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Enhancing the use of Science in International  
Waters projects to improve project results

## ANALYSIS REPORT

# LAKES

A global Analysis of Lakes science  
and transboundary management



# GEF IW:Science Project



# Analysis Report of the Lakes Working Group



IW: Science, or *Enhancing the Use of Science in International Waters Projects to Improve Project Results* is a medium-sized project of the Global Environment Facility (GEF) International Waters (IW) focal area, implemented by the United Nations Environment Program (UNEP) and executed by the United Nations University Institute for Water, Environment and Health (UNU-INWEH). GEF ID Number: 3343.



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# Analysis Report of the Lakes Working Group

March 2012

This report is written as part of the IW:Science series of reports comprising a synopsis and analysis for each of five classes of global transboundary water system: River Basin, Lake, Groundwater, Land-based Pollution Sources, and Large Marine Ecosystems and Open Oceans. The findings and content of the Synopsis and Analysis Reports are then integrated into two IW:Science Synthesis Reports to provide a global water view with regard to *Emerging Science Issues and Research Needs for Targeted Intervention in the IW Focal Area*, and *Application of Science for Adaptive Management & Development and use of Indicators to support IW Projects*. All reports can be found on the IW:Science, UNU-INWEH, IW:LEARN and GEF websites.

This report was prepared under the responsibility of the IW:Science Core Partner and Lead Institution of the Lakes Working Group:



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Cover photo: A young child help plant the rice crop in South East Asia / UN Photo, M. Perret

# List of Acronyms and Abbreviations

| ACRONYM       | MEANING  |
|---------------|--|
| <b>ACSA</b>   | AGENCY FOR CONSULTING AND AGRICULTURE EXTENSION SERVICE, MOLDOVA |
| <b>AGEOM</b>  | AGENCY OF GEOLOGY  |
| <b>APC</b>    | AFRICAN, CARIBBEAN AND PACIFIC GROUP OF STATES                   |
| <b>BSEP</b>   | BLACK SEA ENVIRONMENTAL PROGRAM                                  |
| <b>CEP</b>    | CASPIAN ENVIRONMENT PROGRAM                                      |
| <b>DDNP</b>   | DANUBE-DRAVA NATIONAL PARK                                       |
| <b>DPSIR</b>  | DRIVING FORCES-PRESSURES-STATE-IMPACTS-RESPONSES FRAMEWORK       |
| <b>EU</b>     | EUROPEAN UNION   |
| <b>GCLME</b>  | GUINEA CURRENT LARGE MARINE ECOSYSTEM                            |
| <b>GEF</b>    | GLOBAL ENVIRONMENT FACILITY                                      |
| <b>GIWA</b>   | GLOBAL INTERNATIONAL WATERS ASSESSMENT                           |
| <b>GPA</b>    | GLOBAL PROGRAMME OF ACTION                                       |
| <b>ICES</b>   | INTERNATIONAL COUNCIL FOR THE EXPLORATION OF THE SEA             |
| <b>IW</b>     | INTERNATIONAL WATERS   |
| <b>LEARN</b>  | LEARNING EXCHANGE AND RESOURCE NETWORK                           |
| <b>LTBP</b>   | LAKE TANGANYIKA BIODIVERSITY PROJECT                             |
| <b>MACEMP</b> | MARINE AND COASTAL ENVIRONMENT MANAGEMENT PROJECT                |
| <b>MDG</b>    | MILLENNIUM DEVELOPMENT GOAL                                      |

| ACRONYM        | MEANING  |
|----------------|--|
| <b>MECTD</b>   | MINISTRY OF ECOLOGY, CONSTRUCTION AND TERRITORIAL DEVELOPMENT                      |
| <b>MPAS</b>    | MARINE PROTECTED AREAS   |
| <b>NBWWTTP</b> | NORTH BUDAPEST WASTEWATER TREATMENT PLANT  |
| <b>NGO</b>     | NON-GOVERNMENT ORGANIZATION  |
| <b>OECD</b>    | ORGANIZATION FOR ECONOMIC COOPERATION AND DEVELOPMENT                              |
| <b>OSPAR</b>   | COMMISSION FOR THE PROTECTION OF THE MARINE ENVIRONMENT OF THE NORTH-EAST ATLANTIC |
| <b>PSC</b>     | PROJECT STEERING COMMITTEE   |
| <b>REC</b>     | REGIONAL ENVIRONMENTAL CENTRE  |
| <b>RSTC</b>    | REGIONAL SCIENTIFIC AND TECHNICAL COMMITTEE  |
| <b>SAP</b>     | STRATEGIC ACTION PLAN  |
| <b>SIDS</b>    | SMALL ISLAND DEVELOPING STATES   |
| <b>TDA</b>     | TRANSBOUNDARY DIAGNOSTIC ANALYSIS  |
| <b>TSC</b>     | TRAIN-SEA-COAST  |
| <b>TV</b>      | TELEVISION   |
| <b>UNDP</b>    | UNITED NATIONS DEVELOPMENT PROGRAMME   |
| <b>USD</b>     | UNITED STATES DOLLAR   |
| <b>WB</b>      | WORLD BANK   |
| <b>WIO</b>     | WESTERN INDIAN OCEAN   |
| <b>WW</b>      | WASTEWATER   |

## Analysis Report

# Table of Contents

|  |           |
|--|-----------|
| <b>1. Critical emerging science issues .....</b>   | <b>2</b>  |
| <b>1.1</b> What are the critical science challenges “on the horizon” specific to lakes? .....  | 2         |
| <b>1.2</b> Approach and Methodology .....  | 2         |
| <b>1.3</b> Core Questions .....  | 3         |
| <b>1.4</b> Purpose of this report .....  | 4         |
| <b>1.5</b> What are the critical science challenges “on the horizon” specific to lakes? .....  | 5         |
| <b>1.6</b> What is the significance of regional and global-scale drivers, in particular climate change, in the genesis of transboundary problems? .....  | 6         |
| <b>1.7</b> Describe how understanding and managing multiple causality in a transboundary water context is undertaken? .....  | 7         |
| <b>1.8</b> How are variable spatial and temporal scales in IW projects accounted for? .....  | 8         |
| <b>1.9</b> What approaches were used to understand/asses the coupling of social and ecological systems? .....  | 9         |
| <b>2. Application of science for adaptive management .....</b>   | <b>12</b> |
| <b>2.1</b> Was engagement of both local and global science communities utilized in IW projects? If not, how can improvements be made? ....   | 12        |
| <b>2.2</b> Is scientific expertise well applied within the IW focal area, particularly in accessing new findings on methodologies, science breakthroughs and emerging issues .....                                     | 15        |
| <b>2.3</b> Identify best practices for linking science and management, including policy formulation and broader governance issues .....  | 18        |
| <b>2.4</b> How to better understand and effectively communicate the scientific dimensions of adaptive management to different user groups? .....   | 20        |
| <b>2.5</b> How to better communicate newly-synthesized science knowledge to stakeholders within and external to GEF .....  | 20        |
| <b>3. Development and use of indicators to support results-based IW projects .....</b>   | <b>22</b> |
| <b>3.1</b> Building better monitoring strategies and indicator criteria for future results-based IW project management, including a comparative analysis of current GEF IW indicators and those used by the OECD. .... | 22        |
| <b>3.2</b> Identify effective proxy indicators for use in IW projects in developing countries .....  | 22        |
| <b>3.3</b> How to make better use of appropriate science and best practices for Transboundary Diagnostic Analysis .....  | 23        |

## List of Tables and Figures

|                 |  |    |
|-----------------|--|----|
| <b>Table 1</b>  | Categorized list of themes identified in the lakes projects .....            | 4  |
| <b>Figure 1</b> | Relationships among Drivers, Pressures, State Indicators and Responses ..... | 4  |
| <b>Figure 2</b> | Africa Continent .....   | 13 |
| <b>Figure 3</b> | Eurasia Continent .....  | 16 |
| <b>Figure 4</b> | Americas Continent .....   | 19 |





## CHAPTER ONE

# Critical emerging science issues

### 1.1 What are the critical science challenges “on the horizon” specific to lakes?

GEF International Waters (IW) projects aim at sustainable management of global transboundary water systems. Over one billion dollars of GEF funds, matched by over four billion dollars of co-financing, have been invested in developing a wealth of new scientific knowledge. The GEF IW: Science Project, *Enhancing the Use of Science in International Waters projects to Improve Project Results*, was initiated in 2009 to develop a significant and coherent portfolio-wide effort to recognize, capture, integrate and disseminate the scientific findings from these projects. The project was executed by the United Nations University Institute for Water, Environment and Health (UNU-INWEH) and implemented by the United Nations Environment Programme (UNEP) to strengthen our understanding of transboundary water challenges, and advance exchange and uptake of knowledge and best practices for sustainable water resources management.

About 150 GEF IW projects have been funded across a broad spectrum of systems — from lake and river basins to groundwater aquifers to near-shore and open ocean ecosystems. A working group was formed in each of these areas to summarize and analyze the results to strengthen priority setting, knowledge sharing, and results-based, adaptive management in current and future projects. These findings will play a vital role in the strategic planning of the IW portfolio and help identify future targeted research opportunities to fill gaps.

### 1.2 Approach and Methodology

The approach relies on parallel information extraction and analysis activities by the five working groups (WGs) representing the five main areas in the GEF International Waters portfolio: river basins, lakes, groundwater, land-based pollution sources (coastal waters), and large marine ecosystems and open oceans. A Scientific Synthesis Group (SSG) was formed to integrate the outputs produced by these five working groups. UNU-INWEH assisted the working groups by establishing a GEF IW projects document database and an IW scientific learning network for information sharing and mutual learning.

Each working group was charged with the following responsibilities:

1. Identifying and documenting science as used in GEF IW projects. This was conducted on the basis of a predefined set of projects: results have been reported in the associated Synopsis Report. The Lakes Working Group was originally assigned 55 reports to review, and those results are presented in the Lakes Synopsis Report.
2. Analysing the use of science in the selected set of GEF IW projects, against the background of relevant aspects and from different angles of view. To facilitate this analysis, a set of core questions was developed, to be used by all working groups (see Section 1.3). Results are reported in this Analysis Report.





### 1.3 Core Questions

To focus the analysis and facilitate inter-comparison, a common suite of core questions was incorporated in a project analysis template and organized in three categories:

#### A. Critical emerging science issues

1. What are the critical science challenges “on the horizon” specific to lakes?
2. What is the significance of regional and global-scale drivers, in particular climate change, in the genesis of transboundary problems?
3. Describe how understanding and managing multiple causality in a transboundary water context is undertaken?
4. How are variable spatial and temporal scales in IW projects accounted for?
5. What approaches were used to understand/asses the coupling of social and ecological systems?

#### B. Application of science for adaptive management

1. Was engagement of both local and global science communities utilised in IW projects? If not, how can improvements be made?
2. Is scientific expertise well applied within the IW focal area, particularly in accessing new findings on methodologies, science breakthroughs and emerging issues
3. Identify best practices for linking science and management, including policy formulation and broader governance issues

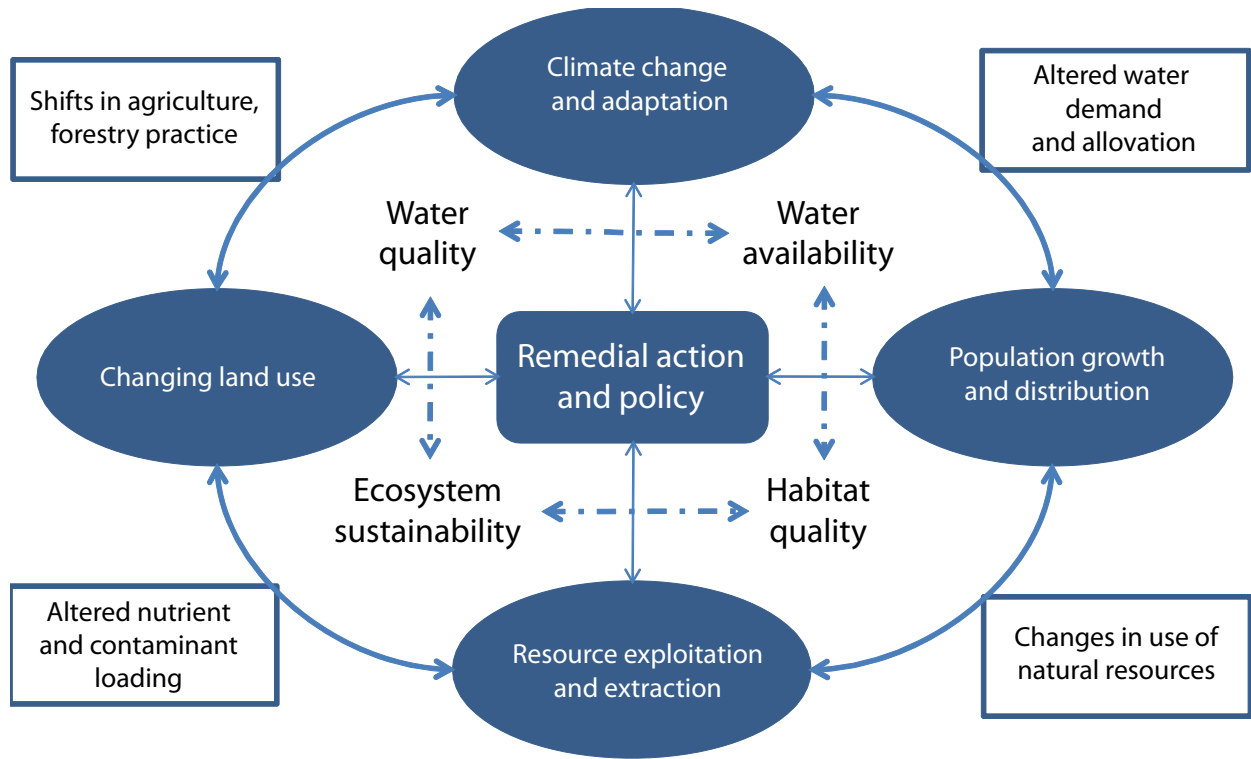
4. How to better understand and effectively communicate the scientific dimensions of adaptive management to different User Groups?
5. How to better communicate newly-synthesized science knowledge to stakeholders within and external to GEF

#### C. Development and use of indicators to support results-based IW projects

1. Building better monitoring strategies and indicator criteria for future results-based IW project management, including a comparative analysis of current GEF IW indicators and those used by the OECD
2. Identify effective proxy indicators for use in IW projects in developing countries
3. How to make better use of appropriate science and best practices for Transboundary Diagnostic Analysis.

## Analysis Report

**Figure 1** Relationships among Drivers, Pressures, State Indicators and Responses



Cartoon depicting the relationships among drivers (outside circles), pressures (outside boxes) and state indicators (inside points) and responses (inside box). Stressors and impacts are not explicitly indicated because they are variable and dependent upon the system.

### 1.4 Purpose of this report

This Lakes Analysis Report presents the results of the core question analysis conducted by members of the Lakes Working Group, as developed during the workshop in Durban, South Africa during October 13-15, 2010, and refined during discussions after the meeting. These results informed the discussions developed by the Integration Group to synthesize the analysis reports.

## 1.5 What are the critical science challenges “on the horizon” specific to lakes?

Major themes that emerged from the review are summarized in Table 1 under the categories of drivers, pressures and indicators.

**Table 1** Categorized list of themes identified in the lakes projects

| DRIVERS                              | PRESSURES                                  | INDICATORS                              |
|--------------------------------------|--|---|
| IRRIGATION                           | EUTROPHICATION, AND NUTRIENT RATIO CHANGES | BASELINE DATA ON CURRENT STATUS         |
| DEFORESTATION                        | SEDIMENTATION                              | DEVELOPING INDICATORS                   |
| AGRICULTURE IMPACTS                  | CHANGES IN BIODIVERSITY                    | WETLAND REHABILITATION                  |
| LAND USE IMPACTS                     | CHEMICAL CONTAMINATION                     | ESTIMATING THE RESILIENCE OF ECOSYSTEMS |
| CLIMATE CHANGE                       | LAKE ACIDIFICATION                         |   |
| INVASIVE SPECIES AND DISEASES        |  |   |
| OVERFISHING                          |  |   |
| POPULATION GROWTH AND REDISTRIBUTION |  |   |

These themes are better categorized under the DPSIR framework, and can be illustrated in a figure encapsulating the relationships between the drivers and pressures working within the systems (Figure 1).

These pressures and drivers help identify potential future science challenges, including the need to increase the focus on ecosystems, development of proxy indicators, climate adaptation, long-range transport of contaminants, and habitat rehabilitation, including reforestation. Consideration of the impacts of adopting best management practices, including new irrigation practices, is also needed. The impact of changes to energy policies, including dam (construction and operation), water diversions, biofuels and resource extraction on water resources and

sustainability of ecosystems, will be a critical issue in the future. These emerging threats will have impacts on water quantity and quality, resulting in altered water balance, changing nutrient availability, and eutrophication and sedimentation. Expanding hydroelectric developments, for example, may create new reservoirs (lakes) that will have a variety of negative impacts on water resources and biodiversity.

The impact of changing agricultural policies and practices is an issue that will grow in importance. Changes will include implementing lower cost growing techniques and shifting to new crops that have different water and chemical-use requirements. Changing demand for agricultural products, such as the increasing demand for meat/protein, will alter types of crops, water and land use, and chemical use for crop protection. There will continue to be shifts in chemical-use policies, as a result of international and global chemical-use restrictions (e.g., the global mercury treaty). Changing foreign investment and trade policies will influence stresses on lakes and water resources by changing land use, crops and agricultural practices. There will be further movement towards consideration of water footprints and the trade in virtual water. There will also be an increasing need to strengthen the linkage of science to economic incentives and policy frameworks and to develop adaptive management capabilities that lead to optimal use of water resources, while sustaining ecosystems on which social and economic systems depend.

Climate change and our ability to adapt to the changes in water availability and quality will continue to be important issues in all watersheds around the globe. Lakes may experience future changes in salinities, water quality, and fisheries (alternate species, new invasive species). Changing lake levels will possibly lead to changes to navigation patterns and use of waterways. Changes in food web structure and biodiversity will be critical issues for fisheries and ecosystem resiliency and sustainability.

There are expanding programs for continuous real time data collection, broader data sharing mechanisms, and development of a better understanding of the time frame of responses due to long residency times. There will be increasing issues with toxic algae, and greater emphasis on new hydrodynamic and water quality models, with growing interests in linkages to groundwater and precipitation rates and maintenance of lake levels (water, salinity).

## Analysis Report

Defining the value and importance of ecosystem services will become a pressing need. The use of water for economic development, such as extraction of mineral, agriculture and water extractions (e.g. municipal), will need to be balanced against the recognized cost of degrading or losing ecosystem services.

A number of critical science challenges were not well addressed in previous IW Lakes projects, including development of baseline data on status at the start of the projects, and development of an adequate understanding of the impacts of eutrophication, nutrient ratio changes, and sedimentation on lakes ecosystems. Relationships of these stressors to land use, and land use changes were not adequately studied. Several existing projects clearly demonstrated that activities and influences external to the basin could have profound impacts on lakes, including the influence of aerial deposition (Lake Victoria studies). Lake Tanganyika studies showed that climate and topography influence sediment transport in the lake, and that these influences could be affected by flow and bottom topography (Project 398).

In past studies, there was also often a failure to have a long-term monitoring plan to evaluate the project's success (e.g. Project 1123). Future challenges will include establishment of monitoring programs to evaluate the impact of beneficial management plans on lake ecosystem recovery; and future programs need to better understand and estimate the resilience of lake ecosystems.

Future science challenges will include gaining a better picture of the impact of climate change on ecosystems and increasing our understanding of the ongoing threats posed by invasive species and diseases. As the economies of countries like India and China grow and other countries continue to develop, there will be increasing threats of chemical contamination, eutrophication, acidification and water diversion to address increased demands for agricultural and commercial products — again with increased impacts on water and land use. Links between the economy and water use/ protection were observed in several projects operating in the European former communist states (such as the Danube and Black Sea projects; 806, 1159, 1355, 1074, 3148, 1351, 2970, 2143) affected by a massive decrease of economic activity post-1989, which resulted in an altered pollution load in the Danube and Black Sea. Future challenges will include monitoring the impact of emerging and shifting economies.

### 1.6 What is the significance of regional and global-scale drivers, in particular climate change, in the genesis of transboundary problems?

One of the challenges in the past has been a failure to recognize the importance of regional or global drivers, such as changing land use, aerial deposition, and climate change. Land-use changes such as deforestation (including for firewood), and wetland destruction contribute to large scale impacts on lakes through mechanisms such as sedimentation and re-suspension, and a variety of associated stressors. The Global International Waters Assessment (GIWA) of the Aral Sea Basin describes how since the 1960s water abstraction for economic activities, particularly irrigated farming, has become unsustainable. Insufficient water has been allocated to the lower reaches of the region's rivers (Project 584 – Aral Sea) resulting in most of the Aral Sea drying up, a massive reduction in biodiversity, and a major impact on the health and economy of local communities.

There are also other types of regional drivers, such as poverty, or economic changes, and these have had a particular impact on eastern European projects. The Dnipro Basin (Project 2544) has been described as a “classic example of unsustainable development” due to the past Soviet legacy of trying to convert a traditionally agricultural region into a major industrial area within a span of a few decades. The situation has been complicated by the extreme social and economic difficulties faced by all three riparian countries in their transition to market economies.

Projects can be complicated by regional or sectoral economic changes, or changes in economic practices. In Project 1159 (and Project 1355), the main problem highlighted was related to the capacity of farmers to implement proper manure management. This was also due to the land reform, from 1990, after which there were over one million farms of one hectare or less. The project also underlined that drainage of the Danube floodplain has reduced the buffer capacity for nutrient reduction.

Interaction of stressors within and external to the project area needs to be given careful consideration, and a further challenge occurs when problems of insecurity overlap. In Lake Victoria (Project 88), major threats to the lake basin were poor land-use and agricultural practices, catchment deforestation, destruction of wetlands, pollution loading, fishing malpractices, and invasion by exotic aquatic



Land use within the Danube River Basin, more than half of all nutrient loads into the Danube River originate from agriculture, Romania / A. Dansie

weeds. These have resulted in rampant land and wetland degradation, leading to poor water quality and consequent water loss; decline in diversity in the commercial fisheries, and biodiversity in general; unsustainable use of resources; decrease in health; and an increase in food insecurity with high levels of poverty among the riparian communities. Problems associated with insecurity and regional conflicts make finding solutions even more complicated.

Project 885 (South China Sea) is another useful example of interacting stressors. In this area, inland water utilization, especially groundwater pumping, leads to land sinking, which affects coastal habitats and potentially increases vulnerability to climate change as sea levels rise. Land-based pollution is linked to degradation of water quality in the South China Sea, which, in turn, affects fisheries. Indeed, in many countries, sea is affected by land-based activities, particularly agriculture and land-use change (e.g. swamp forest to oil palm plantations) linked to increasing energy demands and production of biofuel (energy-water nexus).

### 1.7 Describe how understanding and managing multiple causality in a transboundary water context is undertaken?

Understanding causality and moving beyond simple correlations is a real challenge, which becomes even greater in a transboundary context, and when cumulative effects are involved. At the outset, it is necessary to make a distinction between situations where there are multiple sources of the same stressors versus different stressors. Two parallel strategies can be used – a stressor-based approach (where the stress-response pathways are described and understood), and an effects-based approaches (where the ecological responses are understood and the responsible stressors identified). Stressor-based approaches typically focus on identifying the dominant stressors through land-use mapping, inventory of land use activities, and identification of point and non-point sources. In this context, Project 1123 tried to identify the multiple stressors in the system, including municipal effluents, mining and industrial (fertilizer plant) production associated with restoration of two wetlands across the border of Yugoslavia and Bulgaria.

The monitoring strategy needs to be clearly developed, and should include methodologies for tracking sources, identifying causes, and conducting pilot scale projects to evaluate understanding. Many projects have focused on a suspected chemical cause of impairment and tried to identify the contributing sources. In the Moldova agricultural pollution control project (Project 1355), relationships between farming practices and nutrients in runoff were used as a basis for implementing better management practices. In the Black Sea Environmental Program (BSEP) (Project 1580), studies revealed that 58 per cent of the total dissolved nitrogen and 66 per cent of the total dissolved phosphorous flowing into the Black Sea came from the Danube River basin. More than half of all nutrient loads into the Danube River originate from agriculture, about one-fourth from private households, and about 10-13 per cent from industry.

Projects 806, 1159, 1355, 1074, 3148, 1351, 2970, 2143 belong to the WB-GEF Strategic Partnership for Nutrient Reduction in the Danube River and Black Sea. This was a unique approach to a transboundary problem. It includes 15 years of intervention in the region and covers two parts: development of projects for the Black Sea and for the Danube River basin and a financial package

## Analysis Report

for intervention (around 95 million USD). Within the Danube and Black Sea projects, TDAs have been performed to identify the main pressures and their sources. Based on this analysis, individual (national) projects have been developed. Most of these projects are related to agriculture as a main source of nutrients.

Success can be increased by bringing international expertise to assess environmental problems, such as in the Caspian and Black Seas project (Project 584). The Caspian Sea is the largest land-locked water body on earth, bordered by five countries and influenced by three more in the catchment area. Assessment has been carried out by a multidisciplinary, international expert team that included representatives from each littoral country (Project 1580). Internationally-recognized marine scientists provided mentoring of the Black Sea scientists in research cruises, successfully linking international and local science capacity.

Projects need to consider off-site and distant sources and it helps to compile existing data into a watershed model, and if possible, develop fate and effects models, with some mechanistic understanding. Effective projects included those that used watershed mapping and inventories of land-use activities, and identification of local point and non-point sources for defining the relative importance and priority of stressors and sources.

Another important aspect to be included in the management of lakes is consideration of off-site and distant sources of contaminants. Lake Victoria studies documented that problems in the lake are associated with activities in the catchment, erosion linked to deforestation for firewood, as well as atmospheric deposition (Project 2405 and 88). Re-suspension of sediments was also found to be important for nutrient cycling within the lake. Actions taken to mitigate impacts included (a) regional cooperation in fisheries research, extension and management; (b) research and monitoring of water quality and pollution, strengthening and harmonization of pollution regulations, incentive and enforcement systems, and priority investments in waste water management; (c) monitoring and sustainable use of wetlands; (d) control of water hyacinth; and (e) management of land use in the catchment, including soil conservation and deforestation.

In contrast, some studies considered stressors individually. For instance in Project 398, cumulative effects of

nutrient-loaded discharges and sediment run-off were not examined together in predictive models. However, the stressors were explicitly recognized as a potential contributor to the overall decline of biodiversity in Lake Tanganyika. Although Project 398 did not look at multiple causes in the analysis, it was considered in the discussion of findings.

Understanding and managing multiple causality in transboundary waters is a very important consideration. Considerable insights can be obtained by comparisons to similar projects to identify major barriers to implementation of improvements (political, economic, governance, etc.) early in the project cycle.

### 1.8 How are variable spatial and temporal scales in IW projects accounted for?

There is no consistency in how spatial and temporal scales are examined among projects, and it is often performed informally, because funding size, geographic boundaries, and political constraints often limit the spatial scales upon which a project can work. In many cases, projects are conducted in a generic non-specific manner, such as in the Black Sea project (Project 1159) where large scale/known relationships between agricultural activities and eutrophication were addressed in a generic/non-site-specific way. It is clear that projects benefit from focusing on the catchment, but there are additional challenges because different political levels operate at different scales.

There needs to be ongoing directed monitoring that covers sufficient scales, since most watersheds/lakes have heterogeneity in important properties such as biodiversity, contaminant distribution or habitat composition. There can also be local impacts not expressed across the entire system (e.g. watershed), making it important to understand the basic hydrology, limnology (physical and chemical processes) and ecosystem processes across spatial scales. Projects are often constrained by political considerations, and different political levels operate at various scales not often consistent with ecosystem processes. It is necessary to apply Integrated Water Resources Management within a holistic approach.

In some cases, the spatial scale can be accounted for through selection of variables that integrate on different spatial scales. In Lake Tanganyika (Project 398), variables



included sedimentation, habitat, and fish and mollusk diversity. The temporal scales, however, were not extensively examined and if they were, yearly variation was documented for at most five years. There are also challenges with the scale of the studies; although the spatial scale was extensive, it is not clear how many samples (if greater than one) were collected. The constraints of working large lakes can impede collection of data from multiple years.

There has to be a commitment to monitor within time frames and frequencies appropriate to the system and the response time of indicators. This necessitates consideration of seasonal and annual variability and trends that support implementation and assessment of management objectives. There may need to be some compromise in indicators between response time, causality, historical patterns, etc., and choices in indicators need to consider overall goals. The TDA and existing data provide a launching pad for designing studies, but there should be consistency in methodology over time when considering changes in taxonomy, chemical analysis, sampling protocols, sampling locations and data storage. Projects benefit from centralized databases and availability of data, and use of hypothesis-driven designs with adequate replication, power, etc. It is often difficult to achieve concurrence and testable hypotheses if strategies differ between jurisdictions.

There is a need to involve regional scientific centres and to have good communication with international programmes and projects operating in the region. In the Baltic Sea (Projects 922, 610, 2261, 393), spatial and temporal scales were addressed through joint meetings with multi-governmental steering groups or discussion groups, in this specific case OSPAR, Helcom and ICES. In the Caspian Sea (Project 584), regional scientific centres were involved in the assessment and ensured that results were discussed with local and regional authorities and executive bodies. Representation and active participation of international programmes and projects operating in the region, in particular the Caspian Environment Program (CEP), were also secured.

It is necessary to have longer term planning and implementation, and it is critical to develop mechanisms to ensure long-term implementation and sustainability of activities, monitoring and progress. To be able to develop an appropriate understanding of a system and its natural variability, time frames of 5-20 years are required to ensure success (monitoring and evaluation).



Water collection from the Nile / UN Photo, T. McKulka

It is also important to ensure follow-up in the long term to sustain collaboration among countries and achieve environmental and social goals.

### 1.9 What approaches were used to understand/asses the coupling of social and ecological systems?

Many projects are too focused on understanding natural systems at the expense of social systems. Some projects did evaluate the coupling of social and ecological systems (Projects 2544 - Dnepr River, 3521- Lake Baikal), and considered changes in the social and economic situation and how they were driven by changes in the ecological system (Project 1375 - Aral Sea). It is also very important to consider the socio-economic aspects of environmental impacts (economic, health, etc.; Project 584- Aral Sea). For example, the Tanzanian MACEMP project assumed the link between social and ecological issues and suggested there is a need for alternative liveli-



## Analysis Report

hoods if fishery yield is to be curtailed (Project 2456), acknowledging that effective management of Marine Protected Areas (MPAs) requires education and communication to build community buy-in.

Many of the most successful past GEF projects integrated social and economic research into programmes at the beginning of the projects, and integration continued throughout. This multidisciplinary approach enabled objectives to be advanced more effectively, by identifying barriers, structuring outcomes, gaining public and political support, and ensuring delivery and uptake more effectively. Projects that attempted to deliver the science without the benefit of a better understanding of the socio-economic context in which it will be used were less likely to be as effective. Participatory approaches require more effort upfront, but experience in past GEF projects has shown it is necessary for success.

A focus on community involvement and consultation should be integrated from the start of project planning and be structured in a meaningful way into the review and adaptive management of the project. A diversity of stakeholder interests has been common in projects. Project 3181 focused on capacity building on municipal wastewater management in APC countries (African, Caribbean and Pacific Group of States) that would benefit local managerial staff at the municipal level, as well as national governments. Cross-sector issues related not just to wastewater management but included implications for fisheries, biodiversity, recreation, human health, tourism, financial planning and political aspects. The Aral Sea (Project 584) considered socio-economic aspects of environmental impacts (economic, health and others). In addition to understanding natural systems, there was a balanced consideration of social systems that was important to final implementation. Evaluation of economics and costs of rehabilitating (re-flooding infrastructure) the Persina and Kalimok-Brushlen Marshes (Project 1123) was carried out as part of assessment of possible actions. The China Sea Project (Project 885) is an example where a regional task force was used to conduct an economic evaluation and assessment of legal issues. Stakeholders at all levels and local advisory bodies were established, and each ecosystem working group used experts from all affected countries, ensuring regional collaboration and participation.

The science must be presented in a way that is understandable and relevant to local stakeholders. Building relationships with stakeholders is essential and may require training, education, and public awareness initiatives. Past GEF projects have used a variety of tools including innovative targeted training, workshops and special public meetings. The Lake Ohrid Management Project (Project 113) in Albania successfully considered social systems in the project and included a significant number of local meetings, education, and public awareness initiatives delivered with NGOs.

There are numerous good examples of coupling between social, economic and natural science related to ecosystem protection and rehabilitation. In many cases, governance is a barrier to implementation of the project and local, regional and cross-juristically processes and issues are often ignored or left too late into the project. This and other barriers to implementation can be reduced by including social and economic understanding early and throughout the project, not as an aside, but truly integrated. In the Anatolia (Turkey) watershed rehabilitation project (Project 1074), there was a culture of cooperation involving agricultural activities; unions and associations were common. A lack of infrastructure is related to the inaccessibility of credit to the farming poor and the pressure their reliance on natural resources (such as trees for fuel) places on the landscape.

Socio-economic studies can provide unexpected insight into problems and solutions. In Lake Victoria (Project 2405), sociological studies looked at the livelihoods of the people and showed that erosion was linked to collection of firewood. Global trade had health implications, with the introduction of Nile perch for foreign markets resulting in an ecological cascade with implications for economy and society. Assessment of the current situation and historical trends in the Caspian Sea Project (Project 584) identified that habitat and community modification exerts the greatest impact on the ecosystem of the Caspian Sea. Policy options to address the driving forces need to be presented and discussed in the context of current practices in the region. In Moldova, agricultural pollution control project (Project 1355), the high level of poverty in the area resulted in agriculture geared primarily toward subsistence, with about one third of farmers working their land in association, while about one quarter leased out their land holding. Unauthorized dumping of household and livestock waste was considered the main environmental problem in the villages, followed by

pollution of drinking water. Responsibility for resolving these problems was considered to lie with the Mayor and community, and the village population had little appreciation of the range of environmental issues influencing their daily life.

Successful examples of integration have included use of pilot projects and case studies early in the project to develop an understanding of the issues and barriers. These can also be used as powerful examples for larger scale implementation. If people and governments understand how environmental goals are linked to social and economic impacts, it will be easier to implement and sustain programs. This means that it is very important to develop social and economic valuation of water and ecosystem resources, supported by clear and measureable indicators of the outcomes and impact of projects and resulting programs, so that public, political and government support can be secured and sustained. This should be carried out at appropriate levels and should include links to local people directly affected. Projects must also consider the sustainability of monitoring (including social and economic impacts) that last beyond the projects and are robust enough to be sustained during periods of unexpected external changes, such as the recent economic crisis. In the Lake Manzala Project (Project 395), the quality of life for the local participants will improve as the wetland generates employment, reduces risks of disease from contaminated water and fish, and improves local fisheries. In the Danube (Project 1159), the Agricultural Pollution Control Project in Romania has implemented environmental measures (manure storage and handling, implementation of best agricultural practices) together with household waste management and improvement of the agricultural practices. It was demonstrated that implementation of environmental measures could be an opportunity for new economic activities. Project 1355, also in the Danube, considered socio-economic issues and the relationship with environmental aspects as components related to rural business development.

The nutrient reduction project in Moldova (Project 1355) is a good example of how social and economic factors were integrated into the project. Various stakeholders of the project were consulted frequently during project preparation, including small farmers, members of farming organizations, agro-processing factory managers, NGOs, prefects and their staff, mayors and vice-mayors, government agencies such as the Agency

of Geology and the Meteorological Department, and international agencies like the UNDP. These stakeholders were visited individually or in groups and village meetings were held. A baseline survey and needs assessment program was undertaken where respondents were asked about their agricultural practices, livestock numbers, accessibility to markets, health issues, etc. The purpose of the project was explained, making clear the need to address ongoing soil and water quality problems in the region and their effect on the river system and the Danube Delta. Eventually, working with farmers directly, technical advice and loan programs were used in demonstration watersheds to reduce nutrient loads. This initiative included a large number of people (45,000 rural inhabitants and 11 communities). The proposed project was a demonstration activity that could be replicated in other similar areas of Moldova and countries of the Black Sea region. Thus, the project will have a larger geographic impact and benefit populations beyond Moldova. In a similar way, Hungary and Slovenia (Project 806) aimed to build environmental citizenship to support transboundary pollution reduction in the Danube, providing an example for other countries/regions to reform their government transparency and thereby open new pathways for environmental policy to be enacted to help clean up the Danube River.



In a lakeshore community on Lake Victoria / A. Dansie

## CHAPTER TWO

# Application of science for adaptive management

### 2.1 Was engagement of both local and global science communities utilized in IW projects? If not, how can improvements be made?

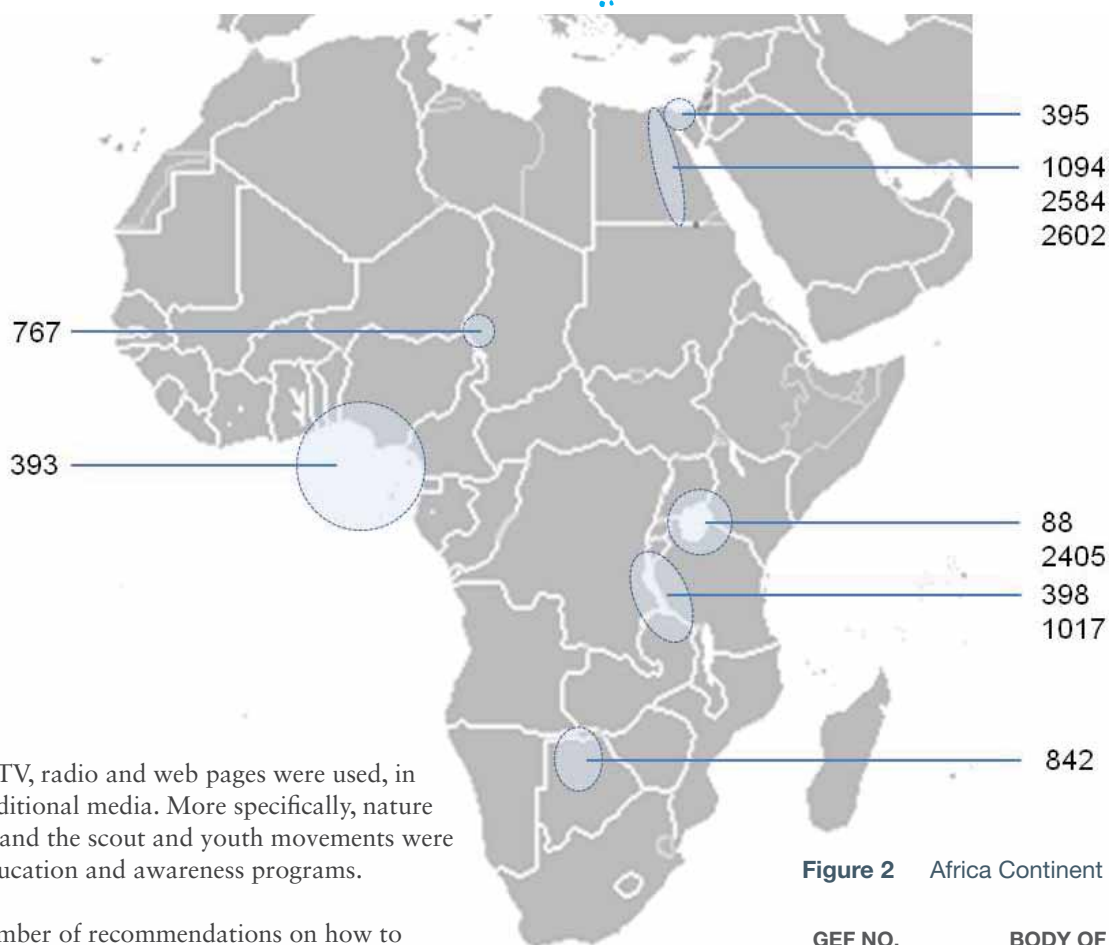
Many of the IW projects reported active and effective engagement of local and global scientific communities. These projects successfully used existing experience and knowledge, and provided support for improvements (including endowment and training for new modern equipment) and transfer of experience and expertise. International science experiences were adapted for local use by engaging and supporting local scientists through the projects (e.g., Projects 806, 1159, 1355, 1074, 3148, 1351, 2970, 2143). Although the use of natural science expertise at both levels was evident, it was often unclear how much social science was involved, and the link between natural and social systems (e.g. humans and fish) and the feedback between them needs to be more explicitly articulated.

To ensure successes at the local level with the non-scientific community, there are a number of recommendations for how the IW projects could be improved. It is critical to develop trust in the local community and for that community to have a sense of ownership of the project. This can be accomplished through consultations during project development (during the proposal maturation phase) to incorporate aspects such as traditional environmental knowledge. It is important to invest some time before the project starts in public workshops to communicate the objectives of the project, and it is often advantageous to provide some economic incentives to engage locals at the start of the project. There needs to be transparency and effective, continuous communication (in the local language at an appropriate level through a variety of media) throughout the process.



Inland freshwater fisheries provide an important source of protein / A. Dansie

There are some advantages to incorporating the local community (including schools) in sampling and monitoring. As an example, for Lake Okavango (Project 842) volunteers at local schools were trained to read gauges and collect daily rainfall data. As a result, the local community was educated and engaged in what was being done. This project also implemented an education programme on the Okavango River basin that could be included in the school curriculum in the region. For Project 1094 on the Nile, basin-wide teams were trained to educate communities. They then designed and developed common environmental education and awareness programs that emphasized transboundary links and connections. Materials were aimed at public and school



audiences and TV, radio and web pages were used, in addition to traditional media. More specifically, nature clubs, schools, and the scout and youth movements were targeted for education and awareness programs.

There are a number of recommendations on how to facilitate and better engage both local and global science in these projects, some of which have proven successful in particular projects. These include:

1. An external team should assess (with consideration to local sensitivities) the scientific level of participating countries. This should be done to determine what expertise is available “in house” and what may need to be sought from the global community.
2. Both the local and global scientific communities should be engaged at the beginning of the project

**Figure 2** Africa Continent

| GEF NO.          | BODY OF WATER   |
|------------------|-----------------|
| 88, 2405         | Lake Victoria   |
| 393              | Gulf of Guinea  |
| 395              | Lake Manzala    |
| 398,1017         | Lake Tanganyika |
| 767              | Lake Chad       |
| 842              | Okavango River  |
| 1094, 2584, 2602 | Nile River      |



## Analysis Report

rather than part way through its implementation. For Project 584 (Aral Sea), a local scientific network was involved from the very beginning of project design, through implementation, to completion. Both international and local scientists were included in scientific conferences, and joint publications were prepared and published.

3. These groups need to cultivate a shared vision. This takes time and resources but is seen as critical to the success of the project.
4. Local and global participants must have shared responsibilities, mutual understanding and respect, and well-defined roles right from the beginning of the project. Some effective steps were taken in the Lake Tanganyika project (Project 398), including training on environmental issues specific to the lake and on project management and conflict management skills for various project affiliates.
5. There is a need to incorporate local approaches and traditional knowledge into the projects. In Project 806, traditional information was explicitly incorporated because these “traditional” practices were to



Incorporation of local and traditional knowledge, community engagement and mutual understanding between all levels of stakeholders is crucial to ensure IW intervention success and sustainability, Ghizou, China

be replaced with more transparent, inclusive, and operational government regulations that deal with environmental issues. Specifically, this project was designed to overcome previous attitudes of nonchalance among the public and foster their involvement in environmental issues.

6. Communication barriers often exist and mechanisms are needed to deal with multi-lingual challenges. One suggestion to help with this is to create special IW project vocabularies of key words or phrases (200-300) that could be used for translating between groups. In particular, words such as sustainability, outreach, stakeholder, etc. do not translate easily from English into certain other languages. For the project on Lake Tanganyika (Project 398), project affiliates were trained to communicate and work with lakeside communities. In addition, a multidisciplinary team was created to relate and translate special study findings to non-scientists. For the project on Lake Okavango (Project 842), the principal means of communication was through workshops with local and national governments, community leaders (including the teaching community), NGOs and other relevant groups. This project also developed publicity materials and sent them out to local, regional and international stakeholders.
7. Capacity building is critical and should involve investments in infrastructure and training of local scientists. The latter could be achieved by allocating funding for internships at partner institutions. To build capacity efficiently, one project (Project 398 - Lake Tanganyika) invested in “human capacity building and training” in which the trainers learned effective training methods and techniques for communities. Specialized technical training for local researchers was also arranged through “in country” workshops or through trips abroad. This project also invested heavily in “material capacity building”, including facility upgrades, equipment and consumables. A number of projects also held capacity-building workshops with representatives from all relevant government agencies (e.g. Project 806) to transfer knowledge. A “Practices Manual” (Project 806) was produced that allowed experts in each country easy access to a variety of options for carrying out their objectives, and allowed them to gain an appreciation of why the policies and procedures were established as they were.

Another option for modernizing policies in IW project countries included consulting with external countries through workshops and tours (Project 806). For Lake Okovongo (Project 842), it was strongly recommended that a small number of suitably qualified graduates, preferably from the region, be employed by the IW project to strengthen capabilities. Previous experience has shown that this type of project can often attract funding for PhD and post-graduate studies, and this sort of support should be encouraged; however, not at the expense of education of grassroots stakeholders. Project 1094 on the Nile Basin supported basin-wide networking among universities engaged in environmental education, with exchanges of information, teachers and students.

8. It is critical to engage local scientific expertise in these projects and facilitate communication between the local and global experts. For the Lake Okavango (Project 842) project, scientific and technical experts were engaged right at the beginning in developing the environmental assessment and integrated management plan and reviewing the TDA and other relevant studies. Issues, concerns and ideas were inventoried and used to create an elaborate Strategic Action Plan (SAP). Websites are viewed as an effective way of doing this and should be regularly maintained and updated with results from ongoing research and the outcomes of the various meetings and workshops. Annual (or perhaps more frequent) workshops should be held, open to all the stakeholders in order to keep everybody informed on progress of the project. This has been done effectively in several projects by holding annual scientific conferences to present results and inviting the wider scientific community to input and exchange knowledge (Project 855). For this same project, committees consistently included local expertise.
9. Global community participation must be respectful and understanding of those engaged from the lake's region. For this reason, education of global participants on local culture, religion, science, practices and limitations is recommended. For example, some cultures only use local names for species and this practice needs to be respected by those from outside the communities.

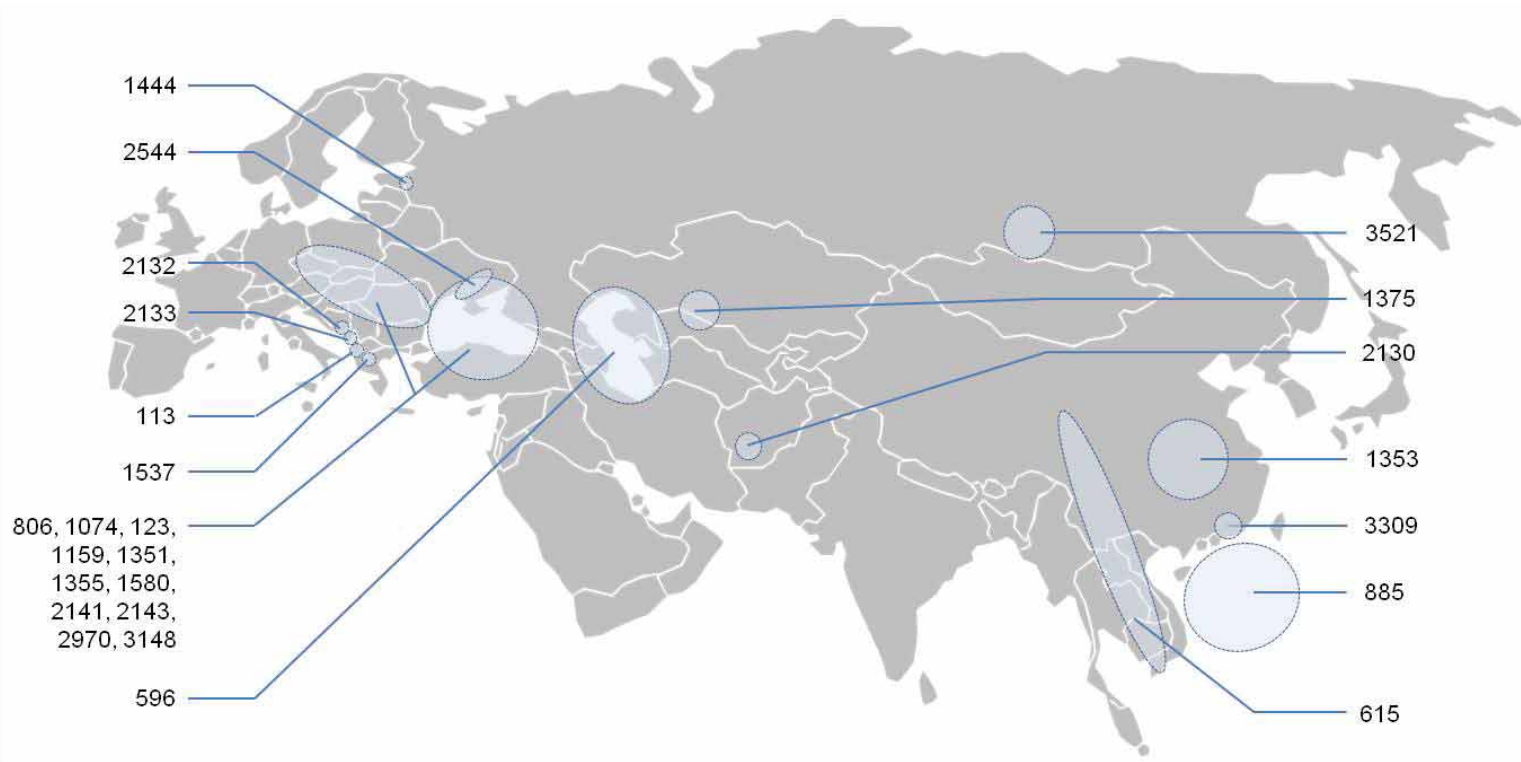
## 2.2 Is scientific expertise well applied within the IW focal area, particularly in accessing new findings on methodologies, science breakthroughs and emerging issues

Science and scientific expertise for adaptive management have been applied in various ways in IW Lakes projects. Projects need to speed up the initiation phase and to bring international science and scientists together at an early stage to find the most appropriate new science. Projects will be more successful if they have a clear picture of ongoing monitoring requirements in terms of cost and logistics and are sensitive to project time frames. International science peer-review processes at regular intervals throughout the project, including initial designs, periodical monitoring, and evaluation of findings and reports, are crucial to the success of the project.

One good example of the role and power of scientific communities is Project 398 (Lake Tanganyika), where early efforts were made to look for local members of relevant international scientific societies or agencies that can provide links to larger scientific efforts, groups, etc. After the 1989 International Limnological Society workshop on conservation and resource management in the African Great Lakes, a group of scientists concerned with conservation issues at Lake Tanganyika was organized. Their efforts led to the First International Conference on the Conservation and Biodiversity of Lake Tanganyika, held at the University of Burundi in Bujumbura, Burundi from 11-13 March 1991. This meeting brought together key individuals from the research, resource management (water, fisheries and agroforestry) and conservation communities to discuss the current state and the future of the Lake Tanganyika Basin.

At the initiation phase of many GEF projects, scientific communities should be brought together because their expertise will be required in problem identification, root cause analysis, justification of project significance, and project design. Many GEF projects successfully used scientific meetings, regional meetings and workshops to facilitate knowledge accessibility and management. Many used existing scientific networks and professional groups to help provide technical expertise and advice and to help facilitate linkages to larger scientific communities, societies, groups and efforts.

## Analysis Report



**Figure 3** Eurasia Continent

| GEF NO. | BODY OF WATER   | GEF NO.   | BODY OF WATER              |
|---------|-----------------|---|----------------------------|
| 113     | Lake Ohrid      | 2130  | Sistan River               |
| 596     | Caspain Sea     | 2132  | Trebisjica River           |
| 615     | Mekong River    | 2133  | Lake Skader-Shkoder        |
| 885     | South China Sea | 2544  | Dnipro River               |
| 1353    | Yangtze River   | 3309  | Shantou River              |
| 1375    | Aral Sea        | 3521  | Lake Baikal                |
| 1444    | Lake Peipsi     | 806, 1074, 1123, 1159, 1351, 1355, 1580, 2141, 2143, 2970, 3148 | Danube River and Black Sea |
| 1537    | Prespa Lakes    |   |                            |



Local knowledge systems are also exceptionally important and cannot be ignored or overlooked. Efforts should be made to incorporate traditional ecological knowledge, and the community should be involved from the very beginning of project design, through project implementation, to completion.

Integration of local science and international science should be promoted and encouraged. Key factors to consider at the outset are adoption and application of an ecosystem approach, a multi-disciplinary approach, trust building, transparent communication, and public accessibility to the project database, information and reports. Project 806 (transboundary pollution reduction in the Danube, Hungary and Slovenia), for example, conducted needs assessment and case study analysis to identify barriers to public access to environmental information, which was a good starting point for developing measures to overcome such barriers. Project 885 (South China Sea and the Gulf of Thailand) is a very good example of how science was well integrated into the project from the outset. This group also developed and used meta-databases at the national and regional levels to help manage all of the project data.

Realistic and measurable targets must be developed and articulated to ensure project success. Many GEF projects were oriented toward solving certain problems (e.g., to reduce agricultural pollution, to build wastewater treatment facilities, to restore wetlands, etc.) and their initial design was oriented to project beneficiaries (e.g. farmers, municipalities, etc.). This is an important point. With well-defined project beneficiaries at an early stage, the beneficiaries can be involved in project development and can voice their opinion on solutions and methods of implementation. Project 1074 (watershed rehabilitation in the Danube River and Black Sea), for example, was very community-oriented and used bottom-up approaches in which the project beneficiaries were very active participants. Methodologies and guidance documents can also be developed using a participatory approach: the most common example is a Code of Good Agricultural Practices or a Code of Good Farming Practices. International science communities, together with regional and national scientists and experts, should be brought in to work together at the project design stage: for example, to brainstorm to find the most appropriate new science to be applied in addressing the emerging issues under consideration. During the design stage, the capacity to access new findings on methodologies

is extremely important to the success, applicability and usefulness of the project.

Projects benefit from local demonstration and evaluation, and efforts should be invested to provide access to international workshops, training opportunities and courses, tours of similar projects for local science teams, and also to include study tours of outside experts. There is a need for multidisciplinary approaches and availability of data and project reports (IW databases should help with some of this).

During project implementation, new scientific findings or breakthroughs are significant in that they can lead to adaptive management and make the project even more successful. The South China Sea and the Gulf of Thailand project (Project 885) is a very good example of how science was well integrated. The project conducted economic valuation, so that all stakeholders could have a common understanding of the tangible values of natural resources and the tangible impacts of land-based pollution on those natural resources. Many GEF projects have successfully conducted local demonstration projects at the site level. The above project, for example, carried out a cluster analysis to systematically select appropriate demonstration sites, using scientific methods to develop criteria for analysis. Such projects are very useful in dissemination of new findings, knowledge sharing and transfer, increasing public access to environmental information, increasing opportunities for public participation, and capacity building for various stakeholder groups. Many projects successfully combined training components, eco-seminars, study visits and study tours within the project design. Such projects also facilitated adaptive management before further replication in wider areas.

Science and scientific expertise are vitally important for long-term project monitoring, planning and development. Well-designed monitoring and evaluation systems are critical for ensuring timely and successful implementation, and for enhancing the impacts of systematic analysis of lessons learned and effective dissemination of results. Programme requirements for monitoring and appropriate indicators need to be clearly understood and well chosen, not only in terms of scientific technical aspects, but also in terms of cost and logistics.

## Analysis Report

### 2.3 Identify best practices for linking science and management, including policy formulation and broader governance issues

Identifying best practices for linking science and management begins with developing clarity on the issues, with a clear focus on solutions. In this context, science should be focused on producing knowledge that will be useful for decision-making and policy change. Communication and workshops are necessary to translate science into relevant management decisions, and vice versa, and to identify relevant targets to receive results.

Early on, it is necessary to secure public support and community involvement. The Danube River Project (Project 806) began by identifying the significant barriers to public access of environmental information, building government and NGO capacity through training and ongoing technical assistance activities, and identifying and developing measures to overcome the identified barriers. These are sound steps that could be replicated region-wide. Participant-initiated activities (that built on the project) expanded the effectiveness of the program and contributed substantially to achievement of the project's objectives; this kind of initiative also contributes to the sustainability of project results. Community involvement initiation is important and can help ensure sustainability. Public access to information is important in removing barriers and encouraging public participation.

Projects need to secure early engagement of government support at the highest levels, along with early development of a communication strategy. Legal constraints and barriers should be identified early in the process, before the project fully develops, with management and policy people included in the design. The scientific capacity of those who will implement the project should be increased. Communication should occur at an appropriate level, with appropriate terminology; and training courses can aimed at candidates who will be able to respond to education and develop knowledge of science, goal, and methods, etc.

Delays in project initiation can really affect these first steps. In the Lake Tanganyika Project (Project 398), there were apparently issues with communication between the funding decision and the awarding of the contract (and other issues surrounding the selection of the implementation team) that limited buy-in of the riparian govern-



Fisherman on the Danube / V. Melo

ments. Ownership was on a study-by-study basis: LTBP's considerable technical programme, for practical reasons, had to be based at the lakeside of the four countries. This led, in some cases, to ambiguity as to the appropriate agency to conduct a study. Different LTBP studies adopted different approaches to dealing with this.

Pilot projects can be effective models for creating a common understanding between all countries involved, leading to increased public involvement and achieving program goals. In the case of reduced nutrient input to the Danube and, therefore, the Black Sea, many countries in transition in the Danube River Basin face similar barriers to public involvement. Measures to improve public access to environmental information developed for the pilot countries can provide good models for other Danube countries committed to increasing public involvement in support of reducing pollutant discharges. It is important to include NGOs and all stakeholders in all phases of the project, and this is essential in developing effective and sustainable measures to improve public involvement.

Building capacity is a critical component, and it is necessary to develop a very strong science community, at the local, watershed (national) and international level. It is important to obtain government support at the highest levels, and national governments need to play an important role in international coordination because results need to be translated and implemented across countries, as well as at local, regional and national levels. This can be facilitated by development of National Action Plans and a Strategic Action Program.

The South China Sea (Project 885) is a very good example of how the scientific knowledge base was used for useful policy formation and implementation. For example, the National Actions Plans and Strategic Action Programme were formulated based on scientific information. This project also provides a good example of a project management framework for managing multi-lateral, intergovernmental projects/programmes, permitting both horizontal (inter-country) and vertical (intra-country) interactions and networking between individuals at all levels of project implementation and execution. This included the RSTC, a body serving as a forum for reconciling regional and national interests and priorities. There was clear separation of discussions of scientific and technical matters from discussions dealing with policy and principles at both national and regional levels, facilitating incorporation of sound scientific and technical advice and information into politically-based decision-making. Regional experts and consultants from participating countries within the region were used. Membership of the PSC was restricted to government representatives only. All this allowed for adaptive man-



**Figure 4** Americas Continent

| GEF NO.    | BODY OF WATER               |
|------------|-----------------------------|
| 2540       | Lera-Chapala-Santiago River |
| 583        | Rio Paraguay                |
| 2095, 3519 | Rio de la Plata             |
| 2364       | Amazon River                |
| 3128       | Sao Francisco River         |

## Analysis Report

agement, not a rigid unchanging structure, and adequate time for detailed planning of the execution arrangements. This project also provides a good overview of national level coordination and inter-ministry collaboration and of operational factors (e.g. inter-agency linkages, steering committee composition, transparency and decision-making, networking and planning time).

### 2.4 How to better understand and effectively communicate the scientific dimensions of adaptive management to different user groups?

Key components of a communication strategy include development of relevant indicators, involvement of local stakeholders, and inclusion of a plan for training of the users. Project 1159 (Romania) dedicated an important part of the project to training users. It organized training in different categories: farmers, local soil and water laboratories, mayors of the localities that have to implement the measures and inspectors. It also organized sessions for training of trainers. Flexibility in implementation is needed, as is integration into the management structure (Project 885). Project 842 (Okavango) created a website and produced pamphlets in at least four common languages. Project 2970 (Romania) was a continuation of Project 1159, and established a centre for continuous training, including building and endowment of facilities.



Small lake fish drying in the sun to be sold at market / A. Dansie

### 2.5 How to better communicate newly-synthesized science knowledge to stakeholders within and external to GEF

There have been a number of approaches to communication that have seen success in the Lakes projects. A focus on promotion of cost-effective solutions provides the best chance of sustained interest in implementing the outcomes of projects.

The most common approaches have been workshops and websites (e.g. Project 806), but these are not sufficient on their own. Focusing the workshop on operators and users, and developing newsletters has also been effective (Projects 1537, 3181), and the Nile Project (Project 1094) used local communities and government agencies/ministries. Project 1580 (Black Sea) developed a variety of web-sites, publications, held an international scientific conference, and designed and published the Black Sea Educational Study Pack, a series of books on the state of the ecosystem, which were recommended and introduced in some schools and universities (Odessa, Ukraine).

Project 885 conducted roundtable meetings with provincial government/site managers (implementation agencies), and included workshops back-to-back with scientific conferences to reduce travel costs, and enhance the ability to uptake new science. Local scale involvement of communities used a participatory approach, and knowledge dissemination was integrated into the structure of the project. It is essential that communication products be targeted at specific audiences, with some projects translating information into multiple languages.

Additional steps have included information campaigns and focusing on public awareness. Project 1355 developed a local and nationwide public information campaign to disseminate the benefits of proposed project activities and encourage replicability. The campaign included organization of national and regional workshops, field trips, visits, training, publication in international agriculture and environmental journals and other activities to promote replication of project activities in other similar areas of Moldova, as well as Black Sea riparian countries.

It has also been helpful to develop roundtable meetings with local managers, and it is important to establish a system of continuous training for achieving a last-





Lakeside fishing community on the shores of Lake Victoria, Kenya / A. Dansie

ing benefit from the projects (Project 2970 – Romania). Results of the Danube River Project (Project 1351) serve as a basis for dissemination, replication and knowledge sharing activities. The project had early objectives to finance workshops and public communication campaigns, and to promote cost effective solutions for nutrient reduction in other areas of Hungary and riparian countries. It is important to link the projects to other similar efforts. The Danube Project set an early objective to link the GEF Danube and Black Sea Regional projects, and the Danube Convention-supported dissemination activities and the GEF-funded IW Learn initiative.

Communication outside GEF IW:Science projects has been an issue even though such communication is recognized as highly important. A clear deficiency in the process has been the availability of, and access to, summary reports of projects accomplishments. The IW database will be a large step forward in providing access to science knowledge for people without direct involvement in IW projects.



## CHAPTER THREE

# Development and use of indicators to support results-based IW projects

### 3.1 Building better monitoring strategies and indicator criteria for future results-based IW project management, including a comparative analysis of current GEF IW indicators and those used by the OECD.

There should be discussion among experts to create lists of possible indicators, with review and selection of those most appropriate for endpoints. These can be based on indicators widely available in the region, but should be made specific for each component and linked to the endpoints. They should include both spatial and temporal components. It is important to search for low-cost opportunities for establishing and sustaining monitoring programs that are based on ecological, social, economic indicators.

Projects should include large-scale meaningful, objective social indicators that are assessable, measurable and implementable. Indicators should be evaluated for statistical power and thresholds set for assessing change. The social and economic capacity for measuring indicators should be assessed, and it is important to consider reference or background levels and have clear targets established. Feasibility of selected indicators should be considered, including the social and economic capacity for management response if the indicator changes.

A discussion and understanding of the relationship of targets to temporal scale, monitoring frequency, and surrogate measures will have to be developed for each project. Ideally, the criteria should be discussed regularly (e.g., twice per year) and agreement reached among participating countries. Informal assessment by techniques such as questionnaires can be helpful.

The monitoring strategy has to be developed using sound science principles and best practices, and provide a framework for the indicators. Scientific and gover-

nance peer review is necessary, as is a significant effort invested in communication targeted at both management and local stakeholders. Communication initiatives must be careful to define the vocabulary and terminology to ensure a common understanding.

### 3.2 Identify effective proxy indicators for use in IW projects in developing countries

Effective proxy indicators will be identified by specifying what we are trying to achieve in quantitative terms (e.g., Tanzanian MACEMP Project 2456). Development and identification of indicators should be included as a project output, and be inexpensive to measure, available through existing processes of data collection where possible (existing monitoring programs, census outputs, etc.), and have defined targets for success.

Proxy indicators developed for the Black Sea Project (Project 1159) included (i) percentage of households with livestock in the project area adopting improved manure-handling facilities - targeted to move from a baseline of zero to 45 per cent by 2006 and 65 per cent by 2010; (ii) percentage of cropped area coming under nutrient management systems including crop rotation, crop nutrient management with soil testing, and use of organic manure - targeted to reach 30 per cent by 2006 and 65 per cent by 2010; (iii) percentage of cropped area employing environment friendly practices - target of 65 per cent by 2010; and (iv) trends in water quality indicators at designated sites - flow of nitrogen and phosphate to the Danube river to be reduced by 10 per cent by 2006.

The Danube River project (1351) indicators included i) annual reduction of nutrient discharges from the NBWWTP (N and P kg/year); ii) average operation cost of the nutrient reduction process in the NBWWTP (US\$/



kg of nutrient reduced); iii) number of hectares of wetlands rehabilitated in the DDNP; iv) annual amount of nutrients retained by the DDNP wetlands (N and P kg/year); and v) average operation cost of wetland management procedures in the DDNP, in terms of nutrient reduction capacity (US\$/kg of nutrient reduced). Project 3181 also had well-developed indicators focused on trying to achieve MDG7, the Johannesburg Plan of Implementation. As an example, training was designed to produce an increased capacity and ability to apply for support to implement wastewater treatment and management efforts; thus, the indicator was directly related to how many of the participants were able to apply what was taught in the workshops (percentage of new wastewater proposals in ACP countries). The indicators within the project were:

- Percentage of new wastewater proposals in ACP countries; sustainable multi-year finance plan for operation and maintenance;
- Number of participants of the wastewater training course who understand and are able to apply objective-oriented planning in WW projects;
- Number of participants of the finance training who understand benefits and method of multi-year financial planning and are willing, competent and able to apply these methods;
- Number of trained project managers and finance committee members willing to cooperate and to involve stakeholders in the planning process;
- Number of staff of GEF projects (SIDS, GCLME, WIO-LaB) involved in demonstration projects to reduce marine pollution from wastewater who received Train-Sea-Coast (TSC) training in either objective-oriented planning or multi-year

finance planning for wastewater projects, or who have access to TSC tools on these issues through IW:LEARN and TSC-GPA web sites

Even though there may be agreement on indicators in National Action Plans and Strategic Action Programmes, there is a strong need for effective implementation, monitoring and evaluation. A regional monitoring programme (Project 885) is needed. Some projects used performance aspects of lake biota as surrogates for the indicators of interest, including using fish and mollusc diversity, rather than using all taxa as surrogates (398, 1123). It was also recommended that water quality parameters, fish productivity, biodiversity and ecosystem health be used as direct indicators for measuring success of the project (project 885), along with increased public awareness of causes, effects and mitigating measures of natural resource degradation, as measured by baseline, mid-term, and end-of-project surveys (project 1074).

### **3.3 How to make better use of appropriate science and best practices for Transboundary Diagnostic Analysis**

The over-arching actions needed to address these transboundary problems are capacity development and training; policy development and harmonization; and development of regional collaboration with respect to surveys and assessment of ecosystem status. There is a need for early engagement with stakeholders and better use of appropriate science; best practices must engage institutions in the region involved with implementation.

Stakeholder involvement should be broader and should be included in the review and implementation stages. Various stakeholders of the Danube River-Black Sea project were consulted frequently during project preparation (Project 1355). These included small farmers,



## Analysis Report

members of farming organizations, agro-processing factory managers, NGOs such as ACSA, and REC, the Prefects of Hincesti and Leova and their staff, Mayors and Vice Mayors of the eleven communes, officials of MECTD, MAFI, Moldolva, Agency of Geology (AgeoM) the Meteorological Department, and international agencies like the EU and UNDP.

It is easier to incorporate the science if the project management structure separates policy and technical aspects but still maintains a strong linkage between them (Project 885 - South China Sea). The science and TDA need to be peer reviewed, and stakeholders should be involved in the reviewing process. It is important to choose consultants who have familiarity with the area and have good experience with recent science. There needs to be explicit inclusion of indicators in the TDA and in the baseline studies conducted as a result of the synthesis.

Information must be synthesized in a timely fashion, and both unpublished and published information and reports be made publicly available. There should be quality control from GEF, and people who develop the TDA should have the appropriate capacity and knowledge to complete this task.

There were a number of approaches to prioritization, including root cause analysis and hot spots methodology. Root cause analysis included: a cluster analysis for demonstration site selection; pilot activities relating to alternative remedial actions to address priority pollutants and water quality objectives and standards; cutting edge intellectual contributions regarding determination of regional economic values; and modelling of the assimilative capacity of the South China Sea marine basin for nutrient pollutants. During the Dnieper River project (Project 2544), the hot spots methodology was successfully used to identify major contaminants. Although many studies included the whole catchment and multiple stressors in the system, these studies did not often consider lake processes as possible modifiers of water pollution (e.g., Project 1123 Danube River-Black Sea on Persina Marshes and Kalimok-Brushlen Marshes east of Tutrakan; Project 1537 Lake Prespa; Project 113 Lake Ohrid). As an example, in considering land-based pollution in the China Sea (Project 885), the functions of the lakes were not considered as a factor modifying water quality.

Capacity development is an issue still requiring improvement, and training courses should be targeted at the correct level to achieve acceptance. This may call for different approaches for different groups/levels. Incentives for participation in training and other activities must be considered as a means to overcome barriers to full participation.

The final area where improvement is needed is implementation. In the Pacific Islands project (Project 3181), there was a discrepancy between the political commitment at the national level and resource accessibility at the municipal level; there was an inadequate time allocation by local institutions for preparing the logistical and instructional aspects of training at the highest possible quality level; and, finally, there was low acceptance of new concepts by some higher level officials within municipalities.



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