



UNDP/GEF PROJECT ENTITLED "REDUCING ENVIRONMENTAL STRESS IN THE YELLOW SEA LARGE MARINE ECOSYSTEM"

UNDP/GEF/YS/RWG-P.1/5
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First Meeting of the Regional Working Group for the Pollution Component

Qingdao, China, 6-9 April 2005

Draft Data and Information Requirements

The final outputs of the UNDP/GEF Yellow Sea Project are to prepare a Transboundary Diagnostic Analysis (TDA), Regional Strategic Action Programme (SAP), National Yellow Sea Action Plans, and demonstration of the SAP. Document UNDP/GEF/YS/RWG-P.1/4 described the general process to develop the TDA and the requirements from the Regional Working Groups to set a common ground for data acquisition. This document describes in more detail the last few steps of the TDA development process, in particular, the causal chain analysis and governance analysis. With understanding of these procedures, the Regional Working Group (RWG) should discuss and agree on the basic requirements and procedures for preparing an initial causal chain analysis, governance analysis, and propose some solutions to address the pollution-related problems in the Yellow Sea.

Causal Chain Analysis

A causal chain analysis is a linear approach to analysing the proximate and ultimate or, root causes of observed environmental issues or problems in a specific location. Whilst such an analysis can be conducted for a wide geographic area, the end results do little more than identify areas of intervention either at the level of issue or problem or the level of cause.

When such an analysis is conducted at the scale of a specific intervention, it provides information regarding the best point of intervention along the chain, and at which point maximum benefit can be derived for minimum cost. Future corrective actions can only be proposed with confidence if the whole chain of symptoms, causes and effects are understood. Such a causal chain analysis has to be carried out for each priority problem. The completed causal chain analysis should help to locate potential areas of intervention for the GEF and respective governments, and is an important basis for the design of the practical actions that will be included in the SAP.

The causal chain relates the problems to their immediate physical causes and their social and economic underlying causes. However, there is a danger here of confusing problems and immediate causes. For example, take the question of 'pollution hot spots'. Should the existence of hot spots be described as the problem to be dealt with, or is it the impact or cause of another problem? The outlined causal chain diagram in Figure 1 shows that the hot spot is the immediate cause of the problem.

During the TDA, the interaction between causes and effects of key transboundary problems has to take into account the **geographical scale** of the environmental and social impacts of a problem. Remember: the problem itself and the causes of the problem may be different.

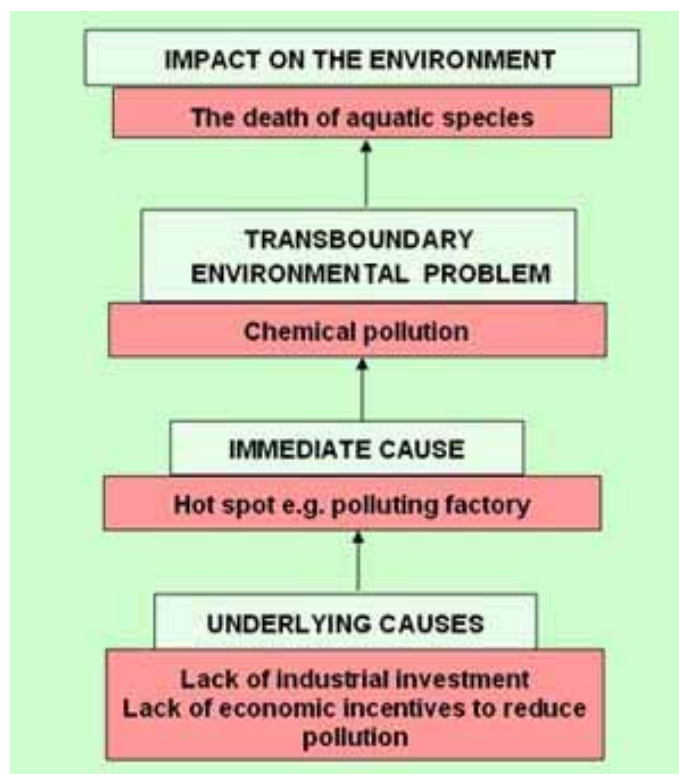


Figure 1. Sample of causal chain diagram.

Completion of a causal chain analysis for each of the priority problems requires a mixture of expertise: scientific for the immediate causes, and social and economic for the underlying and root causes.

Immediate causes are usually technical in nature and should be quantified, prioritised and geographically located. **Underlying causes** are those that contribute to the immediate causes. They can broadly be defined as **sectoral** resource uses and practices, and their related social and economic causes.

Beyond the sectoral causes however, are deeper **root causes** of the problems, often macroeconomy, demography, consumption patterns, environmental values and access to information and democratic processes. Most of these are beyond the scope of GEF's intervention but it is necessary to document them. The reason for this is that some proposed solutions may be unworkable if the root causes of the problem in question are overwhelming. Furthermore, actions taken nearer to the root causes are more likely to have a lasting impact on solving the problem.

To carry out the causal chain analysis in a specific location and for a specific environmental problem, in most cases, the environmental and socio-economic data and information to support the statements are made in the analysis. Only with strong scientific backing, can the causal chain analysis can be persuasive.

Governance Analysis

The term 'governance' is short for the whole political environment: institutions, laws, policies and projected investments that affect environmental problems. The analysis of these is known as **governance analysis**.

The existence of a problem implies that some parts of the current mechanisms or their implementation are insufficient, otherwise the problem would not exist. Therefore, these mechanisms and the reasons for any failure must be documented in order that appropriate interventions can be suggested.

An important characteristic of governance analysis is to find out where decision-making power really sits, and how the mechanisms actually work, as opposed to how they are supposed to work.

Governance analysis should describe the dynamic relations within the political and social structures that underpin such aspects as legislative and regulatory frameworks, decision-making processes and budgetary allocations. In carrying out the causal chain analysis, many cross-cutting underlying causes will be found to be governance issues.

The governance analysis should be conducted by national and regional experts, and there should be regular feedback between all groups in order to understand the dynamics and synergies between the causes of transboundary problems and possible failures in governance.

The example below shows the causal chain and governance analysis for the problem of algal blooms in the Adriatic Sea.

Example 1. Algal blooms in the Adriatic Sea.

Algal blooms in the Adriatic Sea result in unsightly algal deposits on tourist beaches, which in turn result in reduced tourist income. A secondary effect resulting from increased nutrients is eutrophication, increased BOD and reduced availability of dissolved oxygen in the water column, which results in wide-spread fish and invertebrate kills resulting in loss of fisheries income and changes in biological diversity.

The **immediate cause** of the problem is increased nutrient availability in the water column derived from two sources, agricultural fertiliser run-off and discharge of untreated domestic wastes including sewage. Of the two, run-off of fertiliser from the intensive rice production of the Po valley is the dominant source of nutrient input. (*This statement would need scientific and environmental data to support it*). This in turn reflects excessive fertiliser use, poor agricultural practices and the artificially low price of fertiliser due to government subsidy and the common agricultural policy of the European Union. Whilst some environmental improvement could be effected via changes in fertiliser use and agricultural practices, the key to effecting change in this instance involves a change in government policies, which remove the subsidy on fertilisers, which in turn requires a change to the common agricultural policy of the European Union. Effecting change at the level of policy within the European Union requires changes involving all member states of the Union not merely the ones impacted by the observed loss of environmental quality.

The discharge of untreated sewage whilst it represents a significant source of nutrient input which is widespread along the coast of the Adriatic is less significant than agricultural run-off; hence intervention in this chain of cause and effect will have less impact in terms of reducing nutrient loads than intervention in the agricultural sector.

This example illustrates three significant points: 1) firstly, the need to identify the primary causes and rank their importance where more than one source is involved; 2) secondly, the need to identify the precise points of intervention that will have the greatest effect; and, 3) thirdly, that some causes may be beyond the capacity of the involved countries to address, since they involve countries outside the area of impact, i.e. they are transboundary at the policy level.

Table 1. Level of causes of observed problem.

Issue or Problem	Immediate Cause	Level 2 Cause	Level 3	Level 4	Level 5	Level 6	Ultimate or root cause
Algal blooms (Adriatic sea)	Increased nutrients	Agricultural runoff (Po River)	Excessive fertiliser use	Poor agricultural practices	Low price	Govt. subsidy	Common Agricultural policy of the EU
		Discharge of sewage	No treatment	Lack of capital	Political will		

Once the characterisation has been completed, a causal chain analysis needs to be completed for each site that identifies the key environmental issues, problems or threats and their causes prior to conducting a cost benefit analysis for each potential intervention. Then a clear identification of the relative importance of each identified problem and the comparative importance of each cause in the case of problems with multiple-cause choices regarding the priority interventions can be made.

Solution Guideline

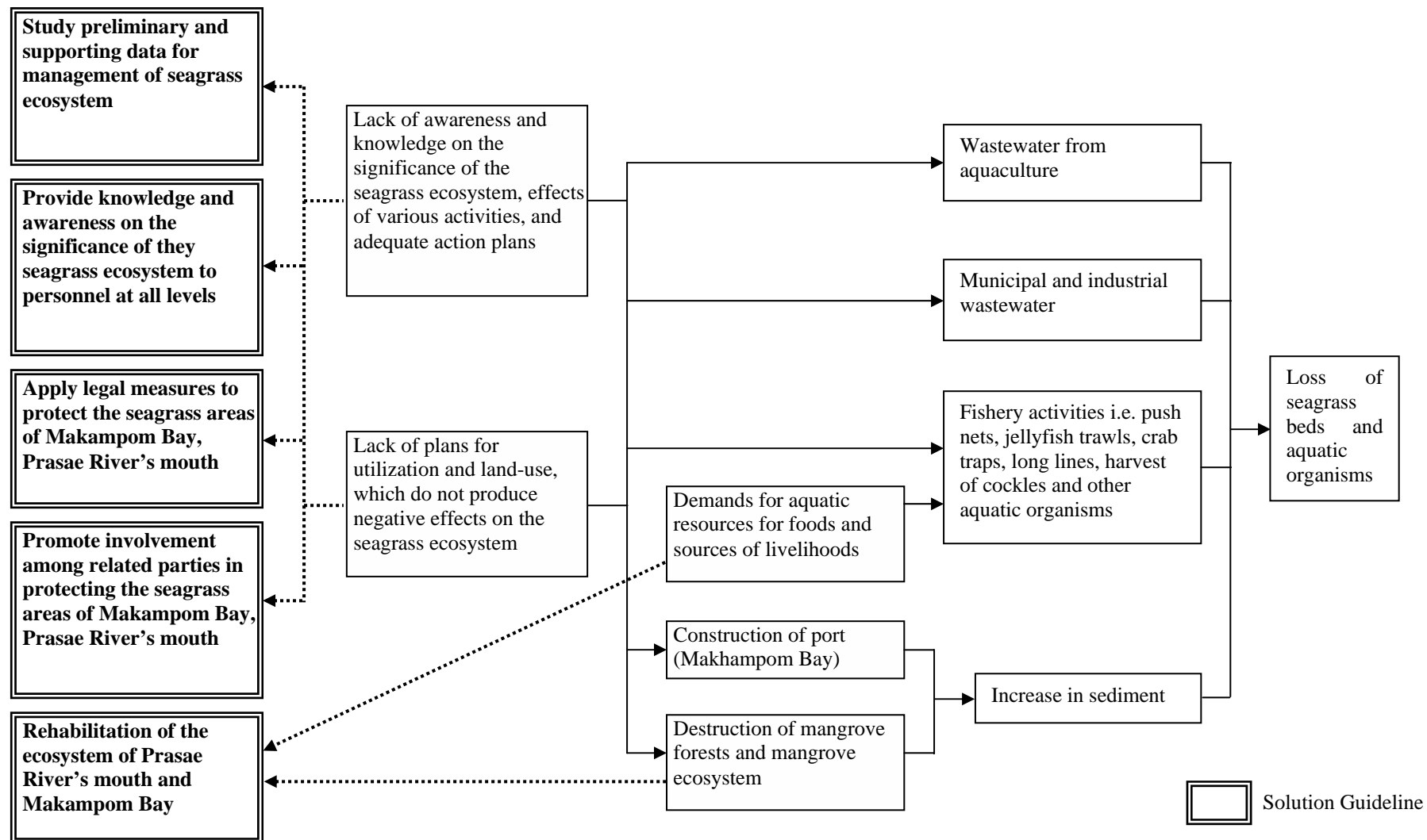
At a later stage, when the causal chain and governance analysis have been completed, one must formulate solutions to address the problems. The solutions and actions will contribute to the SAP. While it is beyond the scope of the First RWG Meeting to start formulating solutions, Example 2 provided below is for future reference, and to give an idea of the RWG's task ahead when the Project reaches the SAP development stage.

At the right hand end is the problem to address. In this example, it is loss of seagrass beds and aquatic organisms in Thailand. In the case for the RWG-P, it may be unsanitary beaches and coastal areas.

Immediately beside the problem, is the first level cause of the problem, and to the left of that, the second level, etc, until the root cause of the problem (second column from left). In this example, the root cause was sometimes a lack of awareness of the impacts of these activities on the ecosystems, and lack of land use planning leading to sedimentation getting to the reefs and seagrasses, etc.

At the far left, are the interventions needed to address the root causes of the problem. Not all interventions may be possible to address, as mentioned in Example 1. However, the interventions will be listed in the SAP, and where possible, tested at demonstration sites. In the longer-term, the proposed interventions will serve as guidelines for regional actions to manage the Yellow Sea ecosystem.

Example 2. Site-specific causal chain analysis for Makhampom Bay, Thailand.



RWG Tasks at Hand

The First RWG-P Meeting will begin the initial steps for TDA/SAP development. Table 2 is a starting point for agreeing on the data requirements for TDA, and Table 3 is a working example for the causal chain and governance analysis. During the Meeting, participants will finalise the table of data requirements, and go through an exercise to develop a causal chain analysis.

Table 2. Pollution Component - Information Requirements.

<u>Problem</u>	<u>Information needed to detect problem</u>	<u>Kinds of data needed</u>	<u>Data Format</u>	<u>Temporal Scale</u>	<u>Spatial Scale</u>	<u>ROK Has Data?</u>	<u>PRC Has Data?</u>	<u>Priority (H, M, L)</u>	<u>Trans-boundary ?</u>
Deteriorating water quality (rivers, lakes, seas)	biological & chemical water quality	dissolved oxygen	% saturation	seasonal for past 20 yrs	river basin and 1 degree sampling stations from coast to "marine border"				
		nutrients	NO ₂ - µg/L	seasonal for past 20 yrs	""				
			NO ₃ - µg/L	""	""				
			ammonium - µg/L	""	""				
			total dissolved N - µg/L	""	""				
			total particulate N	""	""				
			total dissolved P - µg/L	""	""				
			orthophosphate	""	""				
			total particulate P	""	""				
			N:P ratios	""	""				
			chlorophyll a - µg/L	monthly for past 20 yrs	""				
			benthic chlorophyll - µg/L	seasonal for past 20 yrs	""				

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		carbon	total particulate C	seasonal for past 20 yrs	""				
		fecal coliform	colonies/100 ML	seasonal for past 20 yrs	""				
		zooplankton biomass	mg/m3	annual for past 30 yrs	""				
		salinity	ppt	seasonal for past 20 yrs	""				
		heavy metals in biomass, sediment, water	SO4, Cd, Cr, Zn, Se, Cu, Hg, Pb	annual load for past 20 yrs	habitat, provincial coast line				
		organochlorine compounds	HCH - ng/g dry wt		habitat biomass - sediment, fish tissue				
			PCBs - ng/g dry wt		""				
			DDTs - ng/g dry wt		""				
			HCHs - ng/g dry wt		""				
		organic pollutants	PAH	annual load for past 20 yrs	habitat biomass - sediment, fish tissue				
		pesticides	?	annual for past 30 yrs	national				
		total suspended solids	?	annual load for past 20 yrs	river basin and 1 degree sampling stations from coast to "marine border"				
		petroleum	kg/yr	annual load for past 20 yrs	provincial, ship traffic				
		industrial waste	tonnes/yr	""	provincial, ship traffic				
		solid waste	tonnes/yr	""	provincial, ship traffic				

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		atmospheric inputs	???	???	???				
	physical water quality	turbidity (Secchi depth)	light attenuation coefficient	seasonal for past 20 yrs	river basin and 1 degree sampling stations from coast to "marine border"				
		SST	satellite images - degrees C	monthly means for past 20 yrs	5km / pixel - basin wide				
		temperature	degrees C	""					
		pH	pH	""	river basin and 1 degree sampling stations from coast to "marine border"				
		depth	meters	n/a	n/a				
		river discharge	m3/yr	annual for past 20 yrs	each river basin				
		water circulation	?		Yellow Sea				
		tide	?		Yellow Sea				
		water flow	speed - km/hr	seasonal for past 20 yrs	Yellow Sea				
			direction	n/a	Yellow Sea				
contaminated fish and other marine species	disease and death in marine organisms	harmful algal bloom	# occurrences	annual for past 40 yrs	Yellow Sea				
			month(s) of occurrence	annual for past 40 yrs	""				
			areal size of occurrence	annual for past 40 yrs	""				
		fisherfolk income	gross annual income per household	annual for past 40 yrs	provincial				

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			#, type of luxury goods owned	annual for past 40 yrs	provincial				
deteriorating human health quality	death and disease in humans	loss of labour pool	# of able-bodied persons not employed	annual for past 20 yrs	provincial				
		nat'l/individual insurance costs	average insurance premium costs in USD	annual for past 20 yrs	provincial				
		hospitalization / outpatient fee	fee in USD	annual for past 20 yrs	""				
		introduced human-affected diseases	#, type of new diseases	annual for past 20 yrs	provincial				
deteriorating beaches and coastal areas	quality of recreational areas	biological, chemical, physical water quality	see above	--	--				
		sewage discharge to/from area	cubic tons/yr	annual for past 20 yrs	provincial				
		national income from tourism activities	USD	annual for past 20 yrs	provincial				
	water supply in tourist areas	quality	see above	--	--				
		quantity	m3/person	annual for past 20 yrs	provincial				

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Notes:	* Temporal data listed is ideal time frame for historical records. Minimum literature review should include 10 years of historical data.								

Table 3. Pollution Component Draft Causal Chain Analysis.

<u>Problem</u>	<u>Impacts</u>	<u>Immediate causes (technical)</u>	<u>Underlying causes</u>	<u>Root causes</u>	<u>Governance analysis</u>
Deteriorating water quality (rivers, lakes, seas)	loss of recreational areas	eutrophication of waters	urbanisation	rapid coastal population growth	poor/ineffective legal instruments
	loss of tourism income	point & non-point discharges	modification of inland water flow to Yellow Sea	environmentally unfriendly technology	inadequate infrastructure base
	water surface sedimentation	factory emissions	ballast water	inadequate knowledge	inadequate mgmt/planning
	loss of water supply	ship oil leaks	water use conflict		insufficient stakeholder involvement in mgmt/planning
	more costly water supply	restricted water circulation	land reclamation		insufficient financing mechanisms & support
	decline in coastal community health	atmospheric inputs	upland land clearance		
	decline/shift in spp. diversity/numbers		dredging		
	loss to fishing industry				
	decline in human/marine organism health				
	harmful algal bloom and emerging diseases in the ocean				
	"dead zones," reduced O2, fish kills				

<u>Problem</u>	<u>Impacts</u>	<u>Immediate causes (technical)</u>	<u>Underlying causes</u>	<u>Root causes</u>	<u>Governance analysis</u>
deteriorating human health quality	loss of labour pool	eutrophication of waters	urbanisation	rapid coastal population growth	poor/ineffective legal instruments
	increased nat'l/individual hospital/insurance costs	point & non-point discharges	water use conflict	environmentally unfriendly technology	inadequate mgmt/planning
	increased human-affected diseases	atmospheric inputs		inadequate knowledge	insufficient stakeholder involvement in mgmt/planning
					insufficient financing mechanisms & support
					inadequate infrastructure base
contaminated fish and other marine species	decline in food source	eutrophication of waters	water use conflict	rapid coastal population growth	poor/ineffective legal instruments
	loss of income for fisherfolks, aquarium	point & non-point discharges	ballast water	inadequate knowledge	inadequate infrastructure base
	degradation of food web	factory emissions	atmospheric inputs		inadequate mgmt/planning
	decline/shift in spp. diversity/numbers	ship oil leaks			insufficient stakeholder involvement in mgmt/planning
	marine mammal, seabird death				insufficient financing mechanisms & support
	human poisoning				
unsanitary beaches and coastal areas	loss of recreational areas	eutrophication of waters	water use conflict	rapid coastal population growth	insufficient stakeholder involvement in mgmt/planning
	loss of tourism income	point & non-point discharges	land reclamation	inadequate knowledge	insufficient financing mechanisms & support

<u>Problem</u>	<u>Impacts</u>	<u>Immediate causes (technical)</u>	<u>Underlying causes</u>	<u>Root causes</u>	<u>Governance analysis</u>
	decline in coastal community health	atmospheric inputs	urbanisation		inadequate infrastructure base
	decreased water supply	factory emissions	dredging		poor/ineffective legal instruments
		ship oil leaks	upland land clearance		