **(Figure 3)**. It helps bring environmental issues, which often are considered on the fringes of development process, into centre-stage and provide weightage to equal to the social and economic issues.

34 **Figure 3** depicts a situation as prevalent in many societies, where environmental objectives are given minimal consideration in relation to the economic and social objectives. In most cases, economic goals are given highest priority, followed by the social goals *(a)*. SEA attempts to mainstream environmental objectives closer towards integration with the social and economic goals, right at the policy-making stage *(b)*. The desired objective of achieving complete integration of all three components - the environmental, social and economic goals - can be achieved when EIA (Environmental Impact Assessment) and EAP (Environmental Action Plan) are carried out duly considering the inputs from SEA and resorting to adaptive management techniques through continuous monitoring, evaluation and review process. However, it is important to note that the extent of overlap (integration) of the three components depend on the particular societal context within which it is applied *(c)*.

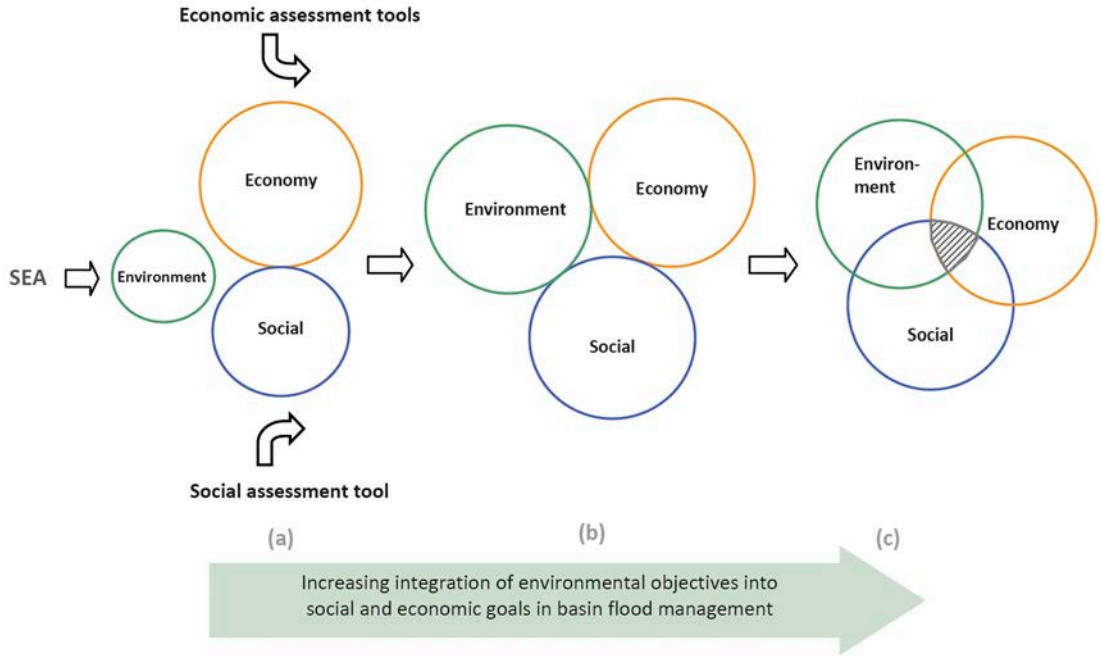

Figure 3 — The SEA Continuum: Integrating Environmental Objectives into Social and Economic Goals (OECD, 2006)

Note: The sizes of the circles represent the relative importance of each of the objectives. The relative distances between each component imply the level of dependency or integration of one component objectives in relation to the two others. However, the relative sizes of all three depend largely on the prevailing socio-economic status and requirements within societies.

35 Strategic environmental assessment for flood management may take different forms, depending on the administrative level (e.g. national, regional, local) and the strategic tier (e.g.

policy, plan or programme) it is applied to. However, depending on the sector, SEA can be used in three complementary ways:

- **To provide inputs into a proposed policy, plan or programme (PPP):** as an integrating tool or mechanism to support, and facilitate the actual development of a PPP (so that they address environmental dimensions effectively) – this is where SEA can be the most effective.
- **To evaluate an existing PPP:** as an environmental sustainability test of PPPs that have already been developed (or might be about to be revised) or of decisions that have already been taken – as a means to generate learning and make mid-course correction.
- **As a monitoring tool:** to track the development and implementation of PPPs, and to provide learning and feedback. The implication here is that there is a willingness to consider changes or adjustments to PPPs.

2.1 Sea Framework for Basin Flood Management Planning

36 SEA process is illustrated in **Figure 4**.

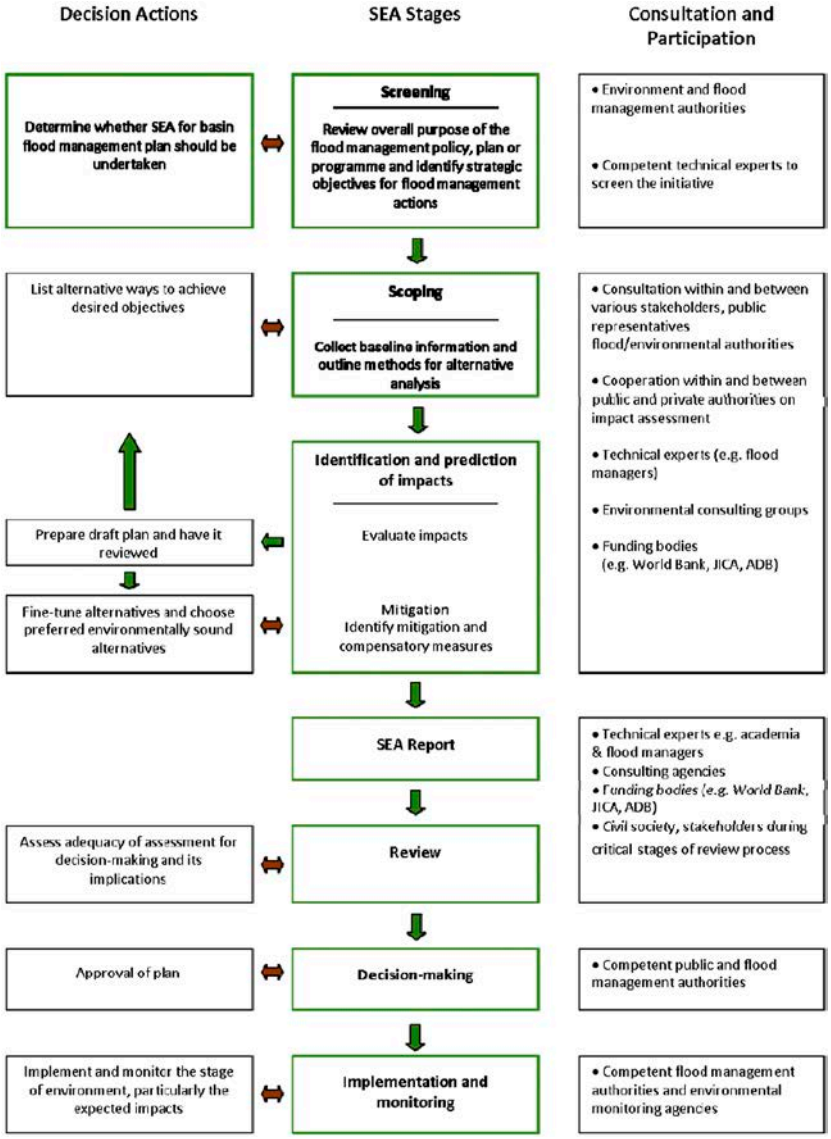

Figure 4 — SEA Flowchart for Flood Management - Adapted from (DEAT, 2004; WMO, 2006)

2.2 The SEA Steps

37 It is useful here to identify various issues that need to be addressed at various stages of SEA process. These issues are listed in the table below.

Table 5 — Issues to Be Addressed at Each Stage of SEA Process (APFM, 2006) (DEAT, 2004)

Stages	Issues to be addressed
1) Screening	• What are the objectives of the flood policies, plans or programmes (PPP)? • What are their relationships with other relevant plans and programmes? • Which are the impacts on the current state of the environment? • Are there likely environmental impacts without implementation of flood PPP? • Which environmental objectives, established at the international, community or member state level, are relevant to PPP? • What are the implementation procedures?
2) Scoping	• What environmental elements are likely to be significantly affected by floods? • Are there particular existing environmental problems (importance) which are relevant to the flood plan or programme? • Which baseline environmental data are required? • What are the assessment methods to be employed and their time frame? • What is the horizon (scope) of assessment alternatives and scenarios to be considered?
3) Identification, prediction and evaluation of impacts	• What are the environmental impacts of proposed PPP? • Are there cumulative impacts? • How significant are the impacts? • How can these be reduced if necessary? • How can these be monitored?
4) Mitigation, reduction and compensation	• How can adverse impacts due to proposed PPP be avoided? • How can adverse impacts be reduced? • Which possibilities exist to offset adverse impacts likely to happen?

2.3 Consultation and Participation

38 Participation of the stakeholders is a pre-requisite for successful SEA at its different stages. In addition to the various government institutions representing related development sectors, the potential stakeholders should include experts from institutions outside of the government and renowned public figures with proven track record on the subject. Consultations through public representatives are required throughout the SEA process to ensure the transparency of the procedure.

39 The process of participation should be designed to include clear objectives, and an analysis of the stakeholders that need to be involved. The role of each stakeholder, and the mechanism of

their involvement need to be carefully identified so that it can be sustained in the long term. The rationale for involving stakeholders in SEA is to:

- Provide all stakeholders including public representatives, with full opportunities to share their views and to influence the outcome;
- Build public support for the outcomes;
- Build stakeholder commitment;
- Ensure active participation of the public in the implementation of basin flood management plans;
- Ensure sustainability of policies, plans, programmes and associated decisions.

The general public should be kept informed of the processes through media and workshops where feasible.

More information on participation is available in the IFM Tool *"Organising Community Participation for Flood Management"* (WMO, 2013).

2.4 The SEA Report

Following is a suggested outline for a SEA report.

A | Executive summary

- Methodology used, who carried out the SEA, who was involved, who was consulted?
- Purpose and objectives of SEA for flood management planning;
- Background to water/flood management policies, plans, and programmes;
- What difference has the SEA process made for flood management plan?

B | Introduction

- Brief objectives of the policy/plan/programme.

C | Screening

40 Screening involves reviewing the overall purpose of the flood management policy, plan or programme and identifies strategic objectives of flood management. The major issues to be addressed here include the following:

- Outline of the objectives of the flood policy, plan or programme **(PPP)**
- Description of the water sector and flood PPP
- Baseline information on environmental issues and sustainability visions
- Assessment of the interrelationships with other PPPs
- Available implementation mechanisms
- Trends in flood incidences

D | Scoping

41 Scoping involves the collection of baseline information and outlining alternative methods, and can be based on the following:

- Collection of baseline information on floods, water resources and environment and its specialisation with Geographical Information Systems (GIS) when possible (more information on this topic in the IFM Tool *"Flood mapping"* (WMO 2013)
- Outline of the available mechanisms of achieving objectives
- Outline of the river basin environment
- Possible alternative solutions and scenarios considered
- Description of the alternatives (system-, site- and design-) and reasons thereof
- Provision of the data sources and outlining difficulties (if any) in collecting data
- Timeframe adopted for assessment

E | Identification and Prediction of impacts

- State of the environment without implementation of the flood PPP
  - Assessment of environment in the basin
  - Overview of natural hazards
  - Impacts of floods in flood prone area
  - Related environmental problems
  - Positive environmental effects of flooding
- Predicted impacts of the proposed flood PPP
  - Identify negative environmental impacts (short-, medium- and long-term, secondary, cumulative, permanent and temporary)
  - Measures to avoid, reduce and offset adverse effects of flooding
- Evaluation of flood impacts
  - Review of environmental protection objectives vis-a-vis flood management objectives
  - Comparison of evaluated net benefits with social, environmental and economic goals
  - Indicators for environmental quality
  - Recommendations for aligning flood PPP and environmental objectives
- Mitigation
  - Identify mitigation measures required to avoid, reduce, and offset adverse environmental impacts without compromising on flood management objectives at strategic level. (It is desirable to minimize the negative impacts of flood management interventions.)

F | Conclusions and Recommendations

- Conclusions
  - Statement on how the SEA process has been developed
  - Legal requirements under which SEA has been carried out
  - Highlight of any conflicts between flood management and other environmental interests

- Decision-making process
  - Recommendations on adoption of the flood policy, plans or programmes
  - Difficulties in carrying out SEA (including legal, technical or institutional)
  - Recommendations on changes required, if any, in institutional arrangements to meet the desired objectives
  - Recommendations on specific issues that need to be addressed during EIA
- Monitoring
  - Measures to monitor the conditions of the chosen scenario
  - Measures to monitor the policy, plan and programme in subsequent planning stages
  - Measures to monitor the policy after its realisation

42 The findings of SEA should be widely publicised to enable external review by public bodies, national environment and flood authorities. They should be made publicly accessible and communicated to the concerned public in appropriate time and form.

2.5 Review

43 An assessment of the report is necessary for evaluating the quality of SEA. In some cases, the approach may indicate certain deficiencies that might have significant consequences and need to be addressed in order to ensure that it has been carried out with due care and diligence. Such deficiencies are likely to creep in if SEA was undertaken too late in the planning processes. The following questions may be required to be answered during the review process:

- Are all relevant issues including alternatives discussed?
- How were the assessments done?
- Who have been involved or consulted?
- Were the reasons for selecting alternatives dealt with?
- Were there any difficulties (e.g. technical deficiencies or lack of know-how)?
- What are the major environmental problems which cannot be ignored?
- Are all forecasts and the associated methods clearly presented?
- Is the report objective or biased?

2.6 Decision-Making

44 Decision-making involves approving basin management plan or rejecting it, based on the information presented in the SEA report. Whether plan is taken up depends on recommendations of SEA. If the SEA report documents major environmental problems, which cannot be ignored or effectively and economically mitigated, decision-making may suggest modifications in the basin management plan or completely rejecting it.

2.7 Implementation And Monitoring

45 Implementation of flood management plan should be monitored with the objective of reducing or offsetting any significant adverse impacts on the environment. The adverse impacts should be mitigated when they are detected and sufficiently before they start manifesting into problems. Monitoring should involve continuous assessment of environmental objectives in the plan in accordance with water/flood laws and regulations.

3 ENVIRONMENTAL IMPACT ASSESSMENT FOR FLOOD MANAGEMENT

46 Environmental Impact Assessment (EIA) is a fairly well established practice, and has been widely applied in various settings e.g. transport, energy, mining sectors etc. However, uncertainties exist concerning its application at the basin level e.g. in how much detail a project should be assessed, within the framework of environmental considerations. EIA is presented as a flexible tool that is adaptable, and help practitioners to conceptualise the environmental impacts of proposed measures at the basin level.

47 EIA is useful in identifying the environmental and social impacts of proposed projects prior to implementation in order to predict these impacts at an early stage in project planning and design. It aims at finding ways and means of reducing adverse impacts, shape project to suit the local environment, and present the predictions and options to decision makers.

48 The benefits of applying EIA in the design and implementation of individual projects include:

- Improving environmental planning and design of project proposals: A well-designed project by EIA can minimise risks and impacts on the environment and people, thereby avoiding associated costs of remedial treatment or compensation for damage that cause delays and cost over-runs.
- Ensuring compliance with environmental standards: Compliance with environmental standards reduces damage to the environment and disruption to communities.
- Saving capital and operating costs: EIA can avoid the undue costs of unanticipated impacts. An 'anticipate and avoid' approach is much cheaper than 'react and cure'.
- Increasing project acceptance by the public: An open and transparent EIA process with provision of opportunities for public involvement helps generate a sense of ownership in the people who are most directly affected by and interested in the outcomes of the project.

49 EIA for flood management projects should be undertaken throughout the project cycle, beginning as early as possible, from the pre-feasibility stage. EIA provides the environmental impacts of the projects to be assessed, forecasted and evaluated during the process of designing the project. The results are then opened to the public to obtain opinions, both from citizens and local governments. An appropriate project scheme can then be developed incorporating various viewpoints received and addressing the critical issues.

3.1 EIA Framework For Flood Management

50 EIA process is illustrated in **Figure 5**.

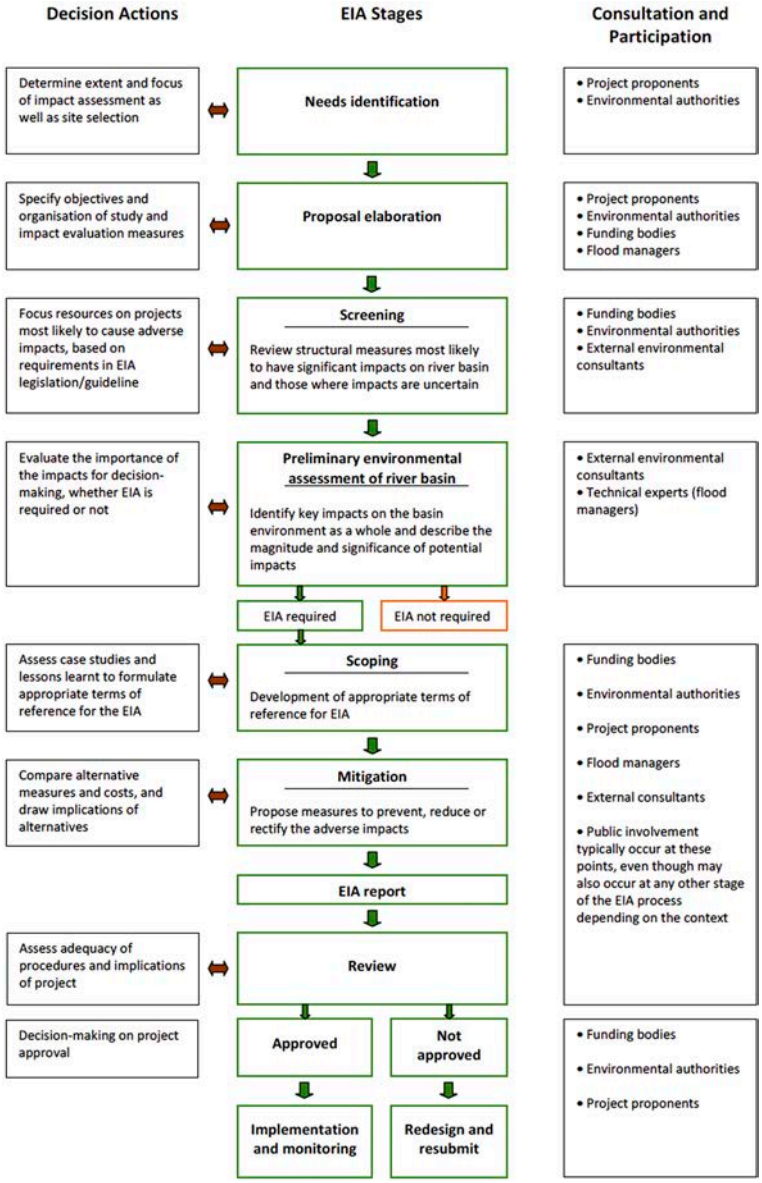

Figure 5 — EIA Flowchart for Flood Management Projects - Adapted from (Donnelly et al., 1998; EC, 1999)

3.2 The EIA steps

51 The issues related to EIA process are listed in the table below.

Table 6 — Issues to Be Addressed at Each Stage of EIA Process (IIED, 1998)

Stages	Issues to be addressed
1) Needs identification	• Is the impact assessment carried out under a legal obligation? • How does it relate to basin flood management plan? • Who is responsible for impact assessment? • Who are the potential stakeholders?
2) Proposal elaboration	• What are the terms of reference of EIA and how is the study to be organised? • Who are the project proponents? • Why is the project located at the given place? • What are the likely significant impacts of project on the environment? • Are there any recommendations from SEA?
3) Screening	• Which alternatives are likely to pose significant impacts? • Which alternatives have uncertain impacts? • What are the requirements as per legislations? • What are the size, cost and location of project?
4) Preliminary environmental assessment	• What are the likely key impacts on the environment? • Are there potential cumulative impacts? • What are the magnitudes and significance of the impacts? • How the evaluation might impact decision-making? • Is the EIA required?
5) Scoping	• What information is required for assessing desired impacts? • Are baseline studies required to determine present state of the environment? • Are there established indicators against which the severity of predicted impacts can be assessed?
6) Mitigation, reduction and compensation	• What measures should be taken at the early stage of the project cycle? • Which measures are proposed to prevent, reduce or rectify adverse impacts? • Is there a provision for monetary compensation, restoration or off-site community compensation programmes? • What are the implications of the different mitigation measures? • Are there any landscaping or architectural restrictions?

3.3 Consultation and Participation

52 In order to provide sufficient recognition to enable EIA become an integral tool within project planning processes, it is important to include important stakeholders e.g. sector ministries, local governments, donor agencies and public stakeholders from an early stage. This is necessary to stimulate from the outset debates among the various sectors to effectively integrate environmental and social considerations into the planning and decision-making on a proposed project. In EIA, even though expert inputs are required, the role of civil society in the planning processes is highly encouraged in gaining public acceptance of projects at the implementation stage.

53 More information on community participation is available in the IFM Tool "Organising Community Participation for Flood Management" (WMO, 2013).

3.4 The EIA Report

54 Following is a suggested outline for a EIA report.

A | Executive summary

- Project proposal under study
- Brief mechanism of EIA
- Significant findings of the EIA report.
- Description of each significant environmental issue and their resolution.
- Brief outline of content of report (techniques used, impacts, their assessments, preventive measures etc.)

B | Introduction

- Brief project description
- Project identification and proponents
- Stage of project preparation
- Extent of EIA study (scope, agency, magnitude of effort)
- Public participation processes

C | Description of the Project

- Type of the project and needs assessment
- Location (use maps and Geographical Information Systems (GIS)) and size
- Proposed schedule for approval and implementation
- Mitigation measures planned to meet environmental standards or EIA requirements
- Recommendations or inputs from SEA, if available

D | Description of the Environment

- Clear delineation of study area
- Description of flood risks
- Collection of baseline data (local and indigenous knowledge should be appropriately incorporated and discussed) and its spatialisation with GIS when possible (more information on this subject in the IFM Tool "Flood mapping" (in preparation)
  - Physical components e.g. topography, soils, surface water, groundwater, geology, climate
  - Ecological components e.g. wetlands, fisheries, aquatic biology, forests, rare or endangered species and protected areas

- Hydrological and morphological regime that determines the ecology in the basin
- Human/ economic development e.g. population and communities i.e. numbers, locations, composition, employment, infrastructure, land use etc.
- Quality of life values e.g. socio-economic values, public health, recreational components, historical treasures and cultural values
- Dependence of local communities on the environmental services

E | Anticipated Environmental Impacts

– Item-by-Item-Review:
  - Evaluation of expected impacts of project on each of environmental items (refer to checklist **Table 3**).
  - Discussion, where adverse effects are indicated, on measures for minimizing and/or offsetting them.

– Irreversible impacts:
  - Determination of the extent to which proposed project would irreversibly curtail potential uses of the environment e.g. alteration of historic sites, etc.

– Effects during project construction:
  - Evaluation of significant environmental impacts during construction phase (usually involves impacts that will cease at completion of construction e.g. long construction projects lasting several years).

While considering the above, the following questions should be answered:

– Will the project create unwanted losses in precious or irreplaceable biodiversity or other resources?

– Will the project induce unwanted acceleration in the use of scarce resources and favour short-term over long-term economic gains?

– Will the project result in unwanted hazards to endangered species?

– Will the project tend to intensify undesirable rural-to-urban migration to an unwanted degree?

– Will the project induce adverse cumulative impacts when added to the other existent structures?

– Will the project tend to increase the income gap between the poor and affluent sectors of the population?

F | Mitigation measures

Proposed measures to prevent, reduce or rectify the impacts. To help make decisions, compare alternative measures and costs, as well as their implications on the project viability.

G | Recommendations

– General
  - Statement on how the EIA process has been developed

  - Legal requirements under which EIA has been carried out
  - Highlight of any conflicts between flood management and other environmental interests
  - Difficulties in carrying out EIA (if any, including legal, technical or institutional)
- Decision-making
  - Recommendations for adoption or modification of the flood project.
  - Recommendation on changes in institutional arrangements to meet the desired objectives, if any.
  - Recommendation on changes required to be made in the project proposal
- Monitoring

The technical plan of monitoring the effectiveness of mitigation measures must be described as follows:

- Indicators to be monitored
- Methodologies of measurements
- Data storage and analysis
- Schedules of report and feedback mechanisms
- Procedures to be followed in case of unexpected development

H | Conclusions

This section should discuss the overall net gains, which justify implementation of the project, explaining how adverse effects have been mitigated or taken care of. Furthermore, explanation of follow-up activities, surveillance and monitoring must be mentioned.

I | Annexes

Following information could be included in form of annexes:

- Literature references
- Scope of EIA
- Abstracts or summaries of relevant background documents
- Tabular and graphical summaries of data
- Major studies and stakeholder involvements in support of EIA preparation should include:
  - Public participation e.g. summary of issues identified by stakeholders
  - Environmental economics of flood management e.g. economic analysis of structural measures, including the present value of all benefits and all costs compared in the form of internal rate on investment, and net present value (Cost-Benefit analysis).
  - Environmental risk assessment e.g. two major categories of risk i.e. those to human health, and those to ecosystem integrity.

3.5 Review

55 EIA reviews entail an assessment of adequacy of the procedures used. The following questions may be addressed in the process:

- What are the major environmental impacts of proposed projects?
- How adequate is the assessment for decision-making?
- In which ways are potential impacts to be addressed? e.g. containment measures
- What are the implications of impact, addressing measures on project implementation and viability?

3.6 Decision-Making

56 Decision-making entails whether the project should be approved or not. Approval implies implementing the project based on the recommended monitoring plan. Disapproval may require redesigning the project on the lines suggested. These suggestive changes should be elaborated in the report.

4 CASE STUDIES

4.1 SEA Case Studies

57 This section briefly describes some case studies available on SEA in the context of basin flood management plans. Readers are encouraged to provide a feedback on these and new case studies.

4.1.1 Regional Environmental Assessment of Argentina's Flood Protection

58 In the northern region of Argentina, the communities occupying the Paraguay, Parana and Uruguay rivers floodplains are periodically exposed to floods that have already caused important losses (Kyorven et al., 2002; OECD, 2006; Sadler, 2005; World Bank, 1996). An investment programme to protect the seven affected provinces was set up, and in this framework a Regional Environment Assessment (REA) was undertaken. Despite the damages, floods maintain ecological systems and many forms of productive activities. In order to preserve these important functions, the strategy of "living with floods" was adopted for the project. A set of structural measures were considered, together with a group of non-structural measures including:

- Reinforcement of institutional capacity
- Coordination in coping with periodic flooding
- Upgrade of flood warning systems
- Support of technical assistance

59 The REA was incorporated in the process of decision-making from the earlier stage and focused on the following topics (OECD, 2006):

- Description of the interaction between hydro-ecological and socio-economic systems of the region;

- Screening of potential investments to select sub-projects with clear economic, social and environmental benefits;
- Analysis of alternatives for each site using criteria of least possible interference with natural flooding patterns;
- Analysis of the cumulative effects of all flood protection projects;
- Public consultation aimed at improving the design of all sub-projects;
- Design change to take into account the results of the REA and public consultation;
- Identification of mitigation and monitoring measures;
- Identification of institutional weaknesses in dealing with the flood problem;
- Recommendation for a regional action plan to address the issues identified.

60 The REA determined the most disturbing human activities on ecosystems. It also identified the importance of preserving interactions of man-made systems with floodplains. The investments then focused on the protection of infrastructures and human well-being together with ensuring the continuity of periodical floods. In the context of environmental and economic benefits enhancement, the REA supported the design of the following project components (OECD, 2006):

- Strengthening of EA procedures in key institutions within the seven provinces
- Technical assistance for urban environmental management
- Environmental education and awareness programmes in communities benefiting from protection works
- Support to protection and management initiatives for wetlands and other ecosystems

61 The number of considered subprojects decreased from 150 to 51, partly due to the valuable contribution of REA in the screening of all potential investments. The selected subprojects were all justified from an economic, social and environmental point of view. The REA team was then in charge of conducting EAs for each project and the examination and reduction of their cumulative impacts. The entire process was participatory which brought valuable outcomes included in the project design.

4.1.2 Transboundary Environmental Assessment in the Nile Basin

62 Ten percent of the African continent is covered by the Nile Basin (3 million km^2) with 160 million people living in it. The basin spreads over ten countries - Burundi, the Democratic Republic of Congo, Egypt, Ethiopia, Eritrea, Kenya, Rwanda, Sudan, Tanzania and Uganda. In a socioeconomic development perspective and in order to diminish poverty, the Nile riparian countries implemented the Nile Basin Initiative (NBI). These countries undertook a Transboundary Environmental Assessment (TEA) under the NBI's Shared Vision Programme (SVP) in cooperation with the United Nations Development Programme (UNDP) and the World Bank, with additional funding from the Global Environment Facility (GEF). Within a collaboration perspective, the TEA summarised the basin environmental trends, threats and priorities and identified the issues in order to implement the Agenda for Environmental Action for the basin. Its

aim was transposing national environmental frames to basin-wide analysis or action structure. The national and local issues discussed by the TEA were the following (Dalal-Clayton et al., 2005):

- A synthesis providing the basis to formulate the elements of an agenda for Environmental Action with complementary preventive and curative actions to address current and emerging issues in the Nile Basin;
- An agenda aimed at a collaborative implementation over the next decade or more in co-ordination with other development activities;
- Outlined transboundary activities to be addressed collaboratively in the initial implementation phase of the Agenda for Environmental Action in the form of a proposed project.

63 In order to complement the report, national participatory consultations were undertaken and a scoping analysis was achieved by United States Agency for International Development (USAID) in order to provide a multi-country technical background paper. The first basin-wide project was based on the priorities of transboundary environmental threats. This action project aimed at improving basin-wide stakeholder collaboration in transboundary issues in the areas selected as priority. The main benefits were (OECD, 2006):

- Enhanced regional co-operation on transboundary environmental and natural resource management issues. Elements include the development and application of a river basin model as part of a decision support system, knowledge management, and linkage of macro/sectoral policies and the environment;
- Enhanced capacity and support for local-level action on land, forest and water conservation. Establishment of micro-grant fund to support community-level initiatives at pilot sites;
- Increased environmental awareness of civil society through environmental education programmes and networking of universities and research institutions;
- Enhanced regional capacity for sustainable management of wetlands and establishment of wetlands management programme at pilot sites;
- Establishment of standard basin-wide analytical methods for water quality measurements and initiation of monitoring of relevant transboundary hotspots. Enhanced capacity for monitoring efforts and pollution prevention.

4.1.3 Strategic Environmental Assessment for the Dutch National Plan on River Flood Protection

64 Netherlands has a population of 16.5 million. Its territory is located in a delta for three rivers, and forty percent of the territory is under the sea level. As a consequence of climate change the risk of flooding is increasing, this is why the Government is funding developments under the national plan for river flood protection with a maximum budget of 2 billion euros. The four main objectives are (Kolhoff, 2011):

- Increase the discharge capacity of the Rhine by 2015
- Improve the environmental quality of the river basin
- Provide the forthcoming need of extra space for the rivers
- Preserve the safe level of the river

65 Despite the long tradition of dyke construction in the Netherlands, the preference concerning flood protection is now shifting towards the restoration of space for the river in its foreland.

66 A "climate-proofed" SEA was carried out for the national plan with the objective of ensuring a climate-proofed country, considering the IPCC mid scenario that predicts high water river level in year 2100. It also comprised an analysis of the developments carried out upstream (outside of the Netherlands) until 2020. The combination of these developments and the future river level are predicted to cause an increase of the high water level in the medium and long terms. To cope with this new situation, nine different scenarios for water management were examined, with all their impacts evaluated and judged by experts. An economic analysis was also conducted that compared the flooding damages versus the cost of the measures. The issues considered and their indicators were the following (Kolhoff, 2011):

Table 7 — Issues and Indicators of SEA

Issue	Indicator
Safety	Impacts of measures on lowering expected high water levels
Management & maintenance	Need for dredging operations
Spatial quality	Utility value of the area
	Perceived quality of the area (on the basis of objective criteria)
	Robustness to change/flexibility

67 The measures were decided to focus on hydraulic aspects (increase of discharge capacity and storage of rivers) because of their cost efficiency. In addition, other measures combining safety and environmental improvement would complete them. The implementation of 25 projects will last 7-8 years . For each project an EIA will be conducted that is more cost-effective thanks to the previous SEA. The Netherlands has thus integrated climate change into SEA and achieved this important cost reduction.

68 In order to achieve a high participation of stakeholders to the process, many actions were carried out:

- Involvement of two regional steering groups with representatives from government agencies and NGOs
- Establishment of regional offices
- Public meetings at 15 locations
- Creation of a dedicated website
- Management of the planning process and the SEA by a "project agency" involving all ministries

69 The final decision on the national plan adopted the best-scored SEA scenario. The chosen scenario did not cause much controversy, without any law suit related to the SEA because of the high community participation. The planned project budget included the compensations for affected farmers and communities as part of the total budet of 2 billion euros.

70 The keys of the success in this SEA were:

- Good dialogue with stakeholders

- Management of SEA by the "project agencies" involving all ministries
- Flexibility of the process
- Stakeholder consultation that permitted an interactive plan development

4.2 EIA Case Studies

4.2.1 Nestos River Project in Greece

71 The construction and operation project of three dams in the Nestos River was analysed using an EIA as assessment tool (EC, 1999). The purposes of the project were hydroelectric power, irrigation and river flow control. The area included in the EIA spread from the Bulgarian border to the delta estuary, based on the river catchment. The Nestos River delta has a valuable landscape interest and is declared a Ramsar site for its sensitive wetland and forest ecosystems.

72 The data used for the EIA came from the environmental studies conducted for the construction of the first dam in 1983, providing planning and socioeconomic issues, together with environmental data compiled for the project of two dams that were previously considered. Ramsar was also able to provide valuable data and data from consultants with previous working experience in this area was used. The identification and assessments of impacts were based on the experience of the project coordinator and specialists appointed to the project team. The overall approach therefore included:

- Description of the existing environment and an assessment of impacts (including indirect and cumulative impacts)
- Consideration of the cumulative impacts of the three dams and the indirect impact on the development downstream of the dams
- Assessment of identified impacts and how they were addressed in the wider area surrounding the dams (i.e. impacts from ancillary development associated with construction and operations) and the designated delta area (designated Ramsar site).

73 The benefits of this approach included:

- Establishment of environmental trends resulting from the current management of the delta, which is considered as a fundamental part of environmental assessment;
- Satisfactory completion of the project within an assigned short time-scale;
- Ability to assess and predict environmental impacts that would occur without the proposed project, which establish accurate baseline conditions and environmental trends.

4.2.2 Volta River Basin Preliminary Transboundary Diagnostic Analysis

74 The governments of the Volta River countries established the Volta River Basin Project (Volta River Basin Preliminary Transboundary Diagnostic Analysis, (TDA)) assisted by the Global Environment Facility of the United Nations Environment Programme (UNEP) (UNEP et al., 2002). Its goal is to deal with the threat over the sustainable management of basin water. This threat is caused by the decreasing regional precipitations together with an increasing use of the regional water resources translated in an expansion of the amount of dams. The dams are constructed

to increase availability of water for agriculture, industries and electricity generation as well as flood impacts reduction. The number of reservoirs therefore grows under population pressure.

75 The TDA was supposed to create the basis for National Action Plans **(NAPs)** and Strategic Action Plans **(SAPs)** regarding the international waters area of the Global Environment Facility **(GEF)**. In order to promote actions at a sustainable level, the TDA identified the links between causes and observed transboundary water issues in order to scale the relative importance of problem sources, both immediate and root. The objective of TDA is to determine preventive and remedial actions.

76 The methodology for the TDA consisted in the following:

- Identification of major issues, including status and information gaps;
- Classification of issues as national or transboundary in nature;
- Causal chain analysis (including root causes);
- Identification of interventions and actions to address the root causes and primary issues.

77 The study identified a range of environmental interventions for all riparian countries:

- Establish guidelines for monitoring and assessment methods of water, sediment and biota (including sampling, analysis, risk assessment);
- Develop data and information management system for national and regional land-based activities as a tool for contaminant assessment and management;
- Develop national and regional aquatic weed management strategies, plans, and frameworks combined with improved monitoring and GIS capabilities;
- Agree regionally on the extraction of river water and the control of river flow regimes;
- Conduct further baseline investigations to establish the minimum river flow threshold required for ecosystem function;
- Establish criteria for 'healthy' fisheries;
- Prepare inventory of selected wetlands sites in the basin to understand condition of habitat and management challenges;
- Implement biodiversity strategy, including specific action plans;
- Evaluate sensitivity of areas and habitats and levels of human impacts on them;
- Evaluate sustainable groundwater use rates and monitoring systems;
- Evaluate priority targets for protection in each protected area and decide how to fit into regional priorities;
- Identify main cause of deforestation, including public and private sectors, as well as legal and regulatory failures;
- Investigate the policy, legal, and cultural basis for land tenure policies.

4.2.3 Assam Integrated Flood and Riverbank Erosion Risk Management (FRERM) Investment Program in India

78 Assam is a state of India where per capita income in 2005 was 45% below the national average (WRD Assam, 2009). One of its major constraints for development is due to the frequent flooding

of the Brahmaputra River which results in serious flooding and riverbank erosion impacts. In fact, deforestation and land use change are degrading and geologically destabilising upper watersheds. This increases sediment loads which, together with monsoons' heavy rainfalls, lead to floods and erosion. To improve this situation, a project was developed to renovate three existing embankment systems and provide sluice gates in natural drainage courses. The project considered structural and non-structural measures and strengthened policy, planning and institutional bases. The three existing structures and their characteristics are the following:

- Palasbari reach in Kamrup district is an agricultural area, which is expected to change into manufacturing and industry areas;
- Kaziranga reach in Golaghat district is an agricultural area and is adjacent to Kaziranga National Park, world heritage site;
- Dibrugarh reach in Dibrugarh district is a densely populated town area.

79 Due to the lack of maintenance, the locally rising riverbed, and the structure failure induced by river erosion, all three structures needed a renovation. The necessity to realise integrated risk management was identified and the following Program and the Plan were established. The major objectives of the Program were to improve institutional capacity for mitigation of flood and erosion damage, to increase economic development, and to reduce poverty with the embankment project. An EIA was carried out to obtain an environmentally and socioeconomically sustainable solution with community participation. The EIA report followed the structure presented in **Section 3.4**, and included an economic assessment based on a Cost-Benefit analysis.

80 An Environmental Management Plan (EMP) was developed whose role was to ensure the proper and timely implementation of identified measures. It designated the responsible parties for each action with reliable feedback and adjustment processes. The EMP also established a contingency response plan in case of the emergencies during implementation. It identified the needs to strengthen institutional capacity and organised training programs to improve these weaknesses. It gathered feedback from the public and NGOs and included corrective actions. Finally, EMP ensured the cost of mitigation, monitoring and institutional capacity building.

81 Community participation was carefully carried out by organising public meetings and consultations with government officials, local people, civil society organisations and vulnerable groups. Simplified project outlines were distributed to stakeholders in their native language along with project perception questionnaires. Socioeconomic and poverty surveys were undertaken and local NGOs were asked for suggestions and opinions. An awareness raising program was undertaken during construction and operation phases together with periodic dissemination of information.

82 EIA identified minimal impacts of the Program on the environment. Then, a comprehensive monitoring program in adaptive manners was planned in order to respond to emerging changes due to the construction or other external factors. This sound management of EIA and the strong public support allowed the EIA to conclude with the recommendation to carry out the planned scenarios. Such a conclusion was however subject to the following conditions:

- The above-mentioned awareness raising program had to be launched and implemented through the participatory local disaster management committees;

- For any major change of the design or proposed activities, the EIA had to be updated and submitted to the government authorities and a funding institution;
- The capacity of the Water Resources Department (WRD) had to be improved regarding environmental and monitoring issues with adequate training and the development of environmental guidelines including performance indicators to assess the mitigation measures.

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