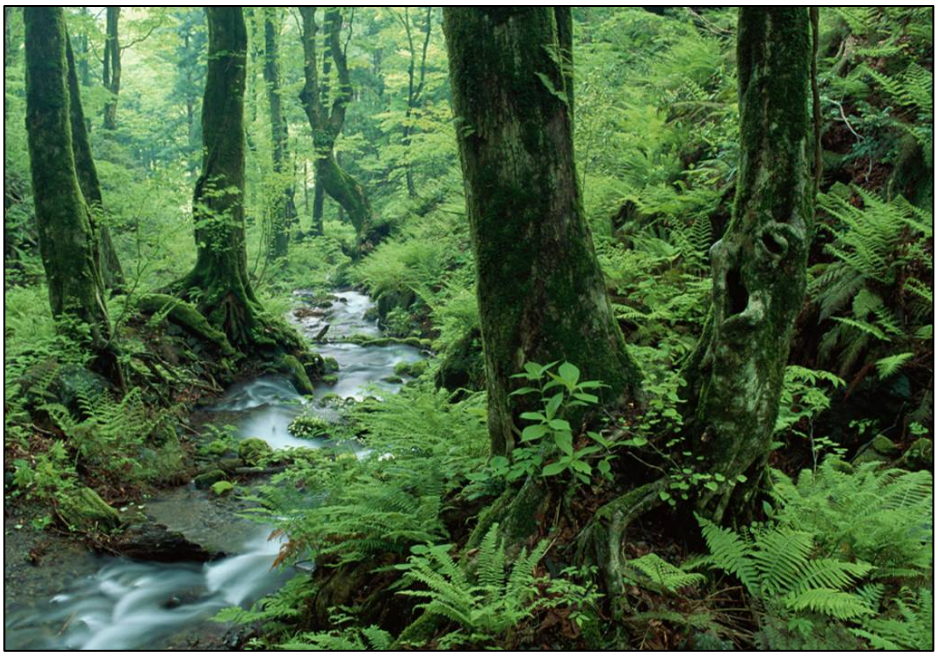
World Meteorological Organization

APPLYING ENVIRONMENTAL ASSESSMENT FOR FLOOD MANAGEMENT



A Tool for Integrated Flood Management

ASSOCIATED PROGRAMME ON FLOOD MANAGEMENT

March 2007

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.

The World Meteorological Organization is a Specialized Agency of the United Nations and represents the UN-System's authoritative voice on weather, climate and water. It co-ordinates the meteorological and hydrological services of 187 countries and territories.

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 "Applying Environmental Assessment for Flood Management" 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 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: "Environmental Assessment for Flood Management Tool".

Acknowledgements

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Disclaimer

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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 to identify, evaluated mitigate and document environmental impacts of flood management measures from the early planning stages to the project implementation stage.

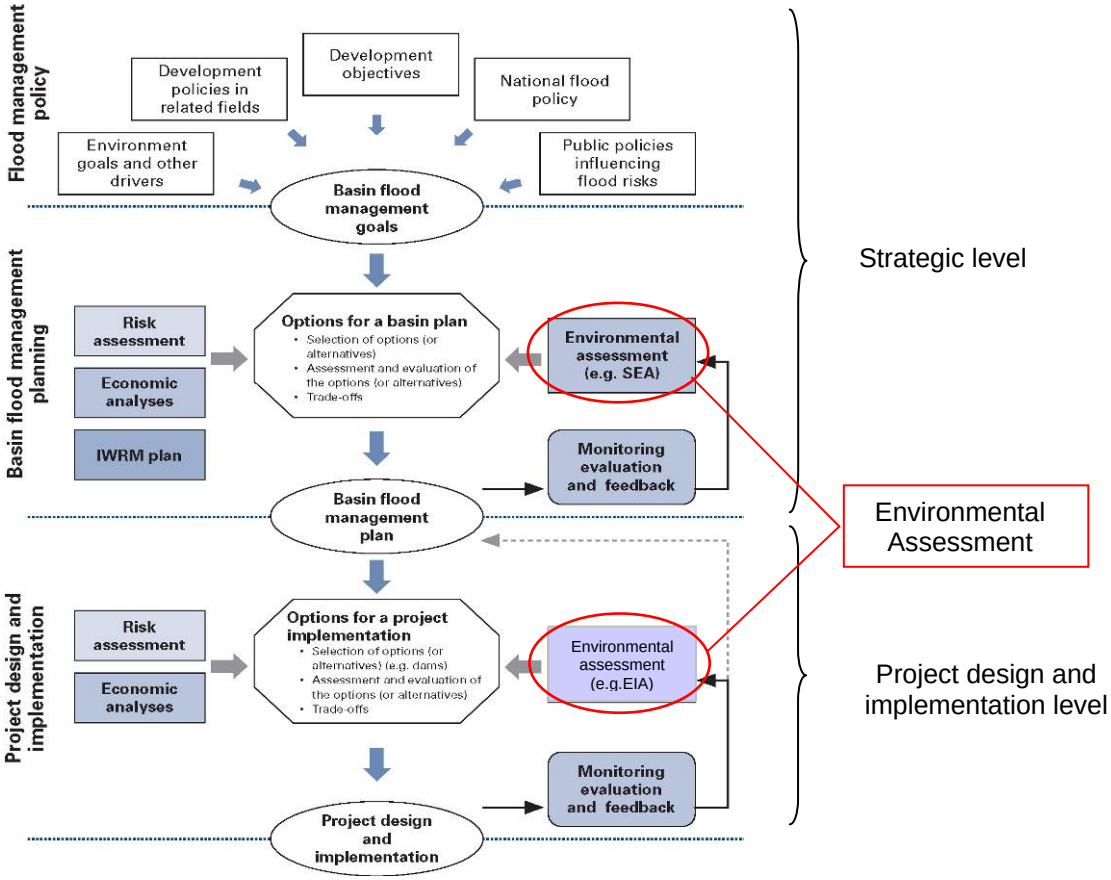

Figure 1. Conceptual framework for integrating environmental assessments in flood management approaches

1.2 ENVIRONMENTAL ASSESSMENT

4 As mentioned above and presented in **Figure 1**, there are environmental assessments is 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 Strategic Environmental Assessment (SEA). Environmental Impact Assessment (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 Policy, Plan and Programme (PPPs) on the state of environment with a view to prevent environmental damage [1]*. It provides an opportunity to integrate environmental, social and economic consideration 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. Strategic issues, that have long term impacts and thereby the focus is on long term actions such as new or amended laws, policies, and plans.

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, JICA, ADB. In general, the public may be less inclined to participate in a PPP process, compared to project, since the public is unable to foresee the likely impact of long-term policies. Therefore, essentially, representatives of general population e.g. mayors, community group leaders, and NGOs form part of the SEA.

1.2.2 Environmental Impact Assessment (EIA)

8 EIA assesses and predicts the impacts of a proposed project or action on human well-being, as well as the well-being of ecosystems on which human survival depends. 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 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 [2].

9 In EIA more widespread public consultation and participation is required and possible 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.

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

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. However, it is 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 [3]. 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 institutionalized procedures to ensure that all proposed development-related actions expected to have environmental consequences are assessed prior to authorization and possible implementation of the projects [3].

11 Some general exceptions do exist in the application of SEA and EIA such as in civil defence programmes. Others may include issues of 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 ELEMENTS OF SEA AND EIA

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

13 The common elements of SEA and EIA, and the sequence of action include [4]:

- 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
- Communication of decisions, with explanations and justifications
- Proposals for monitoring and evaluation

14 First of all, it is important that the responsible agency 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. Various adverse impacts are evaluated and ways and means of mitigating them. 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 the SEA and EIA [1]

	SEA	EIA
Stage of assessment in the proposals	Take place at earlier stages of decision-making	Take place at the end of decision-making process
	Pro-active approach to development proposals	Reactive 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

	SEA	EIA
Characteristics of assessments	Emphasis on meeting environmental objectives	Emphasis on mitigating and minimizing 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 continuing 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

1.5 ENVIRONMENTAL ASSESSMENT FOR FLOOD MANAGEMENT

15 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 and EIA for Integrated Water Resource Management and Flood Management [4]

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 in flood management	
Local	Local water- use and flood management plan				Local infrastructure project

1.5.1 Environmental impacts of structural measures

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

Table 3. Checklist of environmental impacts of structural flood management measures [5][6]

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 [6]

	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.
(3)	Denudation e.g. flood plains and effect on traditional agriculture	Evaluate changes in land use. Increases in population due to planned or unplanned resettlement from inundated areas may increase cultivation, fuel collection, and logging.
(4)	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. Proliferation of weeds can increase disease vectors; affect water quality, fisheries, and navigation.
(5)	Impacts on aesthetic, cultural, scenic or historical sites	Document implications on archaeological, historic, palaeontologic, religious and aesthetic or natural sites and unique values, which need to be conserved or salvaged
(6)	Pollution impacts	Assess pollution from settlements and cultivation. This should be looked at in the context of fisheries, recreation (tourism), perennial waterways and rivers; advantages for drinking and irrigation recreation
(7)	Inundation impacts e.g. loss of vegetation, wildlife habitat/ endangered species	Analyse site implications. Siting may minimize extinctions leading to loss of important species, including birds. Discuss mitigation measures. Biotic rescue can assist.
(8)	Weeds proliferation/ riparian vegetation	Make assessments for weeds proliferation, which can increase disease vectors, and enhance transpiration, and impair fish and water quality (e.g. Water Hyacinth (Eichhornia), Water lettuce (Pistia). Clogging impairs navigation, recreation and irrigation.
(9)	Fisheries e.g. migration effects	Acquire information on migratory fish stocks (if any), which may be impacted without passage facilities. Fish promotion in the reservoir can mitigate and produce more than prior to the project
(10)	Water quality, 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. Depending on what happens upstream and retention time within reservoir, water quality may be affected by salt accumulation with reservoirs for example. Eutrophication from weeds and biomass decay, turbidity, pollution from sediments may result.
(11)	Seismicity	Assess the situation for induced seismicity and tectonic movements may increase due to structural measures; monitoring is to be on routine basis.
(12)	Groundwater level/ recharge	Estimate groundwater levels. Higher levels of due to the high water levels in the reservoir for example. Downstream, in old flood plain areas, the groundwater level may fall but in irrigated areas, it may rise

	Item	Environmental issues
(13)	Health issues	Assess implications of water-borne diseases, which may increase without precautionary measures implemented (e.g. vector control, prevention) schistosomiasis, onchocerciasis, encephalitis, and malaria. Similar problems may result in the reservoir itself, primarily from irrigation and associated canals.
(14)	Impact on settlements- e.g. municipality	Evaluate impact of possible inundation on houses, villages, farms, infrastructure including navigation problems and transmission lines. Can projects become regional development projects, which integrate rural development for people e.g. for vulnerable ethnic minorities, with watershed management and irrigation? Involuntary resettlement imposes major social and economic costs.

1.5.2 Environmental impacts of non-structural measures

17 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. The two main non-structural measures are 'Land use regulation' and 'Coping with floods'.

Land use regulation

18 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 includes 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 by laws for instance, can help in preventing negative consequences due to urbanization or restricting development in such a manner that the hydrological response characteristics of the catchments are not changed. However, certain negative impacts should be recognized and accounted for, e.g., as forestation of watershed if not appropriately undertaken may result in:

- Reduction in biodiversity
- Impacts on scenic and landscape qualities
- Higher evapotranspiration

Coping with floods

19 Coping with floods involves living with floods, flood proofing and emergency response mechanisms and may result in the following [1][5]:

- Likely spread of pollutants and chemicals impacting health
- 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

Now these adverse impacts are to be avoided, if non-structural measures are the preferred choice needs to be addressed.

2. STRATEGIC ENVIRONMENTAL ASSESSMENT FOR BASIN FLOOD MANAGEMENT PLAN

20 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.

21 Advantages of applying SEA in basin planning can be summarized as [2]:

- *Supporting integrated decision-making*: SEA supports a decision-making process that can identify environmental impacts of proposed actions on other sectoral 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.
- *Reinforcing 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.

22 Strategic environmental assessment helps realise the importance and integration of environmental objectives into social and economic goals a society pursues (**Figure 1**) [7]. It helps bring environmental issues, which often are considered on the fringes of development process, into centre-stage and provide weight age to equal to the social and economic issues.

23 In the **figure 2**, depicts a situation as prevalent in many societies, where environmental objectives are given minimal considerations in relation to the economic and social goals. 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).

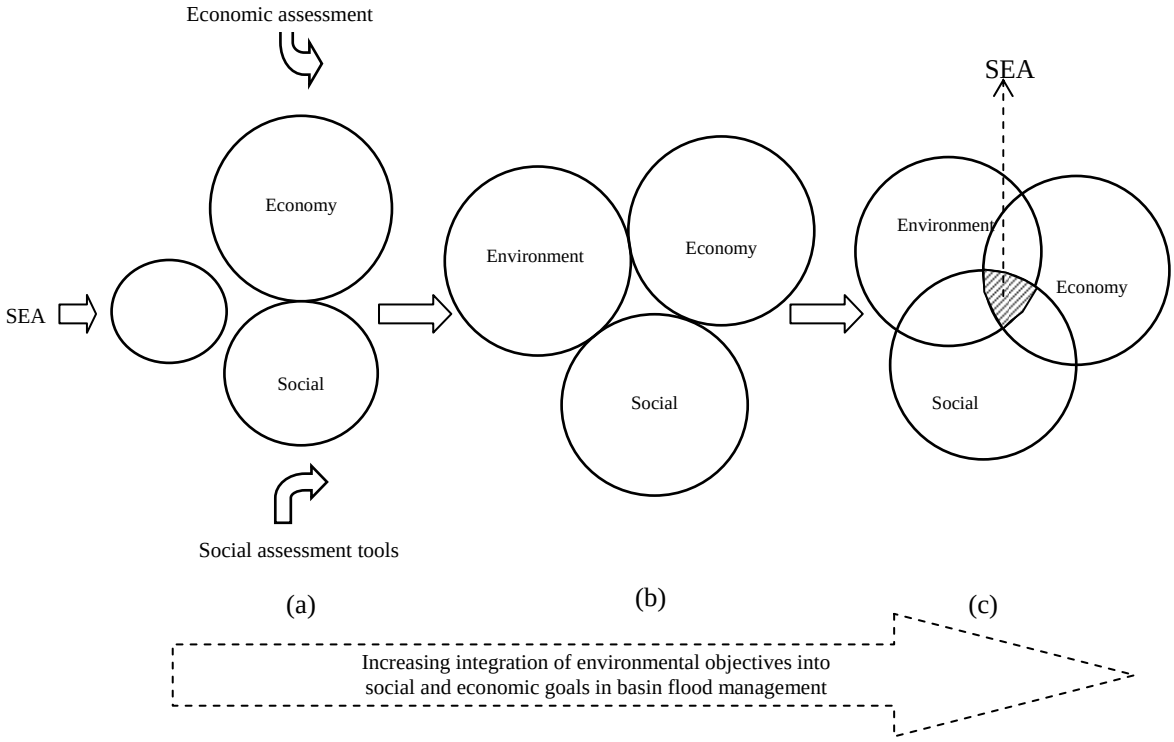

Figure 2. The SEA continuum: Integrating environmental objectives into social and economic goals

Notes:
The sizes of the circles represent the relative importance of each of the objectives. The relative distances from each component, imply the level of dependency or integration of the environmental objectives in relation to the social and economic goals. However, the relative sizes of the three would largely depend on the prevailing socio-economic status and requirements within societies.

24 Strategic environmental assessment for flood management may take different forms, depending on, for example, 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 policy, plan or programme (so that they address environmental dimensions effectively) – this is where SEA can be most effective.
- To evaluate an existing PPP – as an environmental sustainability test of policies, plans and programmes 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 policies, plans and programmes (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

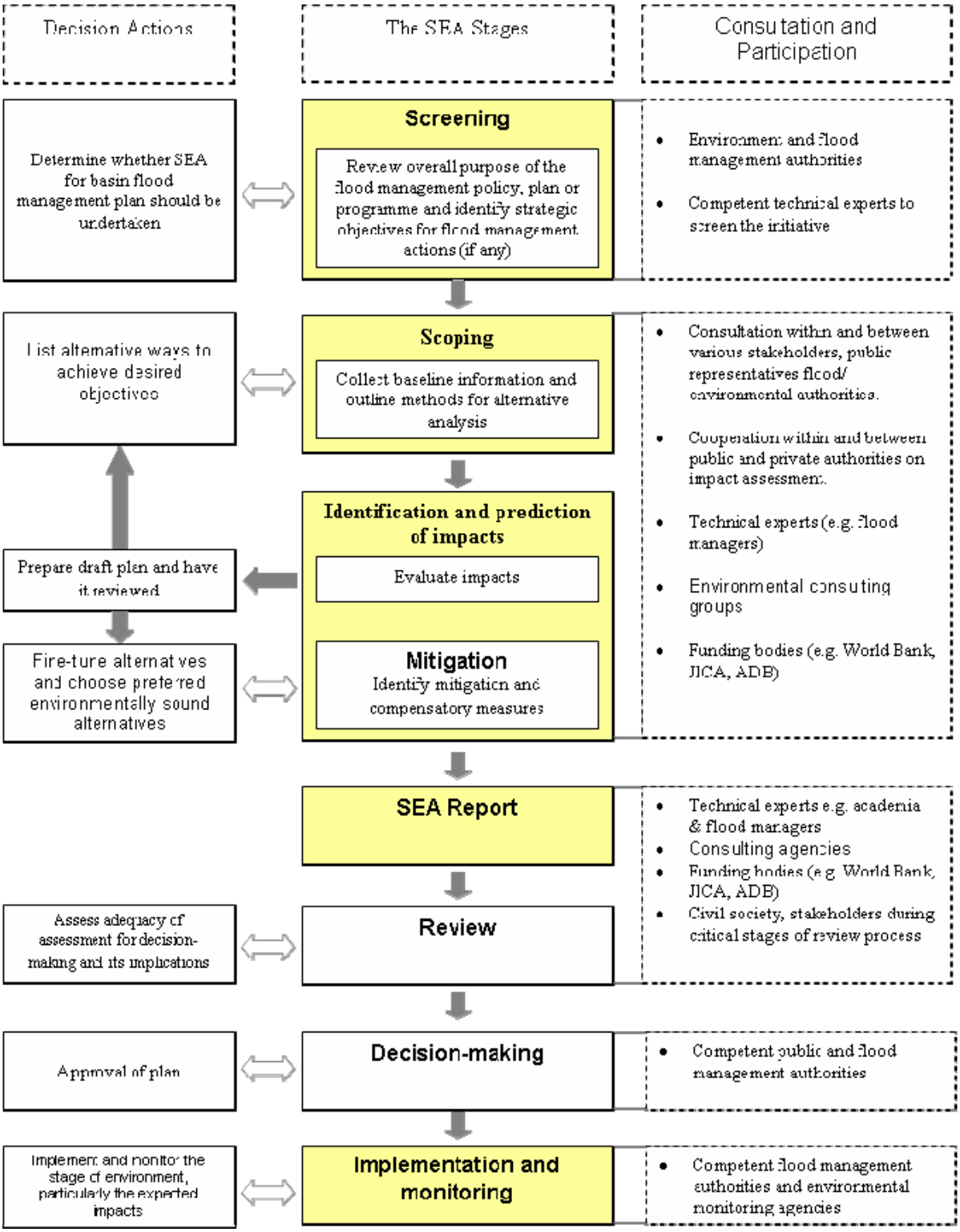

Figure 3. The SEA flowchart for Flood Management [5][8]

2.2 THE SEA STEPS [5][8]

25 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.

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 the policy, plan or programme? • What are the implementation procedures?
2) Scoping	• What environmental elements are likely to be significantly affected by floods? • Are there particular existing environmental problems (- eventually 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? • How significant are the impacts? • How can these be reduced if necessary? • How can these be monitored?
4) Mitigation	• 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

26 Participation of various stakeholders is a pre-requisite for successful SEA at its various 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.

27 The process of participation should be designed to include clear objectives, and an analysis of the stakeholders that need to be involved. Role of each of the stakeholders, 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 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.

2.4 THE SEA REPORT

Following is a suggested outline for a SEA report.

28 **I) Executive summary**

- Methodology used: Who carried out the SEA, who were 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?

29 **II) Introduction**

- Brief objectives of the policy/ plan/ programme.

30 **III) Screening**

This 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:

- Outlining objectives of the flood policy/plan/programme
- A description of the water sector and flood policy/plan/programme.
- Baseline information on environmental issues and the sustainability visions
- Assessment of the interrelationships with other policy/plans/programmes
- Available implementation mechanisms
- Trends in flood incidences

31 **IV) Scoping**

This 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
- Outline of the available mechanisms of achieving objectives
- Outlining the river basin environment
- Possible alternative solutions and scenarios considered
- Description of the alternatives (system-, site- and design-) and reasons thereof
- Providing the data sources and outlining difficulties (if any) in collecting data
- Timeframe adopted for assessment

32 **V) Identification and Prediction of impacts**

- State of the environment without implementation of the flood policy/plan/programme
  - 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 policy/plan/programme
  - Identify negative environmental impacts (whether 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-à-vis flood management objectives
  - Compare evaluated net benefits with social, environmental and economic goals
  - Indicators for environmental quality

- Recommendations for aligning flood policy/plan/programme 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.)

33 **VI) Conclusions and Recommendations**

- Conclusions
  - Statement on how the SEA process has been developed
  - Legal requirements under which SEA has been carried out
  - Highlight 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)
  - Recommendation on changes required, if any, in institutional arrangements to meet the desired objectives,
  - Recommendation 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 realization

34 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 good time and form.

2.5 REVIEW

35 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

36 It 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

37 Implementation of flood management plan should be monitored with the objective of reducing or offsetting any significant adverse impacts on the environment, as and when they are detected and sufficiently before they start manifesting into problems. This should be based on the environmental protection objectives of the plan. 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

38 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.

39 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 option to decision makers.

40 The benefits of applying EIA are in design and implementation of individual projects includes:

- *Better environmental planning and design of project proposals*: A well-designed project by EIA can minimise risks and impacts on the environment and people, and thereby avoid associated costs of remedial treatment or compensation for damage thereby causing delays and cost over-runs.
- *Ensuring compliance with environmental standards*: Compliance with environmental standards reduces damage to the environment and disruption to communities.
- *Saving in 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’.
- *Increased 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.

41 Environmental Impact Assessment for flood management projects should be undertaken throughout the project cycle, beginning as early as possible from the pre-feasibility stage. EIA provides for 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 from local governments. An appropriate project scheme can then be developed incorporating various viewpoints received and addressing the critical issues.

3.1 EIA FRAMEWORLK FOR FLOOD MANAGEMENT

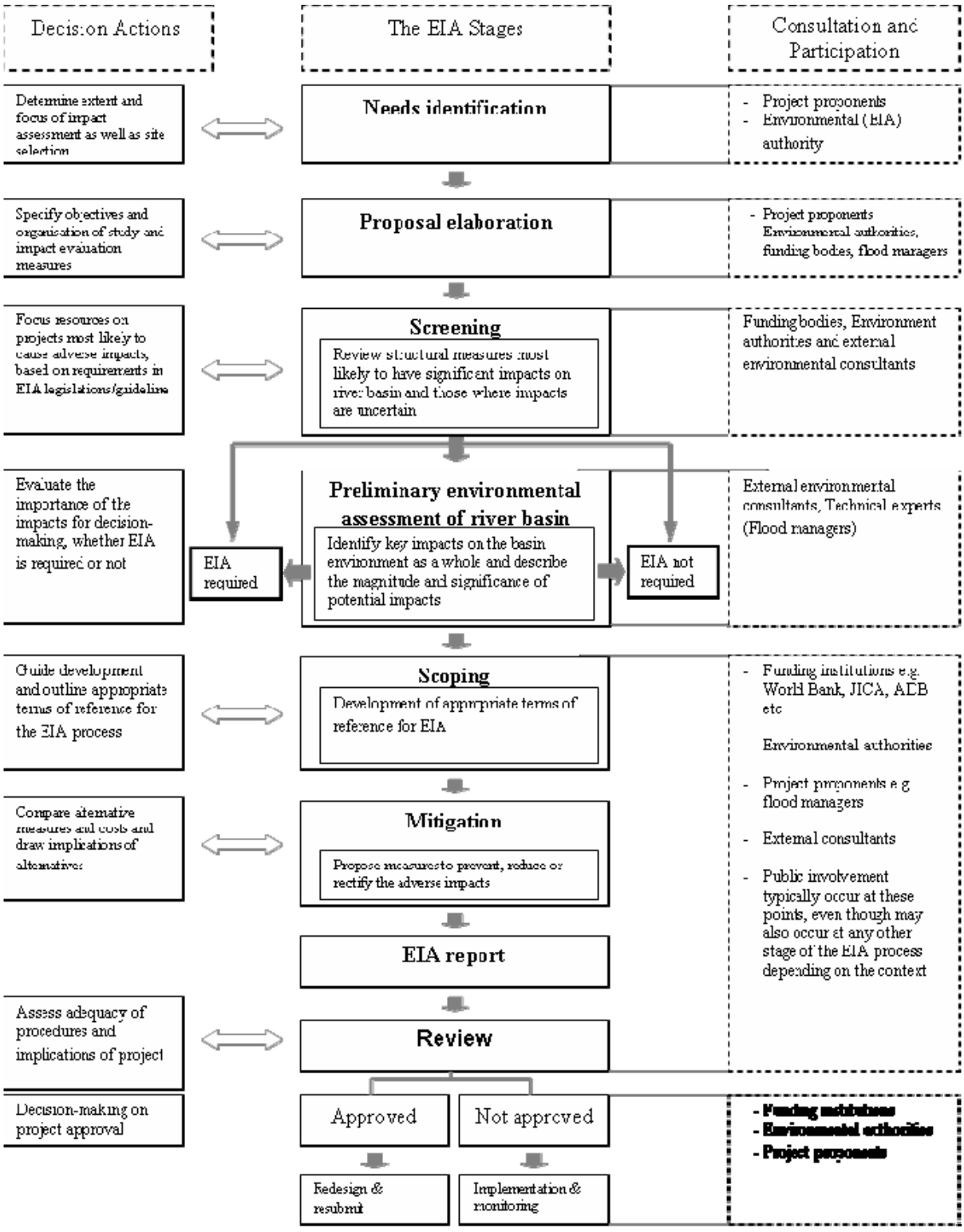

Figure 4. EIA Flowchart for Flood Management Projects [9][10]

3.2 THE EIA STEPS [9]

Main steps	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? • 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	• What measures should be taken at the early stage of the project cycle? • Which measures are proposed to prevent, reduce or rectify adverse impact (s)? • 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

42 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 government, 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.

3.4 THE EIA REPORT

43 **I) Executive summary**

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

44 **II) Introduction**

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

45 **III) Description of the Project**

- Type of the project and needs assessment
- Location (use maps) 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

46 **IV) Description of the Environment**

- A clear delineation of study area
- Description of flood risks
- Established baseline data (Local and indigenous knowledge should be appropriately incorporated and discussed)
  - 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 and employment, infrastructure, land use etc.
  - Quality of life values: socio-economic values, public health, recreational components, historical treasures and cultural values.
  - Dependence of local communities on the environmental services

47 **V) Anticipated Environmental Impacts**

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

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

- Effects during Project Construction:
  - Evaluate significant environmental impacts during construction phase (usually involves impacts that will cease at completion of construction e.g. occurs during long construction projects, lasting several years).

48 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 an unwarranted acceleration in the use of scarce resources and favour short-term over long-term economic gains?
- Will the project result in unwarranted hazards to endangered species?
- Will the project tend to intensify undesirable rural-to-urban migration to an unwarranted degree?

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

49 **VI) 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.

50 **VII) Recommendations**

- General
  - Statement on how the EIA process has been developed
  - Legal requirements under which EIA has been carried out
  - Highlight 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 otherwise 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
  - Reporting schedules and feedback mechanisms
  - Procedures to be followed in case of unexpected development

51 **VIII) 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.

- Acknowledgements
- Literature references

52 **IX) Annexes**

Following information could be included in form of annexes:

- Scope of EIA
- Abstracts or summaries of relevant background documents
- Tabular and graphical summaries of data
- Major studies and stakeholder involvements undertaken in support of EIA preparation should mention below should be considered for inclusion:
  - Public participation e.g. summary 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.
  - Environmental risk assessment e.g. on two major categories of risk i.e. those to human health, and those to ecosystem integrity.

3.5 REVIEW

53 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 containment on project implementation and its viability?

3.6 DECISION-MAKING

54 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 to redesigning the project on the lines suggested. These suggestive changes should have been elaborated in the report.

4 CASE STUDIES

4.1 SEA CASE STUDIES

55 These are very few case studies available on the SEA in the context of basin flood management plans. However, some of the case studies related to flood management issues are described briefly. This section would be continuously updated on and when such studies are available. Readers are encouraged to provide a feedback on these and new case studies.

4.1.1 Regional Environmental Assessment of Argentina's Flood Protection

56 A Regional Environmental Assessment (REA) was undertaken for an investment programme to protect communities occupying the floodplains of the Paraguay, Panama and Uruguay rivers in Northern Argentina. This region had suffered enormous losses from periodic flooding, but the flooding also sustains ecological systems and many forms of productive activities. So the project adopted the strategy of 'living with floods' [11].

57 The REA was initiated at an early stage of the decision-making process and included:

- description of the interaction of 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 Regional Environmental Assessment (REA) and public consultation;
- identification of mitigation and monitoring measures;
- identification of institutional weaknesses in dealing with the flood problem; and
- recommendation for a regional action plan to address the issues identified;

58 The REA found the interactions of many ecosystems and man-made systems within the floodplains. The REA assisted the design of four key project components to help improve the environmental and economic benefits of the project:

- Strengthening Environmental Assessment procedures in key institutions within the seven provinces involved
- 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.

59 The most important outcome of the REA was its direct contribution to screening all potential investments under the project. It helped reduce the number of possible sub-projects from 150 to 51, all with a clear economic, social and environmental justification.

4.1.2 Transboundary Environmental Assessment in the Nile Basin

60 The Nile Basin covers 3 million km2- 10% of Africa, and is shared by 10 countries- Burundi, the Democratic Republic of Congo, Egypt, Ethiopia, Eritrea, Kenya, Rwanda, Sudan, Tanzania and Uganda. The total population is 300 million people, with 160 million in the basin itself. The Nile riparian countries established the Nile Basin Initiative (NBI) to fight regional poverty and promote socio-economic development. Under the NBI's Shared Vision Programme (SVP), a transboundary

environmental assessment (TEA) was initiated and carried out by the Nile riparian in co-operation with UNDP and the World Bank, with additional funding from the Global Environment Facility (GEF). It includes a collective synthesis of basin-wide environmental trends, threats and priorities, and outlines the elements for a long-term agenda for environmental action for the Nile Basin. The main objective was to help translate existing national environmental commitments and interests into basin-wide analytical frameworks and, eventually, basin-wide actions [7][11].

61 The TEA approach addressed basin-wide issues at the national and local levels and included:

- 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.

62 Two related sets of activities informed the report: broad and participatory national consultations; and a USAID scoping study for a multi-country technical background paper. Transboundary environmental threats were prioritized and these guided the formulation of a first basin-wide project for environmental action within the SVP. The Action Project has been designed to encourage more effective basin-wide stakeholder co-operation on transboundary issues in selected priority areas. The main benefits were as follows:

- 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 and sectoral policies and the environment.
- Enhanced capacity and support for local-level action on land, forest and water conservation, and 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.

4.2 EIA CASE STUDIES

4.2.1 The Nestos River Project, West Thrace, Greece

63 EIA for the project assessed the environmental impact of construction and operation of three dams on the Nestos River. The study area extended from the Bulgarian borders to the delta estuary and was based upon the hydrological basin of the Nestos River. The proposed dams were to be used to produce hydroelectric power and to control river flows and irrigation. Water transport would operate during the night time period. The delta of the Nestos River is a Ramsar site and therefore characterized by sensitive forest and wetland ecosystems. The area is also valued for its landscape interest [10].

64 The EIA utilised information available from the environmental work undertaken for the first dam (constructed in 1983), which provided information related to planning and socio-economic issues as well as environmental data collated previously for the other two proposed dams. In addition, a significant amount of data was available to the project team on the delta area as a result of the Ramsar designation. Where possible the project also utilised data from consultants with existing knowledge

and previous experience of working in the area. The identification and assessments of impacts was based on the experience of the project coordinator and specialists appointed to the project team. The overall approach therefore included:

- A description of the existing environment and an assessment of impacts (including indirect and cumulative impacts).
- A consideration of the cumulative impacts of the three dams and the indirect impact of the development downstream of the dams.
- Assessing the type of impacts identified 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).

65 The benefits of this approach included:

- The establishment of environmental trends resulting from the current management of the delta, which is considered a fundamental part of environmental assessment.
- A satisfactory completion of the project within an assigned short time-scale.
- The ability to assess and predict environmental impacts that would occur without the proposed project, which enabled to establish accurate baseline conditions and environmental trends.

66 Although assessment of the cumulative impacts required additional baseline data, this was available as a result of the previous studies undertaken for the Ramsar site and the previous environmental work for the dams.

4.2.2 Volta River Basin Preliminary Transboundary Diagnostic Analysis (TDA)

67 Throughout the Volta River Basin, dams and reservoirs have been created in order to mobilize water for agricultural, industrial and electricity-generating purposes, as well as minimize the impact of floods. The amount of these large and small dams continues to expand as population pressure grows. Increasing use of these waters and decreasing precipitation in the region, however, threaten continued sustainable management of the waters in the basin. Therefore, the Governments of the Volta River Countries launched the Volta River Basin Project (Volta River Basin Preliminary Transboundary Diagnostic Analysis, TDA), with the assistance of the Global Environment Facility (the United Nations Environment Programme).

68 The purpose was to scale the relative importance of sources and causes, both immediate and root, of transboundary ‘waters’ problems, and to identify potential preventive and remedial actions. The TDA was expected to provide the basis for development of both the National Action Plans (NAPs) and the Strategic Action Programme (SAP) in the area of international waters of the GEF. The preliminary TDA attempted to clarify the linkages between root causes and perceived problems to encourage interventions at a more sustainable level.

69 The methodology for the TDA consisted of the following:

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

70 The study identified a range of environmental interventions for all the riparian countries, which includes the following:

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

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Further reading

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

- Tool C1.2 Water resources assessment
- Tool C1.5 Ecosystem assessment

- Tool C2.6 Environmental Assessment (EA)
- Tool C6.4 Land use planning controls and nature protection