

**REPORT OF THE GIWA ASSESSMENT PROTOCOL TESTING
FOR THE GULF OF THAILAND SYSTEM**

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1. BACKGROUND

The Global International Waters Assessment (GIWA) programme was developed to undertake assessments of environmental conditions affecting international water bodies throughout the world. To ensure comparability of the assessments among sub-regions, GIWA had developed a prototype of the methodological protocol to be used by all sub-regions. However, before implementing the worldwide assessment, GIWA needed the methodology tested and revised for improvement. To test the methodological protocol, the Southeast Asia START Regional Centre was subcontracted to set up the Gulf of Thailand Test Team (the test team, hereafter) to carry out two workshops for the GIWA methodology testing in the Gulf of Thailand Aquatic System from the period of June to September 2000.

The first workshop of the GIWA methodology testing for the Gulf of Thailand Aquatic System was held in Pattaya, Thailand, 28 June – 1 July, 2000. It was aimed at testing the scoping and detailed impact assessment methodologies. The purpose of the scoping methodology is to identify priority GIWA Issues for remedial action and intervention. After that, the Issues selected as having higher priority will undergo the environmental and socioeconomic impact assessments in details to quantitatively estimate the impacts.

Geographical scope of the Gulf of Thailand Aquatic System encompasses the entire Gulf of Thailand water and the basins that have influences on the Gulf of Thailand physically, chemically, and biologically including Chao Phraya River Basin, Mekong River Basin, and Malay Peninsula. In terms of political boundary, five countries are enclosed in the System, i.e. Cambodia, Laos, Malaysia, Thailand, and Vietnam. The two major international water bodies shared within the System are Mekong river and the Gulf of Thailand.

To call for partnership and participation to the workshop, the announcement for the first workshop was made through a variety of connections readily available in the region, e.g. the Gulf of Thailand Discussion Group on the Internet, business contacts through SEA START RC, and intergovernmental contacts. After completing compiling a list of specialists in the region, the test team began to make contact and solicit their contribution to the GIWA project. With every contact made, the test team sent out a inquiry form briefly asking for the expert's information regarding his/her interests and work involving water resource in the region. Such information was then used when selecting the participants.

After receiving the returned forms, the test team began the selection based upon their interest and other information given, and how it fitted with the GIWA Issues. In addition, other important criteria such as a balance of national representation, different disciplines, and geographical area of interest were also strongly considered. The total of 30 experts participated at this workshop. Among those divided by the field of interest, 22 were environmental scientists, two social scientists, three socioeconomists and three health scientists. Differentiated by country, four representatives from Cambodia, four from Malaysia, 16 from Thailand, four from Vietnam, and two representatives from international organizations. The test team was unable to bring any participants from Laos unfortunately.

After the test team completed the selection, the GIWA methodology manual was then sent to the participants prior to the workshop. It was to familiarize experts with the GIWA concept, terms, and methodology. Further, in case that the experts were not familiar with specific GIWA Issues and had no knowledge to back up their scoping decision, they would have time to look for data or information needed before doing the scoping exercise.

2. REPORT OF THE WORKSHOP

2.1 Opening of the workshop

The first workshop of the GIWA Gulf of Thailand Methodology Testing was opened by Dr. Anond Snidvongs, the Gulf of Thailand Test Team leader, at the Chonchan Hotel, Pattaya, Thailand on 28 June 2000. In his welcoming speech, Dr. Snidvongs expressed his gratitude towards all participants for their participation and contribution to be given during the workshop. The participants were then asked to give a brief self-introduction on their areas of expertise and interests.

Dr. Snidvongs introduced the concept and framework of the Global International Waters Assessment programme and its purpose. He further briefed on the institutional arrangement and agencies responsible for carrying out the project. Defined by GIWA, the 66 sub-regions and nine mega-regions were presented to illustrate the geographical coverage of all sub- and mega-regions. With emphasis on interconnected and transboundary characteristics, he also elaborated on GIWA' holistic approach necessary for addressing the problems in the international waters.

Dr. Snidvongs then brought the attention of the workshop to the methodological protocol and testing exercise. Three main components of the methodology, Scoping, Detailed Impact Assessment, and Causal Chain Analysis, were introduced to the participants. The Test Team leader further briefed on the concept and framework of each component.

2.2 Organization of the workshop

The aims of workshop attempting to achieve were:

- (i) To test the applicability and feasibility of the scoping methodology using the Gulf of Thailand Aquatic System as a pilot testing site;
- (ii) To identify priority GIWA Issues and Habitats for the detailed impact assessment;
- (iii) To discuss and select appropriate environmental impact indicators for the detailed impact assessment of two pre-selected Issues; and
- (iv) To comment on the methodological protocol in general.

Dr. Snidvongs informed the participants of the above objectives and the agenda of the workshop. The meeting was intended to be as informal as possible and any comments or suggestions were welcome throughout the meeting.

1. SCOPING EXERCISE

Dr. Snidvongs briefed the participants on the general scoring procedure and demonstrated how to score using a mock-up example of deforestation. The test team was asked by GIWA to explore all GIWA Issues except for Global Change Major Concern (Issues 19-23). As for Habitat and Community Modification Major Concern (Issues 12 and 13), the workshop explored all 45 Habitats to identify 10 priority habitats for each Issue.

Each participant was given a book of scoring sheets used for scoring the environmental and socioeconomic impacts and perception of change of all Issues and Habitats. Prior to each scoring session for the Issue, the test team leader briefed the participants on the Issue just enough to set their minds towards the subject and carefully not to influence the answers. The participants were asked to score to their best knowledge on both environmental and socioeconomic impacts regardless of their expertise or interest. That is, natural scientists could also give scores and made comments on cost incurred or health loss indicators.

Each scoring session took approximately 30 minutes to complete. At the end of each scoring session, scores given by the participants were presented on screen immediately. Unlike the Baltic Testing, the test team allowed each expert to individually score the impact as oppose to having the entire group discuss an issue and its impacts, then unanimously agree on one score for each impact.

The conclusion of the scoping methodology testing was held in the morning of June 30th 2000. All results of environmental and socioeconomic impact scores and perception of change scores were present to the participants. The participants were asked to give any comments or recommendations on the scoping methodology.

4. DETAILED IMPACT ASSESSMENT

4.1 Detailed Environmental Impact Assessment

The next step of the GIWA methodology was introduced on the last day of the workshop. Dr. Virginie Hart, GIWA Methodology Task Team member, together with Dr. Snidvongs, led the discussion on the detailed impact assessment. To test this methodology, the test team pre-selected two Issues which were regionally accepted as major problems in the Gulf of Thailand Aquatic System. They are Issue 12 Loss of Ecosystems or Ecotones (Mangrove Habitat) and Issue 14 Overexploitation of Fisheries and Other Living Resources. The detailed impact assessment is divided into two parts, environmental impact and socioeconomic impact assessments. For the environmental impact assessment, the test team asked the participants to comment and choose the most appropriate environmental impact indicators from the indicator list given with the methodology. However, instead of picking any indicators randomly from the indicator list, the test team decided to follow a list of environmental impacts that was also provided by the methodology as a guideline. For each environmental impact, the participants selected a few indicators that best described such impact.

4.2 Detailed Socioeconomic Impact Assessment

The group did not discuss about the socioeconomic impact indicators as the methodology had not been completed prior to the workshop.

5. MAIN RESULTS

5.1 Results of the Scoping Exercise

Table 1 shows the final scores of the environmental and socioeconomic impacts and perception of change for all 18 Issues excluding Global Change Major Concern which was not discussed or scored at the workshop. For the total scoping score of all Issues, only the score of Overexploitation Issue was standing out while a number of Issues received the same score of 4. Looking at the scores of the environmental and mean socioeconomic impact separately, each impact reflected the same trend that most Issues were given equal scores with only a few outliers clearly showing higher or lower scores.

Most Issues received the environmental impact score of 2 meaning moderate impact, while the socioeconomic impacts showed clear distinctions among three proxy indicators of socioeconomic measures. Cost Incurred received mostly Score 2, while Health Loss indicators were rated relatively low or slight impact. Reversibility of damage indicator of most Issues appeared to follow the same trend as a result of the continuing pressure of increasing population in the source areas within the Gulf of Thailand Aquatic System.

For the Habitat and Community Modification Major Concern, the group of experts performed the testing on all 45 habitats listed by GIWA. However, the test team excluded some habitats that are completely irrelevant to the Gulf of Thailand Aquatic System, i.e. deep-sea communities, ocean trenches, hydrothermal vents, and sea ice systems. The scoring results are shown in Tables 2 and 3.

The distribution of the total scoping scores for Issues 12 and 13 appeared to follow the same pattern which is that only several habitats were given clear distinctive scores, while the rest fell in the middle (Figure 1). Standing out from other habitats, coral reefs and mangroves received highest total scores, thus, were identified as habitats suffering from complete loss. Habitats identified as those suffering from modification included floodplains, flood plain rivers, riparian belts, standing waters, coastal marshes, and lagoons.

Table 1. Combined scores obtained during the Scoping exercise performed by the Gulf of Thailand Test Team

Major concern/issue	Environmental Impact Score (a)	Socio-economic Impact Score				Total Scoping Score (a) + (b)	Perception of Future Changes	Major concern score
		Cost Incurred	Health Loss	Reversibility of Damages	Mean Score (b)			
I. Freshwater Shortage								4
1. Reduction in stream flow	2	2	1	3	2	4	1	
2. Pollution of existing supplies	2	2	2	3	2	4	1	
3. Lowering of water table	2	2	1	3	2	4	1	
II. Pollution								4
4. Microbiological	2	2	2	2	2	4	1	
5. Eutrophication (harmful algal blooms)	2	2	1	3	2	4	1	
6. Chemical	2	2	2	2	2	4	0	
7. Suspended solids	2	2	1	3	2	4	2	
8. Solid wastes	2	2	1	3	2	4	0	
9. Thermal	1	1	0	3	1	2	0	
10. Radionuclide	0	0	1	3	1	1	1	
11. Spills	2	2	1	3	2	4	1	
III. Habitat and Community Modification								5
12. Loss of ecosystems or ecotones								
13. Modification of ecosystems or ecotones, including community structure and/or species composition								
IV: Unsustainable exploitation of fisheries & other living resources								5
14. Over-exploitation	3	3	2	2	2	5	1	
15. Excessive bycatch and discards	2	2	2	2	2	4	0	
16. Destructive fishing practices	2	2	1	3	2	4	-1	
17. Decreased viability of stock through pollution and disease	2	2	2	2	2	4	0	
18. Impact on biological and genetic diversity	2	1	1	2	1	3	0	
V: Global change								
19. Changes in hydrological cycle								
20. Sea level change								
21. Increased uv-b radiation as a result of ozone depletion								
22. Changes in ocean CO ₂ source/sink function								

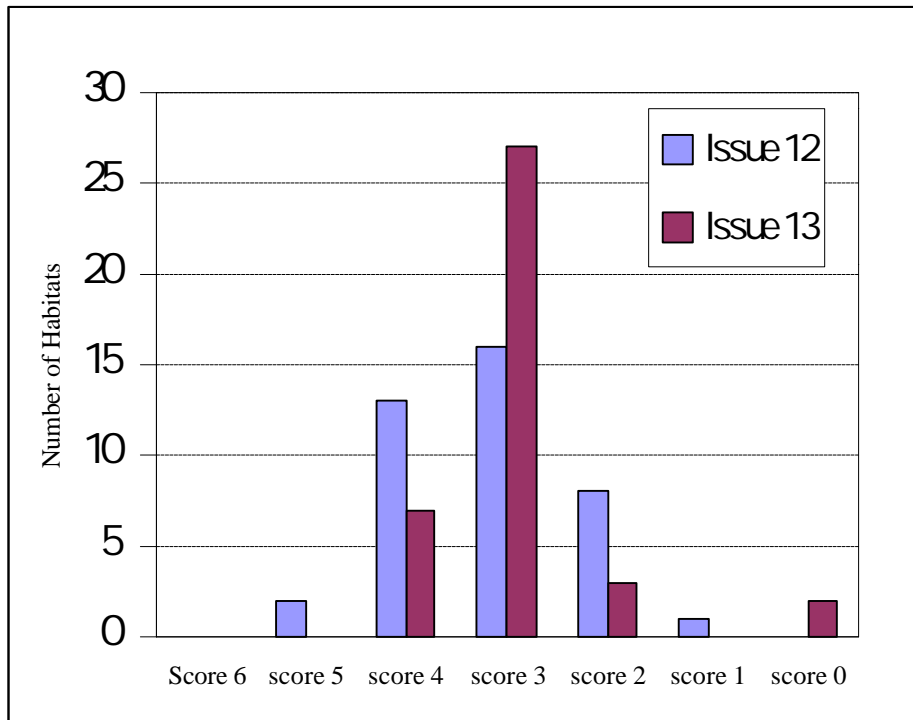
Table 2 Scores of the 41 Habitats of Issue 12 Loss of Ecosystems or Ecotones.

Major concern/issue	Environmental Impact Scores (a)	Socio-economic Impact Scores				Total Scoping Score (a) + (b)	Perception of Future Changes
		Cost Incurred	Health Loss	Reversibility of Damages	Mean Score (b)		
FRESHWATER: Wetland							
1. Peat bogs							
(a) Ombrotrophic bogs	2	2	2	3	2	4	0
(b) Soligenous bogs	2	1	1	3	2	4	1
2. Marshlands							
(a) Marshes	2	2	1	3	2	4	0
(b) Fens	1	2	1	3	2	3	0
(c) Swamps	2	1	0	3	1	3	1
3. Littoral belts alongside lakes and ponds	2	2	1	3	2	4	0
4. Wetlands related to running water							
(a) Riparian belts	2	1	1	3	2	4	1
(b) Springs, rills and flushes	1	1	1	3	2	3	1
(c) Wetlands in estuaries and deltas including tidal rivers	2	2	1	3	2	4	0
5. Periodic waters							
(a) Periodic standing waters with large amplitude fluctuations	2	1	1	3	2	4	0
(b) Periodic standing waters with long period fluctuations	1	1	1	3	2	3	1
(c) Floodplains	2	1	1	3	2	4	1
(d) Rice paddy fields	2	1	1	3	2	4	2
6. Wetlands of saline habitats							
(a) Coastal marshes	2	2	1	2	2	4	1
(b) Brackish reedlands	2	1	0	3	1	3	0
(c) Shoals	1	1	0	3	1	2	1
(d) Foreshores	1	1	1	3	2	3	1
(e) Inland salt marshes	1	1	1	3	2	3	1
FRESHWATER: Open or Running Waters							
1. Running waters (e.g. streams & rivers)							
(a) Fast flowing, stony bottomed	1	1	1	3	2	3	2
(b) Sandy/muddy, flood plain rivers	2	2	1	3	2	4	1
2. Standing waters (e.g. ponds and lakes)							
(a) Oligotrophic	1	2	1	3	2	3	-1
(b) Eutrophic	1	2	1	3	2	3	2
(c) Dystrophic	1	1	1	3	2	3	0
MARINE							
1. Coastal margin ecotones							
(a) Sandy foreshores	2	1	1	3	2	4	1
(b) Shingle foreshores	1	1	1	3	2	3	1
(c) Lagoons	1	1	0	3	1	2	1
(d) Muddy foreshores	1	1	0	3	1	2	-1
(e) Salt marshes	2	1	0	3	1	3	1
(f) Estuaries	2	1	0	3	1	3	1
(g) Rocky foreshores	1	1	1	3	2	3	0
(h) Mangroves	3	3	1	2	2	5	-1
2. Other benthic marine habitats							
(a) Seagrass meadows	2	2	0	3	2	4	1
(b) Kelp systems	1	1	0	3	1	2	0
(c) Coral reefs	2	3	1	3	3	5	0
(d) Mud bottom	2	2	1	2	2	4	1
(e) Sand and gravel bottom	1	1	1	2	1	2	0
(f) Rocky bottom	1	1	0	1	1	2	0
(g) Other seeps	0	0	0	N/A	1	1	0
3. Pelagic							
(a) Upwelling systems	1	1	0	N/A	1	2	0
(b) Major fronts, circulation currents	1	1	0	N/A	1	2	1
(c) Oligotrophic	1	1	1	N/A	1	2	0

Table 3 Scores of the 41 Habitats of Issue 13 Modification of Ecosystems or Ecotones.

Major concern/issue	Environmental Impact Scores (a)	Socio-economic Impact Scores				Total Scoping Score (a) + (b)	Perception of Future Changes
		Cost Incurred	Health Loss	Reversibility of Damages	Mean Score (b)		
FRESHWATER: Wetland							
1. Peat bogs							
(a) Ombrotrophic bogs	1	1	1	3	2	3	0
(b) Soligenous bogs	1	1	1	3	2	3	1
2. Marshlands							
(a) Marshes	1	1	1	3	2	3	1
(b) Fens	1	1	1	3	2	3	0
(c) Swamps	2	1	0	3	1	3	1
3. Littoral belts alongside lakes and ponds	1	1	1	3	2	3	2
4. Wetlands related to running water							
(a) Riparian belts	2	2	1	3	2	4	1
(b) Springs, rills and flushes	1	1	0	3	1	2	1
(c) Wetlands in estuaries and deltas including tidal rivers	1	2	1	3	2	3	1
5. Periodic waters							
(a) Periodic standing waters with large amplitude fluctuations	2	1	1	3	2	4	1
(b) Periodic standing waters with long period fluctuations	1	1	1	3	2	3	0
(c) Floodplains	2	1	1	3	2	4	1
(d) Rice paddy fields	2	1	0	3	1	3	1
6. Wetlands of saline habitats							
(a) Coastal marshes	2	2	1	3	2	4	1
(b) Brackish reedlands	1	2	1	3	2	3	1
(c) Shoals	1	1	1	3	2	3	1
(d) Foreshores	1	1	1	3	2	3	2
(e) Inland salt marshes	1	2	1	2	2	3	1
FRESHWATER: Open or Running Waters							
1. Running waters (e.g. streams & rivers)							
(a) Fast flowing, stony bottomed	1	1	1	3	2	3	1
(b) Sandy/muddy, flood plain rivers	2	2	1	3	2	4	2
2. Standing waters (e.g. ponds and lakes)							
(a) Oligotrophic	1	2	2	3	2	3	1
(b) Eutrophic	2	2	1	3	2	4	2
(c) Dystrophic	1	1	1	3	2	3	0
MARINE							
1. Coastal margin ecotones							
(a) Sandy foreshores	2	1	0	3	1	3	1
(b) Shingle foreshores	1	1	1	3	2	3	1
(c) Lagoons	2	2	1	3	2	4	1
(d) Muddy foreshores	2	1	0	3	1	3	1
(e) Salt marshes	2	1	1	2	1	3	1
(f) Estuaries	2	1	0	3	1	3	2
(g) Rocky foreshores	1	1	1	3	2	3	0
(h) Mangroves	2	2	0	2	1	3	0
2. Other benthic marine habitats							
(a) Seagrass meadows	2	1	0	3	1	3	1
(b) Kelp systems	1	1	1	3	2	3	0
(c) Coral reefs	2	1	0	2	1	3	1
(d) Mud bottom	2	1	0	2	1	3	1
(e) Sand and gravel bottom	1	0	0	2	1	2	0
(f) Rocky bottom	1	1	0	1	1	2	0
(g) Other seeps	0	0	0	N/A	1	1	0
3. Pelagic							
(a) Upwelling systems	1	1	0	N/A	0	1	0
(b) Major fronts, circulation currents	1	1	1	N/A	2	3	1
(c) Oligotrophic	1	1	1	N/A	2	3	1

Figure 1. Distribution of total scoping scores of 41 habitats in Issues 12 and 13.



5.2 Results of the Detailed Impact Assessment

Shown below are the environmental impact indicators selected to quantify the impacts of the Loss of Mangrove Habitat (Table 4). Following a list of environmental impacts, the workshop selected the indicators that best fit each impact, for example, using PROD 4, changes in the area of macrophyte communities, to quantify the loss of natural productivity. Following the same procedure, Table 5 shows indicators selected for the overexploitation of fisheries and other living resources.

Table 4. Environmental impact indicators selected for Loss of Mangrove Habitat.

Environmental Impact	Indicators
1. Loss of natural productivity	PROD 4 : Changes in the area of macrophyte communities
2. Loss of biodiversity	NEW 1 : Indicator species for mangroves, e.g. fiddler crab, mud crab, duck beak clam
3. Loss of natural storm barriers	HYD9 : Changes in sediment flux HYD13 : Loss of habitat due to erosion
4. Loss of natural protection from erosion	HYD13: Loss of habitat due to erosion
5. Loss of carbon sinks and release of carbon to the atmosphere	PROD4: Changes in the area of macrophyte communities SAT1: Change in the extent of each land cover class satellite derived vegetation index
7. Loss of migratory species using the habitat and altered migratory patterns	BIO13: Species arrivals
8. Impacts of estuarine system changes on adjacent coastal marine ecosystems	BIO1: Changes in macrophyte community structure PAR4: Changes in secchi disk transparency data
9. Loss of filtration and cleansing of pollution	POL14 :Suspended particulate matter in water PAR4: changes in Secchi disk transparency NEW2: Satellite data of suspended solids POL15: Nutrients in water

Table 5. Environmental impact indicators selected for Issue 14 Overexploitation of Fisheries and Other Living Resources.

1. Changes in biological community structure due to overexploitation/depletion of one or more key species	
➤ PROD1	Relative abundance of native species or families compared with historic and current baselines
➤ BIO8	Relative number and distribution (or occurrence) of native species or families compared with historic and current baselines
➤ BIO9	Relative number and distribution (or occurrence) of endemic species or families compared with historic and current baselines
➤ BIO10	Changes in the number and distribution (range) of invasive alien species or families
2. Increasing vulnerability of protected species populations	
➤ FS2	The ratio of current biomass to biomass that supports
➤ FS3	Percentage of stocks modeled that are at or above B_{MSY} (or target)
➤ FS5	Proxy indicators based on fishing pressure
➤ FS6	Number of mammals and seabirds caught by species: per fishery; by area; by year
3. Changes in community structure through restocking and habitat manipulation	
➤ PROD1	Relative abundance of native species or families compared with historic and current baselines
➤ BIO8	Relative number and distribution (or occurrence) of native species or families compared with historic and current baselines
➤ BIO9	Relative number and distribution (or occurrence) of endemic species or families compared with historic and current baselines
➤ BIO10	Changes in the number and distribution (range) of invasive alien species or families
➤ FS3	Percentage of stocks modelled that are at or above B_{MSY} (or target)
➤ FS7	The ratio between maximum sustained yield (MSY), abundance and actual average abundance
4. Ecosystem degradation	
➤ NEW4	Echo Sounding Data
➤ SAT2	Changes in the extent of habitat/community types compared with historic and current baselines
➤ SAT5	Changes in gross habitat fragmentation compared with historic and current baselines
➤ FS1	The ratio of current biomass to virgin biomass for modeled stocks
➤ FS2	The ratio of current biomass to biomass that supports
➤ BIO1	Changes in macrophyte community structure
5. Changes in biological communities through deliberate and accidental introductions	
➤ BIO10	Changes in the number and distribution (range) of invasive alien species or families
➤ PROD3	Changes in the abundance of invasive alien species or families

6. GENERAL COMMENTS AND SUGGESTIONS

6.1 Scoping Methodology

In general the workshop felt that the concept of scoping methodology is straight forward and understandable. However, certain areas in the methodology may still need some technical revisions. The first major problem encountered during the exercise was linguistic difficulty. English language was adopted as official language for the workshop while the participants from four countries normally used four different languages. It was not an easy task to make all participants clearly understand the context of the GIWA Issues and go through the assessment in the same direction using the second language. This problem must not be neglected when the actual assessment takes place worldwide. The workshop recommended that the methodology must be translated into local languages as many as possible in order to overcome such language barrier.

With different background and expertise, the participants can interpret one issue very differently regardless of what language they use. As experienced during the workshop, for instance, the participants with expertise in economics found it difficult to understand what *ombrotrophic bog* was. Therefore, the methodology must be revised to make the language simple as much as possible. When using technical or scientific terms, clear meanings must be given with examples where applicable. In addition to text description of habitats, it was also suggested that illustrations of habitats be added to give graphical definitions of the habitats and clarify any confusion that occurs when using only text description.

Validity and reliability of scoping result can be questionable. It is obvious that it does take more than expert opinion to accurately score the environmental and socioeconomic impacts. It is due to the fact that criteria used to determine the scores involve actual values or percentage especially for the three proxy indicators for the socioeconomic impacts. For instance, one environmental impact criterion of Score 3 of Issue 1 says *annual 5-year mean discharge of a river <50% of long term mean*, which means that the experts must already know the values of the annual discharges for 5 years period and long term mean discharge. For the three socioeconomic impact indicators, Cost Incurred, Health Losses, and Reversibility of Damages, it inevitably requires that the experts have data on annual cost, expenditures, illness cases, or which Source Area contributes to which Issue. It is impossible for the experts to know all of the required information to give accurate scores. Therefore, it must be added in the methodology protocol that the experts must bring the data or information to the meeting to back up their decision in scoring as oppose to base their decision solely on their opinion. Another suggestion is that the environmental impact criteria can be expressed in qualitative way instead of quantitative value. In doing so, the actual data may not be necessarily required at the scoping stage.

Another concern raised during the meeting was that the methodology tends to focus only on the negative impacts of the Issues rather than both sides of a coin. That is, some Issues can be positive or benefits. For example, modification of mangrove habitat for aquaculture purposes clearly has ecological ramifications on other ecosystems or food chains, but, at the same time, such industry generates economic benefits and provides food security. The question is how do we justify both kinds of impacts in the methodology context. Should negative impacts be compromised by positive impacts?

Concerning the environmental and socioeconomic impacts scoring, the testing results showed that scores came out closely together. As a consequence, it was difficult to identify which Issue has distinctively higher or lower priority. It was possibly due to the fact that the range of environmental impact scores (0 to 3) and the values set for socioeconomic indicators are probably too low. The environmental impact scores may need more level (e.g. score 4) added to increase distinction between scores. The value ranges for the cost incurred are also set very low and need some adjustment as well. There is no need to increase a score level but it can be simply done by scaling up the values, such as from 900 to 1,500, or from 3,600 to 5,000.

Some participants felt that it was very difficult to determine the score of Health Losses indicator as in some cases the connection between illness and Issue may not be conclusive enough to confirm that such illness cases or death are caused by the Issue. For example, it is easily determined how many deaths are caused by paralytic shellfish poisoning in one extreme event, but it would be very difficult to estimate numbers of death or illness cases caused by consuming contaminated water supplies over a period of 10 years time. Further, it cannot be easily proven that those deaths are entirely caused the contamination or there may be other underlying factors involved. In some cases that can establish a strong connection between the causes and consequences, records may not even exist or widely available.

In the case of Issues 12 and 13, it is very difficult to relate each habitat with health losses measure, e.g. hydrothermal vents and health loss? Therefore, it may not be worth exploring the health losses indicator in the socioeconomic impact measure at all for these two Issues. Moreover, some of the habitats appear relevant to neither cost incurred nor reversibility of damages, e.g. ocean trenches, gyres. Even if a value for Cost Incurred indicator could be found, it may represent the cost incurred for several habitats altogether instead of one single habitat. In other word, the existing economic data do not correspond with the habitats categorized in the methodology. For example, it is impossible to acquire data on the cost spent to manage only *Fast Flowing, Stony Bottomed Habitat*, but it is possible to get access to data on the management cost of *Streams or Rivers*. That means, the current category of habitats must be revised or even reduced for practicality of the assessment.

According to the methodology, to determine the socioeconomic impact score of an aquatic system that combines several countries, the maximal score of all country scores is taken to represent the aquatic system. This method may not well reflect the real situation of such system in the case that most countries give the same score and only a few give higher score. That is, the higher score will be automatically selected for that system. The problem rises when comparing such score to the other system that most countries do give that same higher score. To show in number, suppose five countries within System A score 2, 2, 2, 2, and 1; while System B get scores of 1,1,0,1, and 2. Total scores for each system will come out as 2. That means the severity of the problem in those two systems are clearly not equal, but both scoring results come out the same. When such condition occurs, validity of the assessment is questionable. It may be suggested that the mean of all scores be used instead of the maximum. Another case is when many countries within the system cannot be equally weighed due to their geographical coverage. The score can be overestimated when a smaller country gives a higher score compared to other countries that share a larger geographical proportion within the system. That is, the severity of the Issue is rather localized than regional and the score should be lower.

According to the methodology, the reversibility of damages proxy indicator is defined as a measure of population pressure on the assumption that a growing human population will tend to increase demands on the environment. The value of this indicator is derived from the forecast population growth in the Source Area, which is identified as the geographical area where is situated the social and/or economic activity giving rise to an Issue. It may be easy to see that the overexploitation of marine fisheries in Country A is result of increasing for seafood for growing population in Country B, which is then identified as a *Source Area*. However, for certain Issues the population pressure in the source area may have less influence than other factors such as policy, regulations, or technology. For example, suppose the industries in country C located upstream pollutes the river that runs downstream to country D. When assessing the reversibility of damages of country D for the *Chemical Pollution Issue*, country C will be identified as a source area, possibly with country D itself. However, this does not necessarily mean that the population of country C is the absolute pressure of the Issue. Factors such as regulations on waste water treatment or water treatment technology in Country C may play more important role than the country's population. That is, the reversibility of damages indicator can be meaningless in this case or even falsify the scoping result. Nevertheless, some may argue that the linkage does not end at country C, but instead it continues to country E, and so on, where the demands for the industrial products originate. If following this logic, such chain of demands can continue endlessly and the assessment will get unnecessarily complicated. To avoid such complications, the methodology must confine a scope of this proxy indicator how far it could go, or even reconsider including this indicator as one of the socioeconomic impact indicators at all.

Another fundamental question is that the methodology does not clearly determine how to make the valuation of socioeconomic score in case that one or more proxy indicators becomes zero. The result will come out very different if we add or exclude the zero value(s). For example, in a case of *Upwelling Systems Habitat*, it is obvious that this system is a natural phenomenon and cannot be under influence of any human activities or population pressure, therefore, the *reversibility of damages* score must be 0, while the *Cost Incurred* and *Health Losses* indicators may receive a non-zero score, say 2 and 1, respectively. The socioeconomic impact score of this habitat can be 1 ($= [2+1+0]/3$, slight impact) or 2 ($= [2+1]/2$, medium impact) depending on whether the reversibility of damages indicator is included in the calculation or not. This is not a trivial problem as the calculation could go either way depending on the assumption behind.

6.2 Detailed Environmental Impact Assessment

As mentioned, the workshop decided to follow the list of environmental impacts given in the methodology as a guideline for the indicator selection. The participants found it more practical and less time consuming than randomly picking the indicators from a long list. This helped narrow down the scope and give more focus on the issue. However, a problem arising after selecting the environmental impact indicators was that the most appropriate indicators selected may not be best available or even exist. The methodology requires that data be time-series over at least ten years time. Such data can be scarcely available. To avoid looking for non-existing data, the experts must consider the data availability as well as appropriateness of data. The experts must identify the sources of the selected indicators especially local sources.

6.3 Comments on Workshop Protocol

The selection of experts is obviously a very critical process especially for the scoping methodology. The experts must be carefully selected because the scoping methodology relies entirely on the opinion of experts rather than the actual data, unless the participants are required to acquire some information before coming to the workshop. Therefore, it is possible that the GIWA Issues can be mistakenly prioritized based on just opinion, and, thus, the entire assessment will be questionable.

The scoping methodology strongly requires experts with broad knowledge in different aspects of water issues including diverse physical environments, geographical settings, and their multidisciplinary and multinational elements. Such experts are, however, scarce in this region. Therefore, we attempted to bring together a mix of participants with different expertise and nationalities. By using a reply form to acquire personal information of each expert, the test team based its decision on such information for the expert selection. The reply form was proven to be a useful way to get first-hand information of the experts.

However, scarcity of regional experts in specific fields was still a problem. Due to a limited number of applicants to choose from, the balance of fields and expertise was not met as planned. Both workshops were dominated by natural scientists with only a few experts in social science, and there were more marine scientists compared to freshwater experts.

If the individual scoring was to be adopted, weighing mechanism must be thoroughly planned. In our exercise, we weighed each score equally regardless of the country or discipline of the participant. In terms of difference among countries, weighing could be done based on, for example, the country's land and sea area within the system, country's population, or combination of different factors. With respects to differences in expertise, environmental impact scores each given by an environmentalist and a socioeconomist may not be weighed equally, for example.

As mentioned, manual and workshop materials were sent to all participants prior to the meeting. It was intended to familiarize experts with the Issues and methodology. Moreover, in case that experts were not familiar with some Issues, they would still have time to look for information to back up their decision in scoring as oppose to giving out scores based on no data. To enhance the accuracy of the scoping, this could be an essential part to be added when doing the actual assessment. It may be made mandatory for experts to look for back-up information and bring it to the scoping workshop in order to help making decision.

ANNEXES

Annex 1. Agenda of the Gulf of Thailand GIWA Methodology Testing

June 28th, 2000

6:30 – 10:00 PM Dinner reception hosted by GIWA Pilot Methodology Testing Team

Day 1: June 29th, 2000

9:00 – 9:30	Registration
9:30 – 10:15	Opening and Introduction to GIWA
10:15 – 10:30	Coffee Break
10:30 – 11:20	GIWA Methodology: Scoping, Detailed Impact Assessment
11:20 – 12:00	Scoping Exercise on Issue 14: Over-exploitation
12:00 – 1:30	Lunch
1:30 – 2:00	Scoping Exercise on Issue 15: Excessive by catch and discards
2:00 – 2:30	Scoping Exercise on Issue 16: Destructive fishing practices
2:30 – 3:00	Scoping Exercise on Issue 17: Decreased viability of stock through pollution and disease
3:00 – 3:30	Coffee Break
3:30 – 4:00	Scoping Exercise on Issue 18: Impact on biological and genetic diversity
4:00 – 4:30	Scoping Exercise on Issue 12: Loss of ecosystems or ecotones
4:30 – 5:00	Scoping Exercise on Issue 13: Modification of ecosystems or ecotones, including community structure and/or species composition

Day 2: June 30th, 2000

9:30 – 10:00	Scoping Exercise on Issue 1: Reduction in stream flow
10:00 – 10:30	Scoping Exercise on Issue 2: Pollution of existing supplies
10:30 – 11:00	Scoping Exercise on Issue 3: Lowering of water table
11:00 – 11:15	Coffee Break
11:15 – 11:45	Scoping Exercise on Issue 4: Microbiological Pollution
11:45 – 12:15	Scoping Exercise on Issue 5: Eutrophication (harmful algal blooms)
12:15 – 1:30	Lunch
1:30 – 2:00	Scoping Exercise on Issue 6: Chemical Pollution
2:00 – 2:30	Scoping Exercise on Issue 7: Suspended solids
2:30 – 3:00	Scoping Exercise on Issue 8: Solid wastes
3:00 – 3:30	Coffee Break
3:30 – 4:00	Scoping Exercise on Issue 9: Thermal Pollution
4:00 – 4:30	Scoping Exercise on Issue 10: Radionuclide
4:30 – 5:00	Scoping Exercise on Issue 11: Spills

Day 3: July 1st, 2000

9:00 – 10:30	Summary of results on all issues
10:30 – 11:00	Coffee Break
11:00 – 12:00	Recommendations and plan for the 2 nd Workshop
12:00 – 1:00 PM	Lunch and meeting adjourns

Detailed Impact Assessment Meeting

Day 1: July 1st, 2000

2:30 – 3:30 PM	Detailed Impact Assessment of Issue 12: Loss of Ecosystems or Ecotones
3:30 – 5:00 PM	Detailed Impact Assessment of Issue 14: Over-exploitation of Fisheries and Other Living Resources

Day 2: July 2nd, 2000

9:00 – 12:00 AM	Summary of Detailed Impact Assessment Session
12:00 – 1:00	Lunch
	Meeting adjourns

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