

Table 12. Causal Chain Analysis – Pollution Problems.

Issue/Concern	Fundamental Problem/Driver	Priority	Trend	Primary Cause(s)	Secondary Cause(s)	Tertiary Cause(s)	Quaternary Cause(s)	Root Cause(s)
Eutrophication and Harmful Algal Blooms	Nitrogen Enrichment			Sewage discharge (treated and untreated) into the sea and rivers.	No tertiary sewage treatment		limited knowledge of capacity of system to absorb Nitrogen	Limited application of research knowledge to assimilative capacity calculations
					limited investment in urban infrastructure	Rapidly increasing urban sewage and limited sewage treatment capacity		Limited influence of environmental constituency on government policies
					Inadequate separation of sewage and precipitation drainage systems	Cost of separating precipitation and sewage water in long established urban areas.		Limited influence of environmental constituency on government policies
						Where such separation exists, it is frequently overwhelmed by major storm events.		Limited influence of environmental constituency on government policies
				Toxic substance leakage from chemical industries				irrational industrial distribution
				Residues released from mariculture	Density of mariculture (i.e. cages and ponds) exceeds capacity to absorb Nitrogen (compounded by over feeding of stock)	Lack of recognition of the assimilative capacity of the YS system to absorb nutrient releases.		high density of localized mariculture
				Agriculture - arable farming runoff	Overuse of fertilizers on crops	Lack of knowledge of proper application	Insufficient government requirements for farmer training	Lack of absorption of nutrients by wetland
							China - attempts to improve balance between supply and demand for agricultural products	
						Limited control of waste runoff from agricultural activities.	No use of buffer zones for nutrient assimilation.	Inadequate recognition of problem at national levels

Table 12. Causal Chain Analysis – Pollution Problems (Continued).

Eutrophication and Harmful Algal Blooms (Continued)	Nitrogen Enrichment (Continued)			Agriculture – livestock runoff	Leakage of nutrient from livestock into fresh waters.	No use of buffer zones for nutrient assimilation.	Inadequate recognition of problem at national levels.	Inadequate balance between development and environment	
				NOx emission from human activities	Major increase in number of vehicles	Substantial increase in standard of living	Limited adoption of regulations on vehicular sources.	economic development at scale	
Toxic Algal Blooms (please move to ecosystem)	Silicate depletion (relative to N and P)			Retention of fixed Silicate behind freshwater dams	Construction of dams on major rivers draining into the Bohai and Yellow Seas	Freshwater storage and power production to support economic development	Limited development and imposition of coherent policies on the maintenance of nutrient balances	Economic development without adequate consideration of marine environmental consequences	
Contaminants and Their Effects (please reclassify into industry, oilspill, transportation, and chemicals)	Faecal bacterial contamination and associated risks to human health			Discharge of human sewage.	Inadequate urban sewage treatment capacity.	Korea - limited investment in urban infrastructure China - rapidly increasing urban populations	Limited incidence of disease caused by contact with contaminated seawater and seafood consumption	Limited attention to the problem of sewage treatment in relation to human health protection.	
				PAH contamination	Shipping emissions	Increase in number and size of vessels			Limited compliance with MARPOL Convention
	Power generation emissions				Limited use of atmospheric scrubbers	Growth in demand for electrical power.	Inadequate recognition of problem at national levels.	Limited development of emission controls on industry	
	Oil spills				Increased maritime traffic				Limited compliance with MARPOL Convention
					Inadequate spill prevention.				Limited compliance with MARPOL Convention
	Oil refinery emissions				Increased PAH releases from refining activities.	Increased demand for refined oil products.	Limited controls on PAH releases.	Limited development of controls on emissions from industry	
	Steel production emissions					Increased demand for steel.	Limited controls on PAH releases.	Limited development of controls on emissions from industry	
	Home heating emissions				Limited use of renewable energy sources for home heating purposes.	Limited incentives for renewable power generation.		Absence of balanced energy policy based on the need to mitigate climate change and protect the environment.	
	Diesel engine emissions			Increased traffic due to economic growth.			Regulatory infrastructure does not keep pace with economic growth.		
Road paving emissions	Increased need for road paving due to economic growth.			Regulatory infrastructure does not keep pace with economic growth					

Table 12. Causal Chain Analysis – Pollution Problems (Continued).

Contaminants and Their Effects (<i>i.e.</i> , Pollution) (Continued)	Heavy metal contamination (Cd, Pb, Zn, Cu, Hg, Cr)			Release of metals from industry.	Inadequate compliance with existing regulations.	Limited compliance assurance infrastructure		Inadequate compliance assurance
				Releases of metals from vehicles	Limited restrictions in metals releases from transport			Inadequate regulatory infrastructure or enforcement.
	PCB contamination			Long distance transport from other areas	Emissions to atmosphere in other regions of the world	No jurisdictional influence except through international conventions.		NB: Development and administration of regulations will be promulgated under NIPs for implementation of the Stockholm Convention
				Release of used PCB-containing dielectric/coolant oils	Inadequate facilities for decommissioning transformers, capacitors and other PCB-containing equipment in the electrical industry.			NB: Development and administration of regulations will be promulgated under NIPs for implementation of the Stockholm Convention
	PCDD & PCDF Contamination			Incineration of solid wastes	Inadequate segregation of wastes	Inadequate waste management practices.	Poor regulation of solid waste management and recycling.	NB: Development and administration of regulations will be promulgated under NIPs for implementation of the Stockholm Convention
				Steel industry	Uncontrolled combustion without scrubbing.	Limited implementation of release controls.		NB: Development and administration of regulations will be promulgated under NIPs for implementation of the Stockholm Convention
				Pulp and paper industry	Use of old pulping technologies and contaminated feedstock.	Limited implementation of process and release controls.		NB: Development and administration of regulations will be promulgated under NIPs for implementation of the Stockholm Convention
	Marine litter contamination			Releases of anthropogenic wastes from land-based sources	Inadequate classification of solid waste management and treatment	Lack of appreciation that marine litter is a problem	Public / tourist habits	Low awareness of impact of marine litter entering into the coasts
				Transport of natural materials from land-based sources into the marine environment.	Carriage of natural materials material by floods and storms	Inadequacies in land management – forestry, agriculture, parks and public spaces		Inadequacies in public policies, legislation and regulations to address comprehensively land-based sources of marine pollution.

Table 13. Causal Chain Analysis – Ecosystem Problems.

Issue/Concern	Fundamental Problem/ Driver	Priority	Trend	Primary Cause(s)	Secondary Cause(s)	Tertiary Cause(s)	Quaternary Cause(s)	Root Cause(s)
Change in biomass or abundance	Increase in Korea-greater than 330µm zooplankton. Decrease in China greater than 505 um zooplankton			Change of phytoplankton abundance and composition.	Eutrophication, regional climate change	Change in physical conditions.	Global climate change.	N.B. This is a global issue and relates to the implementation of FCCC. Both countries are parties to the Kyoto Protocol.
				Decrease predator pressure and change in food items consumed.	Change in fish community.	Overfishing.	Increasing demand for seafood.	Weak enforcement of controls on fishing as a means of preventing illegal fishing activities.
	Shift in peak in seasonal patterns of zooplankton and phytoplankton biomass (Korea).			regional climate change	Change of phytoplankton abundance and composition.	Change in physical conditions. Regional climatic change.	Global climate change.	N.B. This is a global issue and relates to the implementation of FCCC. Both countries are parties to the Kyoto Protocol.
				Decrease predator pressure and change in food item consumed.	Change in fish community. eutrophication	Overfishing. eutrophication	Increasing demand for seafood.	Weak enforcement regarding illegal fishing activities.
Change in species composition	Change in dominant groups of zooplankton (Korea).			Change of phytoplankton abundance and composition. regional climate change		Change in physical conditions. Regional climatic change.	Global climate change.	N.B. This is a global issue and relates to the implementation of FCCC. Both countries are parties to the Kyoto Protocol.
	Decrease ratio of diatoms to dinoflagellates (China).			Change of predator (top down control).	Overfishing. regional climate change	Rapid increases in fishing effort.	Insufficient controls on fishing activities to ensure adherence to TACs.	Weak enforcement of controls on fishing as a means of preventing illegal fishing activities.
				Change in nutrient concentrations and ratios.	Changed nutrient influxes.	Increased sewage discharge, agricultural pollutants	Rapid development of coastal zone.	Weaknesses in legislation and/or inadequate enforcement of legislation relating to coastal zone management and protection. climate change
Jellyfish blooms.			Coastal Artificial structure	overfishing	Altered trophic structure	climate change	Climatic change, lack control management and technology, altered ecosystem structure	

Table 13. Causal Chain Analysis – Ecosystem Problems (Continued).

Issue/Concern	Fundamental Problem/Driver	Priority	Trend	Primary Cause(s)	Secondary Cause(s)	Tertiary Cause(s)	Quaternary Cause(s)	Root Cause(s)
Change in benthic	Change in benthic species composition and dominant species.			Degradation of bottom water environment and sediment quality; changes in surficial sediment composition.	Stagnation of bottom water due to thermal stratification.	Changes in Yellow-Sea circulation.	Climate change.	N.B. This is a global issue and relates to the implementation of FCCC. Both countries are parties to the Kyoto Protocol.
	Species distribution area inhating cold water shrinks			Pollution, increasing temperature	Climate change			Need strict control on pollution n discharge, control on CO2 emission
Increased frequency of HABs	Eutrophication** (See Pollution causal chain)							See Pollution causal chain
	Si depletion** (See Pollution causal chain)							See Pollution causal chain
Loss of benthic habitat in coastal areas.	(See Biodiversity causal chain)							See Biodiversity causal chains