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IW:Science

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

ANALYSIS REPORT

# RIVER BASINS

## A global Analysis of **River Basins** science and transboundary management

UNEP

GLOBAL ENVIRONMENT FACILITY 20 YEARS INVESTING IN OUR PLANET

**GEF IW:Science** Project

# Analysis Report of the River Basins Working Group

IW:Science

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 River Basins 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 River Basins Working Group:

UNEP

Department of Early Warning and Assessment


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Cover photo: Agriculture in a river basin in South America

# List of Acronyms and Abbreviations

| ACRONYM | MEANING |
|---|---|
| BDP | Basin Development Program |
| CBD | Convention on Biological Diversity |
| DSF | Decision Support Framework |
| EP | Environment Programmes |
| EPDRB | Environmental Programme of the Danube River Basin |
| EU | European Union |
| GDP | Gross Domestic Product |
| GEF | Global Environment Facility |
| GIWA | Global International Waters Assessment |
| ICPDR | International Commission for the Protection of the Danube River |
| IW | International Waters |
| MRC | Mekong River Commission |
| NGOS | Non-Governmental Organizations |
| RBWG | River Basin Working Group |
| SADC | South African Development Community |
| SAP | Strategic Action Programme |
| TDA | Transboundary Diagnostic Analysis |
| TOR | Terms of Reference |
| UN | United Nations |
| UNDP | United Nations Development Programme |
| UNEP | United Nations Environment Programme |
| UNU-INWEH | United Nations University Institute for Water, Environment and Health |
| US | United States |
| WUP | Water Utilization Program |

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*The appendices for this report are available electronically from the IW:Science, UNU-INWEH, IW:LEARN and GEF websites*

**CHAPTER ONE**

# Introduction

## 1.1 Project background and purpose of the report

*Enhancing the Use of Science in International Waters Projects to Improve Project Results*, IW:Science, is a GEF medium-sized project conducted to recognize, capture, analyze and integrate the scientific findings from GEF International Waters (IW) projects, an investment of more than US $6 billion, and to disseminate them across the IW portfolio and beyond.

Executed by the United Nations University Institute for Water, Environment and Health (UNU-INWEH) and implemented by the United Nations Environment Programme (UNEP), the project was launched in 2009 and covers the five main areas in the GEF International Waters portfolio: surface water; lakes; groundwater; large marine ecosystems; and deep oceans. A working group was formed to address each of these areas.

The project's objective is to enhance — through knowledge integration and information-sharing tools — the use of science in the GEF IW focal area to strengthen priority setting, knowledge sharing, and results-based adaptive management in current and future projects.

The specific objective of this Analysis Report is to present results of the analysis of the current understanding of the River Basin IW System Type in the context of global science. This report is prepared based on the individual project analysis conducted by the River Basin Working Group (RBWG) members.

The production of this report completes the three activities under the first component of the IW:Science project, aimed at "understanding and documenting, for future analysis and reference, the scientific experience and scientific best practices from the IW project portfolio". The report is structured following the core questions developed as described in the next section.

## 1.2 Approach and methodology

In producing this report, each member of the RBWG was assigned, at the second working group meeting held in Durban, South Africa on 13-15 October 2010, a few GEF projects on which to conduct an individual project analysis based on a predetermined number of core questions, as follows:

A. Critical emerging science issues (5 core questions)

- What are the critical science challenges "on the horizon" specific to each ecosystem type?
- What is the significance of regional and global-scale drivers, in particular climate change, in the genesis of transboundary problems?
- Describe how understanding and managing multiple causality in a transboundary water context is undertaken?
- How are variable spatial and temporal scales in IW projects accounted for?
- What approaches were used to understand/assess the coupling of social and ecological systems?
- What scientific knowledge is available and/or used to evaluate trade-offs between the response options developed by IW projects?

B. Development and use of indicators to support IW projects (3 core questions)

- How did the projects help build and implement sound indicators and monitoring strategies to support SAP implementation and/or ultimately assess the achievement of environmental and social benefits?

- How can we identify effective proxy indicators for use in IW projects?

- How to make better use of appropriate science and best practices for Transboundary Diagnostic Analysis?

C. Application of science for adaptive management (5 core questions)

- Was engagement of both local and wider science communities utilised in IW projects? If not, how can improvements be made?

- Is scientific expertise and local knowledge well applied within the IW focal area, particularly in accessing existing baseline information, new findings on methodologies, science breakthroughs and scanning for emerging issues?

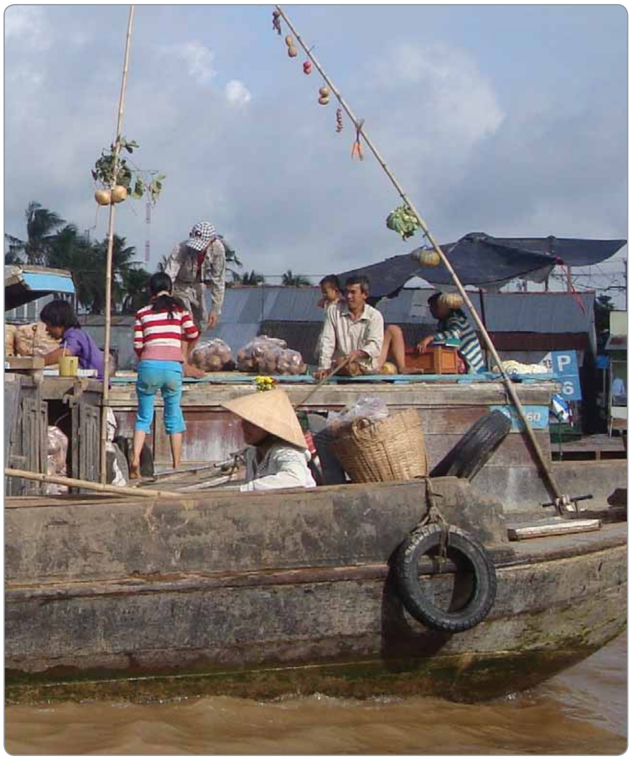
- Identify lessons learned for linking science and policy implementation, including policy formulation and broader governance issues

- Is adaptive management happening? How to better understand and effectively communicate the scientific dimensions of adaptive management to different user groups?

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

These core questions, developed under the IW:Science project, were incorporated in a project analysis template (Appendix A) used by the RBWG. Specific terms or ambiguities in the questions were discussed and clarified during the meeting in Durban. Responses could be on a project basis, or from the perspective of river basin systems in general. In some of the questions, information from the Synopsis Report and synopsis survey by the RBWG were also used in the responses.

Of the 43 projects assigned to the RBWG, individual project reviews were completed for a significant number of projects (Appendix B). Responses in these individual project analyses (Appendix C) as well as notes during the discussions at the second working group meeting were compiled to produce this analysis report, specific to the river basin ecosystem type. This report was finalized following feedback from working group members (Appendix D) on the draft version.



Market life in the Mekong Delta / *A. Dansie*

CHAPTER TWO

# Critical Emerging Science Issues in River Basins

## 2.1 Challenges "on the horizon"

This section presents the critical science challenges currently emerging or expected to emerge in the near future.

Along with impacts on the hydrological cycle and water resources in various regions, climate change is seen as by far the most prominent critical science challenge in the management of river basins (Projects 342, 399, 1111, 1580, 1889, 2129, 2617, 2722, 3340). While many studies have been conducted on this subject, much still remains to be done, as the implications of climate change for river basins are multifold. For instance, with expected changes in the frequency and severity of storm events, flood and landslide risks may increase in some areas; thus, implementation of prevention and mitigation measures is essential (Projects 342, 1889). With increasing importance placed on environmental flows (Projects 615, 2701), the design of flood protection infrastructure, such as dams and diversions, must take relevant issues into account.

In contrast, some river basins may experience less precipitation, which entails constraints with respect to water availability. Therefore, challenges to manage water resources in a water-scarce situation remain significant (Project 1111). Assessment of the impacts of climate change in ecosystems also requires special consideration (Projects 2722, 3340).

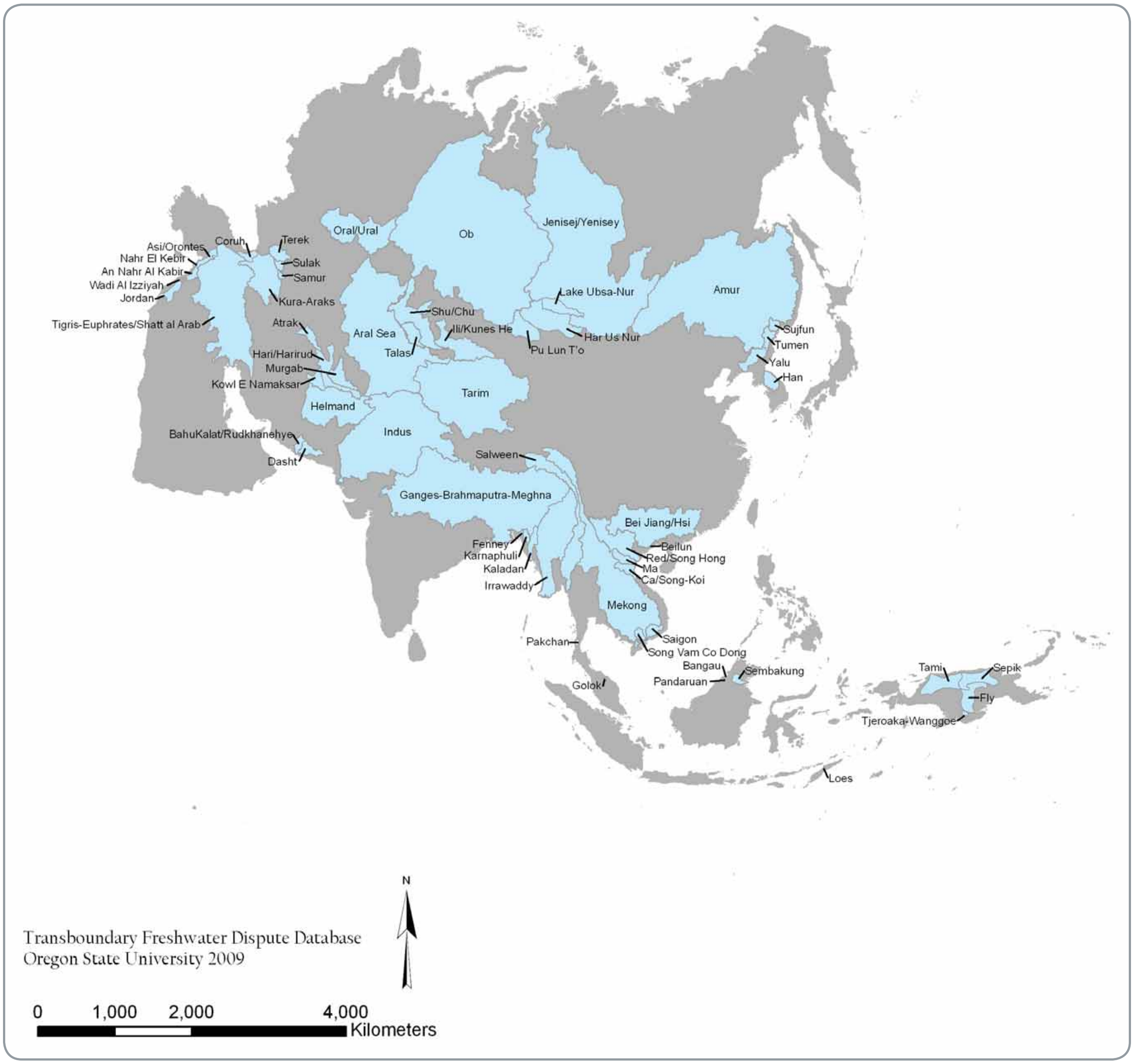
Challenges related to anthropogenic activities are also noteworthy, given that fast economic growth, especially in developing countries, is coupled with high environmental costs, and investments to protect the environment have not kept pace with growth. In river basin management, issues related to improper land use and unregulated development should be addressed (Projects 586, 614, 615, 2722). River basin problems associated with these include soil erosion and land degradation. The need for enhanced understanding of the impacts of land use and other development activities on water resources remains significant in specific river basins (Projects 615, 633) so that integrated land-use and water-resources planning may need to be implemented (Project 1537). In addition, current agricultural practices have led to new challenges with respect to water pollution. For instance, the presence of persistent micro-organic pollutants is a growing concern in many areas (Projects 399, 2617). Furthermore, with increasing attention given to the links between river basin and coastal areas, impacts of activities related to tourism on river basin and coastal resources deserve attention (Project 2129).

Certain challenges have lingered for some time and will continue to remain significant. Solid waste and wastewater continue to be major issues in many places. Eutrophication in water bodies is still a significant problem in many river basins around the world (Projects 614, 806, 1444, 1580, 2263), while invasive species is a new challenge in several river basins (Projects 614, 3340).

On the social science side, conflict resolution is a concern and a challenge (Project 2544). Inadequate geopolitical frameworks are increasingly recognized and appropriate measures need to be developed and implemented (Projects 614, 2722).

In addressing river basin issues, challenges with respect to the availability of scientific data are of particular note (Projects 615, 1111). While methodologies are available for the development and use of indicators, more progress in this area would be welcomed to assist decision making related to river basin management (Project 2617).

**Figure 1** Transboundary River Basins of Asia



## 2.2 Regional and global drivers of transboundary problems

Climate change, in particular, is seen to aggravate existing river basin problems if adaptation mechanisms or measures are not in place. Its effects on the hydrological cycle or hydrological regime are not only significant in terms of increased hazards (e.g., flooding, landslide, droughts, etc.) (Projects 1889, 2129, 2544) including erosion problems and subsequent concerns on reservoir sedimentation (Project 886), but equally important are its impacts on river basin ecosystems, habitats and biodiversity (Projects 530, 842, 1111, 1247, 2544, 3340). Evidence shows that climate change has modified critical habitats in some river basins (Project 530); has altered growth rates and physiological functions, resulting in changes to plant community structure; and has contributed to biodiversity losses (Project 1247). Furthermore, observed warming in specific areas has also resulted in problems regarding invasive or alien species (Projects 2263, 3340), with expansion of alien species now observed from the Mediterranean to the Black Sea (Project 2263).

On the other hand, climate change is not seen to be a significant driver of transboundary river basin problems that can be largely attributed to anthropogenic activities. Environmental pollution, specifically water pollution, a widely considered problem in many IW projects, is seen to be driven by high economic and population growth coupled by low investment in environmental projects, such as wastewater treatment plants (Projects 461, 586, 614, 849, 1323, 2135, etc.). Other environmental problems in a river basin are not addressed because the differing economic situations and political systems of riparian countries hinder effective collaboration (Projects 342, 1580). Other global or regional drivers known to influence river basin issues are trade, globalization and energy, but their impacts are sometimes not clearly evident (Projects 461, 806).

Some regional drivers are seen to contribute positively in addressing river basin problems. The EU directives (e.g. Water Framework Directive), in particular, are driving member states and those aspiring to be members of the EU to implement measures for protection and conservation of ecosystems (Projects 1889, 2617). These directives provide overarching programmes that could lead to long term protection of the water environment and improvement of the quality of all water bodies – ground and surface waters – and associated wetlands.

In other parts of the globe, regional collaborations for managing transboundary river basins are also observed. The Southern African Development Community (SADC), which has created the SADC Protocol on Shared Water Course (Project 842), and the Mekong River Commission (MRC) in Southeast Asia (Projects 584, 615) are among such inter-governmental bodies that actively work on managing water resources in an integrated manner. The Global Water Forum and the Global Forum on Oceans, Coasts and Islands are examples of collaborations on a global scale.

## 2.3 Understanding and managing multiple causality

"Multiple causality" is understood by the Working Group as recognition by projects of different causes of transboundary river basin issues or problems. In assessing how the understanding of multiple causality was undertaken in GEF projects, the focus was on identifying problems and their corresponding causes, or on project implementation activities; for example, establishing and implementing monitoring systems and data collection to determine in detail the different causes of river basin problems. The review of project documents reveals significant examples of such activities. Several projects emphasized the setting up of trans-national data collection, standardized data collection methods and analytical procedures (Projects 342, 2135), as well as establishing environmental databases and monitoring systems (Projects 342, 615, 1247, 1323, 1889). The use of specific tools such as simulation models (Projects 342, 615) and causal chain analysis to identify different causes was highlighted in various projects (Projects 461, 584, 2263). Problems and their multiple causes were also identified through comprehensive literature reviews (Project 2129), comprehensive risk assessments (Project 1889), impact assessments (Project 615), and other transboundary analysis undertakings (Projects 615, 1111, 1247, 2544). Specific examples include identification of multiple stressors from urban household and agricultural practices (Project 1444), and evaluation of the relationship between land cover and land use, as well as between wastewater, sanitation and health (Projects 886, 1542). Moreover, information gathering through surveys, stakeholder consultations, and involvement of different sectors in problem identification or in project development, may be taken as indications that efforts have been made to understand multiple

**Figure 2** Transboundary River Basins of Europe

causality in river basin issues (Projects 399, 849, 2129).

In assessing how managing of multiple causality was undertaken in IW projects, attention was placed on project activities designed as interventions to address problems arising from different causes. Examples found in the reviewed project documents include establishment of a transboundary river basin organization (Project 842); development of problem resolution frameworks (Project 1111); consideration of all possible relevant drivers (Project 2722); definition of priorities (Project 1247); design and implementation of integrated measures instead of isolated interventions or sectoral fragmentation requiring separate projects and entailing overlap of activities (Project 1889); other general approaches such as development of policy papers and environmental management plans (Project 1889, 842, 2617, 2722); and other strategic, integrated and sustainable programs for management of river basins (Project 586).

In a project for the Hai Basin in China (Project 1323), the following activities were related to managing multiple causality: (i) improving integrated water and environment planning and management in basin; (ii) promoting institutionally-coordinated and effective local, municipal/provincial, and basin-wide water and environment planning and management; (iii) enhancing local capacity in water and environment knowledge management and implementation; and (iv) reducing wastewater discharges from small cities along the rim of the Bohai Sea. On the other hand, the fact that the project was still ongoing, with a corresponding absence of final project documents, hindered verification of implementation of such interventions.

International cooperation among riparian countries and coordination between related government agencies were observed and also indicated management of multiple causality of river basin issues (Projects 2617, 1889). Involvement of local experts in project implementation and establishment of regional activity centres were also seen as activities geared for this purpose (Projects 849, 1580).

Management of multiple causality is also indicated in the implementation of a series of specialized experiential learning tools for good governance, focusing on understanding and promoting effective legal and institutional frameworks and decision-making (Project 3340). These tools include case studies, negotiations, role playing exercises, and interactive tools. Establishment of database and monitoring systems in several projects may also be considered as integral parts of managing multiple causality.

## **2.4** Spatial and temporal scales

Within projects, recognition of the importance of variable spatial scales can be seen, for example, in the consideration of the different roles of entities at the regional, national and local levels (Project 399); in hydrological analysis at mainstream, tributaries, and distributary, wetland and flood plain levels (Project 615); in conducting local and national programs (Project 530); in identification and quantification of the extent to which land-based activities and river regulation influence hydrology, water quality, fisheries, and aquatic ecology throughout the system (Project 586); and in understanding and encompassing regional and national issues (Project 2544, 2722). Use of regional approaches, integration of regional data, and a GIS database also seems to indicate consideration of various spatial scales (Projects 342, 842, 2129, 2617).

Some members of the Working Group seemed to focus on the spatial variability of basin characteristics, issues and problems, reflected in selecting project areas based on the geographic characteristic of the basin (Project 1323); in dividing the basin into three major zones

Agricultural produce at the Tanzania – Kenya border / *A. Dansie* for analysis (Project 615); or in the mention of the replicability of specific project activities implemented in one riparian country to other countries, or of pilot projects to other locations (Projects 342, 461, 614, 849, 1889). Across projects, it can be said that the measures or activities implemented at different spatial scales (regional, national, location-specific pilot projects) indicate that variable spatial scales have been accounted for. Moreover, demonstration, capture and transfer of best practices may be expected to accrue further regional and, by extension, global benefits (Project 2129).

An example of an approach to address spatial variability in the social science context was also found during the review of project documents. In the Danube River Basin, where many countries in transition face similar barriers to public involvement, measures to improve public access to environmental information developed for pilot countries also provide good models for other Danube countries committed to increasing public involvement in reducing pollutant discharges (Project 806).

With respect to temporal scales, the review revealed information in some projects but not others. Recognition and inclusion of various temporal scales is indicated in use of appropriate time steps in simulation models, with due consideration to daily, seasonal, and annual variations (Project 615); in the investigation of different scenarios (Projects 342, 615); in the measurement of water quantity and quality parameters (Projects 842, 1537); in studies conducted related to flood protection measures (Project 1889), and in the assessment of the trend or projected status of environmental parameters (Project 399). In other projects, temporal variation seems to be the focus, as indicated, in the analysis conducted for future circumstances and in the emphasis on the applicability of implemented measures or projects to future efforts (Projects 614, 806). On the other hand, indications of a lack of consideration of temporal scales include the non-homogeneity of historical data (Project 2544). With limited information from individual projects, no clear assessment on the use of temporal scales across GEF projects could be made.

In terms of improving integration of various spatial and temporal scales in river basin assessment studies, remote sensing was identified as a specific tool (Project 886).

## 2.5 Coupling of social and ecological systems

The interrelationship between social and ecological systems has been widely recognized; therefore, the importance of considering the coupling of these systems in understanding and addressing transboundary river basin issues cannot be overemphasized.

Although some of the IW projects reviewed do not clearly reveal consideration of the coupling of social and ecological systems, probably partly due to the absence of adequate documents, several pertinent approaches or methodologies were found to have been adopted in most GEF projects reviewed by the Working Group. Such approaches could be general or specific, as can be seen in the discussions below.

One of the most common approaches used is adoption of participatory approaches or stakeholder involvement at different stages of the project (e.g., Projects586, 614, 615, 806, 849, 1537, 1580, 2722). With the involvement of individuals or organizations from different and relevant sectors (i.e., with social, economic, technical or environmental backgrounds), it can be said that their collective input (in discussions or reports) ensures consideration of the coupling of social and ecological systems in addressing river basin problems. Such an approach not only makes certain that coupling of the these systems is included in paper or project documents but also, more importantly, in project implementation, as stakeholder participation remains constant throughout all stages of project activities (Project 806).

Activities under this approach include meetings, seminars, consultations, workshops, roundtables, conferences, symposia, etc. Creation of working groups (Projects 615, 2722) deserves special mention here. Such groups, whose members usually have diverse expertise and come from different backgrounds, are instrumental in preparing important documents such as policy briefs, shown to be useful in updating decision makers and/or policy makers. Capacity-building components in GEF projects are also seen to assist in this, particularly when these programs are aimed at developing the technical and scientific capacities of individuals and research institutions involved in environmental studies (Projects 342, 614).

In the review of project documents, members of the Working Group have observed that understanding and incorporating coupled social and ecological systems is an integral part of feasibility studies, specialist reports, environmental impact assessments, environmental management plans, stakeholder analysis, bibliographic reviews, and other analysis and evaluation undertakings (Projects 615, 842, 1580, 1889, 2263, 2544). Specifically, methods used in several projects include scaling-scoping-screening methods and causal chain analysis (with root cause analysis integrated) in assessment studies, and policy options analysis (Projects 461, 584, 1537). Adoption of causal chain analysis, which aims to determine the immediate and root causes of identified issues and problems, and analysis of policy options together provide some assurance that a comprehensive and integrated approach is applied in addressing international waters issues (Project 584). Moreover, several projects have also demonstrated the use of simulation models and monitoring and information systems to enhance the understanding of social and ecological issues (Projects 342, 615, 2135).

Conducting of pilot projects or programs is also noteworthy in terms of ensuring application of developed methodologies on the ground (Projects 530, 2129).

In a general sense, promotion and incorporation of sustainable development and Integrated Water Resources Management principles in GEF projects also seem to indicate that interrelationships between social and ecological systems have been considered (Projects 2364, 2544, 2617).

## 2.6 Trade-offs between response actions

In analyzing this issue, it was essential to identify response options formulated in the project development phase (possibly available in the TDA) and determine whether trade-offs between or among such options were considered, and what scientific knowledge was available and used in assessment of options. Based on available documents, it can be inferred that while some projects indicate several alternatives were considered in the early stages of project formulation, many other projects do not have available documents that disclose such information. Depending on the nature of the project, particularly when the role of science seems limited, it could be that in some cases activities had been pre-determined, and thus there is no mention of evaluation of trade-offs between alternative options.

In many cases, project documents reveal the approach or method used in evaluating response options or intervention alternatives. Examples of such approaches include scenario simulation and analysis, cost-benefit analysis, causal chain analysis, environmental impact assessments, valuation/assessment of ecosystem goods and services, consultation meetings, use of indicators, and other social and economic diagnostic tools and scientific methods (Projects 342, 530, 615, 842, 886, 1580, 2129,

Social and ecological considerations must be approached jointly for successful river basin management and, ultimately, IWRM / *A. Dansie*

Cooling off in the river, Brazil / *UN Photo, E. Debebe*

2263, 2544, 2617). In other cases, while there is mention of a prioritization process adopted in selecting the specific project activities for implementation, details are not provided in the available project documents (Project 1889). Nevertheless, the mention of such methods at least reveals, in one way or another, the underlying scientific knowledge in their application.

When project documents reveal some information on the scientific knowledge used in evaluating options, the use of standard scientific information can be expected. For instance, knowledge on river basin hydrology, climatic characteristics of the region, stresses in the basin, and other basin characteristics are cited (Project 461, 1537, 1889). There is also mention of knowledge of international practices that influenced the selection of project activities. For example, awareness of documented cases is revealed in the recognition that coordinated disaster management brings better results than the uni-sectoral approach and leads to selection of activities or interventions through a comprehensive framework approach (Project 1889).

While the information described above may not seem meaningful at first glance, nonetheless it is essential. As highlighted in some projects, the use of any methods to evaluate trade-offs among alternatives could not be conducted properly without available scientific data, again highlighting the significance of data collection and, equally important, the establishment of databases for monitoring and decision making.

Considering the regional scope of transboundary river basins, it would be difficult to compare or evaluate data from different countries, and consequently the response options, if they are measured in different ways. Given this, the importance of harmonized data measurement and collection at least within each river basin cannot be over emphasized.

CHAPTER THREE

# Development and Use of Indicators

## 3.1 Building and implementing sound indicators and monitoring strategies

Based on the assessment of project documents, it is not clear how these GEF projects developed new indicators or adopted or tailored existing indicators in applying them to specific projects. In most cases, project indicators are found in the logical frameworks or in the monitoring and evaluation plans developed for the project (Projects 342, 530, 2129). These tend to be a mixture of indicators for project processes or implementation and indicators of project impacts. Indicators of the former type are usually deliverables and completion of activities, whereas indicators of the latter type include natural or bio-physical and socio-economic indicators.

The process for developing or selecting indicators is not clear. However, given the common practice of involving stakeholders in the project development, it is highly likely that indicators were developed or selected through stakeholder consultations, workshops, working groups, etc. and, in some cases, with the possible participation of policy makers (Project 633). In one project (Project 615), identification and selection of indicators started with defining and reviewing international practices in determining appropriate indices for the aquatic environment. Then, environmental indicators were selected and analyzed based on the basin's specific ecosystem components and linkages. The choice of socio-economic indicators, on the other hand, was specifically based upon how the planners intended to interpret the socio-economic goals for the basin, as well as on data availability. Application of the identified indicators is demonstrated in the evaluation of a range of development scenarios to support basin development planning.

Some projects appear to have clear project impact indicators (or indicators of environmental, social and economic benefits) (Projects 530, 842, 886, 1444, 2135, 2364). Moreover, recognition of the need for evaluation of the extent to which expected benefits have actually been achieved is indicated in the inclusion of monitoring and information systems or other monitoring strategies (Projects 399, 1247, 1580, 1889). However, given the absence of key documents, such as the final and terminal evaluation reports, this is difficult to assess — within the timeframe of the IW:Science project (Projects 399, 1323, 2135). Although some documents produced under a project may have included such indicators, such as the Report on International Water Quality Monitoring Programme, pollution assessments, etc., most, if not all, of these documents are currently not locatable (Project 399).

Some deficiencies were also observed that could lead to failure in monitoring project impacts: for instance, the absence of evaluation frameworks or a failure to charge specific entities with responsibility to collect national and international data (Project 2722).

Moreover, it appears that in some projects verification of project benefits (e.g. social and economic impacts) does not form part of the project activities, but rather is delegated to established river basin organizations (such as the International Commission for the Protection of the Danube River [ICPDR] for the Danube River Basin or the Mekong River Commission [MRC] for the Mekong River Basin, Projects 399 and 615 respectively). Hence, relying on project documents to determine the various impacts of projects may not provide the desired information.

## 3.2 Identifying effective proxy indicators

This section is aimed at responding to GEF's intention to identify intervention measures in river basins where data is lacking using established relationships between environmental parameters and the status of the environment in other similar river basins. For instance, if data on pollution in one basin is lacking, but proxy indicator(s) are available in other basins (with similar characteristics) related to the specific pollution under consideration, then interventions may still be identified through considering that proxy indicator. It is generally understood that such proxy indicators should be readily available and/or easy to measure.

In trying to determine how to identify effective proxy indicators, members of the Working Group reviewed the project documents to see if effective and useful proxy indicators have been used in the project and the process by which such indicators were identified. In this section, discussions include the RBWG members' personal experience or ideas on identifying such proxy indicators.

In a significant number of projects, information that reveals the use of proxy indicators is either not present or, at best, not clear. Based on the review, specific information on how to identify effective proxy indicators includes:

- Use of Driver-Pressure-State-Impact-Response methodology (Project 1111);
- Involvement of scientific bodies in the project design (Project 1247);
- Promotion of convergence of evidence, based on several social and environmental indicators (Project 1444);
- Review of international practices in developing or identifying indicators (Project 615); and

Signage to assist with traffic and transport on the Mekong Delta

- Use of technologies such as remote sensing to develop and monitor environmental stress indicators (Project 2364).

The potential of remote sensing in identifying proxy indicators for use in most IW system types is indeed promising due to the applicability of remotely sensed data to wide areas such as international waters. In addition, remote sensing-based indicators are considered effective for use in studies or assessments related to river pollution or to land cover degradation, and they are consistent and cost-effective (Project 886). An example of a remotely sensed indicator that can be used as proxy indicator for water quality degradation (e.g. eutrophication) is the remote sensing-based algal chlorophyll level that may supplement data on biological and nutrient loads (Project 1542). Similarly, proxy indicators that delineate the use of fertilizers, stock farming or land use changes may also be helpful (Projects 342, 1580). Finally on this point, the number of sewage plants can be used as proxy indicator for water pollution with respect to point sources (Project 342).

In assessing the general state of the environment, the ratio of investments for environmental protection to GDP can be a proxy indicator for use in IW projects, as often environmental problems are evident when high economic growth is not matched with such investments (Project 2135).

## 3.3 Use of appropriate science and best practices for TDA

This section deals with processes or approaches that may be adopted at the planning or initial stages of the project for better use of appropriate science and best practices for conducting Transboundary Diagnostic Analysis (TDA).

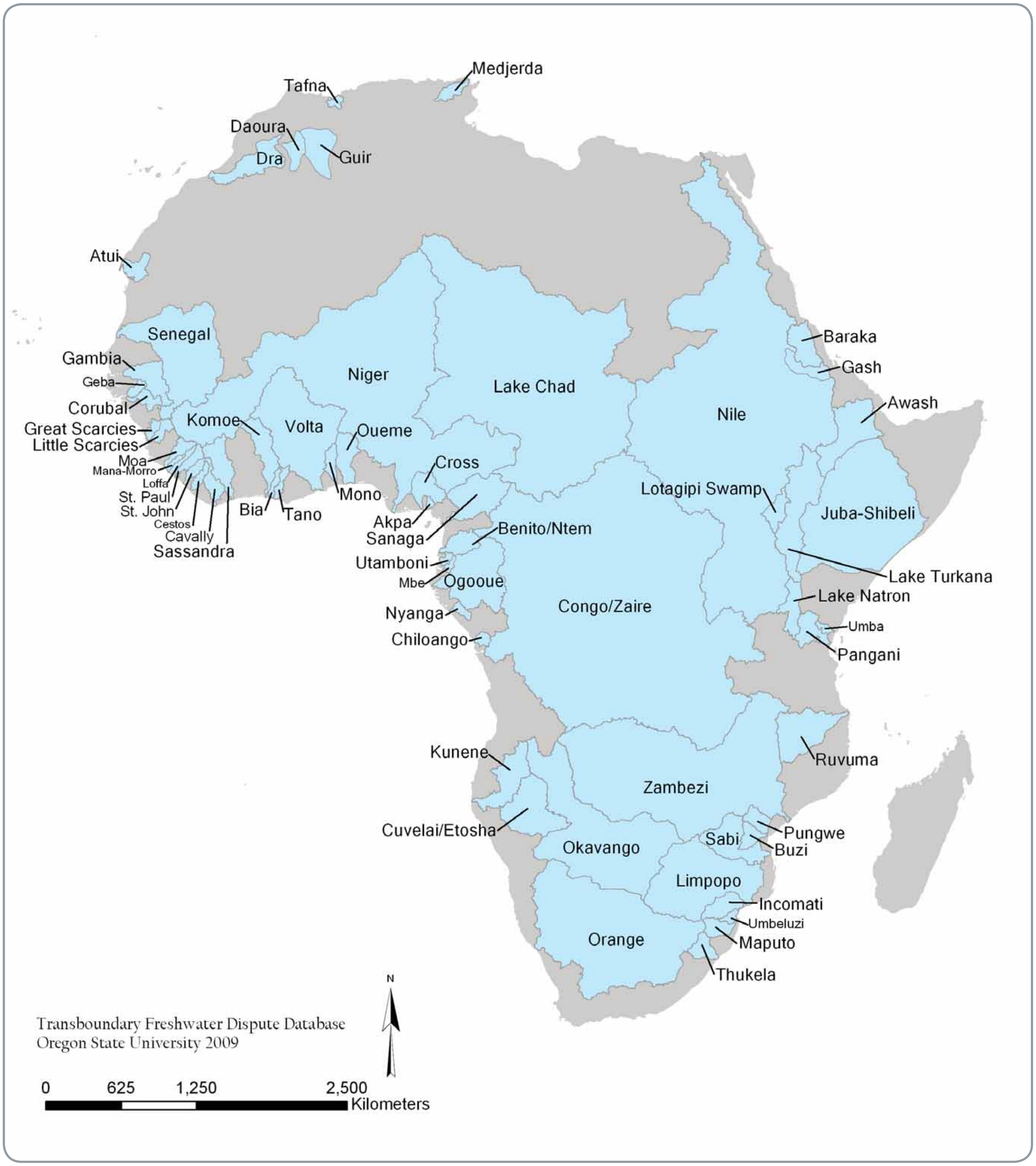
Data on the environment, society and economy in the river basin are the foundation of any TDA. That being said, the application of appropriate scientific tools and best practices for TDA may be constrained by the absence of accurate and up-to-date data and information, again highlighting the importance of data (Projects 530, 2129). It is suggested, therefore, that trans-national data collection, standardized data collection methods and analytical procedures be implemented in each transboundary river basin (Projects 342, 615). Integral to this is establishment of monitoring systems to collect time series data (Projects 586, 1580, 2129, 2135), as well as development of easy-to-measure indicators and indicators systems (Projects 530, 1580). Accordingly, information databases or systems need to be established for stakeholders to access environmental and other relevant information (Projects 342, 615, 806, 1580, 2129), and, consequently, lack of data would no longer be an escape clause in any assessment study (Project 2129).

Another approach that can help in the use of appropriate science and best practices is the strong involvement of stakeholders, particularly local academic and research institutions, in project development, design, and implementation (Projects 1444, 2129, 2544). Their involvement would pave the way for efficient implementation of many activities that may otherwise be compromised. For instance, field work could be conducted in remote areas instead of relying on proxies, model assumptions, etc. (Project 2129). Involvement of such local institutions also implies incorporating or considering local knowledge in the adoption of scientific and best practices that may have been developed in basins with significantly different characteristics (Projects 2129, 2544). In addition, an interdisciplinary approach should be considered as an initial step in the TDA process to prevent shortcomings or inadequacies caused by too narrow a focus in project design and implementation (Projects 1111, 1247).

As demonstrated in one of the projects, use of a comprehensive model package is highly useful in determining the probable transboundary impacts of development scenarios, and is essential, therefore to making decisions concerning basin development and management (Project 615).

Capacity-building activities should be considered, and not only the usual short-term training but as regards building a capacity to produce scientific documents and publications (Projects 633, 2129, 2617), which implies the involvement of postgraduate students. This is vital as scientific publications are a necessary part of deliverables required to improve the application and dissemination of appropriate science and best practices (Project 2129). In line with this is the commissioning of specialist reports, results of which can be used to develop and test scenarios for analysis (Project 842). Adequate referencing should be implemented as part of study reports, reflecting contemporary practices (Project 633). In the end, the sharing of such information through meetings, workshops, print or online publications, etc. (Project 2617) is essential and would help subsequent projects in using the scientific information or practice developed.

**Figure 3** Transboundary River Basins of Africa



CHAPTER FOUR

# Applications for Adaptive Management in River Basins

## 4.1 Engagement of local and wider science communities

As detailed in the RBWG Synopsis Report, engagement of local and wider (or international) science communities is widely used in the GEF projects reviewed and can be grouped as follows:

- Preparation of background documents, reports or assessments or plans (Projects 584, 1111, 1537, 2364, 2722);
- Project inception and design (Projects 586, 615, 791, 886, 1229, 1580, 2617, 2701);
- Involvement in workshops, meetings, seminars, fora, regional/international conventions and conferences (Projects 584, 615, 806, 842, 886, 1444, 1247, 1537, 1580, 2136, 2263, 2444, 2722);
- Involvement in consultations and stakeholder dialogues (Projects 586, 615, 2136, 3340);
- Involvement in steering and working groups and roundtables (Projects 584, 615, 2722, 3340);
- Establishment of networks, partnerships or coordinating groups (Projects 584, 586, 615, 1111, 1247, 3340);
- Research cruises, tours, trainings and other education programs (Projects 586, 615, 842, 1111, 1580, 2136, 2544, 3340);
- Publication and project reviews (Projects 1537, 1580, 2701); and
- Project implementation activities (Projects 615, 1444).

Although details are not shown here, participation of local and international scientific bodies appears mixed in nature, as can be deduced from the types of activities listed above. In a single project, several approaches are adopted. But in general, for specific projects in a river basin engagement of local experts or scientific bodies is high, but engagement of wider science communities is low to medium; whereas for projects with broader scope (e.g. regional or global), the opposite is true — the engagement of international experts and experts at the national or regional level is higher than that of local scientific entities. In certain river basin projects, international or wider science communities are used in two ways: indirectly, through review and adoption of existing knowledge and technologies and drawing from the worldwide experience of international experts; and directly, through involvement of international experts as consultants (or reviewers) in the formulation and implementation of project activities. In other cases, there is low involvement of wider (international or global) science communities, probably due to the availability of regional expertise within the basin, as is to be expected for transboundary river basins (Project 399).

Based on the review of documents, extensive efforts have been made to engage local and international scientific entities. However, while the involvement of specific local and international scientific individuals or institutions was clear in some projects (Projects 806, 3340), cases of low engagement were also observed (Projects 1111, 1355, 2544). In many regional teams, social scientists and policy scientists were underrepresented (Project 584). In some cases, significant involvement of experts from line agencies of riparian countries seemed lacking (Project 615). Moreover, not all projects included relevant institutions or research bodies in their activities. In at least one project, mobilization and incorporation of research bodies was not considered in the project design (Project 2701). Otherwise, this would have "ensured that the work was not just done by 'consultants' but could have meaningfully enhanced the science base as well as building the capacity at the post graduate levels in the region".

In some instances, local communities were not engaged at an early or at any stage of the project (Project 530, 1111), while in others components to engage them were included (Project 530). In some projects, involvement of local universities, in particular, is missing (Project 1580, 2129). In others, the interaction with local communities was limited (Project 584) possibly due to the regional and global scope of the project. This seeming lack of participation from local stakeholders (experts, scientists, or scientific institutions) could be due to the absence of stakeholder analysis and stakeholder involvement plans (although in some cases this is planned in the proposal). Thus, it is necessary to define a framework to involve all stakeholders in the most appropriate manner to achieve project success. Involvement of scientists (e.g., from universities, research institutions, laboratories, etc.), in particular, is helpful in linking communities and policy makers.

Other ways to improve engagement of local and wider scientific communities include strengthening of the regional legal basis of environmental measures, development of regional capacity, and strengthening of institutions (Project 1247).

## 4.2 Application of scientific expertise and local knowledge

With reference to the previous section on engagement of local and international scientific communities, local expertise (e.g., local universities, local governments, and scientists at the national or river basin level) seems to be widely used in GEF IW projects. As described earlier, local expertise was engaged to a varying extent at different project stages, from project development through to project implementation.

On the other hand, there seems to be lack of application of local knowledge, considered to include indigenous knowledge and scientific knowledge that originates from the locality or river basin. Use of local scientific knowledge, in particular, appears to be limited to use of local databases and scientific information in project proposal and development (Projects 1323, 1444, 2135, 2617).

While there is some evidence that local knowledge has been applied —for instance, traditional knowledge (e.g. in fishing) was incorporated in management strategies in some regions [584] or consideration of traditional knowledge was expected to be part of the interpretation of quantitative environmental indicators (Project 615) — adoption of traditional or indigenous knowledge appears to be lacking. Available documents in some projects suggest no use of local knowledge in the design of the project (Projects 1111, 1247, 1542, 2722). In cases where it is included in project proposals, no evidence of its application is to be found in reports, or reports cannot be found. For instance, there may be a good understanding of traditional practices, yet no information was found on their explicit application in project implementation (Project 886).

The technical nature of some projects (Project 1889) or the availability of obvious solutions to specific river basin problems (Project 1542) could also be reasons that local knowledge was seemingly not sought in some projects.

In many cases, participation of local communities, including scientific entities, is widely considered, but consideration of local knowledge seems to have been sidelined or was deemed not significant enough to put in writing. As an example, a project has plans to include the local community through building sanitation facilities and through economic activities, but there was no specific mention of using local knowledge in the project (Project 1444). Nevertheless, it should be noted that though available project documents do not show the incorporation of local knowledge in the projects, participation or involvement of local experts and scientists in the project could have led to the sharing and use of local scientific knowledge in addressing river basin issues and problems.

An experience in one project illustrates this. Having realized that more than 85% of the scientific capacity in the Amazon region is concentrated in public universities and national research and innovation centres, the project (Project 2364) identified that it was essential to stimulate creation of a communication network to foster exchange of local knowledge and expertise in the region, to establish common lines of research, and to support public policies, producing an improvement in regional competitiveness.

No information was found on the influence of local expertise and knowledge on new findings, on methodologies, science breakthroughs and emerging issues. It seems that most projects rely on the international scientific community (e.g. through scientific publications), for guidance in the design and implementation of projects.

## 4.3 Linking science and policy implementation

One of the challenges the scientific community continues to face is adoption or translation of scientific knowledge into policies for implementation at a national or regional scale. It is clear that once a policy has been created, it can drive implementation of scientific measures to a greater extent. As an example, the EU directives have definitely pressed member states and those aspiring for membership to implement stipulated environmental measures. In GEF projects, these directives provided guidance on the selection and implementation of project activities [1889].

In the review process, the following examples show the use of project outcomes in policy-related activities:

- GIWA recommendations have guided development and implementation of GEF projects in Latin America (Project 584);
- The Decision Support Framework (DSF) developed for the Mekong River Basin was used as the scientific analytical basis for formulating technical procedures and guidelines, and the outputs of the project (WUP) were incorporated in the MRC Strategic Plan 2006-2010;
- Use of data/information in the preparation of the Black Sea Diagnostic Report (2010) by the Permanent Secretariat of the Black Sea Commission (Project 1580);
- Project results have contributed to achievement of the goals of the Black Sea-Danube Strategic Partnership for Nutrient Reduction (GEF-World Bank – UNDP), advanced implementation of the EU Water Framework Directive, and in general improved environmental sustainability, in line with the Millennium Development Goals (Project 2617);
- The policy brief on marine biodiversity is playing a catalytic role to the CBD process of measuring progress in implementing programme work on marine and coastal biodiversity (Project 2722);
- Project findings (Project 596) are implemented in national programmes (with ToR).

In addition, several lessons were learned concerning improving the links between science and policy implementation. One is the importance of reliable scientific data and information to influence policy actions (Projects 399, 615, 2617), and its subsequent dissemination. As an illustration, measures implemented to overcome data constraints by obtaining the cooperation and inputs from riparian countries resulted in the successful preparation of the Strategic Action Programme (SAP). Consequently, the SAP was endorsed by Environment or Water Ministers of the Danubian countries and the Member of the European Commission responsible for the Environment in the Ministerial Declaration of Bucharest (Project 399).

Another is related to project ownership, which is mainly addressed through active involvement of stakeholders in the project (Projects 614, 615, 1111, 1247, 1444, 2263, 2364, 2617, 2722). An important feature of this is the particular participation of regional and local players, especially those attached to policy-making or decision-making bodies. When these stakeholders are actively involved in the project and subsequently acknowledge the significance of the project findings, they become advocates in the policy-making realm and, in all likelihood, could influence policy formulation. Moreover, when a large number of stakeholders are involved in the project, this can also translate to enhanced knowledge that could influence future policies, at local, national or regional scales.

The use of pilot projects and national case studies seemed to be helpful in translating scientific measures or interventions into policies (Projects 530, 615, 1444). For instance, a Water and Land Council was established in the River Amme basin (a tributary of Lake Peipsi basin) as a pilot project to gather local authorities, farmers, fishermen, teachers, etc. who help local and state authorities in making decisions and developing policies

Local Man Keeps Bhutan's River Immaculate / *UN Photo, G. Fickling*

concerning use and protection of local resources in the area (Project 1444). The measure was successful and the creation of Lake Peipsi Council was planned using the experience from the pilot project.

Other measures or initiatives that were found to help in linking science and policy include linking project outcomes with formulation of national action plans (Project 461) and the use of independent scientific advisory groups and/or working groups in developing documents intended to be disseminated to policy makers. A project (Project 2722) has specifically reported that "according to a number of representatives from governments, UN agencies, and NGOs, the work of the Global Forum's working groups was very useful in laying the groundwork for the UN Ad Hoc Open-Ended Informal Working Group to study issues relating to the conservation and sustainable use of marine biological diversity beyond areas of national jurisdiction".

The above discussions imply the importance of wide dissemination of reliable scientific information or science-based outputs to influence policy formulation. This is noteworthy given that though significant natural and social science findings are found in GEF projects, which have potential for replication in other areas, their communication to the local (possibly in respective local languages) and wider community seems limited, particularly in peer-reviewed publications. Heightened effort to ensure an increase in peer-reviewed publications

**Figure 4** Transboundary River Basins of Latin America

would contribute to enhancing the quality of science in GEF projects and its further use, particularly in formulating environmental policies.

## 4.4 Evidence of adaptive management

In this section, evidence of adaptive management is presented both within a project and between or among GEF projects. The former is based on individual project analysis, whereas the latter is intended to look at the river basin IW system type as a whole across the projects reviewed. In reviewing the documents of individual GEF projects, evidence of adaptive management within a project may be related to project management or implementation and/or on-the-ground adaptive management as influenced by the project. In addition, suggestions on communicating the scientific dimensions of adaptive management to different user groups are provided.

### Adaptive management within a project

The ongoing status of many of the projects reviewed and/or the limited attention given in available documents constrains identification of evidence of occurrence of adaptive management within individual projects. Nevertheless, some indications were found in some projects and these are presented below.

An example is the case of Mekong River Basin (MRC), where implementation of WUP is an indication of adaptive management in MRC – from separate or unrelated modelling efforts of individual projects to an integrated or comprehensive basin simulation model package that can be used in basin planning and management functions of MRC (Project 615). Outputs of the Water Uilization Programme(WUP) are currently being used in managing the basin, particularly in the Basin Development (BDP) and Environment Programmes (EP) of MRC. Along with WUP's potential outcomes, they have been thoroughly incorporated in the MRC Strategic Plan 2006-2010.

In one project (Project 584), a mid-term evaluation report was highly critical of the project and this resulted in implementation of corrective actions that made the project a success. In another project (Project 1580), there was a series of re-focusing initiatives of the main activities, based on the priorities of key stakeholders and findings of some research activities. This led to a decision to downgrade certain activities that were not found to have enough weight to make an impact, and indicates adoption of adaptive management in the project implementation. The above examples indicate the importance of including in the project design some flexibility for change in project activities, based on progress or experience in project implementation (Project 2129).

Other indications of adaptive management occurring within a project include the continuous upgrading of the project teams' skills and the training of the farmers in the basin (Project 1537); adoption of project outputs as procedures or guidelines to be followed by the member states of the basin commission (Project 615); and changes in the organizational structure of a river basin commission to ensure sustainability of the activities and outputs of the project (Project 615).

Furthermore, while specific evidence is not mentioned in the reviewed documents, involvement of stakeholders and adoption of a participatory planning process in project design, as well as in proposed actions in the SAP, could indicate that adaptive management has been incorporated in the project (Projects 342, 399). It was also observed that the approaches and activities of established scientific communities who are implementing a series of GEF projects (e.g. Global Forum on Oceans, Coasts and Islands) are continuously aligned with current issues and problems (Project 2722).

Examples of on-the-ground adaptive management seemed difficult to find in the available documents, although in reality it may be happening but not be documented. In contrast, indications of the absence of adaptive management were found. For instance, based on the final evaluation report on capacity building, adaptive management seems to be not easily achieved (Project 842).

### Adaptive management across GEF projects

Finding evidence of adaptive management across GEF projects was rather difficult, possibly in part due to the limitations of the working group members in reviewing the project documents. Evidence of adaptive management across GEF projects could be unearthed if careful and chronological assessment of documents of several projects implemented in a specific river basin was carried out. For instance, a number of projects have been implemented in the Danube River Basin (DRB) with funding support from GEF. The Strategic Action Plan for the Danube River Basin (1995-2005) was first completed in 1994 under the GEF-funded Danube River Basin Environmental Management Project (first phase). In accordance with the goals of the SAP, particularly on pollution reduction, the DRB Pollution Reduction Programme (a GEF project, which provided a contribution to the second phase of the Environmental Programme of the Danube River Basin [EPDRB]) was implemented between 1996 and 1999. Under this project, a Transboundary Diagnostic Analysis was prepared and, based on the outputs of the project, particularly national reviews and planning workshop reports, a revised SAP was completed in 1999 integrating a pollution reduction strategy.

On the other hand, it can be said that the approaches adopted in GEF projects may have changed over time given the availability of new findings or advances in river basin management. For instance, adaptive management is apparently the driver for a project, as guided by the World Bank's current thrust. Instead of post-disaster actions, a specific project focused on prevention and mitigation of impacts of extreme events, e.g. earthquake, flooding, landslide, and mining spill accidents (Project 1889).

### Communicating scientific dimensions of adaptive management

A common approach that may still be used in communicating scientific dimensions to different user groups is stakeholder involvement in project activities. It is vital to link the scientific community with other stakeholders to find the best adaptive management in the context of the project (Project 2544). Other methods include use of demonstration projects in communicating with different user groups (Project 1323), and development of communication strategies to disseminate information about the project and its results (Project 2617). Other means of communicating science and results, as detailed in the Synopsis Report, may also be adopted.

## 4.5 Communicating newly-synthesized science knowledge

Based on the review of project documents and following discussions held during the second working group meeting in Durban, South Africa in October 2010, the following are specific suggestions that may improve communication of newly-synthesized science knowledge to stakeholders within and external to GEF.

Develop a mechanism to include and disseminate scientific information: GEF needs to explicitly require preparation, submission, and dissemination of scientific information produced by the project in the project design of. This is following the observation that GEF-required project documents do not contain adequate scientific information, most probably because these reports are not required or tailored to provide such information. For instance, during the working group discussion in Durban, a member revealed that based on the assessed documents a specific scientific tool (i.e. remote sensing) was not utilized in one project although the tool is highly relevant to the project objectives (Project 886). Coincidentally, another member of the group had personal knowledge of the project and disclosed that one doctoral student worked on his dissertation under the project focusing on the use of remote sensing. Thus, while it is possible that many or most GEF projects actually have significant and up-to-date science components, a mechanism to systematically include such information in the project deliverables is lacking.

Establish repository of scientific information: Though project documents are commonly available in the GEF projects or other websites, these do not include specific scientific documents produced under the respective projects. Hence, a database or an information system containing all such scientific documents, probably similar to the IW:Science database, is suggested (Project 1580). More importantly, such a database should be public, meaning accessible to any interested entities. A specific repository of scientific information gathered by every GEF project should also be made available (in electronic and print copies) to the public in the respective locations of the study areas so that the local and wider scientific communities know where they can obtain information when desired. While this is being developed, uploading scientific documents and making them publicly available in respective project websites would fill the gap (Projects 586, 806, 1247, 2263, 2364, 3340).

Encourage participation of certain user groups in the project activities: It has been observed that in several projects, specific user groups are left out of the project design and implementation. Such user groups or stakeholders include local universities or research institutions (Projects 1111, 2617). Inclusion of such scientific entities in the project provides an opportunity to produce a critical mass of information (environmental, social and economic data at national and regional levels) that will be accessible to all stakeholders (Project 1111). The involvement of postgraduate students should form part of these projects and should be quantified (Project 2129). Twinning between tertiary institutions and creation of joint research teams would facilitate collection, analysis and dissemination of scientific information (Project 2129).

Peer-review of documents and publication of scientific papers in refereed journals: Some projects have explicitly noted that there should have been more peer-reviewed literature produced (Project 2722). While the dissemination of information through gatherings or print or online media seems reasonable in many cases, there is a recognized need for a rigorous review of project reports or documents, especially those containing scientific knowledge. This would eventually improve the quality of the documents and may have higher influence or impact on the users or stakeholders, given that peer-reviewed publications tend to get acceptance and serious consideration. Furthermore, publication of scientific papers in refereed journals would indicate the soundness or strength of the scientific components of the project. In order to optimize the exchange or diffusion of scientific knowledge in the process, co-authoring between local and international experts of these publications is strongly recommended (Project 2129).

This suggestion, however, does not undercut the usefulness of publishing or disseminating other documents such as newsletters, annual progress and final reports, case study materials, manuals, and other reports or informational packages (Projects 461, 614, 806, 1111, 2263, 3340). Publishing and disseminating science-based outputs in local languages may also have useful outcomes (Project 615).

Organize events for sharing of scientific findings and information: Apart from the usual consultations, meetings, workshops, etc. (Projects 342, 614, 849, 886, 1537, 1542, 1580) commonly organized under GEF projects, the holding of regional or transboundary basin-wide congresses, seminars, or conferences for the presentation and discussion of scientific findings, which will be attended by basin stakeholders and GEF entities, would certainly help in the communication of scientific information. Other activities such as school outreach and capacity-building activities (e.g. training local young researchers) that are intended to share scientific information obtained under the project would also be helpful (Projects 530, 1444, 1580).

Identify liaison for information sharing among stakeholders and between GEF and other entities: It is important that GEF identify or assign responsible entities to ensure that information is being shared among stakeholders and GEF-related institutions. While this may be applied on a per project basis, this measure is intended to cover all GEF projects.

Mountains contributing snowmelt to the hydrology of Danube River Basin, Romania / *A. Dansie*

CHAPTER FIVE

# Conclusions and Recommendations

In spite of the constraints encountered by Working Group members, particularly the lack of documents and the lack of attention given to scientific components in available project documents, a reasonable amount of information was extracted to produce this Analysis Report for the River Basin IW System Type. The following are the main conclusions and recommendations.

With respect to critical emerging science issues, it was found that the impact of climate change is by far the most prominent emerging challenge in river basin management. This global driver of transboundary problems is particularly significant with respect to increased hazards and their impacts on river basin ecosystems. Other drivers further aggravate river basin problems; for example, population and economic growth not coupled with sufficient investment in environmental projects, or the differences and potential conflicts between economic/political systems of riparian countries. On the other hand, examples of regional drivers that are seen to assist in addressing transboundary problems effectively (e.g. EU directives and intergovernmental organizations such as ICPDR and MRC), were found. Such measures should be considered in other river basins wherever applicable.

Indicators seem to be widely used in river basins, both for assessing project performance and project impacts, though how they were developed or selected for application in specific projects is not clear. On the other hand, application of the latter type of indicators to evaluate the environmental, social and economic benefits of projects is apparently limited. Setting aside the lack of project documents, factors considered to affect assessment of project impacts include lack of an evaluation framework, failure to identify and charge specific entities for this purpose, and possibly the non-inclusion of the verification of project benefits as an integral part of the project. Furthermore, while scientific tools and best practices abound, application of such tools and measures may be constrained by the lack of accurate and up-to-date data and information. Thus, the importance of extensive and harmonized data collection and the establishment of a publicly-accessible information database and a monitoring system are emphasized.

Evidence of application of science for adaptive management with respect to project management was observed, but information about on-the-ground adaptive management is almost non-existent in the available documents. Discussions during the second Working Group meeting seem to indicate that project documents are apparently not designed or intended to include such information. An approach that could have been adopted to unearth such information is the careful and chronological assessment of documents of projects implemented in specific river basins; however, limitations on reviewers hindered the taking of such an approach. Nevertheless, the active involvement of stakeholders and the adoption of participatory processes in most, if not all, of the projects could indicate that adaptive management has been incorporated in the project implementation. On the one hand, though stakeholder participation in majority of projects is reasonable, some inadequacies were observed. In particular, the active involvement of local academic and research institutions, experts from line agencies and other specialists was lacking in some projects. Such inadequacies could be due to the absence of a stakeholder involvement plan and/or a failure to provide sufficient funding for its implementation.

Several recommendations have been put forward in this report A point we would particularly like to stress, however, is that GEF needs to develop a mechanism to capture science in all its projects, include such information in the project deliverables, and widely disseminate these documents to the stakeholders or the general public using various means noted in this report. Publication of peer-reviewed articles or documents, in particular, should be pursued vigorously as these indicate the soundness or strength of the scientific components of the projects. These documents tend to gain acceptance and serious consideration, and therefore have a higher influence on policy formulation and a greater impact on stakeholders and other users.

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