

Public Disclosure Authorized

Public Disclosure Authorized

Public Disclosure Authorized



Integrated
river basin
Management
From Concepts to Good Practice

Briefing Note 11

Charging for Water
Resources Management

Developing efficient water pricing structures and tariffs for the management, monitoring, supply, and distribution of the water resources in a basin

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 describes:

- The aspects to which charges are typically applied
- How charges should be set
- What is the actual cost for water resources management
- Who should set or oversee the charges



Contents

Acknowledgements	2
Introduction	2
Which IRBM Aspects Are Typically Charged?	4
How Should Charges Be Set?	5
What Is the Actual Cost for Managing the Water Resources in a Basin?	6
How Is Water Priced in the Murray-Darling Basin?	8
Who Should Set or Oversee the Final Charges?	11
How to Move Forward with the Development of a Comprehensive Water-Related Pricing Package: A Few Key Questions	13
Abbreviations and Acronyms	14
References	15

Acknowledgments

This Briefing Note series was prepared by Peter Millington, consultant, previously Director-General of the New South Wales Department of Water Resources and Commissioner on the Murray-Darling Basin Commission, Australia; Douglas Olson, World Bank Principal Water Resources Engineer and Task Manager for this Briefing Note Series; and Shelley McMillan, World Bank Water Resources Specialist.

Guy Alaerts (Lead Water Resources Specialist) and Claudia Sadoff (Lead Economist) of the World Bank provided valuable inputs.

The authors thank the following specialists for reviewing the Notes: Bruce Hooper and Pieter Huisman (consultants); Vahid Alavian, Inger Anderson, Rita Cestti Jean Foerster, Nagaraja Harshadeep, Tracy Hart, Karin Kemper, Barbara Miller, Salman Salman, Ashok Subramanian, and Mei Xie (World Bank staff).

The authors are also deeply grateful to the Bank-Netherlands Water Partnership Program (BNWPP) for supporting the production of this Series.

Introduction

Note 1 identified five attributes or components for good or sustainable integrated river basin planning and management. The fifth component relates to the implementation of a detailed, ongoing monitoring and auditing process that assesses in an open and accountable way whether:

- The basin-wide institutional arrangements are achieving the goals and objectives set by governments
- The principal officers charged with these responsibilities are indeed achieving what is intended
- The health or condition of the river basin is being maintained at the agreed level, consistent with the existing and proposed levels of development.

This note concentrates on one key aspect of the basin sustainability matrix: how to establish appropriate water resource user charges to cover the costs of managing the impacts of their actions and to encourage better utilization of the resource and promote conservation. Annual budget issues to support the ongoing IRBM programs are discussed in this note. Other aspects of the sustainability matrix, such as long-term strategic funding and indicators, are covered in Notes 12 and 14, respectively.



Which IRBM Aspects are Typically Charged?

There are three areas where some form of charge is often levied on users. A wide variety of components, methods, and approaches are applied within all three.

- For the *direct provision of a water-related service* such as a potable water supply or flood mitigation benefits through a particular method of dam operation. A fee is applied for the type and level of service provided. This is referred to as a *water delivery, supply, or service charge*. In this discussion, these direct charges cover services provided directly to a customer, plus administrative and other indirect service costs such as service expansion.
- For the *right to use the water resource*, even when the water is extracted without agency/government assistance. This is referred to as a *water resource administration or management charge*. It may have several components, including a license administration charge.
- To cover *the costs of the impacts of economic and social development on the basin's resources*. This is referred to as a *catchment (or sub-basin) management charge*.

The catchment management charge sometimes forms part of the water resource administration charge. This was the more traditional means of charging. In recent times, as the levels of environmental degradation have increased, a separate fee or levy has become necessary to cover the very large rehabilitation programs to restore the health of the river basin.

The *water resource management charge* applies not only to individual users or irrigation companies that take water from a river, but also to towns or that have constructed dams to provide a continuous supply to a range of users, including hydropower operators, commercial fish farms, and the like. These users may be private or government-owned organizations and are as equally liable as the smaller users.

How Should Charges be Set?

Whether the final charges to users are based on a compromise among stakeholders or a political decision, most managers and decision makers will still want to know the true or “real” costs of supplying the service or managing the resource *before* setting the charges to be levied on customers. It is important for a government minister to be accountable and to show wisdom and fairness with respect to how charges have been set. It is also more likely that charges will be accepted if cost reductions are made through gains in efficiency, so officials must also be able to demonstrate this. Setting charges at preconceived “ability to pay” levels can be risky. Moreover, this approach does not provide any indicators upon which to seek efficiency improvements.

The cost of service provision must first be defined. Based on this information, the level of charges to be levied on users would be decided. Cost definition can be done in-house, with verification from external audits to ensure that the process is not being manipulated. Normally, the results from the cost assessments then go to a separate entity responsible for establishing the water charges. This rate setting process would take into account the financial performance of the service provider, consumers’ willingness and abilities to pay, and stakeholders’ concerns. The costs of all water resources and catchment management activities must be paid, either by customer/consumer charges or from the government budget. Normally, the government covers the costs for overall resource assessments, while the costs for the control, allocation, and management of the resource are passed on to the customer. In the

instances where activities such as flood management may have direct benefits to particular groups or farmers as well as some general benefits for the overall community, costs could be apportioned between the direct beneficiaries and the government, the latter as the representative of the community. This is usually decided by the government, but preferably in consultation with the other beneficiaries.

When customers cannot afford to pay either the full water supply charge or the water resources/catchment management fee (which worldwide is normally the case), or where poverty is high and basic needs unmet, government subsidies will be needed to ensure that the service is still provided. For example, it is common for flooding to be reduced as a result of the operation of a dam, simply as part of its irrigation/water supply operation rules. The government may then choose to pay for the share of these community benefits because it is not feasible to collect a “fee” from all those who gain from such indirect benefits.

Setting fair and reasonable resource use and management charges does not equate with the selection of a low level of charges to keep the users happy. A thorough cost definition exercise is required. This will benefit both the consumer and the government. Consumers can verify that they are not being over-charged and the government can ensure that any subsidy is kept to a minimum. A river basin organization (RBO) can serve as an independent entity to analyze how water is being used and managed across the whole river basin. RBOs can also develop some pricing structure options and collection methods to improve cost recovery.

What is the Actual Cost for Managing the Water Resources in a Basin?

The first step to defining the total actual cost for managing the water resources in a basin would be to itemize and dissect all the cost components under the various categories. Then discussion and debate regarding the following should occur:

- Whether adequate provision has been made for each of these components, how these provisions are made, and with what resources
- What percentage of the costs of each category should be passed on to, and collected from, the users
- How much should be paid by government, either as its contribution to normal resource management or as a partial subsidy to users.

The basin organization would not necessarily do all this investigative work. It is more likely that each agency, private company, or group of users with rights or allocations to utilize or manage the resources would be required to submit its costing information in accordance with some previously agreed format. Usually a periodic audit or inquiry process is undertaken to verify the integrity of the information and the cost breakdowns. Though uncommon, there may be incentives to incorrectly report costs: that is, groups may under-report costs if they think their group may incur higher charges, or over-report costs if they think they will be able to recoup more of the expenses.

Some of the costs to be separately identified include:

- Internal costs of each irrigation group or water user association (WUA)
- Costs of any water supply corporations (WSCs) that supply water or other services to urban, industrial, and irrigation/rural users and how these costs are apportioned among the various groups
- Costs of Operation and Maintenance (O&M) of major drainage networks (that is, the drainage systems from WUAs, urban areas, or industrial areas)

- Costs of operation of major gates, diversion works, and major channels, outside or upstream of WSCs
- Costs of main channel and tributary river works, or groundwater extraction works, to control water diversions
- Costs of river improvement works, dredging, and river bank stabilization: what proportion of these costs is for maintaining flow conditions for navigation, recreation/tourism, irrigation, urban or industrial diversions; for general resource management; and to allow downstream flow for environmental purposes
- Costs of maintaining major headwork dams and on-route field reservoirs
- Costs of monitoring quantity, quality, and environmental parameters in both the rivers and the catchment: what percentage is for managing the basin's environment, and for monitoring the impacts of activities and/or regulating users.

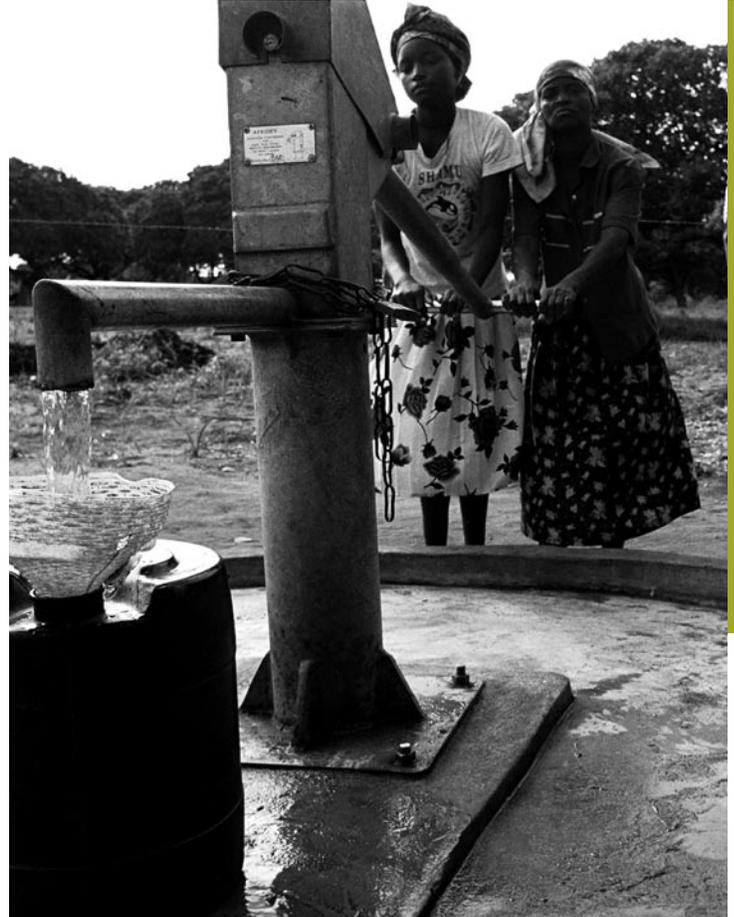
A price component for the long-term replacement of major infrastructure such as dams should also be included in the pricing package. However, since such replacement costs are exorbitant and the need is not immediate or short-term, very few countries (even those with affluent water users) attempt to collect the full amount of these replacement costs. It is nevertheless recommended that they be identified so that governments are aware of the long-term costs and obligations to keep the water infrastructure in reasonable operating condition.

Once these costs are identified, various options for cost recovery and areas where efficiency gains need to be made can be determined. The farmers' and towns' abilities to pay can be debated and any gaps in cost recovery above these levels determined. The question then for state, regional, and prefecture governments is how to recover these costs – and if only a portion is to be covered by user charges, how the shortfall will be made up.

In addition, if user charges are set on a volumetric basis, there is the associated issue of water conservation. The structure of the charge then becomes important so that the poor are not negatively impacted. It is recommended that a tiered structure be used such that charges are low for basic water consumption levels and then increase significantly beyond certain higher levels of consumption. In this way, the charges are appropriately targeted to the user groups and to the consumption levels.

There are many factors other than price that influence how much water a user diverts and consumes. In many cases, particularly in developed countries, improved water conservation has been influenced more by mandatory reductions in water allocations than reliance on a tiered pricing structure. In some developing countries, the farmers may be so poor such that any attempts to promote water conservation through price increases are pointless because farmers simply cannot afford to pay.

It is perhaps better in these cases to develop ways of giving farmers greater control over the management of the irrigation systems. In this way, they are responsible for system efficiencies and water usage patterns so they will seek to minimize expenses, both in terms of system maintenance and water charges. For example, in some parts of China, farmers have formed water user associations (WUAs). Water is priced by volume and delivered collectively to an off-take point for the WUA, which is then responsible for distribution to the farmers. The members have developed an internal roster system to ensure that the minimum volume is diverted at all times, thus greatly reducing seepage and unnecessary drainage flows.



Water pricing as a water conservation/demand management measure is useful and effective, but should form part of a package of initiatives and not be a stand-alone remedy for poor water use practices.

How Is Water Priced in the Murray-Darling Basin?

The Murray-Darling Basin Commission (MDBC) comprises four states and one territory. According to the Australian Constitution, each state has the right to manage its natural resources based on its own policies. This includes the establishment of a water and natural resources pricing and tariff structure.

The main role of the basin organization is to develop, through the high-level Ministerial Council, a package of basin-wide policies to which all states agree to embrace alongside the development of their individual resource management policies. The MDBC then monitors and evaluates whether each state is in compliance with these policies and whether overall sustainable management of the basin's resources is being achieved.

Effective and efficient water pricing structures and tariffs are key to promoting proper use of the basin's scarce resources. An important role of the MDBC is therefore to check and evaluate whether each state is developing and implementing pricing packages that promote sustainability, as well as achieve appropriate levels of cost recovery.

The MDBC controls and operates some major dams and works on the central stream of the large basin – the River Murray – as assigned to it by the Murray-Darling Basin Agreement to provide water ordered by each of the three states along the river on a weekly or daily basis. However, the MDBC cannot charge users directly. Thus it charges its costs to each state that it supplies with water. The states then decide how these costs will be passed on to the users, together with their internal costs for distribution and management of the resource. The states decide the level of costs they want to recover and from which users, but are obligated to reimburse the full amount to the MDBC, even if the government treasury provides subsidies.

As in many other countries, the full or true cost of water was not being charged to users, even though have been

dams and extensive irrigation since 1900. Until the 1980s, water was seen as a very cheap and plentiful resource. There were no pricing incentives to encourage conservation.

The Current Pricing Principles

After some 80 years of intensive water use and unsustainable land use practices, research undertaken by the MDBC and the states showed a need to re-think how the water and land resources were being used and managed. In 1995, all four states across the Murray-Darling Basin – and in fact, all the states in Australia – agreed to change water policy nationwide to redefine water management, allocation, and pricing in an attempt to greatly improve the efficiency of water usage. Specific rules were developed for charging users to reflect the real cost of services. The main new initiatives were as follows:

- By 2001, water charges were to comply with the principle of full cost recovery. In cases where subsidies are considered necessary (for example, for the elderly and disadvantaged groups), they will be clearly and publicly identified.
- The costs of all activities that relate to the assessment, management, and supply of water are to be included in the cost assessment, but only the portion of those costs that apply to users should be charged to and collected from them.
- Pricing will include charges for the full and ongoing maintenance of the major water assets, plus a charge to recover an agreed portion of the replacement costs of these assets. In the case of major dams, this relates only to what are called the moving parts, such as valves and spillway gates.

Each state has been given a ten-year period to introduce all the reforms. The state of New South Wales (NSW) provides an example. It is the largest state in Australia in terms of population and agricultural production. It has a

figure 11.1

MODEL CATCHMENT FOR COST IDENTIFICATION

large network of rivers that supply both urban and rural needs. Over three-quarters of the state is watered by rivers that flow westward and into the Murray or Darling Rivers, which in turn are the major drainage arms of the Murray-Darling Basin. A model catchment or sub-basin was developed to clearly identify which activities were to be included in the cost assessment, to determine the actual cost of provision of each of these activities, and to ascertain which activities and corresponding costs were eligible for inclusion in the user charges. A similar approach was followed by all four states. This is illustrated in figure 11.1.

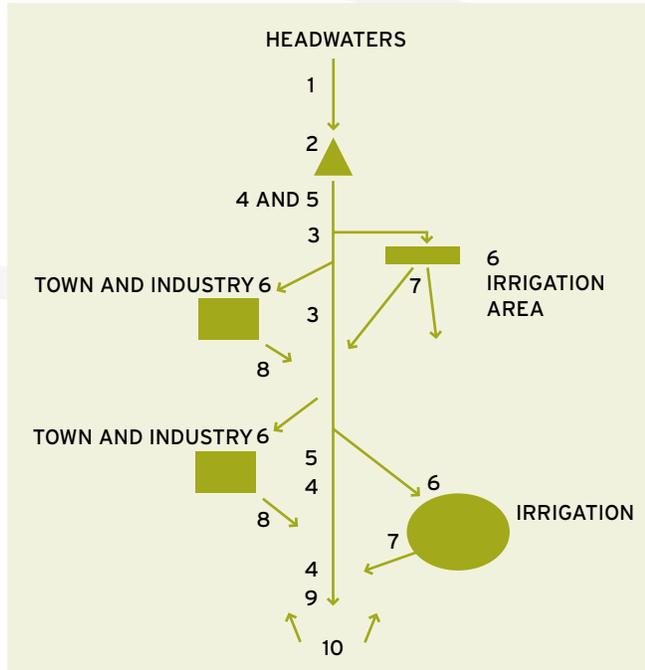
The MDBC was required to comment on whether this model catchment approach matched the agreed new policies for water pricing, and then monitor the implementation of the actual pricing package.

As noted, some of these costs should be borne by the consumer and others by government agencies. In many categories, the costs should be shared between the two groups since the activity involves a service provision (to the customer) and conservation, allocation, and management aspects (for the agency/bureau).

In New South Wales, an expert group made up of some of the stakeholders was established to analyze all the activities, determine the magnitude of associated costs, and assign the cost tags. The next issue to be addressed was whether the users could afford to pay their apportioned shares, whether government subsidies would be required, or whether the activity needed to be cancelled because neither the customer nor the government would cover the costs. The scale used to apportion the costs for New South Wales is described below.

Regulatory activities

- Completely (100 percent) to be met by the water user for permitting and allocation, policing and monitoring water diversions, compliance with license conditions, and so on.



- Category 1** - Activities that are undertaken upstream of the dam (No. 2), such as catchment management and measurement and assessment of water quantity and quality
- Category 2** - Operation, maintenance, and management of dams and weirs. There may be several dams and weirs in the one sub-basin and they may be used for a multitude of purposes, including flood mitigation, irrigation, domestic or town supply, industrial use, and navigation
- Category 3** - Operation and maintenance of weirs and structures to divert water into irrigation or other consumption systems. These structures are not for storage and regulation as in Category 2, but only for distribution.
- Category 4** - River management along the full length of the river, including stream and bank stabilization, carrying capacity, navigation, and riverine vegetation maintenance
- Category 5** - Operation and maintenance of the bulk water supply distribution system, which relates to the activities for delivering the bulk water supplies from the dams to the diversion points, as well as the monitoring of these activities, through permitting, measurement, and billing operations
- Category 6** - Operation and maintenance of distribution systems throughout towns, specific irrigation areas, and the like
- Category 7** - Management and maintenance of drainage from irrigation areas or towns
- Category 8** - Effluent collection, treatment, and management
- Category 9** - Activities to assess and overcome downstream impacts arising from water diversions and use, such as nutrient load increases, pollution, increased salinity, habitat or vegetation loss
- Category 10** - Administration and management of the overall river basin for the benefit of the community



Operational (supply and distribution) activities

- Completely (100 percent) to be met by water user for the operation of major supply channels and diversion gates and the maintenance of gates, regulators, channels, drainage systems
- Mostly (70 percent) to be met by water user for dam operation, infrastructure management, and flood control. The remainder (30 percent) of the costs is to be met by the government.

Water resource management activities

- Mostly (70 to 50 percent) to be met by the water user for water resource data collection, water resource

planning, water quality strategies, river stabilization works. The government funds the remainder (30 to 50 percent).

- Partly to not at all (30 percent to nothing) to be met by the water user for data collection for basin-wide resource assessments, floodplain and wetland management, education and communication programs.

The appropriateness of these percentages is constantly and openly reviewed by the water suppliers, the water resource manager, and by the independent pricing regulator. This review process is discussed in the following section.

Who Should Set or Oversee the Final Charges?

Just who decides and announces the level of water-related charges varies from country to country. Ultimately, the government usually takes final responsibility. However, in countries with a long history of participatory water resources management, a trend is developing in which governments set the policies for water pricing and then install an independent tribunal to hear submissions from the water service providers and other agencies involved in natural resource management for which a charge is proposed. The tribunal also accepts comments on these submissions from the users and the community in general, and then decides what level of charge should be imposed, consistent with government policies.

Such a tribunal is often referred to as the *economic regulator*. With improved efficiencies in service provision, there is an even greater need to ensure that national economic and social goals are not distorted by monopolies or other entities not acting in the public interest. In addition, with the lobby or special interest pressures increasingly applied at the political levels, many governments are finding it worthwhile and more accountable to remove government ministers from such direct pricing roles and establish independent tribunals for this purpose.

Public inquiry into the efficiency and effectiveness of any organizations involved in water-related pricing, as well as the financial assessment of proposed tariffs, would be essential responsibilities in the charter of the regulator. Other factors to be taken into account when setting the charges are local, regional, and national social and economic effects, equity, and cross-subsidies. Efficiency is also very important, as a poor service provider may seek a higher charge to support its inefficiencies. In such a case, the tribunal can refuse a request for a fee increase and demand that certain efficiency gains first be achieved.

Increasingly, such regulation is also being applied to other areas such as electricity, gas, telecommunications,

transportation, and government cargo handling. This trend raises the question of whether there should be a separate regulator for each of these sectors or one to cover all. This decision is largely a matter of size and government preference.

Some specific options of varying complexity for achieving oversight/regulation of water utilities are listed below:

1. A review role by say, a Policy and Strategy Unit within the ministry responsible for water management, to advise either the minister or the National Water Resources Council on the appropriateness of annual charges for water. With this arrangement, the minister remains directly responsible, but there is also some objective assessment.
2. An independent review team set up by the National Water Resources Council (or Cabinet Committee, or Standing Committee), or possibly the government's treasury department, to advise on water prices. The findings would then be sent to the Council/Committee for public disclosure. Under this arrangement, the actual pricing is still left to government but provisions have been made for more transparent, independent advice.
3. An independent and statutory water regulator (similar to OFWAT, or the Office of Water in the United Kingdom) to oversee all aspects of the cost, service, and quality of supply to users. It could have the power to set prices or make recommendations on pricing levels, which it would report to the Water Ministry. These proposals would then be taken to cabinet for endorsement. Normally, the price levels recommended by the regulator would serve as the upper fee limit. The government would have the option to lower the charges. In this case, some compensatory payment or subsidy from the government to the service provider would be normally required to offset the loss in revenue.

4. An independent and statutory regulator covering all service industries: water, electricity, transport, and so on. The regulator would report to the relevant minister, as in Option 3 above, for each particular sector and have power to set upper limits for the various charges.

Either of the two statutory approaches in Options 3 and 4 (or a variation of these) will provide the greatest degree of independence. The selection of Option 3 or 4 depends on the scope of activities to be considered. Normally in countries where the water, electricity, and gas sectors are large, separate regulators have been created for each. In smaller countries or states, one regulator covering all sectors seems to be more efficient.

In New South Wales, the government established the Independent Pricing and Regulatory Tribunal (IPART) to monitor and control the pricing structures for all government monopoly services in New South Wales: electricity, water, gas, rail and transport, ports, taxis. IPART now also assesses compliance of these monopolies with their operating licenses and customer contracts in terms of environment, health, and safety, as well as economics and finances. This task overlaps or conflicts with the responsibilities of the specific resource managers/regulators for each sector, which also do similar compliance audits and seek performance improvements. The comments and recommendations of IPART and the sector resource regulators respectively could vary, so close collaboration and cooperation is needed.

IPART was established under a separate Act and it has a high level of independence from government. It is still dependent on government to provide its budget. (Theoretically the organization could be removed or dismissed by the Premier.) However, in the execution of its work, its inquiries, and its determinations, it is totally independent. Apart from forceful criticism, there is no interference. The Tribunal consists of three persons appointed by the Premier of the state (although IPART is independent, this is necessary, as IPART is a public sector organization), as well as a range of technical staff.

Its determinations are tabled in parliament and cannot be changed, nor can it be asked to revise or revisit its reports unless a new government policy needs to be taken into account. Nevertheless, the government can choose to set a lower price than IPART has determined (but not a higher price). In that case, a subsidy must be paid to the corporation or service provider equal to the difference between the determination and the set price.

A pricing submission is received from a monopoly at an agreed time. This is placed on public display and disseminated online. All comments and corresponding responses by the monopoly are also made available for public scrutiny. Public hearings are held as necessary to ensure proper customer access to the Tribunal.

During the consultation process, the basin organization makes its views known. With respect to inquiries relating to rural water throughout the Murray-Darling Basin, the MDBC would attend meetings and make presentations on how the pricing submission relates to the basin-wide policies on resource sustainability and economic productivity. It would provide information regarding the successes and shortcomings of recent pricing decisions and provide the Tribunal with a broader view on basin-wide impact.

An independent pricing tribunal working in close collaboration with an active basin organization has likely achieved the best combination of commercial pricing structures and improved resource management in Australia, where each state is responsible for developing and managing its own natural resources.

How to Move Forward with the Development of a Comprehensive Water-Related Pricing Package: A Few Key Questions

- Are there clear government or river basin organization policies established that guide how water pricing should be structured? Have all relevant social, economic, environmental and management issues been considered?
- Has one agency been given the specific role to determine the components or categories of activities that make up integrated water (or natural resource) management? Are the real costs for each activity being analyzed? Has the range of activities been endorsed by the government? Are all policy or subsidy issues spelled out clearly by government or the relevant minister?
- Who will give the ultimate approval to a water pricing package? Who will ensure that monopoly organizations do not increase prices to inflate profits and hide inefficiencies? What provisions are in place to audit or otherwise review the management decisions associated with single or monopoly suppliers, whether public or private?
- Who will decide what proportion of the costs of each category of activities should be paid by the user/customer? Should an independent expert group be set up for this purpose? Should there be customer representation? How should the range of stakeholders be best represented or incorporated in this process?
- How will public or community consultation be facilitated? What obligations and accountabilities will be put in place to ensure that their views are taken into account?
- Should the basin organization be an independent regulator? Or should it be removed from direct involvement in price setting since it is a direct stakeholder that has a vested interest in sustainable resource use?

Abbreviations and Acronyms

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

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 Toolkit

<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>

OTHER SOURCES

Barrow, C. J. 1998. "River Basin Development Planning and Management: A Critical Review." *World Development* 26 (1): 171-86.

Boisson de Chazournes, Laurence, and M. A. Salman Salman. 1999. "International Watercourses: Enhancing Cooperation and Managing Conflict." Technical Paper 414F, World Bank, Washington, DC.

Bruning, Stephen D., and John A. Ledingham. 2000. *Public Relations as Relationship Management: A Relational Approach to the Study and Practice of Public Relations*. Mahwah, NJ: Lawrence Erlbaum Associates.

Chenoweth, J. L. 1999. "Effective Multi-Jurisdictional River Basin Management: Data Collection and Exchange in the Murray-Darling and Mekong River Basins." *Water International* 14 (4): 368-76.

- Chenoweth, J. L., H. M. Malano, and J. F. Bird. 2001. "Integrated River Basin Management in the Multi-jurisdictional River Basins: The Case of the Mekong River Basin." *International Journal of Water Resources Development* 17 (3): 365-77.
- Crano, William D., and Gary W. Silnow. 1987. *Planning, Implementing and Evaluating Targeted Communication Programs, A Manual for Business Communicators*. New York: Quorum Books.
- Creech, Bill. 1995. *The 5 Pillars of TQM: How to Make Total Quality Management Work for You*. New York: Plume Books.
- Dinar, Ariel, and D. Marc Kiljour. 1995. "Are Stable Agreements for Sharing International River Waters Now Possible?" Policy Research Working Paper 1474, World Bank, Agriculture and Natural Resources Department, Agricultural Policies Division, Washington, DC.
- Dinar, Ariel, and Donna Lee. 1995. "Review of Integrated Approaches to River Basin Planning, Development and Management." Policy Research Working Paper 1446, World Bank, Agriculture and Natural Resources Department, Agricultural Policies Division, Washington, DC.
- Downs, P., K. J. Gregory, and A. Brooks. 1991. "How Integrated is River Basin Management?" *Environmental Management* 15 (3): 299-309.
- Grunig, James E. 1992. *Excellence in Public Relations and Communication Management*. Hillsdale, NJ: Lawrence Erlbaum Associates.
- Hooper, B. P. 2003. "Integrated Water Resources Management and River Basin Governance." *Water Resources Update*. Issue 126 (November): 12-20.
- Jaspers, Frank G. W. 2003. Institutional arrangements for integrated river basin management *Water Policy* 5 (1): 77-90 (United Kingdom).
- Makin, Ian W., Yvonne P. Parks, and Wouter Linklaen Arriens. 2004. "Supporting the Development of Effective and Efficient River Basin Organizations in Asia: A Discussion of the Application of Organizational Benchmarking Approaches." Prepared for a NARBO Consultation Workshop, Batu-Malang, Indonesia, NARBO Benchmarking Discussion Note ver 3 1.02.
- Miller, Barbara, and Richard Reidinger. 1998. "Comprehensive River Basin Development, The Tennessee Valley Authority." Technical Paper 416, World Bank, Washington, DC.
- Mitchell, B. 1986. "Integrated River Basin Management: Canadian Experiences." Proceedings of Hydrology and Water Resources Symposium, Brisbane, Australia.
- Ruchay, D. 1995. "Living with Water - Rhine River Basin Management." *Water Science and Technology* 31 (8): 27-32.
- Sadoff, Claudia, Whittington Dale, and David Grey. 2003. *Africa's International Rivers: An Economic Perspective*. Directions in Development Series, Report 25396. Washington, DC: World Bank.
- Salman, M.A. Salman. 1999. "Groundwater: Legal and Policy Perspectives, Proceedings from a World Bank Seminar." Technical Paper 456, World Bank, Washington, DC.
- Salman, M.A. Salman, and Kishor Uprety. 2003. "Conflict and Cooperation on South Asia's International Rivers: A Legal Perspective." World Bank, Washington, DC.
- Schultz, G. A. 2001. "Integrated Water Resources Management: The Requirements of the European Union, the Problem of Environmental Impact Assessment, and Implementation of the Sustainable Development Principle." IAHS Publication 272: 3-12.
- Shah, T., D. Molden, and R. Sakthivadivel. Forthcoming. "Limits to Leapfrogging: Issues in Transposing Successful River Basin Management Institutions in the Developing World." International Water Management Institute (IWMI)
- World Bank. 2003. *Stakeholder Involvement in Options Assessment: Promoting Dialogue in Meeting Water and Energy Needs, A Sourcebook*. Report 264/03. Washington, DC.

Copyright © 2006
THE WORLD BANK
1818 H Street, N.W.
Washington, D.C. 20433, U.S.A.
All rights reserved
First printing February 2006
Please check the upcoming WBI training events.
www.worldbank.org/wbi/water

Integrated
river basin
Management



THE WORLD BANK



WORLD BANK INSTITUTE

Promoting knowledge and learning for a better world