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An Evaluation of the Modular Approach to the Assessment and Management of Large Marine Ecosystems*

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ABSTRACT

This contribution discusses the modular approach to the assessment and management of large marine ecosystems (LMEs). It addresses the contents and functions of the five modules; the key elements and processes of the Transboundary Diagnostic Analysis (TDA), Strategic Action Program (SAP) and National Action Plan (NAP) in the LME context; the principal common problems facing LMEs and their causes identified in TDAs and action plans formulated in SAPs, as the results of the practical application of the modular approach in LME projects. It also evaluates the significance of the modular approach for international ocean governance. It concludes that this integrated, ecosystem-based approach has rectified some deficiencies of the traditional sectoral approaches and has improved the understanding of LMEs and their management regimes. As a result the integrated, ecosystem-based approach is increasingly being endorsed in international governance of LMEs.

It is the current worldwide practice for large marine ecosystem (LME) projects to adopt an integrated, ecosystem-based approach to the assessment and management of the marine environment and resources.¹ The core of this approach is the application of a five-module assessment and management methodology to the processes of formulation and implementation of the Transboundary Diagnostic Analysis (TDA), Strategic Action Program (SAP), and National Action Plan (NAP). In view of the importance of LMEs to the global environment and socioeconomics, the approach to managing LMEs has significant effects not only on the LMEs themselves, but also on the densely populated human communities that rely on them. Research into this innovative approach to LMEs, which is being used increasingly by LME projects worldwide, has significant practical value. This article discusses and analyzes the latest methodological developments in the assessment and management of the marine environment and resources at the scales of large marine ecosystems (LMEs) and the application of these methodological developments in the LME projects. It examines the key elements and the processes of the modular approach, investigates its practical application, and evaluates its significance for international ocean governance.

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¹ For an in-depth discussion, see Hanling Wang, "Ecosystem Management and Its Application to Large Marine Ecosystem Management: Science, Law, and Politics," *Ocean Development and International Law*, 35:41-74(2004)

THE FIVE MODULES

The five linked modules for the assessment and management of LMEs have been defined and illustrated by Dr. Kenneth Sherman, *et al.*² and can be summarized as follows.

1) *Productivity module.* This module focuses on an LME's "carrying capacity"³ for supporting fishery resources. Its measuring parameters are mainly photosynthetic activity, zooplankton biodiversity and oceanographic variability.⁴ In this module, systematic measurements are made to monitor and assess the status and changes of these elements. The information obtained not only reflects the natural conditions of an LME, but also indicates the eutrophic impacts on it.

2) *Fish and fisheries module.* The focus of this module is on the changes of biodiversity of fish communities, which not only have impacts on fisheries in an LME, but also affect other components of the ecosystem. In this module, systemic surveys are conducted to obtain information on "changes in biodiversity and abundance levels of the fish community"⁵ as well as their causes.

3) *Pollution and ecosystem health module.* This module deals with marine pollution, which is a major cause of the degradation and deterioration of the environment and resources in LMEs.

² See A.M. Duda and K. Sherman, "A New Imperative for Improving Management of Large Marine Ecosystems," *Ocean and Coastal Management*, 45 (2002): 797-833; K. Sherman, "Modular Approach to the Monitoring and Assessment of Large Marine Ecosystems," in *The Gulf of Mexico Large Marine Ecosystem: Assessment, Sustainability, and Management*, ed. H. Kumpf, K. Sreidinger and K. Sherman (Malden, MA: Blackwell Science, 1999), 34; K. Sherman and A.M. Duda, "An Ecosystem Approach to Global Assessment and Management of Coastal Waters," *Mar Ecol Prog Ser* 190 (1999): 271-287; K. Sherman and A. Solow, "Modular Strategies for Assessing the Changing States of Large Marine Ecosystems," *ICES C.M.* (1996):2; K. Sherman, "Why regional coastal monitoring for assessment of ecosystem health?" *Ecosystem Health* 6(3), (2000): 205-216; K. Sherman, "Marine Ecosystem Management of the Baltic and Other Regions," *Bulletin of the Sea Fisheries Institute*, Gdynia, Poland, 3 (151), (2000): 89-99; K. Sherman and A.M. Duda, "Large Marine Ecosystems: An Emerging Paradigm for Fishery Sustainability," *Fisheries Management*, 24 (12), (1999):15-26; K. Sherman, "Large Marine Ecosystems: Assessment and Management from Drainage Basin to Ocean," paper presented at the Joint Stockholm Water Symposium / International Center for the Environmental Management of Enclosed Coastal Seas (EMECS) Conference in August 1997; K. Sherman, "Large Marine Ecosystems: Assessment and Management," in *Large Marine Ecosystems of the Pacific Rim: Assessment, Sustainability, and Management*, ed. Q. Tang and K. Sherman, (Malden, MA.: Blackwell Science, 1999), 445-448; K. Sherman, "Food Webs: Large Marine Ecosystems," in *Encyclopedia of Ocean Sciences*, ed. J. Steele, S. Thorpe, and K. Turekian (London: Academic Press, Ltd. 2001), 1462-1469; K. Sherman, *et al.*, "The U.S. Northeast Shelf Large Marine Ecosystem: Zooplankton Trends in Fish Biomass Recovery," in *Large Marine Ecosystems of the North Atlantic: Changing States and Sustainability*, ed. K. Sherman. and H.R. Skjoldal (Amsterdam: Elsevier Science, 2002), 197-211; C. Ibe and K. Sherman, "The Gulf of Guinea Large Marine Ecosystem Project: Turning Challenges into Achievements," in *The Gulf of Guinea Large Marine Ecosystem: Environmental Forcing & Sustainable Development of Marine Resources*, ed. J.M. McGlade, *et al.*, (Amsterdam: Elsevier Science, 2002), 27-39; and K. Sherman, "A Modular Approach to the Monitoring and Assessment of Large Marine Ecosystems," *ICES C.M.* (1997) EE:15, 1-12.

³ D. Pauly and V. Christensen, "Primary Production Required to Sustain Global Fisheries," *Nature*, 374 (1995): 257.

⁴ Sherman, "Large Marine Ecosystems: Assessment and Management," *supra* note 2, at 445.

⁵ *Ibid.*

The monitoring and assessment of “the changing status of pollution and health of the entire LME”⁶ are conducted in this module. Systemic monitoring of data on water quality and biological indicator species are used to measure pollution effects on the ecosystem and detect emerging disease. The state of the health of LMEs is examined on the basis of indices of ecosystem “biodiversity, stability, yields, productivity, and resilience.”⁷

4) *Socioeconomic module*. This module addresses the human dimensions of LMEs. It mainly investigates the state of socioeconomic developments of the human communities connected to LMEs, especially the industries and human activities that are closely related to, or depend on, the LMEs. The output of this module is the social science-based, socioeconomic information of LMEs.

5) *Governance module*. The governance regimes for LMEs are formulated mainly on the basis of the information obtained from the above four modules as well as international rules and systems embraced in relevant global and regional agreements applicable to the areas concerned. Policy, legal, and institutional reforms are made, and other measures are taken at the regional and national levels to improve the governance of the LMEs. The guiding principle of an LME governance regime is the adoption of a holistic, ecosystem-based approach to the management and protection of the marine environment and resources. Attaining this requires the integration of scientific findings with socioeconomic considerations in the management of LMEs. Accordingly, an LME’s management plans are developed and evaluated not only on the basis of scientific findings, but also on the socioeconomic elements of the human communities concerned, amongst other things, including their socioeconomic conditions and the socioeconomic impacts of management measures. Mechanisms for integrated management are established with a view to harmonizing the interest of marine environmental resource protection and the long-term socioeconomic benefits of the coastal communities concerned. The governance module, a work-in-progress, is to be based on international experiences gained from LME projects and integrated coastal and ocean management. The trend of the LME governance module is to move away from traditional sectoral, single species approaches to a more holistic, integrated approach to marine management. The general goal is to promote the long-term sustainability of marine ecosystem resources.⁸

Three of the modules (productivity, fish and fisheries, pollution and ecosystem health) focus on the natural state of ecosystems, the outcome of which is science-based information on LMEs. The fourth module (socioeconomics) concentrates on human dimensions, designed to produce social science-based information on LMEs, while the last module (governance) is designed or seeks to adjust human behaviours towards LMEs, and improve the relationship between human society and LMEs. Clearly, all these modules and their components

⁶ *Ibid.*, at 446.

⁷ *Ibid.*

⁸ See generally the material in *supra* note 2 and see also L. Juda, “Considerations in Developing a Functional Approach to the Governance of Large Marine Ecosystems,” *Ocean Development and International Law*, 30 (1999): 89-125 and L. Juda and T. Hennessey, “Governance Profiles and the Management of the Uses of Large Marine Ecosystems,” *Ocean Development and International Law*, 32 (2001): 43-69. For more information on the five modules, see: <http://www.edc.uri.edu/lme/intro.htm>.

interrelate and interact with each other.⁹ The first four models support the Transboundary Diagnostic Analysis (TDA), while the governance module is mainly associated with the Strategic Action Plan (SAP).¹⁰ The adoption of the five modules in the TDA-SAP-NAP processes not only integrates science and socioeconomic elements with management regimes,¹¹ but also promotes the involvement and collaboration of scientists, managers, stakeholders and the public in LME regime building and implementation.¹² Together the modules facilitate the comprehensive assessment and integrated management of LMEs.

TRANSBOUNDARY DIAGNOSTIC ANALYSIS (TDA)

Definition

Transboundary Diagnostic Analysis (TDA) is a scientific and technical assessment of the environment of an international ocean area. TDA identifies, quantifies, analyzes, and assesses the water-related environmental issues and problems, their causes and impacts in the environmental, socio-economic, legal, political and institutional context at the national, regional and global levels. It normally also identifies and prioritizes solutions to the problems as well as the root causes of the problems.¹³

The identification of the elements that are of transboundary character and the linkages between the problems and their causes is crucial in the TDA process.¹⁴ In the context of TDA,

⁹ See *A Framework for Monitoring and Assessing Socioeconomics and Governance of Large Marine Ecosystems*, NOAA Technical Memorandum NMFS-NE-158, ed. J. Sutinen, 2000, at 3, online at: <http://www.nefsc.noaa.gov/nefsc/publications/tm/tm158/tm158.pdf>.

¹⁰ See K. Sherman and A. M. Duda, "An Ecosystems Approach to Global Assessment and Management of Coastal Waters," in *Baltic Sea Regional Project: Project Implementation and Procurement Plan*, Volume 2, Part A, ed. J. Thulin, June 2002, Annex 6, at 27, online at: http://www.ices.dk/projects/balticsea/unzip/vol.2_A_1.doc.

¹¹ In this connection, Duda and Hennessey, *supra* note 8, at 49 point out:

Ecosystem-based management needs the integration of contributions and inputs from both the natural and social sciences. Fundamentally, the natural sciences can provide an understanding of the functioning of natural systems, the relationship and dynamics of system components, and the impacts of human use on the operation and changing states of those natural systems. They may also be able to suggest the human use implications of system changes. On the social science side, the focus is on use management and efforts to modify use patterns to advance purposes such as system sustainability.

¹² See K. Sherman, "Large Marine Ecosystem Monitoring, Assessment, and Management across the global North-South divide," a paper presented at The Global Environment Facility Second Biennial International Waters Conference, Dalian, China, September 25-29, 2002, at 24, online at: <http://www.iwlearn.net/event/presentations/iwc2002/agenda.php>. (hereinafter "2002 Dalian Conference web site").

¹³ See *The Benguela Current Large Marine Ecosystem Transboundary Diagnostic Analysis (BCLME TDA)*, October 1999, online at: <http://www.bclme.org/resources/>; *The Yellow Sea Large Marine Ecosystem Preliminary Transboundary Diagnostic Analysis (YSLME TDA)*, February 2000, at 7, online at: http://www.gefweb.org/COUNCIL/GEF_C15/WorkProgram.htm (C-21, Part IV); *Transboundary Diagnostic Analysis for the Caspian Sea (Volume Two)*, The Caspian Environment Programme, Baku, Azerbaijan, September, 2002, at 1, online at: http://www.grida.no/caspian/additional_info/Caspian_TDA_Volume_Two.pdf; and *Transboundary Diagnostic Analysis for the South China Sea*, 2000, at 2, online at: <http://www.unepscs.org/Publication/PDF-B/PDF-B.htm>.

¹⁴ *International Waters Managers' Insights Regarding the Global Environment Facility (GEF) International Waters Program Study: Transboundary Analysis, Demonstrations, Sustainability and Lessons Learned*, ed. Al Duda, et al, September, 2002, at 9, online at: <http://www.iwlearn.org/ftp/GEF-IW-MGRS-2002-IWPS.pdf>.

transboundary means crossing national maritime boundaries. Thus, transboundary environmental issues include, *inter alia*:

Regional/national issues with transboundary causes/sources; transboundary issues with national causes/sources; national issues that are common to at least two of the countries and that require a common strategy and collective action to address; and issues that have transboundary elements or implications (e.g. implications of fishery practices on biodiversity/ecosystem resilience).¹⁵

TDA identifies the transboundary nature, magnitude, and impacts of the various issues and problems pertaining to water quality, marine resources, biodiversity, habitat degradation, and their root causes, involving socioeconomic problems, policy distortions and institutional deficiencies.

The purpose of conducting a TDA is to assess and scale environmental disturbances and threats to LMEs, and their sources and causes, both immediate, intermediate, and root. It provides information relating to the changing states of LMEs and the causes of their degradation. The goal of a TDA is to provide a sound scientific, technical and factual basis on which to formulate a Strategic Action Plan (SAP) that adopts optimal, cost-effective actions to redress the environmental degradation of LMEs. International experience shows that undertaking TDA prior to the design of a SAP is appropriate and helpful for LME projects.

Process of the TDA

The contents of a TDA process can be classified into two major parts. The first part is a fact-finding process identifying the major perceived problems and their root causes and the second part is an evaluation of the intervention options to deal with the perceived problems.

As regards the fact-finding process and the identification of the major perceived problems, "perceived" problems represent "concerns that may not have yet been identified or proved to be major problems due to data gaps or lack of analyses, and concerns regarding major threats of future degradation conceived in the context of prevailing trends."¹⁶ The major perceived problems of LMEs are normally generic in nature, e.g., pollution of the marine environment and deterioration of marine living resources. However, the extent of such problems in each LME varies. Therefore, the TDA for each LME needs to address the scale of the problems specific to that LME, especially those problems of a transboundary nature in both national jurisdictional areas and international waters.¹⁷

The next step is tying the problem to its cause. The immediate, intermediate and root causes of the identified issues and problems are investigated. The investigation and analysis should not be limited to the natural environment domain, but move through the chain of cause and effect to the root causes in the management, socioeconomic, legal, and cultural domains.¹⁸ The causal

¹⁵ See "Users Guide to the Transboundary Diagnostic Analysis," in the BCLME TDA, *supra* note 13.

¹⁶ J. M. Bowers, *An Evaluation of the Transboundary Diagnostic Analysis (TDA) Approach to the Preparation of Strategic Action Programs (SAPs)*, *International Waters Program Study*, (report to the Global Environment Facility), Annex 8, at 11.

¹⁷ *Ibid.*

¹⁸ John Pernetta, *Working Together: Transboundary Diagnostic Analyses (TDA), Strategic Action Programmes (SAP), and Participatory Processes*, available at 2002 Dalian Conference web site, *supra* note 12.

chain analysis identifies the linkages between human activities and their environmental effects, especially their transboundary consequences, which facilitates the identification of the options for restorative and preventative interventions.

The second part of the TDA process is an evaluation of the options for intervention. Although this can be conducted in the subsequent SAP process, it may also be part of the TDA process. The idea is to assess the net benefits of each of the options for intervention and its possible adverse effects on the natural environment and socioeconomic development since each intervention has costs and benefits. The costs include not only financial costs, but also adverse effects on the environment, resources and socio-economics. Accordingly, various possible interventions should be assessed and compared in order to single out the one that can offer the greatest net benefits in relation to costs and other adverse effects on the communities concerned in the context of the prevailing technical, socioeconomic and political conditions. The results of this assessment allow the incorporation of the optimal interventions in the Strategic Action Plan (SAP).

After the identification of the optimal interventions, the next step in the TDA process is to prioritize the areas for intervention. While each LME has its own priority areas for intervention, the following imminent threats to international waters are considered by the Global Environment Facility (GEF) as priorities for prevention and control: 1) land-based sources of pollution, especially persistent toxic substances, heavy metals and common contaminants such as nutrients, biological contaminants, or sediments; 2) land degradation where transboundary marine environmental concerns result from desertification or deforestation; 3) degradation and modification of critical habitats; 4) unsustainable use of marine resources; 5) ship-based sources of chemicals and alien species. With regard to the methods for addressing the problems, priority will be given to holistic, rather than sectoral, approaches to the management and prevention of these environmental threats.¹⁹

The final step of the TDA process is to further specify the circumstances pertaining to each action area, including a detailed description of the action areas, relevant data and information, contemporary knowledge and gaps in the understanding of the problems and options for intervention.²⁰

In the conduct of a TDA, a number of considerations exist. First, a TDA requires a holistic and multisectoral consideration of the issues and problems of LMEs. The effective participation of the sectors that create stresses on LMEs, stakeholders and the public, is an important component of the TDA and the consequent SAP process. As such, the TDA process is a valuable vehicle for “multilateral consultation and exchanges of perspectives and constraints.”²¹

Second, a TDA is to be prepared and agreed upon jointly by the science and management communities as well as other stakeholders in each collaborating country. The TDA process involves work at both the national and regional levels. It is necessary to gather information on

¹⁹ *Operational Strategy of the Global Environment Facility*, Chapter 4, International Waters, online at: <http://www.gefweb.org/public/opstrat/ch4.htm>.

²⁰ Bewers, *supra* note 16, at 11-13. For an example of this part of the TDA, see the Yellow Sea LME TDA, *supra* note 13, at 32-91.

²¹ *International Waters Managers Insights*, *supra* note 14, at 24-25.

relevant issues and problems as well as their causes within national boundaries. An interministerial committee is normally established in each collaborating state to deal with the national elements of the TDA and the consequent SAP, and develop the National Action Plan (NAP). National environmental plans and documents are used to identify environmental priorities. The analysis of the causes of degradation and the subsequent remedial actions and capacity building should take into consideration national economic development plans, sectoral economic policies, and other relevant legislation and policy.

The TDA needs to be conducted on a multilateral basis involving all the states concerned because the issues and problems of LMEs normally have their origins and consequences beyond the boundaries of individual states. Furthermore, the evaluation of options for intervention has to be conducted at the regional level, especially where the effective implementation of interventions requires international cooperation, and where national interventions have potential effects on other countries sharing the same LME.

A last consideration is that the geographical scope of the regional TDA should cover the whole LME and its basins,²² although some specific problems can be identified in a narrower geographical scope. On the one hand, it is essential to examine linkages among coastal zones, LMEs, and their contributing freshwater basins so that the root causes in upstream basins can be considered in the subsequent integrated management plans.²³ On the other hand, specific problems and their causes in sub-areas and priority hotspots may be geographically identified within the LME so that complex transboundary issues can be divided into “smaller, manageable geographic ones.”²⁴ In this manner, different issues in

²² The justification for a regional and holistic approach to the TDA is well described in some LME TDAs and is worth reproducing.

Conducting a comprehensive transboundary diagnostic analysis is only possible if an entire water basin or Large Marine Ecosystem and its associated drainage basin is covered under the study. This is required in order that the interactions between the aquatic, terrestrial, and human sub-systems are identified in so far as they are linked through the mechanism of the hydrological cycle. More particularly, the impacts of the land-based activities on water resources and their contribution to water-related environmental stresses can be demonstrated only if all sources, sinks, and shared marine resources are included in the assessment. This successful demonstration requires the commitment of all the countries that are located in the catchment basin or surround the shared marine area to participate in the process (from Yellow Sea Large Marine Ecosystem (YSLME) TDA, *supra* note 13 at 9).

See, for example, the YSLME TDA, *supra* note 13, at 9 and Annex 11 of the Caspian TDA, June 1998, at 60, at: www.gefweb.org/wprogram/Oct98/UNDP/caspanex.doc. In the Yellow Sea LME project, although North Korea has not fully participated, it has been actively involved in other related projects and activities concerning marine environmental protection in the region, and its government has indicated that it may participate in the YSLME project at a later stage. See paragraph 44 of *The Project Brief of the YSLME Project*, at 8 and 15, online at: http://www.gefweb.org/COUNCIL/GEF_C15/WorkProgram.htm. (C-21, Part II).

The early phase of the Guinea Current LME (GCLME) Project covered only six countries out of the sixteen countries bordering the GCLME. The GCLME project managed to attract a full participation of all the littoral countries in a later stage. See Edwin P. D. Barnes, “*Large Marine Ecosystems and Coasts: Experiences and Lessons Learned: GEF-UNDP-UNIDO Industrial Water Pollution Control In the Gulf of Guinea Large Marine Ecosystems*,” at 8-9, available at 2002 Dalian Conference web site, *supra* note 12.

²³ Alfred Duda, “*Monitoring and Evaluation Indicators for GEF International Waters Projects (2002)*,” Monitoring and Evaluation Working Paper 10, November, 2002, at 4, online at: http://www.gefweb.org/ResultsandImpact/Monitoring_Evaluation/Evaluationstudies/M_E_WP_10.pdf.

²⁴ *Background Paper – GEF International Waters Focal Area*, para. 3, online at: <http://www.wfeo-comtech.org/ConferenceOutcomes/GEFWatersWorkshop/item18.html>.

different portions of an LME and its basins can be addressed by geographically specific actions.

Major common problems of LMEs and their causes identified in TDAs

LME case studies show that almost all LMEs suffer from degradation and deterioration of the natural environment and resources. According to the modular-approach-based TDAs, common problems of LMEs are: major declines in commercial fish stocks and non-optimal harvesting of marine living resources; deterioration of water quality both chronic and catastrophic; modification to seabed and coastal zones; habitat destruction and alteration; loss of biotic integrity and decline in biodiversity; loss of endangered species and their genomes; and harmful algal blooms.²⁵

The root causes are the same for a large number of these problems: overfishing; climate regime shifts; and pollution and eutrophication.²⁶ Other causes include alterations of physical habitat and invasions of exotic species.²⁷ Furthermore, indirect causes are deficiencies and shortages in law, policy, institutions, economy and technology. For example, in the Benguela Current Large Marine Ecosystem (BCLME), causes are identified as: poor legal frameworks; inadequate implementation of existing legislation; inadequate capacity development (human and infrastructure) and training; inadequate planning at all levels; insufficient public involvement; and inadequate financial mechanism and support.²⁸

THE STRATEGIC ACTION PLAN (SAP)

Definition and Process

In the context of coastal and ocean management, a Strategic Action Plan (SAP) is a regional framework for actions to manage and protect the coastal and marine environment and resources. In international LME projects, an SAP is an instrument agreed among the collaborating countries, which contains a series of policy, institutional and other socioeconomic actions to be taken at both the national and regional levels aimed at enhancing

²⁵ See Benguela Current LME TDA, *supra* note 13; *Project Brief of the YSLME Project*, Annex A Incremental Cost Analysis, *supra* note 16, at A-1; *A Transboundary Diagnostic Analysis and Strategic Action Programme for the Gulf of Mexico Large Marine Ecosystem*, at 2, online at:

<http://www.gefonline.org/projectDetails.cfm?projID=1346>; M. J. O'Toole, "Benguela Current Large Marine Ecosystem Programme: Experiences and Some Lessons Learned," at 2, available at 2002 Dalian Conference website, *supra* note 12, or <http://www.bclme.org/resources/>; and "Gulf of Guinea Project," online at: <http://edu.eforie.ro/carmensylva/iwlearn/guinea.html>. See also Barnes, *supra* note 22, at 1-2.

²⁶ *Large Marine Ecosystem (LME) Approach to the Global International Water Assessment (GIWA)*, Working Document of the Technical Workshop for Establishing a Regular Process for the Global Assessment of the Marine Environment, Bremen, Germany, 18-20 March, 2002, online at: http://www.unep.org/DEWA/water/MarineAssessment/reports/germany_report/LME-GIWA.doc.

²⁷ See Global Environment Facility, *Operational Strategy* (Washington, D. C., February 1996), 47 and *Operational Strategy of the Global Environment Facility*, Chapter 4, International Waters, *supra* note 19. See also M. E. Huber, *et al.*, "Priority problems facing the global marine and coastal environment and recommended approaches to their solution," *Ocean and Coastal Management*, 46 (2003): 479-485 and *Jakarta Mandate: Marine and Coastal Biodiversity – Introduction*, at: <http://www.biodiv.org/programmes/areas/marine/>.

²⁸ See the Benguela Current LME TDA, *supra* note 13 and O'Toole, *supra* note 25, at 2.

the management of the environment and resources of the LME concerned.²⁹ The SAP is to be based on the output of the TDA. In accordance with the priority transboundary concerns and their root causes identified in a TDA, the countries concerned are to collaboratively determine the specific actions that they will take collectively or individually to resolve the identified problems. Normally, these action plans are developed by each collaborating country, often through a national interministerial committee with participation by relevant stakeholders. Then a multinational committee compiles and harmonizes these plans and formulates an SAP for endorsement at the highest levels in governments.³⁰ The SAP for an LME is a political commitment of the governments concerned to accept agreed management principles and to implement agreed policy actions in order to manage and protect an LME.³¹

An SAP usually sets out the agreed priorities and the array of expected environmental baseline and specific actions needed for resolving priority transboundary environmental concerns. Priority preventive and remedial actions are specifically identified and highlighted. The SAP also provides mechanisms for the long-term preservation, protection and restoration of an LME.³²

Besides the above-mentioned elements, the following points should be considered in the formulation of an SAP. First, although the problems of LMEs are complex, each LME has its own features. Second, in principle, the SAPs for LMEs generally adopt an integrated management approach, for instance, “integrated freshwater basin—coastal area management measures” are considered to be important for protecting LMEs.³³ Third, although formulation of an SAP relies on the scientific and technical justification provided in the TDA, legal, policy, and socioeconomic elements must also be taken into consideration in the specific combination of activities contained in an SAP. More particularly, activities included in the SAP should be realistically based on the management resources available.³⁴ Finally, an SAP should embody a philosophy of adaptive management so as to provide for periodic review of the environmental status of the LME, identification of new issues and problems as well as new management measures, and updating of the SAP to better address the ever-changing situation.³⁵

Actions Adopted in SAPs

Up to now most LME projects have not finalized their SAPs, thus a comprehensive assembly of actions adopted by SAPs to address the issues and problems of LMEs is not possible. However, a study of some of the existing SAPs show that actions taken to resolve issues and problems of LMEs at both the national and regional levels consist mainly of improvements in

²⁹ See, for example, *The Strategic Action Programme for the Red Sea and Gulf of Aden*, 1998, at: <http://www.unep.ch/seas/main/persga/redsap.html>.

³⁰ A. Merla, “A Commitment to the Global Environment: The Role of GEF and International waters,” online at: <http://www.oieau.fr/ciedd/contributions/at2/contribution/gef.htm>.

³¹ See O’Toole, *supra* note 25.

³² See *Operational Program Number 8, Waterbody-Based Operational Program*, at 8-4, online at: http://www.gefweb.org/operational_policies/operational_programs/op_8_english.pdf.

³³ *Operational Strategy of the Global Environment Facility*, Chapter 4, International Waters, *supra* note 19.

³⁴ See, for example, *ibid.*

³⁵ For more information on the preparation of SAPs, see, for example, A. Hudson, “*Strategic Action Programme Preparation in Complex Contexts: Issues and Best Practices*,” online at: <http://www.freplata.org/actividades/reuniones/Simposio20020515/Presentaciones/PDF/Andrew%20Hudson.pdf>.

the assessment and management methods and measures; increases of management resources and investments; regulatory reform and policy changes; strengthening of institutional mechanisms for implementation; capacity-building; stakeholder involvement and public awareness activities; program monitoring and evaluation; and coordination of priorities with those identified under other focal areas such as climate change, biodiversity.³⁶ The areas of action can be classified as technical, financial, legal, policy, and institutional.

From a technical aspect, the improvement of LME management relies on advances in the understanding of LMEs and the improvement of management methodologies and techniques, which encompass a number of things. First is improvement of the understanding of LMEs as well as the complex interactions among their components and relevant environmental elements, especially in the transboundary context. Actions taken in this connection include international joint surveys and assessments of shared marine living resources, application of new technologies and equipment in monitoring and assessment, and exchange of information and experience and technical training. Second, methodological improvements of LME management require a shift from traditional and ineffective approaches to innovative and effective approaches, *i.e.* from single-species to multi-species assessment and management; from sectoral management to integrated management; from jurisdictional-boundary-based management to ecosystem-based management; mingling community-based management with regional cooperation;³⁷ and blending integrated coastal zone management with LME management. Specific measures that might be taken include: protection of fish stocks throughout their migratory range; protection of dependent and associated species; establishment of marine protected areas; and protection of marine environment through the prevention, reduction, and control of land-based pollution, air-borne pollution as well as sea-borne pollution.

Sufficient funding is essential to the successful implementation of an SAP, and addressing financial issues is an important part of the SAP. Based on the cost benefit analysis which is normally done in the TDA process, the SAP normally figures out estimated costs for the agreed actions and lays out funding plans. For example, the South China Sea SAP specifically lists the estimated costs for each of the actions planned in the SAP and indicates possible major sources of funding.³⁸ With regard to the means of financing the actions adopted in the SAP, the above-noted Benguela Current Large Marine Ecosystem (BCLME) SAP provides that member states are to seek the necessary funding from “national, regional and international sources,” through “private and general public funding” or through “the application of specific economic instruments” and “grants and loans.”³⁹ Specific projects for bilateral and multilateral funding are to be prepared and donor conferences held every five years. Specific funding arrangements for the national policies and measures are required to be presented in the National Action Plan (NAP) of every member state.⁴⁰

³⁶ See, for example, *Operational Strategy of the Global Environment Facility*, Chapter 4, International Waters, *supra* note 19.

³⁷ Global Environment Facility, *International Waters Program Study* (Final Report), at 22, online at: <http://www.iwlearn.net/ftp/iwps.pdf>.

³⁸ See, for example, *Strategic Action Programme for the South China Sea* (Draft Version 3, 24 February 1999), at 52-68, online at: <http://www.unepscs.org/Publication/PDF-B/PDF-B.htm>.

³⁹ Part V of *the Strategic Action Program for the Benguela Current Large Marine Ecosystem*, revised version of November 2002, at: <http://www.bclme.org/resources/>.

⁴⁰ *Ibid.*

Legal actions to be taken that may be set out in the SAP include formulating a legal framework for the protection and management of the LMEs concerned, for example, concluding a legally binding regional agreement and other arrangements. The SAP may urge the collaborating states to accede to the relevant international agreements and arrangements applicable to the LMEs concerned. Finally, the SAP may call for reform of existing national legislation and the making of new legal regulations. In the SAP for the South China Sea (SCS SAP), for example, member states considered it a priority to endorse a legal framework upon which to facilitate and commit governments to the SAP and relevant regional cooperation.⁴¹ In the SAP for the BCLME, member states agreed to “adopt appropriate legislation.”⁴²

Collaborating states are to incorporate into national and regional policies the relevant policies and principles that are adopted in the SAPs and other relevant international documents, such as the policy documents emanating from the 1992 United Nations Conference on Environment and Development (UNCED) and the 2002 World Summit on Sustainable Development (WSSD).⁴³ For example, the SAP for the BCLME requires member states to adopt the following principles: protection of the ecosystem integrity for future generations; application of the precautionary principle where appropriate; taking anticipatory and cooperative actions, such as contingency planning, environmental impact assessment and strategic environmental assessment; use of environmentally friendly technologies and socioeconomic policies; inclusion of environmental, ecosystem and human health considerations into all relevant policies and sectoral plans; and encouragement and fostering of transparency, public participation and cooperation in the process of LME management.⁴⁴ While these principles are not new to international environmental law and policy, the SAP develops suites of policy actions based on these principles and approaches to address the identified specific priority issues of the LMEs. Some specific actions formulated in SAPs will be discussed below.

SAPs inevitably recommend the need to strengthen the institutional mechanisms responsible for the management of the LMEs concerned. Nationally, this may involve coordination of all the relevant agencies at both the national and local levels. At the regional level, institutional mechanisms for regional cooperation in LME management may need to be established, coordinated and strengthened. At the global level, the SAP may recommend strengthening the cooperation between national, regional institutions and relevant international organizations such as various UN agencies and NGOs involved in the protection and management of the oceans. Furthermore, it is seen as helpful for different marine regions to communicate, cooperate and exchange information. For example, in the case of the Gulf of Mexico, there is no current institutional arrangement for co-operation among the three riparian states—the United States, Mexico, and Cuba—in the protection of the Gulf of Mexico Large Marine Ecosystem (GOMLME). Thus, one of the main objectives of the GOMLME project is to establish a regional institutional arrangement to provide for co-operation among these three

⁴¹ See *Strategic Action Programme for the South China Sea*, *supra* note 38, at 67.

⁴² *The Strategic Action Program for the Benguela Current Large Marine Ecosystem*, Part VI, Principles, *supra* note 39.

⁴³ These documents are available at: <http://www.un.org/esa/sustdev/documents/docs.htm>.

⁴⁴ *The Strategic Action Program for the Benguela Current Large Marine Ecosystem*, Part II, Principles, *supra* note 39.

states.⁴⁵ For the BCLME, the following institutional arrangements have been agreed upon for establishment: 1) a Benguela Current Commission; 2) a program co-ordination unit; 3) three activity centres, which are respectively in charge of environmental variability and predictability, living marine resources, and biodiversity, ecosystem health and pollution; and 4) advisory groups on fisheries and other living marine resources; environmental variability, ecosystem impacts and improved predictability; biodiversity and ecosystem health; marine pollution; legal and maritime affairs; information and data exchange; and training and capacity development.⁴⁶ As noted in the South China Sea SAP, the successful implementation of the actions formulated in SAPs is dependent on coordination of actions by various organizations, agencies, private sectors, and stakeholder groups at both the national and regional levels.⁴⁷

As mentioned above, in an SAP member states determine specific actions to be taken to address the identified issues and problems. Examples of such actions can be seen in the SAPs for the BCLME and the South China Sea.

In the BCLME SAP, the proposed areas for policy actions are as follows: 1) sustainable management and utilization of living marine resources and management of mining and drilling activities; 2) assessment of environmental variability, ecosystem impacts and improvement of predictability; 3) management of pollution; 4) maintenance of ecosystem health and protection of biological diversity; and 5) capacity strengthening.⁴⁸

In the BCLME SAP, policy actions are formulated for each of the above thematic areas. For instance, in order to ensure the sustainable management and utilization of the living marine resources of the BCLME, the member states agree to take the following policy actions:

- establishing a regional structure to assess transboundary fishery resources and ecosystems and to provide advice to governments;
- cooperatively undertaking joint surveys and assessment of shared stocks of key species;
- harmonizing the management of shared stocks through, *inter alia*, addressing technical issues such as fishing gear, mesh size/type, compatible data and assessment methodology;
- cooperatively assessing non-exploited species by gathering and calibration of baseline information on these species, and assessment of the impact of any future harvesting on the ecosystem;
- developing a responsible regional mariculture policy to harmonize national policies in such a manner that actions of one state do not impact negatively on the economic potential of another, nor on the ecosystem as a whole;
- cooperatively analyzing socio-economic consequences of various harvesting methods, the improved use of living marine resources and the economic value of the BCLME as

⁴⁵ *Project documents of the Gulf of Mexico Large Marine Ecosystem project*, PDF-B Document (Revised), at: <http://www.gefonline.org/projectDetails.cfm?projID=1346>.

⁴⁶ *The Strategic Action Program for the Benguela Current Large Marine Ecosystem*, Part II, Institutional Arrangement, *supra* note 39. See also O'Toole, *supra* note 25, at 3.

⁴⁷ See *The Strategic Action Programme for the South China Sea*, *supra* note 38, at 5.

⁴⁸ *The Strategic Action Program for the Benguela Current Large Marine Ecosystem*, Part IV, Policy Actions, *supra* note 39.

an ecosystem, with a view to appropriate intervention within the framework of improving sustainable ecosystem use/management and quantifying regional and global benefits;

- harmonizing national policies on protected areas and other conservation measures; and
- complying with the FAO Code of Conduct for Responsible Fisheries.⁴⁹

In the South China Sea SAP, the priority actions focus on: 1) the protection of mangroves, coral reefs, seagrass, estuaries and wetlands;⁵⁰ 2) protection of fishery resources from overexploitation;⁵¹ and 3) prevention, control, reduction and elimination of land-based pollution.⁵² For each identified issue, specific targets and proposed activities at both the regional and national levels are formulated. For example, to deal with the issue of over exploitation of fisheries, the proposed targets are to achieve the following tasks by 2005:

- 1) to determine regional catch levels of key economically important species;
- 2) to have established a regional system of marine protected areas for the conservation and protection of fishery stock and endangered species; and
- 3) to have developed and implemented a management system for the sustainable development of exploited resources at chosen sites.

In order to meet these targets, the South China Sea SAP proposes suites of activities that are to be carried out at the regional and national level. At the regional level, these activities are:

- developing criteria for selection of marine habitats and areas critical to the maintenance of regionally important fish stocks, particularly those of transboundary importance;
- identifying and prioritizing specific areas for future management and protection;
- formulating regional and national action plans on the development of a regional system of refugia for maintenance of regionally important fish stocks;
- developing and establishing management regimes for the identified areas;
- reviewing destructive fishing activities with the aim of removing and replacing them;
- reviewing fisheries management systems; and
- reviewing compliance to international fisheries conventions.

At the national level, the following activities are proposed:

- establishing marine protected areas in areas identified as critical habitats for fish stock conservation and protection of endangered species;
- implementing programs to provide information on fish stock conservation and sustainable fishery practices among small and artisanal fishing communities;
- conducting resource assessment of fishery resources to determine the level of optimal catch and effort for different fishing grounds in the region;
- developing educational and public awareness materials on sustainable fishery practices for dissemination in member states;
- establishing in selected pilot sites a good management system which can be tested to determine if it is leading to sustainable exploitation of resources; and

⁴⁹ *Ibid.*, Part IV (A), Policy Actions.

⁵⁰ See *The Strategic Action Programme for the South China Sea*, *supra* note 38, at 13-22.

⁵¹ *Ibid.*, at 22-24.

⁵² *Ibid.*, at 24-31.

- promoting the dissemination of and compliance with the Code of Conduct for Responsible Fisheries.⁵³

There are some similarities and some differences between the actions formulated in the SAPs for the BCLME and SCSLME. In general, besides some differences in contents, the actions formulated in the SCS SAP appear to be more concrete than those set out in the BCLME SAP, in that the former creates explicit targets for each issue and formulates specific actions to be undertaken at both the regional and national levels, while the policy actions developed in the BCLME SAP are mainly for the regional level. As pointed out in the BCLME SAP, to ensure transboundary cooperation on integrated management of the living resources of the BCLME, the member states have realized “the pressing need to take further concrete actions individually and collectively, at national and regional levels.”⁵⁴ In the light of this understanding, the BCLME SAP requires each member state to develop detailed national action plans to further facilitate its implementation.⁵⁵

Despite the inevitable diversity and variety of the actions adopted by different SAPs, there are also similarities. The major common feature of the actions formulated in LME SAPs is that they are focused on the priority issues and problems associated with the modules of productivity, fish and fisheries, pollution and ecosystem health, and socioeconomics, which are identified in TDAs and that their aim is to improve the governance of LMEs. Besides this, since many of the issues and problems different LMEs face are similar, some of the recommended actions to be taken to address them are also similar. This is demonstrated, for example, by previously listed actions which address the same problem of over-exploitation of fishery resources in two different SAPs. The same actions that are proposed in both SAPs are fishery resource assessment, establishment of protected areas, improvement of management systems, and promotion of the compliance with the FAO Code of Conduct for Responsible Fisheries.

THE NATIONAL ACTION PLAN (NAP)

As already noted, a regional SAP is normally a compilation and harmonization of individual (preliminary) national action plans (NAPs). The SAP approach aims at “streamlining the linkage between regional and national priority actions.”⁵⁶ In order to facilitate member states to act in accordance with the regional SAP, LME projects provide institutional support for relevant national government bodies. At the regional level, there is normally a steering committee and a program coordination unit (PCU) for each LME project to deal with the development and implementation of the regional SAP. At the regional and global levels, the national implementation of the SAP is guided, coordinated, and assisted by the regional and global consulting, coordinating and supporting mechanisms for LME management.

⁵³ *Ibid.*, at 23-24.

⁵⁴ *Strategic Action Programme for the South China Sea*, *supra* note 38, Introduction, paragraph 8.

⁵⁵ *Ibid.*, Part IV, National Strategic Action Plans.

⁵⁶ UNEP, *Review of Alternative Regional Approaches to Implementation of the GPA*, UNEP/GPA Coordination Office, (2001), at 19.

In order to implement the regional SAP at the national level, each member state has to adjust, modify, and improve its national action plan (NAP) in accordance with the SAP and take necessary enforcement and compliance-enhancing measures at the national, sub-national and local levels. Each member state is to incorporate the contents of the SAP into relevant national legislation, policy, and planning. Specific national measures and investments are required for the implementation of NAPs. Furthermore, each member state should accede to and implement international and regional agreements, arrangements and policy documents that are conducive to the aims and objectives of the SAP.

The requirement for the establishment of NAPs is normally explicitly addressed in a SAP. For example, the BCLME SAP requires each member state to develop a national strategic action plan or other corresponding document, which is to present details of additional national actions, including details of responsibilities and specific projects where possible, to further implement the SAP.⁵⁷ In the SCS SAP, the collaborating states are required to integrate the provisions of the SAP into their national plans and policies, and take necessary actions. To encourage and facilitate national agencies to implement the SAP, a set of guidelines for the preparation of national plans are to be developed at the regional level.⁵⁸

To date, most of the LME projects have not produced completed NAPs. Since many NAPs are under preparation and authoritative guidelines for developing NAPs have not been seen,⁵⁹ a study of the existing NAPs may afford useful lessons.

As a part of the preparation for the development of the regional SAP, preliminary national action plans are normally formulated. Examples of preliminary national action plans can be seen in the reports of the littoral states of the South China Sea (SCS) on the formulation of a TDA and the preliminary framework of the SAP for the SCS.⁶⁰ In these national reports, the NAP was based on the “national TDA” which consisted of: 1) detailed analysis of major water-related concerns and principal issues; 2) national analysis of the social and economic costs of the identified water-related principal environmental issues; and 3) and analysis of the root causes of the identified issues.⁶¹

The NAPs for the SCSSLME member states are uniformly structured as follows.

1) *Constraints to Action*. This part of a NAP analyzes barriers to the member state’s national actions for the identified issues. Common major constraints include: lack of information, scientific uncertainties, and lack of public awareness; economic and financial shortages; and

⁵⁷ *Ibid.*

⁵⁸ See *Strategic Action Programme for the South China Sea*, *supra* note 38, at 74.

⁵⁹ However, there are guidelines on land-based pollution, see UNEP/GPA Coordination Office, *UNEP Handbook on the Development and Implementation of a National Programme of Action for the Protection of the Marine Environment from Land-based Activities*, (The Hague, The Netherlands), at: <http://www.gpa.unep.org/documents/NPA/NPA%20ENGLISH.pdf>.

⁶⁰ National reports of Cambodia, China, Indonesia, Malaysia, the Philippines, Thailand, and Vietnam on the formulation of a Transboundary Diagnostic Analysis and preliminary framework for a Strategic Action Program for the South China Sea, online at: <http://www.unepscs.org/Publication/PDF-B/PDF-B.htm>.

⁶¹ *Ibid.*, the national reports of Cambodia, at 3-69; China, at 10-50; Indonesia, at 11-122; Malaysia, at 10-47; the Philippines, at 4-63; Thailand, at 4-40; and Vietnam, at 7-93.

legal, institutional, and managerial deficiencies.⁶² Other constraints are: shortage of capable human resources;⁶³ lack of political will to apply sustainable development principles in marine resource utilization;⁶⁴ and lack of public involvement in decision making on mega projects.⁶⁵

2) *Ongoing and Planned Activities Relevant to the Identified Issues.* This part objectively describes the member state's existing action plans and programs for the nationally identified environmental issues related to the South China Sea.⁶⁶

3) *Specific Action Proposed for Each Identified Issue.* This part is the core of the national report. It formulates specific actions to address each identified issue.⁶⁷ The National Report of Thailand is a good example of formulating these action plans. In the Report, there is a description of the major content of the action, the rationale of the action, participating agencies, and costs and sources of funding.⁶⁸

4) *Implications for the Proposed Actions by Sectors.* This part mainly illustrates the effects of the proposed actions on relevant sectors, and the involvement and roles of relevant sectors in the implementation of the proposed actions.⁶⁹ A comparison of the SCS national reports shows that the contents of this part in different reports are diverse. Although some of the identified issues in different states are identical or similar, the action plans and programs adopted by each member state are not the same. Discrepancies also exist between the actions proposed in the regional SAP and those in the national reports.⁷⁰ As an international study of the SAP approach asserts:

Due to conflicts of interest influenced by local and national economic and political considerations, priority sites and issues identified on a regional level may be restricted to only those that were politically agreeable to all governments involved. Also national priority setting can differ substantially, because of differences in economic strength and needs between participating countries. This may lead to a gap between national and regional priorities in terms of actions perceived as important. Poverty alleviation and community development are often highly rated as national priorities, but are not listed as priority regional actions.⁷¹

⁶² *Ibid.*, the national reports of Cambodia, at 70-76; China, at 51; Indonesia, at 123-126; Malaysia, at 48-49; the Philippines, at 69-73; Thailand, at 41-46; and Vietnam, at 94-95.

⁶³ *Ibid.*, the national reports of Indonesia, at 125 and Thailand, at 41.

⁶⁴ *Ibid.*, the national report of Indonesia, at 125.

⁶⁵ *Ibid.*, the national report of Thailand, at 42.

⁶⁶ *Ibid.*, the national reports of Cambodia, at 76-80; China, at 52-53; Indonesia, at 126-132; Malaysia, at 50-53; the Philippines, at 63-69; Thailand, at 46-79; and Vietnam, at 95-98.

⁶⁷ *Ibid.*, the national reports of Cambodia, at 81-83; China, at 54-59; Indonesia, at 133-136; the Philippines, at 73-81; Thailand, at 80-95; and Vietnam, at 99-100.

⁶⁸ *Ibid.*, the national report of Thailand, at 80-95, especially 93-95.

⁶⁹ *Ibid.*, the national reports of Cambodia, at 83-87; China, at 59-60; Indonesia, at 136-139; Malaysia, at 53-54; the Philippines, at 73-81; Thailand, at 95-101; and Vietnam, at 101-102.

⁷⁰ For example, actions for the protection and conservation of habitats, see the national report of Viet Nam, at 100; the national report of Cambodia, at 83; and *Strategic Action Programme for the South China Sea*, *supra* note 38, at 22-23.

⁷¹ UNEP, *Review of Alternative Regional Approaches to Implementation of the GPA*, *supra* note 56, at 20.

In order to promote international cooperation in dealing with common transboundary environmental issues and enhance effectiveness, it is necessary to coordinate and harmonize national actions at the regional level. For member states, this means a need to modify their national action plans and programs in accordance with the regional SAP.

The National Caspian action plans (NCAPs)⁷² formulated by the Caspian riparian states can serve as another example of NAPs for the protection and enhancement of the marine environment of a regional sea, although the Caspian Environmental Program (CEP) is not an LME project. Differing from the above-mentioned national reports on the SCS, which are a combination of national TDAs and SAPs, the NCAPs are self-contained. Among them the NCAP of the Azerbaijan Republic⁷³ is most representative.

The Azerbaijani NCAP consists of eight parts and an annex with a list of priority programs and projects for the conservation and sustainable use of the Caspian Sea.

1) The *Introduction* describes the objectives of the NCAP; the connection of the NCAP with the TDA and the SAP; the connection of the NCAP with the priority investment projects portfolio in the region; the methods for developing the NCAP; the national status of the NCAP (the means of its endorsement and implementation by the government); and the process of revision and amendment of the NCAP.

2) The *National Conditions* describes the current national political, institutional, legislative, and socioeconomic situations and their future development prospects, especially in relation to the Caspian environment; and evaluates the nation's social, institutional and financial capacity for the protection of the Caspian environment.

3) The *Importance of the Caspian Sea for the Country* defines the national geographical and economic areas where human activities and the Caspian environment interact and have significant mutual impacts; identifies potentials for the increasing contribution of the Caspian Sea to national economic development; and shows the environmental, economic, and social significance of the Caspian Sea in a national context in the present and in the future.

4) The *Main Problems and Their Root Causes* is the core of the TDA as reflected in the NCAP. This part identifies, quantifies, and prioritizes existing and emerging national and transboundary issues and problems of the Caspian environment from a national perspective; and provides a causal analysis which links these issues and problems to immediate and root causes of both natural and anthropogenic.

5) The *Strategy and Measures* is the core of the NCAP. This part defines criteria for the ranking of causes and determination of primary strategies and measures; and classifies "long term strategies" and "urgent measures" for the elimination of root causes of the Caspian environmental problems.

6) The *Potential Obstacles and Ways of Overcoming* identifies and examines a range of issues in politics, institutions, socio-economics, human resources, technology, and finance that may hinder successful solution of the problems, and proposes solution to these obstacles.

7) The *Resources Attraction Strategy* identifies the main financial resources for the implementation of the NCAP, including national and external resources.

8) The *Mechanisms of Actions* identifies and establishes the organizational structure for implementing the NCAP and the evaluation system for assessing the state of the

⁷² The NCAPs are available at: http://www.caspianenvironment.org/report_technical.htm#ncap.

⁷³ Ministry of Ecology and Natural Resources of Azerbaijan Republic, *National Caspian Action Plan of Azerbaijan Republic*, Baku, 2002, at: http://www.caspianenvironment.org/report_technical.htm#ncap.

implementation. It also establishes a mechanism for making the entire process of the NCAP implementation transparent and accountable to the nation, and for raising public awareness.

As mentioned in the introduction of the NCAP, the previous TDA is used as a technical basis for the NCAP. Thus, the NCAP and the TDA are closely connected. Although the NCAP does not indicate the application of the five modules to its formulation process, the identification of the causes of the environmental issues and problems as well as their solutions has incorporated most of the contents of the five modules. The NCAP deals with environmental issues from a multi-dimensional, multi-sectoral or integrated perspective, involving not only science and technology, but also socioeconomic, political, and legal elements.

SIGNIFICANCE OF THE MODULAR APPROACH FOR INTERNATIONAL OCEAN GOVERNANCE

In the past decades, various mechanisms and programs have been created for international ocean governance. The overall objective of current LME projects, to ensure the sustainable development of marine environmental resources, differs little from other efforts in the protection and management of the marine environment and resources. The most important and unique contribution of LME projects to global ocean governance lies in the developing and consolidating of an integrated and ecosystem-based approach to the monitoring, assessment, and management of the marine environment and resources and their relations with human society. The adoption of the five modules in the formulation of the TDA, the SAP, and the NAP, and the implementation of the SAP in an ecosystem-based context are the core of this approach. Such an approach has led to some advances in international oceans management.

The components of an LME are protected and managed in a holistic, integrated manner. The relations and interactions among components of an ecosystem are comprehensively taken into consideration. This departs from the traditional single-species approach that protects the target species of exploitation without taking into account the dependent and associated species as well as their environment.

The assessment and management of the marine environment and resources are addressed from multiple perspectives, involving natural science, technology, socioeconomics, law, and politics.

The spatial scale of the assessment and management normally extends across different maritime boundaries and jurisdictions to encompass an entire LME. Various political maritime zones and interests are harmonized in the interest of the integrity of marine ecosystems.

In the LME projects, the integrated approach to marine management breaks barriers of sectoral division. Different marine related sectors work in partnership to deal with the same or related issues in the protection and management of the marine environment and resources from a multi-sectoral perspective.

The LME approach deals with marine environmental and resource issues not only across maritime boundaries and sectoral boundaries, but also “across”⁷⁴ various global, regional and sub-regional marine-related instruments. Examples of the global instruments include the United Nations Convention on the Law of the Sea,⁷⁵ the 1995 Agreement on Straddling Fish Stocks and Highly Migratory Fish Stocks,⁷⁶ Chapter 17 of Agenda 21,⁷⁷ the 1992 Convention on Biological Diversity (CBD),⁷⁸ the Jakarta Mandate of the CBD,⁷⁹ the Global Program of Action for the Protection of the Marine Environment from Land-Based Activities (GPA),⁸⁰ the 1995 FAO Code of Conduct for Responsible Fisheries,⁸¹ to name a few. The regional instruments include the agreements emanating from the Regional Seas Program,⁸² agreements of regional fisheries bodies,⁸³ and other instruments applicable to the regional and sub-regional seas concerned. Although some of these instruments adopt a multi-species approach or an ecosystem-based approach to the protection and management of the marine environment and resources, others adopt a single-species approach or a sectoral approach to marine issues. In practice, the development and implementation of these instruments are normally undertaken by different organizations and agencies on a sectoral basis. For example, the regional fisheries bodies naturally deal with fisheries issues, while the Regional Seas Program (RSP) focuses on marine environmental protection. Although the RSP “has a comprehensive, integrated, result oriented approach to combating environmental problems through the rational management of marine and coastal areas,” and “focuses not only on the mitigation or elimination of the consequences but also on the causes of environmental degradation,”⁸⁴ it is executed mainly by UNEP and addresses only one of the marine issues: marine pollution. None of the existing international marine management mechanisms deals with marine issues as a whole in an integrated manner. However, as mentioned in UNCLOS, “the problems of ocean space are closely interrelated and need to be considered as a whole.”⁸⁵ In order to fill these gaps, LME projects adopt an integrated, ecosystem-based approach to the assessment and management of the LMEs concerned, which is reflected in the five modules as mentioned above. An LME project is expected to be a synergy of the existing regional marine management mechanisms for the LME concerned, rather than a duplication of a part of them or another parallel mechanism. Some LME programs have established close links with other organizations and programs. For example, the BCLME project has established closed links with some existing marine-related organizations and programs in the region.⁸⁶ The SCS SAP indicates that all actions are intended to be undertaken in a spirit of collaboration and

⁷⁴ See Duda and Sherman, *supra* note 2, at 828.

⁷⁵ Reproduced in 21 *International Legal Materials* 1261 (1982).

⁷⁶ The Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 Relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks, Aug. 4, 1995, reproduced in 34 *International Legal Materials* 1542 (1995).

⁷⁷ Available at: <http://www.un.org/esa/sustdev/documents/agenda21/>.

⁷⁸ Reproduced in 31 *International Legal Materials* 818 (1992).

⁷⁹ Available at: <http://www.biodiv.org/programmes/areas/marine/>.

⁸⁰ Available at: <http://www.gpa.unep.org/documents/about-GPA-docs.htm>.

⁸¹ Available at: <http://sedac.ciesin.columbia.edu:9080/entri/texts/FAOCode.html>.

⁸² See <http://www.unep.org/water/regseas/regseas.htm>.

⁸³ See <http://www.un.org/Depts/los/Links/IGO-links-fish.htm> and <http://www.fao.org/fi/body/body.asp>.

⁸⁴ *Regional Seas Programme*, at: <http://www.unep.org/water/regseas/regseas.htm>.

⁸⁵ Para. 3 of the preamble of UNCLOS. This is one of the two fundamental principles of the new law of the sea. Another is the principle of the common heritage of mankind. See E. M. Borgese, *The Oceanic Circle: Governing the Seas as A Global Resource* (Tokyo, New York, Paris: United Nations University Press, 1998), at 133.

⁸⁶ O'Toole, *supra* note 25, at 5.

partnership, to enhance synergy between ongoing initiatives at the national and regional levels, and eliminate duplicative and conflicting actions.⁸⁷

Furthermore, the TDAs have led to a more comprehensive, systemic and in-depth understanding of the marine environment and resources, and improved the building of a database of LMEs. This provides a sound scientific basis for marine management and strengthens the integration of science with marine management. The TDA not only enhances the awareness of collaborating states of the common transboundary environmental issues in the LME that they share, but also makes it clear that these issues cannot be effectively resolved without international cooperation. By collaboratively developing and adopting the SAP, member states “commit themselves to cooperate through a set of regional guidelines and plans.”⁸⁸ On the other hand, the SAP approach also “generates regional and international political pressure on the national governments to act.”⁸⁹ The successful implementation of the SAP measures that address the priority transboundary environmental concerns should substantially improve the environmental quality of the LMEs concerned. The SAPs have established a new basis for regional cooperation in marine management. They are also expected to promote cooperation in marine management between individuals, stakeholder groups, international organizations and government agencies at the national, sub-regional, regional and global levels.

More countries are involved in integrated, ecosystem-based assessment and management of LMEs. Sixteen LME projects are underway in Asia, Africa, South America and Europe, involving more than 100 states, the majority of which are from the developing world. In these projects, institutional, technical and financial assistance is provided by various UN agencies and some developed countries to the developing countries concerned.⁹⁰ The implementation of these projects not only substantively promotes regime building but also capacity building for more effective and efficient marine management in developing countries.⁹¹

CONCLUSION

The application of the five-module assessment and management methodology to the TDA-SAP-NAP processes constitutes the modular approach adopted in LME projects. This innovative approach moves away from the traditional single-species and sectoral approaches towards an integrated, ecosystem-based approach to the assessment and management of LMEs, and thus is an attempt to rectify some of the perceived deficiencies of traditional approaches. It has led to improvement in the understanding of LMEs and their relations with human society, and has facilitated the building of more scientific and rational LME management regimes. The LME projects are moving toward two important WSSD targets—

⁸⁷ *Strategic Action Programme for the South China Sea*, *supra* note 38, at 5.

⁸⁸ UNEP, *Review of Alternative Regional Approaches to Implementation of the GPA*, *supra* note 56, at 19.

⁸⁹ *Ibid.*

⁹⁰ See Duda and Sherman, *supra* note 2, particularly at 798, 806, and 829 and *Oceans and the World Summit on Sustainable Development: A Large Marine Ecosystems Strategy for the Assessment and Management of International Coastal Waters*, at: <http://www.edc.uri.edu/lme/intro.htm>. A list of LME projects is available at: <http://na.nefsc.noaa.gov/lme/project.htm>.

⁹¹ For a discussion on some specific achievements of the Gulf of Guinea LME, for example, see Barnes, *supra* note 22, at 6-8.

to introduce ecosystem-based assessment and management practices by 2010; and to recover depleted fish stocks to maximum sustainable yield levels by 2015.⁹²

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⁹² Summit Outcomes A/CONF.199/20: *Report of the World Summit on Sustainable Development*, 4 September 2002 (section 30.d. and section 31.a.), at: <http://www.johannesburgsummit.org/html/documents/documents>.