



GLOBAL INTERNATIONAL
WATERS ASSESSMENT



Final version
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GIWA METHODOLOGY

Detailed Assessment · Causal Chain Analysis · Policy Option Analysis

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Summary

GIWA Rationale and Assessment Framework

Lack of an International Waters Assessment comparable with that of the International Panel on Climate Change, the Global Biodiversity Assessment, and the Stratospheric Ozone Assessment, is a unique and serious impediment to the implementation of the International Waters (IW) Component of the GEF, since there exists no basis on which to identify areas of global priority for GEF intervention. Thus, the Global International Waters Assessment (GIWA) was created with the overall objective of developing a comprehensive, strategic framework for the identification of priorities for remedial and mitigatory actions in international waters, designed to achieve significant environmental benefits, at national, regional and global levels¹. GIWA relies on groups of specialists at sub-regional level. Following a common methodology, these specialists investigate the ecological status of international waters, the causes of their degradation and the policy options available to improve their status. The global picture will emerge by assembling the different sub-regional assessments.

The following box contains a brief description of the components of the Assessment Framework.

Components of sub-regional assessments framework²

Scaling

- defines the geographic boundaries of the sub-region;
- identifies key systems within the sub-region; and
- indicates the major geographic features and economic activities conducted within the sub-region.

Scoping

- identifies the critical GIWA concerns and issues in the sub-region by assessing their environmental and socio-economic impacts;
- produces estimates of the likely environmental and socio-economic impacts by the year 2020.
- establishes priorities among the GIWA concerns and issues.

Detailed Assessment

- is not a self contained component which is confined to one stage in the assessment process;
- is an integral activity within the other components and, therefore, is carried out at several stages in the assessment process;
- substantiates the experts conclusions in the other components;
- identifies and documents the nature and availability of information related to the selected priority concerns and issues;
- quantifies the severity of the impacts of the selected concerns and issues.

Causal Chain Analysis

- traces the proximate to the root causative factors behind the selected GIWA concerns and issues;
- is conducted to serve as the foundation of the selection of policy options.

Policy Option Analysis

- indicates potential policy interventions, based on the identification of the root causes conducted in the Causal Chain Analysis;
- includes the evaluation of alternative scenarios, developed on the basis of projected actions taken to address the identified root causes of environmental degradation.

¹ UNEP/GIWA "Project Proposal", p. 2.

² TDA. It is important to clarify the relation of the Trans-boundary Diagnostic Analysis (TDA) to the Assessment Framework. First, TDA needs to be defined. According to Annex 8 of the International Waters Program Study (IWP, 2000), "... the purpose of a TDA is to assess the relative importance of environmental disturbances and threats to international waters and their causes and to identify potential preventive and remedial actions."

It is apparent from this description of a TDA that its components coincide with the components of our sub-regional assessments (i.e. scaling, scoping, causal chain analysis and policy option analysis). Hence, TDA is not a separate, additional component within the GIWA Assessment Framework, but a combination of all its previously mentioned components.

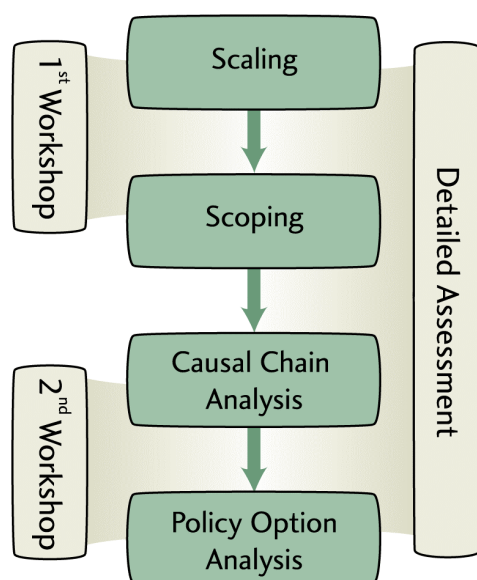
Introduction

The following guidelines are provided to GIWA Sub-regional Task Teams (SRTT) to assist them undertake the last three components of their assessments, i.e. the Detailed Assessment, the Causal Chain Analysis and the Policy Option Analysis. These guidelines draw from many sources. The Causal Chain Analysis section is to a large extent based on “The Root Causes Analytical Approach”, published on the internet by the WWF

(<http://www.panda.org/resources/programmes/mpo/>). The Policy Option Analysis section is based on “A Practical Guide for Policy Analysis” by Eugene Bardach.

The present guidelines are intended to streamline the last three components of the GIWA process. Figure 1 illustrates the process of work envisaged for the GIWA project. The first sub-regional workshop is designed to help each SRTT conduct Scaling (component 1) and scoping (component 2). The second sub-regional workshop will focus on the causal chain (component 4) and policy option (component 5) analyses. Detailed Assessment (component 3) is an activity within the other components and is conducted at different stages of the assessment.

Fig. 1



Due to the great variation in local circumstances under which this methodology will be applied, each SRTT will have the opportunity of adapting this methodology to its particular needs and circumstances. In some sub-regions there are considerable amounts of data and related assessments have been conducted before. Whereas in other sub-regions reliable data are scarce and no related assessments have been conducted. Furthermore, as the GIWA sub-regional boundaries do not follow national borders, aggregation of national data within a sub-region may be difficult. Therefore, these guidelines should be regarded as a framework, rather than detailed instructions.

Detailed Assessment

I. Purpose and Schedule

Purpose

Detailed Assessment is not a self-contained component within the Assessment Framework, which is confined to one stage in the assessment process. It is an integral activity within all components and operates at several stages in the assessment process. In the Scoping, the SRTTs identified the most critical Major Concern and Issue(s) in their sub-regions based upon their personal judgements and experiences. Therefore, it is necessary for the SRTTs to prove and support their conclusions in the Scoping with actual facts and information. This step of GIWA process is called the Detailed Assessment and its aims at this stage of the process are:

1. To substantiate the conclusions of the Scoping based on the expert judgements by actual quantitative information; and
2. To identify and document the nature and availability of information related to the selected priority Major Concern and priority GIWA Issue(s) within the Concern.
3. To quantify the severity of the impacts of the selected priority Major Concern and priority GIWA Issue(s) within the sub-region.

It must be noted that the Detailed Assessment is not meant to be a massive *data* gathering process, but rather a documentation of existing information related to the assessments of impacts of selected priority Major Concerns and Issue(s). These information may come from various sources including previous assessments, research papers, scientific publications, surveys, government reports, status reports, EIA reports, economic reviews, etc. Also, during the Scaling and Scoping process, the SRTTs were asked to give a brief explanation and justification on which information they used to support their judgements, and such information can also be used as an input to the Detailed Assessment process.

In the scaling, the SRTTs assessed the complete sub-region and scaled possible major sub-systems. As part of the detailed assessment also a more precise indication of the geographical location of the Major Concerns and Issues will emerge. The environmental problems may be localized to a certain drainage basin, a part of the river system, a defined coastal area or may even be a major "Hot Spot".

The Detailed Assessment is a continuous process incorporated in all stages of the GIWA process and SRTTs should add to and edit the information table as each Issue is discussed. Later in the GIWA process – the Causal Chain Analysis – the SRTTs will again be required to identify and document available information that supports each step of the Causal Chain Analysis.

Schedule

After the first workshop on Scaling and Scoping and before the 2nd workshop on the Detailed Assessment, Causal Chain Analysis and Policy Option Analysis, the members of the SRTTs are required to search for relevant information on environmental and socioeconomic impacts of the selected priority Major Concern and GIWA Issue(s). They will, then, bring along the gathered information to the 2nd workshop for proper review and discussion. The SRTTs need to decide which information can or cannot be used to best describe the environmental or socioeconomic impacts in their sub-regions. The usable information that can be used will, then, be recorded in the worksheets designed for the Detailed Assessment process.

II. Definitions and Procedure

Definitions

Environmental Impacts:

The adverse effect of a GIWA Issue on the integrity of an aquatic ecosystem.

Socioeconomic Impacts:

The effect of a GIWA issue on human welfare. There are three categories of socioeconomic impacts according to the GIWA Methodology:

1. *Economic Impacts*: Impacts of all changes to the aquatic environment on long-term levels of output in key economic sectors and cost incurred by economic sectors and public authorities.
2. *Health Impacts*: Impacts of changes in quantity, quality and accessibility of international waters on the health of inhabitants and visitors within the sub-region.
3. *Other Social and Community Impacts*: Impacts of changes to the aquatic environment or resettlement and migration, levels of employment, the well-being of vulnerable groups within society, and on the overall quality of community life and its cultural heritage within the sub-region.

Procedure

1. For a selected priority Major Concern, there may be one or more priority GIWA Issues. Therefore, the Detailed Assessment must be conducted for all priority Issues within the priority Major Concern. A separate table should be used for each separate priority Issue.
2. In the report sheets, the SRTTs are required to fill in a description of their sub-regions including sub-region number, name, selected priority Major Concern, and the score given in the Scoping.
3. In the Scaling and Scoping, the SRTTs were asked to score the environmental and socioeconomic impacts for current and future conditions³. Therefore, in the Detailed Assessment of each impact, the SRTTs will be required to document any information that can substantiate the environmental and socioeconomic impacts under current and future conditions. Four separate worksheets are designed for each combination,

³ For the environmental impact scores for GIWA Issues under present and future conditions, please refer to Scoping Report Sheet IIIb. For the socioeconomic impact scores for Major Concerns under present and future conditions, please refer to Scoping Report Sheet IIIc.

- i.e. 1). current environmental impacts; 2). current socioeconomic impacts; 3). future environmental impacts; and 4). future socioeconomic impacts.
4. For each priority GIWA Issue, there can be many environmental impact indicators that can substantiate the impacts of that Issue in either current or future condition. The SRTTs will, therefore, be allowed to document any relevant information as much as they feel adequate or appropriate.

Likewise, there may be many socioeconomic proxy indicators quantifying the Economic Impacts, Health Impacts, and Social and Community Impacts for a selected priority Major Concern. The SRTTs, again, are encouraged to document any related information that may substantiate their conclusions.

- I. In case that some information relevant to the impact assessment is missing, the SRTTs should try to identify possible sources of information or contacts, so that the needed information can be obtained for the Detailed Assessment.
- II. As mentioned earlier, the Detailed Assessment is a continuous process, thus, the SRTTs should add or edit the worksheets when necessary.

III. Worksheets

There are four report sheets for the Detailed Assessment at this stage:

- **Report Sheet I.** Description of indicators substantiating environmental impacts of the selected priority Major Concern and Issue(s) under present conditions.

This report sheet is used to document the information on physical/biological/ chemical indicators or data that can quantify the environmental impacts of each Priority GIWA Issue within the selected priority Major Concern at present conditions.

- **Report Sheet II.** Description of indicators substantiating socioeconomic impacts of the selected priority Major Concern under current conditions.

This report sheet is used to document the information on socioeconomic proxy indicators or data that can quantify the socioeconomic impacts (Economic Impacts; Health Impacts; and Other Social and Community Impacts) of the selected priority Major Concern at present conditions.

- **Report Sheet III.** Description of indicators substantiating environmental impacts of the selected priority Major Concern and Issue(s) under future conditions.

This report sheet is used to document the information on physical/biological/ chemical indicators or data that can quantify the environmental impacts of each Priority GIWA Issue within the selected priority Major Concern under future conditions.

- **Report Sheet IV.** Description of indicators to substantiate socioeconomic impacts of selected priority Major Concern under future conditions.

This report sheet is used to document the information on socioeconomic proxy indicators or data that can quantify the socioeconomic impacts (Economic Impacts; Health Impacts;

and Other Social and Community Impacts) of the selected priority Major Concern under future conditions.

Definitions of fields in the report sheets

Environmental Impact indicator:

A measurement quantifying the magnitude of Environmental Impacts.

Socioeconomic proxy indicator:

A measurement quantifying the magnitude of Economic Impacts, Health Impacts, and Other Social and Community Impacts.

Unit:

Unit of measurement, e.g. cubic meters per year, square kilometres, households, etc.

Format:

E.g. text, data table, map, graph, raw data, CD-ROM, mathematical model, population projection, assumption, etc.

Extent or Area Covered:

Geographical area, e.g. entire sub-region, 300 km upstream from the mouth of Yellow river, etc.

Duration and Frequency:

How long and frequently the data have been collected, e.g. every 3 months from 1985 until 1995, or In July of every year from 1990-1998, etc.

Reliability:

How reliable is the information, e.g. low - medium - high, peer-reviewed, gray-literature, unpublished, scale-dependent, small sample size, etc.

Availability:

E.g. Free of charge, Spanish-language only, confidential, unpublished, personal contact only, web-based access, missing information , etc.

Source of information or contact to obtain information or data:

Annual report, research paper, journal, Ph.D. thesis, contact persons, department, agency, institution, university, etc. If it is a published literature, a citation may be used.

Brief explanation or justification how the indicator supports your conclusion made in the Scaling and Scoping:

Because the methodology does not ask the SRTTs to show *actual raw data* in the worksheets, the SRTTs need to give an explanation how the selected indicator in the study or research support their judgements in the Scoping.

IV. Final product

Besides the recorded worksheets, the final output of the Detailed Assessment will be a descriptive report, an essay supported by graphics or illustrations using the information recorded in the worksheets. "Hot Spot" identification and geographical localization shall be further documented and described.

To write this final essay, the environmental impacts and socioeconomic impacts should be integrated as much as possible to illustrate the relationships between them and to make a coherent statement. Similarly, the results obtained from the assessment of future conditions should also be integrated and this part of the output will again be used when analyzing a Business as Usual scenario in the Scenario Analysis.

Report Sheet I. Description of indicators substantiating environmental impacts of the selected priority Major Concern and Issue(s) under present conditions.

Sub-region No. _____

Sub-region Name: _____

Selected Priority Major Concern: _____

Priority GIWA Issue: _____

Score received in the Scoping: _____

Environmental Impact Indicator and its unit	Format: Map, report, data table, etc.	Extent or Area covered	Duration and Frequency	Reliability	Availability	Source of information or contact to obtain data or information	Brief explanation or justification how the indicator supports your conclusion made in the Scaling and Scoping

Report Sheet II. Description of proxy indicators substantiating socioeconomic impacts of the selected priority Major Concern under current conditions

Sub-region No. _____

Sub-region Name: _____

Selected Priority Major Concern _____

Socioeconomic Impact and its score	Socioeconomic proxy indicator and its unit	Format: Map, report, data table, etc.	Extent or area covered	Duration or Frequency	Reliability	Availability	Source of information or contact to obtain data or information	Brief explanation or justification how the proxy indicator supports your conclusion made in the Scaling and Scoping
Economic Impacts Score: __								
Health Impacts Score: __								
Other Social and Community Impacts Score: __								

Report Sheet III. Description of indicators substantiating environmental impacts of the selected priority Major Concern and Issue(s) under future conditions.

Sub-region No. _____ Sub-region Name: _____ Selected Priority Major Concern: _____

Priority GIWA Issue: _____ Score received in the Scoping: _____

Environmental impact indicator and its unit	Format: Report, model, projection, assumption, or baseline information	Extent or Area covered	Duration or Frequency	Reliability	Availability	Source of information or contact to obtain data or information	Brief explanation or justification how the indicator supports your conclusion made in the Scaling and Scoping

Report Sheet IV. Description of proxy indicators substantiating socioeconomic impacts of the selected priority Major Concern under future conditions

Sub-region No. _____

Sub-region Name: : _____

Selected Priority Major Concern _____

Socioeconomic Impact	Socioeconomic proxy indicator and its unit	Format: model, projection, assumption, or baseline information	Extent or Area covered	Duration	Reliability	Availability	Sources of data or contact to obtain data and information	Brief explanation or justification how the data support your conclusion made in Scaling and Scoping
Economic Impacts Score: __								
Health Impacts Score: __								
Other Social and Community Impacts Score: __								

Examples

Report Sheet I. Description of indicators substantiating environmental impacts of the selected priority Major Concern and Issue(s) under present conditions.

Sub-region No. 55 Sub-region Name: Mekong River: Selected Priority Major Concern: I. Freshwater Shortage

Priority GIWA Issue: Issue 1. Modification of Stream flow Score received in the Scoping: 3

Environmental Impact Indicator and its unit	Format: Map, report, data table, etc.	Extent or Area covered	Duration and Frequency	Reliability	Availability	Source of information or contact to obtain data or information	Brief explanation or justification how the indicator supports your conclusion made in the Scaling and Scoping
Annual flow of Mekong River	Data table, and graph	250 km along Thai-Lao borders	1990-1998, data collected every 2 months	High	Free public access, only in Thai language	Department of Irrigation. 2000. 10-year report. Bangkok, Thailand.	A drastic decrease of annual flow over a period of 9 years esp. for the last 5 years of monitoring that the flow reduced by 1/3 of the long term mean flow
Erosion of river banks (cubic meter of soil per year)	Data table, map	50 km along Mekong River Cambodia	1995-1999, data collected annually	Medium because of a short period	Unpublished	Mr. Mok Sothana Ministry of Environment Phnom Penh, Cambodia	5000 cubic meter of soil loss each year from from 1995-1997 and double amount from 1998-1999. In teams of distance, the bank retreated by 0.90 meter in 1998-1999.
....

Report Sheet II. Description of proxy indicators substantiating socioeconomic impacts of the selected priority Major Concern under current conditions

Sub-region No. 55

Sub-region Name: Mekong River:

Selected Priority Major Concern Freshwater Shortage

Socioeconomic Impact	Socioeconomic proxy indicator and its unit	Format: Map, report, data table, etc.	Extent or area covered	Duration or Frequency	Reliability	Availability	Source of information or contact to obtain data or information	Brief explanation or justification how the proxy indicator supports your conclusion made in the Scaling and Scoping
Economic Impacts Score: <u>3</u>	Cost of deepening wells and pumping (US\$)	Data table	Entire sub-region, country by country	1993-1999	medium	Free of charge	World Bank report 2000	The cost associated with well deepening, pumping and new well installation increased by three folds from 1995 – 1999.
	Reduced agricultural productivity and values
Health Impacts Score: <u>2</u>	Illness cases of dehydration							
Other Social and Community Impacts Score: <u>2</u>	Number of families and villages forced to relocate due to freshwater shortage							

Guidelines to Conduct Causal Chain Analysis⁴

I. Purpose, Approach

Purpose

No water no life; we all know that. Water is essential for meeting direct human needs and for maintaining the ecological processes upon which human survival depends. However, water resources are often mismanaged. Furthermore, policies implemented to address these problems, frequently address only the most visible causes and not necessarily the root causes. In order to understand and solve water related problems in general, and water trans-boundary problems in particular, we must address the root causes, i.e. the diverse social, institutional, economic, technological and political factors that drive water problems. Unfortunately, those factors are not easily identifiable, because frequently they are far away, both in time and distance, from the problems they originate

Causal Chain Analysis traces the cause-effect pathways, associated with each significant concern, from the socio-economic and environmental impacts back to its root causes. Its purpose is to identify the most important root causes of each concern, in order to target them by appropriate policy measures for remediation or mitigation. This last characteristic must be emphasized, the overall objective of GIWA (and, therefore, of GIWA's Causal Chain Analysis) is to develop a conceptual, strategic framework for the identification of priorities for remedial and mitigatory actions in international waters. That is why GIWA's Causal Chain Analysis (GCCA) is policy oriented.

The GIWA Causal Chain Analysis Methodology tries to offer a systematic and practical approach for identifying and understanding the root causes of trans-boundary water problems. We hope that this approach will allow local experts to describe how the relevant components of the puzzle are linked to drive trans-boundary water problems at a particular site. The guidelines offered are suggestions. The approach is based on accepted theoretical models and has been tested in several sub-regions. However, the methodology may have to be adapted to suit the particular characteristics of your own needs and circumstances.

Approach

The core of the GIWA CCA methodology is to look at root causes of the human actions that impact the way in which water and water related resources are used. In order to achieve that, we must identify the factors that shape the actions that have either a direct or an indirect impact on GIWA concerns and issues. These factors are the root causes. Additionally, we would like to know the relative importance of these root causes, the ways in which they influence people's actions and how the most relevant root causes interact with each other. This methodology was developed to offer practical and systematic guidelines for identifying and understanding the complexity of causal factors that drive trans-boundary water problems. The characteristics of both the data required and the statistical tools to prove causality in a scientific way suggest that building predictive, quantifiable models will be extremely difficult (if not impossible) in most sub-regions. However, as has already been

⁴ This paper offers simple guidelines to conduct the GIWA approach to Causal Chain Analysis. The theoretical and methodological foundations of the approach are not discussed in this paper. The guidelines are to a large extent based on the work of the WWF on the root causes of biodiversity loss. This work is published in the internet, <http://www.panda.org/resources/programmes/mpo/>

mentioned, users of this methodology are asked to provide the evidence that justifies their decisions to establish causal links. Quantitative evidence should, therefore, support the conceptual model.

The methodology only provides a non-exhaustive list of root causes and examples of how they may act and influence each other, because at present, there is no unified theory that universally explains how the different root causes are shaped and interact. In the absence of such a theory, we must accept pluralism. However, all the hypotheses on the importance of each root cause and the way in which they interact with each other, must be substantiated with available evidence.

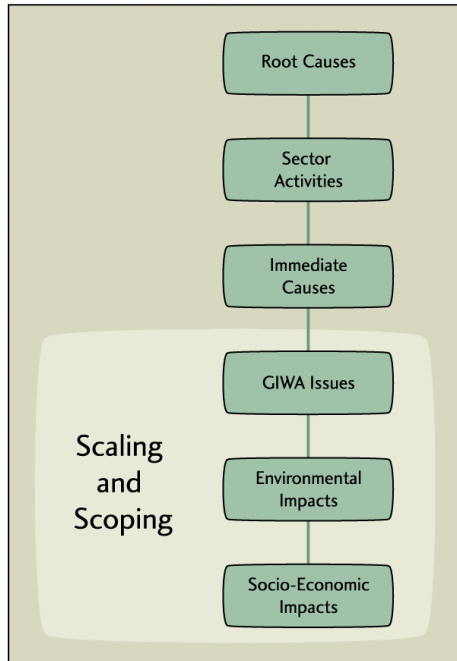
II. Conceptual Model and Final Product

The components of a conceptual CCA model for a particular concern are:

1. **Socio-economic impacts;** the adverse effect of a GIWA issue on human welfare; for example, increased costs of water treatment, or illnesses due to pollution (a list of socio-economic impacts associated to each GIWA concern is presented in Annex 1).
2. **Environmental impacts;** the adverse effects of a GIWA Issue on the integrity of an aquatic ecosystem; for example, loss of aquatic life as a result of eutrophication (a list of environmental impacts is presented in Annex 2).
3. **GIWA Issues;** each of the 22 topics identified in the UNEP Project Document; for example eutrophication (a list of all the GIWA issues is presented in Annex 3).
4. **Immediate causes;** the physical, biological or chemical variables that have a direct impact on a GIWA issue; for example, enhanced nutrient inputs in the case of eutrophication (a list of immediate causes associated to the GIWA issues is presented in Annex 4).
5. **Sector Activities;** have two sub-components; first, the activities (including their growth) in the different economic sectors that provoke the immediate cause; for example, in the agricultural sector, the excessive application of certain kinds of pesticides; secondly, the decisions made by firms, farmers, fishermen, households, government officials or politicians (socio-economic agents in general) that directly or indirectly produce the negative impact; for example, the farmers' decisions on inputs, e.g. a highly pollutant pesticide (a list of sectors and a list of decisions is presented in Annex 5).
6. **Root Causes;** the key factors, trends, processes or institutions that influence a situation, issue, or decision; that propel the system forward, and determine a scenario's outcome; for example, subsidies to pesticides, regulations, enforcement and culture (a list of root causes is presented in Annex 6).

A consolidated (i.e. not showing all the branches) causal chain for a particular concern is illustrated in figure 1.

Fig. 1



The environmental and socio-economic impacts associated to the priority issues have already been identified in the Scaling and Scoping Analysis. The goal of the Causal Chain Analysis is to link the GIWA priority issues to the root causes, using immediate causes and sector activities to identify and build those links.

The Causal Chain Analysis is conducted for a priority concern at a system level. The SRTT should conduct at least one complete analysis. If possible, the SRTT may continue to analyze as many concerns in representative systems as it is deemed necessary. Remember that GIWA was created to help in the identification of priorities for remedial and mitigatory actions in international waters.

Final Product

When conducting the CCA the following four goals must be achieved:

1. Identification of the “international waters” characteristics of the system (e.g. trans-boundary environmental or socio-economic impacts).
2. Identification of the relevant root causes.
3. Description of how the root causes interact with each other to shape the decisions that affect water and water related resources.
4. Substantiation of hypotheses with available evidence (detailed assessment).

In order to achieve these goals, the report will have three different elements:

1. Diagrams.
Diagrams are used to show the conceptual models that identify the different components and link them together.
2. Essay.
Once the conceptual model is completed, an essay must be written to describe the findings. The structure suggested in these guidelines may be helpful. However, the structure of particular essays will suit the needs and circumstances of each sub-region.

The essay may contain the following **sections**:

Introduction- provides a summary of the analysis and the reasons why the particular system was chosen (including why the system can be labeled “international waters”).

System Description- describes the geographical and socio-economic characteristics of the system as well as the main trans-boundary issues.

Methodology- describes the way in which the findings were obtained, i.e. the questions that were asked; the hypotheses that were established and whether they were accepted or rejected; the assumptions that were made; what additional evidence would allow that stronger conclusions be established.

Root Causes- explains the way in which root causes work, including their relative importance and the way they interact with each other (diagrams may accompany these descriptions); groups, if applicable, the main root causes in order to prepare the ground for policy option analysis; e.g. root causes due to market failures, on the one hand and root causes due to policy failures, on the other; or groups driving forces according to the policy level at which they may be influenced (local, state, interstate, national, international and global).

Conclusions- summarizes findings (diagrams may be included).

Bibliography and Annexes.

3. Detailed Assessment Worksheets for CCA.

The worksheets are used to describe the evidence that supports the conceptual model and its findings. The description includes indication of the sources, as well as availability, periodicity and reliability of the information that provides the evidence to support the findings (see Annex VII).

III. Organizing the work

Warning I: As in Stage I of the GIWA process, success in this stage depends as much on the quality of the assessment methodology as on the assessment process. Due to the complexity and comprehensive nature of the Causal Chain Analysis, it is recommended that the focal points or other team members prepare preliminary or draft Causal Chain Analyses prior to the 2nd workshop. The workshop should be used to improve and validate the analyses. The process to conduct causal chain analysis comprises the following stages:

1. System Selection.

The first stage in the preparation for the Causal Chain Analysis is to select the site.

Appropriate sites for analysis may vary in size, scale or composition but the chosen site must include trans-boundary issues. A site might be a specific section of a water body, or it might be a broader area that encompasses a system. The following criteria might be used to select a site:

- The site is representative of one or more important systems.
- The site is representative of a particular social, economic or political situation.
- The site is particularly important for the management of water and water related resources.
- The site is currently experiencing significant problems (hot spot).
- The site should be large enough to generate adequate data for the analysis.

2. Team Selection

An interdisciplinary team should be selected. A team should have at least one expert in social sciences, with experience in policy analysis of problems where environmental, social, political and economic variables interact. The team should also include at least one expert in the system that is going to be analyzed. However, while some team members should be familiar with the site, people working full-time at the site may have some difficulty looking at problems with a fresh perspective.

3. Information Search

Team members should conduct a broad information search to gather background information. The purpose of this information gathering is to be able to generate informed hypotheses regarding the potential forces that affect water and related resources at the site. Team members will likely want to review the following bodies of literature that might be available:

- Surveys or similar documents that provide rapid overviews of relevant research that has looked at the causes of water related problems.
- Materials discussing national policies and political economy for the region of study.
- Documents with information specific to the site to be analyzed.

4. Conceptual Model Development

After a thorough review of relevant information, preliminary hypothesis about the likely root causes of water related problems should be established. These preliminary hypotheses are generated following the causal chain methodology provided in this guide under the heading Detailed Description of Tasks. Preliminary hypotheses should be established and developed **before** the workshop.

Each conceptual model should be specific to the situation at the site. It is not acceptable to only plug names into an existing model or to only follow a checklist of factors to put into the model, without providing evidence and justification (Detailed Assessment).

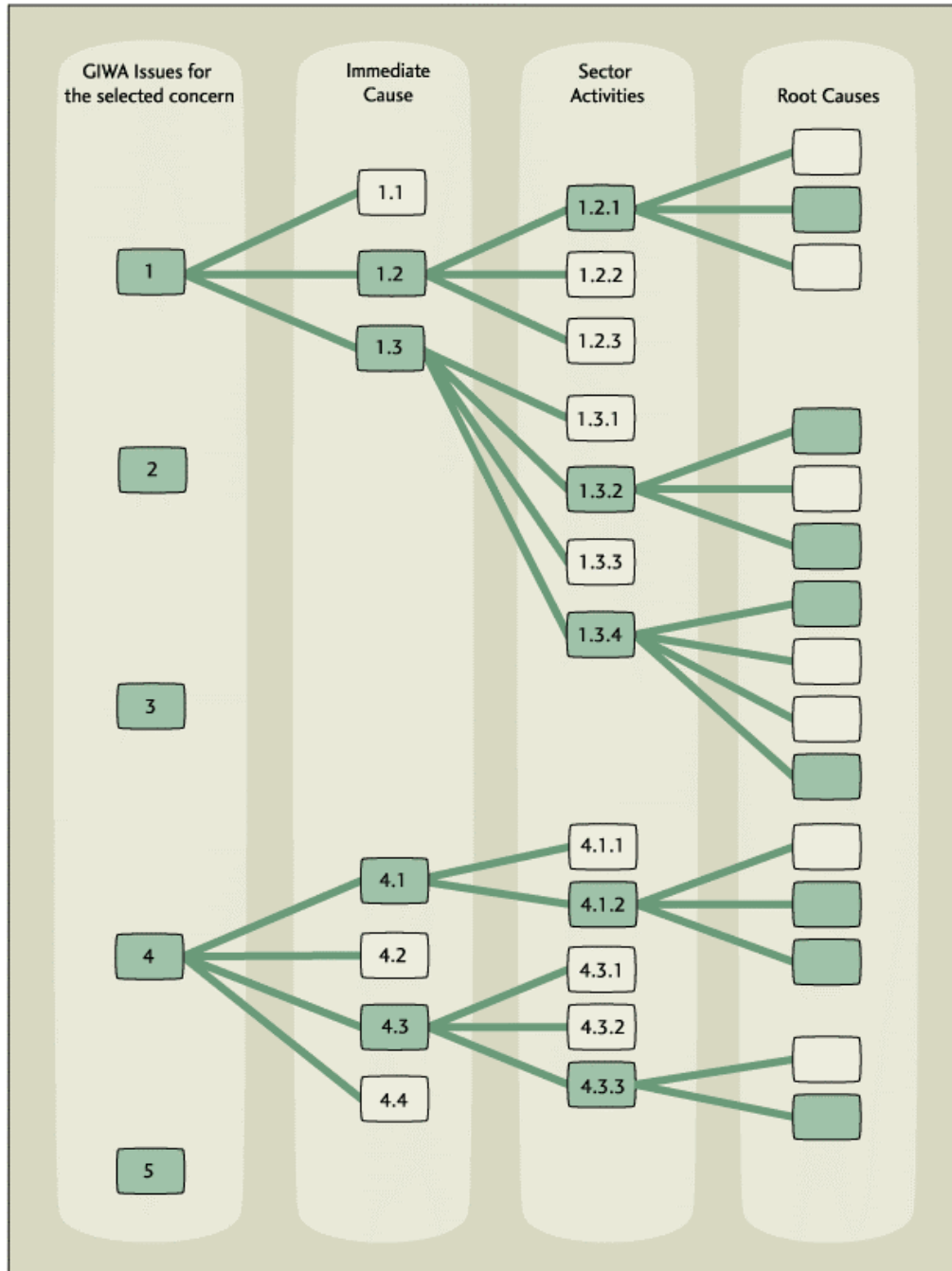
A conceptual model is a description of how the components of the system fit together. It provides a descriptive picture (e.g. a diagram) of a set of relationships between certain factors that are believed to affect specific conditions at the site.

A good conceptual model should:

- Show assumed linkages between factors.
- Show the immediate causes, the sector activities and root causes that are relevant.
- Be based on information and evidence.
- Identify uncertainties that are based on gaps in available information and evidence.

Warning II: A major practical difficulty when applying Causal Chain Analysis is the potentially large number of cause-effect pathways to be investigated. To make the analysis practical and meaningful for policy recommendation purposes, only the relevant, most important links should be investigated. At each stage of the analysis some variables will be considered the most relevant and only those paths should continue to be analyzed. The variables that are not considered relevant should be discarded. However, every time that the experts decide to discard some variables, that decision has to be substantiated by information and evidence -detailed assessment- and not only by qualitative phrases. Figure 2 shows how the causal chain analysis only follows the relevant links.

Fig. 2



5. Detailed Assessment

As has been mentioned previously, Detailed Assessment is an integral activity within all components of the assessment. At this stage, development of the preliminary version of the conceptual model provides a basis for:

- organizing information to validate the hypotheses,
- defining gaps in the availability of information and
- setting priorities for further collection.

6. Revision and validation of the conceptual model

Once the preliminary conceptual model has been established and information has been gathered to validate the hypotheses the team should participate in a workshop to review and amend the original conceptual model (causal chains). As evidence is provided to support

each causal chain, the team should consider whether the initial hypotheses have been verified or whether some chains have to be redefined and assessed.

7. Post workshop Analysis and Reporting

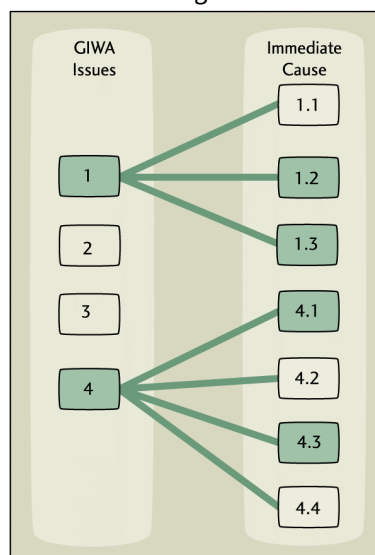
The Team Leader report should have the following two components:

- The report should have the components described under the heading Final Product of Section I (i.e. diagrams to represent the conceptual model; an essay and a copy of the completed Worksheets from which the findings and the substantiation have been derived). The team leader may wish to add comments, which might be helpful in interpreting the findings of the team.
- A report on the effectiveness of the assessment process itself, and of the guidance methodology provided. Additionally, it would be helpful if the Team Leader provided suggestions on how the assessment process and the methodology might be strengthened in the future.

IV. Conceptual Model: Step-by-Step Description of Tasks

1. Select the priority issues of the GIWA in the system that you are analyzing.
2. Justify your decision (this was done in the Detailed Assessment of Scaling and Scoping).
3. Continue the analysis only for the selected issues (see figure 3).
4. Identify the immediate causes that affect each of the remaining issues.
5. Select the most important immediate causes. State their estimated contribution to the GIWA issue (use ranges).
6. Justify your decision (see worksheet CCA I).
7. Continue the analysis for the selected immediate causes (see figure 4).
8. Identify the sectors and activities for the remaining immediate causes.
9. Select the most important sectors activities. State their contribution to the immediate cause (use ranges).
10. Justify your decision (see worksheet CCA II).
11. Continue the analysis for the remaining sectors and activities (see figure 5).
12. Identify the root causes for the remaining sector activities.
13. Select the most important root causes. Remember that there is a very long list of root causes. Select the ones that are likely to have the largest expected contribution to net benefits.
14. Justify your decision.

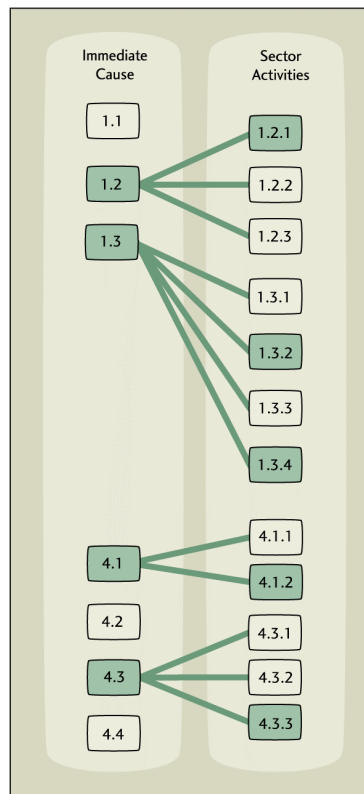
Fig. 3



In this case only GIWA Issues 1 and 4 are the most relevant.

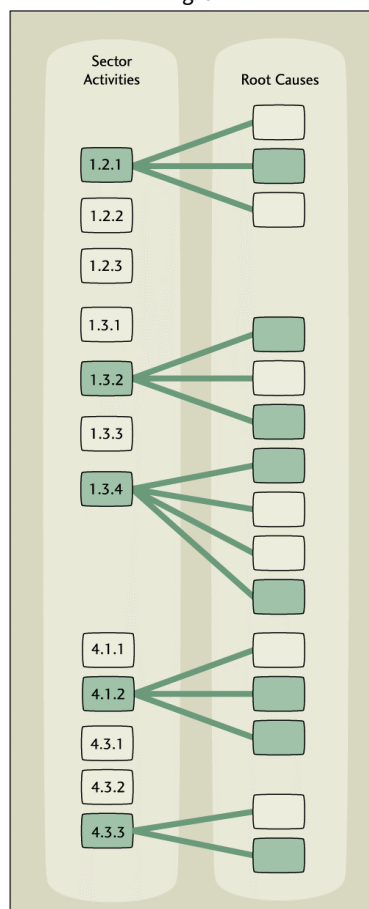
15. Draw a diagram that shows the relevant cause-effect pathways that connect GIWA issues, immediate causes, sector activities and root causes.
16. Link the most important environmental and socio-economic impacts (from the Scaling and Scoping Analysis) to the selected GIWA issues.
17. Draw a diagram to show the relation among the remaining root causes.
18. Group the remaining root causes in a way that may help you analyze the policy options. The following questions will guide you:
 - How controllable is each of these root causes?
 - Are the root causes that you identified likely to be affected by policy changes?
 - What policy instruments could achieve those changes?
 - Who controls those instruments (local, state or federal governments; the legislative power; etc.)?
 - What is the expected quantitative impact of the implementation of a particular instrument?
 - Are there any significant negative side effects?
 - How easy/costly is the instrument to implement?
 - How long will it take for the instruments to affect the root causes and for these to have an impact on the GIWA issues?
 - How certain are the impacts of these policy changes on the GIWA issues?
 - What conditions must be met in order for the policy changes to meet their expected outcome?

Fig. 4



In this case Immediate Causes 1.2, 1.3, 4.1 and 4.3 are the most important

Fig. 5



In this case sector activities 1.2.1, 1.3.2, 1.3.4, 4.1.2 and 4.3.3 are the most important.

- What are the barriers/obstacles for the successful implementation of the policy?
- Are there any groups that will be negatively impacted by the implementation the policy?

Once the relevant causal pathways have been detected and the root causes identified, the analysis may proceed backwards (i.e. from root causes to GIWA issues) and used for crosschecking purposes. For example, it may be used to check whether particular root causes have an additional, undetected cumulative impact on the GIWA concern via those sections of the causal chain that had been previously excluded from the analysis because they were individually non-significant.

ANNEXES

Annex I Socio-economic Impacts (GIWA Scaling & Scoping Methodology)

A. Freshwater Shortage:

1. Loss of agricultural uses.
2. Loss of human drinking water supplies.
3. Loss of recreational use or aesthetic value.
4. Loss of hydro- electric power production.
5. Loss of coastal harbours and inland transport.
6. Loss of industrial uses.
7. Increased potential for conflicts.
8. Reduced availability of food.
9. Loss of waste assimilative capacity.
10. Reduction in options for future use.
11. Increased cost of alternative sources of water supply.
12. Human health impacts.
13. Increased damage to water related equipment.
14. Damage to infrastructure.

B. Pollution:

1. Increased risks to human health.
2. Increased costs of human health protection.
3. Loss of water supplies.
4. Increased clean up costs.
5. Loss of tourism or recreational values.
6. Loss in fisheries.
7. Loss of property value.
8. Potential for international conflicts.
9. Damage to equipment.
10. Endangerment of species.
11. Costs of litigation.

C. Habitat and Community Modification:

1. Reduced capacity to meet human needs.
2. Loss of income.
3. Loss of employment.
4. Loss of aesthetic and recreational value.
5. Loss of cultural heritage.
6. Increased risk from natural disasters.
7. Costs of controlling invasive species.

D. Unsustainable Exploitation of Living Resources:

1. Reduced capacity to meet human needs.
2. Loss of income.
3. Loss of employment.
4. Conflicts among user groups.
5. Inter-generational equity issues (access to resources).

E. Global Change:

1. Freshwater availability.
2. Food security.
3. Employment security.
4. Changes in productivity.
5. Damage to human life and property.
6. Response costs for extreme events.
7. Increased cost of coast protection.

Annex II Environmental Impacts (GIWA Project Identification)

A. Freshwater Shortage:

Reduction in Stream Flow:

1. Modification of riparian habitats.
2. Depletion of fish stocks and species diversity.
3. Water quality change.
4. Decreased wetland areas.
5. Decreased capacity to transport sediments.
6. Reduced groundwater recharge.
7. Changes in biological diversity and food webs.
8. Changes in sediment budgets.

Pollution of Existing Supplies:

1. Modification of riparian habitat.
2. Depletion of fish stocks and species diversity.
3. Changes in terrestrial and aquatic biological diversity and food webs.
4. Potential for impacts on migratory species.

Lowering of Water Table:

1. Reduction in stream flows.
2. Land subsidence.
3. Reduced aquifer capacity.
4. Reduced vegetation cover.
5. Greater potential for saltwater intrusion.
6. Water quality changes.
7. Increased soil erosion.
8. Increased penetration of contaminants into deeper aquifers.

B. Pollution.

Microbiological:

1. Aquatic organisms infections and disease.

Eutrophication:

1. Redox changes (extreme anoxia).
2. Increased algal blooms.
3. Changes in algal community structure.
4. Changes in macrophyte community structure.
5. Loss of habitat (e.g. coral reefs).

Chemical:

1. Reproductive disfunction in aquatic organisms.
2. Behavioral disfunction in aquatic organisms.
3. Modified community structure.
4. Increased mortality of aquatic organisms.

Suspended Solids:

1. Habitat modification.
2. Changes in biological community composition.
3. Changes in the growth/survival/reproduction of species.
4. Enhanced erosion of coastal and river channels.
5. Increased sediment deposition.
6. Destruction of benthic communities.
7. Changes in sediment redox conditions.

Solid Waste:

1. Habitat loss.
2. Hydraulic modification.
3. Suffocation of marine organisms.
4. Beach and sediment compositional changes.

Thermal:

1. Population changes.
2. Barriers to migration.
3. Displacement of organisms.
4. Changes to physical environment.

Radionuclide (from anthropogenic sources):

1. Proximal and stochastic risks to animal life.

Spills:

1. Increased avian mortality.
2. Increased mortality of aquatic life.
3. Habitat damage.
4. Long term contamination of sediments and beaches with associated ecological changes.

C. Habitat and Community Modification.

Loss of ecosystems or ecotones:

1. Loss of natural productivity.
2. Loss of biodiversity.
3. Loss of natural storm barriers.
4. Loss of natural protection from erosion.
5. Loss of sink capacity (carbon).
6. Loss of migratory species and altered migratory patterns.
7. Impacts of estuarine system changes on adjacent coastal marine ecosystems.

Modification of ecosystems or ecotones:

1. Modification of natural productivity.

2. Modification of biodiversity including loss of species and genetic diversity.
3. Changes in ecosystem stability.
4. Changes in plant and animal community structure.
5. Increase in susceptibility to disease.
6. Changes in migratory species populations and in migratory patterns.
7. Modification in natural storm barriers and reduced protection from erosion.
8. Increased vulnerability to opportunistic invaders.

D. Unsustainable Exploitation of Living Resources.

Inappropriate harvesting practices:

1. Depletion of key species.
2. Changes in food webs.
3. Increased vulnerability of protected species.
4. Changes to habitat and community structure.

Resource/habitat changes:

1. Changes in community structure by food chain manipulation.
2. Changes in community structure through restocking and habitat manipulation.

Habitat destruction:

1. Ecosystem degradation.

Decreased viability of stock through contamination:

1. Possible physiological and ecological impacts on populations.

Man induced changes in the physical environment:

1. Potentially severe impacts on ecosystems.

Biodiversity impacts:

1. Long term changes in population genome and gene frequencies.
2. Changes in biological communities.

D. Global Change.

Changes in the hydrological cycle:

1. Land cover change.
2. Shifts in boundaries between sea and fresh water.
3. Feedback to global climate change.
4. Changes in thermohaline circulation.
5. Increased frequency and intensity of extreme events.
6. Changes in precipitation, evaporation and snow accumulation and melting.

Sea level change:

1. Intrusion of sea water to fresh water.
2. Modification of aquatic habitats.
3. Loss of land, damage to coastal zones.

Increased UV-B radiation as a result of ozone depletion:

1. Damage to flora and fauna.
2. Decrease of productivity.

Changes in ocean CO² sink function.

1. Feedback to global climate change.

Annex III GIWA Issues

(GIWA Scaling & Scoping Methodology)

A. Freshwater Shortage:

1. Modification of stream flow.
2. Pollution of existing supplies.
3. Changes in the water table.

B. Pollution:

1. Microbiological pollution.
2. Eutrophication.
3. Chemical pollution.
4. Suspended solids.
5. Solid wastes.
6. Thermal.
7. Radionuclide.
8. Spills.

C. Habitat and Community Modification:

1. Loss of ecosystems or ecotones.
2. Modification of ecosystems or ecotones.

D. Unsustainable Exploitation of Living Resources:

1. Over-exploitation.
2. Excessive by-catch and discards.
3. Destructive fishing practices.
4. Decreased viability of stocks through contamination and disease.
5. Impact on biological and genetic diversity.

E. Global Change:

1. Changes in hydrological cycle and ocean circulation.
2. Sea level change.
3. Increased UV-B radiation as a result of ozone depletion.
4. Changes in ocean CO₂ sink function.

Annex IV Immediate Causes

A. Freshwater shortage.

Modification of the stream flow:

1. Decreased inputs from: changed rainfall-runoff relationship and decreased groundwater inflow.
2. Increased diversion.
3. Increased cover area of standing water.
4. Reduced peak flows.
5. Changes in return flows.
6. Increased evaporation

Pollution of existing water supplies:

1. Inadequate treatment of point source discharges.
2. Agricultural runoff.
3. Evaporation induced concentration.
4. Inputs from atmospheric deposition.
5. Inputs from accidents (e.g. oil spills).
6. Remobilization of suspended solids.
7. Inputs from natural disasters.
8. Chemical releases.
9. Leachates from landfills, mining, etc.

Lowering of the water table:

1. Excessive pumping.
2. Reduced recharge.
3. Reduced peak flow.
4. Increased consumption by vegetation cover (i.e. deep rooted plants such as cedar, cottonwoods and willows which obtain water from the underlying aquifer).
5. Characteristics of the water table (e.g. the hydraulic gradient).
6. Geological effects.
7. Climatic effects.

B. Pollution.

Microbiological pollution:

1. Discharge of effluents.
2. Discharge of animal wastes.
3. Discharge of solids.
4. Atmospheric deposition.
5. Remobilization and leaching.
6. Runoff and storm-water.
7. Altered circulation (flushing of rivers, lakes, coastal systems).

Eutrophication:

1. Enhanced discharge of effluents.
2. Enhanced discharge of solids.
3. Runoff and storm waters.
4. Increased recycling/ mobilization.
5. Trapping of nutrients (e.g. in river impoundments).
6. Inputs from atmospheric deposition.

Chemical pollution:

1. Discharge of effluent.
2. Discharge of solids.
3. Runoff and storm waters.
4. Leachates from landfills.
5. Chemical releases (e.g. from aquaculture).
6. Release from mining.
7. Weed and pest control.
8. Disease vector control.
9. Emissions from fossil fuel combustion (electrical and vehicle).
10. Increased combustion of natural vegetation.

Suspended solids:

1. Soil and sediment erosion, remobilization and leaching.
2. River and stream alteration.
3. Dredging and dredge spoil activities.
4. Mining releases.
5. Discharge of effluents.
6. Discharge of drilling mud and particulate additives.
7. Runoff and storm waters.
8. Soil erosion.

Solis wastes:

1. Releases from ships and offshore platforms.
2. Sewage related debris.
3. Discards of beach users.
4. Municipal/industrial solid wastes.
5. Releases from landfills.
6. Tar balls.
7. Releases from land development.

Thermal pollution:

1. Cooling water discharge.
2. Removal of riparian belts (including trees) exposing the water to direct sunlight.
3. Elevated suspended solids due to soil erosion.

Radionuclides:

1. Incidents at sea.
2. Spills from treatment facilities.
3. Discharges/emissions from nuclear power plants.
4. Discharges/emissions from nuclear fuel reprocessing plants.
5. Accidents involving nuclear-powered vessels.
6. Fallout from nuclear weapons tests.

Accidental spills:

1. Shipwreck or collision.
2. Operational accidents.
3. Breaching of waste containment dams/ponds.
4. Force majeure.

C. Habitat and Community Modification

Loss of ecosystems or ecotones:

1. To land use conversion.
2. As a result of major accidental pollution incidents.
3. As a result of dredging/dredge spoils activities.
4. As a result of natural disasters.
5. As a result of land waste disposal.
6. As a result of coastal erosion.
7. As a result of mining activities.
8. Flooding of ecosystems as a result of human activities.
9. Harvesting of keystone species leading to the collapse of the system.
10. Replacement of natural/endemic species by exotic species.
11. Disease introduction (including parasites).

Modification of ecosystems or ecotones:

1. Land development (land use changes).
2. Unsustainable harvesting practices.
3. Changed freshwater and sediment supply due to dams, diversion, etc.
4. Changed proportion of nutrients through reduction of riverine stream flow.
5. Substitution of natural/endemic species by exotic species.
6. Disease introduction.
7. Monoculture practices resulting in the selection of particular species.
8. Partial conversion of ecosystems/ecotones as a result of pollution (e.g. eutrophication).
9. Partial conversion of ecosystems/ecotones as a result of global change.

D. Unsustainable Exploitation of Living Resources.

Over-exploitation:

1. Increased effort.
2. Gear and mechanization.
3. Decreased level of recruitment.
4. Decreased habitat/nursery grounds.
5. Shift in population distribution.

Excessive by-catch and discards:

1. Gear.
2. Lack of infrastructure.

Destructive fishing practices:

1. Changes within the sector (practice, overall pressure).

Decreased viability of stock through pollution and disease:

1. Changes in the aquaculture sector (overstocking, inappropriate choice of stocks, etc.).
2. Issue related (e.g. pollution).

Impact on biological and genetic diversity:

1. Intentionally released non-native species.
2. Escaped non-native species.
3. Issue related (e.g. loss/modification of habitat).
4. Modification of stream flow (canal construction).

Annex V Sector Activities

A. Sectors:

1. Agriculture.
2. Fisheries.
3. Aquaculture.
4. Forestry.
5. Mining.
6. Industry.
7. Transport.
8. Energy production.
9. Urbanization.
10. Military activity.
11. Infrastructure provision.
12. Water.
13. Other.

B. Activities/Decisions:

1. Firms:
 - Inputs.
 - Outputs.
 - Technology.
 - Location.
2. Households:
 - Consumption.
 - Location.
3. Infrastructure:
 - Provision.
 - Operation.
 - Location.

Annex VI Root Causes

Demographic:

1. Population.
2. Population growth.
3. Urbanization trends.
4. Migration.

Technological:

1. Access to technology.
2. Technological trends.
3. Inadequate knowledge of technological and technical response functions.
4. Inappropriate expert advice on technology.

Economic:

1. Prices (inputs, outputs, consumption goods).
2. Incomes.
3. Income distribution.
4. Poverty.
5. Economic growth.
6. Economic structure.
7. Market structure.
8. Taxes and subsidies.
9. Inadequate valuation of environmental goods and services.

Socio-Cultural:

1. Traditions.
2. Religion.
3. Non-formal rules.
4. Lifestyles.
5. Beliefs.

Legal:

1. Laws (especially property rights).
2. Regulations.

Knowledge:

1. Information.
2. Training.
3. Education.
4. Inadequate scientific understanding.
5. Inadequate or unreliable information.
6. Ineffective information interpretation.
7. Inadequate access to technical and scientific information

Governance (includes Policy Failures):

1. Ability to reach social agreements (legitimacy, stakeholder participation, credibility).
2. Capacity to promote compliance and enforce agreements and policies (adequate budgets, competent, sufficient and motivated staff, adequate legal and judicial framework, credible punishment, credible rewards).
3. Bureaucratic competence (including adequate budgets).
4. Deficiencies in stakeholder participation.
5. Lack of coordination among the different levels of government (local, state and national)
6. Corruption.
7. Inadequate integration of environmental considerations into public policy.
8. Inadequate coordination of national policies.

Political:

1. Power structure (relative capacity of affected groups to oppose/promote policy changes).
2. Conflicts.

Environmental:

1. Natural phenomena (e.g. El Niño).

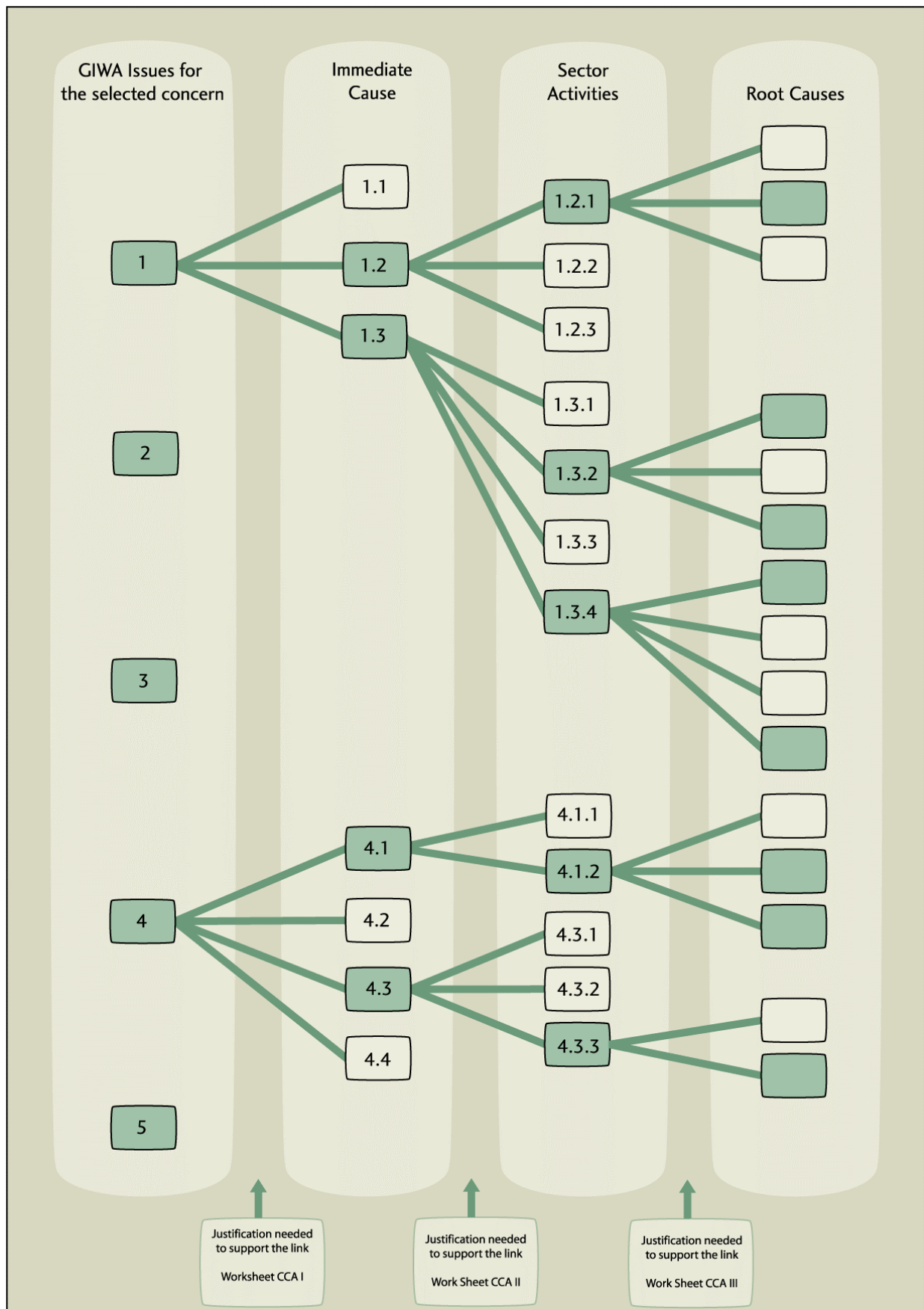
Annex VII

GCCA Detailed Assessment Worksheets

In a causal chain, the Sub-regional Task Teams need to provide justification for drawing a link between chain components. Worksheets were designed to show the grounds of these justifications. The titles and purposes of the worksheets are the following:

1. **Worksheet CCA I.** Description of indicators or quantitative information substantiating links between a priority Issue and Immediate Causes in the Causal Chain.
2. **Worksheet CCA II.** Description of indicators or quantitative information substantiating links between Immediate Cause and Sector Activities in the Causal Chain.
3. **Worksheet CCA III.** Description of indicators or quantitative information substantiating links between Sector Activities and Root Causes in the Causal Chain.

The following diagram shows how and where each worksheet fits in the GCCA.



Worksheet CCA I. Description of indicators or quantitative information substantiating links between a priority Issue and Immediate Causes in the Causal Chain

Sub-region No.: _____ Sub-region Name: _____ Selected priority Major Concern: _____



link

Priority GIWA Issue

Immediate Cause	Indicator or supporting information	Format: map, report, data table, etc.	Extent or Area covered	Duration	Reliability	Availability	Sources of data or contact to obtain data and information	Brief explanation or justification how the indicator support your link between Issue and Immediate Cause

If the Immediate Cause(s) cannot be quantified, please provide qualitative information or justification to support your links between the priority Issue and Immediate Causes:

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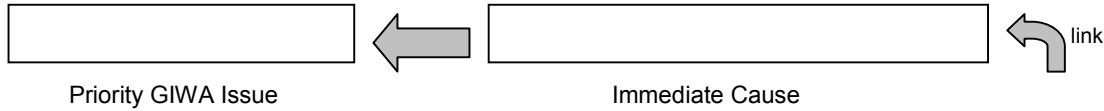
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Worksheet CCA II. Description of indicators or quantitative information substantiating links between Immediate Cause and Sector Activities in the Causal Chain

Sub-region No.: _____ Sub-region Name: _____ Selected priority Major Concern: _____



Intermediate Cause	Indicator or supporting information	Format: map, report, data table, etc.	Extent or Area covered	Duration	Reliability	Availability	Sources of information or contact to obtain data and information	Brief explanation or justification how the indicator support your link between Immediate Cause and Sector Activities

If Sector Activities cannot be quantified, please provide qualitative information or justification to support your links between the Immediate Cause and the Sector Activities:

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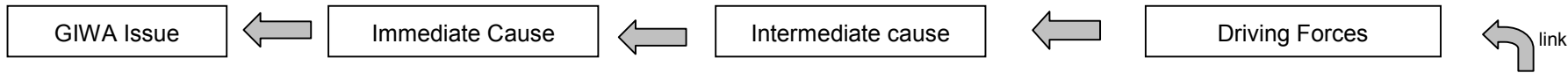
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Worksheet CCA III. Description of indicators or quantitative information substantiating links between Sector Activities and Root Causes in the Causal Chain

Sub-region No.: _____ Sub-region Name: _____ Selected priority Major Concern: _____



Priority GIWA Issue Immediate Cause 1 st Intermediate Cause Driving Forces	Indicator or supporting information	Format: map, report, data table, etc.	Extent or Area covered	Duration	Reliability	Availability	Sources of information or contact to obtain data and information	Brief explanation or justification how the indicator support your link between Sector Activities and Root Causes

If the Root Cause cannot be quantified, please provide qualitative information or justification to support your links between the Sector Activities and the Root Cause

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ANNEX VIII Examples of Conceptual Models for the Different Concerns

Example I (Concern: Unsustainable Exploitation of Living Resources)

Issues:

1. Over-exploitation. (60%-80%)
2. Excessive by-catch and discards. (10%-20%)
3. Destructive fishing practices.
4. Decreased viability of stock.
5. Impact on biological and genetic diversity.

Only issues 1 and 2 are considered relevant in this example.

Issue I to Immediate Cause

Over-exploitation.

1. Increased effort (70%-90%).
2. Gear and mechanization changes.
3. Decreased level of recruitment.
4. Decreased nursery grounds.
5. Shift in population distribution.

Only immediate cause 1 is considered relevant in this example.

Issue I, Immediate Cause to Sector Activities

Key decisions by relevant players and potential players in the fisheries sector:

1. Effort level (including zero).

Issue I, Sector Activities to Root Causes

Effort.

1. Demographic (population growth rate).
2. Technological (reduced costs).
3. Economic (subsidies).
4. Socio-cultural (fishing tradition).
5. Legal (open access, property rights).
6. Knowledge (no alternative skills).
7. Governance (no history of agreements to control catch).
8. Political (political patronage).

Issue II and Immediate Cause

Excessive by-catch and discards.

1. Gear (85%-100%).

Issue II, Immediate to Sector Activity

Key decision by relevant players and potential players in the fisheries sector.

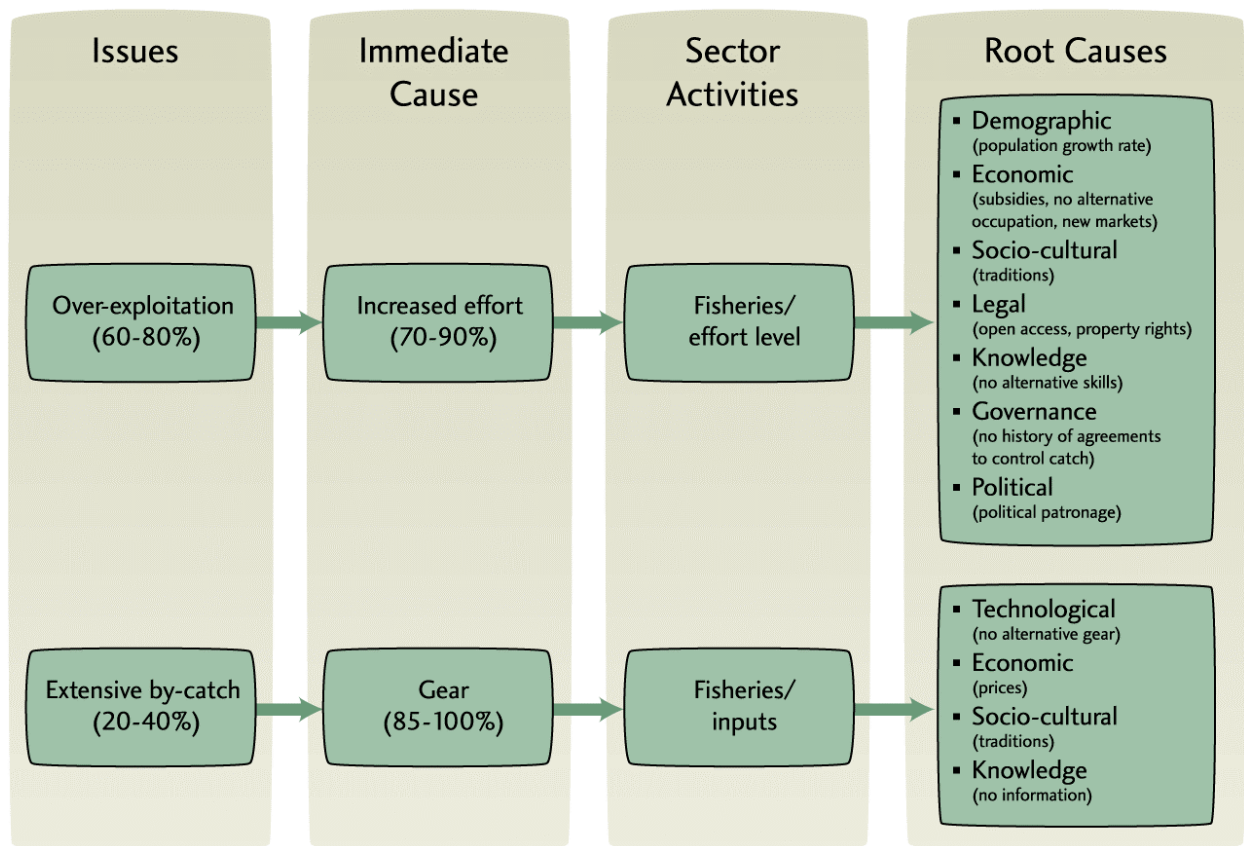
1. Inputs

Issue II, Sector Activity to Root Causes

Inputs.

1. Technological (no alternatives).
2. Economic (prices).
3. Socio-cultural (traditions).
4. Knowledge (no information or skills).

Unsustainable Exploitation of Fisheries



CCA Example II (Concern: Pollution)

Issues

1. Microbiological (50%-70%).
 2. Eutrophication.
 3. Chemical (10%-20%).
 4. Suspended solids.
 5. Solid wastes.
 6. Thermal.
 7. Spills.
- Only issues 1 and 3 are considered relevant in this example.

Issue I to Immediate Causes

Microbiological pollution.

1. Discharge of urban effluents (70%-90%).
2. Discharge of animal waste.
3. Discharge of solids.
4. Atmospheric deposition.
5. Remobilization and leaching.
6. Runoff and storm-water.

Only issue 1 is considered relevant in this example.

Issue I, Immediate to Sector Activities

Key decisions by relevant players in the urban sector.

1. Building water treatment plants.
2. Operating water treatment plants.

Issue I, Sector Activities to Root Causes

Building water treatment plants.

1. Technological (access, trends).
2. Economic (financing schemes).
3. Legal (regulations, responsibilities, dispute resolution).
4. Governance (legitimacy, supervision).

Issue I, Sector Activities to Root Causes

Operating water treatment plants.

1. Economic (revenues, costs, incentives).
2. Legal (regulations, responsibilities, dispute resolution).
3. Governance (legitimacy, credibility).

Issue II to Immediate Causes

Chemical.

1. Discharge of urban effluents (40%-60%).
2. Leachates from landfills (20%-40%).
3. Weed and pest control (10%-30%).

The three immediate causes are considered relevant in this example.

Issue II, Immediate Cause I to Sector Activities

Discharge of urban effluents (has already been analyzed).

Issue II, Immediate Cause II to Sector Activities

Leachates from landfills.

Key decisions by relevant players in the urban sector.

1. Location and technical characteristics of landfills.
2. What kind of waste goes to urban landfills.

Issue II, Sector Activities to Root Causes

Location and technical characteristics of landfills.

1. Technological (access).
2. Economic (costs).
3. Governance (nimby).
4. Political (patronage).

What kind of waste goes to urban landfills.

1. Demographic (trends).
2. Economic (costs).
3. Legal (regulations).
4. Governance (enforcement, legitimacy).

Issue II, Immediate Cause III to Sector Activities

Weed and pest control.

Key decision by relevant players in the agricultural sector.

1. Inputs.

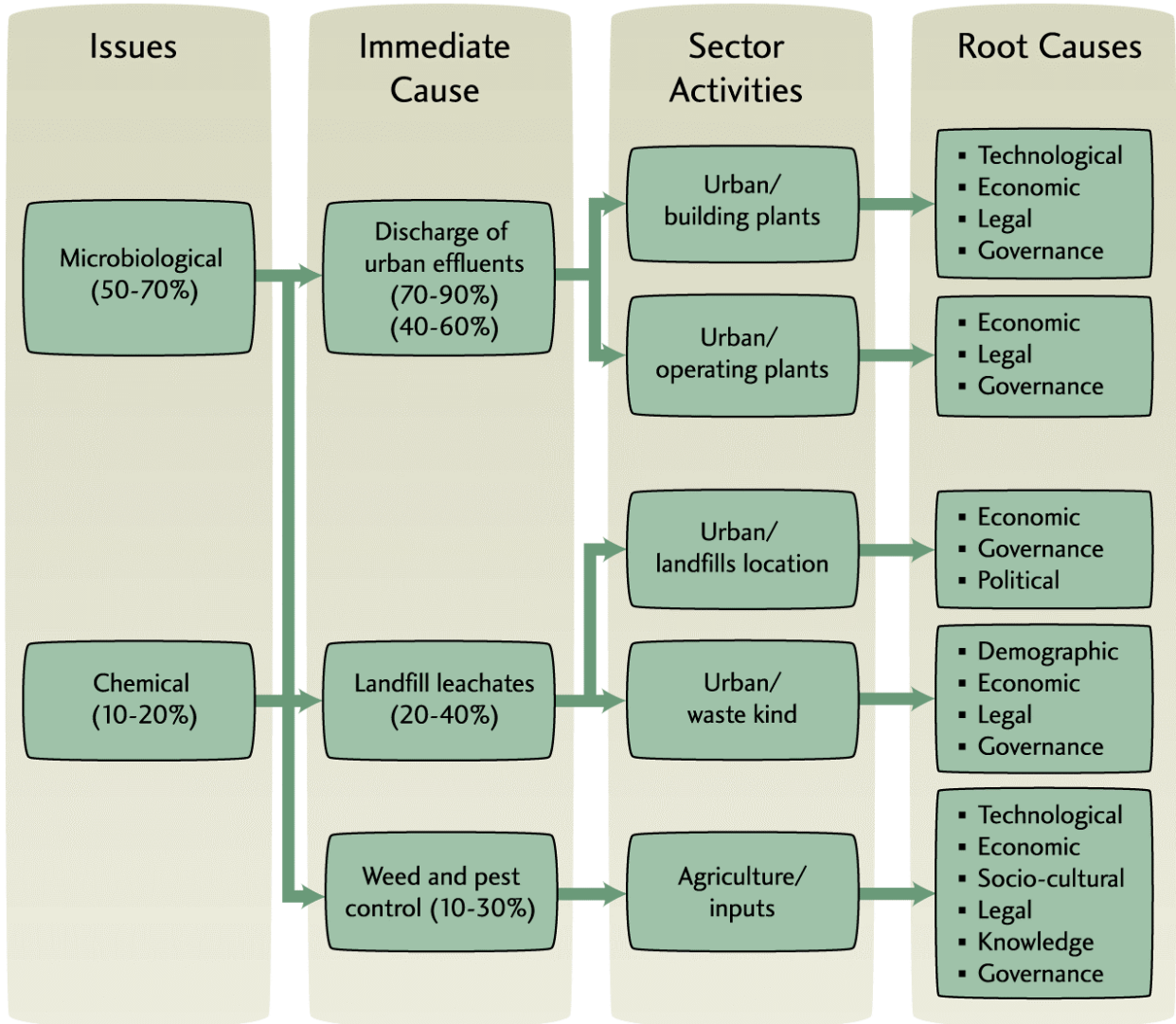
Issue II, Sector Activities to Root Causes

Inputs (weed and pest control).

1. Technological (alternatives).
2. Economic (costs, subsidies).
3. Socio-cultural (traditions).

4. Legal (regulations).
5. Knowledge (information, training).
6. Governance (enforcement).

Pollution



Example III (Freshwater shortage)

Issues

1. Modification of the stream flow (60%-80%).
2. Pollution of existing water supplies.
3. Lowering of the water table (20%-40%).

Only issues 1 and 3 are relevant in this example.

Issue I to Immediate Causes

Modification of stream flow.

1. Decreased inputs (rain, inflow).
2. Increased diversion (75%-90%).
3. Increased evaporation.

Only immediate cause 1 is considered relevant in this example.

Issue I, Immediate to Sector Activities

Increased diversion.

Key decisions by relevant agents in the water sector.

1. Water allocation mechanisms.

Issue I, Sector Activities to Root Causes

Water allocation mechanisms.

1. Technological (measurement).
2. Socio-cultural (free good).
3. Legal (property rights).
4. Governance (legitimacy, credibility, enforcement, water management in the agricultural sector).
5. Political (farmers' political clout).

Issue II to Immediate Causes

Lowering of the water table.

1. Excessive pumping (80%-95%).

Issue II, Immediate to Sector Activities

Excessive pumping.

Key decision by relevant players in the water sector.

1. Water allocation mechanisms.

Key decisions by relevant players in the agricultural sector.

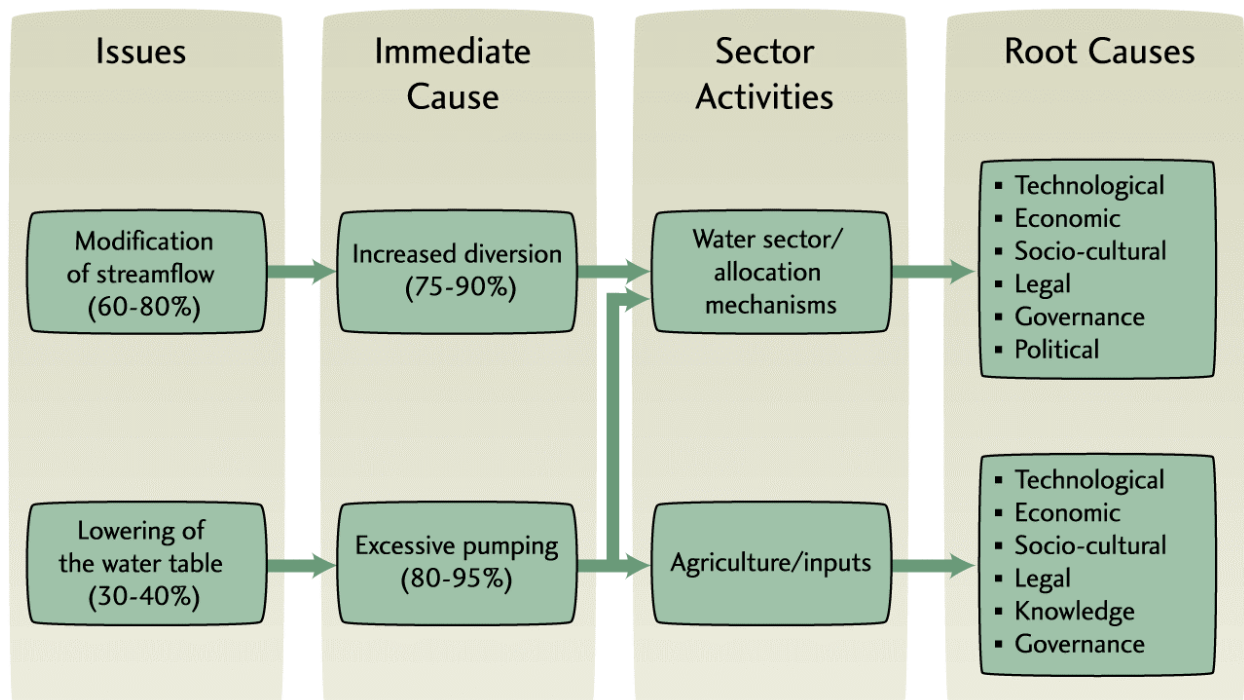
1. Inputs.

Issue II, Sector Activities to Root Causes

Water as an input in agriculture.

1. Technological.
2. Economic (subsidies).
3. Socio-cultural (free good).
4. Legal (regulations).
5. Knowledge (information).
6. Governance (legitimacy, credibility, enforcement).

Freshwater Shortage



CCA Example IV (Habitat and Community modification)

Issues.

1. Loss of ecosystems.
2. Modification of ecosystems (70%-90).

Only issue 2 is relevant in this example.

Issue to Immediate Causes

Modification of ecosystems.

1. Land development (20%-40%).
2. Monoculture (50%-70%).

Immediate Cause I to Sector Activities

Key decisions of relevant players with regard to land use change in the urban sector (tourism is another good example).

1. Authorities (growth and location).
2. Households and firms.

Immediate Cause I, Sector Activities to Root Causes

Root Causes of urban growth decisions by the authorities.

1. Demographic (population growth, urbanization trends).
2. Economic (subsidies, employment).
3. Legal (regulations).
4. Governance (enforcement).
5. Political (patronage, popularity).

Root Causes of location decisions by households and firms.

1. Demographic (population growth).
2. Economic (subsidies, employment, infrastructure).

Immediate Cause II to Sector Activities

Monoculture.

Key decision of relevant players in the agriculture sector (production).

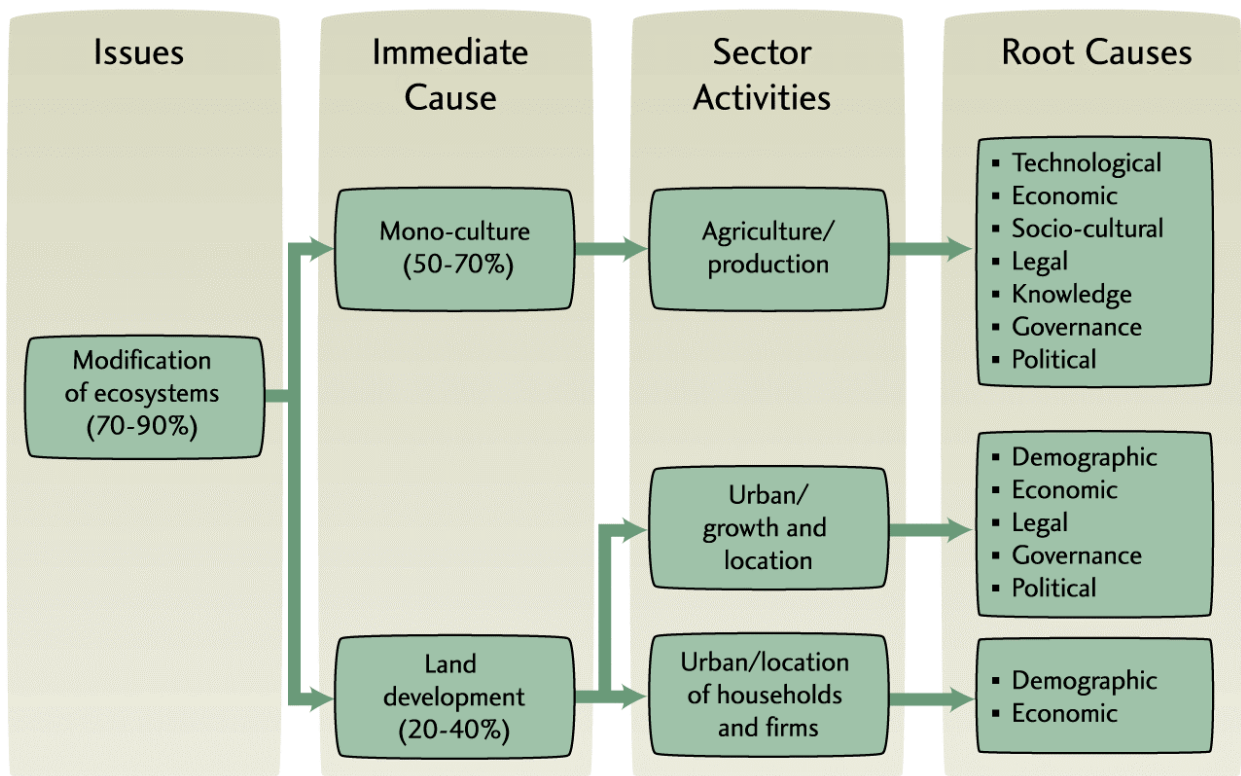
1. Outputs.
2. Inputs.
3. Technology.
4. Location.

Immediate Cause II, Sector Activities to Root Causes

Driving forces of production decisions in agriculture:

1. Technological (compatibility of commercial crop with indigenous vegetation, e.g. coffee).
2. Economic (prices, markets, poverty).
3. Socio-cultural (consumption habits).
4. Legal (regulations).
5. Knowledge (information).
6. Governance (enforcement).
7. Political (farmers' political clout).

Habitat and Community Modification



Policy Option Analysis⁵

General Comments:

- Policy analysis is ideally distinguished by transparency of method and interpretation.
- Policy analysis has to synthesize the viewpoints of the different professions in the working group (i.e. scientists, resource specialists, social scientists).
- Policy analysis is more art than science. It draws on intuition as much as on method.
- The primary utility of this structured approach is that it reminds you of important tasks and choices; its primary drawback is that taken by itself it can be mechanistic.
- The problem solving process is iterative, so that you usually must repeat some of these steps, sometimes more than once.
- Some of the guidelines are practical, but most are conceptual.
- Projecting the outcomes (scenario analysis) is an essential component of the GIWA methodology⁶.
- Your team should include a public policy analyst.

The Eightfold Path:

1. Define the problem.
2. Assemble some evidence.
3. Construct the policy options.
4. Select evaluative criteria.
5. Project the outcomes (scenario analysis).
6. Confront the trade-offs.
7. Decide (state your recommendations).
8. Tell your story (report).

These steps are not necessarily taken in precisely this order, nor are all of them necessarily significant in every problem.

1. Define the Problem.

(This is taken from S&S). Starting from the GIWA concern that was chosen, you will focus on only a few GIWA issues, otherwise the analysis may get out of hand.

The definition should, insofar as possible, include a quantitative feature. In many cases, you will have to estimate- or “guesstimate,” more likely- the magnitudes in question. Sometimes you should furnish a range as well as a point estimate of magnitudes.

2. Assemble some evidence.

This task corresponds to GIWA’s Detailed Assessment. A few thoughts about it. Time pressure is probably almost as dangerous an enemy of high quality POA as politically motivated bias, if not more so.

⁵ These guidelines were elaborated with excerpts from “A Practical Guide For Policy Analysis” by Eugene Bardach. The Core Team will provide the book to each SRTT.

⁶ According to the GIWA Project Identification document, the analyses of alternative scenarios will incorporate scenarios developed on the basis of projected actions taken to address the identified societal causes of environmental degradation (p. 6).

For POA purposes, try to collect only those data that can be turned into information that, in turn, can be converted into evidence that has some bearing on your problem. (Data are facts- or representation of facts- about the world. Information is data that has some meaning, in the sense that it can help you sort the world into different logical or empirical categories. Evidence is information that affects the existing beliefs of stakeholders about significant features of the problem you are analyzing and how it may be solved or mitigated.)

3. Construct the policy options.

You should start comprehensive and end up focused. Make a list of all the options you might wish to consider in the course of your analysis. Later on you will discard some obvious losers, combine others, and reorganize still others into single “basic” options with one or more subsidiary “variants”. For your initial list where should you turn for ideas?

1. The options that key political actors are actively proposing or seem to have on their minds.
2. Survey “smart” practices.
3. Try to “invent” options (use the Causal Chain Analysis to suggest possible “nodes” in the chain for intervention).
4. Always include in your approach the alternative “let present trends continue undisturbed”.

Be aware that after all your analytical work, the final list of options- the ones you include in your final report- will almost certainly look quite different from the one you started with.

4. Select evaluative criteria.

Please note that evaluative criteria are only indirectly used to evaluate policy options. They are to be applied to the projected outcomes. Evaluative criteria commonly used in policy option analysis include:

1. Efficiency (maximization of net benefits).
2. Equality, equity, fairness, “justice” (there are a great many different, and often opposed, ideas about what these terms do, or should, mean; your particular definition should be justified).
3. Practical criteria (legality, political acceptability and robustness- a policy option is robust when even if the implementation process does not go very smoothly, the policy outcome will still prove to be satisfactory).

5. Project the outcomes (scenario analysis).

For each of the policy options on your list, project the outcomes (or impacts). Projecting outcomes often (more often than not) requires you to think not just about the general direction of an outcome but about the magnitude as well. It is not enough to say, “We expect this program to have a very positive effect on reducing pollution”. Sometimes a point estimate of your single best guess about some magnitude will suffice. But in some cases you should provide a range. Be realistic. Making policy imposes a moral burden that is heavier than many people care to acknowledge. Understandably, we would rather believe that our preferred or recommended option will actually solve the problem completely and that it will impose fewer costs than we might realistically fear. These cautionary notes notwithstanding, remember that we do not wish to swing towards pessimism either. Realistic projection is our goal.

Describe the undesirable side effects. It is hard to overstate the importance of worrying about the possible side effects of otherwise “good” policies, not to mention the possibility that even intended “good” main effects may fail to materialize under many circumstances.

Sometimes it is convenient to describe scenarios that might cause the proposal to fail to produce the desired outcome. The list of adverse outcomes is unfortunately long: “capture” of policy benefits by an unintended or undeserving constituency; excessive administrative costs; lack of enforcement; waste; abuse that undermines political support; etc. The most common sources of failure are neglecting to consider the resistance of bureaucratic and other stakeholders in the status quo, and the lack of an entrepreneur in the relevant policy environment who has incentives to pick up what seems like a good idea and see it through. It is also useful to try to estimate the likelihood of those scenarios (at least those that seem more likely).

The step of projecting outcomes leads you into a dense thicket of information. You may not want to present or discuss all of it in your final report. A convenient way to get an overview of all this information is to display it in an outcomes matrix. The typical outcomes matrix format arrays the policy options down the rows and the evaluative criteria across the columns. Any cell contains the projected outcome of the row policy option as assessed by reference to the column criterion. You can simplify the mass of information you need to display and assimilate in your outcome matrix if you eliminate information about outcomes that will be the same for all the policy options.

6. Confront the trade-offs.

It sometimes happens that policy makers have to rank policy options, either because some of them are substitutes or because of lack of resources to implement all of them. In those cases, policy options must be compared. It may happen that one of the policy options under consideration is expected to produce a better outcome than any of the other options with regard to every single evaluative criterion. In that case there are no trade-offs among the policy options. This is called dominance. Usually, though, you are less fortunate, and you must clarify the trade-offs between outcomes associated with different policy options. Suppose some policy option O1 stacks up very well on criterion C1, moderately well on criterion C2, and poorly on C3. And suppose that policy option O2 stacks up in the opposite way. We can choose between the two policy options if we can weigh the importance of the criteria and if we can express their relative weights in units that are commensurable across the criteria. Money is sometimes a convenient metric. However, there are limits to the money metric and to commensurability as well.

If you are not able to use money or other any common metric, do what you can to simplify the process of comparing alternatives and focusing on the critical trade-offs. It may help to eliminate any alternative that is clearly dominated by at least one other option. You should also look for policy options that would be dominated if you weighed one criterion rather less heavily than most of the other criteria. Upon reflection, you might decide that this criterion should be weighed this low, and that these policy options too can be dropped from further consideration.

7. Decide!

The Decide! Step appears as a check on how well you have done your work up to this point. Even though you are not the decision maker, you should at this point pretend that you are. Then, decide what to do based on your own analysis. If you find the decision difficult or troublesome, perhaps the reason is that you have not clarified the trade-offs, or that you have not said quite enough about the probability of serious implementation problems emerging, or that a crucial cost (or benefit) estimate is still too fuzzy and uncertain.

Think of it this way:

Unless you can convince yourself of the plausibility of some course of action, you probably will not be able to convince your client. Of course, in your report, you might not think it appropriate to make

reference to your own decision. You may, instead, limit your story to a clarification of the relevant trade-offs.

8. Tell your story.

When you tell your story, do so clearly and simply. The guiding principle is that other things being equal, shorter is always better. A common, though not uniformly applicable, organizing framework is to begin with a good problem definition and then to treat all the policy options you consider as a major section. Within each such section, you would project the probable outcome (including undesired effects) of implementing the policy option and assess how likely such outcome is in the light of the causal chain model and associated evidence. Following these discussions, you might review and summarize the alternative outcomes and discuss their trade-offs.

Final Product

The final product of POA would look like this: In a coherent, narrative style you will describe the problem that needs to be mitigated or solved. You will lay out a few alternative courses of action that might be taken. To each course of action you will attach a set of projected outcomes, suggesting the evidentiary grounds for your projections. If no alternative dominates all other alternatives with respect to all the evaluative criteria, you will indicate the nature and magnitude of the trade-offs implicit in different policy choices. Finally, you may state your own recommendation as to which alternative should be chosen.