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Integrated
river basin
Management
From Concepts to Good Practice

Briefing Note 4

Water-related Data
and Information Management

Meeting the information needs of all basin partners and stakeholders

This note is one in a series explaining the attributes and practical application of integrated river basin management. The purpose of the Briefing Note series and the issues and aspects that are covered are outlined in the mini-guide.

This note discusses:

- The importance of good data and information
- Some of the difficulties regarding information sharing among the various administrations
- How to develop a water-related data and information sharing protocol or agreement, and
- How such agreements operate.



Contents

Acknowledgments	3
Introduction	3
What Constitutes Good Data?	4
Why is Information Sharing So Important?	5
Why is “Equitable and Reasonable Utilization of Resources” One of the Cornerstone Concepts of IRBM?	6
What are the Rules and Procedures for Sharing Data?	8
How Can a Data Directory be Created?	11
How to Move Forward in Information Management: A Few Key Questions	12
Annex. Mekong River Commission Procedures for Data and Information Exchange and Sharing	13
Abbreviations and Acronyms	15
References	15



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Introduction

The availability of comprehensive water-related data, information, models, and systems that allow planners, managers, stakeholders, and the basin community to identify and evaluate problems and solutions is critical to successful IRBM. Indeed, the sharing of data between all groups involved in the water-related planning and management of a river basin is such a basic criterion that many would say it is pointless to attempt integrated river basin management without it.

Usually, information systems in a river basin context are considered adequate if the following four main components are present:

- *Good data and information on the natural resource base of the basin and its related social environment and behavior* (the human interactions with the natural resources)
- *A well-developed set of simulation models and other analytical tools* for testing policies, development options, and any particular projects proposed by a basin partner
- *A set of decision support tools* to present information and the outputs from models in a manner that can be clearly understood by managers and decision makers

- *A clear and agreed set of rules and procedures* for notifying and consulting on new projects and policies.

Common terms related to this subject include data, information, knowledge, and wisdom. What do these terms mean in a river basin management context?

- *Data*: Quantifiable and qualitative facts about the characteristics of water-related resources (quality, quantity, location, frequency of occurrence, spatial variability)
- *Information*: How these data can be assembled into meaningful patterns for specific purposes
- *Knowledge*: Understanding the implications of trends and values in data over time; personal and organizational understanding of resource use practices and their impacts
- *Wisdom*: Agreement about commonly accepted methods of using water resources to ensure sustainability.

This Briefing Note concentrates on good data and information. Note 5 discuss the translation of data into knowledge and wisdom. The modeling aspects are discussed in Note 6, while Note 9 covers project notification, evaluation, and consultation issues.



What Constitutes Good Data?

Good data are defined differently by different organizations and people. However sufficient data will be needed to support planning and management efforts, as well as to support real-time, operational systems for river flows, flood monitoring, water quality monitoring, and the like.

Comprehensive water resources information systems that underpin good river basin management include data on the following:

- > Climate - hydro-meteorological, including rainfall and snowfall
- > Surface water flow
- > Water usage data
- > Surface water quality
- > Groundwater occurrence, volumes, and other related aquifer characteristics
- > Groundwater quality,
- > Land use and land condition
- > Vegetation coverage and condition
- > Other environmental and catchment information.

In addition, there is a range of socioeconomic data and information that must be made available.

Each of these data sets has a number of subcomponents. A comprehensive and exhaustive information system would thus involve large amounts of data for each of these areas. However, it is not necessary for a single organization to undertake all these tasks. In most countries, such a single administrative responsibility would be almost impossible to achieve. A vast amount of information is also embedded in completed reports and/or ongoing investigations, which often remains hidden in the organization that undertook the study. The key is coordination at the most suitable level and a good system describing data locations, format, and quality, so that all agencies operating in the basin can readily access the data and avoid costly duplication.

Why is Information Sharing So Important?

If the data and information held in the numerous agencies operating in a basin are not readily available for use by the basin planners and managers, then models and analytical tools become almost useless because adequate feed data are absent.

Perhaps more importantly, river basin agreements function most effectively when basin partners come together for mutual satisfaction of their needs and in recognition that their collaborative efforts are required to resolve basin issues. This demands that data and information be available to all and provided in a transparent and open manner. In this way, the needs of all partners can be understood and balanced decisions and trade-offs made. This applies whether the basin partners are international organizations involving two or more countries, or national organizations involving two or more states/provinces.

Usually, the realization that there is a need to cooperate comes when managers recognize that regional revenue is impacted and that by developing institutional systems, especially in regard to data for the common management of a shared resource, the economic potential for all subregions and sectors will increase.

As budget constraints limit each institution's ability to carry on with its own data programs independently, data sharing occurs much more readily. When cost saving from shared data collection programs become evident, departments/ministries begin to cooperate effectively.

The important points are thus:

- River basin agreements are built on mutual interests.
- Data need to be shared, but sovereign rights must also be respected (some data will remain confidential).
- Progress will occur only at the rate of the most reluctant partner.
- Progress will occur much more readily when financial limitations become evident and force decisions.
- Progress will stall without mutual trust, respect, and confidence among basin partners.
- Not only must data be shared or managed in common databases, but the type, frequency, and analysis of the data must be compatible and useful. This is why a data and information sharing agreement is so important for quality assurance of data collection and management.

Why is “Equitable and Reasonable Utilization of Resources” One of the Cornerstone Concepts of IRBM?

The most universal expression of water resource sharing and management on a river basin basis is generally considered to be the United Nations Convention on the Law of the Non-Navigational Uses of International Watercourses. The convention was adopted in 1997, although it is still not fully ratified by all relevant countries. It is founded on the principles of “equitable and reasonable utilization.” Article 5 states:

1. Water course states shall, in their respective territories utilize an international watercourse in an equitable and reasonable manner. In particular, an international watercourse shall be used and developed by watercourse States with a view to attaining optimal and sustainable utilization thereof and benefits there from, taking into account the interests of the watercourse States concerned, consistent with adequate protection of the watercourse.

2. Watercourse States shall participate in the use, development and protection of an international watercourse in an equitable and reasonable manner. Such participation includes both the right to utilize the watercourse and the duty to cooperate in the protection and development thereof, as provided in the present Convention.

Article 6 states:

1. Utilization of an international watercourse in an equitable and reasonable manner within the meaning of Article 5 requires taking into account all relevant factors and circumstances including:

- Geographic, hydrographic, hydrological, climatic, ecological and other factors of a natural character,
- The social and economic needs of the watercourse States concerned,
- The population dependent on the watercourse in each watercourse State,

- The effects of the use or uses of the watercourses in one watercourse State on the watercourse States,
- Existing and potential uses of the watercourse,
- Conservation, protection, development and economy of use of the water resources of the watercourse and the costs of measures taken to that effect,
- The availability of alternatives, of comparable value, to a particular planned or existing use.

2. In the application of Article 5, watercourse States concerned shall, when the need arises, enter into consultations in the spirit of cooperation.

3. The weight to be given to each factor is to be determined by its importance in comparison with that of other relevant factors. In determining what is a reasonable and equitable use, all relevant factors are to be considered together and a conclusion reached on the basis of the whole.

Article 9 states:

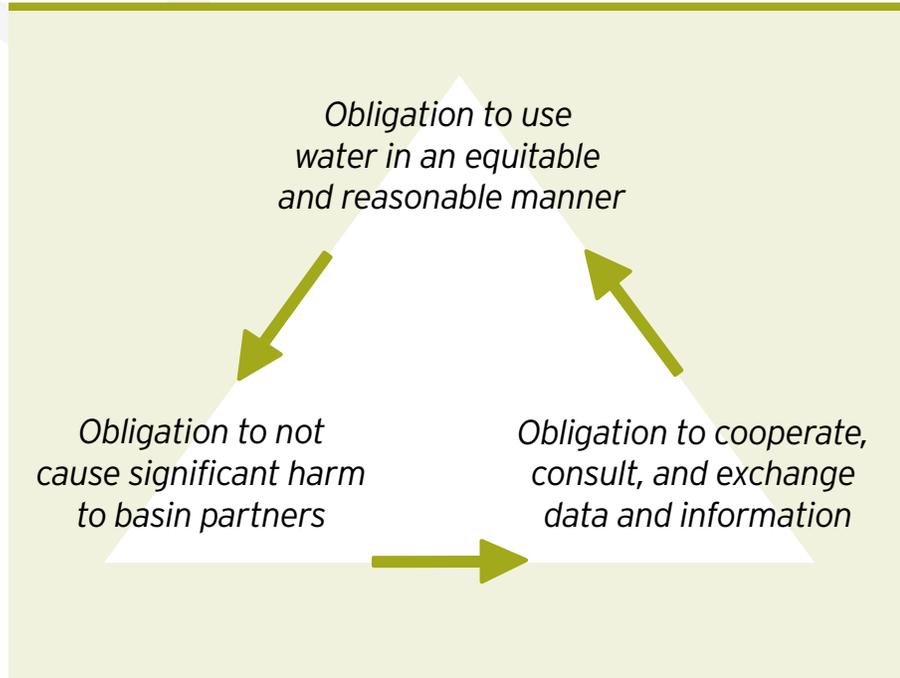
1. Watercourse states shall on a regular basis exchange readily available data and information on the condition of the watercourse, in particular that of a hydrological, meteorological hydrogeological and ecological nature and related to the water quality as well as related forecasts.

2. If a watercourse state is requested by another watercourse state to provide data or information that is not readily available, it shall employ its best efforts to comply with the request but may condition its compliance upon payment by the requesting state of the reasonable costs of collecting and processing such data and information.

3. Watercourse states shall employ their best efforts to collect and process data and information in a manner which facilitates its utilization by the other watercourse states to which it is communicated.

figure 4.1

THE TRIANGLE OF MUTUAL OBLIGATIONS



Simply put, countries within a basin - or states/provinces within a basin in one country - have a moral right to participate in the beneficial use of a shared river, and a complementary obligation to cooperate, provided things are done in an equitable and reasonable manner.

- Equitable meaning fair, just, not favoring one more than another.
- Reasonable meaning sensible; not asking too much.

Participation and cooperation, in turn, hinge largely on open, transparent data and information exchange. This interrelationship can be presented as a triangle of mutually dependent obligations (figure 4.1).

For this triangle of obligations to be effective, clear rules and responsibilities are needed for collecting, processing, and sharing data and information pertaining to all water-related aspects of a basin. Rules or protocols are also needed to advise on possible impacts of proposed water-related projects and policies.

Data collection, processing, and sharing are addressed in this note. Notification and evaluation are covered in Note 9.

By initially sharing general basin-wide data and information, and then sharing more specific information about proposed projects, programs, and policies (known as notification procedures), the basin partners will more readily develop trust and respect for one another.

In the case of a World Bank project, it is important for the basin partners, especially countries within an international river basin, to commit to share data and information for the long term, not just while the World Bank project is under implementation and supervision. Too often, countries tend to retract some of the data sharing once the project is completed. Incentives for data sharing agreements to remain effective in the long term are needed. Improved economic conditions resulting from improved IRBM would also go a long way in ensuring the continuation of data sharing.

What are the Rules and Procedures for Sharing Data?

Some long-standing or mature river basin organizations rely totally on the general provisions of their agreement or regulations to define how data should be collected and shared. But with new or restructured organizations, when there is likely to be a degree of suspicion among the new partners, it is more common for the parties to devise a specific Data and Information Sharing Protocol (or Rules or Procedures). This can be an attachment or annex to the overall agreement. Then, to operationalize the protocol, a Data Directory can be developed that explains where data are held, what the data cover, what format they are in, what is the quality, and who to contact.

How Can a Data Sharing Protocol be Created?

As mentioned above, the protocol is often an attachment to the basin agreement, but it can be a stand-alone document. In addition, in the case of new organizations, where information sharing is a sensitive issue, data protocols are likely to evolve over time as the trust grows. The protocol can then be incrementally developed around specific projects and/or needs.

Unfortunately however, it is still common practice throughout the world for organizations to be secretive about their data, based on the notion that data is power - and to release information is to relinquish that power. This leads to significant duplication of effort, as each group in a basin, particularly the river basin organization itself, seeks to obtain all the necessary data by establishing its own networks and processing and storage facilities. Many river basins in developing countries have government administrations that have limited funds and can support only skeleton data monitoring networks. In such instances, the absence of data sharing would render a comprehensive approach to basin-wide management virtually impossible. But this does not mean that the basin partners cannot begin to cooperate on some aspects that do not rely on large amounts

of data. Many long-standing basin organizations started this way. The member-states of the Murray-Darling Basin Commission, for example, started cooperating in basin-wide matters around 1900, but it was not until about 1915 that a formal agreement was signed that included agreements on how to share data and information.

Some of the larger RBOs established many years ago with strong planning, construction, and operation roles, such as the Tennessee Valley Authority in the United States, have developed separate extensive data networks. However, the more recent approach is for the RBO to be the focal point regarding data availability and for the other organizations in the basin to continue to collect and maintain data pertaining to their expert areas and disciplines. The data are then made available to all involved in planning and management through the RBO.

In this case, each state/provincial organization that collects and holds relevant data is referred to as the custodian of that data. It is important that such custodians follow a set of practices to maintain compatibility among the various data sets held throughout the basin. The role of the custodians is similar to that of librarians; they are responsible for collecting, safely storing, and making available to readers/users accurate and up-to-date information.

The data sharing protocol should therefore include sections covering at least the following:

- > Principles and objectives
- > Type of information to be exchanged
- > Extent, content, and format of information, and emerging priority needs
- > Accountability links - who does what, to what quality, and when
- > Timing and method of transfer of information
- > Responsibility for maintaining databases - the custodian role

- Access to databases - classified material/limited or restricted access versus full access
- Procedures for access
- Requests from basin partners for additional data networks
- Dispute resolution.

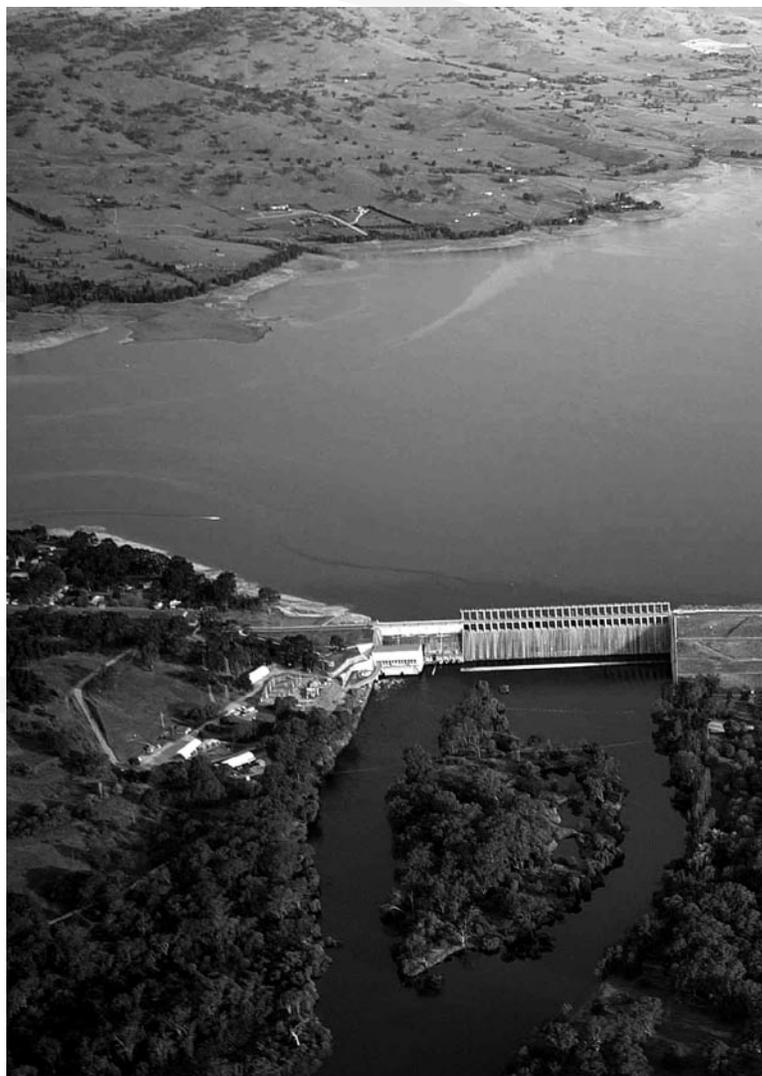
The views and roles of the key stakeholders also need to be considered in defining the extent and nature of the data. Without a clear definition of the intended use of the data, a “collect everything” attitude (if budgets permit) can result in very large and unsustainable information management systems.

The discussion that follows presents two different examples: the Murray-Darling Basin Commission (MDBC) in Australia, and Mekong River Commission (MRC) in Southeast Asia.

The Murray-Darling Basin Commission’s Role In Data Sharing

The MDBC oversees water management in a basin located in a highly developed country where institutions have adequate judicial backing to fulfill their mandates, ample capacity in the natural resource sector, adequate budgets, and sufficient political will and support for the basin agreement. These conditions are seldom met in developing countries. Hence the MDBC example should be viewed as a best case situation. Developing countries may be able to meet only a few aspects for data and information sharing. Nonetheless, this still is a successful start, which can improve incrementally with time.

Clear statements as to how MDBC acquires data and under what circumstances it can collect data itself have always been present in the MDBC agreement. As such, it has not been necessary to prepare a specific data sharing protocol. ▶



Part V of the agreement - Investigations, Measurement and Monitoring - covers all aspects of water and related data and stipulates that MDBC:

- > May coordinate, carry out or cause to be carried out, surveys, investigations and studies...along the main stem of the Murray River as it requires, and within the tributary streams and catchment, with the approval of the particular state,
- > Must establish and maintain an effective monitoring system to continuously record flow at key sites along the main river and the tributaries, and the volume of stored water, to enable proper management of the annual water distribution and water accounting and recording procedures,
- > Can adopt the results of any monitoring and data collection undertaken by the member states, or can request the states to collect some particular data from the network that the states operate,
- > Must regularly report to the Ministerial Council on the adequacy and effectiveness of the arrangements adopted for data collection and monitoring, and recommend changes if thought necessary to achieve effective sustainable river basin management.

The MDBC agreement therefore contains the necessary powers and procedures for the data that have been collected by any of the partners to be shared with all. The agency that collects, processes, and stores the data also make them available electronically to all the natural resource organizations within the member-states and the MDBC. External or private organizations are required to pay a charge to obtain basic data. This cost increases if the data must be processed or analyzed before being made available. (This charge covers the cost of data transfer and any data analysis and does not usually include a profit margin.)

The Mekong River Commission's Role in Data Sharing

The MRC agreement does not contain specific clauses or articles that define how and what type of data should be exchanged or shared. Rather, there are general clauses that require broad participation such as "cooperation in all fields of sustainable development" and "an agreement to promote, support, cooperate and coordinate in development of the basin."

The most specific clause is in regard to the duties of the Joint Committee (equivalent to a Board of Commissioners). This clause reads: "to regularly obtain, update and exchange information and data necessary to implement the MRC agreement." However, MRC found that this is not specific enough to cover the quality and extent of data exchanged, the type and extent of processing, and the quality assurance issues that have arisen within each of the four member-countries. Thus the MRC Ministerial Council adopted Rules and Procedures for Sharing Data and Information. These are reprinted at the end of this note in the annex.

The document is brief: three pages long, with seven sections.

1. Preamble
2. Definitions of Key Terms
3. Objectives
4. Principles
5. Data and Information Exchange and Sharing
6. Implementation Arrangements
 - a. Custodianship of MRC-information System
 - b. Reporting
7. Entry into Force

This data sharing protocol is a good example for developing river basin organizations. It is relatively simple and short, yet it covers all the attributes and details needed to ensure effective data and information sharing among all basin partners.

How Can a Data Directory be Created?

What data, information, and reports that are relevant to basin management exist within organizations in the basin? How can the data, information, and reports be accessed, in what form, and at what cost?

An RBO may choose to maintain its own integrated database, with all or most of the data sets. Alternatively, as is often the case, databases may be created and maintained elsewhere. In both cases, the RBO and the other agencies in the basin must have agreed upon access to the relevant data (through the sharing protocol) and must also know where to find the various types of data (through the data directory).

The creation of a data directory helps prevent the costly duplication of effort that occurs when persons are unaware of what data already exist. The actual data are not contained in the data directory; it describes the nature of the data. This is called meta-data. This directory would detail what data is available, its extent and quality, the time periods and geographical coverage, who should be contacted to obtain the data, and the like. The director is an information access system. Eventually, it could be made available electronically.

THE BASIC COMPONENTS OF A DATA DIRECTORY SHOULD BE:

Component	Comments
<i>Data set component</i>	Nature or description of entry
<i>Data set</i>	Name of dataset Organization holding the data Location of the organization
<i>Description</i>	Short description of the database contents Theme word to easily identify database Geographic extent and map reference
<i>Currency of data</i>	Earliest date of data in the set End date of data
<i>Data set progress</i>	Status of the data when set created Frequency of changes or additions made
<i>Access</i>	Format of the stored data Format in which it can be accessed Any restrictions or legal requirements Costing information and pricing policy
<i>Data quality</i>	Comment on history and processing method, Accuracy, consistency, completeness
<i>Contact information</i>	Contact details of data custodian Names of people to contact

Each organization holding data would complete a questionnaire similar to the format above for each data set. If the RBO is the specified custodian of the data directory, it could then develop a computerized directory containing all the information and establish Internet or Intranet connections so that all persons, groups, or organizations could access the data in accordance with the policies described in the Data and Information Sharing Protocol.

The role of the basin organization should be to ensure that an integrated basin water resources information access system is developed that:

- Covers the whole basin
- Includes all water resources and related data sets to the required level of detail needed for management decision making
- Configures the data on the basis of the geographical area of the basin and its major sub-basin elements (tributary sub-basins)
- Is capable of coordinating data from different archives covering different components of the natural resource base, to provide an integrated information output
- Maintains consistent data quality standards and compatibility criteria across the data network
- Enables electronic data transfer between all participating organizations
- Includes rules and agreements for the exchange of information between data providers and other organizations.

How to Move Forward in Information Management: A Few Key Questions

- Are existing water-related data being collected and processed efficiently and shared among administrations within the basin?
- What type of data is recorded? Is this being done systematically? Do the various stakeholders know where it is stored and how to access it?
- Should sharing procedures be formalized through a specific protocol or set of rules? Does a directory need to be established specifying where data are held and their extent and quality? Should this be the responsibility of a RBO or another agency?
- Are financial resources adequate to support processes and agreements to collect, analyze, and store data?
- Can information be readily exchanged among countries, or among states/provinces within one country? If not, why not? Are sharing and exchange limited by poor Internet access or connection?

ANNEX

MEKONG RIVER COMMISSION - PROCEDURES FOR DATA AND INFORMATION EXCHANGE AND SHARING

CONTENT

PREAMBLE

1. DEFINITIONS OF KEY TERMS
2. OBJECTIVES
3. PRINCIPLES
4. DATA AND INFORMATION EXCHANGE AND SHARING
5. IMPLEMENTATION ARRANGEMENTS
 - 5.1 CUSTODIANSHIP OF MRC-IS
 - 5.2. REPORTING
6. ENTRY INTO FORCE

PREAMBLE

Recognizing the existing cooperation in data and information collection, exchange, sharing and management through the Mekong cooperation frameworks from 1957 to date;

Affirming the imperative for operationalising an effective, reliable and accessible data and information system for the Mekong River Commission (MRC) and its member countries to implement the AGREEMENT ON THE COOPERATION FOR THE SUSTAINABLE DEVELOPMENT OF THE MEKONG RIVER BASIN, signed in Chiang Rai, Thailand on 5 April 1995, hereinafter referred to as the "Mekong Agreement";

Pursuant to the Council Resolution on the Water Utilization Programme of 18th October 1999, and the Decision of the 13th Meeting of the Joint Committee of 8th March 2001,

We hereby approve the following procedures for data and information exchange and sharing:

1. Definition of Key Terms

For the purpose of the present Procedures, the following terms shall mean, unless otherwise stated:

Data: representations of facts, in a formalized manner, suitable for communication, interpretation or processing.

Data and information exchange: reciprocal transfer of data and information among the member countries.

Data and information sharing: provision of full access to data and

information maintained in the MRC-IS (Information System) to the member countries through MRCS (Mekong River Commission Secretariat).

Information: data interpreted, processed and refined, and then displayed by the competent authorities having ownership or possession thereof, which is required for exchange and sharing for the purpose of the implementation of the Mekong Agreement.

Standards: guidelines for data handling that are recognized as best practice in their relevant scientific or technical disciplines, with the objective to minimize the transaction costs of using data

2. Objectives

The objectives of the undertakings under the present Procedures are to:

- Operationalize the data and information exchange among the four MRC member countries;
- Make available, upon request, basic data and information for public access as determined by the National Mekong Committees (NMC's) concerned; and
- Promote understanding and cooperation among the MRC member countries in a constructive and mutually beneficial manner to ensure the sustainable development of the Mekong River Basin.

3. Principles

In conformity with the provisions of the Mekong Agreement, the data and information exchange and sharing among the MRC member countries should be governed by the following principles:

- Subject to the laws and regulations in their respective countries, in particular concerning the national defense or security, and commercial-in-confidence and copy right protection, exchange, on a regular basis, data and information that are necessary to implement the Mekong Agreement;
- Data and information exchange and sharing, including the prioritization of information needs should be based on an efficient, equitable, reciprocal and cost effective manner.
- The data and information contained in the MRC-Information System that is maintained by MRCS (hereinafter referred to as "the MRC-IS), should be relevant, timely and accurate, and exist in established usable formats for MRC and its member countries through an appropriate network and communication system.
- Any additional and unavailable data and information that is required from time to time to facilitate MRC activities, programs and projects will be agreed by the MRC Joint Committee, including procedures and cost sharing arrangements for collecting the minimum necessary data at the lowest feasible cost in a timely and equitable manner.

4. Data and Information Exchange and Sharing:

Each NMC and MRCS shall cooperate with one another in the following:

1. Supporting and promoting the implementation of the present Procedures;
2. Providing data and information to the MRCS, as appropriate and where applicable subject to the following requirements:
 - Major groups/types of data and information required for implementation of MRC program/activities and Mekong Agreement, inter alia:
 - Water Resources;
 - Topography;
 - Natural resources;
 - Agriculture;
 - Navigation and Transport;
 - Flood management and mitigation;
 - Infrastructure;
 - Urbanization/Industrialization;
 - Environment/Ecology;
 - Administrative boundaries; and
 - Socio-economy;
 - Tourism.

Standards to be determined by the MRCS and approved by the Joint Committee, including but not limited to:

- the format, standardization, classification, and acceptable level of data quality;
- Delivery schedules; and
- Modalities for exchange and sharing.

3. Endeavoring to provide, on a case-by-case basis, historical data required for the implementation of the Mekong Agreement.

Cost for collecting additional data and information other than those required for the implementation of the MRC projects, programs, and not available shall be borne by any requesting party.

Channel of communication shall be made through MRCS.

5. Implementation Arrangements

The MRC Joint Committee shall oversee the effective implementation of the present Procedures as required by the Mekong Agreement.

5.1 Custodianship of MRC-IS

The MRC Secretariat shall be responsible, as custodian, for the following:

- (a) Obtaining and updating of required data and information;
- (b) Managing of this on behalf of the Mekong River Commission (MRC);
- (c) Ensuring proper access to, and maintenance and quality of the data and information that meet the required standards;
- (d) Providing a recognized contact point for the distribution, transfer and sharing of the data and information;
- (e) Estimating and collecting cost incurred according to Section 4; and
- (f) Preparing the MRC guidelines on custodianship and management to be adopted by the MRC Joint Committee.

The obligations and responsibilities of users, on the use of the data and information shall be elaborated in the MRC guidelines on custodianship and management of MRC-IS.

5.2 Reporting

Reports will be made annually by the MRCS to the MRC Joint Committee and Council respectively as to the overall effectiveness of the present Procedures, the status of the MRC-IS and the suitability of the technical guidelines and standards for ensuring the protection and integrity of the data, information and systems and its accessibility and quality, as well as the remedial and rectifying measures taken, and recommendations for further guidance and direction, including modification and amendments of the Procedures and related guidelines, if any.

6. Entry into Force

The present Procedures shall take effect among the member countries on the date of the signature by the MRC Council members.

Abbreviations and Acronyms

BDP	Basin Development Plan	OMVS	Organisation pour la Mise en Valeur du Fleuve Senegal
BET	Beneficial Evapo-transpiration (ET)	RBO	River basin organization
CU	Consumptive Use	SMART goals	Goal that are S (Specific), M (Measurable), A (Achievable), R (Realistic), and T (Time-based)
DSF	Decision Support Framework	SW	Surface water
ERS	Environmental Resources Study	SWOT analysis	Analysis of Strengths, Weaknesses, Opportunities, and Threats
ET	Evapo-transpiration	TBWRC	Tarim Basin Water Resources Commission
GW	Groundwater	TQM	Total Quality Management
IRBM	Integrated river basin management	WSC	Water supply corporation
KRA	Key Result Areas	WUA	Water user association
LWMP	Land and Water Management Plans	WUP	Water Utilization Program
MDBC	Murray-Darling Basin Commission		
MRC	Mekong River Commission		
NBET	Non-beneficial Evapo-transpiration (ET)		
O&M	Operation and maintenance		

References

WEB SITES

Water Resources Management

Sectors and themes including:

Coastal and marine management
Dams and reservoirs
Groundwater
Irrigation and drainage
River basin management
Transboundary water management
Water and environment
Water economics
Water supply and sanitation
Watershed management

Information and access to the respective Web sites can be found at:
<http://Inweb18.worldbank.org/ESSD/ardext.nsf/18ByDocName/Sector-sandThemes>

Dams

Benefit Sharing from Dam Projects, November 2002
<http://www-esd.worldbank.org/documents/bnwpp/2/FinalReportBenefit-Sharing.pdf>

Good Dams and Bad Dams: Environmental Criteria for Site Selection of Hydroelectric Projects
[http://essd.worldbank.org/essdint.nsf/90ByDocName/WorldBankSafeguardPolicies404NaturalHabitatsGoodDamsandBadDamsEnvironmentalCriteriaforSiteSelectionofHydroelectricProjects/\\$FILE/Good+and+Bad+Dams+final.pdf](http://essd.worldbank.org/essdint.nsf/90ByDocName/WorldBankSafeguardPolicies404NaturalHabitatsGoodDamsandBadDamsEnvironmentalCriteriaforSiteSelectionofHydroelectricProjects/$FILE/Good+and+Bad+Dams+final.pdf)

Groundwater

GW-MATE: Groundwater Management Advisory Team Briefing Note Series.

The overall structure of the series is as follows:

Notes 1 and 2 - Broad introduction to the scope of groundwater management and groundwater system characterization
Notes 3, 4, 5, 6, and 7 - Essential components of management practice for major aquifers with large groundwater storage under stress from intensive water-supply development for irrigated agriculture and/or urban water-supply
Note 8 - The protection of potable groundwater supplies
Notes 9, 10, and 15 - Planning national and regional action for groundwater resource management
Notes 13 and 14 - Management of smaller-scale water supply development in the rural environment
The remainder of the series (Notes 11, 12, 16, and 17) deals with a number of specific topics that pose a special challenge.
<http://Inweb18.worldbank.org/ESSD/ardext.nsf/18ByDocName/Sector-sandThemesGroundwaterBriefingNotesSeries>

The Murray-Darling Basin
Murray-Darling Basin Initiative
<http://www.mdbc.gov.au/>

The Living Murray Initiative
<http://www.thelivingmurray.mdbc.gov.au/>

Heartlands Initiative
<http://www.ciw.csiro.au/heartlands/partners/index.html>

Toolkits

Benchmarking, Rural Water Supply and Sanitation for Multi-Sector Projects, Gender, Hygiene and Sanitation, Private Sector Participation, Small Towns

<http://www.worldbank.org/html/fpd/water/toolkits.html>

Global Water Partnership IWRM Toolbox

<http://gwpforum.netmasters05.netmasters.nl/en/index.html>

Water Demand Management

Building Awareness and Overcoming Obstacles to Water Demand Management, Guideline for River Basin and Catchment Management Organizations, IUCN

http://www.gwpforum.org/gwp/library/River_basin_management_guideline_26Oct2004.pdf

Water Resources and Environment Technical Notes

The overall structure of the series is as follows:

- A. Environmental Issues and Lessons
- B. Institutional and Regulatory Issues
- C. Environmental Flow Assessment
- D. Water Quality Management
- E. Irrigation and Drainage
- F. Water Conservation and Demand Management
- G. Waterbody Management
- H. Selected Topics

<http://Inweb18.worldbank.org/ESSD/ardext.nsf/18ByDocName/Sector-sandThemesWaterandEnvironmentWaterResourcesandEnvironmentTechnicalNotes>

Water Supply and Sanitation

<http://www.worldbank.org/html/fpd/water/index.html>

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Integrated **river basin** Management



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