

Table 14. Causal Chain Analysis – Fisheries Problems.

Issue/Concern	Fundamental Problem/ Driver	Priority	Trend	Primary Cause(s)	Secondary Cause(s)	Tertiary Cause(s)	Quaternary Cause(s)	Root Cause(s)
Decline in landings of many traditional commercially-important species and increased landings of low value species (including changes in dominant species)	Unsustainable natural resource exploitation practices			Overexploitation of target fish species	Deficiencies in management and control of fisheries activities	Over capacity of fishing fleets	Lack of alternative livelihood	Problem is being addressed through buy-back programs and re-training, but is not complete.
								Insufficient monitoring and enforcement
					Deficiencies in fisheries stock management (Lack of comprehensive and effective system of fisheries stock management)	Weak scientific-based knowledge of ecosystem processes	Insufficient support for, and guidance of, education and research	Insufficient recognition of the limits to sustainable natural resource exploitation
				Climatic change				See Ecosystem causal chain
Unsustainable maricultural practices	Unsustainable development of coastal zone			Over-intensive mariculture	Unguided/unchecked increased in demand for seafood as the result of changing lifestyle		Inadequate controls and regulations for maricultural development	
				Limited and variable natural food supply	Variation of environmental conditions (e.g., primary productivity) combined with overintensive maricultural activities	Insufficient knowledge of carrying capacity		
				Environmental consequences of releases of nutrients, bacterial, viral and faecal matter and food residues from mariculture	Overfeeding, inadequate effluent treatment, poor quality of feed	Insufficient application of environmental friendly techniques and considerations of carrying capacity		
				Potential impacts on human health	Chemical and pharmaceutical residues in farmed organisms	Inappropriate use of chemicals in mariculture and frequent algal blooms	Insufficient application of environmental friendly techniques and environmental changes	
Effects of natural toxins generated by harmful algal blooms (HABs)			See Pollution causal chain					

Table 15. Causal Chain Analysis – Biodiversity Problems.

Issue/Concern	Fundamental Problem/ Driver	Priority	Trend	Primary Cause(s)	Secondary Cause(s)	Tertiary Cause(s)	Quaternary Cause(s)	Root Cause(s)		
Loss of Biodiversity	Habitat Loss	High	Increasing	Land reclamation	Increase in demand for coastal lands			Growth-driver (economic) policies		
	Loss of wildlife			By-catch, unsustainable use, invasive species, illegal catch.				Inadequate regulatory infrastructure or enforcement.		
	Habitat modification			Gaps in MPA planning / marine spatial planning						
				Aquaculture	Increase in the demand for fishery products				Rising standard of living, population increase, decrease in natural and commercial species.	
				Reduced river flows	Increase in water use, damming.	Water demand increase.		Economic and population growth.		
				Construction of artificial structures	Increase in demand for coastal infrastructure,				Economic growth and tourism demand	
					Coastal disaster prevention				Climate change results in increased coastal disasters.	
					Energy demand				Improved standard of living.	
					Sea level rise	Global warming			Fossil fuel consumption, deforestation, increase in agricultural land.	
	Changes in community structure (shift of ecosystem)			Eutrophication	Increase in nutrient input.	Urbanization, fertilizer use, deforestation.		Inadequate controls on growth.		
Pollution		Increase in pollutant input			Population growth, poor sewage treatment, economic growth, livestock farming, antibiotics and pesticides.					
Introduced species		Ballast water				Inadequate enforcement.				
		Intentional introduction of alien species				Aquaculture, blue carbon, land growth.				
By-catch and accidental injuries.						Decrease in profit margin, increase in demand, population growth.				
Benthic habitat loss	Littering of benthic habitat with wastes	Inappropriate solid waste disposal practices	Poor compliance with regulations	Lack of public awareness	Development being undertaken with limited comprehensiveness and coherence in the legislative basis for environmental and biodiversity protection coupled with poor enforcement and inadequate public information					
	Coastal shoreland habitat loss	Land reclamation	Rapid industrial and social development in the coastal zone	Development undertaken without full understanding of the consequences		Deficiencies in comprehensive development planning				
	Pollution	Domestic and industrial waste discharges	Growth of urban conurbations and associated industry in the coastal zone	Development undertaken without full understanding of the consequences		Deficiencies in comprehensive development planning				

Habitat loss and degradation	Loss of habitat in estuaries/deltas			-Reductions in river discharge -Sediment impoverishment (!)	River basin development (construction of dams for water impoundment and power generation)	Pressure for hinterland development, power production, irrigation and improved water supplies	Development undertaken without full understanding of the consequences	
				Changes in locations and amounts of river discharge	River diversion schemes			
	Habitat conversion			Reclamation for aquaculture ponds for shrimp and crab (from recent years only), etc.	Increasing demand for seafood	Lifestyle changes and increased desire for a plentiful and affordable supply of seafood	Population growth and increased affluence	
					Demand for job opportunities	Social development with increased personal aspirations		
Habitat degradation				Reclamation for salt production	Increasing demand for edible salt	Rapidly growing population	Deficiencies in comprehensive development planning	
					Increasing demand for chemical products	Requirement for more chemical products for rapidly growing population		
				Degradation and fragmentation of habitat due to natural change and human activities	Indiscriminate local and community development	Local development undertaken without full understanding of the consequences		See Pollution Causal Chain
					Climatic change			
Issue/Concern	Fundamental Problem/ Driver	Priority	Trend	Primary Cause(s)	Secondary Cause(s)	Tertiary Cause(s)	Quaternary Cause(s)	Root Cause(s)
Changes in species abundance and diversity	Decline in vulnerable birds			Overhunting	Sustainability not considered by local harvesters	High demand for food including the continuation of traditional exploitation practices	Continuation of traditional practices without regard for consequences of increased production	Deficiencies in policy and regulation of traditional natural resource exploitation practices and inadequate public information
				Unsustainable egg harvest				
				Destruction of reproductive, resting and feeding habitat especially coastal wetlands	Lack of consideration of species protection in social and economic development practices	Inadequate balance between developmental aspirations and the need to protect the environment and biodiversity	Deficiencies in comprehensive development planning	Development being undertaken in the absence of comprehensive and coherent legislation for environmental and biodiversity protection combined with poor enforcement of existing legislation
				Climatic change				See Pollution Causal Chain
	Decline in Sea Turtles			Unsustainable egg harvest	Sustainability not considered by local harvesters	High demand for food including the continuation of traditional exploitation practices	Continuation of traditional practices without regard for consequences of increased production	Deficiencies in policy and regulation of traditional natural resource exploitation practices and inadequate public information

				Destruction of reproductive (?) habitat	Lack of consideration of species protection in social and economic development practices	Inadequate balance between developmental aspirations and the need to protect the environment and biodiversity	Deficiencies in comprehensive development planning	Development being undertaken in the absence of comprehensive and coherent legislation for environmental and biodiversity protection combined with poor enforcement of existing legislation	
Changes in species abundance and diversity (Continued)				Overexploitation	Sustainability not considered by local harvesters	Inadequate controls on natural resource exploitation practices	Continuation of traditional practices without regard for consequences of increased production	Deficiencies in policy and regulation of traditional natural resource exploitation practices and inadequate public information	
	Decline in anadromous and catadromous fish and mammals (Continued) suggest to only include mammals, i.e. spotted seal and finless porpoises, and exclude fishes.)			Spawning/migration route blocked by dams	Construction of river barrages without adequate consideration of environmental and biodiversity consequences	Inadequate balance between developmental aspirations and the need to protect the environment and biodiversity	Deficiencies in comprehensive development planning	Development being undertaken in the absence of comprehensive and coherent legislation for environmental and biodiversity protection combined with poor enforcement of existing legislation	
				Accidental injury	Increased maritime transport				
				By-catch	Inappropriate fishing practices	Inadequate controls on fishing practices	Deficiencies in fisheries management	Weak enforcement of controls on fishing activities	
	Decline in vulnerable species e.g., Hemichordata, Polychaete, Brachiopoda,, mollusca and shrimp (difference in scope with species, please delete). Can list lancelet. Suggest to make reference to the redlist				Physical destruction by bottom trawling	Inappropriate fishing practices	Inadequate controls on fishing practices	Deficiencies in fisheries management	Development being undertaken in the absence of comprehensive and coherent legislation for environmental and biodiversity protection coupled with poor enforcement of existing legislation and inadequate public information
					Overexploitation of species	Demand for seafood	Increased population and increased affluence	Deficiencies in fisheries management	
					Destruction of spawning, nursery and overwintering grounds	Inadequate recognition of the importance of habitat protection to the maintenance of environmental quality and amenities and to biodiversity protection	Social and economic development considerations outweighing environmental and biodiversity protection concerns		
					Climatic change			See Pollution Causal Chain	
Loss of species and diversity				Loss of habitat	(see habitat loss and degradation)				
Decline of endemic pelagic and demersal fish species (irrelevant)				Overexploitation of marine and coastal living resources	Overfishing			See Fisheries Causal Chain	
Introduction of xenobiotic (alien) species				Hull and ballast water transport of non-indigenous organisms	Marine transport	Inadequate control and regulation of ballast water collection and discharge		As yet, limited implementation of the provisions of the Ballast Water Convention	